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DIRECTIONS IN DEVELOPMENT
Trade

Quality Systems and Standards for a Competitive Edge

J. Luis Guasch, Jean-Louis Racine,
Isabel Sánchez, and Makhtar Diop



THE WORLD BANK

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Contents

<i>Foreword</i>		xvii
<i>Preface and Acknowledgments</i>		xix
<i>About the Authors</i>		xxi
<i>Abbreviations</i>		xxiii
Chapter 1	Introduction	1
	Globalization, Quality, and Standards	2
	Defining Standards and Quality	9
	The National Quality System: An Overview	9
	Organization of the Book	11
Chapter 2	Economic Impact and Effect of Quality and Standards	15
	Functions of Standards	15
	Positive Economic Effects of Standards	17
	Negative Economic Effects of Standards	24
	The Impact of Standards on Economic Growth: Empirical Evidence	28
	The Impact of Standards on International Trade: Empirical Evidence	32
	Standards and Quality as an Entry Point for SMEs: The Path to Industrial Upgrading	41

Chapter 3	The Jurisdiction Issue: Roles of the Private and Public Sectors	51
	Coordination Mechanisms for Technology Adoption	52
	Government Involvement in Standardization	54
	National Standards Bodies	56
Chapter 4	Evaluating Compliance with Standards: The Conformity Assessment Framework	63
	Certification	65
	Testing, Calibration, and Inspection	68
	Accreditation	69
	Metrology	74
Chapter 5	Opening Doors: Standards, Conformity Assessment, and International Integration	81
	The WTO Agreement on Technical Barriers to Trade	83
	International Coordination in Standardization	84
	The Need for International Recognition of National Accreditation Systems	92
	The Need for International Recognition of National Metrology Institutes	95
Chapter 6	The ISO 9000 Quality Management Standards	97
	The Function of ISO 9000	97
	ISO 9000 and Competitive Advantage	99
	Internal Firm-Level Barriers to ISO 9000 Certification	105
	National Factors Influencing the Diffusion of ISO 9000	114
Chapter 7	Standardization in Latin America	127
	The Standards-Setting Institutions	128
	The Performance of Standards Bodies	136
	International Integration	139
Chapter 8	Certification in Latin America	149
	Certification Activities	149

	The Supply of Certification Services	159
	Possible Factors Influencing ISO 9000 Diffusion	162
Chapter 9	Accreditation in Latin America	171
	Accreditation Institutions	171
	Accreditation Activities	177
	International Integration	180
Chapter 10	Metrology in Latin America	185
	The National Metrology Institutions	185
	Metrological Activities	189
	International Cooperation and Recognition of Metrology Institutions	190
Chapter 11	Existing Policies and Support Programs	193
	Brazil: Center for Quality, Safety and Productivity	193
	Colombia: Quality and Environmental Management Program	194
	Peru: CERTIpyme, PYMEvaluación, and PRECISO	196
	Mexico: National Committee on Productivity and Technological Innovation	197
	Chile: Chilean Economic Development Agency	198
	Argentina: Standards and Quality Accreditation Program	199
Chapter 12	Policy Recommendations and Conclusion	201
	General Principles for Implementation and Reform of National Quality Systems	201
	Consolidating the National Quality System	203
	Accreditation	204
	Metrology	207
	Standardization	209
	Supporting the Demand for Certification, Testing, and Calibration	212
	Conclusion	216

Appendix A	An Evaluation of Mexico's National Quality System	219
	Standardization	220
	Metrology and Calibration	221
	Accreditation	224
	Certification, Testing, and Inspection	227
Appendix B	An Evaluation of Turkey's National Quality System	233
	Certification, Testing, and Inspection	236
	Accreditation	243
	Metrology and Calibration	249
	Standardization	252
	Conclusion	258
	<i>Notes</i>	261
	<i>References</i>	269
	<i>Index</i>	281

Boxes

1.1	Surviving Crises in Low-Quality Markets: Brazilian Footwear and Chilean Wines	5
1.2	Leather PDA Covers in Bolivia: Using Quality to Enter New Export Markets	7
1.3	The Components of a National Quality System	12
2.1	Quality Standards in the Ugandan Coffee Industry	20
2.2	Transatlantic Competition for First- and Second-Generation Mobile Phones	22
2.3	The Economic Value and Impact of Measurement Standards	26
2.4	Differing Standards and Trade Costs: The Case of Pallets	34
2.5	Food Safety Standards in the European Union	35
2.6	Standards and Quality as an Entry Point to Upgrading in a Horticultural Value Chain	44
2.7	Grapes in India: Changing Market Requirements for Standards and Quality	46
4.1	The Consorcio del Jamón Serrano Español's Quality Control	67
4.2	Regional Cooperation on Accreditation: The Southern African Example	72

4.3	Evolving Needs of Metrology in Health Care	77
5.1	The Struggle to Create a Single Global Standard for 3G Telephony	84
5.2	South Africa's Contribution to International Timber Standards	88
6.1	China and the Drive for Quality	106
6.2	Quality Adoption in the Indian Software Sector: Moving Up the Value Chain	121
B1	Conformity Assessment and Access to the EU Market	254

Figures

1.1	Ratio of World Exports to Global GDP	3
1.2	Share of Manufactures in Global Exports of Goods and Services	3
1.3	Price of Developing-Country Manufactured Exports Relative to Price of Developed-Country Exports of Machinery, Transport Equipment, and Services, 1975–95	4
1.4	Schematic Representation of a National Quality System	11
2.1	Contributions of Different Factors to Output Growth in the United Kingdom, 1948–2002	30
2.2	Long-Run Growth of Labor Productivity in the United Kingdom, 1948–2002	30
2.3	Average Productivity Gains Due to Adoption of Quality Standards	32
2.4	Effects of British Standards on UK Exports, Imports, and Trade Balance, 1985–91	38
3.1	The Centralized Approach to Standards Development	57
3.2	The Decentralized Approach to Standards Development	58
4.1	Traceability of Measurements	64
5.1	Number of Standards in Selected Industrial Countries and International Standards	86
5.2	The Internationalization of British Standards, 1948–2003	89
6.1	Global Adoption of ISO 9000 Standards Top Ten Countries for ISO 9000 and ISO 9001 Certificates, with Mexico Comparator	107
6.2	Share of Brazilian Firms Reporting Important Certification Investments in Different Categories	112
6.3	Regional Shares of Worldwide ISO 9000 Certificates, 2004	114

6.4	Top 10 Sectors Registering the Most Worldwide ISO 9000 Certificates, 2004	116
6.5	Top 10 Sectors Registering the Most Worldwide ISO 9000 Certificates, Standardized by Global Export Volume, 2004	117
7.1	Funding Sources of the National Standards Bodies	133
7.2	Budgets of the National Standards Bodies	134
7.3	Number of National Standards, 1990 and 2002	137
7.4	Number of New Standards, 2004, and Active Technical Committees, 2005	138
7.5	Price of National Standards Based on ISO 9001:2000	139
7.6	Number of Participant and Observer Memberships in ISO Technical Committees and Subcommittees, 2005	141
7.7	Participation in ISO Standards Development, 2004	142
7.8	Participation in COPANT Standards Development Activities	145
7.9	Number of TBT Notifications on Technical Regulations and Conformity Assessment Procedures, 2004	146
8.1	ISO 9000 Certificates in Latin America and the Caribbean, 1993–2004	150
8.2	Number of ISO 14000 Certificates in Latin America and the Caribbean, 1995–2004	150
8.3	Number of ISO 9001:2000 and ISO 14001 Certificates, 2004	151
8.4	Growth Rates of ISO 9000 Certificates in 2004 vs. Number of ISO Certificates; World Average Annual Growth Rates, 2001–04	152
8.5	Growth Rates of ISO 14000 Certificates in 2004 vs. Number of ISO Certificates; World Average Annual Growth Rates, 1998–2004	153
8.6	ISO 9000 Adoption Standardized by Value Added in Manufacturing and Services, 2004	154
8.7	Number of ISO 9000 Certificates and Value Added in Manufacturing and Services, 2002	155
8.8	Aggregate Number of ISO 9001 Certificates Standardized by Number of Establishments in 10 Major Manufacturing Sectors	156
8.9	Number of ISO 14000 Certificates and Value Added in Manufacturing and Services, 2002	156

8.10	Aggregate Number of ISO 14000 Certificates Standardized by Number of Establishments in 10 Major Manufacturing Sectors	157
8.11	Number of QS 9000 and ISO/TS 16949:2002 Certificates vs. Number of Enterprises in the Automobile Sector	158
8.12	Accredited Domestic Certification Bodies and Foreign Affiliates Offering Quality Management Systems Certification, 2005	159
8.13	Market Shares of Top Five Certification Bodies in Brazil, Argentina, and Mexico	160
8.14	Number of ISO 9001:2000 Certifications in 2004 Standardized by Number of Accredited Certification Bodies Operating Domestically in 2005	161
8.15	Number of Lead Auditors Certified for ISO 9001:2000 with IRCA in 2005, Standardized by Total Value Added in Manufacturing and Services in 2004	161
8.16	Exports to the EU and Japan as a Share of GDP and Certification Rates	162
8.17	Inward FDI Stock as a Share of GDP and Certification Rates	163
8.18	Exported Goods in Global Quality-Focused Sectors as a Share of GDP	164
8.19	Regional SME Sector Share of Manufacturing Employment, 1990-99 Averages	165
8.20	SME Sector Share of GDP and Certification Rates	166
8.21	ISO 9001 Adoption and Firm Size in Mexico	166
8.22	Average Business Environment Indicator, by Region	167
8.23	Business Environment Indicator and Certification Rates, by Country	168
8.24	Average Institutional Development Indicator, by Region	168
8.25	Institutional Development Indicator and Certification Rates, by Country	169
8.26	Secondary School Enrollment and Certification Rates	169
9.1	Accreditation Body Personnel, 2005	174
9.2	Number of Qualified Lead Assessors, 2005	175
9.3	Number of Qualified Technical Experts, 2005	176
9.4	Minimum Time Required for the Laboratory Accreditation Process	177

9.5	Number of Accreditations of Management System Certification Bodies	178
9.6	Number of Accreditations of Inspection Bodies	179
9.7	Number of Accreditations of Testing and Calibration Laboratories	180
9.8	Proportion of Foreign Affiliates of Quality System Management Certification Bodies Accredited by the National Accreditation Body	181
10.1	Number of Measurement Areas in the National Metrology Laboratories	189
10.2	Number of Calibration Services Offered by NMIs, Standardized by Manufacturing Value Added, 2005	190
10.3	International Laboratory Comparison Activities, Absolute Number and Standardized by Number of Measurement Fields Offered by the NMI, 1995–2005	191
A1	Metrology Services Chain in Mexico	222
A2	Concentration of Calibration Labs in Mexico City, Jalisco, and Nuevo León	223
A3	Concentration of Testing Labs in Mexico City, Jalisco, and Nuevo León	229
A4	ISO 9000 Certificates, 2004	231
A5	Mexican ISO 9000 Certificates and Share of Latin American Total	231
A6	Mexican ISO 9000 Certificates and Share of World Total	232
B1	Contribution of Investment Climate Variables to Average Employment by Turkish Firms	234
B2	Contribution of Investment Climate Variables to a Turkish Firm’s Probability of Becoming an Exporter	235
B3	Number of ISO 9001 Certificates as a Percentage of the Number of Firms in Manufacturing, Wholesale and Retail Trade, Business Services, and Real Estate in Selected OECD Countries	237
B4	Number of ISO 9001 Certificates vs. Number of Enterprises in Manufacturing, Wholesale and Retail Trade, Business Services, and Real Estate in OECD Countries	237
B5	Number of ISO 9001 Certificates as a Percentage of the Number of Manufacturing Firms in OECD Countries	238

B6	Number of ISO 9001 Certificates vs. Number of Manufacturing Firms in OECD Countries	238
B7	Growth of the Number of ISO 9000 Certificates in Turkey	239
B8	Number of ISO 9001 Certificates per Number of Establishments in Turkey, Spain, and Romania in Different Manufacturing Sectors	240
B9	Number of National Notified Bodies Recognized by the EU in Selected Countries, February 2006	241
B10	Number of Organizations Accredited by the National Accreditation Body in Selected Countries, March 2006	243
B11	Number of Organizations Accredited by the National Accreditation Body in Selected Countries, Standardized by Value Added in Manufacturing and Services, March 2006	243
B12	Number of Accreditations Granted Each Year by TÜRKAK	244
B13	Number of Accreditations per Permanent Staff Person in the Accreditation Body, Selected Countries	246
B14	Budget of the National Accreditation Body, Selected Countries	246
B15	Average Cost of an Accreditation, Selected Countries	247
B16	Number of Calibration Activities Relative to Manufacturing Value Added, and Number of Calibration Customers Relative to Number of Manufacturing Firms, in NMIs of Selected Countries, 2005	248
B17	Number of Key and Supplementary Measurement Comparisons by Signatories of the CIPM MRA	250
B18	Number of National Standards, Selected Countries	251
B19	Standards Stock vs. Value of Trade in Turkey	252
B20	Participant and Observer Memberships in ISO Technical Committees and Subcommittees	257

Tables

1.1	Share of Manufactures in Total Merchandise Exports, by Region percent	4
2.1	The Economic Effects of Standards According to Their Function	26

2.2	Partial Production Elasticities in Selected European Countries	31
2.3	Empirical Results on the Effect of Idiosyncratic and Harmonized National Standards on Trade	37
5.1	Duplication of Testing Procedures to Meet Foreign Requirements	82
5.2	Members of IAF and ILAC Mutual Recognition Agreements, 2006	94
5.3	Firms with Products Subject to an MRA	94
5.4	Perceived Export Advantage of Participating in an MRA with an Export Destination Country	94
6.1	Summary of Studies Evaluating the Effect of Certification on Firm Performance	108
6.2	Firms Using External Consulting Services for Certification in Two Brazilian Surveys	109
6.3	Total ISO 9000 Implementation and Certification Costs	110
6.4	Typical Consulting Costs for Firms Seeking Certification, Argentina, 2005	112
6.5	Typical ISO 9000 Registration Costs in Latin America, 2005	113
7.1	Characteristics of the National Voluntary Standards Bodies	128
7.2	Activities of Standards Bodies	130
7.3	Proportion of National Standards Body Staff Involved in Standardization Activities (percent)	130
7.4	Private Sector Participation in the Governance of Standards Bodies	131
7.5	Staff of the National Standards Bodies	135
7.6	Share of Mandatory Standards in Total National Standards, 1990 and 2002 (percent)	136
7.7	Growth of the Standards Stock between 1990 and 2002 (percent)	137
7.8	Membership in International Standards Bodies	140
7.9	Evolution of the Share of National Standards Based on International Standards (percent)	140
7.10	Membership in Organizations and Preferential Trade Agreements with Standards-Related Measures	143
7.11	Principal Regional Agreements and Organizations with Standards-Related Measures	143

9.1	Legal Status of National Accreditation Bodies	172
9.2	Activities of National Accreditation Bodies	173
9.3	Private Sector Participation in the Governance of Accreditation Bodies	173
9.4	Implementation of ISO Guides and Standards for Accreditation Bodies	182
9.5	Principal Regional and International Organizations Operating Mutual Recognition Agreements for Accreditation Within, or in Cooperation with, Latin American Countries	183
9.6	Membership in International Organizations and Mutual Recognition Agreements	184
10.1	Organization of Scientific and Legal Metrology Institutions	186
10.2	Activities of the National Scientific Metrology Institutions	187
10.3	Accreditation of the National Metrology Laboratories	188
10.4	Membership in International Organizations	192
11.1	CYGA: Participation and Subsidies	195
11.2	Distribution of Enterprise Size in Two COMPITE Programs, 2004	197
11.3	COMPITE Programs: Participation and Subsidies	198
A1	Official Mexican Standards by Agency, June 2005	220
B1	Organization of Accreditation in Selected Countries	245
B2	Governance of the National Voluntary Standards Bodies, Selected Countries	254
B3	Turkey's National Quality System: Deficiencies, Ongoing Actions, and Recommendations	259

Foreword

During the last decade, economic growth in the fastest-growing developing countries, particularly China and India, has been accompanied by their rapid integration into world markets. This has created new opportunities for all countries but also new competitive pressures, and it has placed new demands on policies to support trade development.

As increased competition among developing countries in labor-intensive manufactures erodes economic returns, higher-quality markets and high-value goods are increasingly important to maintaining dynamic competitive advantage. Globally integrated production networks, typically governed by buyers from developed nations, have raised competitiveness to the top of developing countries' policy agendas. Countries need to offer the high-quality products demanded by consumers and global supply chains and deliver them to markets to meet just-in-time production schedules.

Against all major competitiveness rankings, Latin America has lost ground. Growth has been mediocre, especially if compared with the growth of most Asian economies. This has led to lively policy debates about the path back to high growth, from which has emerged a growing consensus that better and more effective coordination between the public and private sectors is required—and that this needs to be complemented by institutional and microeconomic reforms. For Latin America, a new trade and competitiveness agenda has three key elements: (a) upgrad-

ing the value of traditional exports *and* diversifying exports away from primary products; (b) removing constraints to “speed-to-market” goods to fully exploit proximity to the United States and other markets; and (c) enhancing productivity growth to offset rising wages while boosting the development of technological capabilities and skills.

But diversifying and upgrading exports—whether manufactured products within large supply chains or high-value food products—means developing quality and standards. It also means addressing weaknesses in logistic, financial, and administrative support services. These are not easy tasks, and they present a major challenge both for policy makers in the region and for development partners.

This book responds to this challenge by providing a comprehensive account of quality systems for private sector development: what works on the ground and what doesn’t, and why. It explains why quality and standards matter for export growth, productivity, industrial upgrading, and diffusion of innovation, all central ingredients in improving economic growth and generating real gains in poverty reduction. The book examines the diversity of institutions, linkages, and arrangements involved in quality systems, identifying success factors and obstacles in the quality strategies of particular countries. A portion of the volume is devoted to experiences in Latin America and the Caribbean, a region with a great deal at stake in the drive to improve quality. (One of the authors, J. Luis Guasch, is one of the World Bank’s leading experts on private sector development in Latin America.) Policy makers in Latin America and throughout the developing world will find *Quality Systems and Standards for a Competitive Edge* to be a valuable tool for meeting the challenges of building trade competitiveness in the new global economy.

Danny Leipziger
Vice-President
Poverty Reduction and Economic Management Network
The World Bank

Preface and Acknowledgments

Chi fa fala, e chi non fa sfarfalla.

“Those who act make mistakes,
and those who do nothing really blunder.”

Lackluster growth in many middle-income countries has led to the realization that while macroeconomic stabilization and liberalization are necessary, they are not sufficient to boost growth in developing countries. As the emphasis has shifted to microeconomic reforms, most developing countries have launched broad trade and competitive initiatives in search of that elusive goal, sustained high growth. Yet most of those initiatives have fallen short of providing the necessary infrastructure for the development and adoption of quality and standards that are critical for securing access to external markets and supporting increased competitiveness. There is limited awareness of the benefits to be gained from systematically producing high-quality products and adopting appropriate, internationally expected norms and standards.

These observed shortcomings provided the motivation for undertaking this book. As we began to help countries establish and improve national quality systems to support their trade and export development initiatives, we saw the need for an integrated guide that would bring together in a coherent way all the different components that countries need to consider in building a national quality system. We hope that this book will raise awareness of the impact of quality and standards, place quality

issues high on the strategic agendas of firms and policy makers, and prove useful to reform-minded governments as they seek to improve, modernize, and implement their national quality systems.

We are grateful to many people for encouragement in writing this book, particularly policy makers, development practitioners, and firms and private sector organizations in developing countries. They had a clear vision of the need for an integrated reference work to create broad awareness of the quality and standards issue and help promote the systematic adoption of good quality practices. Our dialogue with these stakeholders greatly enriched our analysis. Their perceptions and suggestions were lucid, and a number of them provided vivid examples of the challenges as well as illuminating examples of success.

At the World Bank, we are most grateful to Danny Leipziger for his strong support and encouragement from the start; to Enric Banda, Carl Dahlman, Marianne Fay, Pablo Fajnzylber, Esperanza Lasagabaster, José Guilherme Reis, and Joseph Stiglitz, who provided comments and suggestions on the evolving manuscript; and to Amelia Camino-Forsyth, Thomas Haven, and Joy Troncoso, who very generously assisted us in the production of this book.

The authors alone take responsibility for the content of the book and the views expressed here, which do not necessarily reflect the views of our colleagues in the World Bank Group.

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J. Luis Guasch, a Spanish national, is currently Senior Regional Advisor for the Latin America and Caribbean Region of the World Bank, Washington, DC, responsible for the areas of competitiveness, regulation, infrastructure, innovation, and technological development. In that role he has assisted a number of countries with the design and implementation of their national quality systems. A professor of economics at the University of California, San Diego, since 1980, he has published extensively in leading economic journals and has authored or coauthored several books, including *Managing the Regulatory Process: Design, Concepts, Issues, and the Latin America and Caribbean Story*; *Closing the Gap in Education and Technology*, and *Granting and Renegotiating Infrastructure Concessions: Doing it Right*. He holds a Ph.D. in Economics from Stanford University, California, USA, and an engineering degree from the Polytechnic University of Barcelona, Spain.

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Abbreviations

ABNT	Associação Brasileira de Normas Técnicas Brazilian Technical Standards Association
AENOR	Asociación Española de Normalización y Certificación Spanish Association for Standardization and Certification
AMPS	Advanced Mobile Phone System
ANCE	Asociación de Normalización y Certificación Association for Standards and Certification (Mexico)
ANSI	American National Standards Institute
APEC	Asia-Pacific Economic Cooperation
APLAC	Asia-Pacific Laboratory Accreditation Cooperation
ASEAN	Association of Southeast Asian Nations
BIPM	Bureau International des Poids et Mesures International Bureau of Weights and Measures
CAN	Comunidad Andina Andean Community
CDMA	Code Division Multiplexing Access
CEM	Centro Español de Metrología Spanish Metrology Center
CEN	Comité Européen de Normalisation European Committee for Standardization
CENAM	Centro Nacional de Metrología National Metrology Center (Mexico)

CENELEC	Comité Européen de Normalisation Electrotechnique European Committee for Electrotechnical Standardization
CFE	Comisión Federal de Electricidad Federal Electricity Commission (Mexico)
CGPM	Conférence Générale des Poids et Mesures General Conference on Weights and Measures
CIPM	Comité International des Poids et Mesures International Committee of Weights and Measures
CIS	Commonwealth of Independent States
CITAC	Cooperation on International Traceability in Analytical Chemistry
CMM	Capability Maturity Model
CODEX	Codex Alimentarius Commission
COMPITE	Comité Nacional de Productividad e Innovación Tecnológica National Committee on Productivity and Technological Innovation (Mexico)
CONACYT	Consejo Nacional de Ciencia y Tecnología National Council on Science and Technology (Mexico)
COPANT	Comisión Panamericana de Normas Técnicas Pan American Standards Commission
CORFO	Corporación de Fomento de la Producción Chilean Economic Development Agency
CSRM	Committee on Standards-Related Measures (of NAFTA)
CYGA	Calidad y Gestión Ambiental Quality and Environmental Management Program (Colombia)
DGN	Dirección General de Normas General Bureau of Standards (Mexico)
DTI	Department of Trade and Industry (UK)
EA	European Co-operation for Accreditation
EFTA	European Free Trade Association
EMA	Entidad Mexicana de Acreditación Mexican Accreditation Body
EMS	environmental management systems
EN	European standard
ENAC	Entidad Nacional de Acreditación National Accreditation Body (Spain)
ETSI	European Telecommunications Standardization Institute

EU	European Union
EUROMET	European Collaboration in Measurement Standards
FCC	Federal Communications Commission
FDI	foreign direct investment
FOMIPYME	Fondo Colombiano para la Modernización y el Desarrollo Tecnológico de las Micro, Medianas y Pequeñas Empresas Colombian Fund for the Modernization and Technological Development of Micro, Small and Medium Enterprises
GDP	gross domestic product
GNP	gross national product
GSM	Global System for Mobile Communications
HACCP	Hazard Analysis and Critical Control Point
IAAC	InterAmerican Accreditation Cooperation
IAF	International Accreditation Forum
ICONTEC	Instituto Colombiano de Normas Técnicas y Certificación Colombian Institute for Technical Standards and Certification
IEC	International Electrotechnical Commission
ILAC	International Laboratory Accreditation Cooperation
INDECOPI	Instituto Nacional de Defensa de la Competencia y de la Protección de la Propiedad Intelectual National Institute for the Defense of Competition and the Protection of Intellectual Property (Peru)
INEN	Instituto Ecuatoriano de Normalización Ecuadorian Standardization Institute
ININ	Instituto Nacional de Investigaciones Nucleares National Nuclear Research Institute (Mexico)
INMETRO	Instituto Nacional de Metrologia, Normalização e Qualidade Industrial National Institute of Metrology, Standardization and Industrial Quality (Brazil)
INN	Instituto Nacional de Normalización National Standardization Institute (Chile)
INTI	Instituto Nacional de Tecnología Industrial National Institute of Industrial Technology (Argentina)
IRAM	Instituto Argentino de Normalización y Certificación Argentine Institute of Standardization and Certification
IRCA	International Register of Certificated Auditors
ISO	International Organization for Standardization

IT	information technology
ITU	International Telecommunication Union
KAB	Korea Accreditation Board
KAS	Korea Accreditation System
KATS	Korean Agency for Technology and Standards
KOLAS	Korea Laboratory Accreditation Scheme
KOSGEB	Small and Medium Industry Development Organization (Turkey)
KRISS	Korea Research Institute of Standards and Science
LAC	Latin America and the Caribbean
Mercosur	Mercado Común del Sur Southern Common Market
MLA	multilateral recognition arrangement
MRA	mutual recognition arrangement or agreement
NAFTA	North American Free Trade Agreement
NMI	national metrology institute
NMT	Nordic Mobile Telephone
NWML	National Weights and Measures Laboratory (UK)
OAA	Organismo Argentino de Acreditación Argentine Accreditation Bureau
OAE	Organismo de Acreditación Ecuatoriano Ecuadorian Accreditation Body
OECD	Organisation for Economic Co-operation and Development
OHSAS	Occupational Health and Safety Assessment Series
OIML	Organisation Internationale de Métrologie Légale International Organization of Legal Metrology
PABCO	Planteles de Animales Bajo Certificación Oficial Animal Premises Under Official Control
PAC	Pacific Accreditation Cooperation
PDA	personal digital assistant
PEMEX	Petróleos Mexicanos Mexican Petroleum Company
PNAC	Programa Nacional de Aseguramiento de la Calidad National Program for Quality Assurance (Colombia)
ProCal	Programa de Normas y Acreditación de la Calidad Standards and Quality Accreditation Program (Argentina)
QMS	quality management systems

QSP	Centro da Qualidade, Segurança e Produtividade Center for Quality, Safety and Productivity (Brazil)
R&D	research and development
RTA	regional trade agreement
SADC	Southern African Development Community
SADCA	Southern African Development Community Accreditation
SADCAS	Southern African Development Community Accreditation Service
SEI	Software Engineering Institute
SENA	Servicio Nacional de Aprendizaje National Training Service (Colombia)
SERNAC	Servicio Nacional del Consumador National Consumer Service (Chile)
SIC	Superintendencia de Industria y Comercio Superintendency of Industry and Commerce (Colombia)
SIM	Sistema Interamericano de Metrologia InterAmerican Metrology System
SME	small and medium enterprise
SPG	standards preparatory group (Turkey)
SPI	software-process improvement
STQC	Standardization, Testing, and Quality Certification
TBT	Technical Barriers to Trade (of the WTO)
TC	Technical Committee (of the ISO)
TNC	transnational corporation
TQM	total quality management
TSE	Turkish Standards Institution
TSG	Traditional Specialty Guaranteed
TÜBITAK	Scientific and Technical Research Council of Turkey
TÜRKAK	Turkish Accreditation Agency
UK	United Kingdom
UKAS	United Kingdom Accreditation Service
UME	National Metrology Institute (Turkey)
UMTS	Universal Mobile Telephone System
UNE-EN ISO	Spanish national standard
WTO	World Trade Organization

Note: All dollar amounts are U.S. dollars unless otherwise indicated.

CHAPTER 1

Introduction

In the past few decades, changes in global trade flows have enhanced the role of quality and standards in economic development. Global trade flows have experienced changes with respect to their magnitude, nature, composition, and patterns. While the relative *magnitude* of trade flows has continuously increased, the *nature* of trade has been radically altered by the emergence of closely integrated global production networks. Shifts in trade *composition* have given a greater importance to manufacturing. Manufacturing has replaced other industries to become the most important export sector in many developing countries, if not the most promising export sector. *Patterns* of trade have significantly changed with the entry of developing countries in export markets for labor-intensive manufactures. However, an expanded presence of developing countries in global markets has not always coincided with rising economic returns, as intense competition has eroded the profitability of low-cost manufactures. All these changes have amplified the importance of standards and quality in the world economy. Higher-quality markets have not been subject to falling profitability and present a sustainable alternative to price competition.

In this book we argue the urgent need for countries to move forward aggressively on adopting and upgrading quality and standards. The focus is on developing countries, many of which are lagging in the race for standards adoption, and within that category, on middle-income countries. The book analyzes the economic impact of quality and standards on economic growth, on international trade, and as an entry point for the industrial upgrading and mainstreaming of small enterprises. It offers detailed guidelines for the creation of national quality systems that can effectively support the use and

adoption of standards. It describes the optimal structure for a national quality system, evaluates the precise roles of the public and private sectors, and proposes best-practice guidelines and norms for these roles. It also addresses the financing issue, including the extent of and rationale for targeted subsidies, and questions of jurisdiction. Special emphasis is given to international integration through mutual recognition agreements that enhance access to external markets—a key objective for developing countries.

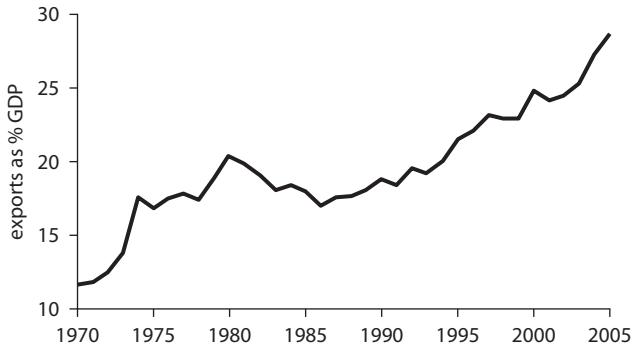
The first part of the book is generic and normative, providing empirical evidence and guidelines for reform. The second part describes and evaluates the performance of a number of Latin American countries with respect to various components of the national quality system. Latin America offers several good examples of countries that are moving ahead on quality and standards. Moreover, most countries in the region are choosing exports as the engine for growth, and for that to be successful, quality and standards are essential. Finally, the appendix presents case studies of Mexico and Turkey to illustrate the methodology of analysis for making a diagnosis and appropriate recommendations.

Globalization, Quality, and Standards

Globalization, characterized by significant increases in global flows of information, ideas, production factors, technology, and goods, has brought about a deep and pervasive integration of the world economy. Traditional barriers to trade no longer play as important a role as before, in part because of advances in information, communication, and transportation technologies, but also because of a new international environment of trade policy. Successive rounds of international agreements have systematically reduced trade barriers in rich countries, and developing countries have followed suit, inspired by the success of several East Asian economies. Latin American and Caribbean countries have not been excluded from these trends, and policies aimed at outward-oriented growth have gradually overturned decades of protection and subsidies in this region.

These changes have affected the magnitude of global trade, whose importance in the global output has grown rapidly in the past three decades. World exports as a proportion of global gross domestic product (GDP) have risen from a little more than 10 percent in 1970 to close to 30 percent in 2005 (figure 1.1).

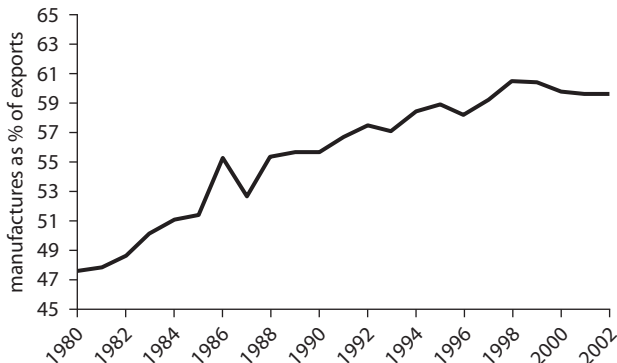
Manufacturing now accounts for a much greater share of trade than two decades ago, around 60 percent in 2002 versus 48 percent in 1980 (figure 1.2).¹ Many developing countries have made major gains in their

Figure 1.1 Ratio of World Exports to Global GDP

Source: IMF 2005.

share of world trade in manufactures. These countries have increased their collective share of global manufactures exports from 10 percent in 1980 to almost 30 percent in 2002 (UNCTAD 2004). In Latin America, for instance, manufactures rose to become the largest export category in the late 1990s (table 1.1).

Intense competition in global markets for cheap low-quality manufactured goods has eroded economic returns in developing countries. As a result, the prices of manufactures exported by developing countries continue to fall in relation to prices of the skill-intensive manufactured goods exported by developed countries. This has provoked a deterioration of terms of trade in manufacturing in developing countries. Figure 1.3 shows the evolution of a

Figure 1.2 Share of Manufactures in Global Exports of Goods and Services

Source: UNCTAD 2002.

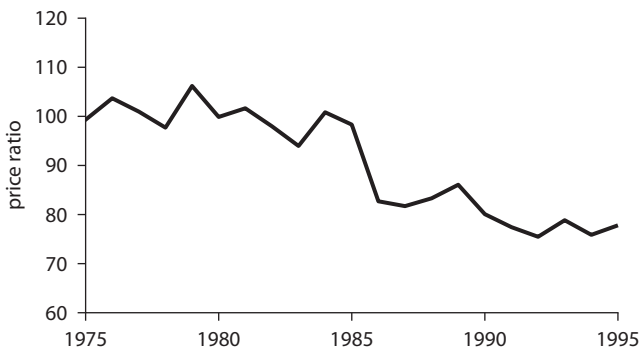
Table 1.1 Share of Manufactures in Total Merchandise Exports, by Region
percent

<i>Region</i>	<i>1980–1983</i>	<i>1989–1992</i>	<i>1999–2003</i>
All developing countries	31.4	55.7	68.1
Latin America and the Caribbean	32.6	35.9	56.6
Africa	12.7	15.7	23.0
West Asia	16.8	17.7	21.0
East and South Asia	54.9	76.5	84.8

Source: UNCTAD 2005.

terms-of-trade index from 1975 to 1995. The index considers the price of manufactured exports from developing countries relative to prices of manufacturing inputs and equipment exported by developed countries. These deteriorating terms of trade can have a sizeable impact on economies where manufactured exports represent a large share, such as in Latin America, where the manufacturing sector accounted for almost 60 percent of exports in 2003. In 2004 manufactures contributed to approximately a 2 percent decrease in terms of trade for both Peru and Mexico (UNCTAD 2005).

Competition on quality can lead to a more sustainable competitive advantage than competition on price alone. High-quality market segments are not as vulnerable to declining terms of trade. There are many examples in which producers of high-quality goods have been able to withstand an industry crisis much more easily than their low-quality counterparts (box 1.1).

Figure 1.3 Price of Developing-Country Manufactured Exports Relative to Price of Developed-Country Exports of Machinery, Transport Equipment, and Services, 1975–95

Source: Wood 1997.

Note: 1980 = 100.

Box 1.1**Surviving Crises in Low-Quality Markets:
Brazilian Footwear and Chilean Wines**

Brazil's footwear industry went into deep distress in the 1990s as a result of the entry of Chinese producers with lower labor costs. Brazil reduced its share of the global footwear market from 7.6 percent in 1985 to 4.1 percent in 1990 and 3.8 percent in 1998. Meanwhile, China's share increased from 1.4 percent in 1985 to 7.2 percent in 1990 and 23.3 percent in 1998. The Brazilian footwear industry experienced dramatic losses of profitability and was squeezed out of its main segment of cheap, standardized leather shoes. To survive, Brazilian enterprises were forced to find new strategies to produce higher-quality shoes and open up new markets and marketing channels. Some firms sought technical support from their suppliers to improve their productive processes. Others increased their quality by seeking the services of local testing institutions and investing in personnel training. Many of the firms decided to cooperate on the creation of a cluster brand with local design and quality requirements.

Chile's wine industry suffered a similar shock. In the late 1990s, after a decade of soaring exports, prices of "popular premium" and "premium" wines began a decline triggered by excess supply in world markets. These were Chile's main wine export segments, and the average price of wine exports decreased from a high of \$2.15 per liter in 1998 to \$1.70 per liter in 2003. Just as Brazil's initial labor cost advantage did not guarantee the permanent profitability of its footwear industry, natural conditions favorable to wine production in Chile were not sufficient to ensure the sustainable growth of that country's wine industry. In response to this crisis Chile's wine industry has been trying to shift its focus to quality and product differentiation. Some of the struggling firms have increased their profits by participating in a government program called PROFO (Proyectos de Fomento), which creates small networks of firms that are eligible for subsidies on collaborative projects. PROFOs have proven useful in upgrading soft technologies such as those in the organization and management of production processes and in quality control.

Sources: Bazan and Navas-Alemán 2001; Schmitz 1999; Giuliani and Bell 2004.

In light of the increased competition associated with globalization, developing countries seeking sustained growth need to free themselves from dependence on primary products and diversify into manufacturing exports, whose value added translates into wealth. A poor investment climate and small market hampers that development, but an even bigger obstacle is lack of the often sophisticated standards required to enter global trade markets. It is the systematic use and adoption of quality standards and technology that allows developing-country producers to close the gap with the leading countries.

Increasingly, developing countries, particularly small ones, are adopting export-led growth strategies. Their relatively small internal markets and limited purchasing capabilities force them to look for markets abroad. Countries are liberalizing trade and aggressively signing bilateral free trade treaties to secure favorable access to their products. But while a free trade treaty is essential, it is not sufficient, as countries also have to offer the right products for sale. This is where quality and standards come to bear.

To access global markets, independent manufacturers from developing countries must join global production networks typically governed by transnational corporations (TNC) and global buyers from developed countries. The multiplicity of global sourcing arrangements, the numerous horizontal and vertical networks, and the dynamic nature of these networks give a critical importance to standards in global production systems. Trade increasingly involves subcomponents and services, making it much more complex than the arms-length relationships of the past. TNCs and global buyers impose standards on their suppliers to ensure compatibility between products and processes throughout their global chains. They also use standards to ensure that they can satisfy the high customer requirements of developed-country markets with respect to quality as well as environmental and social impact. Firms that are unable to meet these standards find themselves excluded from global markets, while those that meet them may be able to profit from new opportunities (box 1.2).

Adoption of the right quality and standards can also have a significant impact on poverty and inequality. The entry of small firms into supply chains, supplier networks, and export consortia entails the use, adoption, and certification of quality standards. Increasingly, partners, networks, customers (in the case of final goods), and major firms require potential small suppliers to guarantee appropriate standards and quality in goods and services. The impact on earnings and growth and on employment for those small firms or farmers can be quite significant. There are many examples (in Peru, Brazil, Ecuador, Guatemala, Bolivia, and elsewhere)

Box 1.2**Leather PDA Covers in Bolivia:
Using Quality to Enter New Export Markets**

In the mid-1990s personal digital assistants (PDA) made their successful entry into the mass consumer market thanks to novel designs such as the Palm Pilot. PDAs have since evolved from simple electronic organizers and address books to powerful handheld computers and communication devices. They are used throughout the world, with a global unit shipment of 15 million in 2005.

When PDAs first became popular, a leather tannery owner in Cochabamba, Bolivia, saw a unique opportunity for a new export market. With his industry experience, insight from trade shows, and export knowledge, he formed a new company called Macaws SRL. The company was to concentrate on leather cases for PDAs, in addition to exporting a broad range of leather products. Today the firm exports 150,000 PDA cases per month to markets in Europe, North America, and South America. These include large lots for PDA manufacturers as well as individual or customized items ordered over the Internet. Macaws has grown from 25 to 300 employees, with enough orders to hire another 150.

Macaws attributes its success to the design and functionality of its products, but also to the high quality of the workmanship. In fact, the firm's quality management system is based on the ISO 9001 standard. Macaws places heavy emphasis on training its new employees to make high-quality products. Initial employee training takes approximately two months.

Production of leather cases is labor-intensive, and labor accounts for 60 percent of costs. Macaws's orientation toward the higher-quality market segments is important because it would be difficult to compete on price alone against countries where low-cost labor is abundant, such as China. In fact, some of the Macaws PDA cases are priced at around \$40, the upper end of the price range, while competitors' products sell for \$20 or \$30. The firm's ability to expand its production, enter new markets with high prices, and pay its employees an average of \$650 per month is a testimony to the many advantages of competing on quality in export markets.

Sources: World Bank 2005a; Macaws SRL Web site.

of small firms, microenterprises, artisans, and farmers stepping up from poverty and subsistence-level production by adopting standards, or by making minor adjustments in their products, that have opened new markets or facilitated linkages with major firms. In some cases they have tripled their earnings and output (World Bank 2004, 2006a). The use of quality standards is critical for the mainstreaming of small and medium enterprises (SMEs) and can also serve as a powerful incentive for the formalization of informal firms.

However, upgrading quality and standards is not a simple matter for many firms, particularly SMEs in developing countries. They often lack the knowledge, expertise, and resources to adopt and implement high quality and standards. They may lack the information to make educated choices and often fail to understand the impact of their choices. Governments in developing countries can help by enabling the private sector to learn about and adopt the quality and standards demanded by international markets. The main argument for government support in this regard rests on the “public good” aspect of standards—the associated externalities, critical mass issues, and network goods characteristics of standards—and the fact that the market is unlikely to produce the optimum standards and levels of adoption. Governments can compensate for market failures by creating programs and policies that promote the widespread use and diffusion of standards. It is quite common for governments to develop and offer programs and training, with direct or indirect subsidies, to help firms adopt quality standards. But it is often the case that only formal firms can qualify for this assistance.

In summary, in the past three decades, the rapid growth of global trade and the increasing share of manufactures in global trade has made quality a critical factor in export success. Low entry barriers in labor-intensive industries and new trade policies present export opportunities for low-cost manufacturers, but competition on price alone, at the expense of quality, is not sustainable. The manufacturing sector depends on standards and quality to a much greater extent than do primary sectors such as agriculture and mining. This is not only because manufacturing by its nature offers more possibilities for specifying technical requirements, but also because the manufacturing sector is more concerned with the greater integration of global production networks. New technologies, trade policies, and corporate strategies have changed the nature of global trade and have integrated producers ever more tightly in global production networks, where standards and quality play an important role.

Defining Standards and Quality

Standards are ubiquitous in today's world, defining much of the way people, products, and processes interact with each other and with their environment. In the most general sense, a standard can be considered as a model or an example that has been established by some form of authority, custom, or general consent. Standards define characteristics or performance, convey information, or provide a means of communication. They are used everywhere in both the public and private sectors. They allow governments to collect taxes fairly and efficiently, based on measurements of economic output or amounts of goods traded. People rely on standards when they purchase electrical appliances and expect them to fit a given electrical outlet. Standards allow railroads to connect so that shipments and passengers can cross multiple regions unimpeded. They instill confidence in the safety of drinking water by specifying minimum acceptable levels of harmful contaminants.

For the purpose of this book, we will define quality as the degree to which a set of inherent characteristics fulfills stated and unstated customer requirements and expectations or complies with stated norms, regulations, and laws, or both. Standards and quality are intrinsically connected, in that standards are often used to codify the technical characteristics expected by customers. In fact, the entire industrial infrastructure that is used to create quality goods and services relies on standards.

The National Quality System: An Overview

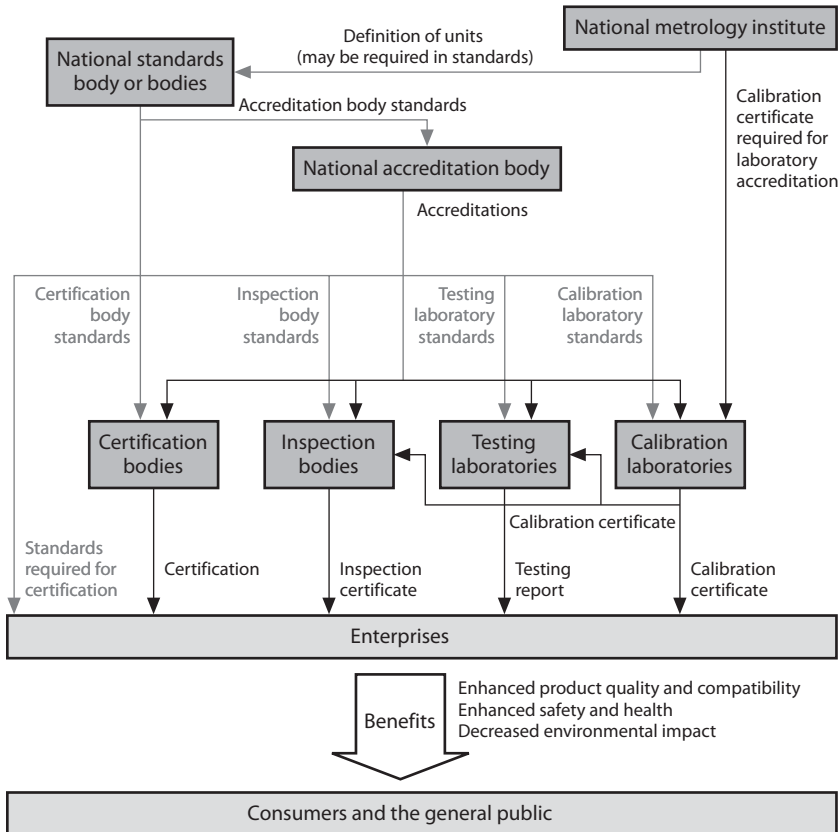
Countries rely on their national quality systems to remain competitive in the global economy. Producers that face growing pressure to meet quality requirements cannot do so on their own, but must rely on a comprehensive system of interrelated actors that facilitate the diffusion of standards and quality in the economy. In the private sector, producers themselves diffuse quality through backward linkages, by exerting pressure on their suppliers, and through forward linkages, by supplying high-quality inputs to buyers. Producers also enhance quality awareness through horizontal linkages, through either informal communication channels, demonstration effects, or formal associative programs. In addition, most countries have developed an entire industry of service providers that specialize in the diffusion of quality and standards through the provision of quality assessments, technical assistance, information, and training services.

Finally, public and nonprofit institutions also play a central role in ensuring that the private sector has the necessary infrastructure to coordinate the development and adoption of standards throughout the economy. These institutions provide vital links to other countries' national quality systems and allow for greater harmonization and recognition of different national quality systems.

The activities used to evaluate whether a product, process, or service fulfills specified technical requirements are part of what is known as *conformity assessment* procedures. These requirements can be described in terms of either voluntary or mandatory standards. The actual conformity assessment procedures differ according to the product or process and can include any combination of testing, inspection, calibration, and certification, performed by one of several conformity assessment bodies. *Testing* involves performing measurements with certain instruments to evaluate a product or process according to a specified procedure; *inspection* is similar but involves less sophisticated instruments or no instruments at all. *Calibration* is used to determine the relationship between an instrument's input and its output, and *certification* provides assurance that a product or process complies with a certain standard. In sum, conformity assessment activities provide the vital link between standards and the products, processes, and services themselves.

Conformity assessment activities are supported by a multidimensional infrastructure of calibration, metrology, accreditation, and standards organizations. Although conformity assessment activities can be performed by the supplier or by the purchaser of the good whose quality is to be ascertained, independent organizations often perform this function. Calibration laboratories ensure that the measurements performed by testing laboratories and inspection bodies are reliable. Third-party calibration of instruments is also sometimes required as a condition for certification. To demonstrate the accuracy and precision of their measurements, calibration laboratories can establish traceability to reference measurement standards by calibrating their own equipment at a national metrology institute. All conformity assessment bodies can demonstrate that they have the competence to offer such services by seeking accreditation from a national accreditation body. All aspects of these activities rely on standards, which provide the basis for evaluation of conformity assessment bodies and define the requirements against which conformity assessment is performed.

Box 1.3 describes the different components of a national quality system, and figure 1.4 shows the relationships between these components.

Figure 1.4 Schematic Representation of a National Quality System

- > Standards and definitions
- > Conformity assessment processes

Source: Authors' elaboration.

Organization of the Book

The first half of this book presents a conceptual framework, highlighting the importance of a national quality system and explaining its role in international trade and economic development. Chapter 2 examines the systemic impact of quality and standards on economic growth and international trade. In particular, it looks at the usefulness of standards as an entry point for technological upgrading and for the mainstreaming of SMEs. Chapter 3 addresses the relative roles and jurisdictions of the public and private sectors in the implementation of an effective national quality system.

Box 1.3

The Components of a National Quality System

National standards bodies

National standards bodies are organizations that bring together public and private stakeholders to develop official national standards. They are usually either public sector entities or nonprofit private entities. Standards bodies usually adopt the standards through consensus and publish them so that they are available to industry, public sector institutions, and consumers. The standards may be voluntary, in which case there is no obligation to use them, or mandatory, in which case they are enforced by governmental authorities.

Certification bodies

Certification consists of the provision of assurance that a product, service, system, process, or material conforms to one or more standards or specifications. Although there exist some self-certification schemes, certification is usually conducted by a third party that is independent of the supplier or purchaser. Certification bodies are usually commercial for-profit or nonprofit entities, although in undeveloped markets they are sometimes public sector organizations. Product certification can involve various degrees of confidence, depending on the referenced standard. In the simplest case, a prototype or a product from a preproduction run is tested and inspected against a specific standard. More vigilant tests involve surveillance of the manufacturing process, random testing of samples, batch testing, and 100 percent testing, where every product is examined individually. Process certification involves an assessment of the variables that have an impact on a firm's output. For example, certification of a firm's manufacturing process quality to a certain standard may be based on an audit verifying the quality of the components or materials, equipment, equipment calibration and maintenance, the training and experience of the personnel, and the environmental conditions.

Testing laboratories

Testing involves determining the characteristics or performance of a product or process according to a specified procedure. Testing is often a requirement for certification, but it is also used for a variety of purposes such as product design and research, quality control, satisfying contractual agreements, satisfying regu-

latory requirements, buyer protection and information, medical health and services, or product repair and maintenance. Testing laboratories come in all forms and sizes. They are usually private sector entities when they concern voluntary standards, but they can be found in both the public and private sectors when they test against mandatory requirements.

Inspection bodies

Inspection can be conducted alone or in combination with testing to determine whether a product or process meets certain requirements. The inspection of products is usually conducted by visual means or by using simple instruments. In contrast to test results, the outcome of the inspection process depends highly on the subjective judgment and experience of the inspector. Like testing laboratories, inspection bodies can be either private or public sector entities, depending on their role in enforcing mandatory requirements.

Calibration laboratories

Calibration involves determining the relationship between an instrument's input and the magnitude or response of its output. It also serves to establish the accuracy and precision of a measuring instrument. Calibration must be performed using equipment of known uncertainty. Commercial calibration laboratories compete for final industrial users, or what is called the secondary calibration market. Those users do not themselves offer commercial calibration services.

The national metrology institute

The role of a national metrology institute (NMI) is to establish a country's national measurement system; to maintain, develop, and diffuse measurement standards for basic units; and to diffuse metrological expertise to the economy. Countries often have a single NMI, but when there are several NMIs each is responsible for distinct areas of measurement. It is common for NMIs to be public sector organizations, but they can also be private sector organizations. NMIs operate in the primary calibration market: they disseminate measurement standards by providing calibration services to independent calibration laboratories and to other organizations responsible for regulations and standards. When their industrial measurements are traceable to the NMI through an unbroken chain of comparisons, firms are able to guarantee the accuracy and precision of their calibration instruments, process control instruments, and quality control instruments.

continued on the next page

Box 1.3**The Components of a National Quality System—Continued****The national accreditation body**

Accreditation is defined as the procedure by which an authoritative body gives formal recognition that an organization or person is competent to carry out specific tasks. Accreditation is sought on a voluntary basis as proof of competence in a given area. Most countries have a single national accreditation body responsible for all areas of accreditation. It can be either a public or a private not-for-profit organization. Accreditation provides certification and inspection bodies, as well as testing and calibration laboratories, with a means to signal that they are conducting their work to appropriate standards and that they are able to provide reliable services. The accreditation body evaluates the personnel and supporting management system of the accreditation candidates and, when relevant, can request practical tests for laboratories. These tests take the form of proficiency testing schemes through which the measurement results of different laboratories are compared. Accreditation is usually valid for a few years after initial assessment, during which time the accredited organization is subject to regular surveillance.

Chapter 4 presents the structure, organization, and functioning of the certification, testing, calibration, inspection, accreditation, and metrology bodies of the national quality system. Chapters 5 and 6 discuss international aspects of the system, especially the ISO 9000 quality management standards.

Chapters 7 through 10 focus on the experience in Latin America and the Caribbean. These chapters examine the standards-setting institutions, certification activities, accreditation processes, and metrology institutions in this region.

The last two chapters of the text turn to the policy framework. Chapter 11 analyzes existing policies and support programs implemented in several Latin American countries to facilitate the diffusion of standards and quality in the productive sector. Finally, chapter 12 presents detailed policy recommendations for developing countries for implementing effective national quality systems and ends with a brief conclusion.

CHAPTER 2

Economic Impact and Effect of Quality and Standards

Standards fulfill a variety of functions. They convey information, allow interoperability between products and processes, guarantee minimum levels of quality and safety, and result in economies of scale by reducing variety. Positive economic effects of standards include their ability to exploit network externalities, to enhance productive and innovative efficiency, to reduce imperfect information, to diffuse information on innovation, and to promote competition. Depending on the context and the content of standards, they may also have negative economic effects by imposing constraints on innovation and decreasing market competition. In light of these mixed positive and negative effects, a number of empirical studies have attempted to isolate the net economic effect of standards. The results of these studies all point to the fact that, under the right conditions, standards have a net beneficial effect on growth.

Functions of Standards

Standards are commonly classified according to their specific function. This classification is useful in understanding the economic effects of standards through analytical models, but it should be viewed as a simplification of reality. Most standards serve several purposes and cannot be neatly classified into a single category. Furthermore, standards with different intended or immediate functions may ultimately have very similar economic effects, and this limits the utility of a strict functional

separation. Keeping this in mind, we can distinguish four basic categories of standards functions (DTI 2005; Swann 2000; Blind 2004).

Information and reference standards, also called *measurement standards*, establish a common technical language in which to compare physical attributes and convey descriptive technical information. They include unit standards, such as the number system, which were probably the first technical standards. Weights and measures were first codified as early as 3500 BCE, largely to facilitate the fair and reliable collection of taxes. Centuries later, in 1799, different unit and reference standards in various kingdoms coalesced into the metric system (Krechmer 2000). These standards also include information standards, which present rules on how to communicate product characteristics. For instance, bolt standards explain how to designate bolt dimensions. A bolt manufacturer need only specify “M10 x 1.5-6g-S” to be perfectly understood by its customers; it need not describe a specific bolt as a “metric fastener thread profile M, fastener nominal size (nominal major diameter) 10 mm, thread pitch 1.5 mm, external thread tolerance class 6g, and thread engagement length group S (short).”

Variety-reducing (or interchangeability) standards define the common characteristics of two or more entities. In this way they provide interchangeability and generate economies of scale and economies of learning in production. The majority of standards fall into this category. Variety-reducing standards grew out of the Industrial Revolution, when the efficiency of mechanized manufacturing depended on codifying the characteristics of products and processes. A well-known standard of this type is the international paper standard, ISO 216, which defines the A4 format used in most of the world except for North America. The widespread use of A4 paper has many advantages other than economies of scale in paper production itself. It avoids the need to rework documents to fit different formats, and it allows consumers to choose between competing paper brands, calculate shipping weights from the number of pages (most A4 sheets have the same weight), and fit papers from different sources into the same envelopes and binders, among many other advantages.¹

Compatibility and interface standards define physical or virtual relationships between independent entities for the purpose of interoperability or communication. Most of a country’s infrastructure uses compatibility standards to connect a number of disparate private and public entities. Consider the case of electricity distribution standards in the United Kingdom, an early adopter of compatibility standards. All electrical outlets

accommodate a single type of plug, type G, and supply 230V at 50Hz. In contrast, in Cuba, there is a single 60Hz frequency standard, but the electric voltage supplied is either 110V or 220V, and outlets can come in any of five types—A, B, C, F, or L. Hence, Cuban consumers might need to fit electrical appliances with burdensome adapters and converters before being able to use them at home.

Minimum quality and safety standards allow consumers to assess the quality or safety of a product before purchasing it. The best-known quality standards, the ISO 9000 standards of the International Organization for Standardization (ISO), are perhaps the most misunderstood. ISO 9000 standards do not specify the quality of a product, but of a management system. They are process standards that describe the organizational procedures that an organization must follow to ensure the consistent quality of its products and services. Suppliers adhering to these standards signal to buyers that they are able to produce goods and services of consistent quality. These standards play a particularly important role in the world economy today and they will be revisited many times throughout this book. Like quality standards, safety standards are widely present among consumer goods such as toys, food, drugs, and electrical appliances. They may specify requirements related to product design, product performance, or manufacturing process.

Positive Economic Effects of Standards

Productive and innovative efficiency

Some of the most common economic benefits of standards are to increase productive and innovative efficiency. Variety-reducing standards lead to economies of scale and economies of learning. They allow suppliers to achieve lower per-unit costs by producing large homogeneous batches. In addition, producers gain skills and experience by focusing on fewer product variations and can increase their efficiency through economies of learning. By allowing producers to concentrate on a manageable number of product options instead of fragmenting their research and development (R&D) efforts, variety-reducing standards also increase innovative efficiency. The national standards body of the United Kingdom, now known as BSI British Standards, describes how the first public standards resulted in significant savings:

On 26 April 1901 the first meeting of the Engineering Standards Committee took place. As a result, the variety of sizes of structural

steel sections was reduced from 175 to 113 and the number of gauges of tramway rails was reduced from 75 to 5. This brought estimated savings in steel production costs of £1 million a year. Steel merchants' costs were reduced due to fewer varieties. This made steel cheaper for the users so everyone benefited.²

Compatibility standards can facilitate both productive and innovative efficiency by providing interfaces for components in a system. They give producers the flexibility to quickly modify products or processes or create new designs and experiments by simply introducing new components, without having to generate a completely different system.

Diffusion of innovation

An often unintended benefit of standards is to spur innovation by providing information on the state of the art of a particular technology. When information on innovations is codified in standards and this information is nonproprietary, it is accessible to everybody, at least in principle. Firms, universities, and research organizations can use the knowledge embodied in standards to adopt innovations or generate new ideas. Standards play a particularly useful role in disseminating knowledge in industries where products and processes supplied by various providers must interact with one another. They ensure that information on innovations in one part of the sector will be diffused to other parts of the sector. A survey of British companies found that over 60 percent of product and process innovators used technical standards as a source of information for innovation (DTI 2005). This was twice the number of companies that cited universities or research laboratories as sources of innovation. Because standards can be acquired across borders, they can also constitute important sources of technical knowledge for firms in developing countries.

The nature of the standardization process itself also facilitates the diffusion of technological information. Often, standards are the outcome of a formal development process in which interested parties come together to study and discuss technical specifications. Usually participants try to advance standards that are as close as possible to their own products or processes. As a result, engineers and other experts working in the same technological areas must agree to share their own technical and commercial information during the standard-setting process. In fact, a survey of 4,000 companies in Austria, Germany, and Switzerland found that businesses reduced both the economic risk and the cost of their R&D activities by participating in standardization (DIN 2000).

Reduction of imperfect information

Problems arise when consumers, producers, or governments do not have all the information they need to make sound purchasing, investment, or policy decisions. Certain standards draw their utility from conveying information that corrects for problems of imperfect information.

Minimum safety standards are the most straightforward example of standards used to solve imperfect information problems. By conveying information about the harmful effects of products, they allow customers to avoid products that might negatively affect them, the public, or the environment, and they allow regulators to exclude unsafe products from the market. These standards thus reduce the societal costs of dealing with potentially harmful effects of certain products. These savings in turn allow a more efficient allocation of resources and can contribute to economic growth.

Standards can also reduce the transaction and search costs that are caused by imperfect information. This is another role of minimum safety standards, but it can also be accomplished by quality standards and product description standards. These standards allow buyers to confirm that products and processes have the characteristics they want without the additional transaction costs of independent testing. By codifying market preferences, standards also save sellers the additional costs of defining consumer preferences.

By reducing information asymmetries, standards can help mitigate adverse selection problems. In many situations of imperfect information, the seller has better information than the buyer. Sellers cannot charge a price premium for high-quality products if buyers are unable to distinguish them from low-quality products. If the costs of high-quality producers are greater than the costs of low-quality producers, high-quality producers will undersupply or could even be driven out of the market. Minimum quality or safety standards help consumers confidently differentiate product quality and safety, and hence help mitigate adverse selection problems (box 2.1).

Exploitation of network effects

Compatibility and interface standards add economic value to goods with network externalities and facilitate the development of networks. Compatibility standards can increase *direct* network externalities by allowing products to work as part of a system or network. They allow each individual participant in the network to derive benefits from interacting with other participants in the network. This is the case of the telephone

Box 2.1**Quality Standards in the Ugandan Coffee Industry**

Coffee plays an important role in the Ugandan economy and represented 17 percent of exports in 2004. However, in the early 1990s a combination of factors inside and outside Uganda started to erode the incomes and export revenues of coffee growers and threatened the long-term viability of the industry. These factors included aging coffee trees, pests and diseases, poor postharvest handling methods that resulted in lower quality levels, and, especially, an over-supply on the international market that drove down prices. Low world prices in turn worsened quality levels by acting as a disincentive for producers to invest in better crop husbandry. At the same time, liberalization of the coffee industry exacerbated the quality problems and threatened the image of Ugandan coffee overseas.

The coffee industry has a long history of regulation in Uganda. Until the early 1990s, the Coffee Marketing Board, the state-controlled monopoly, had the exclusive rights to purchase and export all dry processed coffee. In 1991, the coffee industry was liberalized, and by 2001, about 200 licenses had been issued to private exporters. The liberalization improved the producers' revenues but also had undesirable outcomes. Increased competition and the entry of inexperienced exporters led to a decrease in coffee quality. This effect was exacerbated when a number of coffee buyers (middlemen) and producers realized that they were able to sell low-quality coffee and started to ignore quality at the expense of export quantity. These quality issues had negative repercussions for

network, for example: subscribing to the network is only useful insofar as there are other subscribers with compatible telephones (box 2.2).

Compatibility standards can also generate *indirect* network externalities when they allow users to derive benefits from a system involving two or more complementary components. In the case of the personal computer, the value of owning the hardware increases with the number of compatible software options. In turn, the market will provide more software options if there are more owners with compatible hardware. The indirect externalities are caused by the incremental effects of each purchasing decision on the future variety and price of complementary products available within the system. More hardware purchases will stimulate the supply of software and vice versa. This positive feedback

all Ugandan coffee exporters. Exports of low-quality coffee tarnished the image of Ugandan coffee abroad, which in turn reduced incentives for production of high-quality coffee. Given that the global production surplus had led international buyers to be more selective on quality, Uganda's inability to strengthen producer practices posed a serious threat to the viability of its coffee industry.

Uganda reacted by establishing a mix of voluntary and mandatory coffee quality standards. In 1994, the Coffee Regulations were adopted to stipulate coffee standard and grade requirements for exporters. The quality standard requirements were enforced by the Uganda Coffee Development Authority through periodic inspections. The Coffee Regulations were complemented by the Uganda Coffee Trade Federation's Code of Practice, which directed members to conform to minimum quality standards. Federation members who consistently did not comply with quality requirements were issued fines. Moreover, the federation could make recommendations on the licensing of coffee exporters to the Uganda Coffee Development Authority, and it would not support members that breached the Code of Practice. As an additional incentive for coffee producers, the federation made the list of its members who had subscribed to the Code of Practice available to coffee associations in importing countries.

Although enforcement has sometimes been difficult, the main effect of the Coffee Regulations and the Code of Practice has been to promote exports by projecting a positive image of Ugandan coffee quality in world markets and helping foreign buyers distinguish low-quality from high-quality suppliers.

Source: Rudaheranwa, Matovu, and Musinguzi 2003.

effect will increase the value of both the hardware and the software and expand the network of users.

Increased competition

By codifying market preferences and technical information and establishing interchangeability, standards promote competition. By specifying the characteristics of products and services, standards give all producers equal access to market information and level the playing field. In particular, compatibility standards can increase competition by reducing entry barriers in markets with network effects. By specifying interface designs, standards make it possible for a company to enter a market without investing in an entire fully integrated system; it can compete

Box 2.2

Transatlantic Competition for First- and Second-Generation Mobile Phones

Standards have played a critical role in the development and diffusion of mobile phone networks. While in 1990 there was only one cellular subscriber per 1,000 people, as of September 2005 there were more than 2 billion mobile phone subscribers in the world, or approximately 300 subscribers per 1,000 people. The success of the mobile phone industry has not been limited to high-income countries; for instance, in Sub-Saharan Africa there were six times more mobile phone subscribers than telephone land lines in 2003.

First-generation cellular phone systems, based on analog technology, emerged in the 1970s, thanks in large part to the invention of the microprocessor. By 1978 the Bell telephone company was experimenting with the first commercial cellular network using Advanced Mobile Phone System (AMPS) standards. Based on Bell's proposal, the U.S. Federal Communications Commission (FCC) mandated AMPS as the cellular standard in the United States and imposed antitrust legislation to ensure competition in the mobile phone market. The establishment of a single standard created a critical mass of subscribers able to communicate with compatible networks throughout the country and leveraged network externalities. By 1993 more than half of the world's wireless cellular systems were based on the AMPS standard.

In Europe, two dominant standards emerged for first-generation phone systems. Ericsson and Nokia developed the Nordic Mobile Telephone (NMT) standard in the 1970s, which was subsequently adopted by a number of European countries in the 1980s. The Total Access Communications System (TACS) standard originated in the United Kingdom and Italy and was the main European rival to NMT. In addition, a number of other proprietary phone systems were established across Europe but for the most part each one operated in a single country. The incompatibility of first-generation cellular networks across countries proved to be a serious handicap for the European cellular telecommunications industry, as it failed to achieve economies of scale. As a result, there were far fewer mobile phone subscribers in Europe than in the United States in the 1980s.

An important problem with first-generation analog phones was their inefficient use of a finite amount of available bandwidth. As more subscribers

adopted first-generation phones, cellular networks approached saturation levels. In contrast, second-generation phone systems, based on digital technology, utilized spectrum much more efficiently and also offered better voice quality. Commercial operation of second-generation phones began in Europe and the United States in 1991. This time, the United States and Europe reversed their original approach to cellular standardization.

In the United States, the FCC decided not to adopt an official cellular standard but to allow market competition to select the optimal technology. This approach led to segmentation of the market into a number of competing industry standards in the United States, including CDMA, TDMA (or "D-AMPS"), and the first-generation AMPS system. However, the FCC's expected results did not materialize and no dominant second-generation technology emerged. Multiple standards coexisted well into the end of the 1990s. Limited network externalities significantly slowed digital phone adoption rates and by 1998 only 30 percent of subscribers were using digital phones in the United States.

In Europe, the development of the Global System for Mobile Communications (GSM) had already begun in 1981 as an effort of the European Commission, telecommunications operators, and equipment manufacturers to create a single open pan-European digital standard. In 1989 GSM was officially accepted by the European Telecommunications Standards Institute and was adopted by each of its member countries. The GSM standard would allow one cell phone to work in all European countries. As a result of standards harmonization, GSM phone networks diffused rapidly across Europe and displaced the old analog technologies. By 1998 over 90 percent of cellular subscribers in Europe were using GSM technology. The vast European market produced economies of scale and economies of learning that gave European phone manufacturers and network operators a critical advantage over their American and Japanese competitors. This enabled them to capture most of the world's cellular market. By September 2005 there were 1.6 billion GSM users worldwide, representing 77 percent of cellular subscribers. The GSM standard even captured an important share of the North American mobile telecommunications market and was used by 20 percent of its cellular subscribers in 2003. There are currently GSM operator members in 210 countries and territories.

Sources: Ritchie et al. 1999; ITU 2005, 2006; GSM Association 2005.

in the market for a single component of that system instead. Thanks to standards, a more open market results in more consumer choices, lower prices, and higher quality. The publication of interface standards decreases the ability of suppliers to extract high rents on replacement parts or new complementary products. If interface information is widely accessible, no single supplier can internalize the benefits of the entire network or has incentives to create switching costs for customers. Increased competition in turn leads to an optimal allocation of resources and greater efficiency in the economy.

Cost reductions

Standards are being developed by leading nations to reduce operating costs and increase competitiveness. For example, a group of 12 countries led by Singapore has developed an international standard for electronic seals on freight containers that is expected to save the global shipping community \$64 million annually. The global standard, to be called ISO 18185, dictates a protocol for electronic recognition of the seal number and for checking seal conditions electronically using radio frequency identification technology.

The global standard is expected to speed up and improve these services, leading to quicker customs clearance for cargo in ports. It is also expected to help small and medium enterprises (SMEs) bring their supply chain and security planning needs up to multinational companies' standards. This will help avoid unnecessary delays during customs inspections.

Negative Economic Effects of Standards

Some of the very elements associated with the positive economic value of standards, such as compatibility and interchangeability, can also be detrimental to public welfare. Depending on the specific content of a standard and on market characteristics, standards can have a negative impact on two important contributors to economic growth: innovation and market competition.

Constraints on innovation

The positive effects of standards on technical change are counterbalanced by their negative effects on product variety. By specifying product characteristics, such as form, performance, or interface, standards limit innovation. New designs need either to satisfy the given standards or to embody radical technological improvements that place them outside the

scope of existing standards. This can significantly increase development time and cost. By decreasing variety, standards also reduce the diversity in the pool of products that can be used as a basis for further innovation.

Obsolete, inappropriate standards may hamper technical change by preventing the adoption of superior technology through the lock-in effect. Standards may create situations in which users are locked into a network or a product that uses less efficient technologies. If standards are formulated too late, the costs of switching to a new technology may become too high and prevent its diffusion. The QWERTY computer keyboard is a well-known case of technological lock-in. Although many alternative keyboard layouts have been designed to increase typing speed and comfort, the nineteenth-century QWERTY layout is still used because the costs of retraining workers to use a different keyboard would be prohibitively high. Furthermore, new users will still prefer to learn to type on a QWERTY keyboard as long as this layout dominates the market.

The effects of standards on innovation largely depend on timing. While standards encourage adoption of new technologies, newer technologies are not necessarily superior to older ones. An early switch of technology can prevent beneficial improvements to more mature technologies or can preclude the development of potentially more beneficial future technologies. For example, had early typewriter manufacturers waited for further advances in keyboard design before adopting the QWERTY layout, we would perhaps have been using a more efficient keyboard today.

Constraints on competition

Standards can have anticompetitive effects if only one or a few companies are able to internalize their benefits or control their content. In this case, standards can be used as strategic instruments to expand market power. This occurs when the content of the standards covers technological areas in which a limited number of firms have property rights, exclusive knowledge, or the exclusive resources needed to use a technology. In the case of compatibility standards, owners of proprietary information on interface technologies are able to control their use and extract high rents from their rivals. In 1998, Microsoft was taken to court for abusing its monopoly power. Some of the charges were directed at its exclusive control of application programming interfaces (APIs), interface standards that define how one piece of computer software communicates with another. Microsoft was accused of not disclosing the APIs that would enable other companies to produce Internet browser software that could work in the Microsoft Windows operating system and compete with

Table 2.1 The Economic Effects of Standards According to Their Function

<i>Function</i>	<i>Positive effects</i>				<i>Negative effects</i>	
	<i>Exploitation of network effects</i>	<i>Innovative and productive efficiency</i>	<i>Reduction of imperfect information</i>	<i>Innovation diffusion</i>	<i>Constraints on innovation</i>	<i>Constraints on competition</i>
Compatibility and interface	X	X		X	X	X
Minimum quality and safety			X	X	X	X
Variety reduction		X		X	X	X
Information and reference			X	X	X	X

Source: Authors' elaboration.

Microsoft's own browser. It was found that Microsoft would only release this information to a company that entered in a "special relationship" with Microsoft.³

Table 2.1 provides a summary of positive and negative economic effects of standards according to their function. Again, it must be emphasized that few standards fit clearly into a single functional category and that a combination of functions will result in some combination of economic effects. Box 2.3 provides an example of the quantifiable economic effects of measurement standards.

Box 2.3

The Economic Value and Impact of Measurement Standards

The economic role of measurement standards is of particular interest because they are the most widely used type of standard. Measurement standards involve the definition of units of reference and their method of measurement. The accuracy and consistency of measurements in an economy reflect the specification of measurement standards and their diffusion throughout the economy.

Measurement plays a significant role in assessing the quantity of goods being traded. A report for the International Committee of Legal Metrology (Birch 2003)

cited studies in several countries that point to the importance of measurement standards. A study of the Canadian economy reported that the total value of goods traded over all classes of trade-related weighing and measuring instruments totaled 32 percent of the gross national product (GNP) in 1989–90, excluding prepackaged goods and utility metering. Similarly, the total value of trade transactions involving measurement in Australia in 1998 was estimated to be 60 percent of GNP, including prepackaged goods and utility metering. Another study estimated that weights and measures regulations impacted transactions involving 54.5 percent of United States GDP in 1996, including prepackaged goods and utility metering. Figures from these three countries are consistent with one another and confirm the importance of measurement in trade.

Several economy-wide analyses have estimated the total cost of measurement activities in the United States and Europe. Early studies by the U.S. National Bureau of Standards between 1967 and 1984 found that industry, government, and community expenditures on measurement-related activities totaled between 3 and 6 percent of GNP (Birch 2003). A more recent study found that

The European Union spends 83 billion euros per year, or nearly 1% of European Union GDP, on measurement activity (NMI turnover, accredited calibration laboratories turnover, certification costs to industry, instrument costs, and industrial spending on measurements). Adding social spending on health, environmental regulation, safety testing, antifraud projects and normal day-to-day measurement activities raises this figure considerably. (BIPM 2003: 116)

Estimating the impact of measurement on the economy as a whole is a much more complex task. Studies commissioned by the European Commission's Directorate-General for Research (DG Research) illustrate the role measurement can play in specific economic sectors and economy-wide. One study finds that a metering error of 1 percent in the gas industry equals about 4 billion cubic meters per year in Western Europe, with a commercial value of 800 million euros. The authors note that in reality metering errors easily attain 4 to 6 percent. Another DG Research study points to the cost of measurement and testing in European health services, which totals 13 billion euros per year. Econometric estimates also showed that expenditures on measurement activities generated 230 million euros of benefits, equivalent to 2.67 percent of European Union GDP. The model excluded social benefits related to health, safety, and the environment. The resulting benefit-to-cost ratio of measurement was found to be 2.73 (Birch 2003; BIPM 2003).

The Impact of Standards on Economic Growth: Empirical Evidence

If standards affect technology diffusion, innovation, and technical change, endogenous growth theory implies an associated change in growth rates. The economic effects listed in table 2.1 give theoretical reasons to believe that standards impact economic growth, but do not establish in which direction. Two series of studies provide insight into the role of standards in innovation and economic growth. One set of studies was sponsored by the United Kingdom's Department of Trade and Industry (DTI 2005) and the other by the German Institute for Standardization (DIN 2000).

The empirical relationship between innovation and standardization shows an inverted *U* nonlinear pattern, under several specifications. As sources of information on innovation, standards promote the adoption of new technologies by firms and consumers, but they also introduce economic constraints that impede the innovation process. Econometric models, based on surveys of firms and the corresponding standards stock in different economic sectors in the United Kingdom, suggest how the constraining and informative roles of standards vary with the number of standards and the median age of the standards stock (DTI 2005).

A first model, concerned with information provision, finds that an increase in the number of national standards provides more information to producers. However, the model finds a nonlinear relationship between information provision and the median age of the standards stock in an industrial sector. As the median age of standards increases, producers find standards more informative, but after a certain point the standards start to lose their information content and median age begins to have a negative effect on information provision. The explanation is simple: newly published standards are not widely diffused or properly understood and thus are of limited impact, while older standards become outdated and lose their information value as the technologies and products they refer to reach the end of their life cycle.

A second model, concerned with the constraining role of standards, finds significant quadratic relationships with both the number and median age of standards. As the number of standards in a sector increases, producers at first find them less constraining on innovation, but after a certain point they start to find them more constraining. The model also finds that both rather new and rather old standards constrain innovation. Here, the authors contend that new standards constrain advances in the latest technologies by locking innovators into legacy systems, while older

standards constrain innovators by forcing them to conform to outdated technologies. The complex nature of the effect of standards on innovation may explain why, in another study based on time-series analyses using patents and standards, Blind (2004) only reports a weak positive impact of standards on innovation.

Time-series investigations suggest a significant positive long-run contribution of standards to economic growth in the United Kingdom. A first study is based on an econometric analysis of time-series data over the period 1948–2002 in the United Kingdom (DTI 2005). The macroeconomic model specifies total factor productivity (TFP) at time t as a function of the patent stock (PAT), expenditures for foreign patents and licenses (LEX), and the standards stock (STD).

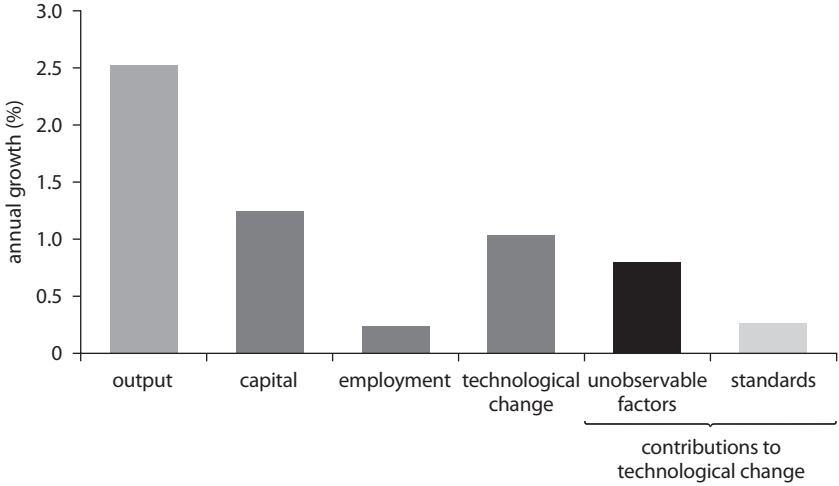
$$\text{TFP}(t) = f [e^{\lambda t} \text{PAT}(t)^{\Delta} \text{LEX}(t)^{\Delta} \text{STD}(t)^{\epsilon}]$$

This TFP is an index of the “technological level” of the economy. The construction of TFP in this model is based on the premise that standards alone cannot contribute to economic growth. Instead they contribute to technology *diffusion* and must work in *conjunction* with foreign and domestic innovation to increase productivity. In this model, the output Y is determined according to the following production function:

$$Y(t) = \text{TFP}(t) F(\text{K}(t), \text{L}(t))$$

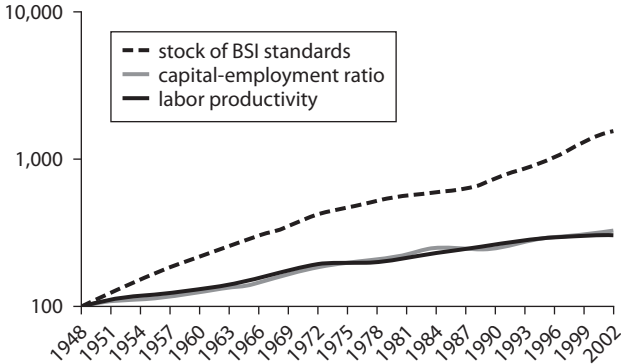
where K stands for capital, L for labor, and TFP is calculated as the Solow residual. The results of the analysis find that standards contributed to about 13 percent of the growth in labor productivity in the United Kingdom over the given period, or to about 0.28 percent per year. The United Kingdom’s GDP grew 2.5 percent per year between 1948 and 2002, of which 1.5 percentage points could be explained by labor and capital accumulation and 1 percentage point could be explained by technological change. More than 25 percent of the growth induced by technological change could be attributed to standards (figure 2.1). Central to the contribution of standards to productivity was an annual growth of the standards stock at an average rate of 5.1 percent per year (figure 2.2). The computed long-run elasticity of labor productivity on the stock of standards was about 0.05. Hence, a 1 percent increase in the number of standards could be associated with a 0.05 percent increase in labor productivity. Further analysis of the model shows that standards did not have a significant short-run effect. Rather, standards take time to diffuse among a user population and their impact is long run in nature.

Figure 2.1 Contributions of Different Factors to Output Growth in the United Kingdom, 1948–2002



Source: DTI 2005.

Figure 2.2 Long-Run Growth of Labor Productivity in the United Kingdom, 1948–2002



Source: DTI 2005.

Note: 1948 = 100 log scale.

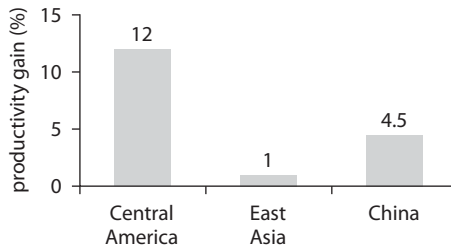
In Germany, a similar study found that, after capital accumulation, standards were the second factor contributing to growth. A slightly older macroeconomic analysis of standards was performed by Jungmittag, Blind, and Grupp (1999) for the German economy over the 1960–96 period. This study was the precursor of the DTI study and used the same methodology, incorporating standards in the production function of the model, along with technology imports and patents. The results showed that standards were at least as important to technical innovation as patents and second only to capital accumulation in their contribution to growth. In the period 1960–90, the analysis found standards contributed to about 0.9 percentage points out of an average overall growth rate of 3.3 percent. However, from 1990 to 1996, after German reunification, the contribution of the standards stock decreased to 0.3 percentage points of an overall growth of 1.5 percent per year.

An empirical study of different manufacturing sectors in Europe confirms the major impact of the standards stock on productivity growth but draws attention to the differential impact of standards across sectors and countries (DTI 2005). The four countries included in this project, France, Germany, Italy, and the United Kingdom, all experienced a rapid growth of their standards stocks during the 1990–2003 period. The methodology was basically the same as in the two previously mentioned macroeconomic studies by DTI, but it was applied to 12 individual manufacturing sectors and did not consider technology imports. The estimated impact of standards on productivity across all 12 industries and all four countries was found to be of the same order of magnitude as that reported in the economy-wide analysis. Country-level models suggest a differential impact across countries. Table 2.2 shows the partial production elasticities of patents and standards in each country and at the aggregate level. The contribution of standards was positive in each country. Standards were as important as patents for productivity in the United Kingdom, far more important in France, and less important in Germany and Italy. When the models are run individually on different industry sectors, a rough pattern in the results suggests that standards have a more signifi-

Table 2.2 Partial Production Elasticities in Selected European Countries

	<i>All four countries</i>	<i>United Kingdom</i>	<i>Germany</i>	<i>France</i>	<i>Italy</i>
Patent stock	0.105	0.047	0.094	0.072	0.059
Standards	0.079	0.052	0.027	0.147	0.017

Source: DTI 2005.

Figure 2.3 Average Productivity Gains Due to Adoption of Quality Standards

Sources: Escribano and Guasch 2005a, 2005b.

Note: Central American sample includes El Salvador, Guatemala, Honduras, and Nicaragua. East Asian sample includes Indonesia, Malaysia, the Philippines, and Thailand.

cant impact on productivity in mature industries than in R&D-intensive industries, where patents are more important. This observation makes sense, because low- and medium-technology sectors tend to rely on established technologies, which are documented in standards.

Studies using firm-level surveys of investment climate factors in developing economies also found that the adoption of standards had a significant impact on several measures of productivity. This analysis used a total of 10 productivity measures based on total factor productivity, rates of growth, and input-output elasticities based on the levels of the relevant variables. The adoption of standards was proxied by certification to ISO standards. Average productivity gains were estimated to be between 2.4 percent and 17.6 percent for four Central American economies, less than 1 percent for four Southeast Asian economies, and 4.5 percent for China, as shown in figure 2.3 (Escribano and Guasch 2005a, 2005b).

The Impact of Standards on International Trade: Empirical Evidence

The impact of standards on trade is a priori ambiguous. The role of standards in trade can essentially be derived from their micro-level economic effects on public welfare, discussed earlier in this chapter, which may be either positive or negative.

Many of the positive economic effects translate directly into positive effects on trade. By diffusing market and technological information across borders, standards allow countries to compete in new international markets. They enhance transparency and allow foreign producers to appropriate national preferences and technical specifications and adapt their

products and services accordingly. By establishing product and process characteristics or performance, standards reduce transaction costs between business partners in distant countries and reduce information asymmetries. When the same standards are used in different countries, they promote trade by enabling specialization and the generation of economies of scale. Also, compatibility and interface standards allow countries to specialize in system components for which they have comparative advantage.

However, there are many other circumstances in which standards will have no effect on trade or even act as a deterrent to trade. Many of the theoretical arguments that support a positive role for standards in trade are based on the assumption that standards are public goods that can be accessed and adopted on an equal basis by producers in any country. In some cases this may be far from the reality. For example, standards may not be well documented, they may be difficult to find, they may be poorly understood, or they may be protected by intellectual property rights. If each country uses its own idiosyncratic or country-specific standards, global economies of scale will not be realized and each country may end up focusing exclusively on its domestic market. If products must be adapted to conform to different national standards, additional costs can hinder trade (box 2.4). Some countries may even find themselves excluded from international markets when compliance with foreign standards requires technological capabilities that are beyond their reach. But shared standards that reduce variety can also hamper trade. Standards that are harmonized between countries can distort trade if their content strongly favors one trade partner over the other. A country may be placed at a competitive disadvantage if it does not have the technological capabilities, the industrial infrastructure, or the natural resource endowments needed to comply with a shared standard.

Some studies involving business surveys highlight the potential of standards as barriers to trade. This is the approach used in a study sponsored by the German Institute for Standardization (DIN 2000). Business surveys in Austria, Germany, and Switzerland showed that 27 percent of firms had to adapt their products and services to foreign standards. Adaptation costs averaged DM 350,000 per year at the firm level, ranging from DM 2,500 to DM 6 million.⁴ However, the data presented in the DIN report make it difficult to evaluate the relative importance of these costs to exporters.

A survey by Wilson and Otsuki (2004) offers more insight on the trade barriers posed by mandatory standards.⁵ This survey, which covers 17 developing countries, shows that a high share of firms face technical regulations

Box 2.4**Differing Standards and Trade Costs: The Case of Pallets**

Raballand and Aldaz-Carroll (2005) provide a detailed account of how the absence of harmonized pallet standards increases trade costs. The pallet is a portable platform for storing, stacking, handling, and transporting goods. Pallets were initially developed to protect products, facilitate storage, and improve distribution efficiency. They are used extensively in most countries and carry 80 percent of traded goods in the United States.

Part of the efficiency of pallets is compromised by the incompatible pallet standards used in different countries. There are hundreds of different pallet sizes around the world, so goods shipped from one country to another must often be manually unloaded from the pallet of the country of origin and reloaded onto the pallet of the destination country. This operation increases delivery costs for a number of reasons. Transferring goods between pallets requires additional time and labor and a warehouse might need to own different equipment to handle each type of pallet. Moreover, manual handling of goods between pallets can lead to product losses and deterioration of the pallets. A study of banana exports from Ecuador to Europe found that different pallet sizes introduce inefficiencies that increase total transport costs by 21 percent, or \$27 million annually.

Developing countries are particularly affected by the costs of using multiple pallet sizes because these costs are high relative to the low value added of their exports. In Uganda, for example, packaging costs account for 50 percent of the product value for the export of a pallet of bananas. Additional packaging costs can create trade costs that reduce market access to countries with different pallet sizes.

Source: Raballand and Aldaz-Carroll 2005.

in export markets, including 76 percent of firms in Latin America and the Caribbean. In all countries, firms consider foreign technical regulations to hinder the expansion of trade. Many of the firms facing technical regulations have additional compliance costs for each export market, which in total make up between 1 and 10 percent of investment costs. These compliance costs most often concern investments in additional plant or equipment (38 percent of firms), product redesign, and contracting of additional workers. On average, investments to comply with technical regulations amount to 4.4 percent of total sales.

Another study of technical barriers to trade by Chen, Otsuki, and Wilson (2006) attempts to quantify the impact of standards and technical

Box 2.5**Food Safety Standards in the European Union**

New EU food safety regulations that came into force in 2005 include stringent reporting requirements for developing-country farmers. As reported by Wallace (2004), the new regulations “make it mandatory for all fruit and vegetable products arriving in the EU to be traceable at all stages of production, processing and distribution.” EU assistance to help farmers meet these stringent new standards, which involve tracing production back to the seed, is reported to be inadequate. Consequently, many developing-country farmers risk being closed out of this important market. An additional problem is that the standards are applied in a discriminatory fashion, and meeting them requires specialized skills and equipment beyond the capability of most low-income countries.

Such a tightening of standards can have economic ramifications. Otsuki, Wilson, and Sewadeh (2001) examined proposed EU standards for aflatoxin (toxic compounds produced by molds) in food exports from Africa. The authors estimated that the standards, which would reduce EU health risks by less than 2 deaths per billion per year, would decrease African exports of cereals, dried fruits, and nuts by 64 percent (\$670 million).

Source: Goldin and Reinert 2006.

regulations on the export performance of firms. The study is based on the above-noted survey of 17 developing countries. The survey collected information on the perceived effects of standards and technical regulations on the ability to export. Using these data and a model of a firm’s decision to export, the study suggests that testing procedures reduce export share by 9 percent. Meeting standards also affects a firm’s ability to enter foreign markets, reducing a firm’s likelihood of exporting in more than three markets by 7 percent.

While the previous studies offer valuable insight into the perceived effects of standards on trade at the firm level, they do not establish a solid relationship between standards and trade at the macro level. Nonetheless, a number of empirical studies have attempted to do just that, and they have delivered interesting results.

Box 2.5 on food standards in the European Union (EU) presents an example of how setting standards can have a significant impact on trade. The balance between the costs and benefits needs to be carefully evalu-

ated so the right balance is achieved, and remedial measures to respond to new requirements are available and do not become an insurmountable burden.

A review of empirical studies finds that there is mixed evidence on the role of idiosyncratic standards but that shared or harmonized standards are trade-promoting (table 2.3). The empirical evidence does not produce a strong consensus on the role of country-specific standards, and it reveals their ambiguous effect on trade. Idiosyncratic standards promote trade by reducing information costs but hamper trade by introducing adaptation costs, so it is the relative weight of these two effects that will determine the net trade effect. However, the empirical evidence shows that the adoption of harmonized standards by trade partners increases imports, exports, or both. When countries use the same standards, many of the trade-hampering effects of standards are eliminated. Exporters no longer need to adapt their products for other markets, information on standards is more easily available to exporters, and economies of scale promote the exploitation of national competitive advantages.

Blind and Jungmittag (2005) perform a panel study of bilateral trade flows between Germany and the United Kingdom between 1980 and 1995 in 31 sectors to ascertain the causality of the relationship between different types of standards, exports, and imports. The model, which considers both German and British standards, is based on trade equations that incorporate factors of technological competitiveness and macroeconomic indicators. Blind and Jungmittag find evidence that it is specifically harmonized standards that enhance trade. International standards adopted by Germany have a significant positive effect on German exports, whereas German idiosyncratic standards have a negative effect on German exports. These results support the hypotheses that national idiosyncratic standards create a competitive disadvantage for exporters, and that, conversely, international standards represent a competitive advantage for German producers. As for imports, German international standards have a slightly positive effect on German imports from the United Kingdom, whereas national German standards have no impact on imports.

In another study, Swann, Temple, and Shurmer (1996) perform an econometric analysis of the effects of standards on UK trade performance. Their study considers *total* intra-industry trade in the United Kingdom in 83 manufacturing sectors from 1985 to 1991. British standards in each sector are introduced in the trade equation, and although this study is not restricted to trade with Germany, German standards are also introduced as a measure of international best practice. These authors find that

Table 2.3 Empirical Results on the Effect of Idiosyncratic and Harmonized National Standards on Trade

<i>Authors</i>	<i>Model</i>	<i>Effect of idiosyncratic standards</i>			<i>Effect of harmonized standards</i>		
		<i>Imports</i>	<i>Exports</i>	<i>Trade volume</i>	<i>Imports</i>	<i>Exports</i>	<i>Trade volume</i>
Blind and Jungmittag (2005)	Time series, 1980–95, bilateral trade, 2 countries	0	–	–	+	+	+
Swann, Temple, and Shurmer (1996)	Time series, 1985–91, bilateral trade, 2 countries	+	+	+	+	+	+
Moenius (2004)	Time series, 1985–95, bilateral trade, 12 countries	+	n.a.	+	+	n.a.	+
Chen and Mattoo (2004)	Time series, 1986–2001, bilateral trade, 42 countries	n.a.	n.a.	n.a.	+	+	+
Hummels and Klenow (2005)	1995 data, bilateral trade, 126 countries	n.a.	n.a.	n.a.	+	+	+

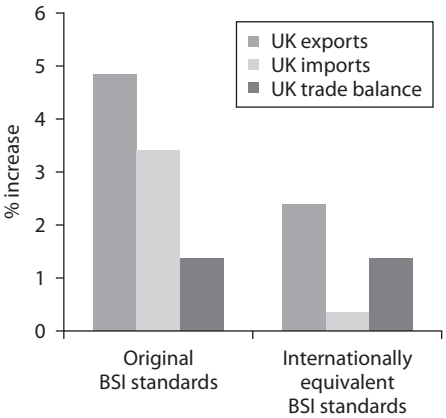
Source: Authors' compilation.

Note: + = positive effect; – = negative effect; 0 = no effect; n.a. = not available.

an increase in the number of either idiosyncratic or international standards has a comparable positive impact on the trade ratio, but that the stock of idiosyncratic standards encourages imports and exports more than the stock of international standards (figure 2.4). Specifically, 100 additional idiosyncratic British standards increase imports by 34 percent and exports by 48 percent, while 100 additional international standards increase imports by 3 percent and exports by 24 percent. The study suggests that the weaker effect of international standards on trade may be due to the specific nature of these standards. If international standards are mainly variety-reducing standards, the negative effects of reducing variety on intra-industry trade may offset the positive effects of sharing standards.

Moenius (2004) uses a slightly different approach to investigate the role of shared versus idiosyncratic standards. Standards documents adopted in a given country usually include links to the international standards to which they are related, if any. The author’s measure of shared standards is based on a count of the number of links between similar standards in two countries. This contrasts with the traditional approach used by Blind and Jungmittag (2005) and Swann, Temple, and Shurmer (1996), which counts the number of international standards in each country and assumes that these standards are shared on a bilateral basis.

Figure 2.4 Effects of British Standards on UK Exports, Imports, and Trade Balance, 1985–91



Source: Swann, Temple, and Shurmer 1996.

Note: Values shown represent percentage increases in trade caused by the adoption of 10 additional standards in the United Kingdom. At the time of the study, British standards were administered by what was then called the British Standards Institution (BSI), the precursor of BSI British Standards.

Moenius uses a gravity-based model, which predicts that the volume of trade between two countries will be proportional to their economic mass, usually measured by GDP, and inversely proportional to the physical distance between them and other obstacles to trade. The model uses sectoral bilateral trade data for 12 countries of the Organisation for Economic Cooperation and Development (OECD) during the time period 1985–95. The results show that trade volumes are higher for countries that share more standards. On average, a 1 percent increase in the number of shared standards increases the bilateral trade volume by 0.3 percent. This implies a \$6 billion increase in U.S. trade volume for a 1 percent increase in the number of shared standards between the U.S. and its trading partners. When the analysis is repeated for imports only, both shared standards and country-specific standards are also found to promote trade.

An examination of the effects of standards at the industry level provides additional insight into the effect of each type of standards. The results show that for simple product sectors, such as food and beverages or crude mineral fuels, the stock of either country-specific or shared standards in the importing country hampers imports, while for complex manufacturing sectors, both types of standards promote imports. In sum, the Moenius study reveals that country-specific standards are not necessarily a barrier to imports. In technologically complex sectors, informational requirements to export in foreign markets are high, so standards reduce information costs by documenting technical specifications and market preferences. In simple industrial activities, products are relatively homogeneous and informational requirements are low, so the reduction of information costs through standards will not outweigh product adaptation costs. However, while this explains why country-specific standards have a positive effect on trade in manufactures and a negative effect on trade in nonmanufactures, it does not fully explain why shared standards should negatively affect trade in nonmanufactures.

In another study, Chen and Mattoo (2004) examine bilateral trade among 42 countries to determine the effect of shared standards on trade. This study takes a unique approach in that it does not actually count shared standards but quantifies the extent of standards harmonization by identifying harmonization directives in different industrial sectors. The model also includes regional trade agreements and mutual recognition agreements.⁶ The time-series analysis yields a statistically significant relationship between shared standards and trade. The results imply that a harmonization directive implemented by two countries raises bilateral imports in the concerned industry by 32 percent and imports

from countries outside the harmonizing region by 10 percent. This study supports the argument that shared standards reduce the transaction and adaptation costs of trade. However, because this study relies on harmonization directives, it does not cover all shared standards and is principally concerned with mandatory standards.

Hummels and Klenow (2005) provide evidence of the impact of quality on export performance. Using 1995 data on exports from 126 countries to each of 59 importers in over 5,000 six-digit product categories, they show that large exporters are able to sell large quantities at higher prices, consistent with producing higher-quality goods. Their wider set of goods accounts for 62 percent of the greater exports of larger economies. By exporting higher-quality goods, richer economies can export larger quantities without lowering the prices of their varieties on world markets. Quality is a demand shifter, raising the quantity a country can export to a market at a given price. This study also finds that quality differences can account for 9 percent of country differences in real income per worker.

To summarize, the empirical evidence in the literature supports the trade-enhancing role of harmonized standards but does not produce a strong consensus on the role of country-specific standards. Nonetheless, there are important limitations to the methodologies used in these analyses. A first caveat is that apart from the Chen and Mattoo (2004) study, the studies mainly concern developed countries. As suggested by Moenius (2004), the different economic structures of developed and developing countries could lead to significant difference in the effects of idiosyncratic standards. For instance, the content of a standard depends on the process used to develop the standard. In theory, countries with more mature standards bodies should have a lesser tendency to create trade-distorting standards.

A second caveat is that it is not completely appropriate to examine the role of different standards by measuring the number of standards because a standard's economic impact varies highly with its content. Harmonized standards and idiosyncratic standards could have different effects on trade simply because of the nature of their content. Also, different countries have different methods of documenting technical specifications in standards. The same specifications may be included in a single standard in one country and distributed among 10 standards in another. These two cases would register different numbers of standards even though the amount of standardized information is effectively the same in both countries. Finally, many countries harmonize their standards for political

reasons, or as part of a regional trade agreement. While these standards may be completely irrelevant to a country's economy they would still be counted as shared standards in the models.

Standards and Quality as an Entry Point for SMEs: The Path to Industrial Upgrading

With the new organization of global trade, buyer-driven value chains are playing a growing role in exports of manufactured goods to developed countries. Value chains are composed of enterprises that add value to a product or service through discrete, though interrelated, activities involved in the production and distribution of goods and services. For example, in the case of the apparel industry the value chain extends from "raw materials (e.g., cotton or petrochemicals), to the production of natural or synthetic fibers and textiles, then to the design, cutting, assembly, laundering, and finishing of apparel, and, finally, to the distribution, marketing and retailing of garments" (Bair and Gereffi 2001). In buyer-driven chains, "large retailers, brand-named merchandisers, and trading companies play the central role in shaping decentralized production networks in a variety of exporting countries, frequently located in the periphery. Buyer-driven value chains are of particular relevance to the integration of small developing countries' exporters to the global economy. This pattern of industrialization is typical in relatively labour-intensive consumer goods such as garments, footwear, toys and housewares" (Gereffi 1994 quoted in Schmitz 1999).⁷

Firms in developing countries that adopt standards and quality practices can find opportunities for upgrading in buyer-driven value chains (Kaplinsky and Readman 2001). Increasingly, global trade in low-cost manufactures is characterized by an ever-expanding pool of producers that compete for an ever-more-concentrated group of buyers in developed countries. Global buyers often do not own any production facilities of their own but play pivotal roles in coordinating decentralized production processes. These global buyers are the gatekeepers to the markets in developed countries and control strategic segments of the value chain, such as research, design, sales, marketing, and branding. As in other forms of global production networks, conformance to standards and quality requirements is a precondition for participation in buyer-driven value chains.

Participation in buyer-driven chains can also facilitate industrial upgrading and innovation. Upgrading can be defined as the transition to higher-value-added activities. Much of it involves innovation, because

the firm must learn to develop new processes, products, and services. Humphrey and Schmitz (2000) distinguish three types of upgrading:

1. *Process* upgrading is transforming inputs into outputs more efficiently by reorganizing the production system or introducing superior technology.
2. *Product* upgrading is moving into more sophisticated product lines in terms of increased unit values.
3. *Functional* upgrading is acquiring new, superior functions in the chain, such as design or marketing, or abandoning existing low-value-added functions to focus on higher-value-added activities (see also Giuliani and Bell 2004).

Upgrading is not only necessary to increase earnings, but offers an opportunity for a firm to react to competition from other low-wage countries and globally mobile capital as well as unpredictable market demand and stringent product requirements. To do so, firms need to adopt dynamic learning and innovation-based business strategies. In developing countries, remaining competitive without upgrading often involves squeezing wages and profit margins. Japan, the newly industrial economies, and China all achieved their initial export success through functional upgrading, in addition to process and product upgrading. These countries started as mere assemblers of imported inputs for labor-intensive consumer products and gradually moved to higher-value-added activities such as full-package supply and original equipment manufacturing production, where the supplier is involved in producing to the specifications of the buyer. Some of these countries moved beyond original equipment manufacturing into original brand-name manufacturing by combining their production expertise with design and marketing activities. Functional upgrading, as has occurred in East Asia, is more difficult to achieve than product or process upgrading, but examples of successful functional upgrading can still be found in many buyer-driven chains (box 2.6). According to Gereffi (1999), “participation in global commodity chains is a necessary step for industrial upgrading because it puts firms and economies on potentially dynamic learning curves.”

Buyers in value chains play an active role in transmitting technical and organizational knowledge to their suppliers. Local producers have benefited a great deal from buyers’ knowledge about improving production

processes, attaining consistent product quality, developing new products, and increasing delivery times (Humphrey and Schmitz 2000). For example, in the 1970s, when Brazil's shoe industry was still at an incipient stage, international buyers maintained a substantial technical staff in Brazil and played a key role in helping firms reach international quality and delivery standards (Schmitz 1999). Today, support has diminished but buying agents for foreign retailers still actively support Brazilian footwear producers in product and process upgrading. In a study of the Sinos Valley cluster, Brazil's main footwear cluster, Bazan and Navas-Alemán (2003) found that approximately half of firms that serviced the U.S. market had introduced new lines in this market, mostly at higher prices. The producers acquired new skills by developing these new lines. East Asian economies were able to transition to higher-value-added activities by using their tight linkages to buyers in value chains to receive technology and knowledge embedded in inputs, equipment, and technical advice.

Producers of higher-quality goods benefit from much tighter relationships with global buyers or transnational corporations (TNCs). Buyers in quality-driven value chains need to engage in intense communication with their suppliers, instruct them on specifications, and assist them with technology transfer to ensure that they produce high-quality products. Having invested in their suppliers, these buyers are unlikely to change partners for the sake of lower short-term prices because they would face high switching costs (Schmitz and Knorrninga 2000). Evidence from the Costa Rican electronics industry showed that when TNCs sourced high-quality inputs from local SMEs, this resulted in stable relationships and cooperation with the public sector to assist in SME upgrading (Monge-González, Rosales-Tijerino, and Arce-Alpizar 2005). Experience from Brazil's Sinos Valley footwear cluster showed that buyers that focused more on quality needed to work closely with suppliers to meet the desired standards, and these close relationships made local suppliers less vulnerable to competition from low-cost countries. Furthermore, firms that had benefited from buyers in higher-quality export markets were able to use their knowledge to penetrate new export markets with their own brands and designs (Vargas and Alievi 2003).

Another interesting example of adaptation to market requirements and its effects is the case of grapes in India (box 2.7).

Box 2.6**Standards and Quality as an Entry Point to Upgrading in a Horticultural Value Chain**

In the past two decades the fresh vegetable industry in the United Kingdom has increasingly taken the form of a buyer-driven value chain. This restructuring has created both new challenges and new opportunities for Sub-Saharan African exporters. On the one hand, they are faced with a growing number of standards and quality requirements that they are expected to fulfill. On the other hand, the restructuring of the vegetable trade has opened up new opportunities for upgrading and innovation.

In the 1960s, 90 percent of fresh fruits and vegetables in the United Kingdom were traded in wholesale markets. There were no direct relationships between supermarkets and growers. As a result, barriers to entry were low. Supermarkets could not impose specific requirements on their suppliers, and suppliers in turn had no incentives to invest in meeting the requirements of any particular supermarket. Relationships were loose across all links in the value chain, and most exporters of African horticultural products purchased their vegetables through spot markets in rural areas.

In the 1990s, the fresh fruit and vegetable trade experienced a dramatic restructuring, and supermarkets began to bypass wholesale markets to buy directly from producers. This allowed supermarkets to enhance their coordination and control of the supply chain. These changes occurred in a context of demand for greater product variety, product innovation, and increased packaging and processing. Supermarkets began to view the quality of fresh produce as the most important factor in building a competitive advantage. At the same time, the UK supermarket industry was becoming increasingly concentrated, with the top four retailers accounting for nearly 75 percent of all food sales.

The change in structure to a buyer-driven value chain and the growing focus on quality induced supermarkets to seek tighter and more exclusive relationships with exporters and growers. Sub-Saharan African countries were particularly affected by this restructuring because their vegetable exports to the European Union had grown significantly in the 1990s (by 151 percent between 1989 and 1997). The largest supermarkets, such as those in the United Kingdom, purchase 70–90 percent of their fresh produce imports from Africa, from a large number of suppliers.

The change in chain governance meant that supermarkets increasingly specified both product and process parameters all along the chain. Quality, regulatory, environmental, and labor requirements guided all the activities, from how products were grown to how they were transported, stored, processed, and packed. All export firms in Africa were required to have sophisticated quality assurance systems that documented all the steps from planting to shipping. Standards included both company standards and external standards developed by trade associations, consortia of trade unions, non-governmental organizations, and enterprise associations. The supermarkets demanded regular audits of production and processing facilities to control and monitor compliance with the standards. This was done either through the supermarket's own staff or through third-party auditors from recognized certification bodies. The restructuring of the horticultural value chain thus brought many challenges to African growers and exporters as they were obliged to invest in new skills and equipment to meet quality and process requirements.

However, these buyer-driven value chains have also presented African countries with new opportunities for industrial upgrading. Not only have growers and exporters acquired new capabilities in areas of quality control, logistics, storage, distribution, and transport, but processing activities have also been transferred from UK importers to African exporters. These include simple tasks like washing and trimming and more technically complex activities such as packaging, bar-coding, and labeling. Processing functions in Africa have recently extended to the production of ready-to-eat foods, which requires high hygiene levels. It is cheaper for supermarket chains to push back these processes to Africa because they are labor-intensive, repacking in the United Kingdom is avoided, and processed products have a higher value-to-weight ratio, which reduces transport costs. Participation in the horticultural value chain has also opened up new opportunities for innovation. Many importers work closely with their African suppliers to develop new products, packaging, and presentations. Innovation projects have led to the development of long-term relationships between suppliers and buyers through which African exporters have acquired significant technical and market information from European buyers and have minimized their risks of substitution.

Sources: Dolan, Humphrey, and Harris-Pascal 1999; Dolan and Humphrey 2004.

Box 2.7**Grapes in India: Changing Market Requirements for Standards and Quality**

Exports of grapes from India have been largely stagnant over the past decade. While a mix of internal and external factors is responsible for this trend, non-tariff barriers are an increasingly critical factor (Chaturvedi and Nagpal 2003). To export to the European Union, grape-producing farms have to meet the standards issued by EurepGAP, an initiative of retailers belonging to the Euro-Retailer Produce Working Group. EurepGAP's aim is to develop widely accepted standards and procedures for the global certification of good agricultural practices (GAP). EurepGAP's July 2003 standards require that exporters meet a set of conditions pertaining to worker training, planning and production, pesticide record keeping and disposal, testing for pesticide residues at the farm, and post-harvest operations. One estimate contends that compliance with EurepGAP increases production costs by 40 percent (Chaturvedi and Nagpal 2003).

Physical and chemical characteristics are used to determine grape quality. Standards vary by country.

1. *United Kingdom.* The United Kingdom has set rigid standards. The minimum acceptable diameter of an individual grape is 18 mm, and the berry must be a "light, milky green." Grape bunches must be a uniform 350 to 700 grams and packages are to hold 9 kilograms. British grocers sell grapes by the bunch, not by weight, the practice in India.
2. *European Union.* The minimum acceptable diameter of the berry is 16 mm. The specified color is a light, milky green. The packaging has to be a uniform 4.5 kg.
3. *Middle East.* India's main export market is an extension of the local market and is lax on standards.

Given India's small-scale production, individual farmers are hard-pressed to meet demand for quality grapes. Moreover, the effort increases costs by an additional Rs 50,000 to Rs 75,000 per hectare.

Pruning is the most important practice in quality grape production. To achieve market-specified sizes for bunches and berries, yields must be sacrificed. Growers must thin shoots and clusters and apply gibberellic acid, a growth hormone that promotes elongated clusters. Berries themselves must be thinned and girdled. These practices reduce the number of bunches per vine, giving the fruit ample space to attain the required size. Thus yields are much lower in vine-

yards that cater to the export market. The average yield for a vineyard catering to the local market is about 35 tons per hectare; from vineyards that cater to the export market, the yield drops to about 25 tons per hectare.

Besides lower yields, the quality of the export and the exportable volumes also matter. Even in for-export vineyards, only the very well maintained ones are able to ensure that the entire available yield is exportable. In other vineyards, on average, only about 80 percent are of export quality—i.e., about 20 tons/hectare. It has been estimated that from most export-oriented vineyards, about 8 tons would meet the United Kingdom's quality standards; the remaining 12 tons could be exported to other EU countries.

The color specifications ("milky green") of the UK and EU markets require certain changes in preharvest practices—namely, the use of shade or light-cutting nets. Exposure to sunlight turns the berries golden, an acceptable color for the domestic market but deemed undesirable abroad. The costs of these shade nets must be borne by the farmer.

To achieve the desired size of berries and bunches, grape farmers must employ techniques that lead to crop suppression, namely the application of synthetic chemicals and arid plant-growth regulators, the residues from which may be toxic. All pesticides have minimum residue limits prescribed by the importing countries. The UK standards are more stringent than those of other countries and in fact are stricter than the international CODEX standards. To keep pesticide residues within the limits, there is a waiting period prior to harvesting.

Because this waiting period is different for each pesticide, spraying must be done according to a special, sequenced schedule. Grape growers normally require technical assistance.

The application of chemicals also adds to the costs by way of testing and certification, practices required for the European market. Grape exports require two kinds of certification:

4. *The EurepGAP certification.* This is a mandatory certificate needed to market produce in Europe. The certificate is based on three safety criteria: labor, environmental, and consumer.
5. *Certified pesticide-residue tests.* The cost of testing and certification for pesticide residue is currently Rs 7,000/sample/pesticide. The number of tests undertaken depends on the export destination. Countries with more stringent measures, like the United Kingdom, require more tests, incurring higher costs.

continued on the next page

Box 2.7**Grapes in India: Changing Market Requirements for Standards and Quality—continued**

In addition to certification, other postharvest processes for export grapes include grading, packing, precooling, cold storage, and transport. Grapes are immediately transported to the packhouse after harvesting and then sorted and graded. Bunches are put in polypacks, which are placed in properly cushioned boxes treated with grape guard, according to market requirements. At each stage, the proper temperature and humidity levels have to be maintained, which constitutes a major bottleneck to growth in exports because of infrastructure limitations. The investments are substantial and normally beyond the means of individual farmers. Facilities are currently provided either by cooperative societies or private enterprises.

In consequence of the above-mentioned issues, new challenges are emerging for fruit and vegetable exports. The now-mandatory EurepGAP certification is costly, with a registration charge of Rs 35,000 per farm, making exports prohibitively expensive for the small grape grower. Pesticide-residue limits (set by importing countries) are growing more stringent, and satisfying them creates additional costs and delays. In light of those requirements the Indian grape sector has been adapting and responding to the challenge and the government has assisted in its corresponding jurisdiction to facilitate the response. The growers' association and other organizations are seeking to meet those challenges in order to keep the grape sector competitive and profitable. APEDA [Agricultural

and Processed Food Products Export Development Authority], for example, has developed a pesticides-monitoring program, while the Maharashtra state government is arranging to issue pesticide-residue certificates.

By 1995, the main producer of grapes, Mahagrapes, and the cooperatives had the infrastructure and knowledge they needed to produce and export quality grapes. Rejected consignments fell to less than 10 percent by 1995. But while Mahagrapes was able to build brand recognition, exports fell from 1,800 tons in 1991/92 to 357 tons in 1994/95. The drop grew out of a conscious decision to export only quality produce. Since 1998/99, exports of Mahagrapes have increased to about 800 tons, about 2 percent of the EU market during the period. The prices commanded for Mahagrapes have steadily improved over time.

Mahagrapes, in short, succeeded in establishing a system for the export of high-value perishables from India. Mahagrapes is extending its product line to mango, pomegranate, strawberries, and other fruits and vegetables.

Ten new cooperatives in the state of Maharashtra have recently emerged to export grapes, and it is estimated that cooperatives now account for 35 percent of total grape exports. Many producers are also exporting grapes individually. These and other exporters, a total of 150, have gained from association efforts to building a grape-cultivation and -export knowledge base. India now is able to send about 60 percent of its export produce to the high-value EU market and capture about 35 percent of that market during the export season.

Source: Excerpted from Naik 2006.

CHAPTER 3

The Jurisdiction Issue: Roles of the Private and Public Sectors

As shown in chapter 2, different types of standards can have different economic impacts, often acting in opposite directions. One factor that is likely to influence the economic effects of standards is the standards development process itself. The actors, processes, and institutions involved in elaborating standards may ultimately shape their contribution to technical change and economic growth.

Standards can be classified into categories according to their origin and the type of cooperation mechanism. There are two main categories, market standards and formal standards. Market (de facto) standards are the result of industry self-regulation. There is no explicit mechanism for cooperation between interested parties; these standards evolve through a series of unilateral, irrevocable purchasing choices. One agent chooses first, and others follow with their choices based on previous choices and personal preferences, creating a bandwagon effect. There are three basic types of market standards:

1. Market standards can be *unsponsored* if they do not involve any proprietary rights or identifiable author and are accessible to all market participants. This is often the result of an iterative design process based on uncoordinated collective innovation. The four filing holes commonly found on A4 paper are an example of an unsponsored de facto standard. Although the location and dimension of the two center holes are specified in an international standard (ISO 838), the

two other holes, located 80mm above and below the center holes, are not documented in any standard or patent.

2. *Sponsored* market standards involve the proprietary rights to a set of technical specifications, where a specific design wins a position of market dominance. The owners can determine their specifications and extract rents from their use. An example of a proprietary standard is the set of technical specifications for Adobe Acrobat's Portable Document Format (pdf). Files in this format can only be read using Adobe's Acrobat Reader software.
3. A growing number of market standards have been established through *industry consortia*. These are voluntary but exclusive alliances of organizations or individuals that coordinate specific industry standards. The archetypal consortium is the Internet Engineering Task Force, which manages the Internet.

Formal (de jure) standards involve an explicit coordination and negotiation process prior to commitment to a particular standard. These standards are of two types:

1. *Voluntary standards* can be developed by interested groups through voluntary standards development organizations. Here stakeholders, including both producers and consumers, agree on a standard through an open committee. This contrasts with the exclusive nature of standard development in industry consortia. Formal standards are used, for instance, to specify the material, size, and strength of bolts. Any interested party is in principle free to use these standards.
2. *Mandatory standards* or *technical regulations* are elaborated by governmental authorities and their application is compulsory. Ideally, they occur when externalities are so strong that the private incentives to standardize are suboptimal. This is the case of standards that regulate the environmental impact of products and processes. The individual costs of complying with a standard may outweigh individual benefits because the detrimental effects of environmental contaminants may be distributed over a large number of people and over time.

Coordination Mechanisms for Technology Adoption

Market standards can have divergent effects on technical change, depending on market structure and corporate strategy. If a variety of standardization choices are available and consumers favor producers who are

offering the best technology, then market forces may drive convergence toward a single industry standard using that technology. But many factors can steer markets away from the best technology. Often, it is not technological choice but corporate strategy that determines who wins the standards race. In that case, market standardization can lead to the adoption of a suboptimal technology as an industry standard. In the early 1980s, although Sony's Betamax format for video recorders was technologically superior to JVC's VHS format, JVC's ability to license the technology to other manufacturers eventually overwhelmed Sony and led VHS to become the dominant standard.

The market mechanism to generate standards incorporating new technologies can be particularly weak when it is confronted with network effects. Individual decisions to participate in a network only consider personal benefits, not the benefits to the network community. Costs may discourage participation in a network when there are few members in the network and the individual benefits are small. Hence, a new technology that derives its value from being part of a network will only be accepted if a sufficient number of economic units have already accepted it. This may create a suboptimal equilibrium where society is locked into a network using older, less efficient technology. The lock-in effects and high switching costs inherent to the video recorder market ensured that once VHS became the standard it would be difficult for new entrants to compete in this market. In fact, it took two decades before a new technology, the DVD, could challenge VHS as the *de facto* standard. In the absence of perfect competition, dominant firms with installed bases are likely to prevail in standards races because there are often increasing returns to cumulative adoptions. Firms can also use anticompetitive practices to gain a critical mass of customers and tip the market toward a preferred proprietary standard.

Market forces may lead not only to a suboptimal standard but to understandardization, where various technologies coexist in the market. While in some cases, variety in the market reflects consumer preferences, in other cases, adoption externalities hinder the convergence toward a single standard because social costs and benefits are not taken into account by consumers or producers in their individual choices.

When market mechanisms fail to yield an optimal solution, cooperative committees can be used to develop standards that make a better outcome possible. For example, cooperative committees can remedy lock-in effects by coordinating the diffusion of new technologies. Open participation in the standardization process enhances the likelihood that all relevant information will be included in the cost-benefit analysis

of competing standards. To be effective, a committee should include a diverse set of actors with competencies in technological, social, and economic issues. Industry participants should represent both the supply and demand sides of the market. If committee decisions are based on consensus and voting rights do not depend on market power, the process becomes more egalitarian than a market-based approach.

However, there are limitations to standardization through open voluntary associations. In particular, open participation can slow standardization because it requires coordinating a large number of participants, documenting the process, and organizing reviews. This can be long and cumbersome. Moreover, it is often the case that not all participants have a genuine interest in contributing to the process. The knowledge spillovers involved in the open standardization process may encourage participants to free-ride. When participants have vested interests in incompatible positions, the process can become long and costly. In contrast, industry consortia are much quicker and more efficient because they involve fewer participants and these participants tend to be like-minded. The use of consensus in voluntary committees can also lead to strategic behavior, where participants falsely represent their preferences. Minority interests can be favored over the interest of the group as a whole. While latecomers in the market would accept a new technology, users of an old technology could block a change that would be associated with high switching costs. However, if majority rule is adopted instead of consensus, decisions will be reached quickly but solutions will tend to ignore individual interests. Finally, open participation is not always a viable option because it requires the involvement of all the players in the market. Market leaders may not wish to participate in a formalized standardization process if they can instead invest in new proprietary standards without incurring too much risk.

Government Involvement in Standardization

The strong “public good” element of a standard can sometimes justify government involvement. Formal standards are nonrivalrous because anyone can benefit from them without diminishing their utility to others, and they are nonexcludable because once they are created anybody can use them. The economic rationale for government intervention in standardization is that a free market is unlikely to produce the optimum amount of a public good. The market may provide for too many standards, as in the case of incompatible measurement units, or standardization of the wrong sort, as in the case of the QWERTY keyboard.¹

Information is a public good, and this also suggests a role for government. Knowing the characteristic of standards required by users or established in norms by governments in diverse potential markets is key for access to those markets. The acquisition of that information is costly: it is not efficient for each producer to invest in that endeavor, and coordination and cost sharing are difficult. This points to a role for government in the process. Likewise, government can also play a role in raising awareness about impacts of the adoption of standards.

Governments can support standardization by ensuring open participation and a balanced representation in voluntary committees. Many of the advantages of formal standards over market standards stem from the fact that they incorporate the views of a much broader range of stakeholders. However, uneven representation in voluntary standards committees can occur for a variety of reasons and can lead to short-sighted and biased standards. Large firms, which tend to benefit more than small firms from the economies-of-scale benefits of standards, are more likely to have the resources and personnel necessary to participate in the standards-setting process. As a result, large companies are often overrepresented in voluntary committees and can capture the standardization process. Standardization may also exclude potential stakeholders because it requires significant technical expertise. While consumers are directly affected by standards, they are unlikely to have the qualifications to participate in the standardization process. Often, consumers form a large and uncohesive group, which makes it difficult for them to organize and enhances their tendency to free-ride the standardization process. Hence, producer interests are likely to be more represented than user interests in standards committees. A possible role for the government is to help balance standards committees by promoting the involvement of marginal participants or by representing excluded interests in the committees.

Governments can also play a role in correcting market failures in the diffusion of formal standards. Some standards are network goods, and the value of adopting the standard increases with the number of adopters. If the cost of adopting the standard is high, the market may never reach the critical mass of users necessary for the individual benefits of standards to exceed their costs. Many standards also involve significant adoption barriers caused by a lack of technical skills, time, or resources, which make them poorly understood and difficult to adopt. Governments can compensate for these market failures by creating programs and policies that promote the widespread diffusion of standards.

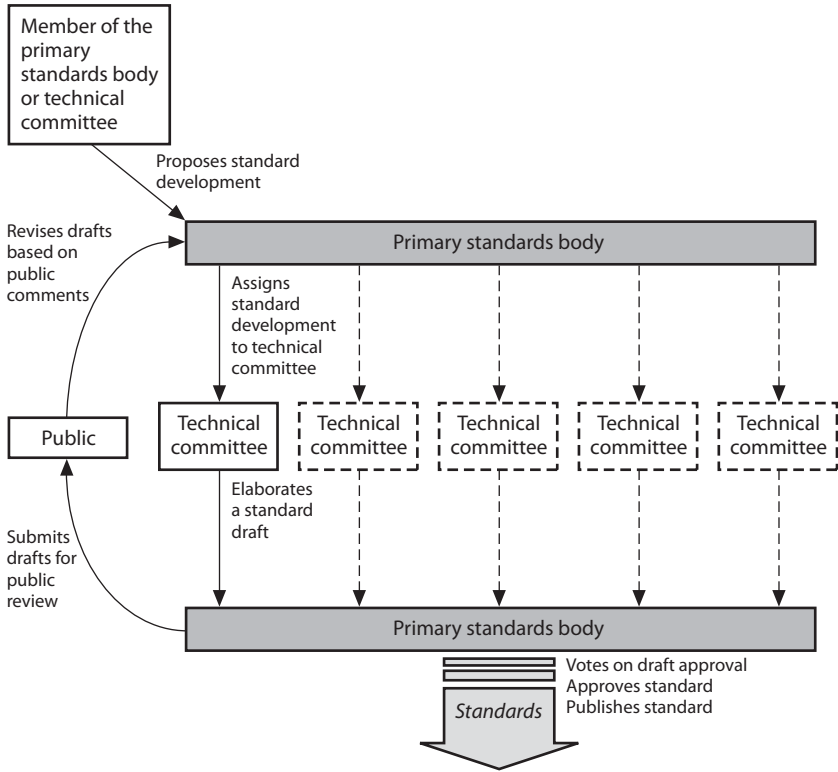
Mandatory standards can provide an optimal solution when private agents would not be able to internalize the benefits of standardization. This is often the case when there are so many stakeholders that a committee process would be unmanageable. Government bodies can be used to represent the interests of all members of an economy in the standardization process. Rather than relying on voluntary coordination committees, governments can enforce the adoption of standards through binding regulations, with punitive measures for nonobservance. Mandatory standards may have a much stronger effect in terms of decreasing product variety because only products and processes conforming to these standards can circulate in the market. This may be desirable in domains where negative externalities are high, such as in safety, health, environmental protection, and consumer protection, as well as where positive externalities are high, such as in markets of network goods. Nonetheless, decreasing variety can have detrimental effects on innovation because it places constraints on the development of new technologies. Government standards can also result in suboptimal solutions if the state does not have the necessary technological foresight to make informed decisions.

National Standards Bodies

International experience shows that a wide variety of institutions can be used to organize the standards development process.² There is no dominant system, and most standards bodies cannot be neatly classified into specific categories according to typology (Stephenson 1997). The standardization process can be more or less centralized, the standards organizations can be either public or private, and there may be more or less juxtaposition of voluntary and mandatory standards development within a single organization.

In the European Union (EU), most countries have adopted a very centralized approach to standardization. A central national organization is involved in developing all of the national standards (figure 3.1). Typically, the organization implements a work program and delegates the technical aspects of standards development to technical committees consisting of representatives from government agencies, the productive sector, consumer associations, academia, and research institutions. Members of technical committees are usually volunteers who do not receive remuneration from the standards body for their work, but they may be sponsored by their organizations. Each technical committee is responsible for developing standards in a specific area and may be formed and dissolved by the standards body as the need arises.

Figure 3.1 The Centralized Approach to Standards Development



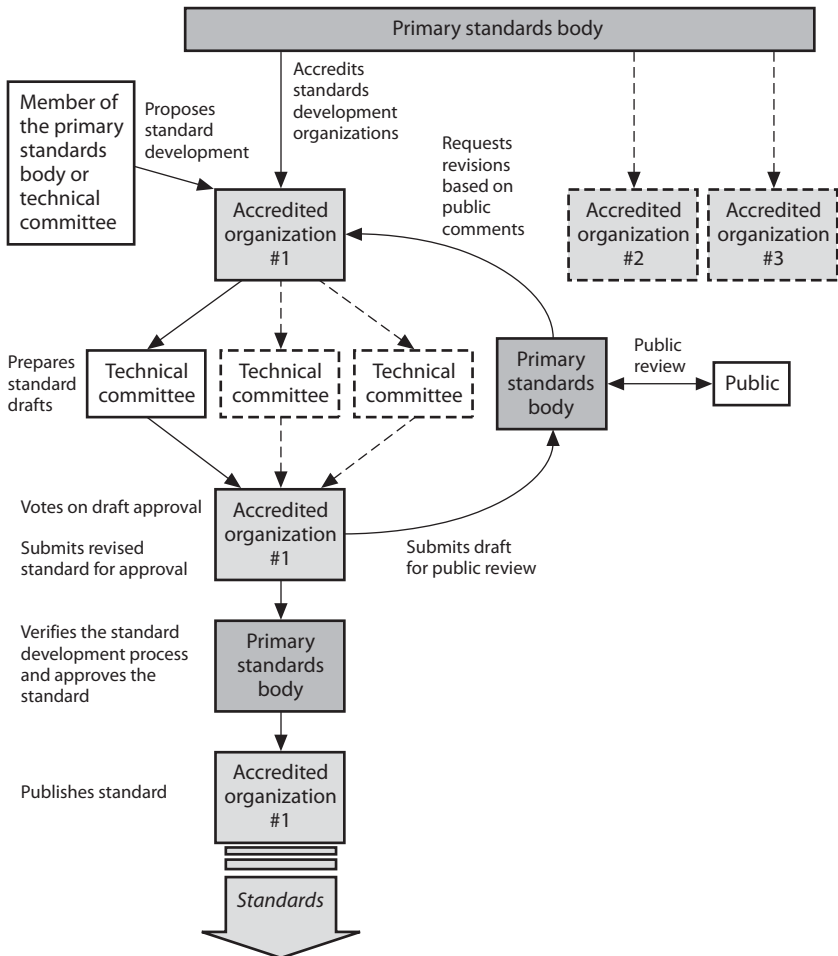
Source: Authors' elaboration.

Members of the standards organization, often members of a technical committee, propose plans for new standards, but proposals can sometimes come from outside the standards development organization. If there is sufficient support for a plan in the standards organization, the technical committee begins to study and elaborate a standard. Once the technical committee has reached a consensus, a draft of the standard is submitted to a vote by members of the national standards body. If approved, the standards body then subjects the draft to public enquiry. During the public review process, the draft is typically made available to the public for two months. Once the technical committee has revised the draft to incorporate public comments, the standards body finalizes, adopts, publishes, and distributes the standard.

In the United States, by contrast, the standardization process is extremely decentralized and market-oriented. Although the American National Standards Institute (ANSI) serves as a coordinating body and

accredits standards bodies, it does not itself develop standards, and no single organization has oversight over the entire voluntary standards process. Instead, more than 600 private sector organizations develop voluntary standards (DeVaux 2001). These include professional and technical organizations, trade associations, research and testing institutions, and others. The individual standards bodies follow basically the same standards development process as is used in the EU: they work through technical committees, approve drafts by vote, and then submit the drafts to public enquiry through ANSI (figure 3.2). ANSI is not involved in determining

Figure 3.2 The Decentralized Approach to Standards Development



Source: Authors' elaboration.

the actual content of standards and does not even monitor whether standards conflict. Rather, accredited standards bodies must document the development process of each new standard and ANSI performs periodic audits seeking evidence of compliance with the approved development procedures. The individual standards bodies then publish and sell the standards. Canada and Mexico have adopted similar decentralized systems of standards development.

The legal status of standards bodies varies widely across countries. These bodies can be part of the public sector, operating as government agencies or autonomous statutory bodies, or they can be not-for-profit organizations in the private sector. When the organization is private, a general assembly or consultative council often provides for representation of both the private and public sectors. A 2003 survey of the 147 members of the International Organization for Standardization showed that half of these standards bodies were public organizations, while the other half were private organizations (ISO 2003a).

Another distinction among standards bodies is membership policy. In Europe, membership in a national standards body requires that the member be a European organization or enterprise or have business interests in Europe. In contrast, membership in standards bodies in the United States is unrestricted (Delaney and van de Zande 2000).

Standards bodies must adhere to some globally accepted principles to respond effectively to both social and economic demands. These principles are contained in publications of the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the World Trade Organization (WTO), especially the *Code of Good Practice for Standardization* (ISO/IEC Guide 59) and the WTO's *Code of Good Practice for the Preparation, Adoption and Application of Standards* (see chapter 5). Standardization procedures reflecting these international principles are usually described in the laws and charters that govern standards bodies. In decentralized systems, following these procedures is typically a requirement for becoming accredited as a national standards developer. They can be summarized as follows:

- Written procedures based on the consensus principle should govern the methods used to develop standards.³ These procedures should be available to interested parties.
- The standards development process should be open. Standards bodies should be proactive in opening participation to all interested parties and there should be broad-based public reviews of draft standards.

Foreign parties should be given equal access to the public review process.

- The standardization process should be based on a balanced representation of interests, with no single interest dominating.
- There must be an appeals mechanism for participants who believe that the procedures guiding the standards development process have not been respected.
- Standards should be reviewed periodically and revised in a timely manner.

Most governments provide some level of support to the standards body. In fact, 63 percent of ISO members receive at least 50 percent of their revenues from government grants, and 83 percent receive at least 20 percent (ISO 2003a). However, it is important to interpret these statistics carefully because ISO membership is only open to one standards body per country. In decentralized models, the primary standards body may be delegating most of the work to other organizations that may receive different levels of subsidies.

It is common for standards bodies that receive little government support to offer a number of income-generating services. Membership fees and publications are often used to complement the standards body's budget, but the level of income from such sources rarely exceeds half of the standards body's total income. This shows that it may not be possible to achieve self-sustainability through standardization activities alone. In fact, a memorandum of understanding between BSI British Standards and the UK government acknowledges the role of other business activities in cross-subsidizing standards development. Standards bodies often offer certification, testing, training, and quality consulting services.

It is difficult to estimate the total national budget for standardization activities. Estimating the resources that a country dedicates to standardization is hard because the costs of standardization are usually distributed among several entities and most of these entities are also involved in activities other than standardization. An ISO survey in 2002 showed that 58 percent of national standards bodies had annual budgets over \$660,000 and 14 percent had budgets over \$13.2 million (ISO 2003a).

National standards bodies are sometimes involved in the development of mandatory standards, but these rarely make up the majority of a country's standards. In some cases, the voluntary standards developed by private standards bodies are referenced in law or technical regulations

and effectively become mandatory. In other instances, the national standards bodies are directly responsible for developing both voluntary and mandatory standards. Sometimes the primary standards body restricts its activities to mandatory standards, while decentralized private sector bodies are responsible for voluntary standards. When both mandatory and voluntary standards are decentralized, a national standards body may be responsible for accrediting both private and government standards developers. The ISO survey shows that for 56 percent of ISO members, less than 10 percent of standards are mandatory (ISO 2003a).

CHAPTER 4

Evaluating Compliance with Standards: The Conformity Assessment Framework

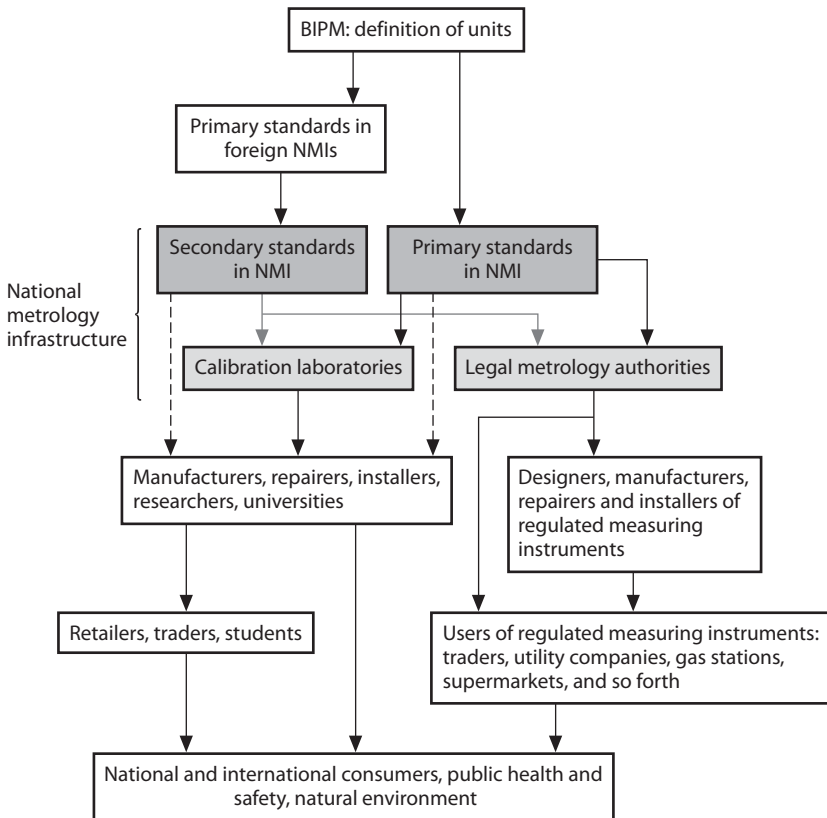
The mere existence of standards does not ensure their proper diffusion. Standards contain technical specifications that can enhance quality, safety, interchangeability, compatibility, and information diffusion, but these benefits can only be realized if producers understand and comply with the standards. For many standards, especially quality and safety standards, the incentives for self-enforcement are low and producers have much to gain by claiming that a noncompliant product or process adheres to a standard. Furthermore, the highly technical content of some standards may make it difficult for producers to know whether they have appropriately complied with a standard. If there is no means of differentiating products that conform to a standard from those that do not, standards are of limited use.

A country requires institutions that evaluate and verify compliance with standards to reap the economic benefits of standards. The conformity assessment framework consists of all the activities that are necessary to demonstrate that a product or process conforms to technical specifications such as those included in technical standards. The full economic benefits of standards can only be realized if there exist organizations for certification, testing, calibration, inspection, accreditation, and metrology in the national economy. This multidimensional system includes, at a lower level, certification, testing, calibration, and inspection bodies

evaluating the conformance of products, processes, services, and organizations to technical specifications, and at a higher level, accreditation and metrology bodies ensuring that the lower-level bodies themselves conform to relevant standards (figure 4.1).

Conformity assessment can be performed through three alternate channels. Assessment activities can be performed by the suppliers themselves (first-party assessment), by the purchasers (second-party assessment), or by independent organizations (third-party assessment). In first-party assessment, a supplier performs the conformity assessment procedures internally, using its own staff and equipment. In some cases the supplier performs first-party assessment for internal quality control reasons, but in other cases it does so to declare to potential buyers that a product or process satisfies one or more requirements. Confidence in the

Figure 4.1 Traceability of Measurements



Source: Authors' elaboration.

Note: BIPM = International Bureau of Weights and Measures; NMI = National Metrology Institute.

supplier's declaration relies on the supplier's capabilities, integrity, and reputation. When a buyer cannot have confidence in a supplier's declaration of conformance, the buyer must conduct a second-party assessment on each individual supplier. This method can be expensive if a buyer has many potential suppliers, and the purchaser may not even have the capabilities to assess the conformance of each supplier. Instead, an independent organization can validate a producer's claim of conformance through third-party assessment.

Certification

Certification consists of the provision of assurance that a product, service, system, process, or material conforms to one or more standards or specifications. Certification is usually conducted by a third party that is independent of the supplier or purchaser.

Certification schemes increasingly involve systems rather than specific products. Quality management system certification involves evaluating conformance to a quality standard through auditing of a firm's management practices, in addition to collecting data and generating test results, if relevant. Similarly, environmental management system certification involves an examination of a firm's environmental management procedures. Many of the activities involved in the certification process can be either conducted by the certifier or delegated to other parties, such as independent testing and calibration laboratories or external auditors. Certification often results in the granting of a mark, certificate, label, or registration, such as ISO 9000 or ISO 14000, with a quality system registrar.¹

The certification market usually involves a number of competing private bodies. In the vast majority of countries, subsidiaries of the 20 or so largest global certification bodies have an important share of the market.² While most certification bodies operate as private for-profit companies, others operate as individual not-for-profit organizations or as part of industry associations.

There are internationally accepted guidelines outlining the proper operation of a certification body.³ To produce credible assessments of a product or process, it is generally accepted that a certification body should adhere to the following principles:

1. *The certification body should be impartial and independent.* This concerns the overall strategy and policy of the body, the evaluation process, and the decision to certify. The certification body should ensure

that its ownership or shareholding and its involvement in other activities do not affect its impartiality and independence. For example, a certification body should not offer consulting services that are aimed at improving a client's chances of obtaining certification, and auditing personnel should not be simultaneously employed in such activities.

2. *The certification body should be objective.* For this purpose, it should have the proper resources to undertake the relevant tests and inspections, or it should contract these out appropriately. The credibility of the certification will depend on the quality of the auditor. Auditors should have proper technical expertise and competence, including an adequate educational level, specialized training, and significant experience in their area of auditing. To demonstrate their competencies, auditing personnel often seek auditor certification by specialized national bodies or through international associations such as the International Register of Certificated Auditors (IRCA).
3. *Finally, all information collected through the evaluation process should remain confidential.* Certification bodies often obtain access to detailed information about the operations and technology of a candidate organization. Employees and subcontractors of the certification body should not share this information with third parties, employees, or employers.

Accreditation by a national accreditation body, as discussed later in this chapter, will ensure that the conformity assessment body operates according to the above guidelines and is competent and credible, provided that the accreditation body itself is recognized. Membership in international organizations such as IQNet, an international certification network with 38 members, can also enhance the credibility and reputation of a certification body.

Certification provides benefits for producers of goods and services, consumers, and government regulators, as well as for international trade. Manufacturers and service providers can have their products or their management systems certified to particular standards to distinguish themselves from less reputable suppliers. Buyers benefit from certification because it allows them to compare and differentiate products and services in terms of quality, safety, or other desirable characteristics (box 4.1). It avoids the costs of having each buyer independently validate the characteristics of a supplier's products or services—which buyers may not have the resources or expertise to do—and reduces the risk of purchasing faulty products or services. Certification is also more transparent

Box 4.1**The Consorcio del Jamón Serrano Español's Quality Control**

In 1990, the producers and exporters of air-dried cured ham in Spain formed the Consorcio del Jamón Serrano Español to harmonize standards and create a quality brand. The Consorcio's seal, which is given only to hams that meet its standards, guarantees the high quality of the certified product.

Under EU regulation, the "Serrano ham" denomination is protected as a Traditional Specialty Guaranteed (TSG). The TSG standard for Serrano ham specifies the method of processing the meat, although it does not refer to a specific processing area or to the origin of the raw material. Cured ham cannot be sold in the EU with the words "Serrano ham" on the label unless it is duly certified as meeting the TSG standard for the product.

In addition to meeting the TSG requirements, the Consorcio also imposes its own standards, which in certain aspects are more demanding than the TSG standards. For a ham to earn the Consorcio seal of quality, it must

1. be "Serrano" ham (meeting TSG requirements), produced by a certified company;
2. use only Spanish raw material (Spanish pigs slaughtered in Spain);
3. be processed exclusively in Spain;
4. be cured a minimum of nine months;
5. have a fat covering of at least 1 centimeter (to ensure the ham's texture and aroma);
6. have shrunk 34 percent in relation to the weight of the original fresh ham;
7. pass an individual sensorial inspection (piece by piece); and
8. be produced by a company that has passed the quality inspections that the Consorcio constantly carries out.

The inspections performed by the Consorcio are certified according to the UNE-EN ISO (Spanish national) standards. The Consorcio strives to ensure that hygienic, temperature, and humidity conditions established in the TSG standard, as well as the boning, slicing, and packaging procedures, are respected during the different stages of the process. In addition, each piece of ham is subjected to visual inspection. A ham that meets all the standards will have a fire seal on the skin with the Consorcio del Jamón Serrano Español logo and will also have a numbered control label. Consumers who purchase the certified products pay a premium price in exchange for the quality assurance that the certification provides.

Source: Adapted by authors from Consorciodel Jamón Serrano Español.

than relying on a producer's reputation,⁴ and it conveys standardized information about the capabilities of a producer that may not be obtainable elsewhere. It reduces search costs for global suppliers and hence reduces technical barriers to trade. In fact, verification by third-party organizations is increasingly included in trade contracts (Schuurman 1997). Finally, regulators benefit from certification because it provides them with a tool to enforce governmental health, safety, and environmental legislation.

There are costs associated with certification. The range and magnitude of these costs vary, depending on the standard for which a firm is seeking certification. An organization is faced with both internal and external certification costs. Internal costs include salaries of employees dedicated to meeting the certification requirements, along with documentation costs, overhead costs, internal training expenses, and investment in production and quality control technologies. External costs involve the procurement of services outside the firm. The firm can prepare itself for the certification process by hiring internal auditors or seeking assistance from external consultants to provide diagnostic and training services. Where relevant, laboratories may be involved in technical support for calibration and quality control equipment. External costs are also associated with the auditing process itself and include administrative fees paid to the certification body. These vary according to the complexity of the certification task. Because certification involves continuous surveillance and periodic reassessment of the firm, some of the costs must be added to the firm's operational costs.

Testing, Calibration, and Inspection

Testing, calibration, and inspection involve performing consistent and reliable measurements. Testing seeks to determine the characteristics or performance of a product or process according to a specified procedure. Calibration determines the relationship between an instrument's input and the magnitude or response of its output. Inspection is another form of assessment that relies on less sophisticated instruments than testing. The inspection of products is usually conducted visually or by using simple instruments.

Testing and calibration laboratories and inspection bodies can differ widely from one another in size, range of services, legal status, purpose, and technical competence. They are plentiful in most economies: they can operate as government regulatory laboratories or bodies, government

research laboratories, university laboratories, independent private sector laboratories or bodies, manufacturers' in-house laboratories, or customers' in-house laboratories.

Testing, calibration, and inspection are integral components of the conformity assessment process. Independent testing laboratories and inspection bodies can be contracted by a firm to obtain a test or inspection certificate as evidence that a product or process conforms to certain characteristics. Independent calibration laboratories can be used to guarantee the performance of a company's measurement equipment. A third-party laboratory calibration certificate can provide evidence that a firm has the quality control equipment that meets the requirement for product or system certification. In certain cases, testing, calibration, and inspection are required for firms to implement a quality control system, such as ISO 9000. These may be essential elements in proving that a firm is complying with customer requirements.

There are internationally accepted standards guiding the operation of testing and calibration laboratories and inspection bodies.⁵ To play a credible role in the conformity assessment system, testing and calibration laboratories and inspection bodies must display many of the same characteristics as certification bodies, notably impartiality, objectivity, and confidentiality. Objectivity relies heavily on the procedures guiding the evaluation process, the equipment used, and the skills and qualifications of staff. Equipment and measurement reference systems must be calibrated to other widely accepted metrological references. This is the concept of *traceability* of measurement discussed in more detail in the section on metrology in this chapter.

Accreditation

The function of accreditation

Accreditation is defined as the procedure by which an authoritative body gives formal recognition that an organization or person is competent to carry out specific tasks. Accreditation is sought on a voluntary basis as proof of competence in a given area. Accreditation provides certification and inspection bodies, as well as testing and calibration laboratories, with a means to signal that they are conducting their work to appropriate standards and that they are able to provide reliable services to support quality in firms. The accreditation body evaluates the personnel and supporting management system of the candidates for accreditation and can request practical tests for laboratories when relevant. These tests take

the form of proficiency testing schemes through which the measurement results of different laboratories are compared. Accreditation is usually valid for a few years after initial assessment, during which time the accredited organization is subject to regular surveillance.

There are well-recognized international criteria that guide the accreditation process. Most accreditation bodies base their accreditation decisions on the performance of interested entities against widely recognized international guides and standards that establish operational requirements, such as ISO/IEC Guides 62, 65, and 66 for certification bodies, ISO standard 17025 for laboratories, and ISO/IEC standard 17020 for inspection bodies. These requirements include the impartiality, objectivity, and confidentiality practices described in the sections above on certification and testing, in addition to sound management practices.

Accreditation contributes to economic development by reducing risk, ensuring quality, and increasing productivity. Accreditation protects customers from the risk of receiving poor service by guaranteeing that accredited organizations are both independent and technically competent. Accreditation enhances quality in the economy by strengthening the credibility of the entire conformity assessment system and decreasing information asymmetries. Accreditation also enhances productivity by providing independent assessments of commercial and in-house laboratories. The laboratory assessment process always contains an implicit element of technology transfer, with comments and suggestions that can lead to improvements in a laboratory's quality and performance (UNIDO 2003).

The scope of accreditation can be broad or specific, depending on the accreditation body and on the product and standard for which the certification body is seeking accreditation. In some cases a certification body will receive multiple accreditations to allow it to cover many areas. Likewise, laboratories can be accredited for a broad or narrow range of tests and calibrations. The International Laboratory Accreditation Cooperation (ILAC) recommends specific practices for defining the scope of laboratory accreditation through standardized descriptors (ILAC 1994), but many accreditation bodies use their own methodology to establish the scope of their testing and calibration accreditations. As a result, there is often no one-to-one correspondence between the scopes of laboratory accreditations offered by two different accreditation bodies.

Accreditation institutions

Establishing an accreditation body requires significant investments and government support. Accreditation requires well-trained personnel and

may have important technological requirements, even for simple systems. The accreditation process is costly and time-consuming, because it must be accompanied by surveillance activities. It also involves a lengthy learning process that can only be realized by having a large customer base. With the exception of countries where there are large markets, such as the United States, accreditation is not usually financially self-sufficient and depends on government subsidies (UNIDO 2003). Investing in accreditation needs to be justified by an adequate demand for accreditation from certification bodies and testing and calibration laboratories, or at least a demand for conformity assessment services from domestic firms and organizations. In most countries, accreditation bodies indirectly benefit from government support through policies that provide incentives for accreditation or that require product certification by accredited entities in public procurement provision.

Some countries do not have a national accreditation body and have decided to provide accreditation services by engaging in agreements with foreign accreditation bodies or through regional cooperation. This is possible because national accreditation bodies often allow organizations from other countries to seek accreditation. However, to be effective, a foreign accreditation must be recognized in the accredited organization's home country. One option is to create a nominal national accreditation body that contracts with a foreign body to undertake accreditation activity on its behalf, with the national body retaining some authority over the process. Alternately, regional accreditation bodies can be established to spread costs among several countries. The Joint Accreditation System of Australia and New Zealand is an example of such a model. The Southern African Development Community (SADC) is also building a novel regional model for accreditation (box 4.2). It is important to note that although regional bodies may provide superior solutions in some cases, they can be very difficult to implement for political reasons.

Accreditation bodies have different structures and legal status in different countries, with no single model demonstrably superior to any other. Accreditation bodies may be subject to various degrees of government involvement depending on the country. Nonetheless, countries are increasingly finding the government-managed model less desirable than a public autonomous agency or nonprofit organization. This is due to a recognized need for greater flexibility and independence. The structure of the national accreditation system may also vary but the norm is to have a single national accreditation body. In a few countries, such as the Republic of Korea, laboratory accreditations and certification body

Box 4.2**Regional Cooperation on Accreditation:
The Southern African Example**

The Southern African Development Community (SADC) was formed in 1992 and now consists of 14 states. One of the community's objectives has been to lower technical barriers to trade. Toward this end, in 1997 SADC in Accreditation (SADCA) was tasked with defining a suitable regional accreditation infrastructure or forming a regional accreditation body, or both. One of its principal objectives has been to create a pool of internationally acceptable accredited laboratories and certification bodies in a region where most countries do not have the resources to establish a national accreditation body. Currently only two member states, South Africa and Mauritius, have established national accreditation bodies.

In its first phase, SADCA's objective was to become a regional accreditation management committee to allow member states to cooperate at the international level with the International Accreditation Forum (IAF) and ILAC, along with other regional organizations.

In a second phase, which started in 2002, SADCA initiated a novel approach to regional cooperation. This consisted of establishing a regional accreditation service, SADCAS, which will work alongside the current and future national accreditation bodies to provide affordable services to member states. SADCAS will provide a cost-effective and transparent mechanism for member states that do not want to establish their own national infrastructure, for lack of resources, but that want to provide some input in the decision-making process and technical operations of accreditation through "national accreditation focal points." Any state that finds it cost-effective to do so is allowed to create a national infrastructure for accreditation that will coexist with SADCAS. A project management committee has thus far been able to secure some donor funding for initial training for SADCA members and national accreditation focal points. The project will train technical assessors in each country to become part of a pool of regional assessors for SADCAS. By pooling scarce resources to create a regional accreditation infrastructure, SADCAS has become a unique model for developing countries.

Sources: UNIDO 2003; SADCA Web site; SADC Web site on Standardisation, Quality Assurance, Accreditation, and Metrology.

accreditations are the responsibilities of two distinct bodies. An extreme case is the United States, where a number of federal, state, and local government accreditation bodies operate in parallel with private sector accreditation bodies. What matters more than legal status and structure is the ability of an accreditation body to comply with a few key principles. Internationally accepted standards, guides, and codes of conduct⁶ emphasize the need for impartiality, objectivity, and nondiscriminatory policies and practices, and call for the avoidance of conflicts of interest.

Involving stakeholders in the governance and technical functions of the accreditation body can help ensure impartiality and build confidence in the organization. A governing board is often established to represent the interests of both the public sector and potential clients, although this is less common when there is tight governmental control over the accreditation body. The establishment of technical consultative committees of external specialists also ensures that accreditations are granted on the basis of sound and objective technical decisions. The technical committees should include a balanced representation of the concerned sectors.

Conflicts of interest can arise when accreditation bodies are involved in other activities. Offering certification, testing, and calibration services leads to conflicts of interest because it puts the accreditation body in competition with potential candidates for accreditation. Not all related commercial activities present these problems, and an experienced accreditation body may be in a unique position to offer some services to industry. This notably includes training services, not only for future assessors but also for technical laboratory staff who conduct internal audits and quality management staff in firms.

The objectivity of the accreditation process largely depends on the quality of its technical staff. Assessor training programs are highly specialized and are usually only found in mature accreditation bodies. The staff of new and developing-country accreditation bodies often receive training through formal courses and field practice in more experienced bodies abroad. Assessment teams must have sufficient collective scientific and technical skills to understand the testing and calibration activities of laboratories and the management systems of certification bodies. In the area of laboratory accreditation, technical expertise requires assessors to have current knowledge of the latest technologies and scientific practices. In certain fields it may be difficult for full-time assessors to maintain an adequate level of current knowledge to perform their tasks reliably. For this reason, assessors are often selected from accredited organizations or from academic or technical institutions and are engaged on short-term

contracts or as volunteers. For assistance with accreditation, lead assessors can also rely on external technical experts, although these experts may have no formal training in conformity assessment.

Metrology

Metrology is the study of a system of measures. Measurements are not only an integral part of the national quality system, but an integral part of our daily lives. Because the engineering behind most of the technology we use relies on measurements, accurate measurements allow equipment to be calibrated to produce consistent product quality, and they allow tests to be performed to verify that a product or process conforms to predetermined requirements. Correct measurements also play a key role in the economy by facilitating commercial transactions and their regulation.

Metrology is usually supported by one or more institutions in a given country. They provide a support infrastructure for all measurement-related activities performed by enterprises, individuals, and governments. Scientific metrology is the branch of metrology concerned with developing measurement standards and promoting their acceptance and equivalence. Legal metrology consists of the legislative, administrative, and technical procedures established to regulate the credibility of measurements related to official controls, trade, health, safety, and the environment.

Scientific metrology

The role of a national metrology institute (NMI) is to establish the national measurement system; to maintain, develop, and diffuse measurement standards for basic units; and to disseminate metrological expertise to the economy (figure 4.1). The NMI establishes the national measurement system by adopting a national system of units with a view to incorporating it in legislation. In establishing the measurement standards for these units, an NMI can make use of either primary or secondary standards.

Using a *primary standard* is the most fundamental approach because it provides an absolute basis of reference for a unit and its value is accepted without reference to another standard of the same quality. An NMI can create the physical *realization* of the unit from its definition to establish a primary standard. For example, a standard for temperature can be obtained by realizing the equilibrium state of a pure substance that occurs at a highly reproducible temperature. Realizing the triple point of water, which corresponds to the thermal equilibrium between solid, liquid, and vapor, will provide a temperature of exactly 273.16 kelvin.

Obtaining the physical realization of a standard can be a difficult and costly approach, but it is possible in the case of some physical quantities to establish a primary standard by creating a *reproduction* of the standard. For example, the meter is defined as the length of the path traveled by light in a vacuum during a time interval of $1/299,792,458$ of a second. The practical reproduction of this standard is not a physical realization because it does not involve timing the passage of a light beam; rather, it consists of comparing length to be measured to the wave length of a frequency-stabilized laser.

An NMI can also establish a *secondary standard*, its value being determined through periodic comparisons with a primary standard in another country. For instance, the kilogram is defined as equal to the mass of the International Prototype of the Kilogram, a cylinder made of platinum and iridium fabricated in 1889 and maintained in Paris by the International Bureau of Weights and Measures (BIPM). Because the definition and the construction of this unit are based on an artifact, the original kilogram is considered to be the only primary standard. To establish their secondary standards, NMIs must compare their own mass standards to the original kilogram or to other secondary standards that are traceable to the original kilogram.

The NMI is the primary scientific metrology laboratory in a country and its exact measurement standards are disseminated to industry and other users. In countries where the commercial metrological network is well developed, the NMI conducts very few calibrations directly for industrial clients. Instead, measurement standards are disseminated through a network of calibration laboratories and through organizations responsible for regulations and standards. When their industrial measurements are traceable to the NMI through an unbroken chain of comparisons, firms are able to guarantee the accuracy and precision of their calibration instruments, process control instruments, and quality control instruments. International standards used to assess the competence of accredited laboratories and quality systems require the internationally recognized traceability of measurements and test results.⁷ Often, experts from the NMI participate in the technical evaluation of laboratories seeking accreditation. The NMI disseminates metrological expertise by offering specialized technical consultancy and training services to industry, research institutions, and educational institutions.

NMIs also conduct research and development activities in areas related to metrology to develop new systems and deepen their own technological capabilities. Measurement standards evolve continually and

reflect advances in science as well as changing industrial and other needs. The primary purpose of research in measurement science is to develop more advanced and accurate calibration methods to ensure that the long-term needs of society, industry, and government will be fulfilled. Research and development (R&D) also serves the important purpose of enhancing an NMI's ability to identify, assimilate, and exploit existing knowledge in the field of metrology, or what Cohen and Levinthal (1989) refer to as "absorptive capacity" in their seminal work on the dual role of R&D. This absorptive capacity depends on tacit knowledge, which cannot easily be transferred through traditional means such as manuals and courses. Absorptive capacity gives an NMI the opportunity to acquire outside information and technology that its scientists and engineers will find most relevant to national needs. R&D is also necessary to attract and retain the high-skilled personnel required for many of the NMI's activities. A survey of 26 NMIs indicated that on average, 32.5 percent of their annual budgets were spent on R&D and 34.6 percent of their employees could be classified as research scientists (KPMG Consulting 2001). NMIs in developing countries are generally less involved in R&D than those in developed countries, and when they do conduct R&D, they tend to focus more on the development of new standards than on basic measurement research.

It is necessary to continuously invest in new metrology infrastructure to keep up with the pace of technological and market changes. These changes are driven by growing demands for quality and performance in global markets. A former director of the International Bureau of Weights and Measures, the primary international organization concerned with metrology, notes

Engineering tolerances, i.e., the amount by which dimensions are permitted to depart from specification, have tightened in practically all industrial production by a factor of three every 10 years since 1960. The result is that production engineers in the large-scale manufacture of automotive and electronic products are now required to work at tolerances previously attempted only in fine, small scale work. (Quinn and Kovalesky 2005)

The recent growth of certain industrial sectors has made it necessary to redefine the scope of activities of the NMI. In the past decade, NMIs have invested in expanding metrology from the traditional areas of physics and engineering to chemistry and biology, as the latter two fields have become more prominent factors in high-growth industries (box 4.3).

Box 4.3**Evolving Needs of Metrology in Health Care**

Metrology has a direct influence on people's lives when it involves medical diagnosis or therapy. The accuracy requirements for measurements in medicine are not as high as in other fields, but the reliability of these measurements must exceed all standards because they can have life-or-death consequences for human health. In economic terms, the impact of medical diagnosis measurements is very large and growing. In 2003, spending on medical care reached 8.62 percent of GDP on average in Organization for Economic Co-operation and Development countries, up from 7.8 percent in 1993. In the United States, 15 percent of the GDP was spent on health in 2003. As much as 30 percent of health costs have been found to concern measurement and tests related to diagnosis.

Progress in measurement capabilities has improved the diagnoses of patients in the past decade, increasing their chances of successful treatment, but there are still many problems in health care metrology. The EU has recently addressed this problem by issuing the In Vitro Diagnostics Directive, which came into force in 2003 and requires that all diagnostic kits be calibrated to higher-level standards. A key challenge for metrology authorities in the EU and in countries exporting products to the EU has been to make available reference materials, seroconversion panels, and critical samples for manufacturers.

In medical therapy, there are still accuracy issues in ionizing radiation, and scientific progress has been slow in this field in the past 20 years. Without proper calibration, underdosing and overdosing would be common, because the radiations themselves are invisible and have no immediately observable effects on the patient. Errors in radiotherapy greater than a few percentage points can easily lead to detectable physiological effects. Ultimately, the accuracy of ionizing radiation depends on the development and maintenance of high-accuracy standards by the NMIs. This requires considerable resources and effort.

Sources: OECD 2005; Quinn and Kovalesky 2005; BIPM 2003.

Most NMIs in industrial and rapidly developing countries receive significant funding from their central governments. This is even the case when the NMI is managed by a private organization. Public funding is usually justified by the wide range of individuals and organizations that benefit from the existence of measurement standards. The private sector alone would tend to provide fewer resources to the production and maintenance of measurement standards than is desirable from the point

of view of the economy as a whole because of the “public good” nature of these standards. In industrial countries, governments spend between 0.002 percent and 0.007 percent of GDP on metrology infrastructure. This figure is roughly equivalent to \$300 million for the United States. Governments of some rapid-growth East Asian economies have invested as much as 0.01 percent of their GDP in establishing a measurement infrastructure (BIPM 2003; Quinn and Kovalesky 2005). NMIs also fund part of their activities through the fees they charge for their calibration, consulting, and R&D services. In most developed countries these fees are determined by the NMIs themselves, while in other countries they are sometimes specified in national legislation.

Laws require the establishment of a national metrology institute in practically every country (BIPM 2003), but these institutions can be organized in different ways. NMIs are usually public institutions but are often granted some operational autonomy. It is often the case that all metrological activities are incorporated within a single organization because this facilitates efficiency and transparency.

However, some countries do have several national metrology institutions. This occurs when a central NMI is not able by itself to establish metrological activities in all the fields of interest. In that case, a central NMI or the government designates other public or private institutes to maintain national measurement standards and related calibration facilities for one or more quantities and measurement ranges. In Spain, a total of six institutions maintain national standards. These include laboratories affiliated with the Ministry of Defense and the Ministry of Science and Education, but also an independent foundation affiliated with a university. In the United Kingdom, one of the four custodians of the national standards is a private for-profit engineering consultancy company called the National Engineering Laboratory. In Chile, the national metrology institute operates no laboratories of its own but coordinates a network of five custodians. A decentralized national metrology system should guarantee a level playing field, especially when commercial companies are involved. A drawback of operating multiple NMIs is that they are unlikely to enjoy the same credibility and recognition as a single NMI responsible for a broad range of scientific research. A number of countries require their multiple NMIs to demonstrate their competence by having their laboratories accredited.

Legal metrology

Legal metrology involves the legislative, administrative, and technical procedures that cover regulated areas where there is a public interest

in the correctness of units, measurements, and measuring devices. These areas cover all official measurements, measurements involved in enforcing mandatory standards, and commercial transactions that involve the use of measuring instruments for the determination of prices, such as weighing devices, taxi meters, and electric meters. The role of a national legal metrology organization is to guarantee accuracy by ensuring that measuring instruments comply with legal regulations. This is achieved by approving the types and models of measuring instruments used for certain activities, and by coordinating or conducting verifications and inspections of measurements and measuring instruments.

Although most governments find it generally undesirable to make standards mandatory, measurement standards present significant externalities and are usually integrated into legislation. Some of the benefits of legal metrology include

1. *Reduction of disputation and transaction costs.* Enforcing the use of official measurement units provides transparency and decreases information asymmetries in trade transactions involving measurement. Market efficiency is increased, consumers are protected, and fraud involving faulty measurements or measuring instruments is reduced.
2. *Helping the government fulfill its fiscal functions.* Governments collect significant amounts of revenue through excise and taxes based on measurement. Legal metrology reduces fiscal arbitrariness and increases the predictability of business costs.
3. *Contributing to public safety, health, and the environment.* Regulations aimed at the public interest often involve specific measurements, such as determining permissible amounts of contaminants in water and monitoring automobile emissions. These regulations cannot be enforced without a properly functioning legal metrology infrastructure.

Empirical evidence confirms that reducing measurement errors in legal metrology decreases trade costs. Canada's legal metrology agency, Measurement Canada, conducted a study to quantify the benefits of metrological control on trade. The study combined information on the total value of goods traded over trade weighing and measuring instruments and estimates of the compliance rates of the different instruments to find the annual trade costs of measurement errors. Measurement Canada found that each dollar spent on periodic inspection of measuring instruments saved \$11.40 in measurement errors. When targeting measuring

instruments for which errors would be the most costly, the benefit-cost ratio increased to 28.7 (Birch 2003).

Because legal metrology affects the public interest so extensively, legal metrology institutions are not often privatized or given substantial autonomy. Regulations are established by public authorities and national legal metrology institutions have a role in their formulation and enforcement. Furthermore, legal metrology organizations cannot be self-supporting because they conduct supervision and consultancy tasks for which they cannot charge (Marban and Pellecer 2003).

There are different approaches to organizing legal metrology. In some countries a single organization covers both legal and scientific metrology. This is usually not possible unless the national metrology institute is integrated in the public sector. In other countries there are separate institutions for legal and scientific metrology. In this case, there should be close cooperation between the two fields to ensure that the country has the technical capacity to enforce regulations. In most countries legal metrology is decentralized and a large number of responsibilities, including verification and inspection, are delegated to states or municipalities. In principle, all measurements performed outside the national legal metrology body should be traceable to the national standards (figure 4.1). Fees are usually charged for model approval, verification, test center accreditation, and maintenance service accreditation, and fines are collected for infractions of metrology law, such as use of nonauthorized measure units and use of nonverified instruments.

CHAPTER 5

Opening Doors: Standards, Conformity Assessment, and International Integration

Differences in standards and technical regulations between countries, even when justified, may sometimes create technical barriers to trade. Differences in standards can reflect differences in national consumer preferences, income levels and distributions, the natural environment, technological capacity, or historical technological trajectories. Similarly, differences in technical regulations can reflect national preferences for promoting health, safety, or the environment. Hence, there is sometimes sound economic justification for not aligning national standards and technical regulations with those of actual or potential trade partners.

However, as discussed in chapter 2, there are cases in which standards and technical regulations are purposely used as nontariff trade barriers to protect markets from foreign competition. This occurs when differences between countries are not justified by legitimate health or safety objectives or technological capabilities, or when standards and technical regulations are not properly publicized. In those cases, a lack of harmonization can create a net welfare loss in both an importing and an exporting country.

Even when national standards or technical regulations have been harmonized, incompatible conformity assessment procedures can deter trade. Complying with a standard or a technical regulation is only useful if compliance can be demonstrated to the buyer or the government at

reasonable cost. Demonstrating compliance through conformity assessment is itself only useful if the testing and certification requirements are similar in the exporting country and the importing country. If testing laboratories are not recognized abroad, tests on products carried out in the exporting country have to be repeated by a recognized laboratory in each of the importing countries. An adverse test report in the importing country can result in the rejection of an entire shipment. Likewise, if certification in one country is not recognized abroad, domestic firms requiring quality system and environmental management certification for export purposes¹ need to be certified by organizations in each of the importing countries. Conformity assessment procedures vary widely across countries and in many cases constitute a larger technical barrier to trade than standards. Nonrecognition or nonharmonization of conformity assessment procedures do not persist due to inherent national differences, but because conformity assessment is particularly vulnerable to misuse if bureaucratic procedures are not transparent.

In developing countries, duplication of testing and certification is frequent and very costly. A recent survey of firms in developing countries showed that 44 percent of firms had to conduct significant duplication of testing procedures to meet foreign requirements after domestic requirements had been met, and 30 percent had to conduct complete duplication of testing procedures, as shown in table 5.1 (Wilson and Otsuki 2004). In the same survey, 68 percent of firms cited testing and certification costs as an important reason for not exporting. Because many small and medium enterprises can barely afford a single certification, redundant conformity assessment procedures make exporting prohibitively expensive. In sum, a lack of confidence in another country's accreditation system, or the absence of infrastructure for accreditation, are significant obstacles to trade.

Table 5.1 Duplication of Testing Procedures to Meet Foreign Requirements

<i>Duplication effort</i>	<i>Share of firms (%)</i>
No duplication	7
Minor duplication	13
Significant duplication	44
Complete duplication	30
Not answered	6

Source: Wilson and Otsuki 2004.

The WTO Agreement on Technical Barriers to Trade

In light of these problems, the World Trade Organization's (WTO's) Agreement on Technical Barriers to Trade (TBT) forbids the use of standards, conformity assessment procedures, and technical regulations as nontariff trade barriers. The TBT Agreement is an integral part of the WTO Agreement, which now extends to 148 countries. The principles of the TBT Agreement include the following:

1. *Avoidance of unnecessary obstacles to trade.* The agreement allows for legitimate divergences between countries with respect to tastes, income, geography, and other factors. It accords flexibility in the preparation of technical regulations on condition that they be consistent with a given policy objective and have legitimate objectives.² Conformity assessment procedures are not to be stricter or more time-consuming than is necessary to evaluate a product.
2. *Harmonization.* When appropriate, countries should use international standards, such as those produced by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), as a basis for technical regulations to fulfill given policy objectives. The agreement requires signatories to follow international guides or recommendations in national conformity assessment procedures unless they are inappropriate. Exceptions can be made for developing countries in cases where implementing and enforcing international standards is not possible due to specific technological or socioeconomic conditions. The agreement also encourages members to participate in the work of international standards bodies to ensure that international standards reflect their production and trade interests.
3. *Nondiscrimination.* Technical regulations and conformity assessment procedures should treat all products equally, irrespective of national origin.
4. *Equivalence.* Members should accept technical regulations that are different from their own, provided they fulfill the same objectives.
5. *Mutual recognition.* Members are encouraged to enter into negotiations with other members for the mutual acceptance of conformity assessment results.
6. *Transparency.* Members should provide notification to the WTO when work or international agreements on technical regulations and conformity assessment procedures could have a significant impact on

trade. Notifications should also be given for measures taken to ensure the implementation of the agreement and acceptance or withdrawal from the Code of Good Practice.³ Countries should establish a national enquiry point where WTO members can obtain information on technical regulations, standards and test procedures, and relevant international agreements.

International Coordination in Standardization

International and regional standards

The three organizations responsible for the vast majority of international standards are the ISO, the IEC, and the International Telecommunication Union (ITU). Their role is to elaborate and diffuse international standards that allow businesses to compete in markets around the world. ISO and the IEC are private, nongovernmental organizations. ISO has 153 members, consisting of the primary national standards bodies from each country. The IEC membership consists of 63 national committees representing the public sector, the private sector, or both, depending on the country. The ITU is an international organization within the United Nations whose membership includes 189 governments and 620 members of the private sector. Development of international standards requires consensus between all major global stakeholders and can sometimes be a very difficult process (box 5.1).

Box 5.1

The Struggle to Create a Single Global Standard for 3G Telephony

When countries join efforts to develop an international standard it is usually because all major public and private stakeholders agree on the benefits of using a shared standard. However, even with full global support, coordination problems, market forces, and technological trajectories can hinder the adoption of common standards when stakeholders cannot agree on which standard to choose. This was the fate of the ITU's attempt to establish a single global standard for third-generation (3G) mobile phones.

Third-generation phone systems are based on superior technology that can transmit both voice data and nonvoice data such as e-mail, Internet, and real-time video images. In 1985, as a response to the emergence of incompatible cellular standards in Europe, Japan, and the United States, the ITU started to develop specifications for a 3G standard. Its objective was to establish a single worldwide standard that would enhance the performance of first- and second-generation phones while offering seamless global roaming, enabling a user to move across borders while using the same number and handset. By 1998, two technologies were competing to become the global 3G standard and were proposed to the ITU. European and Japanese firms formed a coalition to back Universal Mobile Telephone System (UMTS), while in the United States, Qualcomm supported Code Division Multiplexing Access (CDMA-2000).

Today, it is clear that strong strategic and economic interests prevented the adoption of a single 3G standard. In 2000, the vision of the ITU could not be realized and it adopted the IMT-2000 standard as a family of standards (comprising UMTS, CDMA-2000, and three other standards) rather than as a single standard. In this context, regions have been adopting incompatible 3G standards and the role of the IMT-2000 project has become one of increasing the compatibility between cellular technologies.

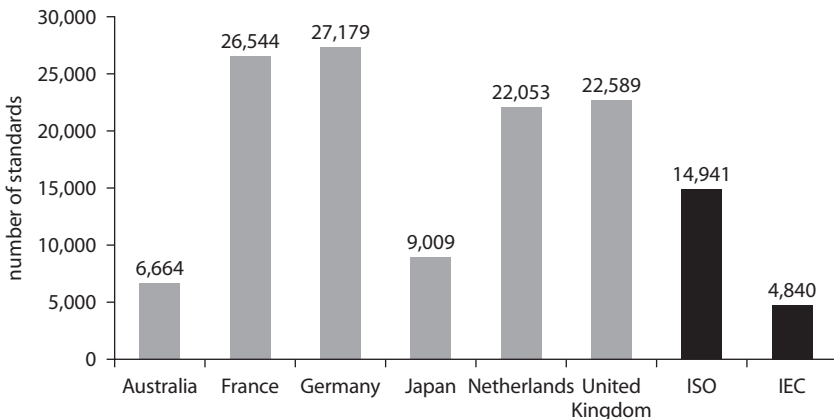
A number of Global System for Mobile Communications (GSM) countries, mainly in Europe, have freed up the larger frequency ranges necessary for UMTS networks. UMTS is not compatible with GSM, so UMTS handset manufacturers in Europe have decided to produce dual-mode phones that can operate using both technologies. In North America, the adoption of UMTS has been hampered by spectrum limitations. The UMTS spectrum established in the ITU standard has not been made available for cellular telephony in the United States or Canada. As a result, UMTS handsets used in North America operate at different frequencies and cannot be used in Europe. CDMA-2000 does not require new spectrum allocation and is compatible with second-generation CDMA technology, so it has been widely adopted outside the GSM zone in the Americas, Japan, and the Republic of Korea. GSM operators in North America have temporarily adopted another IMT-2000 standard, EDGE, which does not make use of additional spectrum and is compatible with existing GSM handsets. Meanwhile, China has been developing its own IMT-2000 3G standard, TD-SCDMA, and is preparing to launch its first operational network.

Sources: Ritchie et al. 1999; ITU 2005, 2006; Henten and Saugstrup 2004.

International standards are playing a growing role in the global economy as they become the basis for an increasingly large share of national standards. Together, ISO and the IEC produce about 85 percent of all international standards (WTO 2005). ISO has produced a total of 14,941 international standards, including 1,247 new standards in 2004 alone. These standards include all fields except for electrotechnologies and telecommunications. The IEC has developed 4,840 international standards, including 343 in 2004. The ITU has more than 3,000 standards in force.⁴ Although these numbers are smaller than the total number of standards in some industrial economies (figure 5.1), international standards are quickly gaining momentum in terms of adoption rates. In some countries, such as the Netherlands and the United Kingdom, roughly 45 percent of national standards are based on international standards (ISO 2003b).

International standards are developed through the voluntary participation of members. ISO, the IEC, and the ITU develop standards using generally similar systems. In the specific case of ISO, standards are first proposed by an industry or business sector that communicates the requirement to their national member. If there is sufficient support for the standard among ISO members, responsibility for the development process is given to technical committees, subcommittees, or working groups consisting of national delegations of experts. These experts incorporate representatives of the public or private sectors. If a new technical committee needs to be cre-

Figure 5.1 Number of Standards in Selected Industrial Countries and International Standards



Sources: ISO 2003a; IEC and ISO Web sites.

Note: Country data are December 2002; ISO and IEC data are December 2005.

ated, its administration is given to the national member organization that proposed the committee. When committees, subcommittees, and working groups reach consensus on a draft standard, it is submitted to a vote of the member states before becoming a standard. The main costs of standardization are borne by the member bodies, which manage standards development projects, and business organizations, which provide the expertise for the technical work. ISO, IEC, and ITU members are not obliged to adopt the international standards developed by these organizations.

There are important benefits to participating in the international standardization process. Active participation increases the chance that national concerns will be reflected in international standards (box 5.2). It also makes possible the compatibility of national standards with international standards. Participation in international standards development can also provide a forum for exchange of technical information with representatives from international industrial and scientific organizations. The international standardization process tends to be dominated by Organisation for Economic Co-operation and Development (OECD) countries and their needs are usually more closely reflected in international standards. In fact, four countries—the United States, the United Kingdom, France, and Germany—account for roughly 60 percent of all secretariats and governorships of ISO committees and working groups.

Along with international standards, regional standards represent a growing share of the standards stock of many countries. The most developed regional system can be found in Europe, where the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC), and the European Telecommunications Standardization Institute (ETSI) develop regional voluntary standards. Member states of the European Community and European Free Trade Association (EFTA) are represented in CEN and CENELEC through their primary standards organizations. ETSI is open to all organizations, governmental and private.

The European regional institutions use a standardization process similar to that followed by their counterparts in other regions. A number of organizations in other regions have organized regional standards development schemes, but these are far less developed than those in the EU. In the Americas, the Pan American Standards Commission (COPANT) develops common standards for most countries; in the Asia Pacific region, the Asia-Pacific Economic Cooperation (APEC) carries out standards harmonization activities; and in Africa, harmonized standards are adopted in the Southern African Development Community (SADC) through the SADC Cooperation in Standardization (SADCSTAN).

Box 5.2**South Africa's Contribution to International Timber Standards**

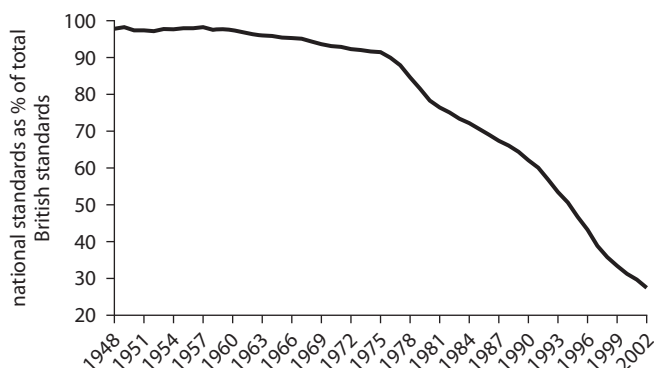
South Africa is active in approximately 270 ISO technical committees (TCs) and subcommittees and is an observer in 108 more. The main strategy of the South African Bureau of Standards is to influence international standardization in areas where South Africa participates in global trade. For example, South Africa is very active in ISO TC 165, the technical committee concerned with structural timber. TC 165 develops international standards that establish design requirements for timber structures, structural properties, and performance, and standards for test methods and requirements to establish physical properties and performance of timber.

South Africa has few indigenous natural forests and has gained significant expertise in obtaining construction timber from plantations. Plantation forestry trees in South Africa grow faster than the same species in the northern hemisphere. As a result, one of the main problems with South Africa's trees is that they produce a lower quality or grade of timber, based on the strength of the timber. Much of South Africa's wood is of grade 5, 6, or 7, whereas 7 is usually the lowest grade in the northern hemisphere. Although grades lower than 7 were not originally to be included in the standards, one of South Africa's important contributions in TC 165 was the inclusion of these grades, so that the standards take technical problems of the tropical and subtropical regions into consideration.

South Africa was also successful in influencing standards related to methods of testing treated timber. Many timber species are not suitable for specific uses in many regions of Africa and are susceptible to local environmental threats such as the African termite. However, foreign donors would often specify the use of such unsuitable or untreated imported timber for their projects. Through its involvement in TC 165, South Africa was able to have the ISO standards include test methods to ensure that laminated beams are adapted to an African environment.

Sources: Jooste, Kruger, and Kotzé 2003; ISO Web site.

In many European countries, a growing majority of standards are regional. The European standards bodies produce two kinds of standards: *European standards* and *harmonization documents*. Member organizations are obliged to adopt European standards and withdraw conflicting national standards. Harmonization documents can be implemented somewhat more flexibly, and members are obliged to incorporate their techni-

Figure 5.2 The Internationalization of British Standards, 1948–2003

Source: DTI 2005.

cal content in one or several corresponding national standards. CEN has an agreement with ISO through which many of the standards are developed in common. As a result, about 30 percent of European standards are identical to ISO standards (CEN 2004). The number of European standards grew from 774 in 1992 to 9,320 in 2005, and the number of harmonization documents grew from 85 to 1,554 during the same period (CEN 2005). Given the magnitude of the regional standards stock, it is not surprising that purely national standards now account for only a minority of standards in many European countries. In 2003, 26 percent of standards in the United Kingdom were purely national, a sharp decline from 64 percent in 1990 and 98 percent in 1948 (figure 5.2).

Approaches to upgrading standards in developing countries

In developing countries, upgrading standards toward international norms is necessary but costly. Standards that are idiosyncratic to developing countries are generally less demanding than international standards and refer to less modern technologies. For this reason, a standard can be considered “upgraded” when its content has been changed to bring it closer to that of a corresponding international standard. Thus, not only does standards upgrading allow for greater economic integration, as discussed in chapter 2, but it also diffuses foreign technology and increases export quality. Moreover, the regional harmonization of standards between developed countries, such as in the EU, has increased intraregional trade while reducing exports from excluded developing countries. In an empirical study of standards, conformity assessment recognition agreements,

and trade, Chen and Mattoo (2004) find that regional harmonization induces a 16 percent reduction in imports from developing countries that are excluded from the harmonization process. Developing countries can benefit from these integrated markets if they are able to align their own standards more closely with the harmonized standards.

However, there are significant costs involved in standards upgrading. The technological content and the health, safety, and environmental objectives of international standards, which are usually developed by OECD countries, may not be consistent with a developing country's stage of technological and socioeconomic development. Upgrading unilaterally to an intermediate standard is risky because trading partners may not consider the new standard up to par and market access is not guaranteed. Upgraded standards may also render an industry less competitive if neighboring trading partners have less demanding standards.

Rather than unilaterally upgrading their standards, some developing countries have adopted a coordinated approach in which a group of countries agrees to upgrade standards simultaneously. Products meeting the upgraded standards are guaranteed market access to all countries in the group. This is the approach used by APEC. The problem with such an agreement is that it is difficult to enforce. The agreement is not necessarily supported by formal regional institutions, and dispute panels are typically given a mediation role instead of an arbitration role (Aldaz-Carroll 2006). Because a cooperation approach does not entail the elimination of other market barriers, members can also undermine the agreement by raising tariffs in a particular industry sector once standards have been harmonized.

Regional trade agreements (RTAs) can be an effective forum for developing countries to coordinate standards upgrading. RTAs are characterized by more formal institutions, greater enforcement, and a greater level of trust caused by frequent interactions between RTA members. The comprehensive nature of RTAs allows for cross-issue retaliation. RTAs also imply the reduction of tariffs in some areas of trade, so it can be more difficult for countries to raise tariffs to protect a market once standards have been harmonized.

RTAs have adopted several strategies for standards harmonization. One approach, followed by the Association of Southeast Asian Nations (ASEAN), is based on harmonizing standards in key sectors around international standards. Members are not forced to adopt the identified standards as their national standards but are compelled to accept products from partners complying with these standards. This approach does not

require standards development committees because regional standards are simply equated to international standards.

Other RTAs have followed a gradual, coordinated approach to standards upgrading. Here, members adopt regional standards and gradually upgrade them toward more demanding international standards. The main potential benefit of a gradual, coordinated approach is that it avoids the adoption of international standards that may not be aligned with a country's level of development (Aldaz-Carroll 2006). Nonetheless, the costs of adopting a regional standard may outweigh the benefits if exports to the region of a particular product are small relative to its exports to other countries where international standards are required. In Latin America, the Andean Community and Mercosur (the Southern Cone Common Market) have adopted a gradual, coordinated approach to harmonize their standards and technical regulations.

Some RTAs with weak regional institutions, such as free trade areas,⁵ have chosen to remove barriers to trade by making standards compatible with each other rather than harmonizing them. Unlike harmonization, compatibility does not imply the development of new regional standards shared by more than one country. Instead, compatibility requires that the content of national standards in one country not conflict with the content of one or several standards in another country. This is the case of the North American Free Trade Agreement (NAFTA), which establishes committees and working groups to facilitate the development of compatible standards and technical regulations. The provisions of the NAFTA agreement are similar to the WTO TBT provisions and emphasize the need for members to adopt international standards, except where these would be inappropriate or would not effectively fulfill legitimate objectives.

Besides lowering the cost and risk of upgrading, there are other benefits to regional coordination. These include the possibility of pooling resources in the area of international standards information diffusion, pooling resources to participate more effectively in shaping international standards, and dividing standardization tasks among countries with different regulatory comparative advantages. Limiting standards harmonization to small groups of countries can render the coordination process more effective by simplifying and expediting the harmonization process, although it decreases economies of scale. It is important to emphasize that in the short run, upgrading standards is not always beneficial because stricter regional standards may divert trade from low-cost extraregional partners with looser standards.

The Need for International Recognition of National Accreditation Systems

Mutual recognition of accreditation procedures promotes trade by decreasing transaction costs and eliminating technical barriers. When accreditation in one country is recognized by other countries, the work performed by that country's certification bodies, inspection bodies, and calibration and measurement laboratories will be accepted in other countries. Countries that harmonize or upgrade their national standards will only gain greater market access if they can prove that their products and services truly conform to the standards. In the study by Chen and Mattoo (2004) described in chapter 2, the authors demonstrate that the regional mutual recognition of conformity assessment procedures increases intra-regional trade in affected industries and even promotes trade with third countries if there are no restrictive rules of origin. In the EU, for example, the European Commission estimates that the perfect operation of mutual recognition could yield trade benefits of as much as 1.8 percent of the EU's gross domestic product (GDP) (Commission of the European Communities 2001).

Membership in the two principal international organizations for accreditation, the International Accreditation Forum (IAF) and the International Laboratory Accreditation Cooperation (ILAC), enhances an accreditation body's prospect of gaining international credibility. Accreditation bodies must demonstrate that they operate at high international standards to join the IAF or the ILAC. In this sense, IAF and ILAC membership is a form of assurance that accreditation bodies are competent to undertake their work and are not subject to conflicts of interest. Furthermore, these international organizations facilitate technology transfer in areas related to quality assessment and provide a forum for learning from other experienced accreditation systems. Although membership in these organizations enhances the reputation of an accreditation body, in no way does it guarantee the recognition of its accreditation process by other countries.

A first step to achieving mutual recognition of accreditation processes across countries is to adopt harmonized standards and guidelines for conformity assessment procedures. Although trading partners can formulate and adopt their own requirements for accreditation, most countries have now decided to follow the international requirements published by ISO and the IEC. These requirements concern accreditation of certification and inspection bodies and measurement and calibration laboratories⁶ and establish the criteria for accreditation in areas concerning operational

procedures, quality system, personnel, and equipment. However, recognizing that requirements for accreditation are equivalent across countries is not very useful if decisions to grant accreditation are affected by idiosyncratic features of accreditation bodies. Hence, to ensure that accreditations in different countries are performed with similar levels of objectivity, impartiality, and transparency, the accreditation bodies themselves should operate according to harmonized standards or guidelines. Such standards and guidelines have also been established by ISO and the IEC and are followed by accreditation bodies globally.⁷

For *full* recognition, accreditation bodies must establish agreements with other countries based on mutual evaluation and acceptance of each other's accreditation systems. Membership in a mutual recognition arrangement or agreement (MRA) at the bilateral level (with one other country) or at the regional or international level (with many other countries) is critical to guaranteeing the credibility of the national conformity assessment system. MRAs are based on peer evaluation processes through which signatories evaluate each other's compliance with the agreed-upon requirements and evaluate the performance of assessment staff. They usually cover specific types of accreditation (for example, quality management system certifiers).⁸

MRAs are now widespread among industrial countries and affect an increasing portion of traded products. In an effort to integrate its internal market, the EU has long depended on mutual recognition of conformity assessment systems. In 2001, 21 percent of industrial production or 7 percent of GDP inside the EU was covered by mutual recognition (Commission of the European Communities 2001). The EU has exported the MRA model and has been at the forefront of the proliferation of bilateral MRAs with other countries. The MRA between the EU and the United States covers approximately \$41 billion in bilateral trade (Maskus and Wilson 2000). The importance of the EU in world trade has created global incentives for countries to consider adopting the MRA model. Several regional accreditation bodies sponsor MRAs, including those in Asia and the Americas.

At the international level, the IAF and the ILAC administer the most important mutual recognition agreements, referred to as multilateral recognition arrangements (MLA) in the case of the IAF (table 5.2). Often, signing an MRA or MLA at the regional level is less demanding and represents a first step toward signing an international MRA. Some regional MRA organizations have signed the agreements of the IAF and the ILAC, thus extending international MRA membership to all of their regional signatories.

Table 5.2 Members of IAF and ILAC Mutual Recognition Agreements, 2006

<i>MLA or MRA</i>	<i>Number of member countries</i>
IAF Quality Management System MLA	42
IAF Environmental Management System MLA	38
IAF Product MLA	29
ILAC Testing MRA	50
ILAC Calibration MRA	50

Source: Wilson and Otsuki 2004.

Note: Countries are only counted once, even if multiple national bodies are MRA or MLA signatories. National members of regional accreditation body members are counted as individual members.

A survey of firms in developing countries reflects the potential benefits MRAs could have on trade with developed countries (Wilson and Otsuki 2004). Although the majority of firms (69 percent) do not subject their products to an MRA (table 5.3), most firms agree that it would be easier to export to developed countries if an MRA with those countries were in place (table 5.4).

Table 5.3 Firms with Products Subject to an MRA

<i>The firm has products subject to an MRA</i>	<i>Share of firms (%)</i>
Yes	23
No	69
Not answered	8

Source: Wilson and Otsuki 2004.

Table 5.4 Perceived Export Advantage of Participating in an MRA with an Export Destination Country

% of firms

<i>Destination</i>	<i>Much harder</i>	<i>Somewhat harder</i>	<i>No effect</i>	<i>Somewhat easier</i>	<i>Much easier</i>	<i>Not answered</i>
Australia	6	2	17	58	11	3
Canada	7	3	18	55	13	3
European Union	9	4	15	54	12	4
Japan	5	2	13	69	8	1
United States	7	3	15	62	10	2
Total	7	3	16	60	11	3

Source: Wilson and Otsuki 2004.

Note: Rows may not total 100 because of rounding.

The Need for International Recognition of National Metrology Institutes

When the capabilities of a national metrology institute (NMI), its measurement units, or its physical embodiments of the national standards are not recognized internationally, the credibility of all measurements traceable to that NMI is affected. Calibration and test certificates establishing product or process characteristics can be refused by overseas buyers or governments if they are not traceable to recognized measurements. Lack of recognition affects the entire accreditation system because international standards used to assess the competence of accredited laboratories and quality systems require the internationally recognized traceability of measurements and test results. In sum, the full recognition of conformity assessment systems requires the recognition of both the national accreditation body and the NMI.

NMIs can increase the credibility of their metrology infrastructure by joining international metrology organizations and participating in international laboratory comparisons. Membership in regional organizations, such as the Inter-American Metrology System, and international organizations, such as the International Bureau of Weights and Measures, offers a host of advantages. These organizations allow NMIs to exchange information on the latest developments in metrology; they also coordinate the dissemination and use of measurement units, facilitate technology transfer, and allow members to receive technical support from more experienced NMIs. International and regional metrology organizations also provide the institutional framework to organize regional and international comparisons of national laboratories. These inter-laboratory comparisons play a key role in demonstrating the accuracy and equivalency of measurements.

A mutual recognition arrangement in metrology provides for the formal recognition of national measurement standards and calibration capabilities. Through measurement comparisons, it establishes the degree of equivalence of national measurement standards maintained by NMIs and thereby guarantees the international acceptance of measurement results that are traceable to the NMI by the other MRA signatories. It also provides governments and other parties a secure technical foundation for wider agreements related to trade and regulatory affairs.

Although mutual recognition was originally conducted at the bilateral level, most countries now focus on joining regional or international MRAs. The most comprehensive multilateral MRA, that of the International Committee of Weights and Measures (CIPM), is organized by the

International Bureau of Weights and Measures and had 64 participating institutes as of January 1, 2006. As in most multilateral agreements, participation in the CIPM MRA is more cost-effective than participation in individual bilateral MRAs. An impact assessment conducted by KPMG Consulting (2001) concluded that if NMIs were to maintain *separate individual* MRAs with *each* partner NMI, the annual cost of establishing and maintaining mutual recognition with each partner NMI would be €75,000 greater than it currently is with the CIPM MRA. Exports between CIPM MRA participants accounted for 89 percent of world trade in merchandise in 2001 (Quinn 2003). As a result, the measurement comparisons required by the CIPM MRA have become the principal reference for information on the technical capabilities of NMIs. The criteria for joining the CIPM MRA concern not only participation of NMIs in international measurement comparisons, but also verification through a peer-review process that the national calibration services make use of an internationally recognized quality system.

International cooperation in legal metrology can also reduce technical barriers to trade. Bulk and prepackaged goods subject to metrology laws account for a significant portion of exports and national income in many countries. Without harmonized means and procedures for verifications and tests, it is difficult to establish whether metrological control is equivalent in different countries. Similarly, measuring instruments accepted in one country may not be accepted in another country because of differing regulations or procedures for product approval. Membership in the International Organization of Legal Metrology (OIML) helps countries harmonize policies regarding the trade of products and services with a commercial value based on measurements, as well as trade in measuring instruments. When necessary, the OIML also provides governments with technical assistance for the development of sound metrology policies.⁹ The OIML Certificate System for Measuring Instruments facilitates administrative procedures and lowers transaction costs in the trade of legal instruments subject to legal requirements.¹⁰

CHAPTER 6

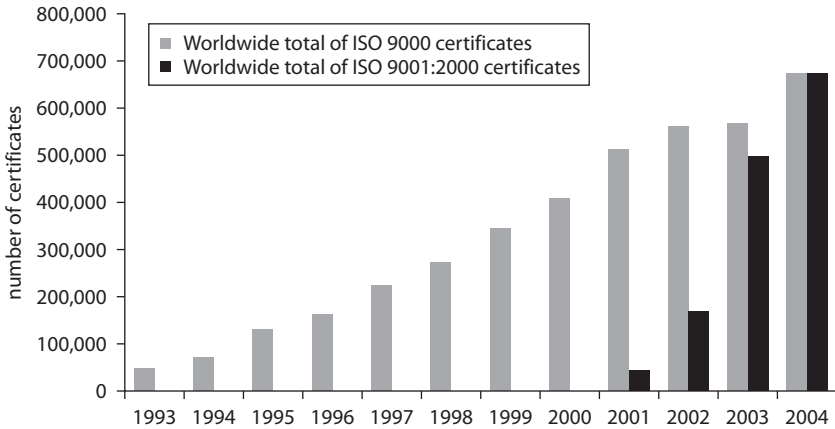
The ISO 9000 Quality Management Standards

The ISO 9000 standards are the most widely known and fastest-growing international quality standards. They were first developed by the International Organization for Standardization (ISO) in 1987 and represent the state of the art in quality management. The ISO 9000 family of standards is implemented in more than 670,000 organizations in 154 countries (figure 6.1).

The Function of ISO 9000

ISO 9000 standards provide an organization with a model to follow for the design, implementation, and assessment of quality management systems. *Quality management* refers to the steps an organization can take to fulfill the customer's requirements and regulatory requirements while aiming to enhance customer satisfaction and achieve continual improvement of its performance in pursuit of these objectives. Mechanisms are established to research and understand customer needs and expectations and act on the result. Special emphasis is placed on the consistent use of documented, standardized procedures to guide processes in the organization. Processes that are subject to such constraints are more likely to enhance product uniformity and conformance to specifications.

ISO 9000 standards are generic management system standards. They can be applied to any organization regardless of its size, products, sector, and activity, and regardless of whether it is a business enterprise, a public

Figure 6.1 Global Adoption of ISO 9000 Standards

Source: ISO Web site.

agency, or a government department. In effect, ISO 9000 incorporates quality system requirements but does not dictate how they should be met. This provides great scope and flexibility for implementation in different types of organizations.

The ISO 9000 family of standards consists of three standards:

- ISO 9000:2000 describes the fundamentals and vocabulary of quality management systems.
- ISO 9001:2000 specifies requirements for quality management systems. This standard was published in 2000 to improve and replace three previous 1994 versions of ISO 9001, ISO 9002, and ISO 9003.¹
- ISO 9004:2000 provides guidelines beyond the requirements given in ISO 9001:2000 to consider both the effectiveness and the efficiency of a quality management system, and consequently the potential for improvement of the organization's performance. Certification bodies cannot register organizations against ISO 9004.

In this book, the term "ISO 9000" will refer to the family of ISO 9000 standards recognized by the International Accreditation Forum for accredited certification. This includes ISO 9001:1994, ISO 9002:1994, and ISO 9003:1994 up to December 15, 2003, and only ISO 9001:2000 after that date.

ISO 9000 standards can bring benefits to an organization due to both internal and external factors. Benefits due to *internal* factors include

- lower costs and shorter cycle time due to more effective use of resources;
- higher-quality processes, leading to fewer costly inspections, warranty costs, and reworking;
- greater customer focus, resulting in flexible and fast responses to market opportunities;
- greater management involvement in improving quality performance and control over employee performance; and
- better working conditions and motivation for employees.

Benefits due to *external* factors include

- greater consumer confidence that products will meet their requirements or regulations, leading to an increase in customer base;
- greater consumer satisfaction, leading to repeat purchases; and
- better image of the organization.

ISO 9000 and Competitive Advantage

The overwhelming popularity of ISO 9000 certification has prompted much debate about the business value of this quality assurance system. While most of the debate has been fueled by anecdotal evidence from practitioners, 18 years of ISO 9000 have also provided plenty of opportunity for more rigorous empirical studies of the costs and benefits of certification. The debate has been focused on two main questions. First, does ISO 9000 certification actually improve operational performance? And second, regardless of its effect on operational performance, does certification affect financial performance based on revenue growth and profitability? Unfortunately, much of the empirical work addressing these issues has produced conflicting results, and this has posed a serious challenge to unambiguous arguments in support of certification. Nonetheless, a closer examination of the literature helps explain some of the mixed evidence and does yield several reasons to support ISO 9000 certification.

Why do firms get certified?

A firm's motivation for seeking certification can affect the benefits it derives from the certification process. Firms seek ISO 9000 certification

for two types of reasons: internal reasons, related to operational performance, and external reasons, related to market requirements. Opinions and empirical results have essentially converged regarding the effect of motivation on the ensuing benefits of certification. Many researchers posit that certification serves as a *necessary* but not *sufficient* condition for improving organizational performance and quality. Thus, firms with a genuine interest in establishing a quality management system will use certification as a foundation for further improvements and are likely to derive internal benefits. In contrast, firms pursuing certification as a reaction to market requirements tend to adopt a minimalist approach to quality management and derive few internal benefits.

Firms seeking certification for internal reasons believe that ISO 9000 can help them improve their quality management systems (Casadesús and Giménez 2000; Singels, Ruël, and van de Water 2001). A quality management program can increase profitability by reducing defects, duplicate work, and waste, enhancing internal organization and communication, and enabling a better response to customer needs. These firms see certification as a means of acquiring a better quality management system (Wayhan, Kirche, and Khumawala 2002; Terziovski, Samson, and Dow 1997). It is one step among many in a constant process of improving productivity, efficiency, and quality.

In contrast, firms motivated by external reasons see certification as an end in itself. They believe it will improve their image and allow them to enter new markets, or they may simply be responding to customer pressure. For these firms, certification serves as a signal to communicate desirable organizational attributes to potential customers. Customer requirements are now an increasingly important motivation for certification. Supply chain transactions are becoming more distant and international and it is difficult for buyers to observe the qualifications of suppliers (Brown, van der Wiele, and Loughton 1998; Terlaak and King 2006; Terziovski, Samson, and Dow 1997). As other companies acquire certification, firms pursue certification to avoid losing their competitive positions.

Does certification improve organizational performance?

Several empirical studies have explored the relationship between ISO 9000 certification and internal benefits in organizational performance, with mixed results. On one side of the debate, some studies have found a positive relationship between certification and organizational performance. A cross-sectional analysis of 649 mostly large firms in China, India, Mexico, and the United States by Rao, Ragu-Nathan, and Solis (1997) found that certified

firms had higher levels of implementation of quality management practices and higher-quality products or processes.² Firms planning to get registered for ISO 9000 had similar results as firms with no interest in registration. Given that obtaining registration for ISO 9000 would represent a small additional cost relative to the total costs of ISO 9000 implementation, it is reasonable to assume that the firms that are not interested in registration have not already complied with the internal requirements of ISO 9000. This suggests an actual role for certification in yielding internal benefits, as opposed to a simple self-selection of superior firms into certification. In a survey of 288 Spanish companies, Casadesús and Giménez (2000) found that firms gained from certification through a number of internal benefits related to the implementation of a quality system.

These cross-sectional studies do not necessarily imply causality. Sharma (2005) was able to infer causality through a time-series study of 70 firms in Singapore over a six-year period. The author found that certification was associated with improvements in operating efficiency, based on profit margins, but also with growth of sales and improved overall financial performance based on earnings per share. The effects of certification were greater on profit margin than on growth of sales, suggesting that an improvement in overall performance was largely due to improvements in internal business processes.

On the negative side, other studies have found limited or no effect of certification on organizational performance. Terziovski, Samson, and Dow's (1997) cross-sectional analysis of 858 manufacturing firms in Australia and New Zealand showed that ISO 9000 certification was a poor predictor of organizational performance and quality. The authors argue that many companies pursue certification to satisfy customer requirements but revert to traditional practices immediately after certification, thus nullifying any potential beneficial effect of certification. Quazi, Wing Hong, and Tuck Meng (2002) administered Rao and colleagues' questionnaire to 93 Singaporean firms and found no relationship between certification and quality management practices and quality results. Disagreements with Rao and colleagues' results could be due to differences in the profile of the firms in the surveys. Rao and colleagues' survey consisted mainly of large firms in the manufacturing industry, whereas Quazi and colleagues' survey consisted mainly of small and medium enterprises (SMEs) in a broader range of sectors. Recent work by Terlaak and King (2006), based on an 11-year panel study of 19,713 manufacturing facilities in the United States, found that, controlling for inventory size, ISO 9000 did not have a significant effect on operational improvements, proxied by the generation

of process waste (or scrap). However, this study must be interpreted with care because the amount of process waste is only one measure among many of a quality system. This contrasts with the studies by Rao, Ragunathan, and Solis; Casadesús and Giménez; Terziovski, Samson, and Dow; and Quazi, Wing Hong, and Tuck Meng, who included more comprehensive measures of the implementation of a quality system.

Does certification improve financial performance?

From a manager's perspective, what may ultimately matter most is whether certification leads to improved financial performance. Here, empirical results suggest different degrees of performance improvements. An empirical study of 146 large firms in Singapore by Chow-Chua, Goh, and Wan (2003) showed that certification had indeed led to better overall financial performance. These conclusions were based on a survey of perceptions of certification on business performance and an examination of financial data over a 10-year period. In their study of U.S. manufacturing facilities, Terlaak and King (2006) found that production volumes grew faster after certification, even after controlling for operational performance and inventory. Hence, although certification did have some business value, it was ultimately functioning as a market signal that reduced information asymmetries and helped differentiate between high-quality and low-quality suppliers. Recent work based on firm-level surveys of investment climate factors in developing economies found that ISO 9000 certification had a significant impact on several measures of productivity. Average productivity gains were estimated to be between 2.4 percent and 17.6 percent for three Central American economies, less than 1 percent for four Southeast Asian economies, and 4.5 percent in China (Escribano and Guasch 2005a, 2005b).

Other studies have provided less optimistic conclusions about the financial performance implications of ISO 9000 certification. Heras, Dick, and Casadesús (2002) examined sales and profitability of 800 Spanish firms over five years and found that the performance of companies that sought certification was likely to be superior to that of companies that did not seek certification, but that this was already true before certification; performance did not actually improve after certification. Furthermore, firms demonstrating an intent to pursue certification performed as well as certified firms. This seemed to agree with Terlaak and King's (2006) implication that firms with superior performance show a greater propensity to become certified. But in contrast to Terlaak and King's conclusion, the firms examined by Heras, Dick, and Casadesús (2002) did not benefit from certification. Nonetheless, the Heras, Dick, and Casa-

desús study does not rule out the possibility that the *prospect* of obtaining certification changes a firm's organizational practices and enhances its performance in the years preceding certification.

In a study of 48 manufacturing companies in the United States over the 1990–98 period, Wayhan, Kirche, and Khumawala (2002) found a very limited impact of certification on financial performance, as measured by returns on assets. Moreover, this effect dissipated quickly over time and ISO 9000 did not affect any other indicators of financial performance such as revenue, stockholder equity, or gross profit. This could be linked to Terziovski, Samson, and Dow's observation that firms are unwilling to accept and use the standard operating procedures defined in ISO 9000 once they have completed the certification process. However, Wayhan, Kirche, and Khumawaki do note that during the period of the study U.S. suppliers had not yet begun to require their suppliers to be ISO 9000 certified. Of interest to Latin America, Lima, Resende, and Hasenclever (2000) compared certified and noncertified firms in Brazil over the 1992–98 period and concluded that ISO 9000 certification had an effect on only one of five financial performance indicators, sales to total assets, which increased with certification. None of the indicators related to operational or net income were affected, perhaps suggesting that certification increases costs as well as revenues. However, Lima, Resende, and Havenlever note that the accounting indicators that were used could not measure changes in productive efficiency.

In view of the mixed evidence, is there still a role for ISO 9000?

In spite of conflicting views on the overall effect of certification, researchers on both sides of the debate acknowledge that ISO 9000 does provide the *potential* for improving organizational performance and producing higher-quality products and services (Escanciano, Fernández, and Vázquez 2002). Terziovski, Samson, and Dow (1997) argue that the role of certification has been misunderstood. While many managers view certification as an end in itself, either for marketing or for internal reasons, conformance to ISO 9000 alone cannot produce sustainable improvements in organizational performance. Rather, managers must use it as a means to implement better quality management systems, such as a total quality management (TQM) scheme.

TQM is a comprehensive approach to quality leadership in which quality tools and techniques are applied to all functions and all levels of an organization. There seems to be broad agreement that intangible factors that are difficult to transcribe in a standard, such as employee empowerment and capable senior management, have a great influence on a firm's ability to implement TQM. Singels, Ruël, and van de Water

(2001) point out that the procedures described in ISO 9000 guarantee constant product quality, a precursor to higher quality. Thus, ISO 9000 is a necessary condition for good product quality, but certified organizations do not automatically have good product quality. This seems to be the opinion of managers as well. In a survey of Australian firms by Brown, van der Wiele, and Loughton (1998), a majority of respondents viewed ISO 9000 certification as a first step in implementing a TQM program. In fact, very few companies thought that TQM could be implemented before ISO 9000 certification. A survey of Singaporean SMEs by Quazi and Padibjo (1998) found that ISO 9000 provided a "stepping stone" toward TQM practices.

Empirical evidence confirms that a firm will benefit from certification if it is truly working toward a better quality assurance system. Evidence of such a relationship was first unearthed in surveys of British firms by the Science and Engineering Policy Studies Unit (Heras, Dick, and Casadesús 2002; Dick 2000). The study was limited to descriptive statistics but found that companies that cited consumer pressure as a motive for certification were less likely to report improvements (Terziowski, Samson, and Dow 1997). Jones, Arndt, and Kustin (1997) conducted a survey of 272 certified Australian companies and found that those companies that viewed certification as an instrument to satisfy customer requirements were less likely to report having achieved benefits from certification than companies that pursued certification for internal reasons. Interestingly, this second group of proactive and developmental companies represented a low proportion of respondents. This could provide an explanation for the lack of internal benefits observed in a number of empirical studies.

Another analysis of a survey of 160 Australian firms, mostly SMEs, by Brown, van der Wiele, and Loughton (1998) led to the same conclusion. Brown, Arndt, and Kustin echoed Jones, van der Wiele, and Loughton in noting that the external reasons for seeking certification were far more important than the internal reasons, but that a stronger drive to achieve internal benefits led to a more positive perception of the organizational, quality, and financial improvements realized. Singels, Ruël, and van de Water (2001) investigated the relationship between certification motives and benefits by examining the organizational performance of 192 organizations in the Netherlands. The authors found that, on the whole, certification did not lead to statistically significant improvements in organizational performance. However, when motivations for certification were accounted for, the study found that organizations that pursued certification out of an internal motivation profited in terms of performance outcomes.

Finally, it is worth noting the contribution of quality adoption, particularly of ISO 9000, to export performance, and the best example is China. Chinese firms understood very early the need to incorporate quality standards (box 6.1). That was critical for the remarkable performance of Chinese export growth during the last two decades.

Conclusion

Table 6.1 summarizes the literature results discussed in this section. Two important points emerge from the existing evidence. First, firms with superior organizational performance and quality management practices are more likely to obtain certification. This implies that ISO 9000 can be used as a market signal for distinguishing high-quality firms from low-quality firms. Second, a firm's motives for pursuing ISO 9000 certification have an effect on the internal benefits of certification. Firms that view certification as a genuine tool for improving their quality management system and as a first step toward TQM are more likely to gain from certification. Given this result, if certification is used to improve organizational performance, it should involve follow-up processes that build on ISO 9000 to achieve quality leadership.

Internal Firm-Level Barriers to ISO 9000 Certification

Despite the potential business value of implementing a quality management system, a number of internal barriers can hamper the adoption of ISO 9000 by firms. The most frequently cited barriers to certification are lack of quality awareness and resistance to change; difficulty of understanding and interpreting standards; the time commitment required; limited financial resources; and limited availability of calibration services or equipment (Santos 2002; Schuurman 1997; ITC 2004; Brown, van der Wiele, and Loughton 1998; Karapetrovic, Rajamani, and Willborn 1997). Many of these obstacles are particularly difficult for SMEs to overcome because of their lower levels of human and capital resources and their relative isolation.

Lack of awareness and understanding of quality and standards

A lack of quality awareness among firm management and staff can constitute one of the greatest obstacles to the implementation of a quality management system. This problem is particularly acute in small firms, where managers generally have fewer interactions with external knowledge networks and are less familiar with the latest quality management

Box 6.1**China and the Drive for Quality**

The remarkable economic performance of China since the early 1990s—annual GDP growth rates near 10 percent, extraordinary export sales, huge trade surpluses—is often attributed at least partially to its low labor costs. But cheap labor alone cannot explain China’s success. Bangladesh has labor costs that are half those of China, yet its performance has been nowhere near China’s. While China does indeed have low labor costs, at least relative to many countries, the reasons for its success are more complex. One important and often overlooked factor is China’s determined drive to adopt quality standards.

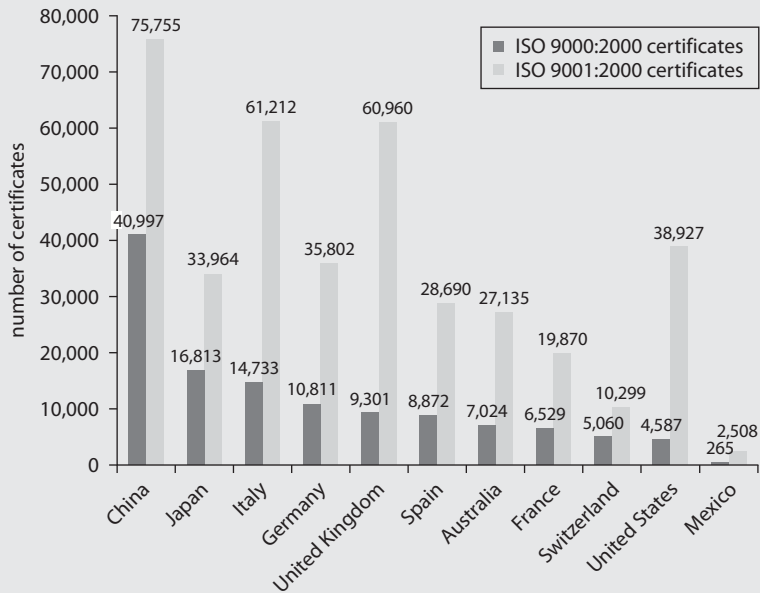
If ISO certification is used as a proxy for adoption of quality standards, China’s progress and its current predominance become clear. In the late 1980s, the number of firms in China that had adopted ISO 9000 or 9001 was very low, just a few thousand firms. By 2003, however, China was leading all countries in the number of firms with ISO 9000 and ISO 9001 certification, as the figure on the following page shows. China had 75,755 firms with ISO 9000, compared with 61,212 such firms in Italy, 38,927 in the United States, and 33,964 in Japan. Similarly, China led in the number of firms with ISO 9001, with 40,997 certified firms; the second country in the ranking, Japan, had 16,813, and the United States had only 4,587. Latin American countries lag significantly in obtaining certification: in 2003 Brazil had 6,120 firms with ISO 9000, Argentina had 4,149, and Colombia had 4,120. Mexico had only 2,508 firms with ISO 9000 and 265 firms with ISO 9001.

practices. Furthermore, SME managers tend to be risk averse and may be reluctant to abandon their traditional management practices.

When managers do decide to implement a quality management system, their lack of knowledge or confidence in ISO 9000 can deter them from committing sufficient time and resources to the process. This can compromise their chance of obtaining certification (ITC 2004; Santos 2002). Top and middle management may be especially reluctant to adopt ISO 9000 if they perceive the requisite changes in power structures as undermining their leadership (Schuurman 1997). Resistance to change may also be found among employees who do not understand the ultimate benefits of reorganizing their tasks or taking on different responsibilities. Employee reluctance appears to be more pronounced in SMEs than in larger firms

China and its firms thus understood very quickly the need to use and adopt quality standards, setting up an effective national quality system. While the numbers for ISO certification are particularly easy to track, similar trends with respect to China's performance exist for just about any other indicator of quality adoption.

Top Ten Countries for ISO 9000 and ISO 9001 Certificates, with Mexico Comparator



Source: ISO 2005.

and was found to be the top obstacle to certification in surveys of certified micro and small enterprises in Brazil (Santos 2002) and of certified SMEs in Australia (Brown, van der Wiele, and Loughton 1998).

It is difficult for individuals outside the quality management profession to understand and interpret ISO 9000 standards. Due to greater indivisibilities of labor, personnel in small firms tend to be less specialized than those in larger firms. Small firms may not have the human resources to establish a quality department or to maintain staff specifically dedicated to quality. Furthermore, SMEs tend to invest less in training than larger firms, which limits the skill levels of their workers and their ability to interpret ISO 9000 standards. This poses a serious obstacle to the adoption of ISO 9000. In Brazil, a survey of certified firms found that

Table 6.1 Summary of Studies Evaluating the Effect of Certification on Firm Performance

<i>Study</i>	<i>Model</i>	<i>Performance measure</i>	<i>Effect of certification</i>
Rao, Ragu-Nathan, and Solis (1997)	Cross-sectional, mainly large manufacturing firms, United States, India, China, and Mexico	Quality management practices and output quality	+
Casadesús and Giménez (2002)	Cross-sectional, Spain	Quality management practices	++
Sharma (2005)	Time-series, 6 years, Singapore	Operating efficiency and financial performance	++
Terziovski, Samson, and Dow (1997)	Cross-sectional, manufacturing firms, Australia and New Zealand	Organizational performance and output quality	0
Quazi, Wing Hong, and Tuck Meng (2002)	Cross-sectional, mainly SMEs, Singapore	Quality management practices and output quality	0
Terlaak and King (2006)	Time-series, 11 years, manufacturing firms, United States	Operational and quality improvements, production volumes	0 ++
Chow-Chua, Goh, and Wan (2003)	Times-series, 10 years, large firms, Singapore	Overall financial performance	++
Escribano and Guasch (2005a, 2005b)	2 years, 9 developing countries	Productivity and exports	++
Heras, Dick, and Casadesús (2002)	Time-series, 5 years, Spain	Financial performance	0 (but performance of certified firms is already superior pre-certification)
Wayhan, Kirche, and Khumawala (2002)	Time series, 10 years, manufacturing firms, United States	Financial performance	+ (effect dissipates over time)
Lima, Resende, and Hasenclever (2000)	Time-series, 7 years, Brazil	Financial performance	+
Jones, Arndt, and Kustin (1997)	Cross-sectional, Australia	Organizational performance and output quality	Internally motivated firms: ++ Others: +
Brown, van der Wiele, and Loughton (1998)	Cross-sectional, Australia	Organizational performance	Internally motivated firms: ++ Others: 0
Singels, Ruël, and van de Water (2001)	Cross-sectional, Netherlands	Organizational performance	Internally motivated firms: ++ Others: 0

Source: Authors' compilation.

Note: 0 = no effect, + = slight positive effect, ++ = significant positive effect.

Table 6.2 Firms Using External Consulting Services for Certification in Two Brazilian Surveys

<i>Survey</i>	<i>Firm size</i>	<i>Proportion of firms using consulting services (%)</i>
SEBRAE 1994	Small	80
	Medium	45
	Large	25
INMETRO 1996	<100 employees	70
	All firms	55

Source: Schuurman 1997.

25 percent of the firms had difficulty understanding ISO 9000 (Santos 2002). While this survey represented firms of all sizes, another Brazilian survey of exclusively micro and small enterprises found that 72 percent of them considered their lack of understanding of ISO 9000 to be an obstacle to certification. As a result, smaller firms need to rely on external consulting services to successfully implement a quality management system (table 6.2). Reluctance to devolve such responsibilities to outsiders can act as a barrier to certification for smaller firms.

Limited time and financial resources

Implementing a quality management system requires significant time commitments from all company personnel. Implementation time depends on many factors, including the complexity of the company, the current level of quality, the skill level of the personnel, and the degree of management commitment. Companies usually dedicate a first phase of the process to training of management and employees, followed by a second phase in which the company adapts its procedures to ISO 9000. Because ISO 9000 targets all processes in the enterprise, every staff member needs to dedicate some time to implementing the quality system in addition to their existing tasks. This may require extending the total number of person-hours and even hiring new personnel. Table 6.3 shows that in Australia, Canada, and the United States, smaller firms are able to obtain certification faster than larger firms, possibly a reflection of the more complex tasks performed by larger firms. The relationship is the opposite in Argentina, where smaller firms take longer than larger firms. Overall implementation times are also longer in Argentina than in Australia, Canada, and the United States.

The financial costs of implementing a quality management system can be a barrier to certification, especially for SMEs. Table 6.3 lists average

Table 6.3 Total ISO 9000 Implementation and Certification Costs

<i>Country</i>	<i>Year</i>	<i>Firm size</i>	<i>Average total implementation costs (US\$)</i>	<i>Average implementation time (months)</i>	<i>Total costs as % of turnover</i>	<i>Registration costs as % of total implementation costs</i>
United States, Canada ^a	1999	small and medium	72,502	—	—	—
		medium-large	106,890	—	—	—
United States, Canada ^b	1996	small and medium	71,000	14	1.20	16
		medium	102,000	15	0.50	15
United States ^c	1994	medium	250,000	—	—	—
Australia ^d	1995	small	55,000	7–12	—	—
		medium	83,000	10–16	—	—
		large	144,000	13–18	—	—
Argentina ^e	1995	small	80,000–100,000	24	—	—
		medium	—	21.3	—	—
		large	20,000–40,000	18.3	—	—
Brazil ^f	1999	small	77,323	15	—	—
		medium	166,737	—	—	—
		large	526,034	—	—	—
Saudi Arabia ^g	2003	all	84,104	—	—	12
South Africa ^h	1998	small	13,321	—	0.30	12
		medium	31,937	—	0.05	17
		large	72,795	—	0.05	13

Sources: a. Wilson, Walsh, and Needy 2002; b. Schuurman 1997; c. Stevenson and Barnes 2001; d. Schuurman 1997; e. Ramos 1995; f. Santos 2002; g. Magd, Kadasah, and Curry 2003; h. Turner, Ortmann, and Lyne 2000.

Note: — = Not available. Firm sizes are defined as follows:

a. Small and medium = less than \$25 million annual sales; medium-large = \$25 million to \$200 million annual sales.

b. Small and medium = less than \$11 million annual sales; medium = \$11 million to \$25 million annual sales.

c. Medium = \$25 million annual sales.

d. Small = less than 50 employees; medium = 50–350 employees; large = more than 350 employees.

e. No definitions.

f. Small = 20–99 employees in industry and 10–49 in commerce; medium = 100–499 employees in industry and 50–249 in commerce; large = 500 or more employees in industry and 250 or more in commerce.

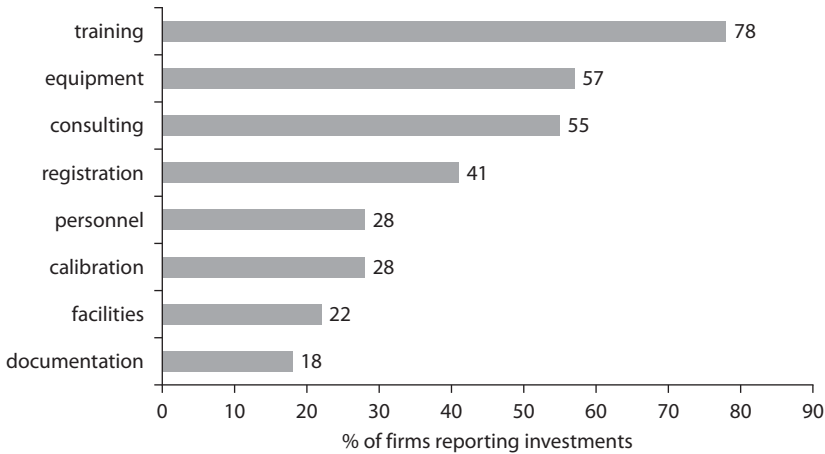
h. Small = less than \$18 million turnover; medium = \$18 million to \$117 million turnover; large = more than \$117 million turnover.

total ISO 9000 certification costs by firm size in various countries. The level of those costs for firms in developing countries is quite significant and even more so when converted into purchasing power parity. So, perhaps not surprisingly, one does not see a rush toward certification, especially among small firms.

Cross-country comparisons are difficult to interpret due to differing definitions of firm size, but the survey data do not seem to indicate substantial variations in costs across countries, except for South Africa, where the costs are much lower.³ Although in most countries costs increase with firm size, a survey of firms in Argentina showed an opposite relationship. Here, small firms had to spend more than twice as much as large firms to become certified. Ramos (1995) attributes this to small firms having weaker quality management systems and having to spend much more of their resources to upgrade them. In general, SMEs are more likely than large firms to view certification costs as a barrier. A Brazilian survey showed that 85 percent of small companies, 75 percent of medium companies, and 55 percent of large firms reported difficulties in obtaining the necessary resources for certification (Schuurman 1997). This is not only because SMEs have less access to finance than their larger counterparts, but also because certification tends to represent a larger share of turnover for smaller enterprises (table 6.3). All that begs the question of whether there is a role for the public to assist in the financing of quality certification.

Certification costs depend on a company's size and complexity and its existing level of preparedness for the process. Training is often one of the most important costs involved in certification (figure 6.2). Key staff members need to receive specialized training to maintain the quality system, and all personnel must receive some general training on the operational aspects of ISO 9000. Specialized technical training is particularly needed when a firm introduces new technologies to implement a quality management system. Many firms, and especially SMEs, rely on external training services if they have not already been operating some form of quality management. Also, there can be significant costs associated with the additional salaries that need to be paid to cover the time spent on implementing the quality management system. These costs may be significant if workers are poorly trained and spend a lot of time implementing the quality system or if additional workers need to be hired to supervise and maintain the system.

Purchases related to new equipment and facilities also account for a major share of costs (figure 6.2), and these costs vary widely across

Figure 6.2 Share of Brazilian Firms Reporting Important Certification Investments in Different Categories

Source: Santos 2002 using data from Federação das Indústrias do Estado do Rio Grande do Sul.

industries, depending on capital intensiveness. In addition to purchasing equipment, companies may also incur costs to have existing equipment calibrated by third-party laboratories. External consultant fees constitute another significant cost (figure 6.2 and table 6.4). Consultants can assist firms with any part of the certification procedure or they can be employed to take a company through the entire implementation process. These costs are usually a greater burden for smaller firms that do not have the internal capabilities to implement ISO 9000 on their own.

Registration costs account for a minor share of total ISO 9000 adoption costs, but they can still act as a barrier to entry for some small firms. To receive an official ISO 9000 certificate and be included in the certification body's registry, firms have to request an audit from a certification body. The actual ISO 9000 registration process includes auditing and

Table 6.4 Typical Consulting Costs for Firms Seeking Certification, Argentina, 2005

<i>Firm size</i>	<i>Cost of certification-related consulting</i>
Up to 10 employees	\$8,000–\$10,000 + travel expenses
11–100 employees	\$14,000–\$17,000 + travel expenses
More than 100 employees	At least \$23,000 + travel expenses

Source: Informal interviews with certification bodies in Argentina.

Table 6.5 Typical ISO 9000 Registration Costs in Latin America, 2005

<i>Country</i>	<i>Firm size</i>	<i>Cost of registration</i>
Argentina	Up to 10 employees	\$1,500 + travel expenses
	11–100 employees	\$2,500 + travel expenses
	More than 100 employees	\$4,000–\$5,000 + travel expenses
Ecuador	All firms	\$400–\$1,000 including 2 follow-ups
Mexico	26–45 employees	\$3,900 + \$1,700 per follow-up
	66–85 employees	\$5,700 + \$2,300 per follow-up
	172–275 employees	\$8,000 + \$3,100 per follow-up
Peru	Up to 10 employees	\$1,400 including 2 follow-ups
	86–110 employees	\$4,400 including 2 follow-ups

Source: Interviews with certification bodies in Argentina, Ecuador, Mexico, and Peru.

administration costs that the certification body determines according to the size and complexity of the enterprise. The costs are affected by the time that auditors spend on the evaluation. Registration costs can vary across countries but generally do not exceed a few thousand U.S. dollars for small firms (table 6.5). ISO 9000 registration is usually valid for three years, during which time the certification body conducts two follow-up evaluations, with additional costs to the firm. The amount paid to the certification body accounts for a minor share of total ISO 9000 adoption costs, usually around 12 to 17 percent (table 6.3), but these fees can still act as a barrier to certification for some firms.

Limited supply of services

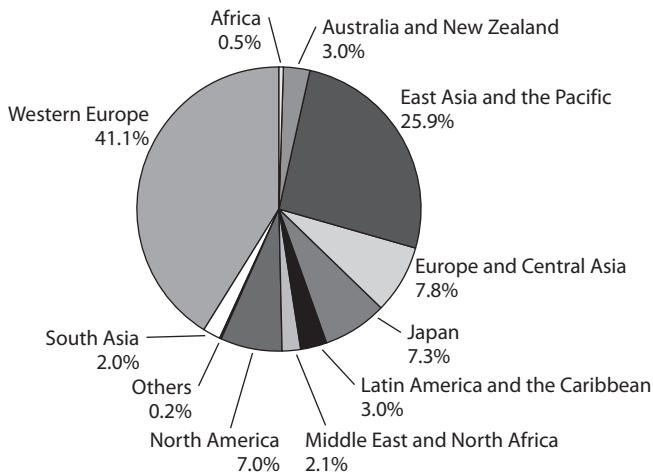
Quality support services necessary for ISO 9000 certification may be difficult to find. Depending on the nature of the firm, the implementation of a quality management system may require the use of external consulting, training, inspection, testing, and calibration services. While this is not usually a problem in industrial countries, these services may be unavailable in developing countries. Consulting and training services may be required to help firms understand the complex technical requirements of ISO 9000 and relate them to the organizational management of the firm. Testing and inspection can be required to meet customer quality requirements but will constitute a serious barrier to certification if they are not available locally. Quality control requires that measurement-related equipment be traceable to an accepted reference standard. Sometimes neither calibration equipment nor services are available to the firm.

In a survey of certified Brazilian firms, 15 percent mentioned that the unavailability of calibration services and equipment was an obstacle to certification, and 10 percent mentioned that the lack of a traceable measurement standard was an obstacle (Santos 2002). Finally, firms may find themselves in isolated areas where they do not have access to certification bodies and auditors able to provide them with ISO 9000 registration.

National Factors Influencing the Diffusion of ISO 9000

The pattern of ISO 9000 adoption is highly uneven across countries and regions. Figure 6.3 shows that Europe and the Asia Pacific region account for about 85 percent of worldwide certificates, while Central and South America together account for a mere 3 percent of certificates. In addition to firm-level factors, a number of country-specific factors can create opportunities and incentives for ISO 9000 adoption by affecting access to information, expected costs, and expected benefits. These factors can be broadly categorized as market factors, shaped by the characteristics of the individual market actors and the market structure, and the economic environment, shaped by the institutions, the infrastructure, and the inputs available to market actors.

Figure 6.3 Regional Shares of Worldwide ISO 9000 Certificates, 2004



Source: ISO 2005.

Note: Developing countries are grouped according to the World Bank regional classification system.

Market factors

International trade. International trade can spur the diffusion of ISO 9000. Firms often cite market pressure as an important reason for seeking certification. Many international buyers routinely require ISO 9000 as a contractual condition for suppliers. This is especially true for buyers in countries where certification is widespread. These buyers are likely to understand the need for certification and are integrated in supply chains where certification is the norm. Trade also encourages formal and informal interactions among business actors from different countries. These interactions serve as information channels through which technical knowledge and experiences about organizational practices can be exchanged. Through these channels, firms that export are likely to gain access to information on the implications and benefits of certification.

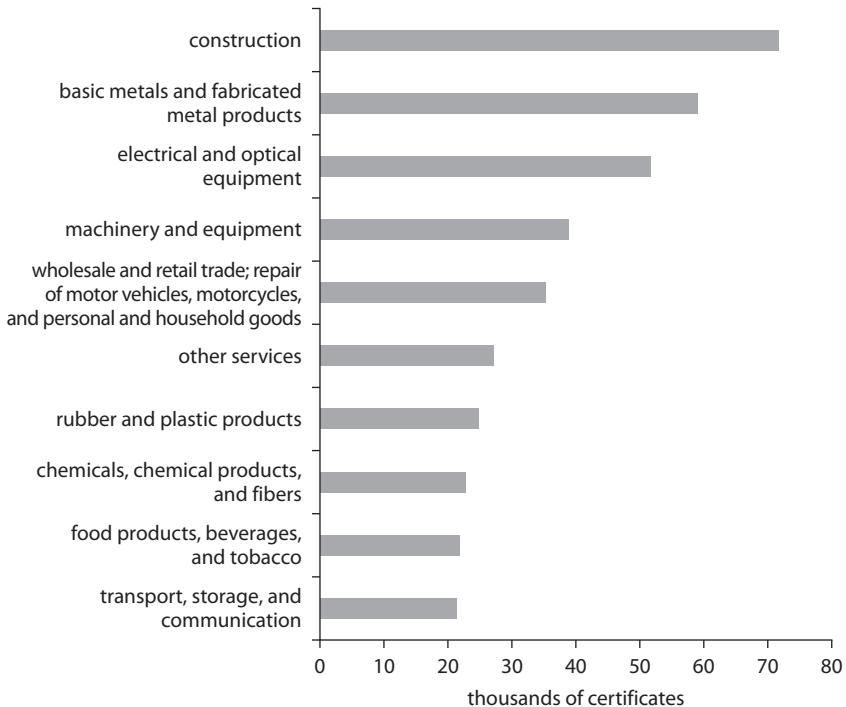
Countries that export a large share of their output have greater incentives to become certified, especially when they export to regions where certification is already widespread, such as the European Union. Two panel data studies of certification and bilateral trade by Guler, Guillén, and Muir Macpherson (2002) and Neumayer and Perkins (2005) show that trade with countries that have high certification rates has a positive effect on domestic certification. Using annual ISO 9000 certificates in 34 countries over the 1993–98 period, Guler, Guillén, and Muir Macpherson find that the number of certificates significantly increases when countries have strong trade ties with other countries that have a high number of certificates. Neumayer and Perkins find that the number of ISO 9000 certificates in 130 countries over the 1995–2001 period is positively correlated to exports to a market with a high number of certificates (in this case the EU).

Grajek (2004) investigates the directions of causality between certification and trade, using data ranging over 1995–2001 and covering 101 countries.⁴ His regressions confirm that while ISO 9000 does in fact increase bilateral exports, there is also a positive effect of foreign customers' adoption of ISO 9000 on domestic adoptions. Albuquerque, Bronnenberg, and Corbett (2004) use an ISO diffusion model on 56 countries over nine years to examine cross-country influences. They find bilateral trade flows to be a strong determinant of cross-country influences in ISO 9000 adoption. Corbett (2003) combines firm-level and country-level data for nine countries in another diffusion model to explore global ISO 9000 adoption mechanisms. Corbett first shows that Europe has the highest proportion of customers requiring ISO 9000 certification, followed by North America and Japan, then Asia, South America, and Africa. The author then demonstrates that in countries considered to be late adopters of ISO 9000, firms

with higher exports to early-adopting countries (that is, the EU) tend to become certified earlier. Anderson, Daly, and Johnson (1999) use financial and accounting panel data for North American firms over a six-year period to show that industries exporting to Europe are more likely to seek certification. According to these authors, this is consistent with the greater role of ISO 9000 as a regulatory and customer requirement in the EU.

Type of sector and market structure. Although ISO 9000 is generic and can be applied to any organization, some industrial sectors have shown a greater preference for this standard and have adopted it more rapidly than others. This is in part because quality is a more important competition factor in some sectors than in others. For example, sectors like mining and agriculture generally do not rely on quality to compete, but on low production and transportation costs. ISO 9000 certification has been more prevalent in the manufacturing industry, where quality and safety are most important to output, and services are starting to represent an increasing share of certificates (figure 6.4). In 2000, manufactur-

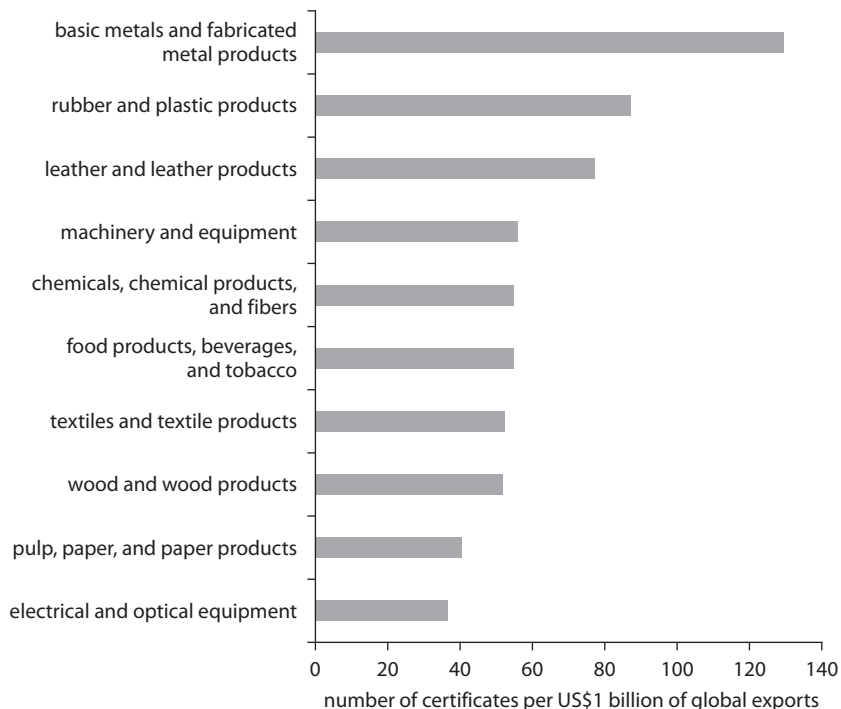
Figure 6.4 Top 10 Sectors Registering the Most Worldwide ISO 9000 Certificates, 2004



ing accounted for 64 percent and services for 25 percent of worldwide certificates (ISO 2001). Neumayer and Perkins's (2005) empirical study confirms the positive relationship between the share of the manufacturing sector in the economy and ISO 9000 diffusion rates.⁵

Figure 6.4 displays aggregate numbers of worldwide certificates by sector. However, these data must be interpreted carefully because they do not appropriately represent the relative importance of certification in a particular sector. A large number of certificates in a sector may simply reflect the economic size of the sector or the degree of atomization. Certification intensity within a sector could be better captured by standardizing the number of certificates by number of productive facilities or the level of economic output. Unfortunately, global data on output and facilities are neither available nor reliable for many countries. Nonetheless, for tradable goods, the number of worldwide ISO 9000 certificates can be standardized by global export volume, as shown in figure 6.5. Again,

Figure 6.5 Top 10 Sectors Registering the Most Worldwide ISO 9000 Certificates, Standardized by Global Export Volume, 2004



in terms of traded goods, manufactured products appear to exhibit the highest certification intensity.

Some industries may exhibit low rates of ISO 9000 certification because they use other quality system standards. These include standards such as Hazard Analysis and Critical Control Point (HACCP), which addresses food safety, and an increasing number of sector-specific quality management standards based on ISO 9001, such as QS 9000 and ISO/TS 16949 in the automobile industry, TL 9000 in the telecommunications industry, and ISO 13485 for the medical instrument industry.

The average size of firms in a sector affects the number of certificates. Micro, small, and medium enterprises generally show less propensity to adopt ISO 9000 than large firms. Not only do small enterprises have fewer financial and human resources to implement quality management system techniques, but they are also generally less aware of quality issues and more resistant to change. Furthermore, ISO 9000 implementation and certification costs represent a larger percentage of total turnover in smaller firms, and it takes longer before benefits are captured (Schuurman 1997). These factors provide disincentives for certification in sectors dominated by SMEs.

Type of market players. The presence of transnational corporations (TNCs) supports the diffusion of ISO 9000 in an economy. TNCs often originate in developed countries where certification is widespread. These firms operate using best-practice organizational forms and their corporate strategies often require them and their subsidiaries to implement ISO 9000 (Schuurman 1997). Thus, the mere presence of foreign affiliates can be expected to create a local demand for certification.

But TNCs also encourage ISO 9000 adoption in other ways. Much like foreign importers, TNCs operate at high international standards of quality and demand that their local suppliers also become certified.

Furthermore, TNCs are recognized for their superior management practices and viewed as models by local organizations (Mendel 2000). Local firms will be inclined to mimic the organizational practices of TNCs because these practices are seen as fostering success. Moreover, the interaction of foreign affiliates with foreign peers and local organizations will facilitate the transfer of technical knowledge across borders. Finally, TNC personnel gaining employment in domestic firms or spinning off their own companies will have been acquainted with the culture of quality and will act as channels of knowledge transfer on ISO 9000 quality management systems.

A few empirical studies have demonstrated the effect of TNCs on ISO 9000 diffusion. Using panel data on global ISO 9000 diffusion, both Guler, Guillén, and Muir Macpherson (2002) and Neumayer and Perkins (2005) found a statistically significant relationship between the presence of foreign multinationals and the number of ISO 9000 certificates.⁶ The presence of foreign multinational corporations was proxied by the value of inward foreign direct investment stock.

In many countries, the government has been an important market force for the diffusion of certification. Governments have played the roles of both supplier and producer in many of the industries that provided the initial thrust for certification, such as energy, defense, and telecommunications equipment (Guler, Guillén, and Muir Macpherson 2002). Government agencies throughout the world now require their contractors to become certified. Even in the United States, considered a late adopter of ISO 9000, the Department of Defense, the Department of Energy, the Food and Drug Administration, and the National Aeronautics and Space Administration all require ISO 9000 certification from their large contract suppliers (Rao, Ragu-Nathan, and Solis 1997; Guler, Guillén, and Muir Macpherson 2002).

The economic environment

Supply and demand characteristics are not alone in influencing the diffusion of ISO 9000. The economic environment in which firms operate plays a significant role in creating quality awareness and shaping incentives for certification.

Government regulations. Regulations can act as significant incentives for certification, but they can also be a deterrent if they increase business risk. The ISO 9000 standard's rapid adoption in Europe was partly the result of harmonized regulations from the 1992 European Community Single Market Initiative (Grajek 2004; Guler, Guillén, and Muir Macpherson 2002; Mendel 2000; Anderson, Daly, and Johnson 1999). In these trade directives, the EU mandated minimum quality requirements of products and production processes affecting public safety. In most cases, ISO 9000 registration was accepted as a valid conformity assessment procedure. These legal rules turned ISO 9000 into a marketing instrument for suppliers, who themselves imposed certification requirements down their supply chains. However, government regulations can also hamper certification. An excessive or unpredictable regulatory burden can be expected to discourage the types of long-term investments needed to implement a quality management system.

Government support programs. Governments can also promote the diffusion of certification through awareness and support programs. These may include quality awareness campaigns, training, technical assistance, and financial assistance programs for the implementation of quality management systems. Governments have mounted major national campaigns for ISO 9000 certification in many developed and high-growth economies such as the United Kingdom, the EU, Japan, and countries in the Association of Southeast Asian Nations (Mendel 2000).

Prior certifications. The number of past ISO 9000 adoptions has an important impact on the rate of certification. A large domestic base of certified organizations is likely to create a high demand for certification because certified organizations often require their own suppliers to become certified as well. A large base of certified organizations also reduces implementation costs by enhancing the supply of information on ISO 9000 and increasing the number of complementary services such as training programs, quality consultants, auditors, and certification bodies. In fact, Neumayer and Perkins (2005) include past certificates as a lagged dependent variable in their empirical study. They find a bandwagon effect through which certification in one year positively affects certification in the following year.

Education. Education levels are likely to affect the cost of implementing a quality management system. Employees need solid basic education skills to benefit from the training programs necessary to implement ISO 9000. A more educated workforce will be able to implement the requirements for ISO 9000 more quickly and effectively, and they may also have more prior knowledge about organizational practices. Again, Neumayer and Perkins's empirical work shows a statistically significant relationship between secondary school enrollment rates and ISO 9000 diffusion.

The Indian software sector provides a good example of the drive by firms to adopt ISO 9000 quality certification and other standards (box 6.2). In particular, the sector has shown a clear understanding of the need to develop skilled human capital.

Box 6.2**Quality Adoption in the Indian Software Sector:
Moving Up the Value Chain**

The leading Indian firms have moved up the value chain in software services, developing organizational and managerial capabilities that enable them to offer more comprehensive services than merely low-cost programming. One sign of maturity is that the industry increasingly procures fixed-price contracts, rather than the time-and-materials contracts of earlier years. With the greater risk of fixed-price contracts comes flexibility in organizing work, greater management control, and an opportunity to earn higher returns as efficiency improves.

Revenue per worker is increased, indicating a move up the value chain—from an average of \$9,000 in fiscal 1995/96 to \$20,500 in 2000/2001—but revenues are still lower than what they are in product-based companies.

In order to build client value, companies have expanded their capacity to service a wider range of software-development tasks, as well as to move into new services, such as product design and information services outsourcing. Software development includes analysis and specification of requirements, software design, writing and testing of software, and delivery and installation. Indian companies are trying to move beyond only writing and testing, which require the least skill and account for only a small portion of the overall project costs, to higher skill levels that require deeper business knowledge of the industry for which software solutions are being developed.

In their quest to climb the value chain, India's software firms ensured product quality and reliability by adopting internationally recognized standardized work processes. An increasing number of firms have met international certification requirements for key quality standards. For many, this was an exercise in brand building, but the processes and procedures put in place left their hallmark on the quality of software products and services.

Firms seek certification from various sources, beginning with quality management practices that meet ISO 9000 standards to ensure consistent and orderly execution of orders. The next stage focuses on software engineering and certification under the People Capability Maturity Model (CMM) framework of the Software Engineering Institute (SEI) at increasing levels of process maturity. Another stage focuses on aligning internal practices with the CMM, which is a framework to guide attracting, motivating, and retaining a talented technical staff. The Six Sigma methodology ensures end-to-end quality across all company

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Box 6.2**Quality Adoption in the Indian Software Sector:
Moving Up the Value Chain—*continued***

operations and focuses on improved customer satisfaction by reducing defects, with a target of virtually defect-free processes and products. As of December 2003, India had 65 companies at SEI CMM Maturity Level 5. In October 2002, the SEI of Carnegie Mellon University published a list of high-maturity organizations as part of its Survey of High Maturity Organizations and High Maturity Workshop research. The full set of 146 high-maturity organizations includes 72 Level 4 organizations and 74 Level 5 organizations. Of the 87 high-maturity organizations assessed outside the United States, 77 are in India.

Because most Indian software firms are export-oriented and serve clients around the world, meeting globally acceptable frameworks and standards has been critical to validating their credentials to new clients, who often demand that vendors adopt ISO and CMM standards.

The reasons for the success of the quality improvements can be grouped in three categories: people-based, business-related, and management-related (Jalote 2001). The Indian software industry primarily delivers services, which have embraced globally software-process improvement (SPI) more than those who deliver products. As Indian companies serve worldwide clients who demand that their vendors adopt standards such as ISO and CMM, companies were motivated to certify their credentials and used these frameworks to also deliver real software-process improvement. As companies moved to an offshore model, SPI became a necessity to succeed. Managing subcontracted work typically requires monitoring structures to contain risk. This imposes a degree of formality at the interface between the users and developers—something that is generally hard to achieve with in-house development.

For most organizations, software development is their core competency that must be continually improved. Their high-growth trajectory required the infusion of a large number of new engineers every year. Without tightly controlled processes, it would have been impossible to absorb new recruits into the development process quickly. Since the cost of manpower was not very high in India, it was possible for most companies to dedicate a team for its SPI effort. A survey of high-maturity organizations in India indicated that most companies had dedicated manpower for SPI equal to about 1 to 2 percent of their engineering manpower (Jalote 2001).

Most of the software companies in India are very young. Being followers in the software-development process, they could exploit the collective knowledge and

experience of organizations the world over in implementing SPI. Most companies introduced quality systems very soon after they were formed. This ensured that the company had work standards to which each new entrant had to conform. After that, the company, people, and quality systems all matured together. As the people in the company have contributed actively to the SPI movements from the early days, it induced among the practitioners a sense of ownership for the quality system.

Software companies attract the best talent from engineering schools. Some of the CMM lead assessors have observed that the scores on the Myers-Briggs personality tests conducted as part of the capability appraisals often indicate that Indian engineers are different from their counterparts in the United States. Indian employees are ambitious and look for improvement in the way the organization works, which creates a need for process orientation. The average age of the Indian engineers is in the 20s and that of managers is late 20s to early 30s. Younger professionals are more receptive to change, as they have not invested in traditions and, indeed, want changes.

Indian culture is more family-oriented rather than individualistic. This prompts people to conform to established frameworks and systems. Professionals do not mind being measured. There are fewer privacy concerns, and in-house surveys have indicated that most engineers are more concerned about the nature of work and the overall work environment and not so much about being measured. The software background of top managers helps to secure backing from senior management for SPI initiatives.

Most of the facilitating factors are based in more general and societal contexts. Such factors are hard to emulate once the context changes. The government had little role to play in this movement. India does not have centers along the lines of the U.S. or European software engineering institutes. The Ministry of Information Technology in India did bring in the world's best Software Testing and Assessment of Software Maturity through licensing arrangements with the Software Engineering Institute at Carnegie Mellon University. Under this agreement, the Indian Standardization, Testing, and Quality Certification (STQC) Directorate of the Ministry of Information Technology undertook the job of certification, testing, and training of trainers and assessors in India.

The increasing importance of outsourced information technology (IT) services from developed countries prompted many clients to voice concerns about data protection practices of service providers. Issues of data confidentiality, integrity, and availability have come to the fore. The latest EU data protection laws are designed to ensure that personal data of EU citizens are not sent to a country that has less stringent legal protection.

Box 6.2**Quality Adoption in the Indian Software Sector:
Moving Up the Value Chain—*continued***

Clients are also demanding adherence to security standards to ensure information security.

The government of India and NASSCOM [National Association of Software and Service Companies] are working closely to respond to these concerns. The government introduced clauses in its IT Act of 2000 covering privacy, digital signatures, and cyber crime to meet EU requirements. More generally, the government strengthened software testing and assessment capabilities in India, in association with some of the leading organizations internationally. The Ministry of Information Technology set up the STQC directorate to train assessors and implement security standards. An Information Security Technology Development Council has also been set up to promote research in the area of information security.

Research and development

To secure ultimate success the efforts on quality and standards need to be complemented with appropriate R&D expenditures. Those expenditure amounts have been and continue to be small, with some increase in recent years. Low R&D expenditures can partly be explained by the service (instead of product) focus, which would require greater investment in R&D.

The bulk of R&D occurs in subsidiaries set up by multinationals.

As a cost reduction strategy, a number of large and medium product companies started captive development centers in India. Other companies have partnered with Indian firms to set up product development centers, and still others are outsourcing to India functions such as requirement specification, design, testing, and maintenance. The availability of capable and low-cost Indian technical expertise, coupled with the deep financial resources of the multinationals, provides for cost-effective R&D. However, as multinationals increasingly distribute R&D or product development operations globally, they become less likely to develop whole products in a single place such as India.

Indian firms were reluctant to invest in product development because they lacked resources and expertise and, more importantly, because of the difficulties in designing products for distant and unfamiliar markets. Even when firms have the resources, they find it hard to justify the high risks of product develop-

ment. The risks are much lower in providing services than in selling product, in part because of the lower level of skill and financial risk.

In the software industry, product development is a small component of the overall costs of developing and promoting software products. Software firms may spend as much as 50 percent of revenues on advertising and marketing and as little as 10 to 15 percent on product development.

There are few examples of successful product development by Indian software companies. For the industry as a whole, only 1 to 5 percent of the software packages typically succeed in the market. Only recently have Indian companies reached a size and maturity to consider investing in R&D and marketing. One successful example to date consists of products developed by Indian companies for the banking sector.

Indian software companies as learning organizations

Tschang, Amsden, and Sadagopan (2001) examined the different ways in which upgrading takes place in the Indian software industry.

They used the R&D classification of pure, basic, and applied research to differentiate different firms' technological abilities and functions. They found sufficient evidence of firms upgrading to the applied-research stage—itsself an achievement, since it involves more conceptual work or longer-term efforts at research. The two highest levels of research—pure science and basic research—are almost nonexistent in India, especially in domestic firms. This shows that the nature of the industry is “applied,” “service-oriented,” or “incremental” in its innovation. The technologies developed are typically not breakthroughs, but are rather first implementations, involving “transforming, varying, and reapplying” known techniques to the software product under design.

The model of upgrading into products is perhaps the most difficult task, given the many reasons for failure. There is a paucity of success stories. The leaders of domestic firms who went into products, including those who left Wipro, Satyam, and other service companies to build their new enterprises, all noted that they had a different mentality and business objective in mind. Their goal was to build products or to create a fundamentally new service. Their plans would not have materialized if they remained in their former software service firms. Each new start-up may have also been trying to find a defensible or competitive niche within the Indian software industry.

Many firms are discouraged from trying the product market because of the distance from the final market and lack of sufficient resources or expertise at

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Box 6.2**Quality Adoption in the Indian Software Sector:
Moving Up the Value Chain—*continued***

the outset. Service companies have resources, but find it hard to justify risk taking when they have such nice returns. Ultimately, even firms that break into the product market can stumble and fall. Ramco was an example. The shortage of this risk-taking attitude across the broader industry, coupled with resource and distance-from-market constraints, will make it difficult for more product firms to emerge. Unless all these factors change, it is unlikely that the Indian industry as a whole will change its complexion to one with more diverse models of upgrading.

The Indian service companies are clearly following a trajectory laid out by their original competencies, continuing to dominate the larger part of the services value chain all the way back to the requirements analysis and consulting stages.

The emergence of the specialized services model, such as Mindtree's contract R&D service, shows that the Indian industry does have its own style of promising entrepreneurial capabilities and the resourcefulness to develop a wider variety of areas.

Ultimately, the running of multinational subsidiaries on a cost center basis (and the continued tradition of defining product requirements elsewhere) will constrain these subsidiaries from promoting new ideas or products locally. This pattern is different from domestic firms, which run as profit centers, giving them both heavier responsibility and greater scope for doing challenging work. In summary, both domestic firms and multinationals appear to be able to upgrade to applied research, but the business models themselves suggest that the domestic firms have broader scope to do products, if they so choose. Those local firms may engage in a broader range of R&D, though not necessarily the most advanced technologies.

The Indian product company Sassken built a large R&D arm to research technologies for making the "first implementation" of a communication standard (high-level and detailed design). That effort can be considered to involve both (a) "learning" in applied research and (b) implementation in models of applied research.

The same kind of learning and concept modeling in applied research has been done at the CMC, one of India's earliest software companies set up by the national government. CMC had to design systems from scratch, many of which had social objectives, such as India's first railway reservations system, perhaps the most complicated systems endeavor ever undertaken in India.

Source: Excerpted from Bhatnagar 2006.

CHAPTER 7

Standardization in Latin America

The issues described in the first half of this book are relevant to all developing countries. They are particularly essential, however, for middle-income countries and for countries that have chosen exports as a key strategy for economic growth. Countries are taking a number of measures to improve their national quality systems, but most often these measures are not systemic and coherent enough to provide the desired result. Rather, they tend to produce fragmented and incomplete systems. This is the case for most countries in Latin America and the Caribbean (LAC). The second half of this book focuses on that region to illustrate what developing countries typically are doing in this area and the issues and problems of the existing systems. The region was chosen for its abundance of middle-income countries, most of which are choosing export promotion as a key engine for growth.

We begin with an assessment of the national standardization systems in Latin American countries, with a particular focus on industrial voluntary technical standards. We review the standard-setting institutions in a number of countries in the region, as well as in several benchmark countries outside the region, and compare their structure, role, functions, and resources. We evaluate the performance of these institutions in terms of the number of standards produced, their scope, and their overall potential for diffusion in the economy. While the number of standards may be the most readily available performance indicator, it does not reflect the quality of the standards being adopted. The international integration of a country's standardization system, also covered in this section, provides valuable additional insight on the quality of national standards in Latin America.

The discussion in these chapters draws on a survey of national conformity assessment institutions conducted by the authors in a number of mostly Latin American countries (hereafter referred to as *authors' research*). Questionnaires were sent to national standardization, accreditation, and metrology bodies in Argentina, Brazil, Colombia, Ecuador, Mexico, Peru, and Turkey. The aim was to obtain direct information and a comprehensive understanding of institutional characteristics, quality, and performance by focusing on issues such as scope, governance, autonomy, personnel, finances, activities, facilities, international integration, and recognition, and adherence to best practices. This information was complemented by legislative and regulatory research and online information available from national, regional, and international conformity assessment organizations.

The Standards-Setting Institutions

The organization of standards-setting

There is no dominant model for the organization of standardization activities in Latin America. Countries have adopted and combined different types of systems, all more or less attached to the public sector with various degrees of decentralization (table 7.1). Where the primary standards bodies are part of the public sector, they usually operate as autonomous agencies. In the cases of Ecuador and Peru, the standards body is attached to a government ministry but operates autonomously.

Table 7.1 Characteristics of the National Voluntary Standards Bodies

<i>Country</i>	<i>Primary voluntary standards body</i>	<i>Legal status</i>	<i>Degree of centralization (voluntary standards)</i>
Argentina	IRAM	private	centralized
Brazil	ABNT	private	centralized
Chile	INN	private	hybrid
Colombia	ICONTEC	private	hybrid
Ecuador	INEN	public	centralized
Mexico	DGN	combination	decentralized
Peru	INDECOPI	public	centralized
Korea, Rep. of	KATS	public	hybrid
Spain	AENOR	private	centralized
United Kingdom	BSI British Standards	private	centralized

Source: Authors' research.

In Chile, the National Standardization Institute (INN) is a private-law organization but was originally established by CORFO, an autonomous economic development agency attached to the Ministry of Economics. At the other end of the spectrum, the standards bodies in Argentina, Brazil, and Colombia originate in the private sector. They operate as private nonprofit organizations but are officially recognized as national standards bodies through government decrees or resolutions. In return for official recognition, these bodies must adhere to legislation on national standardization.

There is no systematic preference for a centralized or decentralized system in Latin America. In Mexico, the primary national standards body, the General Bureau of Standards (DGN), is deeply integrated in the national government and operates as a department of the central government's Ministry of the Economy. However, Mexico operates on a highly decentralized model of standardization and the DGN is mainly concerned with mandatory standards, developing voluntary standards in exceptional circumstances only. Voluntary standards are developed by private sector organizations registered with the Ministry of the Economy. In contrast, Argentina and Brazil have adopted highly centralized systems much like those of their European counterparts. Chile and Colombia have adopted a hybrid version of standards-setting, with the responsibilities for standards development distributed between a primary national body and sectoral organizations.

Standards bodies in Latin America are usually involved in a host of activities. None confine themselves to developing voluntary standards (table 7.2). In some countries, the national standards body also develops mandatory standards. Some Latin American countries have a single public institution performing national standardization along with metrology or accreditation functions or both. Integrating metrology and accreditation with national standardization is not the norm in most developed countries but often occurs in small countries or countries where the standards infrastructure is not mature.¹ However, many of the standards bodies in Latin America perform certification, testing, or calibration tasks, which is also the case in many standards bodies throughout the world. In Mexico, where the standardization system is very decentralized, the primary standards body, the DGN, focuses on mandatory standards; a number of independent standards bodies develop voluntary standards while also participating in testing, certification, and training activities. Most Latin American countries also offer training services in the area of voluntary standards.

Table 7.2 Activities of Standards Bodies

<i>Country</i>	<i>Mandatory standards</i>	<i>Accreditation</i>	<i>National metrology</i>	<i>Calibration and testing</i>	<i>Certification</i>	<i>Training</i>
Argentina	no	no	no	no	yes	yes
Brazil	no	no	no	no	yes	yes
Chile	yes	yes	yes	no	no	yes
Colombia	no	no	no	yes	yes	yes
Ecuador	yes	no	yes	yes	yes	yes
Mexico: DGN	yes	no	no	no	no	no
Mexico: others	no	no	no	yes	yes	yes
Peru	some ^a	yes	yes	yes	no	no
Korea, Rep. of	no	yes	yes	yes	yes	no
Spain	no	no	no	yes	yes	yes
United Kingdom	no	no	no	no	yes	yes

Source: Authors' research.

Note: a. Only legal metrology.

Table 7.3 presents the share of personnel in standards bodies involved in developing standards. This proportion is low in some countries, such as Colombia, Ecuador, and Peru, suggesting an important role for complementary activities in these organizations. Chile is an exception, with 75 percent of INN's personnel involved in standardization activities.

Table 7.3 Proportion of National Standards Body Staff Involved in Standardization Activities

percent

<i>Country</i>	<i>Proportion of staff involved in standardization activities</i>
Brazil	30
Chile	75
Colombia	14
Ecuador	15
Peru	2

Sources: Authors' research; INN Web site.

Note: Uses 2004 data for Brazil, Colombia, Ecuador, and Peru; 2002 data for Chile.

Governance and autonomy

All of the private bodies and some of the autonomous public bodies are governed by executive councils elected through a general assembly of members (table 7.4). In some cases, a number of seats on the executive council are reserved for government appointees. In the cases of Chile and Peru, there is no general assembly and all council members are nominated by the central government. While Peru has a consultative council to represent the interests of the public, private sector representation is limited to technical committees in Chile. Peru is the only country in Latin America where the executive director is directly appointed by the government.

The standards bodies operate with a substantial level of technical autonomy from the government. In general, the bodies have full authority over the standardization process, they are free to formulate their own budget, they are not affected by government staffing policies, they may diversify their services (as long as it does not affect their ability to act as a standards body), and they may engage in international negotiations. There are some exceptions, such as in Ecuador, where salaries are subject to public sector restrictions. Regardless of the level of autonomy of the organization, each country has laws and decrees articulating the obligations or activities of its standards bodies.

Table 7.4 Private Sector Participation in the Governance of Standards Bodies

<i>Country</i>	<i>General assembly</i>	<i>Consultative council</i>	<i>Share of executive council members appointed by government (%)</i>	<i>Executive director appointed by government</i>
Argentina	yes	no	0	no
Brazil	yes	no	10	no
Chile	no	no	100	no
Colombia	yes	yes	33	no
Ecuador	yes	yes	71	no
Mexico ^a	yes	yes	0	no
Peru	no	yes	100	yes
Korea, Rep. of	no	yes	100	yes
Spain	yes	no	0	no
United Kingdom	yes	yes	0	no

Sources: Authors' research; Web sites of the national standards bodies.

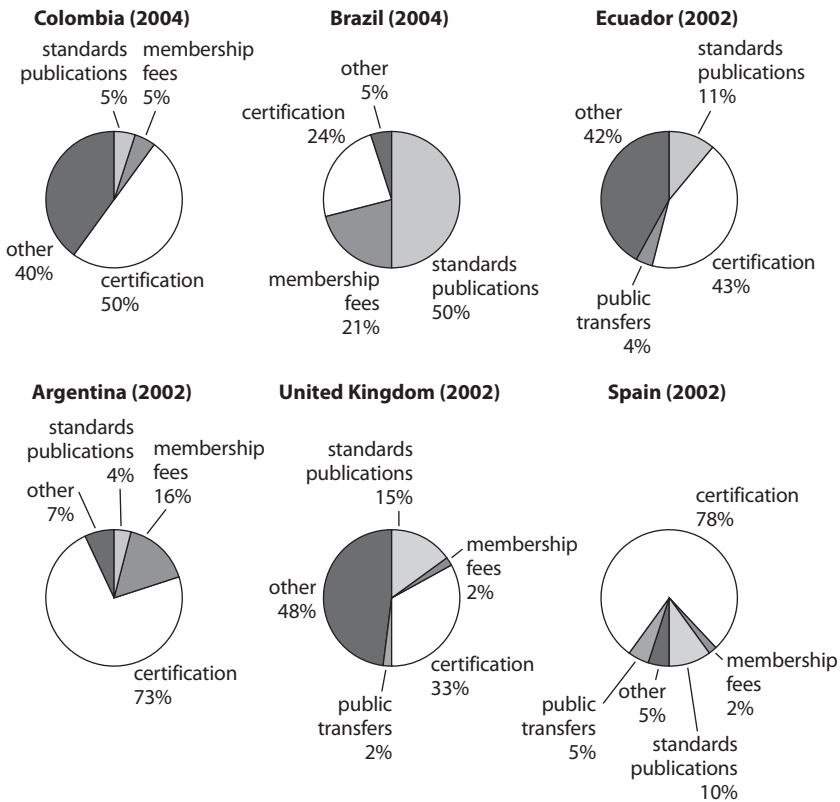
Note: a. In the case of Mexico, information is given for the private standards bodies (*organismos nacionales de normalización*).

The standards development process in most Latin American countries is conducted according to international norms. The general public may propose standards development projects to the standards body. Standards drafts are then developed by technical committees through a consensus process. In most cases, standards projects and drafts are approved by committees of experts representing different societal and economic interests. Colombia and Ecuador differ from this practice in that the executive council of the standards body needs to approve each standard. In Chile, the standards must be approved by a relevant government ministry.

Resources for standardization

Although there is significant variability in the main sources of funding for Latin American standards bodies, most of them depend only minimally on public transfers (figure 7.1).² In Latin America the public funding devoted to support for standards bodies is practically nonexistent. The other two activities more directly related to standardization, publication sales and membership fees, do not play an important role either. As is typical throughout the world, standards publications account for only a small fraction of the revenues of the standards bodies surveyed, except in Brazil, where they constitute 50 percent of the revenues of the Brazilian Technical Standards Association (ABNT). There is great variability in the extent to which the standards bodies in Latin America generate income through membership fees. In Chile, INN is not a membership organization and thus derives no revenues from membership fees. In Colombia, membership fees account for a small portion of total revenues, as in Spain and the United Kingdom. In contrast, in Argentina, Brazil, and especially in Peru, membership fees account for a significant portion of income. Standards bodies that offer certification services depend on them for a large share of revenues; this is true of the Colombian Institute for Technical Standards and Certification (ICONTEC) and the Argentine Institute of Standardization and Certification (IRAM). The case of Mexico is more complex because it is essentially a decentralized system. The primary standards body is integrated in the Ministry of the Economy and depends solely on public funding. The private national standards bodies (*organismos nacionales de normalización*) do not receive public funding for standardization purposes. Their funding comes from membership fees and services.

Although it is difficult to evaluate the total resources for standards development based solely on the budgets of the primary standards bodies, Latin American countries appear to dedicate relatively few funds

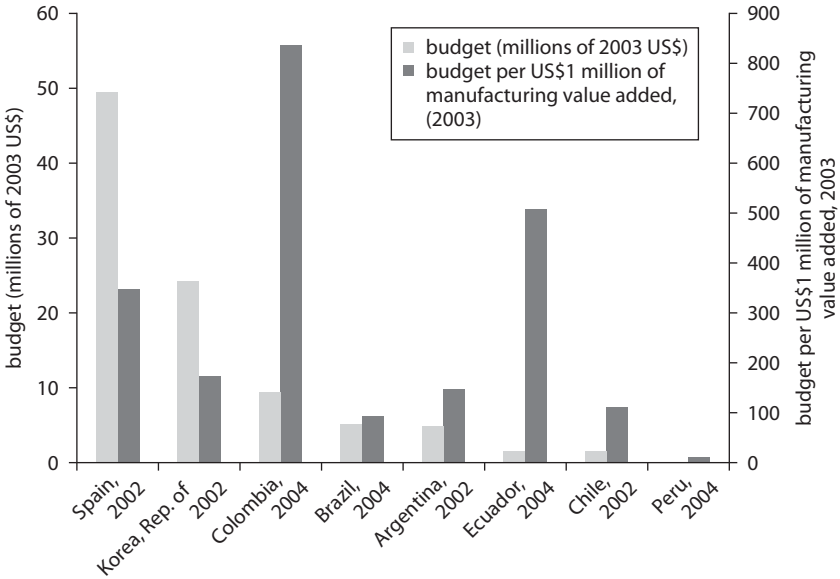
Figure 7.1 Funding Sources of the National Standards Bodies

Sources: ISO 2003a; authors' research.

to this activity. Figure 7.2 shows the budgets of the different standards bodies. The budgets for the United Kingdom (not shown), Spain, and Korea are several times larger than those of Latin American countries. Because most standards affect manufactured goods, standardizing institutional resources by manufacturing value added facilitates cross-country comparisons. In terms of standardized budgets, Colombia and Ecuador dramatically outperform Spain and Korea, while other Latin American countries lag behind.

However, the budget of the standards body is not necessarily a good reflection of the resources for standardization activities because an important part of the budget may be dedicated to complementary activities such as certification and testing. Furthermore, in decentralized standardization systems, organizations other than the primary standards body

Figure 7.2 Budgets of the National Standards Bodies



Sources: ISO 2003a; authors' research.

may be providing many of the resources for national standards development. Finally, standardizing the budget by the manufacturing value added allows for a rather imperfect comparison of resources. Even if a country performs little manufacturing activity, its population will still consume manufactured goods and there will still be a need for a certain number of standards.

Likewise, it is difficult to compare national resources devoted to standardization by comparing the number of staff in the national standards bodies because some staff members may be involved in activities other than standardization. In some countries, the decentralization of standards setting also involves the use of staff in other organizations. Table 7.5 provides an indication of the resources used in developing national standards by examining staff in the entire standards body and the proportion of staff members dedicated uniquely to standardization activities. In this table, a comparison of the standardization staff, relative to manufacturing value added, brings out the relatively low number of personnel involved in standardization activities in Brazil and Peru. In both of these countries, the development of standards is centralized and one would expect a large number of staff in the national body rather than a low number.

Table 7.5 Staff of the National Standards Bodies

<i>Country</i>	<i>Total permanent staff</i>	<i>Number of staff involved in standardization activities</i>	<i>Number of staff involved in standardization activities, relative to 2003 manufacturing value added</i>
Argentina	170	n.a.	n.a.
Brazil	70	21	0.39
Chile	53	40	3.45
Colombia	200	28	2.54
Ecuador	89	13	4.46
Peru	149	4	0.36
Korea, Rep. of	244	n.a.	n.a.
Spain	469	n.a.	n.a.
United Kingdom	5,788	n.a.	n.a.

Sources: ISO 2003a; authors' research.

Note: 2004 data for Brazil, Colombia, Ecuador, Peru, and the United Kingdom; 2003 data for Spain; 2002 data for Argentina, Chile, and Korea. n.a. = not available.

Mandatory standards and technical regulations

The share of mandatory standards produced by the national standards bodies has decreased in some countries and increased in others. Table 7.6 shows the shares of mandatory standards in the total number of standards developed by the standards bodies in 1990 and 2002. In Brazil and Colombia, the national standards body does not develop mandatory standards. This does not imply that they have no national mandatory standards, but simply that these are the responsibility of a separate governmental entity. In Peru, the only mandatory standards published by the national standards body relate to legal metrology. Although Argentina has a larger share of mandatory standards than Brazil, Colombia, or Peru, the Argentine standards body, IRAM, does not have a mandate to publish mandatory standards. Rather, the government sometimes incorporates its voluntary standards in national law, effectively rendering them mandatory. Mexico has an even larger proportion of mandatory standards, which are the responsibility of the primary standards body, the DGN. In Ecuador and Chile, the proportion of mandatory standards is quite high. However, while their share has been reduced drastically in Ecuador, from 95 percent in 1990 to 25 percent in 2002, the change has occurred in the opposite direction in Chile, where 40 percent of standards are now mandatory, which is high by international standards.

Table 7.6 Share of Mandatory Standards in Total National Standards, 1990 and 2002

percent

<i>Country</i>	<i>1990</i>	<i>2002</i>
Argentina	5	9
Brazil	7	0
Chile	30	40
Colombia	8	0
Ecuador	95	25
Mexico	4	15
Peru	1	1
Korea, Rep. of	0	0
Spain	n.a.	20
United Kingdom	n.a.	0

Sources: Stephenson 1997; ISO 2003a.

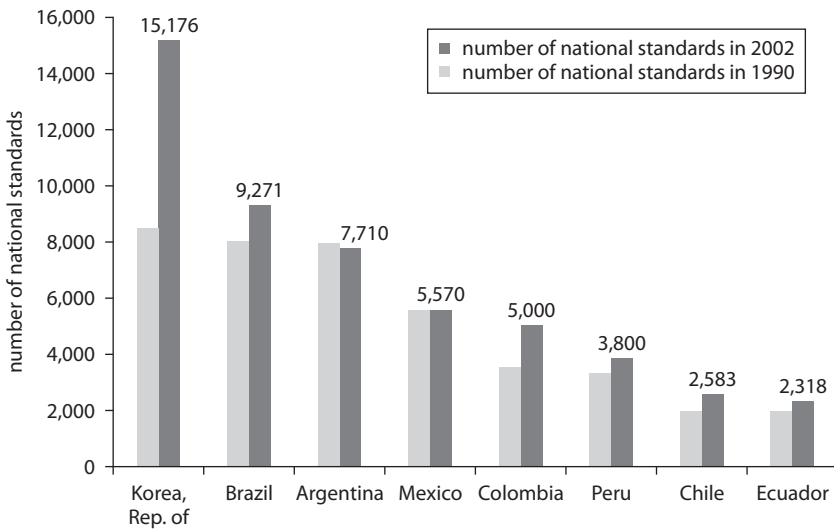
Note: n.a. = not available.

The Performance of Standards Bodies

Standards development activities

Most of the surveyed Latin American countries have increased their stock of standards since 1991, but not at a rate comparable to developed countries. As can be seen in figure 7.3, Argentina and Brazil had nearly the same number of standards as Korea in 1990 but were lagging far behind about a decade later. While the stock of standards nearly doubled in Korea between 1990 and 2002, and more than doubled in the United Kingdom between 1990 and 2003, most Latin American countries have seen their standards stocks increase by 16 percent or less during the 1990–2002 period (table 7.7). Colombia and Chile have had larger relative increases than their counterparts, although Chile started out with a very low number of standards in 1991. However, the net growth rate of the standards stock may hide much of the national standardization activity given that old standards may be eliminated while new standards are being created. If many of a country's standards are obsolete and are being eliminated at a high rate, then a low growth of the standards stock during a limited period does not necessarily imply that few standards are being developed.

Latin American countries lag far behind Korea, the United Kingdom, and Spain in terms of the number of new standards adopted in 2004.

Figure 7.3 Number of National Standards, 1990 and 2002

Sources: Authors' research; Web sites of the national standards bodies.

Table 7.7 Growth of the Standards Stock between 1990 and 2002
percent

United Kingdom ^a	Korea, Rep. of	Brazil	Argentina	Mexico	Colombia	Peru	Chile	Ecuador
124	79	16	-2	1	43	15	29	16

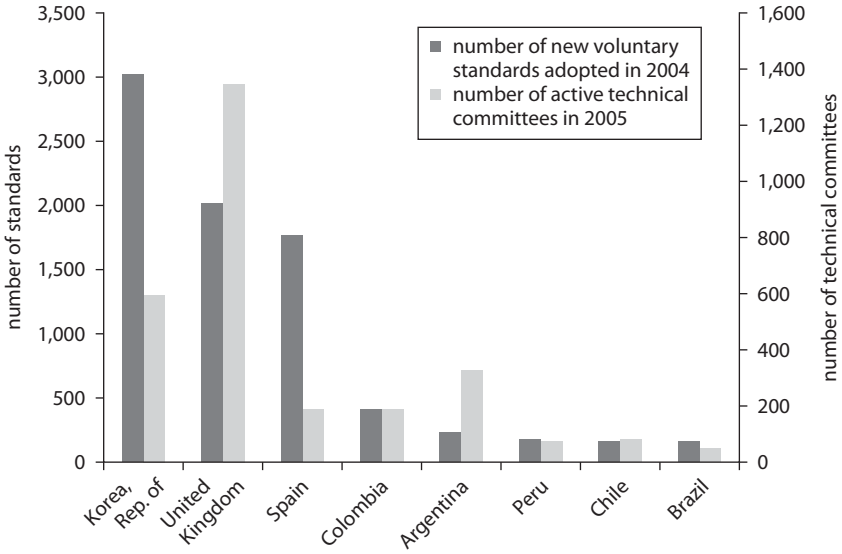
Sources: Stephenson 1997; ISO 2004; DTI 2005.

Note: a. 1990–2003.

Of those three countries, Spain developed the fewest standards in 2004, but still about four times more than Colombia, the best Latin American performer (figure 7.4). Surprisingly, Brazil, the largest economy in Latin America, adopted the fewest new standards in 2004.

Latin American countries have far fewer technical committees than the United Kingdom and Korea (figure 7.4). Argentina leads the Latin American group with more committees than Spain, followed by Colombia. The number of technical committees represents the number of technical areas in which standards are being developed. Generally, technical committees can develop many standards simultaneously, so more standards per committee may not necessarily be a measure of efficiency but may simply imply that there are more members in the committee.

Figure 7.4 Number of New Standards, 2004, and Active Technical Committees, 2005



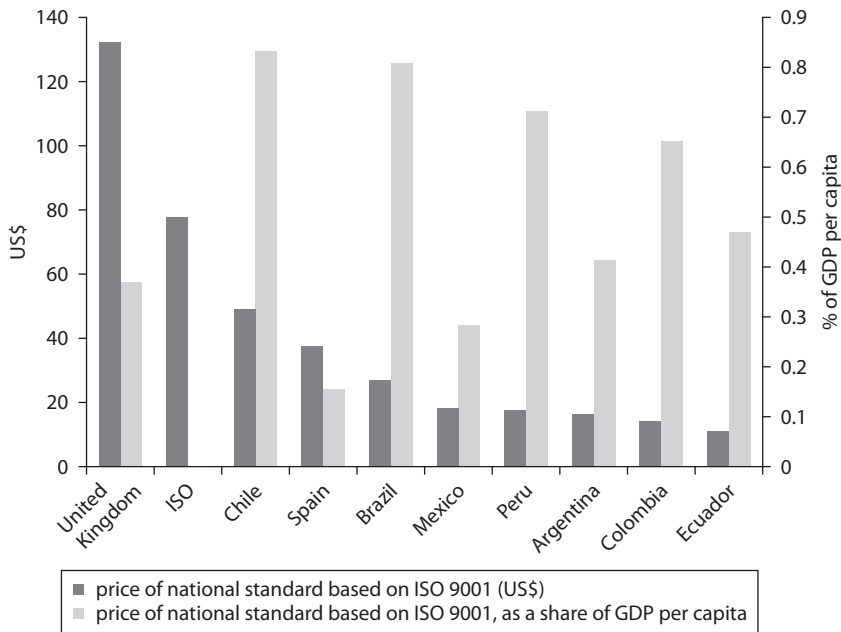
Source: Web sites of the national standards bodies.

The scope of technical activities covered by committees may also vary across countries, rendering comparisons of the number of committees less meaningful. For example, while there is one committee for PVC and another for plastic tubes in Chile, these two areas are covered by a single ISO technical committee at the international level.

The numbers of new and existing national standards and technical committees give a general idea of the performance of each standards body but cannot on their own lead to strong conclusions about the effectiveness of the standards. Standard statistics do not reflect the relevance of standards to the domestic industrial structure, their impact on technical change, and their impact on trade. Standards can actually impede growth if they are ill conceived. Hence, standardization statistics should be interpreted carefully.

Diffusion of standards

The price of written standards documentation in Latin American countries is relatively high. Although in most countries the price of a single standard would be relatively low for a small or medium enterprise, marginal increases in prices may become prohibitive when a business requires a large array of standards to compete. Figure 7.5 displays the cost

Figure 7.5 Price of National Standards Based on ISO 9001:2000

Source: Web sites of the national standards bodies.

of purchasing a national standard based on ISO 9001:2000 in different countries and from the International Organization for Standardization (ISO) itself. The ISO 9001:2000 standard is used as a proxy for the price of other national standards. The figure shows that while the average price of standards is lower in most Latin American countries than in developed countries such as Spain or the United Kingdom, this no longer holds true when prices are adjusted to reflect differences in per capita income. In this case, only national standards sold in Mexico remain competitive.

International Integration

Adoption of international standards

Most of the surveyed Latin American countries are full members of the organizations responsible for the development of most international standards (table 7.8). Peru is an exception. It is not a member of the International Electrotechnical Commission (IEC) and, as a correspondent member of ISO, it cannot take part in the development of ISO standards.

Table 7.8 Membership in International Standards Bodies

<i>Country</i>	<i>ISO</i>	<i>ITU</i>	<i>IEC</i>	<i>CODEX</i>
Argentina	yes	yes	yes	yes
Brazil	yes	yes	yes	yes
Chile	yes	yes	no	yes
Colombia	yes	yes	associate	yes
Ecuador	yes	yes	no	yes
Mexico	yes	yes	yes	yes
Peru	correspondent	yes	no	yes
Korea, Rep. of	yes	yes	yes	yes
Spain	yes	yes	yes	yes
United Kingdom	yes	yes	yes	yes

Sources: ISO, ITU, IEC, and CODEX Web sites.

Note: CODEX = Codex Alimentarius Commission; ITU = International Telecommunication Union.

Although progress is being made in some Latin American countries, others have incorporated very few international standards in their national standards. The evolution of international standard adoption rates shown in table 7.9 brings out the major differences in adoption rates across countries. Argentina and Ecuador have barely increased their extremely low share of international standards, while Brazil and Peru have seen dramatic increases. Colombia, the Latin American country with the most

Table 7.9 Evolution of the Share of National Standards Based on International Standards

percent

<i>Country</i>	<i>2002</i>	<i>2004</i>
Argentina	1	1
Brazil	4	30
Chile	25	n.a.
Colombia	27	35
Ecuador	1	2
Peru	5	22
Korea, Rep. of	46	n.a.
Spain	18	n.a.
United Kingdom	45	n.a.

Sources: ISO 2003a; authors' research.

Note: n.a. = not available.

international standards, was still far behind the United Kingdom and Korea in 2002.

Participation in international standards development activities

Latin American countries are not very active in the development of international standards. Brazil and Mexico, each with a larger economy than Spain's or Korea's, participate in far fewer ISO technical committees than Spain or Korea. When Latin American countries are members of ISO committees, it is mostly as observers rather than as participating members (figure 7.6). In particular, Argentina, Mexico, and Brazil are observer members of roughly 35 percent of the 734 ISO technical committees and subcommittees.³

Few international standards originate in Latin American countries. In the region, Brazil and Colombia take the lead in developing new international standards, as suggested by their higher numbers of technical committee secretariats and working group governorships (figure 7.7). However, they are for the most part leading working groups, which have responsibility for fewer standards than technical committees or subcommittees. Brazil, with the largest number of secretariats in Latin America,

Figure 7.6 Number of Participant and Observer Memberships in ISO Technical Committees and Subcommittees, 2005

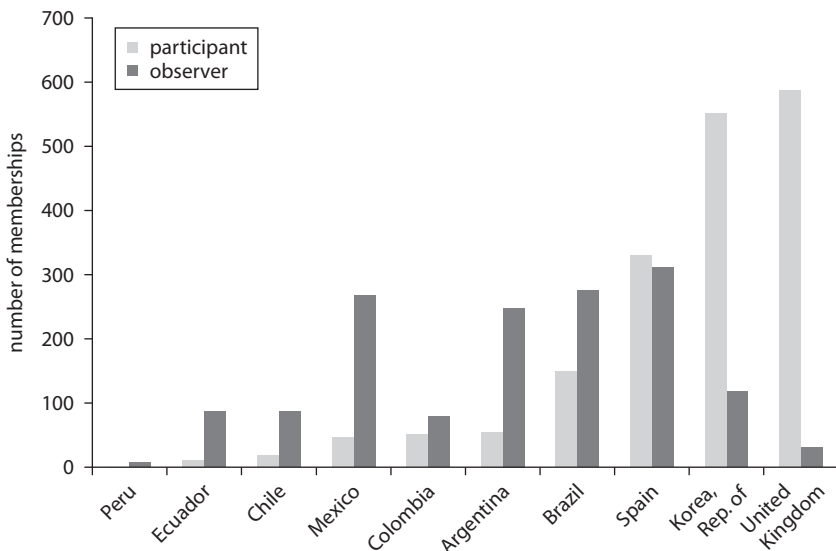
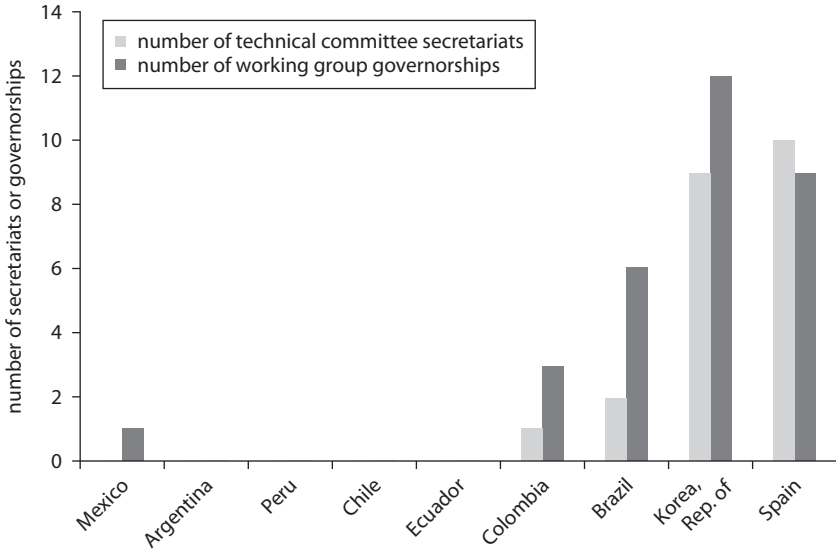


Figure 7.7 Participation in ISO Standards Development, 2004



Source: ISO Web site.

has only two, as compared to 10 for Spain and 99 for the United Kingdom. Apart from Brazil, Colombia, and Mexico, other Latin American countries in the survey do not have a single governorship or secretariat.

Regional coordination as a standards upgrading strategy

Latin American countries participate in a number of overlapping regional standards coordination schemes involving harmonization and compatibility strategies. The overwhelming majority of these standards-related measures originate in preferential or regional trade agreements (table 7.10). Most of the trade agreements, especially the bilateral agreements or extraregional agreements, refer to the provisions of the World Trade Organization Technical Barriers to Trade (WTO TBT) Agreement and promote standards compatibility by adopting international standards where possible. The five trade agreements and organizations with the most ambitious mandates for standards upgrading are listed in table 7.11 and described below.

APEC. APEC’s main approach is to align the standards of member economies with international standards in a number of priority areas. Four original priority objectives were designated in 1996.⁴ Developed economies

Table 7.10 Membership in Organizations and Preferential Trade Agreements with Standards-Related Measures

<i>Country</i>	<i>Regional or preferential trade agreements</i>	<i>Total</i>
Argentina	Mercosur; Chile-Mercosur; COPANT	3
Brazil	Mercosur; Chile-Mercosur; COPANT	3
Chile	Chile-Mercosur; APEC; Chile-Mexico; Central America-Chile; Chile-EU; Chile-Korea; Chile-U.S.; COPANT	8
Colombia	Andean Community; Group of 3; Colombia-CARICOM; COPANT	4
Ecuador	Andean Community; APEC; COPANT	3
Mexico	NAFTA; APEC; Group of 3; Bolivia-Mexico; Chile-Mexico; Costa Rica-Mexico; Mexico-Nicaragua; Mexico-Northern Triangle; Mexico-EU; Mexico-Israel; Mexico-Nicaragua; Mexico-Uruguay; COPANT	13
Peru	Andean Community; COPANT	2

Sources: Aldaz-Carroll 2006; OAS Foreign Trade Integration System (SICE) Web site.

Table 7.11 Principal Regional Agreements and Organizations with Standards-Related Measures

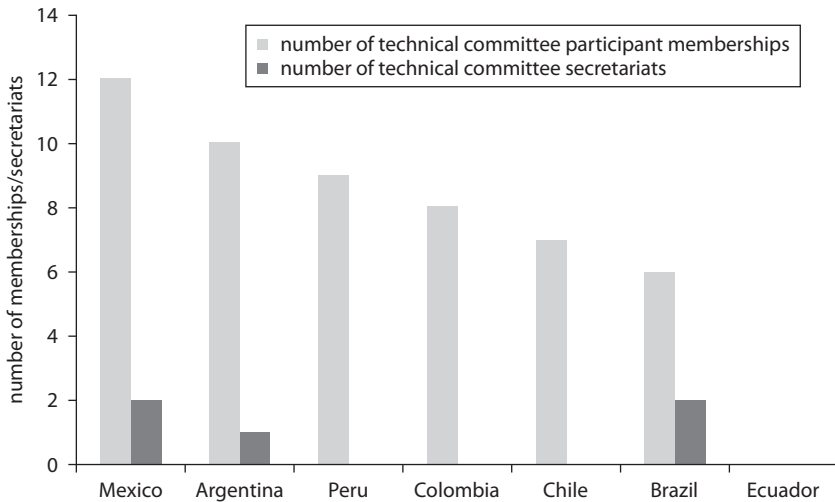
<i>Agreement/organization</i>	<i>Countries</i>	<i>Description</i>	<i>Standards policy objective</i>
APEC (Asia-Pacific Economic Cooperation)	Australia, Brunei Darussalam, Canada, Chile, China, Hong Kong (China), Indonesia, Japan, Rep. of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, Philippines, Russian Federation, Singapore, Taiwan (China), Thailand, United States, Vietnam	Intergovernmental organization and free trade agreement	Harmonization
COPANT (Pan American Standards Commission)	Argentina, Barbados, Bolivia, Brazil, Canada, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Grenada, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Lucia, Trinidad and Tobago, United States, Uruguay, Venezuela	Private nonprofit association of national standards bodies	Harmonization
Andean Community	Colombia, Bolivia, Ecuador, Peru, Venezuela	Customs union	Harmonization
Mercosur (Southern Common Market)	Argentina, Brazil, Paraguay, Uruguay	Customs union	Harmonization
NAFTA (North American Free Trade Agreement)	Canada, Mexico, United States	Free trade agreement	Compatibility

were given until 2000 to harmonize their standards in these areas, and developing member economies until 2005 (APEC 2004a). Since then, three additional priority objectives and alignment timetables have been defined. Not all APEC countries have shown interest in voluntary harmonization, and in 2004 only 15 members submitted progress reports. Of these 15 economies, 10 had reached their alignment targets, including Peru. Chile had aligned in 76 percent of the original priority areas. Mexico did not submit a progress report. Fourteen of these countries, including Peru and Chile, had achieved alignment in the additional priority areas (APEC 2004b). Despite the successful upgrading of standards in Chile and Peru, the impact of the APEC “voluntary action plan” is limited. In Chile, the priority areas concern a total of 56 national standards out of 2,300, and in Peru they concern as few as 17 standards out of 3,797.

Another part of APEC’s harmonization strategy is to encourage the participation of member states in the development of international standards by ISO and the IEC, in anticipation of the subsequent alignment of member economies to these standards. Here again, APEC has selected a limited number of priority areas and member participation in the standards development process is entirely voluntary.

COPANT. COPANT promotes the harmonization of standards in the Americas with an emphasis on the adoption of international standards, or the development of regional standards when there are no relevant or appropriate international standards. COPANT was created in the 1940s and now comprises 28 standards bodies. As of March 2003, 12 technical committees were responsible for developing “Pan American standards.” Their adoption as national standards in member countries is voluntary. Each of the surveyed Latin American countries participated in at least half of the technical committees, except for Ecuador, which was not involved in a single technical committee (figure 7.8). COPANT has not been very active in the past few years. Based on the most recent available information, only two Pan American standards were adopted in 2002.

The Andean Community. The Andean Community has provided the region with a forum for standards harmonization. Since 1997, its approach has been to adopt regional standards and gradually upgrade them toward more demanding international standards. The Andean Community prioritizes the use of international standards to develop “Andean standards,” but when international standards are unavailable or unsuitable for regional needs, there is a preference for regional standards (such as COPANT or European

Figure 7.8 Participation in COPANT Standards Development Activities

Source: COPANT Web site.

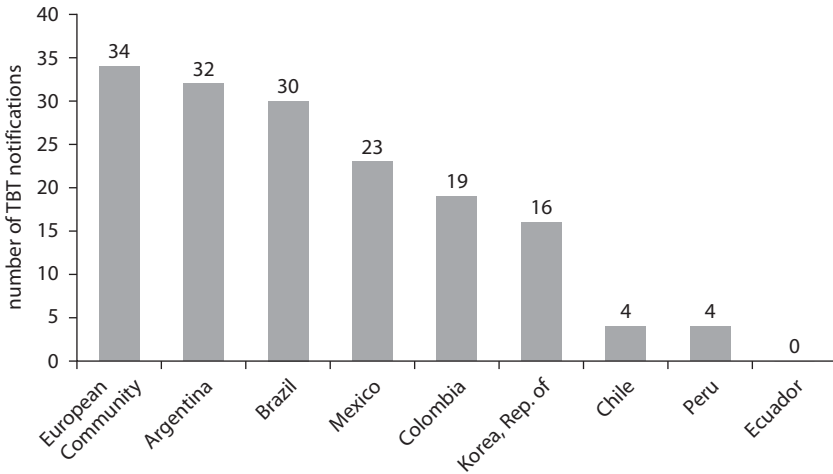
Committee for Standardization standards) rather than national standards. The Andean standards are developed through an association representing the national standards bodies, the Red Andina de Normalización, which is administered by a regional coordination body (Ente Coordinador). When Andean standards projects are based on international standards they must be approved by at least three countries; otherwise they must be approved unanimously.⁵ The national standards bodies of member states must adopt the Andean standards as national standards but their application remains voluntary. There are currently 50 Andean standards.

Mercosur. Mercosur's approach also involves the gradual upgrading of regional standards. Standards harmonization in this trade bloc is led by the Mercosur's Standardization Committee, which was officially created in 1991 in a common market resolution⁶ and represents the national standards bodies of the four members. The Mercosur Standardization Committee consists of a directing council of representatives from each standards body, along with 18 sectoral committees focusing on different industries. Brazil and Argentina dominate the sectoral committees, Brazil holding 11 secretariats and Argentina six. The directing council approves regional standards by consensus. Like the Andean Community, Mercosur prioritizes harmonization with international standards, followed by

regional standards and national standards. There are currently 493 Mercosur voluntary standards.

NAFTA. The provisions on standards in the 1994 NAFTA treaty closely follow those of the WTO TBT Agreement but place an added emphasis on compatibility. The member economies are encouraged to use international standards, except when these are inappropriate to fulfill legitimate objectives. Chapter 9 of the treaty states that the three countries should “to the greatest extent practicable, make compatible their respective standard-related measures.” A NAFTA Committee on Standards-Related Measures (CSRSM) oversees the implementation of chapter 9. The treaty requires the CSRSM to establish working groups and subcommittees in four key sectors, and subsequently in other sectors as needed. The North American Trilateral Standardization Forum was formed by the three standards bodies of the member states to work with the government-only CSRSM. A particular feature of the NAFTA treaty is that it allows interested parties of member states to participate directly in the development of new standards on the same basis as domestic firms in the NAFTA countries.

Figure 7.9 Number of TBT Notifications on Technical Regulations and Conformity Assessment Procedures, 2004



Source: WTO Web site.

The implementation of WTO TBT and SPS agreements

The surveyed countries have complied with the basic obligations of the WTO TBT Agreement, but some countries have submitted few notifications. Each country has established a national enquiry point for standards, conformity assessment, and technical regulations and has submitted notifications on technical regulations and conformity assessment procedures (figure 7.9). In 2004, a few countries submitted almost as many notifications as the European Community for the regional standards developed for EU and European Free Trade Association countries, and more than Korea. This either implies that they are fulfilling the terms of the agreement or that they are very active in the development of technical regulations and conformity assessment procedures. Three countries, Chile, Peru, and Ecuador, submitted very few notifications relative to their regional counterparts. The Latin American countries surveyed have all accepted the TBT Code of Good Practice.

CHAPTER 8

Certification in Latin America

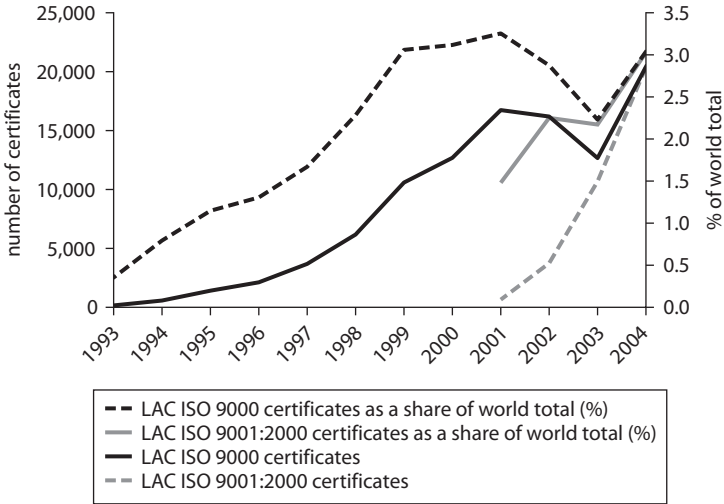
Certification is a critical area in Latin American countries, but their progress in this regard has been slow and uneven. The institutional structure is not very friendly and financial/cost issues remain. Moreover, a deficient investment climate does not encourage firms to move forward. Efforts by countries have been tepid at best; both greater emphasis on certification and proper incentives are needed.

Certification Activities

As a region, Latin America registers a low number of ISO 9001 quality management systems certificates, in both relative and absolute terms. Figure 8.1 displays the number of ISO 9000 certificates in Latin America and the Caribbean, including earlier versions of the ISO 9000:1994 family (up to 2003) and ISO 9001:2000 (as of 2001). On average, the total number of certificates in Latin America has increased over the past decade, but in 2004 this number represented a smaller share of global certificates than it did in 2001. This may be due to new sector-specific quality management system certificates that have replaced ISO 9000 in the past few years. The dip in the number of ISO 9000 certificates in 2003 can be explained by the deadline for the transition from ISO 9000:1994 to ISO 9000:2000 and the fact that withdrawn certificates were not reported in some countries.

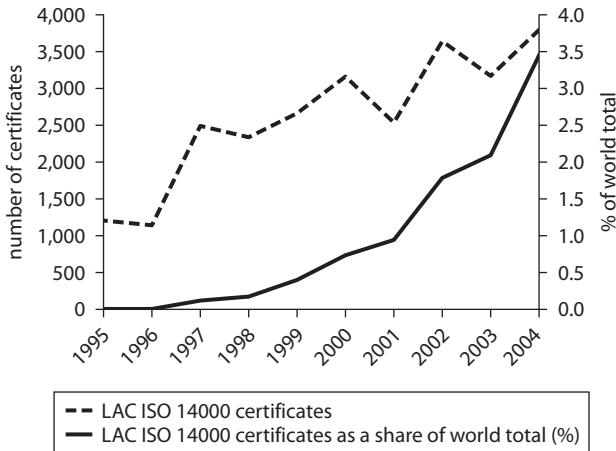
In Latin America, the number of ISO 14000 environmental management systems certificates has been steadily increasing since 1994 (figure 8.2). The region accounts for a growing share of the world's total,

Figure 8.1 ISO 9000 Certificates in Latin America and the Caribbean, 1993–2004



Sources: ISO 2001, 2003b, 2005.

Figure 8.2 Number of ISO 14000 Certificates in Latin America and the Caribbean, 1995–2004



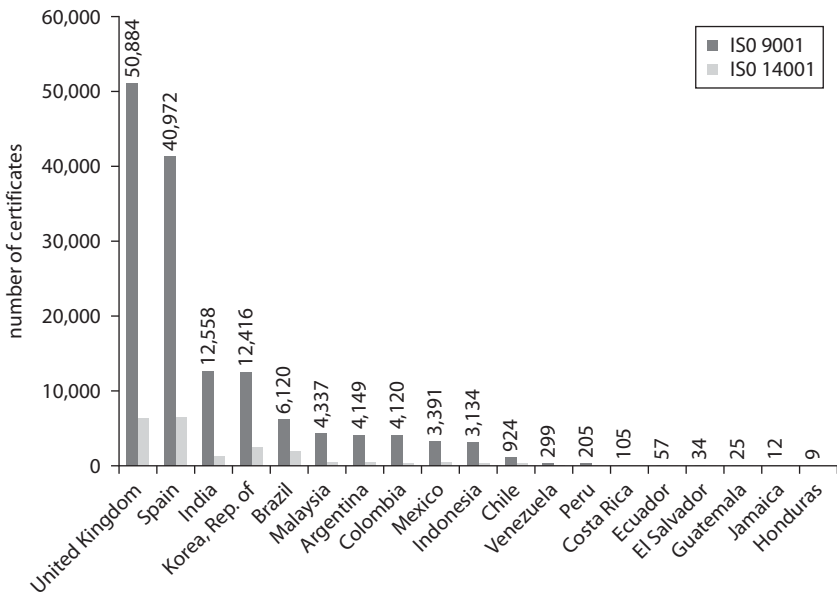
Sources: ISO 2005.

holding 3.8 percent of certificates at the end of 2004. Latin American countries are performing better in relation to ISO 14000 than in relation to ISO 9000.

Latin American and Caribbean countries have far fewer ISO 9000 and 14000 certificates than the United Kingdom or Spain, but there are wide differences in certification within the Latin American and Caribbean region (figure 8.3). At the end of 2004, all countries in Central and South America registered at least one ISO 9001 certificate, and all countries, apart from Belize and Surinam, registered at least one ISO 14001 certificate. However, some countries, like Ecuador and Peru, registered extremely low numbers of management system certificates.

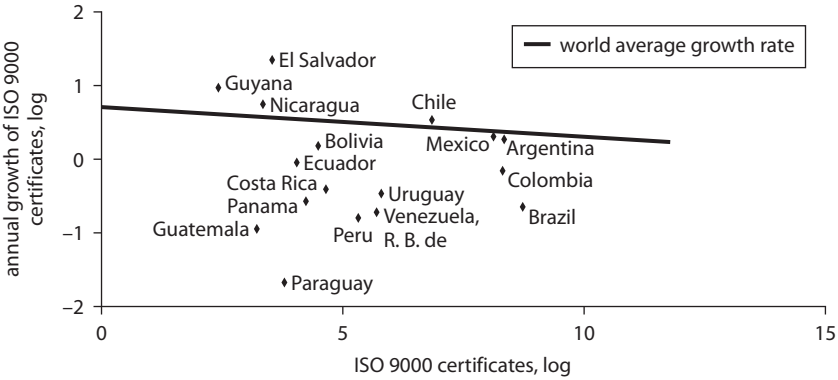
In 2004, the growth rate of ISO 9000 certificates in most Latin American and Caribbean countries was lower than their expected growth rate, given world averages. The fitted line in figure 8.4 represents average global growth rates from 2001 to 2004 for a given number of certificates. Given their current number of ISO 9000 certificates, only El Salvador, Nicaragua, and Guyana, each with an extremely low number of certificates, and Chile, had growth rates higher than their expected values. One country, Belize, had a negative growth rate.

Figure 8.3 Number of ISO 9001:2000 and ISO 14001 Certificates, 2004



Source: ISO 2005.

Figure 8.4 Growth Rates of ISO 9000 Certificates in 2004 vs. Number of ISO Certificates; World Average Annual Growth Rates, 2001–04



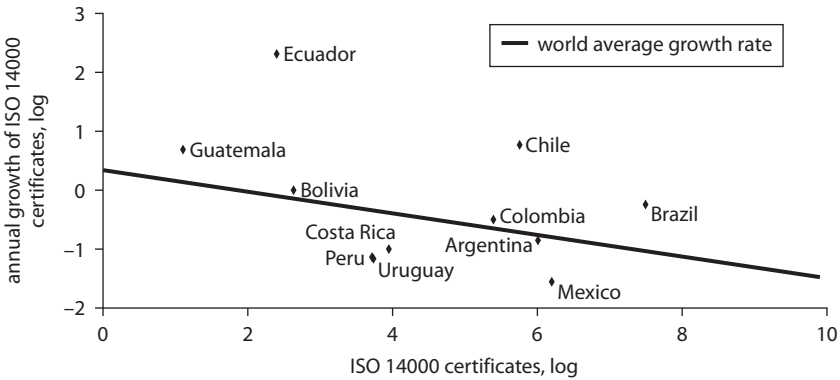
Source: ISO 2005.

Note: The world average growth rate was calculated using data from 170 countries. Belize had a negative growth rate and is not shown in the figure.

Roughly half of Latin American and Caribbean countries have ISO 14000 growth rates above their expected value, according to world averages. The fitted line in figure 8.5 shows average global growth rates for all countries from 1998 to 2004 for a given number of certificates. ISO 14000 adoption has grown faster in Latin America and the Caribbean than in the rest of the world. Some countries, such as Ecuador and Chile, are performing particularly well. Nonetheless, a few countries have had negative or zero growth rates.

Relative ISO 9000 certification rates vary widely in Latin America and the Caribbean, but most countries are not performing to global standards. Because most ISO 9000 certificates are obtained in the manufacturing and service sectors, standardizing the number of certificates by the total value added of these two sectors allows for more informative cross-country comparisons. Ideally, certification data would be standardized by the number of firms in a given country, but due to the difficulty in obtaining reliable and comparable firm-level data for a broad range of countries, certification rates are standardized by value added instead. While a better indicator than crude certification, this method has a few shortcomings. A country with a very concentrated market structure (where a small number of large firms produce most of the value added) will appear to have a lower standardized certification rate than a country

Figure 8.5 Growth Rates of ISO 14000 Certificates in 2004 vs. Number of ISO Certificates; World Average Annual Growth Rates, 1998–2004



Source: ISO 2005.

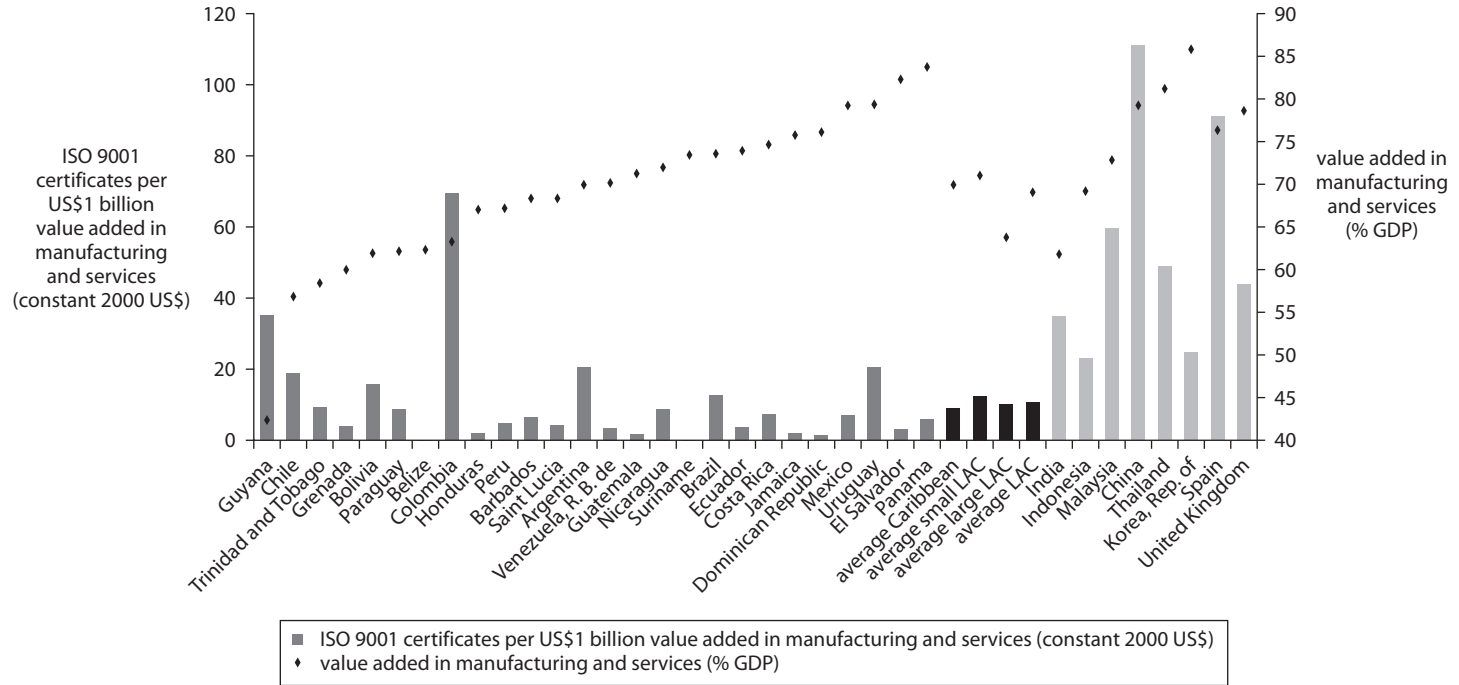
Note: Belize, Guyana, Honduras, Panama, Paraguay, and República Bolivariana de Venezuela had negative or zero growth rates and are not shown in the figure.

with a very atomized market structure (where value added is distributed among a large number of small firms), even if the actual number of certified firms is greater in the former than in the latter. Hence, standardizing the number of certificates by value added should only be used as a proxy for the diffusion of quality standards in the economy, not as an accurate indicator.

As shown in figure 8.6, differences in certification performance are not merely due to differences in the value added of manufacturing and services across countries. Colombia leads the Latin American and the Caribbean region and, even by global standards, registers an extremely high number of ISO 9000 certificates given the size of its manufacturing and service sectors. In contrast, Mexico, which registers a high absolute number of certificates, does not perform well considering the size of its manufacturing and service sectors.

Figure 8.7 shows the certification performance of Latin American and Caribbean countries around a line representing predicted certification rates based on world averages. While a few countries, such as Colombia and Uruguay, are performing better than world averages, most countries display lower certification rates or lag far behind. This contrasts with the more uniform situation presented in East Asia, where most countries are performing better than world averages.

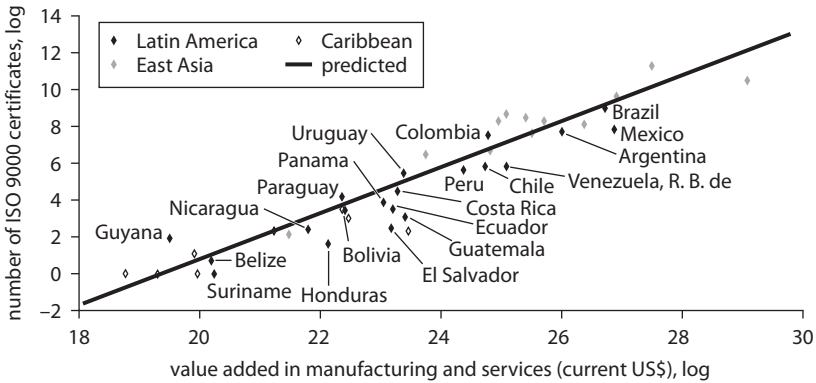
Figure 8.6 ISO 9001 Adoption Standardized by Value Added in Manufacturing and Services, 2004



Sources: World Bank 2005c; ISO 2005.

Note: LAC = Latin America and the Caribbean.

Figure 8.7 Number of ISO 9000 Certificates and Value Added in Manufacturing and Services, 2002



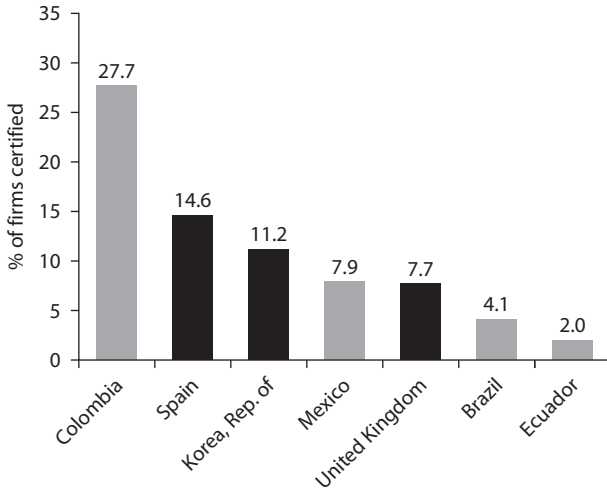
Sources: World Bank 2005c; ISO 2005.

Note: Predicted values were computed using data from 116 countries.

The number of ISO 9000 certificates standardized by the number of establishments in the major manufacturing sectors confirms the large diffusion disparities across Latin American and Caribbean countries. For some countries, reliable data are readily available on both the number of establishments and the number of certificates in certain manufacturing sectors. This allows for a standardization of the number of certificates by the number of establishments in the 10 major manufacturing sectors that account for 46 percent of global ISO 9000 certificates. This exercise reveals again Colombia’s leadership position in adoption of quality management systems, with almost 28 percent of firms certified (figure 8.8). Colombia performs better than Spain, Korea, the United Kingdom, and the other Latin American countries. At the other extreme, Ecuador lags far behind all other countries, with only 2 percent of firms certified in the 10 sectors of interest.

Latin American and Caribbean countries perform relatively poorly in terms of ISO 14000 certification rates. As shown in figure 8.9, most of the Latin American and Caribbean countries performing better than expected from their value added in manufacturing and services are countries with very few ISO 14000 certificates, such as Belize and Guyana. The bulk of countries, with more mature environmental certification markets, underperform. The comparison with East Asian countries is striking. Most countries in that region exhibit higher ISO 14000 certification rates than would be expected.

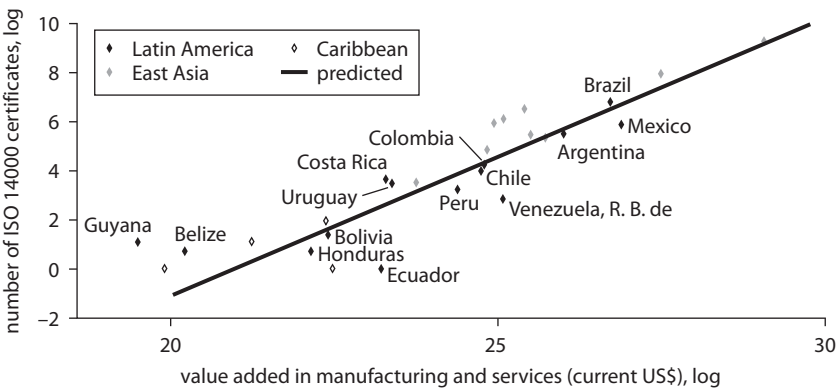
Figure 8.8 Aggregate Number of ISO 9001 Certificates Standardized by Number of Establishments in 10 Major Manufacturing Sectors



Sources: ISO 2005; UNIDO INDSTAT 4 (Industrial Statistics Database), Rev. 3, 2005.

Note: Manufacturing sectors include basic metal and fabricated metal products; chemicals, chemical products, and fibers; concrete, cement, lime, plaster, etc.; electrical and optical equipment; food products, beverage, and tobacco; machinery and equipment; pulp, paper, and paper products; rubber and plastic products; textiles and textile products (except Brazil); leather and leather products (except Brazil). Certificate data are December 2004. Establishment data are 2000 (Colombia, Spain, Mexico), 2001 (Korea, the United Kingdom), and 2002 (Brazil, Ecuador).

Figure 8.9 Number of ISO 14000 Certificates and Value Added in Manufacturing and Services, 2002

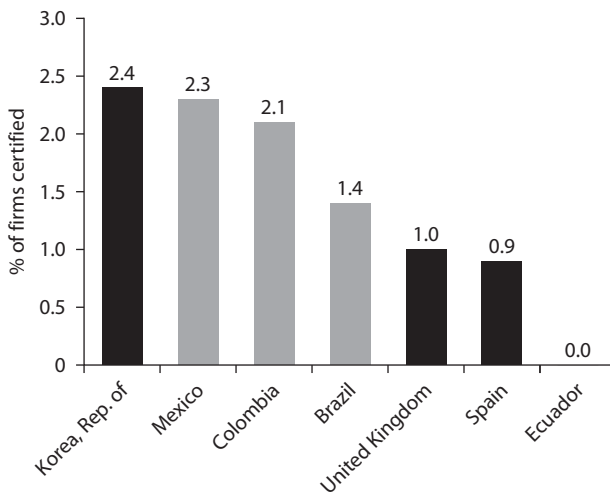


Sources: World Bank 2005c; ISO 2005.

The number of ISO 14000 certificates standardized by the number of establishments in the 10 major manufacturing sectors gives a much more positive picture of the performance of certain Latin American and Caribbean countries in relative terms. In manufacturing, Mexico, Colombia, and Brazil have adopted nearly as many certificates on a per-firm basis as Korea, and twice as many as Spain and the United Kingdom (figure 8.10). This can be explained by the fact that the vast majority of environmental management system certificates in Latin America and the Caribbean are adopted in the manufacturing sectors, as opposed to the service sector. Again, at the other extreme, there are still countries that do not register a single ISO 14000 certificate in the major manufacturing sectors.

In the automobile sector, Latin American countries are performing near or above world averages in terms of their adoption of sector-specific quality management system certification. Examining sector-specific certification rates allows us to correlate certification data with data concerning the number of firms, because the number of firms in the sector

Figure 8.10 Aggregate Number of ISO 14000 Certificates Standardized by Number of Establishments in 10 Major Manufacturing Sectors

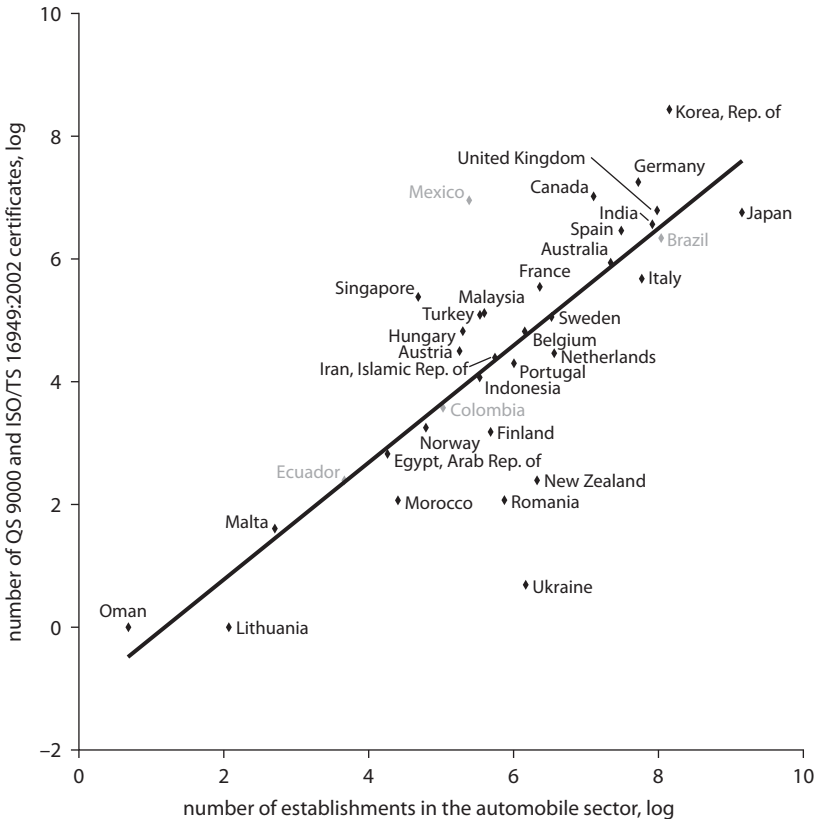


Sources: ISO 2005; UNIDO INDSTAT 4 (Industrial Statistics Database), Rev. 3, 2005.

Note: Manufacturing sectors include basic metal and fabricated metal products; chemicals, chemical products, and fibers; concrete, cement, lime, plaster, etc.; electrical and optical equipment; food products, beverage, and tobacco; machinery and equipment; pulp, paper, and paper products; rubber and plastic products; textiles and textile products (except Brazil); leather and leather products (except Brazil). Certificate data are December 2004; establishment data are 2000 (Colombia, Spain, Mexico), 2001 (Korea, the United Kingdom), and 2002 (Brazil, Ecuador).

is more readily available than the total number of firms in an economy. Figure 8.11 displays the numbers of QS 9000 and ISO/TS 16949 certificates in different countries compared with the number of establishments in the automobile industry. Both of these standards incorporate the requirements of ISO 9000 in addition to some industry-specific requirements.¹ Colombia, Ecuador, and Brazil are close to world averages relative to the number of establishments in the auto industry. Mexico registers many more certificates than would be expected for its number of manufacturers, and roughly as many certificates as Canada, Germany, or Japan.²

Figure 8.11 Number of QS 9000 and ISO/TS 16949:2002 Certificates vs. Number of Enterprises in the Automobile Sector



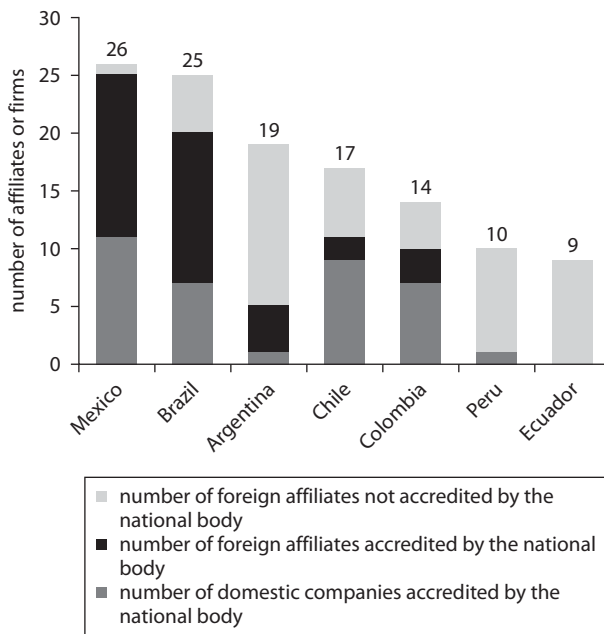
Sources: ISO 2005; QSU Publishing Co. Web site; UNIDO INDSTAT 4 (Industrial Statistics Database), Rev. 3, 2005.
 Note: 2005 data for QS 9000; 2004 data for ISO/TS 16949; 2000, 2001, and 2002 data for number of enterprises.

The Supply of Certification Services

Domestic firms can have their quality management systems certified by either national or foreign certification bodies, but foreign certification bodies dominate the certification markets of Latin American and Caribbean countries. Figure 8.12 shows the number of foreign affiliates represented in different countries of the region, along with the number of national certification bodies. Foreign certification bodies with no local representation may also provide certification services to local firms, but they are not accounted for in the figure. Only certification bodies accredited nationally or abroad are considered. Most countries, even those with small certification markets like Peru and Ecuador, have a reasonable supply of certification services, but with the information available it is difficult to confirm whether there is sufficient competition in the certification industry.

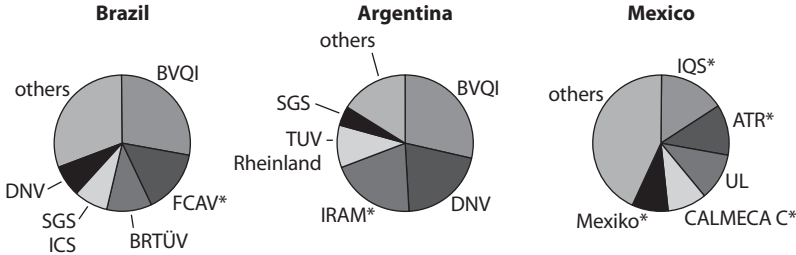
Available market share information in Argentina, Brazil, and Mexico shows that the market is relatively concentrated. As shown in figure 8.13, Mexico's four largest certification bodies, with size measured by

Figure 8.12 Accredited Domestic Certification Bodies and Foreign Affiliates Offering Quality Management Systems Certification, 2005



Sources: Web sites of the national accreditation bodies and certification bodies.

Figure 8.13 Market Shares of Top Five Certification Bodies in Brazil, Argentina, and Mexico



Sources: Web sites of the Ministry of the Economy of Mexico, the Brazilian National Institute of Metrology, Standardization and Industrial Quality (INMETRO), and the Argentina Accreditation Bureau (OAA).

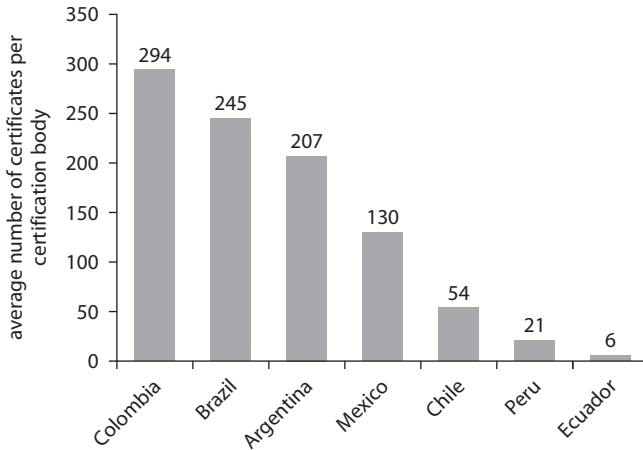
Note: Market share is measured by the number of ISO 9001:2000 certifications issued. * denotes a domestic certification body, as opposed to a foreign affiliate. 2005 data for Brazil and Mexico; 2003 data for Argentina.

the number of ISO 9001 certifications issued, hold close to 50 percent of the market. The dominant bodies in Mexico tend to be domestic. In Brazil and Argentina the top four certification bodies control a much larger share of the market, above 70 percent. Most of them are affiliates of foreign certification bodies; in fact, in these two countries there is only one national certification body among the top five certifiers. Most Latin American countries, especially those registering few ISO 9000 certificates, have virtually no domestic certification bodies. This is the case of Ecuador and Peru. Colombia is an exception; in 2004, 42 percent of ISO 9000 certifications were granted by ICONTEC, a national certification body.

The average number of ISO 9000 registrations per certification body shows wide cross-country disparities in the development of the certification market. Figure 8.14 displays the average number of certifications by certification body operating within a country. Foreign bodies with no permanent local representatives or affiliates were not included in this analysis. Certification bodies in Colombia are the most active, having registered on average 294 quality management systems in 2004. Those in Ecuador are the least active, having registered only six firms each in 2004.

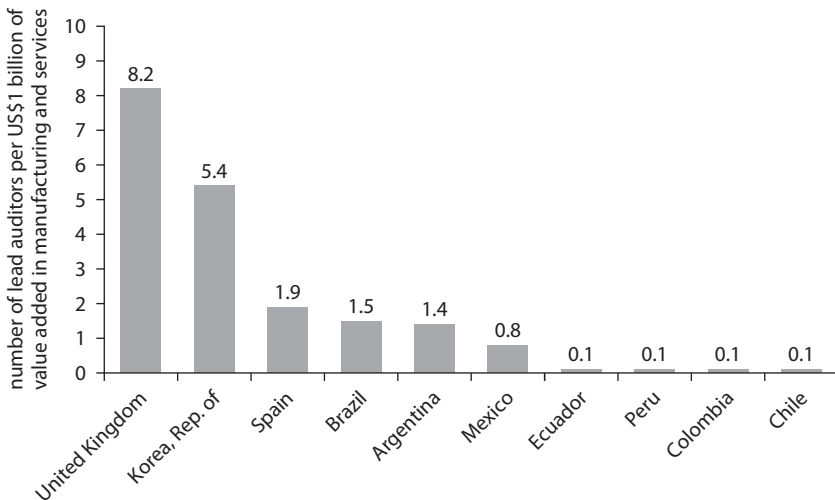
The quality of certification services in Latin America and the Caribbean depends on the quality of the auditing staff. There are relatively few lead auditors with internationally recognized credentials in this region. The International Register of Certificated Auditors (IRCA) is the largest international certification body for auditors of management systems. IRCA standards are high and IRCA certification instills confidence in an auditor's qualifications. When value added in the manufacturing and service sectors is accounted for, Latin American countries have few lead

Figure 8.14 Number of ISO 9001:2000 Certifications in 2004 Standardized by Number of Accredited Certification Bodies Operating Domestically in 2005



Source: ISO 2005.

Figure 8.15 Number of Lead Auditors Certified for ISO 9001:2000 with IRCA in 2005, Standardized by Total Value Added in Manufacturing and Services in 2004



Sources: IRCA Web site; World Bank 2005c.

auditors certified for ISO 9001 with the IRCA compared to the United Kingdom or Korea (figure 8.15). Brazil is the top performer in Latin American and registers nearly as many IRCA-certified auditors, relative to its national manufacturing and services value added, as Spain.

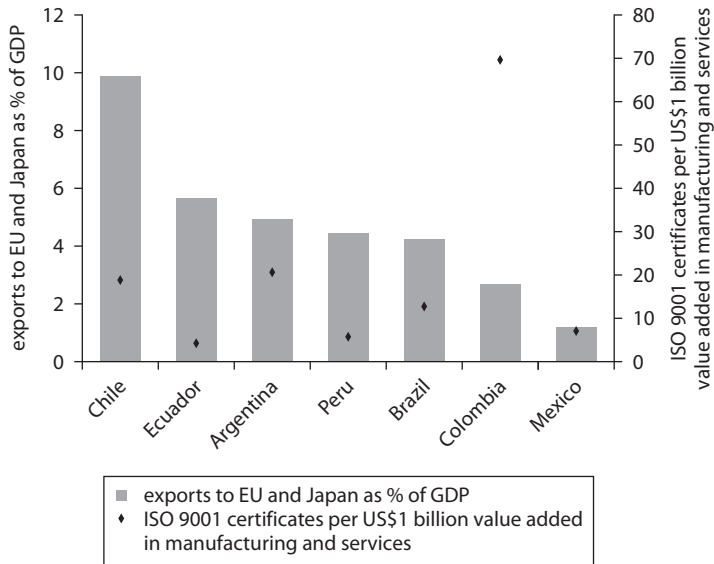
Possible Factors Influencing ISO 9000 Diffusion

As discussed in chapter 6, national characteristics can significantly affect ISO 9000 adoption rates. A comparison of national market and trade characteristics, and of institutional and business environments, can provide some context for understanding cross-country differences in ISO 9000 diffusion.

Market and trade factors

Trade destination does not appear to be a prime determinant of certification in Latin America. The European Union (EU) and Japan are high adopters of ISO 9000 and are likely to impose certification requirements on their international suppliers. Countries with higher shares of exports to the EU and Japan should be expected to have more incentives for certification. However, heterogeneity in ISO 9000 adoption in Latin America does not appear to be determined by trade patterns. Countries where exports to the EU and Japan play a more important role in the economy do not display noticeably higher certification rates than others (figure 8.16). An extreme case is Colombia, which displays the highest certification rate despite sending relatively few exports to the EU or Japan. One explanation is that coun-

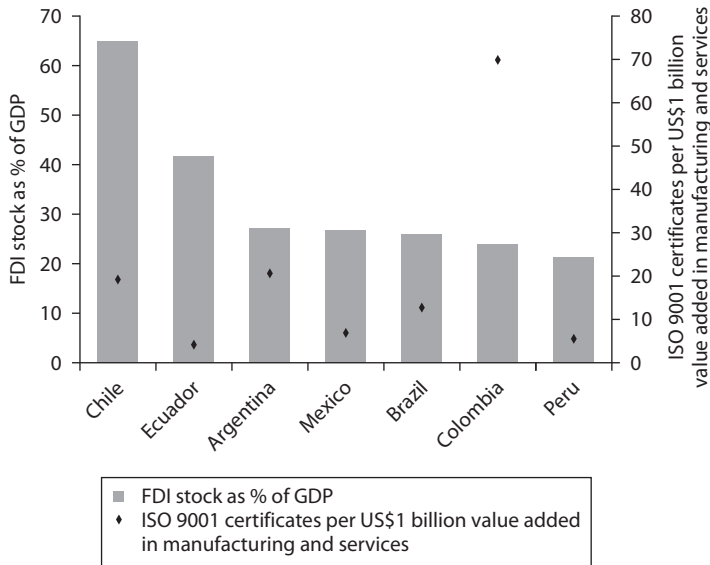
Figure 8.16 Exports to the EU and Japan as a Share of GDP and Certification Rates



Sources: UNCTAD 2004; IMF 2005; World Bank 2005c; ISO 2005.

Note: ISO 9001 data are 2004; export data are 2003.

Figure 8.17 Inward FDI Stock as a Share of GDP and Certification Rates



Sources: UNCTAD 2004; IMF 2005; World Bank 2005c; ISO 2005.

Note: ISO 9001 data are 2004; FDI data are 2003.

tries trading heavily with the EU and Japan may not be exporting goods in sectors where quality is necessary. Another explanation is that other factors affect ISO 9000 adoption to a greater extent than trade destination.

In Latin America, the presence of transnational corporation (TNC) subsidiaries is not a prime determinant of ISO 9000 adoption. The situation with respect to TNCs is very similar to that of trade destination: there is no obvious pattern of higher certification rates in countries with a greater presence of TNCs. Figure 8.17 uses inward foreign direct investment (FDI) stock as a proxy for the presence of foreign affiliates. As for trade destination, either the TNC subsidiaries are not in sectors where quality is important, or other factors play a larger role in the diffusion of ISO 9000.

The presence of export sectors that are conducive to certification appears to be moderately related to ISO 9000 adoption. As discussed in chapter 6, some export sectors are associated with higher global certification rates than others. As of December 2004, the top eight global sectors in terms of ISO 9000 concentration were (ISO 2005)

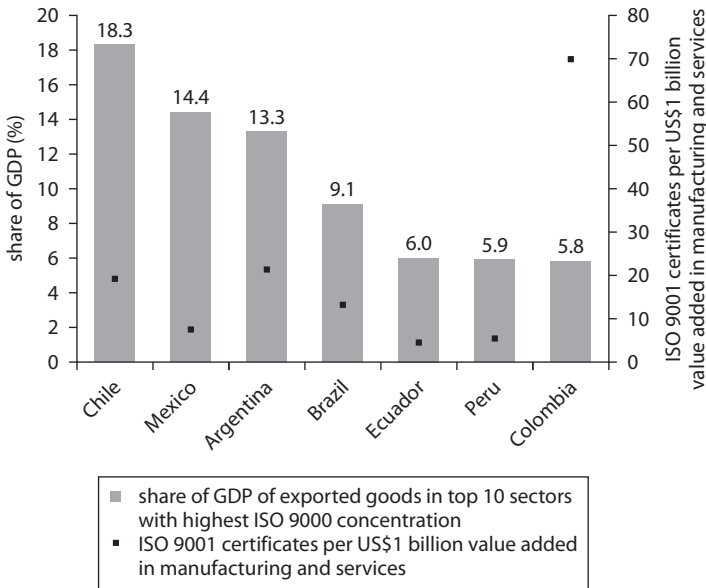
1. Construction
2. Basic metals and fabricated metal products

3. Electrical and optical equipment
4. Machinery and equipment
5. Wholesale and retail trade; repair of motor vehicles, motorcycles, and personal and household goods
6. Rubber and plastic products
7. Chemicals, chemical products, and fibers
8. Food products, beverages, and tobacco

These sectors register high certification rates, either because quality is considered to be an important competitive factor in these sectors or because ISO 9000 is particularly effective in increasing organizational efficiency in these sectors. Countries where exports in these *quality-focused global sectors* account for a large share of GDP should also display high certification rates. This pattern seems to hold for Latin America, except for Mexico, where a high share of exports are destined to the United States, and Colombia, where ISO 9000 diffusion is exceptionally high (figure 8.18).

It is not clear that the size of manufacturing firms is influencing ISO 9000 diffusion in Latin America. Smaller firms are generally less aware of

Figure 8.18 Exported Goods in Global Quality-Focused Sectors as a Share of GDP



Sources: UNCTAD 2004; World Bank 2005; ISO 2005.

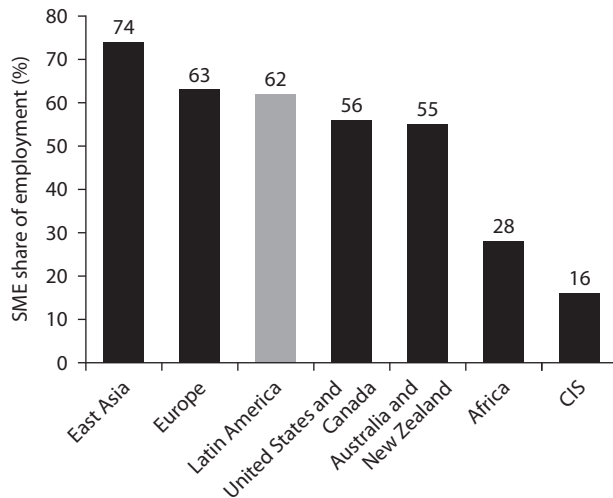
Note: ISO 9001 data are 2004; export data are 2003 for all countries except Argentina, 2002.

the benefits of ISO 9000 and the implementation of a quality management system is more costly to them. Thus, countries where small and medium enterprises (SMEs) account for a high share of firms should display relatively fewer certificates per firm. According to figure 8.19, Latin American countries do not seem to have a particularly high share of SMEs in their economies, as proxied by the share of manufacturing employment in SMEs. East Asia, where SMEs account for a larger share of manufacturing employment, have attained significantly greater certification rates than Latin America and the Caribbean.³ Figure 8.20 displays SME shares of GDP in different countries, based on data from the manufacturing sector. Here, no clear trend emerges, possibly because certification data are standardized by output and not by the number of establishments. Nonetheless, firm size and certification data in Mexico (figure 8.21) do reveal a generally higher tendency to adopt ISO 9000 in larger firms.

The economic environment

Latin America's poor business environment may be reducing incentives for certification. A business climate characterized by uncertainty and high business costs may discourage any long-term investments in a quality management system. An aggregate indicator constructed by Beck, Demirgüç-Kunt,

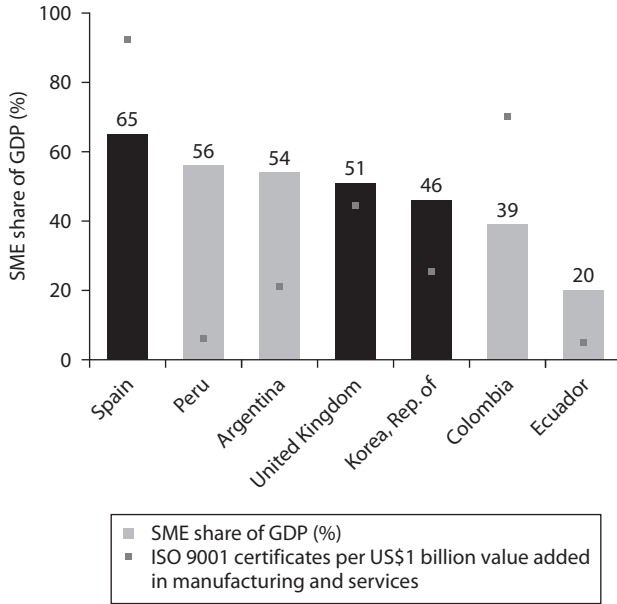
Figure 8.19 Regional SME Sector Share of Manufacturing Employment, 1990–99 Averages



Source: Beck, Demirgüç-Kunt, and Levine 2003.

Note: SMEs are defined as having fewer than 250 employees. CIS = Commonwealth of Independent States.

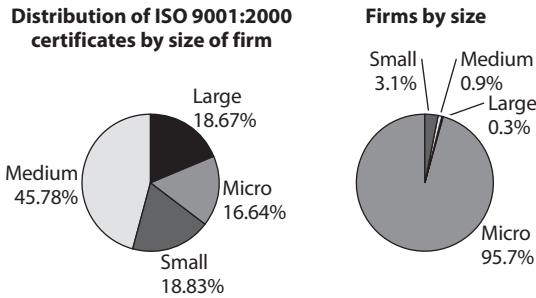
Figure 8.20 SME Sector Share of GDP and Certification Rates



Sources: Ayyagari, Beck, and Demirgüç-Kunt 2003; World Bank 2005c; ISO 2005.

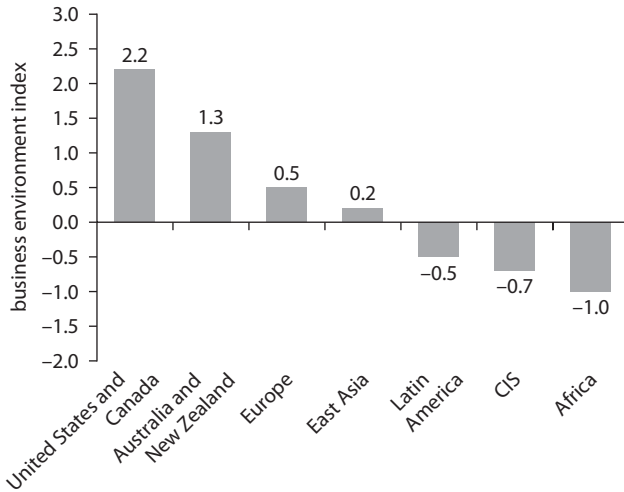
Note: ISO 9001 data are 2004 for every country except 2003 for Korea, 2002 for Spain, 2001 for the United Kingdom. National SME definitions are used. SME sector share is based on 1990–99 averages in the manufacturing sector.

Figure 8.21 ISO 9001 Adoption and Firm Size in Mexico



Sources: Mexican Ministry of the Economy Web site; Contactopyme Web site.

Note: Percentages may not add to 100 due to rounding.

Figure 8.22 Average Business Environment Indicator, by Region

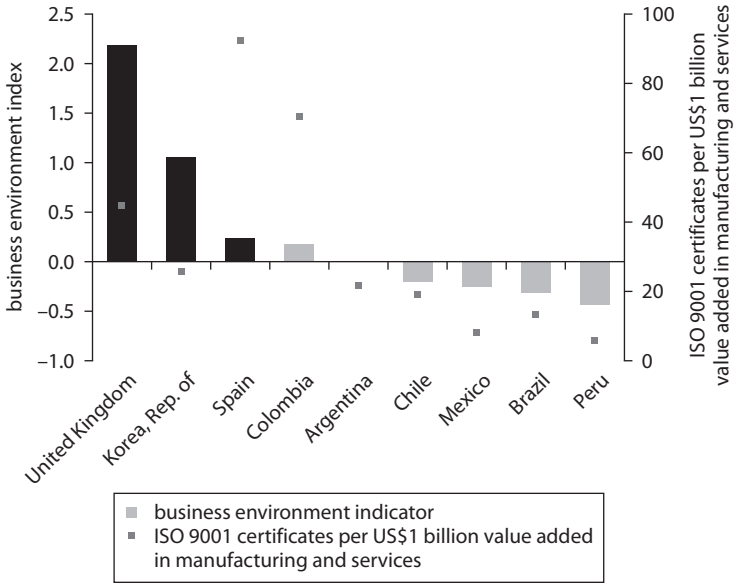
Sources: Beck, Demirgüç-Kunt, and Levine 2003; World Bank 2005c; ISO 2005.

Note: Based on data from 64 countries. CIS = Commonwealth of Independent States.

and Levine (2003) includes information on the degree of private property rights protection, the cost of contract enforcement, the cost of entering the market, and the efficiency of the bankruptcy system. Average regional business environment indicators reveal a particularly poor business climate in Latin America (figure 8.22). A comparison of national business environment indicators and certification rates shows a tendency for countries with sounder business climates to exhibit higher certification rates (figure 8.23).

Latin America's poor institutional environment may also serve to reduce incentives for certification. Ineffective and unpredictable institutions can discourage the implementation of a quality management system, because firms are unable to predict the returns on their investments. An aggregate indicator constructed by Beck, Demirgüç-Kunt, and Levine (2003) rates the institutional environment in which firms operate. This indicator contains information on voice and accountability in the political system, the quality and consistency of regulations and regulatory enforcement in the country, political stability, rule of law, lack of official corruption, and effectiveness of the government bureaucracy. Again, Latin America performs poorly according to this indicator (figure 8.24). With respect to individual countries, there is a tendency for countries with better institutional environments to have greater ISO 9000 diffusion rates (figure 8.25). Colombia is an exception here, as it displays the

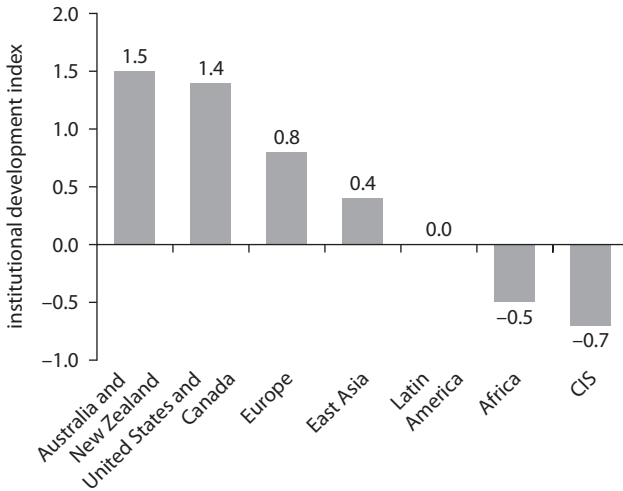
Figure 8.23 Business Environment Indicator and Certification Rates, by Country



Sources: Beck, Demirgüç-Kunt, and Levine 2003; World Bank 2005c; ISO 2005.

Note: ISO 9001 data are 2004 for every country except 2003 for Korea, 2002 for Spain, and 2001 for the United Kingdom.

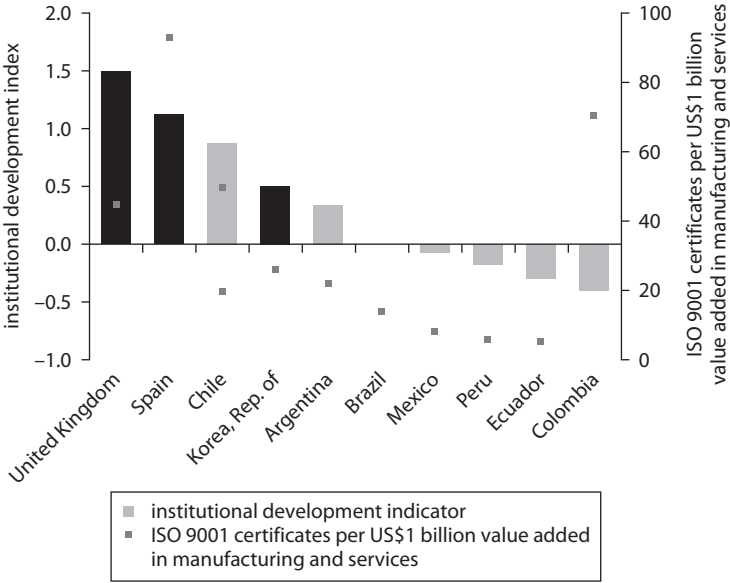
Figure 8.24 Average Institutional Development Indicator, by Region



Source: Beck, Demirgüç-Kunt, and Levine 2003.

Note: CIS = Commonwealth of Independent States.

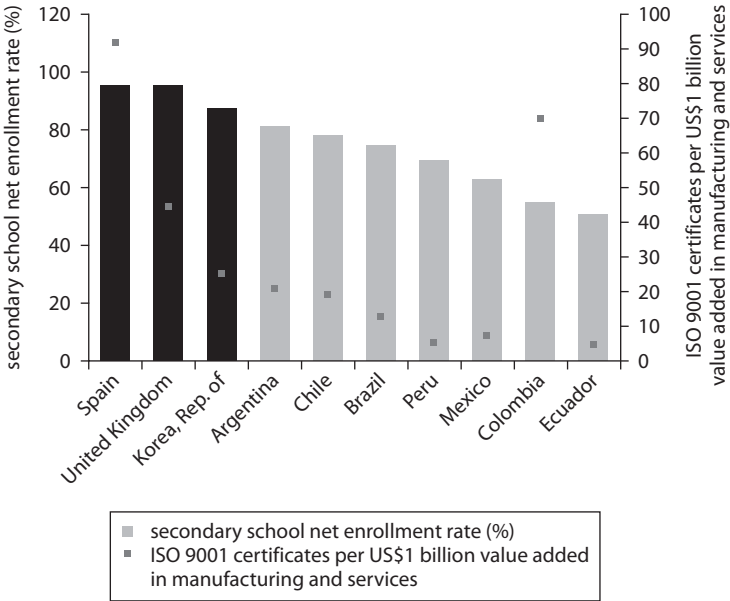
Figure 8.25 Institutional Development Indicator and Certification Rates, by Country



Sources: Beck, Demirgüç-Kunt, and Levine 2003; World Bank 2005c; ISO 2005.

Note: ISO 9001 data are 2004 for every country except 2003 for Korea, 2002 for Spain, and 2001 for the United Kingdom.

Figure 8.26 Secondary School Enrollment and Certification Rates



Sources: World Bank 2005c; ISO 2005.

Note: ISO 9001 data are 2004 for every country except 2003 for Korea, 2002 for Spain, 2001 for the United Kingdom. School enrollment rates are for 2002.

worst institutional environment in the sample but the highest certification rate in Latin America.

Latin America's low educational levels hinder the implementation of quality management systems. ISO 9000 implementation costs and time are lower when the involved personnel have received at least minimum levels of basic educational training. Latin American countries are generally characterized by low levels of educational attainment. In particular, de Ferranti et al. (2003) observe that most Latin American countries have massive deficits in net enrollment in secondary schools. These enrollment rates are much lower than what would be predicted based on per capita GDP. Figure 8.26 points to a strong correlation between ISO 9000 adoption rates and net secondary education rates in Latin America. Countries with higher education rates tend to have higher ISO 9000 diffusion rates, Colombia, as always, being an exception. It follows that low educational levels could contribute to Latin America's general difficulty in implementing ISO 9000.

CHAPTER 9

Accreditation in Latin America

International recognition is critical for access to markets, and while Latin America has been making progress, much more is required to support the aggressive export strategies embraced by most countries in the region. Accreditation bodies need increased private sector representation—it is now minimal—and much more autonomy to enable them to quickly respond to sectoral needs and firms' demands.

Accreditation Institutions

The organization of accreditation

Latin American accreditation bodies vary in legal status. As is the case in the rest of the world, there are both private and public accreditation bodies in the region (table 9.1). When they are part of the public sector, accreditation bodies tend to operate as autonomous government agencies, sometimes affiliated with a specific government ministry. Examples include Peru's INDECOPI (National Institute for the Defense of Competition and the Protection of Intellectual Property) and Brazil's INMETRO (National Institute of Metrology, Standardization and Industrial Quality). Mexico has recently moved its accreditation system from the Ministry of the Economy to a private nonprofit organization. In the case of Chile and Argentina, the National Standardization Institute (INN) and the Argentine Accreditation Bureau (OAA) are private organizations but were created by the government. In all countries surveyed, the functions and obligations of both public and private accreditation bodies are governed through national legislation, which gives full authority over voluntary standards to a single accreditation body. Many accreditation systems in Latin American countries are relatively new and were formed in the past decade.

Table 9.1 Legal Status of National Accreditation Bodies

<i>Country</i>	<i>Name</i>	<i>Status</i>
Argentina	OAA	private
Brazil	INMETRO	public
Chile	INN	private
Colombia	SIC	public
Ecuador	OAE	public
Mexico	EMA	private
Peru	INDECOPI	public
Korea, Rep. of	KAB	private
Korea, Rep. of	KATS-KOLAS/KAS	public
Spain	ENAC	private

Sources: Web sites of the national accreditation bodies.

Note: EMA = Mexican Accreditation Body; ENAC = National Accreditation Body; KAB = Korea Accreditation Board; KATS-KOLAS/KAS = Korea Agency for Technology and Standards, Korea Laboratory Accreditation Scheme, Korea Accreditation System; OAE = Ecuadorian Accreditation Body; SIC = Superintendency of Industry and Commerce.

Accreditation bodies in Latin American countries tend to be involved in more activities than their developed-country counterparts (table 9.2). In some Latin American countries, the accreditation body is responsible for accrediting organizations against regulatory standards in addition to voluntary standards. This is also the case in Spain. In countries where the accreditation body operates as part of the public sector, it is often responsible for other activities related to voluntary conformity assessment. In Brazil, Chile, Colombia, and Peru, the accreditation body is also the national metrology institute (NMI). This may be problematic if the accreditation and metrology functions are not clearly separated, because the NMI offers calibration services that could theoretically compete with the services of potential candidates for accreditation. In Chile and Peru, the national accreditation body is also the national standards body. In these cases, it is important that the NMI, itself potentially involved in the development of standards, not influence the standardization process disproportionately. In developed countries such as Spain and the United Kingdom, metrology and standardization functions are usually performed by different organizations. None of the accreditation bodies in Latin America currently offer commercial certification services.

Governance and autonomy

In Latin America, some accreditation bodies have very little private sector representation (table 9.3). This is often the case in public sector bodies, where

Table 9.2 Activities of National Accreditation Bodies

Country	Accreditation against regulatory standards				
	Standards	National metrology	Calibration and testing	Certification	
Argentina	yes	no	no	no	no ^a
Brazil	yes	no	yes	yes	no
Chile	no	yes	yes	no	no ^b
Colombia	yes	no	yes	yes	no
Ecuador	yes	no	no	no	no
Mexico	yes	no	no	no	no
Korea, Rep. of: KAB	no	no	no	no	yes ^c
Korea, Rep. of: KATS-KOLAS/KAS	no	yes	yes ^d	no	yes
Peru	no	yes	yes	yes	no
Spain	yes	no	no	no	no
United Kingdom	no	no	no	no	no

Sources: Web sites of the national accreditation bodies.

Note: KAB = Korea Accreditation Board; KATS-KOLAS?KAS = Korea Agency for Technology and Standards, Korea Laboratory Accreditation Scheme, Korea Accreditation System.

a. By law, OAA is entitled to certify auditors, but it has never exercised this right.

b. INN certified auditors until 2004.

c. Certification of management system auditors.

d. Legal metrology only.

Table 9.3 Private Sector Participation in the Governance of Accreditation Bodies

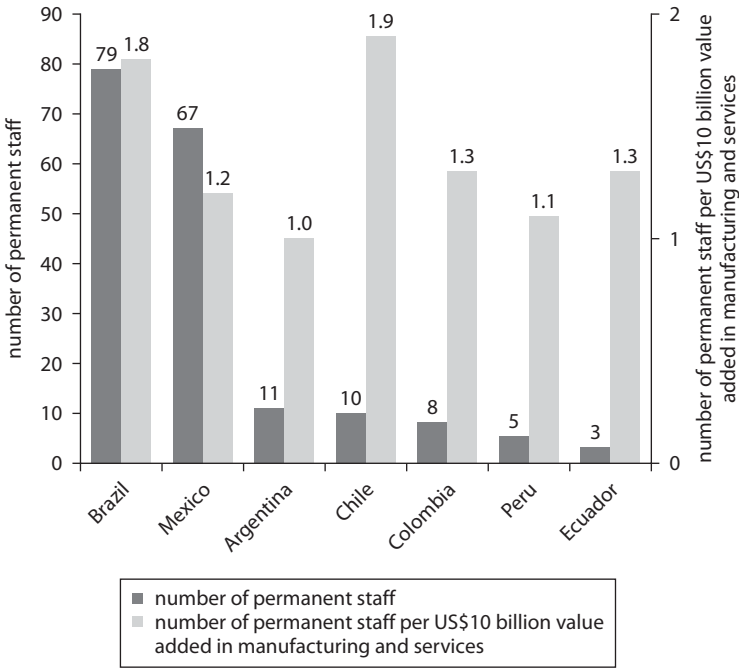
Country	Private sector participation in general assembly	Private sector participation in consultative council	Share of executive council members appointed by government (%)	Executive director appointed by government	Status
Argentina	yes	no	15	yes	private
Brazil	no	yes	100	yes	public
Chile	no	no	100	no	private
Colombia	no	no	100	yes	public
Ecuador	yes	yes	50	no	public
Mexico	yes	no	28	no	private
Peru	no	yes	100	yes	public
Spain	yes	yes	0	yes	private
United Kingdom	yes	yes	0	no	private

Sources: Web sites of the national accreditation bodies; authors' research.

there is no formal membership mechanism for the private sector, such as in the Superintendency of Industry and Commerce (SIC) in Colombia and INDECOPI in Peru. But this is also the case in Chile, where the INN was created by the government as a private foundation. In the case of Colombia and Chile, there is neither a general assembly nor a consultative council to represent the interests of stakeholders. In contrast, most private accreditation bodies have a general assembly of members who elect an executive council or board of directors. Nonetheless, in all of these cases a share of the executive council members are appointed by government entities to ensure that they are adequately represented. The case of Argentina is fairly similar to that of Spain: there is heavy private sector representation in the executive council, but the executive director is appointed by the central government.

Accreditation bodies operating in both the private and public sectors are far from fully autonomous. An autonomy index, showing an organization’s ability to exercise authority over its financial, technical, administrative, and human resources, can be calculated.¹ While this index reaches unity for most Latin American standards bodies, it is much lower for accreditation bodies,

Figure 9.1 Accreditation Body Personnel, 2005



Sources: Authors’ research; Web sites of the national accreditation bodies.

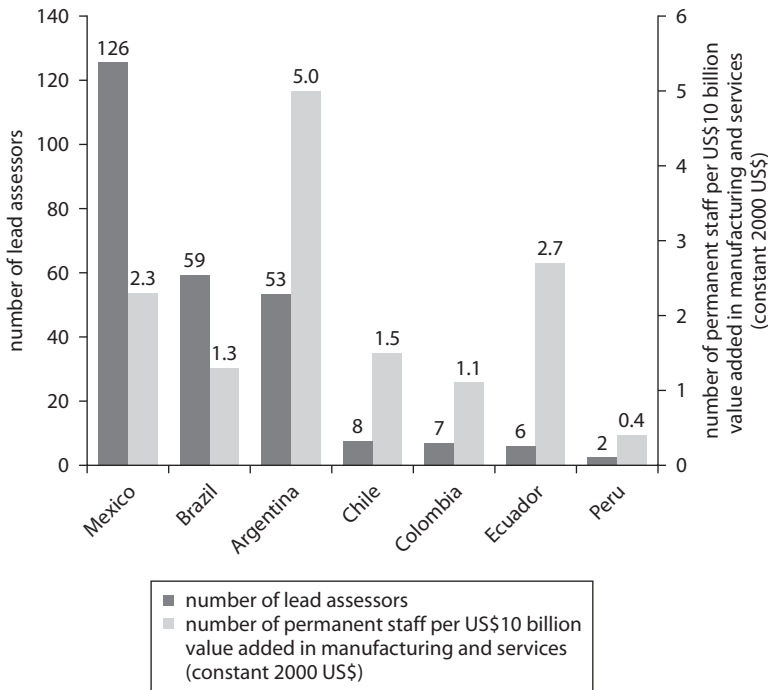
reaching 0.250 for Peru's INDECOPI and Colombia's SIC, 0.625 for Brazil's INMETRO, and 0.875 for the Ecuadorian Accreditation Body (OAE).

Resources for accreditation

There are important differences in the number of staff working in the different accreditation bodies, but these differences are smaller if the size of the industrial economy is taken into account. Brazil's INMETRO and the Mexican Accreditation Body (EMA) have a large number of personnel, but this is mostly due to the size of their manufacturing and service sectors (figure 9.1). When the number of personnel is standardized by value added in manufacturing and services, most accreditation bodies have roughly the same number of personnel.

The number of evaluation staff supporting the accreditation process is highly unequal across countries. Standardizing the number of lead assessors by value added in manufacturing and services highlights important disparities in this regard (figure 9.2). Ecuador and Argentina have an exceptionally

Figure 9.2 Number of Qualified Lead Assessors, 2005



Sources: IAAC 2004; World Bank 2005c; Superintendencia de Industria y Comercio of Colombia; authors' research.

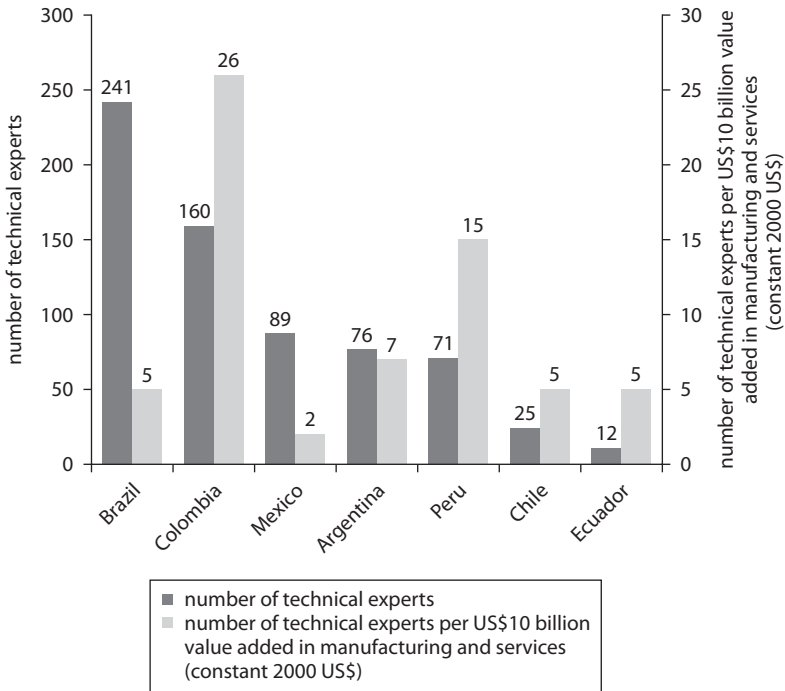
Note: 2004 data for Argentina, Chile, and Mexico.

high standardized number of lead assessors, while Peru has very few. Lack of evaluation staff can constrain the speed of accreditation.

The picture changes when comparing the number of technical experts. Technical experts are usually contracted to offer expertise in areas where assessors are not specialized. Hence, a low number of technical experts will limit the number of technical areas in which the accreditations can be performed. Brazil and Colombia have the largest number of technical experts in Latin America (figure 9.3). When this number is standardized by value added in manufacturing and services, Colombia and Peru have the highest numbers of technical experts, while Mexico has the lowest number. Technical experts may be especially useful where a low number of lead assessors limits their ability to specialize in different technical areas.

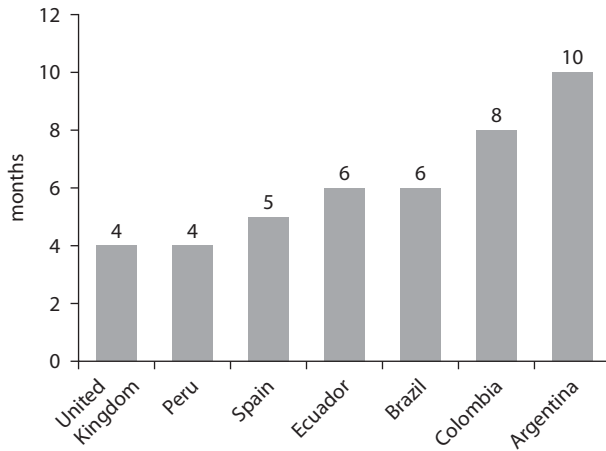
Latin American accreditation bodies are generally slower at delivering accreditations than counterpart bodies elsewhere. It takes 50 percent to

Figure 9.3 Number of Qualified Technical Experts, 2005



Source: Authors' research.

Note: 2004 data for Argentina, Chile, and Mexico.

Figure 9.4 Minimum Time Required for the Laboratory Accreditation Process

Source: Authors' research.

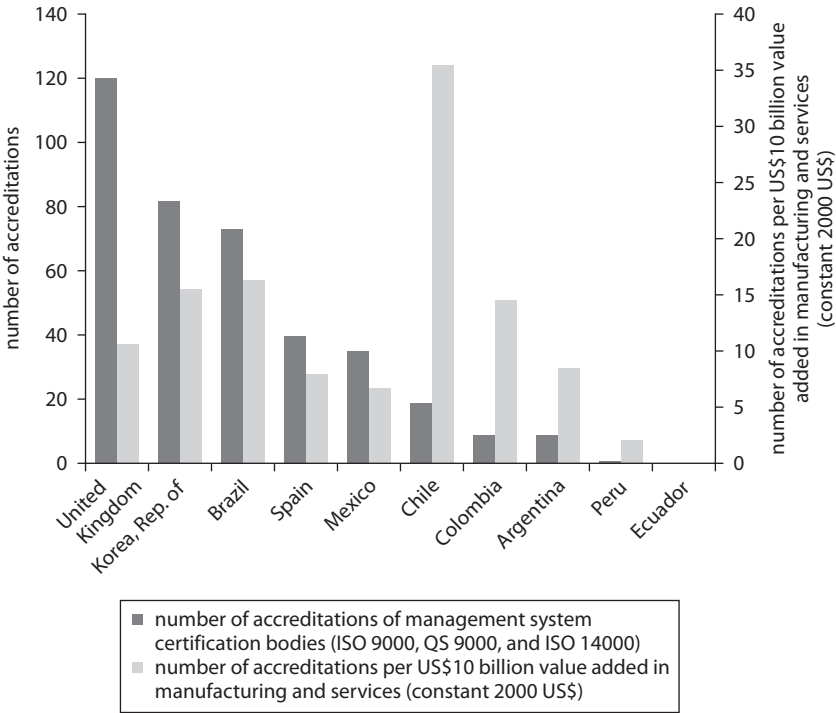
150 percent longer to accredit a laboratory in Latin America than it does in the United Kingdom, the exception being Peru (figure 9.4). This could produce a disincentive to accreditation.

Accreditation Activities

Most Latin American national bodies have accredited a significant number of quality system certification bodies (figure 9.5). Relative to value added in manufacturing and services, some Latin American countries have accredited as many as or more such certification bodies than Spain. Three countries, Brazil, Chile, and Colombia, have accredited more quality system certification bodies than the United Kingdom, relative to value added in manufacturing and services. Peru and Ecuador are exceptions and lag behind, having accredited very few certification bodies.

When the number of accredited inspection bodies is standardized by value added in manufacturing and services, Chile and Brazil perform much better than the United Kingdom, Korea, or Spain, and Colombia performs slightly better (figure 9.6). However, these comparisons can be misleading because they do not show the scope of accreditation. Accreditations issued by Latin American bodies cover a limited number of technical areas. In Chile, the vast majority of inspection bodies are accredited

Figure 9.5 Number of Accreditations of Management System Certification Bodies

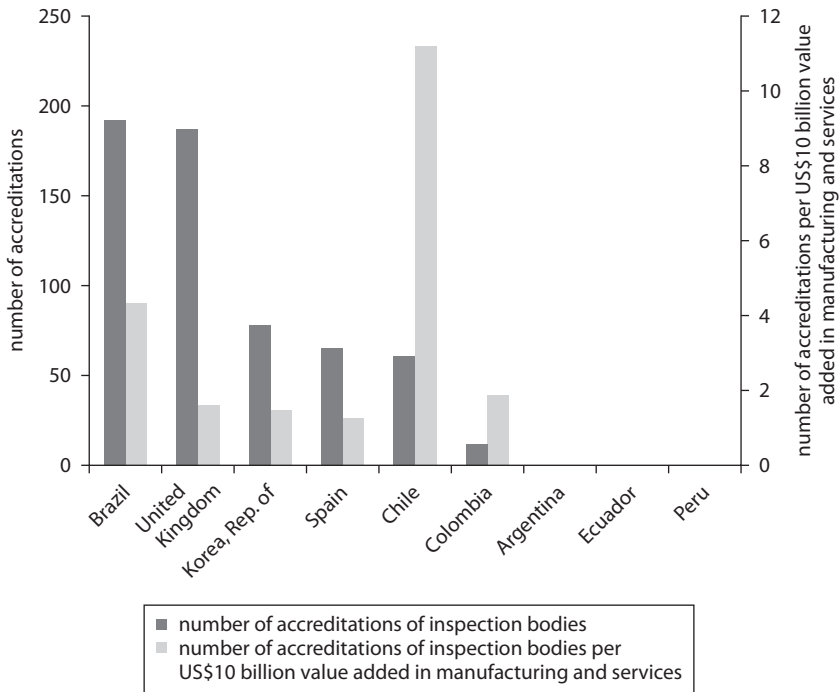


Sources: Web sites of the national accreditation bodies; World Bank 2005c.

Note: 2003 value added for the United Kingdom, Korea, and Spain; 2004 for other countries.

in the areas of gas installations and electrical products. In Colombia, most are accredited for gas installations. In both these countries, there are few or no inspection bodies accredited in other areas such as electrical installations or machine safety. Three countries, Argentina, Peru, and Ecuador, have not accredited a single inspection body in any area. This can inhibit certification, because some certifications require inspections.

Most Latin American countries have accredited a relatively high number of testing and calibration laboratories (figure 9.7). Comparing standardized numbers of accreditations, Latin American countries either exceed Spain's and Korea's performance or are not far behind. Nonetheless, it is difficult to assess the performance of accreditation bodies in terms of accredited calibration and testing laboratories. There may be cross-country differences in scope of accreditation. The scope of some

Figure 9.6 Number of Accreditations of Inspection Bodies

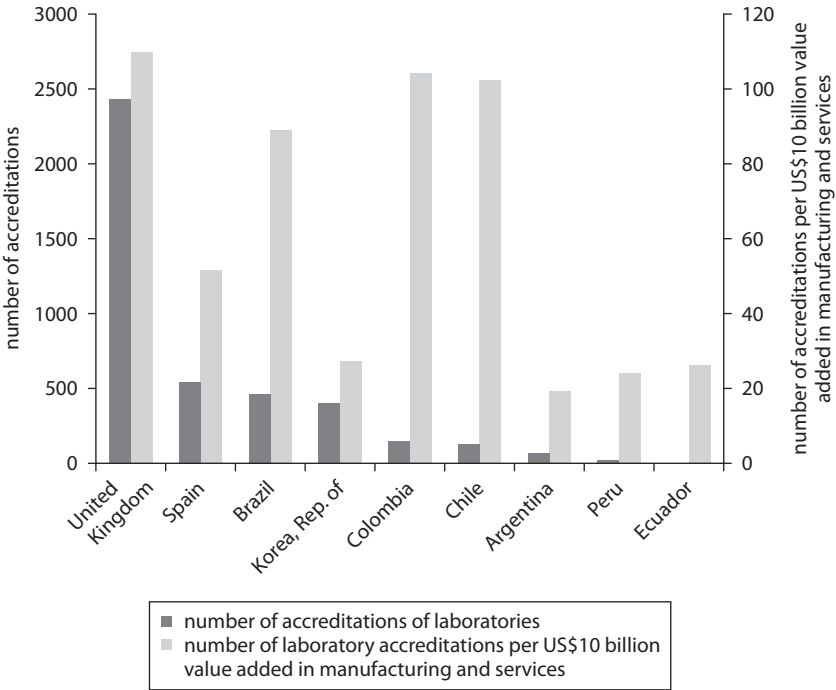
Sources: Authors' research; World Bank 2005c.

Note: 2003 value added for the United Kingdom, Korea, and Spain; 2004 for other countries.

accreditations may be quite narrow, covering only one calibration or test area, while in other cases an accreditation may cover a wide range of measurements and tests in different fields. While an examination and comparison of individual accreditations would be an option, this is complicated by the fact that most Latin American countries do not follow internationally accepted guidelines in defining the scope of laboratory accreditation.

In some Latin American countries, the national accreditation system appears to be either unrecognized domestically or not performing adequately. Evidence is provided by the number of foreign certification bodies that operate in Latin American countries but are not accredited by the national accreditation body (figure 9.8). In Peru and Ecuador, none of the nine quality system certification bodies operating nationally are

Figure 9.7 Number of Accreditations of Testing and Calibration Laboratories



Sources: Web sites of the national accreditation bodies; World Bank 2005c; authors' research.

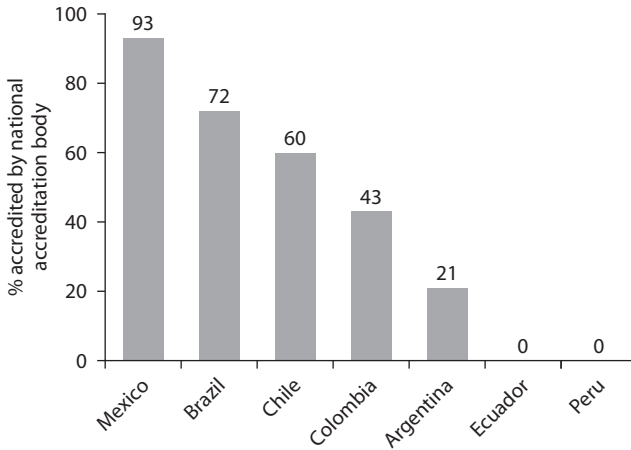
accredited by the national accreditation body. Instead, they are accredited in foreign countries. This points either to a disregard for national accreditations or to the incapacity of the national accreditation body to offer competitive accreditation services.

International Integration

Adoption of international standards for accreditation

Accreditation bodies in Latin American countries base their accreditation requirements on international standards. All of the accreditation bodies require conformance with standards based on ISO/IEC Guides 62, 66, and 65 for system and product certification bodies, and ISO/IEC 17025 for laboratories. In terms of inspection bodies, all countries base their requirements on ISO/IEC 17020, except for Chile, where INN uses a national standard, and Ecuador, where OAE does not offer accreditation for inspection bodies. Apart from Chile, all accreditation bodies

Figure 9.8 Proportion of Foreign Affiliates of Quality System Management Certification Bodies Accredited by the National Accreditation Body



Source: Authors' research.

theoretically also offer accreditations for personnel certification bodies, based on ISO/IEC 17024. However, few countries have delivered any accreditations in this area, and only Mexico and Brazil have accredited certification bodies in areas related to auditor certification.

Not all accreditation bodies fully conform to international best practice. Table 9.4 shows that Argentina is the only country to meet the requirements of ISO 17011:2004. This new international standard was published in September 2004 and establishes the general requirements for accreditation bodies accrediting conformity assessment bodies in the areas of testing, inspection, management system certification, personnel certification, product certification, and calibration. Members of the International Laboratory Accreditation Cooperation (ILAC) and the International Accreditation Forum (IAF) agreed to meet the requirements of ISO 17011:2004 by January 2006. This will become a prerequisite for joining the ILAC Mutual Recognition Arrangement and the IAF Multilateral Recognition Arrangement (MRA), effectively replacing the previous requirements established in Guide 58 for laboratory accreditation systems, Guide 61 for certification body accreditation systems, and ISO/IEC 17010 for inspection body accreditation systems. Currently, only INMETRO in Brazil and EMA in Mexico conform to these three sets of general requirements. Other accreditation bodies partially meet the general requirements.

Table 9.4 Implementation of ISO Guides and Standards for Accreditation Bodies

<i>Country</i>	<i>ISO Guide 58 (laboratories)</i>	<i>ISO Guide 61 (certification bodies)</i>	<i>ISO 17010 (inspection bodies)</i>	<i>ISO 17011 (all conformity assessment bodies)</i>
Argentina	T	T	P	T
Brazil	T	T	T	P
Chile	P	P	P	P
Colombia	P	P	P	P
Ecuador	T	P	N	P
Mexico	T	T	T	P
Peru	T	T	P	P

Sources: Authors' research; IAAC Web site.

Note: N = none, P = partial, T = total. Uses 2004 data for Argentina, Chile, Ecuador, and Mexico; 2005 data for Brazil, Colombia, and Peru.

Regional and international cooperation and mutual recognition agreements

Accreditation bodies in Latin America are involved in a number of MRAs at the subregional, regional, extraregional, and international levels. Table 9.5 shows the principal regional and international agreements and organizations operating MRAs involving Latin American countries. Each MRA is limited to specific categories of accreditations, including certifiers of products, of quality management systems (QMSs), of environmental management systems (EMSs), of persons, testing laboratories, calibration laboratories, and inspection bodies.

While some Latin American accreditation bodies are fully cooperating with regional and international organizations to establish MRAs, others remain isolated (table 9.6). Membership in an international or regional organization is a first step toward demonstrating credibility, obtaining technical assistance, and participating in MRAs, but Colombia's accreditation body, the SIC, is not a member of a single international or regional accreditation organization. As a member of the InterAmerican Accreditation Cooperation (IAAC), Peru's INDECOPI remains slightly less isolated than the SIC, but it is not a member of either the IAF or ILAC. Colombia, Peru, and Ecuador are only parties to the Andean Community's incipient MRA, which itself is limited to product certifications. In contrast, countries such as Mexico, Argentina, and Brazil are extremely well connected and internationally recognized, having secured intraregional, extraregional, and international MRAs covering most of their trade partners.

Table 9.5 Principal Regional and International Organizations Operating Mutual Recognition Agreements for Accreditation Within, or in Cooperation with, Latin American Countries

<i>Agreement or organization</i>	<i>Description</i>	<i>Member countries</i>	<i>MRA or MLA signatories</i>
Mercosur (Southern Common Market)	Customs union	Argentina, Brazil, Uruguay, Paraguay	MRA under development
CAN (Andean Community)	Customs union	Colombia, Bolivia, Peru, República Bolivariana de Venezuela, Ecuador	Product: 5 countries
IAAC (InterAmerican Accreditation Cooperation)	Regional organization	23 countries in the Americas	QMS: 4 countries Calibration and testing: 5 countries
APLAC (Asia-Pacific Laboratory Accreditation Cooperation)	Regional organization	21 countries in the Asia Pacific region	Calibration, testing, and inspection: 15 countries
PAC (Pacific Accreditation Cooperation)	Regional organization	16 APEC countries + accreditation bodies of Islamic Republic of Iran, Pakistan, and India	QMS: 15 countries EMS: 10 countries Product: 4 countries
EA (European Co-operation for Accreditation)	Regional organization	Members and cooperative agreements: 36 European countries + 11 non-European countries	Calibration and testing: 28 countries QMS: 21 countries EMS: 21 countries Product: 22 countries Inspection: 17 countries Persons: 19 countries
IAF (International Accreditation Forum)	International organization	44 countries + 4 regions	QMS: 36 countries + 2 regions (EA and APLAC) EMS: 29 countries + 2 regions (EA and APLAC) Product: 24 countries + 2 regions (EA and APLAC)
ILAC (International Laboratory Accreditation Cooperation)	International organization	71 countries + 5 regions	Calibration, testing, and inspection: 40 countries + 2 regions (EA and APLAC)

Source: Authors' research.

Table 9.6 Membership in International Organizations and Mutual Recognition Agreements

<i>Country</i>	<i>IAF</i>	<i>ILAC</i>	<i>Regional</i>	<i>MLA or MRA</i>
Argentina	yes	yes	IAAC	IAF, ILAC, IAAC
Brazil	yes	yes	IAAC, EA	IAF, ILAC, IAAC, EA
Chile	yes	associate	IAAC	IAF
Colombia	no	no	no	CAN
Ecuador	no	affiliate	IAAC	CAN
Mexico	yes	associate	IAAC, APLAC, PAC	IAF, ILAC, IAAC, PAC
Peru	no	no	IAAC	CAN
Korea, Rep. of	yes	yes	PAC, APLAC	IAF, ILAC, PAC, APLAC
Spain	yes	yes	EA	IAF, ILAC, EA
United Kingdom	yes	yes	EA	IAF, ILAC, EA

Sources: IAF, ILAC, IAAC, EA, APLAC, and PAC Web sites.

CHAPTER 10

Metrology in Latin America

The Latin American region has a long history in metrology, but limited capacity to date. There is an urgent need for modernization of the relevant institutions so they can keep pace with new market demands and also respond more quickly to users' needs and demands. Emphasis should be given to erasing conflicts of interest and facilitating the accreditation for calibration of most metrology laboratories.

The National Metrology Institutions

Organization of scientific and legal metrology institutions

Apart from Chile, all Latin American countries in the survey have public scientific metrology institutions (table 10.1). This is the norm in most countries throughout the world. Although Chile's INN is technically a private nonprofit organization, it is largely subject to public sector control, thus rendering it a quasi-public institution. Legal metrology institutions in all countries are always public.

Scientific and legal metrology functions are performed by a single institution in most Latin American countries. This is an accepted practice found in many other countries, although a separation of functions is also common. In Brazil, Colombia, Ecuador, and Peru, the National Metrology Institute (NMI) acts both in scientific and legal metrology. Argentina presents a hybrid situation where the NMI is jointly responsible for legal metrology with the Secretariat of Technical Cooperation within the Ministry of the Economy and Production. In Chile and Mexico, legal metrology is the responsibility of another institution. This is also the case in the Republic of Korea.

Table 10.1 Organization of Scientific and Legal Metrology Institutions

Country	National scientific metrology institution	National legal metrology institution	Legal status of national scientific metrology institution	Number of national depositories of reference standards
Argentina	INTI	Technical Cooperation Secretariat, Ministry of Economy and Production/ INTI	public	2
Brazil	INMETRO	INMETRO	public	3
Chile	INN	SERNAC	private	6
Colombia	SIC	SIC	public	1
Ecuador	INEN	INEN	public	1
Mexico	CENAM	DGN	public	2
Peru	INDECOPI	INDECOPI	public	1
Korea, Rep. of	KRISS	KATS	public	1
Spain	CEM	CEM	public	7
United Kingdom	NWML	NWML	public	4

Source: Authors' research.

Note: CEM = Spanish Metrology Center; CENAM = National Metrology Center; DGN = General Bureau of Standards; INDECOPI = National Institute for the Defense of Competition and the Protection of Intellectual Property; INEN = Ecuadorian Standardization Institute; INMETRO = National Institute of Metrology, Standardization and Industrial Quality; INTI = National Institute of Industrial Technology; KATS = Korean Agency for Technology and Standards; KRISS = Korea Institute of Standards and Science; NWML = National Weights and Measures Laboratory; SERNAC = National Consumer Service; SIC = Superintendency of Industry and Commerce.

National metrology standards are relatively centralized in most Latin American countries. In many Latin American countries, a single national metrology institution maintains all of the national reference standards (table 10.1). Even in the case of Mexico and Argentina, where two institutions are responsible for national reference standards, the system is rather centralized. In both of these countries, the primary NMI holds the totality of the reference standards, with the exception of the radiation standards held in a separate national nuclear laboratory. Chile is an exception in that its NMI does not maintain any of the national standards. Instead, six independent laboratories, which include for-profit companies, are designated by government decree. This system is similar to that of the United Kingdom, where a combination of for-profit and nonprofit laboratories maintain the national reference standards.

Table 10.2 Activities of the National Scientific Metrology Institutions

<i>Country</i>	<i>Voluntary standards</i>	<i>Accreditation</i>	<i>Intellectual property</i>	<i>Certification</i>
Argentina	no	no	no	yes
Brazil	no	yes	no	no
Chile	yes	yes	no	no
Colombia	no	yes	yes	no
Ecuador	yes	no	no	yes
Mexico	no	no	no	no
Peru	yes	yes	yes	no
Korea, Rep. of	no	no	no	no
Spain	no	no	no	no
United Kingdom	no	no	no	yes

Sources: Web sites of the national metrology institutions.

In some cases, the NMI is also involved in activities that may create conflicts of interest. NMIs in the United Kingdom, Spain, and Korea concentrate most of their activities on metrology. In Spain and Korea, they restrict their scope of operation to metrology and research and development. In the United Kingdom, the National Weights and Measures Laboratory (NWML) also performs other activities, but these are limited to certification services (table 10.2). By contrast, a number of Latin American NMIs are housed in multifunctional institutions. In Chile, Ecuador, and Peru, the NMI is also the national standards body. Chapter 7 discussed how this could affect the impartiality of the standards development process if the two functions are not properly separated.

In four Latin American countries, the NMI is also the national accreditation body. This could create conflicts of interest because the accreditation body could require candidate laboratories to be calibrated with the NMI, even though this would be less reliable or more costly than with a globally recognized NMI in another country. The accreditation body could also discriminate against candidate laboratories that compete with the NMI in the market for industrial calibrations. Even when there are no competing private laboratories, the accreditation arm of the NMI could face pressures from its metrological arm to accredit its own laboratories to enhance their credibility. Another potential conflict of interest is found in Colombia and Peru, where the SIC and the INDECOPI serve as the NMI as well as the intellectual property registration agency. Metrology institutions conduct research and development, which may at times

involve patentable technology. Any dispute over intellectual property rights can be unfairly resolved in favor of the NMI if the two functions are not sufficiently separated. In Argentina and Ecuador, the NMI also offers certification services. This should not pose conflicts of interest and may enable the NMI to raise additional income.

Scientific and technical capabilities

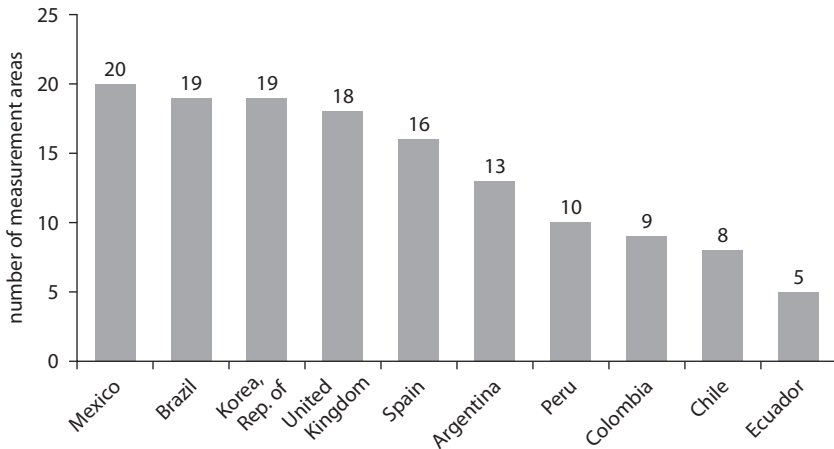
Most national metrology laboratories are not accredited for calibration (table 10.3). The calibration services provided by the national metrology laboratories are the starting point for the national chain of traceability and should meet the highest standards. Accreditation of an NMI's laboratories can help create national confidence in the institution, increase its customer base, and facilitate the signing of MRAs. Chile stands out from the other Latin American countries, because five of its six metrology laboratories are accredited. However, these laboratories are accredited by INN, which itself is the NMI and coordinates the national metrology laboratory network. It is unclear whether this dual role has influenced the INN's impartiality. The only other NMI with laboratories accredited for calibration is in Peru, but only one of its six labs has accreditation. None of the other countries have accredited their national metrology laboratories for calibration. As mentioned in chapter 4, it is not universal practice to require national metrology laboratories to be accredited, but this can be of great benefit. Two of Spain's six national laboratories are accredited, and all four of the United Kingdom's national laboratories are accredited.

While some NMIs offer national traceability in a wide range of scientific areas, others have a very narrow range of technical capabilities

Table 10.3 Accreditation of the National Metrology Laboratories

<i>Country</i>	<i>Number of national metrology laboratories accredited for calibration</i>
Argentina	0
Brazil	0
Chile	5 of 6
Colombia	0
Ecuador	0
Mexico	0
Peru	1 of 6
Korea, Rep. of	0
Spain	2 of 6
United Kingdom	4 of 4

Source: Authors' research.

Figure 10.1 Number of Measurement Areas in the National Metrology Laboratories

Sources: Web sites of the national metrology institutions; authors' research.

Note: Possible measurement areas are accelerometry, acoustic, dimensional, electrical, force, flow, hardness, humidity, magnetic flux, mass, optical and photometric, pressure and vacuum, radiological (including ionizing radiation), surface texture, thermal, time and frequency, vibration, viscosity, and volume.

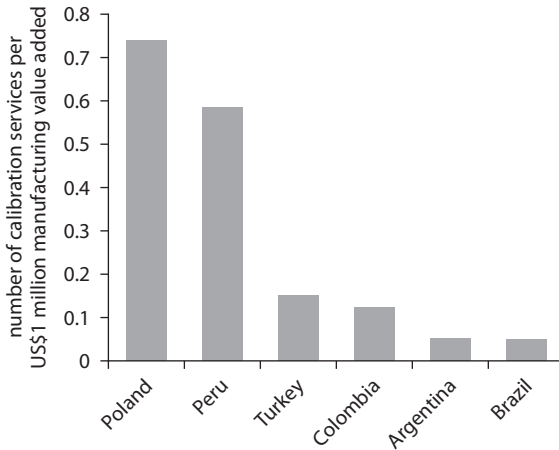
(figure 10.1). The scientific capabilities of an NMI are limited by the accuracy, precision, and range of its measurements, but also by the number of measurement areas it covers. Countries with technologically advanced and diversified industrial sectors require metrological services in more scientific areas. The most basic calibration services, which include dimensional, mass, force, and pressure measurements, are offered by all of the surveyed Latin American NMIs. The Ecuadorian Standardization Institute (INEN) offers services in these four areas as well as volume measurements, but none in other slightly more complex activities, such as flow and thermal measurement. Argentina, Chile, Colombia, and Peru have capabilities in a wider range of measurement areas than Ecuador, but these tend to be in technologically simple activities. Only NMIs in Mexico and Brazil are involved in the full spectrum of metrological activities found in the United Kingdom's and Korea's NMIs.

Metrological Activities

Calibration services

There are important disparities in the number of calibration services offered by NMIs in different Latin American countries. Figure 10.2 shows the number of calibration services offered by the NMIs of different countries, standardized by manufacturing value added. The figure shows Peru with a

Figure 10.2 Number of Calibration Services Offered by NMIs, Standardized by Manufacturing Value Added, 2005



Sources: Web sites of the national metrology institutions; authors' research.

Note: 2003 data on manufacturing value added.

much larger number of calibration services than Colombia, Argentina, or Brazil. One possible explanation for the very large number of calibrations displayed in some countries is that the private market for calibration is underdeveloped in those countries. In such cases the NMIs may be serving both the primary market (calibration laboratories) and secondary market (industrial users), while in other countries with more developed calibration markets the NMIs are only serving the primary market.

Verification

There are deficiencies in the enforcement of legal metrology in certain countries in Latin America. While there were more than 12 million measuring instrument verifications in Brazil in 2004, there were only 1,500 in Peru and 50 in Colombia during that year. It is clear from these numbers that the legal metrology infrastructure is at very different stages of development in different countries. While Brazil's system is well established, Colombia's is still in its infancy.

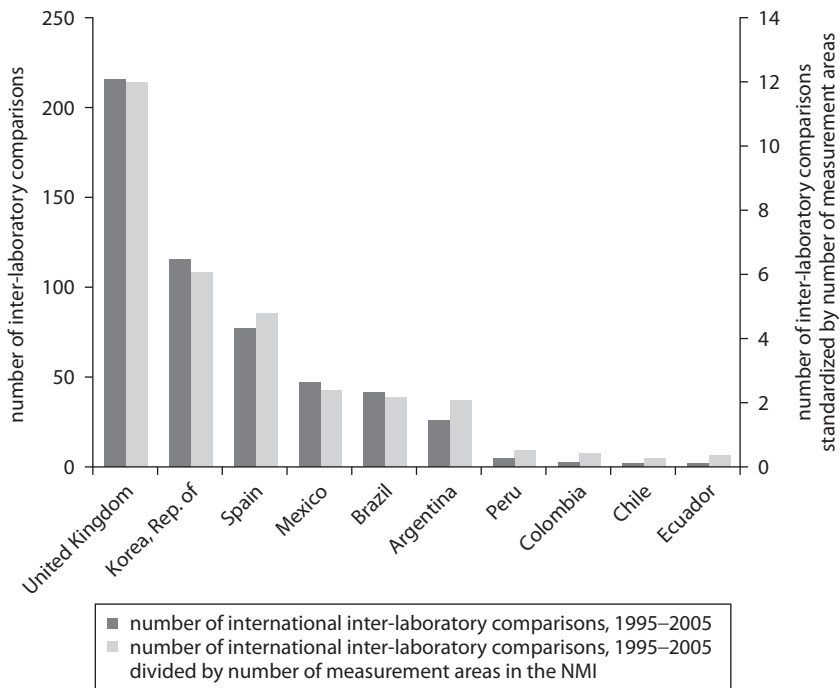
International Cooperation and Recognition of Metrology Institutions

International laboratory comparisons

Latin American countries are involved in few international and regional programs for the comparison of laboratory measurement and calibration.

Inter-laboratory comparison programs conducted at the regional level by the InterAmerican Metrology System (SIM) and at the international level by the International Bureau of Weights and Measures (BIPM) are the most widely accepted references for the technical capabilities of metrology laboratories. Without such references, it is difficult to assess the accuracy and precision of a laboratory's measurements. Latin American countries have been involved in few inter-laboratory comparisons. This holds true for both the total number of comparisons and the average number of comparisons for a given measurement area offered by the national laboratory. Mexico and Brazil, the Latin American countries that have participated in the most comparisons, participated in less than half as many as Korea between 1995 and 2005 (figure 10.3). Peru, Colombia, Chile, and Ecuador are the worst performers in the region, having only participated in two to five comparisons during that period, in contrast to 216 in the United Kingdom.

Figure 10.3 International Laboratory Comparison Activities, Absolute Number and Standardized by Number of Measurement Fields Offered by the NMI, 1995–2005



Source: National Institute of Standards and Technology International Comparisons Database, based on appendixes B, C, and D of the International Committee of Weights and Measures Mutual Recognition Arrangement.

Table 10.4 Membership in International Organizations

<i>Country</i>	<i>CGPM Metre Convention</i>	<i>CIPM MRA</i>	<i>OIML</i>	<i>CITAC</i>
Argentina	yes	yes	corr.	yes
Brazil	yes	yes	yes	yes
Chile	yes	yes	no	no
Colombia	no	no	no	no
Ecuador	associate	yes	no	no
Mexico	yes	yes	corresponding member	yes
Peru	no	no	corr.	no
Korea, Rep. of	yes	yes	yes	yes
Spain	yes	yes	yes	no
United Kingdom	yes	yes	yes	yes

Sources: BIPM, OIML, and CITAC Web sites.

Note: CITAC = Cooperation in International Traceability in Analytical Chemistry.

Membership in international organizations

At an institutional level, only Brazil is fully integrated in the international metrology system (table 10.4). Brazil is a member of the two main international metrology organizations, the International Bureau of Weights and Measures (BIPM) and the International Organization of Legal Metrology (OIML), and of the Cooperation on International Traceability in Analytical Chemistry (CITAC), and it has signed the CIPM MRA. While most other Latin American countries are members of the Metre Convention of the General Conference on Weights and Measures (CGPM), Brazil is the only country in the region that is a full member of the OIML. Colombia and Peru are the two most isolated countries in terms of membership in international organizations and MRAs.

CHAPTER 11

Existing Policies and Support Programs

A number of support programs have been implemented in Latin American countries to facilitate the diffusion of standards and quality in the productive sector. These are the result of efforts by governments, international donors, and the private sector. Most programs aim to correct the specific market failures affecting small and medium enterprises (SMEs) and limiting their adoption of standards, many of which were mentioned in chapter 6.

Brazil: Center for Quality, Safety and Productivity

In Brazil, the Center for Quality, Safety and Productivity (QSP) is a non-profit organization created by a group of enterprises, academics, and consultants in 1991. Its objective is to help firms implement and improve their management systems and become sustainable. The QSP focuses on the main international and Brazilian standards, which include ISO 9001, ISO 14001, and OHSAS 18001. A \$36 monthly membership fee provides firms with access to QSP benchmarking instruments, information on quality and certification, training manuals and interactive training guides, networking opportunities, mutual assistance schemes, and seminars. There are currently 135 member firms.

In addition, QSP offers consulting and internal auditing services for the implementation of management systems and has assisted more than 400 firms in this area. The center also offers training in quality management practices and safety practices, including personalized courses for

enterprises. Specialized assistance is available to SMEs. So far, more than 600 firms have participated in a specialized SME consulting program. A cooperation agreement with Banco do Brasil also provides low-cost financial services to SMEs participating in the training, consulting, and auditing programs. In this scheme, firms with revenues of up to \$2.2 million are eligible for financing of up to 80 percent of project costs.

Colombia: Quality and Environmental Management Program

Much of Colombia's recent success with the diffusion of management system certification can be attributed to several support programs funded by the government, international donors, and private organizations. In particular, the Quality and Environmental Management Program (CYGA) has been credited for playing an important role in increasing certification in Colombia.¹

CYGA operated from 1999 to 2003 under the auspices of two domestic organizations: ICONTEC, the national standards organization, and SENA, the National Training Service. Approximately half of the \$2.4 million program budget was funded through a grant from the Inter-American Development Bank. The objective of the program was to increase the competitiveness of SMEs by strengthening concern for quality assurance and environmental conservation. CYGA focused on introducing quality assurance systems based on ISO 9000 and ISO 14000 standards. The program was based on a holistic approach to certification and had four complementary components:

1. Raising SME awareness of buyer requirements
2. Training auditors and consultants in quality and environmental systems
3. Supporting the implementation and certification of quality and environmental management systems in SMEs
4. Providing marketing and know-how transfer to ICONTEC

The first component consisted of conferences and training activities. Free conferences were organized in seven cities to sensitize SMEs to the advantages of implementing quality management systems. Courses on quality assurance and environmental management were offered to SME personnel in the different cities. SME candidates were selected for the training courses based on a number of requisites, including size, turnover, export potential, and willingness to participate in the program.

The second component consisted of offering high-level technical training for management system auditors and consultants (trainers for SMEs)

Table 11.1 CYGA: Participation and Subsidies

<i>Subcomponent</i>	<i>1999–2003 participation</i>	<i>Subsidies (%)</i>
Internal auditor training	1,283 auditors	0
Consultant training	682 consultants	0
Enterprise training	503 enterprises	50
Consulting	526 enterprises	50
Pre-audits	337 enterprises	50
Audits	924 enterprises	Not specified

Source: CYGA.

who would participate in later stages of the program (component 3). Auditors and consultants were expected to bear the full cost of the course, based on market price, the rationale being that they would recoup these costs through their participation in the SME advisory program.

The third component provided financial support for participating SMEs to hire technical advisory services, training services, and pre-auditing in ISO 9000 or ISO 14000. Firms that had not participated in the initial training courses could still participate in component 3 if they demonstrated that they had at least one internal quality system auditor on their payroll. CYGA also subsidized the actual auditing and registration process, conditional upon available funding from the program. Otherwise, CYGA had undertaken agreements with two commercial banks to provide loans for this process. Some details on the results of components 1 to 3 are shown in table 11.1.

Component 4 consisted mainly of training the staff of ICONTEC and other related entities in developing technical assistance methods for SMEs and marketing their program.

Other quality promotion programs in Colombia

Besides CYGA, two other programs have been credited for contributing to the success of certification in firms in Colombia. These are the National Program for Quality Assurance (PNAC) and the Colombian Fund for the Modernization and Technological Development of Micro, Small and Medium Enterprises (FOMIPYME).

PNAC was designed by the National Training Service (SENA) to offer specialized training and technical assistance to exporting firms and firms with export potential to help them implement and become certified for ISO 9000, ISO 14000, and the Hazard Analysis and Critical Control Point (HACCP) food safety standard. SENA cofinances 50 percent of the value of the project, and the firm covers the remaining 50 percent.

SENA contributed more than \$4.7 million in cofinancing from 1999 to 2005. During that period, 561 firms participating in the program received certification, and 132 are in the process of becoming certified. Roughly 57 percent of the program participants are small firms, 37 percent are medium firms, and 6 percent are large firms.

FOMIPYME was created by national legislation in 2000. Its objective was to cofinance programs, projects, and activities to promote the technological development of SMEs and to provide technical assistance to these firms. FOMIPYME cofinanced up to 65 percent of the total value of each project. From 2001 to 2004, FOMIPYME financed 155 projects involving the implementation of a quality system. Of these beneficiaries, 72 percent were microenterprises and 28 percent were SMEs.

Peru: CERTIpyme, PYMEvaluación, and PRECISO

In Peru, there are three recent private sector initiatives to increase quality control and certification in SMEs. Together, these programs provide various certification schemes that are tailored to the needs and means of small business.

CERTIpyme aims to gradually increase the competitiveness of micro and small enterprises by taking them through various certification schemes. The program is operated by COPEME, a consortium of nongovernmental organizations dedicated to the development of SMEs; Quality Consulting, a quality management systems consulting firm; and CERPER, a private certification body. There are two certification levels that are designed to progressively take the firm toward a quality management certification scheme. Level I, "organization certification," establishes that a firm complies with all official requirements to operate in the formal sector. Level II, "process certification," includes the requirements from Level I and is based on a firm's productivity and its adoption of a basic quality system. The program includes all of the activities to support certification, including consulting, training, and auditing. The costs are \$80 for Level I certification and \$120 for Level II certification.

SGS, an international certification body, operates two programs for SMEs. PYMEvaluación is a certification program in which SGS evaluates various aspects of a company's technical capacity and its ability to fulfill customer requirements. These aspects include logistics management, commercial management, human resources, productive facilities and capacity, quality control, and financial condition. The objective of the evaluation is to provide SMEs with a means to evaluate their strengths

and weaknesses. The certificate, when obtained, can be used to enhance buyer confidence in a supplier. However, this certificate is tailor-made for the Peruvian market and is not widely recognized internationally.

A second SGS program, PRECISO, is designed to offer low-cost ISO 9001:2000 certification to SMEs. Prices are adapted to the specific needs and structure of each firm. PRECISO is open to firms with fewer than 25 employees, and to firms of between 26 and 45 employees subject to a preliminary evaluation.

Mexico: National Committee on Productivity and Technological Innovation

In Mexico, the National Committee on Productivity and Technological Innovation (COMPITE) was established in 1997 as a nonprofit organization to promote productivity, quality, and social responsibility in SMEs. There are currently six COMPITE offices throughout Mexico that offer subsidized training, courses, workshops, and consulting services and organize congresses. Although COMPITE offers services to firms of all sizes, micro and small enterprises constitute most of those receiving workshops and consulting services (table 11.2).

COMPITE receives funding from the Ministry of the Economy to offer subsidized services for SMEs. In 2004 the ministry provided COMPITE with \$1.74 million. SMEs and individual participants may only receive subsidies for one service from COMPITE annually, but they can combine this funding with other state or municipal funding.

A number of courses are offered in the areas of ISO 9000, quality culture, managerial skills, and productivity. These courses are designed for entrepreneurs, business employees, and consultants. Also, COMPITE's

Table 11.2 Distribution of Enterprise Size in Two COMPITE Programs, 2004

<i>Program</i>	<i>Enterprise size</i>	<i>Share of total participating firms (%)</i>
Workshops	Micro	72
	Small	19
	Medium	5
	Large	5
Consulting	Micro	40
	Small	39
	Medium	15
	Large	6

Source: COMPITE.

Table 11.3 COMPITE Programs: Participation and Subsidies

<i>Program</i>	<i>Participation, 2001–04</i>	<i>Subsidies (US\$)</i>
Training courses	20,698 enterprises 291,812 hours 54,298 participants (individuals)	Entrepreneurs: up to 50%, \$885 maximum Consultants: up to 70%
Workshops	8,289 enterprises 189,664 hours	Microenterprise: up to 70%, \$3,628 maximum Small enterprise: up to 50%, \$3,097 maximum Medium enterprise: up to 30%, \$2,212 maximum
Consulting	2,269 enterprises 78,477 hours	Microenterprise: up to 70%, \$5,752 maximum Small enterprise: up to 50%, \$5,310 maximum Medium enterprise: up to 30%, \$4,867 maximum

Source: COMPITE Web site.

four-day workshops provide quick solutions to problems related to manufacturing processes.² Workshops are offered to individual firms, but are also available to groups of firms in the case of microenterprises.

COMPITE's consulting services are designed to help SMEs implement the ISO 9000 quality management system. Consulting services are offered to individual companies, but also to groups of firms in the case of microenterprises. Consulting services include a diagnostic service that establishes the degree of implementation of a quality system in the enterprise; an implementation consulting service, which consists of 10 hours per month of assistance in the implementation of a quality system; and revision of the quality system by a different consultant. The participation and subsidies of the training, consulting, and workshop programs are shown in table 11.3.

Finally, COMPITE organizes an annual International Congress on Quality for Micro, Small, and Medium Enterprises. The objective of the congress is to promote an exchange of experiences and knowledge between SME entrepreneurs. The cost of the congress is subsidized for SME entrepreneurs and personnel. Attendance varies each year and has ranged from 35 to 1,800 SMEs in the past three years.

Chile: Chilean Economic Development Agency

In Chile, a central government agency, the Chilean Economic Development Agency (CORFO), has been supporting quality and certification through two funding instruments. The Technical Assistance Fund, established in 1992 for SMEs, and the Enterprise Management Support Pro-

gram, established in 1999 for large enterprises, have both provided grants to subsidize consulting services, including, but not restricted to, services for implementation of quality management systems. In 2004, CORFO contributed 3,505 million pesos to 2,188 enterprises through these programs (CORFO 2005).

Both of these programs are being phased out and replaced by a new funding instrument explicitly dedicated to quality. The Quality Promotion instrument consists of a grant to subsidize consulting services for SMEs wishing to implement a management system based on a verifiable or certifiable standard. Eligible consultants must be listed in the national registry of consultants maintained by INN, Chile's national standards institute. Firms may seek certification against standards such as ISO 9001, ISO 14001, NCh 2909 (the national standard for SME management systems), PABCO (Animal Premises Under Official Control), OHSAS (Occupational Health and Safety Assessment Series), and HACCP. The grant can be used for the entire process leading to the certification or verification, including the conformity assessment procedure itself. The grant covers 70 percent of the implementation costs and 90 percent of the certification costs for the NCh 2909 standard, and 50 percent for implementation and certification of ISO 9001, ISO 14001, OHSAS, and HACCP. The maximum disbursement depends on the standard against which the firm is being certified.

Argentina: Standards and Quality Accreditation Program (ProCal)

In Argentina, the objective of the Standards and Quality Accreditation Program (ProCal) is to improve the competitiveness of SMEs by promoting management, process, and product quality. This program, operated through the Argentine Accreditation Bureau (OAA) and partially financed by a grant from the Inter-American Development Bank, aims to strengthen both the supply and demand of accreditation services. On the supply side, ProCal provides financial assistance to the OAA for training and program development. On the demand side, ProCal provides financing to prepare testing and calibration laboratories to qualify for ISO/IEC 17025 accreditation. It also promotes secondary demand for accreditation by holding informative seminars for SMEs to explain the commercial advantage of testing, calibrating, and certifying products of accredited entities. The budget for the demand component of ProCal totals \$1,077,000 over three years, of which roughly half is provided by the Inter-American Development Bank.

CHAPTER 12

Policy Recommendations and Conclusion

This closing chapter presents recommendations for developing countries that are committed to implementing and modernizing effective national quality systems to facilitate trade, successfully integrate in the global economy, and enhance competitiveness. While this book has highlighted the structure and performance of selected Latin American countries, the recommendations presented here apply not only to them but to all developing countries. The objectives, themes, issues, and problems related to quality and standards are quite similar across countries. The main differences tends to be in the countries' initial conditions.

The chapter begins by setting forth a list of general principles and actions needed for successful reform. It next examines the process of consolidating the national quality system and looks at each of four specific functions of the system in turn—accreditation; metrology; standardization; and certification, testing, and calibration. For each of these functions, recommendations are presented in three areas: the organization of the function, the type and structure of government support, and efforts to enhance international integration.

General Principles for Implementation and Reform of National Quality Systems

A successful national system of quality and standards that can effectively support trade and competitiveness initiatives will embrace a number of

key principles and elements. Countries that set out to build such a system should

- Ensure *political commitment* to the task. This commitment will be reflected in a clearly stated and integrated vision, in appropriate resource allocation, and in the development or reform of the right type of institutions.
- Assign a *single government agency or unit* to be responsible for the coherence, coordination, and oversight of the national quality system and for proposing appropriate government interventions. It may be more effective to create a new agency by restructuring existing units with diverse or overlapping jurisdictions.
- Involve the *private sector* from the start, and establish a clear understanding of the relative roles and jurisdictions of the public and private sectors in this public-private undertaking. An advisory council on quality is one option, and often a best practice.
- Make a special effort to *integrate small and medium enterprises (SMEs)* in the process of adopting all relevant types of standards.
- Pursue a *decentralized approach* that brings service delivery as close as possible to the users and beneficiaries.
- Offer a well-planned *information and advocacy program* to show the need for and benefits of the use and adoption of quality standards. Such a program should be targeted particularly to SMEs.
- Provide adequate *budget support* and capacity to carry out the relevant functions assigned to the public sector.
- Develop and nurture the necessary *human capital* through the training of personnel who will administer the quality services of the system.
- Strengthen the *international projection and recognition* of the national quality system in selected countries, as references to establish benchmarking, levels of compatibility, competitiveness, and affectivity. This will help facilitate its recognition by other countries with similar systems, through bilateral or multilateral agreements, so as to benefit domestic industry and avoid unfair competition and technical trade barriers. Steps should be taken to establish national procedures and processes for the accreditation of laboratories and certification institutions that bring international recognition and compliance.
- Establish *national reference systems* for weights and measurements.
- Legislate appropriate sunset provisions for the *government to withdraw* from certain roles and tasks as the system evolves and the private sector can take over.

- Place an overall emphasis on facilitating *competition*, among domestic firms and between domestic and foreign firms, as a key motivator for the use and adoption of standards.
- Observe the *rule of law and property rights*, including international property rights, in all cases.
- Design and implement effective programs to increase awareness of the need for and impact of adopting *modern quality management systems*, and implement policies and incentives to build demand for services of metrology, norms, testing, and quality certification by private firms, organizations, and leading government institutions.

Consolidating the National Quality System

Most countries in Latin America and the Caribbean, and many elsewhere, have begun taking the first steps in the process of creating an effective national quality system. Many have an adequate—albeit not perfect—legal and regulatory framework of laws and decrees that defines the system of metrology, accreditation, normalization, and certification. A number of countries also have institutions at the national level with a formal mandate to carry out those tasks.

Quite often, however, application of the established system of norms and standards is insufficient or flawed. The level of development of the activities and the capacity of the institutions and their international recognition are highly variable and frequently low. In practically all countries there are serious coordination problems and significant overlap in the functions and jurisdiction of the relevant institutions. This is indeed a grave problem with a large adverse impact, especially given the scarcity of public resources assigned to the national quality systems. In the process of building up and improving the supply of services in the system, it is critical not to lose focus on the need to tailor those services to the needs of industry.

The first step is to carry out an extensive and systemic evaluation of the current normativity to see whether it meets the changing needs of the country in the current context of increasing globalization. In the process of updating the country's normativity, it is essential to set up a proper coordinating mechanism among institutions to remedy the systemic incoherence that is a problem practically everywhere. In a number of countries, this has been accomplished through the creation of a national quality council comprising members of the different institutions with jurisdiction in specific areas of the national quality system. The suc-

cess of such councils has been moderate. While the level of representation has often been high—in some cases the council reports directly to the president or prime minister of the country—councils sometimes lack an executive secretariat and a unit with resources to implement policies and decisions and monitor progress toward their implementation.

Accreditation

Organization

Ideally, there should be a single accreditation system in which the responsible institution, the national accreditation agency, is technically, operationally, and financially independent. Where accreditation functions are spread over several institutions, firms incur additional costs because the requirements for accreditation typically vary across institutions. However, many countries do have more than one accreditation institution to be able to cover not only the industrial sector but also the phytosanitary, environmental, health, energy, and other sectors. In such cases it is important to establish the mandate, jurisdiction, and functional scope of each accreditation body and establish procedures for coordinating their actions.

The system for accreditation of the certification institutions should have a clearly defined scope, which should be consistent with a standard system of industrial classification and can be extended periodically according to the needs of national industry. In some countries the scope of accreditation has remained limited to the quality system with ISO 9000 norms. In other countries it has been extended to include, for example, QS 9000 and ISO 14000 standards. The extension of accreditation to areas of increasing demand requires that appropriate regulations be issued to cover the new areas, that the structure and capacity of the national accreditation institution be enlarged and strengthened, and that proper training be given to the auditors.

The operating norms of the national accreditation institution should follow international best practices. Since 2006, for example, the ISO/IEC 17011 norm must be adopted by all accreditation institutions that seek international recognition. Governments should provide the financial resources and properly qualified staff needed to meet those institutional standards.

Accreditation bodies in developing countries should incorporate private sector representatives in their governance structure. Some public accreditation bodies are mainly governed by public sector representatives or appointees, but the productive sector is often best placed to articulate

the needs of industry. Including private sector representatives in a general assembly or on consultative committees helps ensure that accreditation bodies reflect the views of the private sector, increasing the effectiveness of the national accreditation system.

Some countries may need to increase the pool of technical staff used in accreditation activities. When an accreditation body has access to very few assessors capable of offering specialized technical services, the pace of accreditation and the range of sectors in which the accreditation body can work are limited. Accreditation bodies should provide training programs to ensure that they have the necessary personnel. Also, their structure should not be too rigid so that they can operate efficiently and adapt to changing market requirements.

Government support

In the early stages of developing an accreditation system, the national accreditation body should receive government support. Without an established customer base, the accreditation body will find it difficult to be self-sustainable through accreditation fees; in particular, it needs government financial support to train technical personnel. Once a critical mass of customers has been reached, the government should gradually phase out its financial contributions to the national accreditation body.

Countries with insufficient resources should consider creating regional accreditation bodies. In some cases a country's economy may be so small that it is difficult to justify the establishment of a national accreditation body. Countries in Central America and the Caribbean, for instance, where there are few potential candidates for accreditation, should pool their resources and establish a regional accreditation body that is recognized in each economy.

Countries with limited accreditation activities should investigate whether support is needed on the demand side or the supply side of accreditation. Countries may register very low numbers of accreditations for a variety of reasons. On the supply side, low activity could be due to the limited capacity of the accreditation body, which may not have the technical capacity to perform some accreditations or may not have enough trained personnel to step up the pace of accreditation. In general, Latin American and Caribbean countries are slow in delivering accreditations, and in such cases the accreditation body must invest in training more personnel.

An underdeveloped accreditation market may also be due to a problem on the demand side. In this case, there are several possibilities:

(a) the conformity assessment market does not value accreditation by the national body because it is not well recognized; (b) there are not enough conformity assessment bodies to create adequate demand; or (c) there are technical and financial barriers to accreditation that potential customers are not able to cope with. In the case of a demand-side problem, a government should create programs that diffuse information on the advantages of accreditation. It should also work to gain international recognition of its accreditation system and should provide technical assistance to organizations that wish to obtain accreditation.

The national accreditation institution should diffuse information on accreditation to ensure that industrial firms understand the benefits of accreditation. The accreditation process is largely unknown in many Latin American countries. Currently, a number of ISO certificates and testing services in various countries are delivered by nonaccredited certification bodies. Promoting the benefits of accreditation will increase the demand for accreditation and reduce the risk of fraudulent or low-quality conformity assessment services. It would be useful to seek and gain recognition through the use of a single accreditation label or symbol that follows rules similar to those established by the main accreditation institutions in other countries. That label or symbol should include a single and unique accreditation number, allowing users to know the extent of accreditation and the date of accreditation.

The government should also provide support for the accreditation of testing and calibration laboratories and for proficiency testing programs to ensure competition in these markets. In many countries the public sector holds a large share of these markets because of historical government support for its activities. New entrants will be able to compete in offering these services if they receive initial technical and financial support for accreditation. In particular, proficiency testing programs, often required for many types of laboratory accreditations, are very expensive and demand a high level of technical expertise. Providing support for proficiency testing programs would help increase the number of accredited laboratories available in the country.

As long as the national accreditation agency is not internationally recognized—as is the case in many countries—the government should consider supporting the accreditation of certification institutions by entities that are internationally recognized. Governments should consider programs offering partial financial support, such as matching grants, to help cover the high costs of international accreditation of the certification entities operating in the country. Certifications issued by duly accredited

entities will facilitate trade and lower its costs, allowing domestic producers to compete more effectively in external markets.

International integration

Developing countries should seek full membership in the main international accreditation organizations, the International Accreditation Forum (IAF) and the International Laboratory Accreditation Cooperative (ILAC), and should sign their mutual recognition agreements. A number of countries still have not joined these organizations. As a result, their accreditation systems can lose credibility at home and abroad, which impedes the development of a market for accreditation. Latin American countries' most important trade partners recognize the MRAs of both the IAF and the ILAC, and joining these treaties would significantly decrease technical barriers for Latin American exporters.

Countries that have significant regional trade with signatories of the InterAmerican Accreditation Cooperation's (IAAC's) MRA should seek to join this agreement. Several of the large Latin American countries have already done so. Countries that face technical barriers in joining the ILAC or IAF agreements should join the IAAC agreement if this is more in line with their technical capabilities. At the same time, the IAAC should continue its efforts to have its MRA recognized by the IAF and ILAC.

Metrology

Organization

At the national level it is essential to have a single metrology institution that can coordinate the reference laboratories as well as the testing and calibration laboratories. In some countries the primary or secondary measurement standards are offered by various institutions, allowing the provision of calibration services at moderate cost. To ensure that the development of measurement services keeps pace with the growth of industry, an institution should be established to coordinate the activities of the industrial calibration laboratories with those of the testing laboratories and facilitate the linkage (traceability) of such measures to the primary measurement standards. The coordination of actions and strategies among public and private institutions will help ensure strictly impartial behavior and build technical and scientific capacity.

Countries should ensure that their national metrology institutions (NMIs) are not associated with activities that introduce conflicts of interest. There are a few cases in which the NMI is part of an institution that conducts activities in the areas of standardization, intellectual property registration, and accreditation. This can threaten the impartiality and credibility of the

NMI. Countries where a single institution conducts work in these areas should create clear financial and administrative barriers between the different functions and ensure that the decision-making process is transparent.

Current regulation, especially regarding legal metrology, needs to be updated. Countries should ensure that their metrology framework reflects the current national and international environment. In some countries, the national calibration system is barely outlined in applicable regulations.

Developing countries should accredit the laboratories in their NMIs. An internationally recognized laboratory accreditation will increase the quality and credibility of calibration services provided by the NMI. This should be especially useful in countries where the NMI has not established a large customer base, or where the country is preparing to join the International Committee of Weights and Measures (CIPM) MRA.

Government support

Policies to strengthen the existing metrology system should first identify deficiencies in the system. This should include an evaluation of the measurement instruments and other metrology equipment that may become necessary in the future. The national metrology system requires a significant investment program and thus competes with other areas that require public financing. It is therefore essential to set priorities according to the current needs of the productive system and its potential for expansion in external markets. It is most important to do a cost-benefit analysis of new investments in domestic laboratories to support new metrology fields or to establish regional or local legal metrology centers.

Countries not able to provide traceability to the productive sector in enough technical areas should collaborate with other countries to invest in new metrological infrastructure. Although the larger countries have developed technical capabilities for a wide range of measurement areas, NMIs in smaller countries only offer measurement services in a limited number of spheres. Those countries should consider expanding the number of measurement services by engaging in collaborative arrangements with neighboring countries and specializing in certain measurement areas.

Specialized human capital is needed to increase the metrology capacity of the country and guarantee precise measurements and a supply of reliable services. Accurate measurements depend not only on well-equipped laboratories but also on the presence of competent and well-paid staff. Scientific personnel must have specialized training and research experience. Likewise, technical staff have to be prepared to construct testing modules and to maintain measurement instruments.

International integration

Developing countries should participate in more international inter-laboratory comparisons to expand the international recognition of their measurements. Latin American countries currently participate in far fewer comparisons than countries in the developed world. As manufacturing quality becomes more important for exports, Latin American countries need to provide their domestic industries with a national infrastructure that allows for proper traceability of measurements in the most relevant economic sectors.

Some developing countries remain internationally isolated and should seek membership in the main international metrology organizations and work toward signing an MRA. NMIs can increase the credibility of their metrology infrastructure and receive technical support by joining international metrology organizations and signing the MRA of the CIPM. Without an MRA in metrology, countries may face technical barriers to trade that hinder exports and the development of the productive sector. Once the CIPM MRA has been signed, the scope of the measurements it covers should be progressively extended.

Developing countries should become more internationally integrated in legal metrology to further reduce technical barriers to trade. Without harmonized means and procedures for verifications and tests, it is difficult to establish whether metrological control is equivalent in different countries. Membership in the International Organization of Legal Metrology (OIML) helps countries harmonize policies regarding trade in products and services with a commercial value based on measurements, as well as trade in measuring instruments.

International cooperation in metrology should be strengthened. In recent years international technological cooperation and technology transfer in scientific and industrial metrology has played a major role in the start-up of the national metrology system in many countries. That type of collaboration should be continued, making use of the funds that often exist in developed countries for the implementation of research and development projects in this area.

Standardization

Organization

Every country should ensure that the private sector is included in the governance of the standards bodies and that its participation is balanced. In general, the standardization process is open and transparent in Latin

America, but there are some exceptions to this rule. In some countries the agency that issues the standard is biased toward a particular sector; as a result, the overall interests of society suffer. In other countries, such as Peru and Ecuador, standards bodies are subject to excessive government influence and lack proper private sector representation in their governance structure through a general assembly of members or at least through a consultative committee. The participation of the private sector in determining the overall objectives, strategy, and structure of the standards body will enable the institution to more closely serve the needs of industry and will increase transparency.

Active participation of scientists and technologists trained as standards specialists should be emphasized. Consultative committees and standards bodies do not have strong enough ties to science and technology institutions. Even when the law requires the participation of academic specialists, their participation frequently does not affect the relevant standard. Academia has demonstrated an increasing interest in standards, but there are currently few incentives to encourage such involvement. Moreover, there are no training programs for standards specialists. Most people learn about standards development by actually participating in the process, which can be an inefficient way to learn.

Countries should ensure that they are dedicating sufficient resources to standardization. Standards development requires a number of administrative personnel to coordinate all of the technical committees, review the standardization process, interact with international organizations, and ensure the diffusion of standards in the economy. There are large discrepancies in the amount of resources dedicated to standards development across countries. Some countries, for example Peru, have very few staff and a very small budget for standardization relative to the size of their economies.

Whenever standards bodies raise revenues through commercial activities, the government should ensure that these activities are administratively and financially separated from its standardization activities. This will help prevent conflicts of interest in the normal operation of the national standards body. Also, it will be useful to examine the financing mechanisms that other standards bodies use to raise revenues through standardization activities. Standards bodies in other regions raise more income than those in Latin American countries through sales of standards publications and membership fees. These sources of revenue should be increased to make the standards bodies less dependent on certification and testing activities, because revenue from the latter may decrease once there is more competition in the market.

Standards development activities and international integration

Developing countries should increase their standards adoption rates while removing obsolete standards. Latin American countries are not increasing their standards stocks as fast as developed countries, even though their standards stocks are small. Of course, the objective should not be to produce as many standards as possible, because inadequate standards can actually inhibit growth, but to produce as many useful standards as possible. The low number of standards in countries such as Ecuador, Chile, and Peru seems to indicate potential for substantially increasing the size of the standards stock.

Countries should ensure that mandatory standards do not account for a growing share of standards. Although mandatory standards are on the decline in many countries, there are countries in which their share of total standards has actually increased in the past 15 years. Too many obligatory standards can place constraints on the productive sector that stifle innovation and prevent industries from becoming competitive. Countries should systematically review their national standards to reduce and update their standards stock. A mechanism to conduct cost-benefit analyses of mandatory standards has not been developed in most Latin American countries. As a result, the review of standards often occurs without any information about their impact and becomes no more than an administrative exercise.

Developing countries should combine parallel approaches to upgrade their standards toward international standards. Many Latin American countries have already made remarkable progress in the adoption of international standards in the past 15 years. Countries should select a strategy of unilateral upgrading toward international standards in sectors where the domestic technological conditions are adequate and there is a high potential for conducting trade with countries outside the region. In sectors where standards upgrading would be technologically infeasible or would place countries at a regional competitive disadvantage, countries should follow a gradual, coordinated approach and adopt regional standards. This approach has the most potential inside regional trade areas such as Mercosur and the Andean Community.

Creation of regional standards bodies in Latin America (and in other regions) would not only facilitate coordinated standards upgrading but would enable countries to pool their limited resources for standardization activities. Developing standards can be expensive in terms of time as well as financial and human resources. Regional standards bodies would allow Latin American countries, especially the smaller economies, to

divide standardization tasks among countries with different comparative advantages and to accelerate the standards development process, especially in areas of common regional interest.

Developing countries should increase their participation in the development of international standards. Toward that end, their governments should support membership in more International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC) technical committees and subcommittees. Few international standards originate from Latin American countries, or from the countries of any other developing region. If developing countries do not contribute to the development of standards used in global trade, the countries that dominate the process, mostly developed countries, may impose unfavorable specifications with which developing countries will then have to comply to access markets. Latin American countries should consider forming collective blocks to influence the development of ISO and IEC standards.

Governments should support participation of the private sector in international standardization activities. High travel costs can make it difficult for firms, especially SMEs, to represent national interests in ISO or IEC technical committees. Private sector participation in these organizations should be supported by government funding.

Supporting the Demand for Certification, Testing, and Calibration

Most developing countries should increase their adoptions of quality and environmental system standards. The multiplicity of factors affecting ISO 9000 diffusion should provide a case for carefully assessing cross-country differences before evaluating a country's quality management performance. Some low certification rates may simply reflect market factors, such as industry structure, and may not reflect a poor quality culture as such. The economic environment is responsive to government policy but should also be closely examined before policies are prescribed, because a deficiency in one factor, such as education, cannot always be compensated for by addressing another factor, such as quality awareness.

Nonetheless, the governments of developing countries should continue supporting quality management certification programs for SMEs. Although ISO 9000 certification is starting to become widespread in the manufacturing sector in many countries of the region, this is not the case for SMEs. Programs targeting SMEs have proven to be successful, even in countries with unfavorable economic environments. Technical and finan-

cial support should be focused on SMEs because they are usually less aware of quality issues and face more barriers than larger firms. Financial support should not be exclusively limited to the registration costs because these account for only a small share of total certification costs. Support covering training, technical assistance, and even upgrading of equipment and facilities should also be considered. In general, programs that stimulate demand—through matching grants or low-cost loans that allow firms to freely choose providers—have been more successful than programs that subsidize one or several privileged providers.

Governments should also support quality management certification in the service sector. Enterprises and organizations in the service sector have adopted far fewer certificates on a per-firm basis than those in the manufacturing sector. However, in many Latin American countries the service sector provides valuable input to the manufacturing export sector and should not be neglected.

Countries should promote the availability of lead auditors and support the creation of a national registry of quality management consultants and auditors. There are relatively few lead auditors with internationally recognized credentials in Latin America. The quality of certification services in the region depends on the quality of the auditing staff. In addition, it is difficult for firms and organizations to identify skilled consultants who can help them prepare for certification. A national registry or a business association of consultants could promote the development of this market and improve quality adoption in firms.

It is useful to have a national-level registry of firms that have obtained process or product certifications. Such a registry, if used by consumers and major buyers in the public and private sectors, can facilitate trade by enhancing the reliability of firms and products.

Governments should lead by example, adopting good quality practices in the ministries and in related government institutions and agencies. A program to foster the improvement of institutional quality should be launched at the highest level of government, with a realistic but ambitious calendar and with the proper assignment of resources. Such a program would help develop a culture of quality and efficiency in the public sector. Moreover, to facilitate the development of quality management and adoption of quality practices in public sector procurement, a training program for personnel responsible for implementation at the national and subnational levels should be implemented.

Governments should implement programs that provide incentives for providers and suppliers to adopt quality practices. Cooperation

among large buyers and their suppliers is rare in many countries in Latin America. Governments should establish programs that encourage large firms to provide incentives to their suppliers to adopt quality improvement measures and to develop groups or a registry of quality-minded suppliers. Firms within the club work together for the development of quality processes required by the large firm, with the assistance of a quality consultant, the cost of which is shared by the members of the club.

To address coordination failures and take advantage of economies of scale, governments should support the strengthening of the quality infrastructure. In most countries, most firms do not have their own proper facilities for testing, metrology, and calibration, and the availability of external facilities is very limited. In many sectors and regions the existing market demand does not provide sufficient incentive for independent firms to set up testing and calibration services and cover their costs. However, the industrial development of some regions requires the availability of such services, so it becomes necessary to assist their creation. This can be done either by providing the services directly in universities or public laboratories or by providing support to consortia of firms, industrial associations, or chambers of commerce or industry to set up and administer the services. When demand reaches the level where provision of the services becomes financially sustainable, public support should be phased out and the services run on a purely commercial basis.

Finally, it is necessary to systematically advocate and communicate to firms the critical impact that quality and quality management can have on competitiveness and business success, particularly in terms of increasing exports. This is all the more true for SMEs. Large companies—especially subsidiaries of multinationals and joint ventures, both national and foreign—usually have ample know-how and opportunities for technology transfer and adoption of quality systems. Large firms also tend to have easy access to the services of the national quality system. Medium companies, on the other hand, tend to depend on external funding sources for securing quality standards, metrology, calibration, testing services, and training. Small companies usually have limited information and resources and often do not place high priority on adopting quality standards.

Many managers of SMEs in developing countries perceive quality—and the processes related to the system of norms, certification, testing, and calibration—as an additional burden and not as a source of poten-

tial cost savings and competitive advantage. That attitude inhibits the investment in laboratories and capital equipment and in improved quality processes and also reduces investment in relevant training. A main reason for that attitude is that the clients of SMEs seldom demand compliance with specific quality standards and norms. Most consumers in developing countries respond primarily to price and only secondarily to product quality. Similarly, governments as buyers of goods and services often do not demand that their suppliers meet and comply with relevant quality standards. Periodic information campaigns should be undertaken to explain quality concepts and techniques to SMEs, with references to domestic companies that have adopted best practices and experienced good results. Such a demonstration effect can have a significant impact on firm behavior.

Governments should systematically enforce the requirement that firms comply with the relevant quality standards and practices to be eligible to participate in any public procurement process or auction. Such a policy should be phased in on a reasonable timetable to give firms the chance to qualify and comply with the new requirements.

In the case of all these recommendations, the budget requirements and timetable for implementation will vary according to initial conditions. Some of the recommendations concern regulatory or organizational changes that can be implemented in most countries without large resource allocations and without delays because they are not tied to the cycle for approval of the annual national budget. Their implementation can probably be completed in a relatively short period, less than a year. However, recommendations related to improving the supply of services in the areas of metrology, norms, testing, and quality system management do require new resources. Thus, it is essential to go through an exercise of identifying industry needs and country priorities before undertaking such efforts. Last, recommendations related to advocacy—to promote awareness of quality adoption, to increase firms' demand for such services, and to secure international recognition of the institutions of the national quality system—will require a longer timetable and should be incorporated in medium-term national strategies.

In all cases it is essential to ensure periodic oversight and evaluation of the progress and impact of the policies and programs throughout the implementation period. This will allow for midcourse adjustments to ensure that the policies and programs are effective and fulfill their objectives.

Conclusion

As increased competition among developing countries in labor-intensive manufactures erodes economic returns, higher-quality markets and high-value goods are increasingly important to maintaining dynamic competitive advantage. Globally integrated production networks, typically governed by buyers from developed nations, have raised competitiveness to the top of developing countries' policy agendas. Countries need to offer the high-quality products demanded by consumers and global supply chains and deliver them to markets to meet just-in-time production schedules.

The reform of quality systems has been one of the key missing pillars of the reform program in most developing countries. The history, at least in most Latin American countries, of operating as closed economies for so many years is partly to blame. Yet most countries have realized or are beginning to realize that the rules of the game in this new, highly globalized context have changed and that these changes are likely to be irreversible. In response to this new environment, many reform-minded governments have launched initiatives to enhance competition and trade and to make exports a key engine for growth. Providing for a balanced and effective quality infrastructure has to be an integral part of that program. An effective and coherent national quality system is essential if a country is to access markets, particularly external ones, and become competitive. The pace of reform is accelerating in a number of countries around the world; other countries cannot afford unnecessary delays in their reform programs, lest they fall further behind.

The findings presented here suggest that a well-executed reform program and an effective national quality system, consistent with internationally accepted and required practices, would have a quite significant impact, particularly in terms of improving trade and access to markets and overall competitiveness. Moreover, there are a number of mostly positive by-products and spillovers. Improvements in quality, standards, and so on are often entry points into innovation and technological improvements, an area where most countries, particularly in Latin America and the Caribbean, are lagging behind. Thus, initiatives to upgrade quality could help jump-start or accelerate the push for innovation. Moreover, when properly targeted, quality improvement programs for SMEs can facilitate their mainstreaming into value and export chains and in this way improve the livelihood of small producers that are so important to developing countries.

If reforms to enhance quality and adopt standards are to be effective, they must be implemented coherently and broadly. Most such reforms are uncontroversial and relatively easy to implement, and the resource requirements are quite manageable. The potential benefits for economic growth and poverty alleviation are significant and sustainable, enabling quality and standards reforms to win wide public support.

APPENDIX A

An Evaluation of Mexico's National Quality System

Mexico's institutional quality framework has four basic elements:

- *A standardization system* through which activities in the public and private sectors are regulated. There are standards related to health; the environment; consumer safety; commercial information; and industrial, labor, and trade practices, among other areas. In Mexico, official standards are generated by 11 secretariats and the process is overseen by the General Bureau of Standards (DGN) in the Secretariat of the Economy.
- *A metrology institute* that maintains appropriate measurement standards at the national level. In Mexico, this is done by the National Metrology Center (CENAM).
- *A national accreditation system* to accredit bodies that assess conformity—testing labs, calibration labs, certification bodies, and verification or inspection bodies. The Mexican Accreditation Body (EMA) performs this function.
- *Certification, testing, calibration, and inspection bodies*, collectively known as conformity assessment bodies, that certify businesses in aspects relating to metrology and quality.

These four elements are closely linked. Calibration laboratories ensure that the measurements performed by testing laboratories and inspection bodies are reliable. Calibration laboratories themselves must demonstrate

the accuracy and precision of their instruments, based on their traceability to reference measurement standards held at CENAM, the national metrology institute. The competence of calibration and testing laboratories and of certification and inspection bodies must be evaluated by a national accreditation body, the EMA. All aspects of these activities rely on standards. Standards provide the basis for evaluation of all conformity assessment bodies and define the requirements against which conformity assessment is performed. In sum, conformity assessment provides the vital link between standards and the products, processes, and services themselves.

Standardization

Standards in Mexico can be mandatory (*normas oficiales mexicanas*), referential, or voluntary (*normas mexicanas*). The Federal Metrology and Standardization Law was passed in 1992 and reformed in 1997 to accommodate the North American Free Trade Agreement (NAFTA). Mandatory (official) standards can be issued by 11 federal government agencies and reference standards can be issued by the Federal Electricity Commission (CFE) and PEMEX, the state-owned oil company. As of June 2005, there were 800 official standards in force and 198 more in progress (table A1). At that time also, there were 5,651 voluntary standards in place and 150 in progress. In principle, anyone can propose a voluntary standard, which will then be submitted to one of 30 technical standards commit-

Table A1 Official Mexican Standards by Agency, June 2005

<i>Agency</i>	<i>In force</i>	<i>In progress</i>
SE	110	20
Sectur	8	0
Sagarpa	139	9
Semarnat	107	15
STPS	38	3
Sener	87	23
Sedesol	0	0
SS	195	24
SCT	115	104
Segob	1	0
SSP	0	0
Total	800	198

Source: CENAM.

tees (the committees are validated by the DGN and supported by eight national standards bodies) for review.

There are a number of problems with the standards institutional framework. Standards that require physical or chemical measurements frequently do not include adequate consideration of measurement characteristics—for example, traceability and uncertainty—to produce the required level of confidence. As a result, the standards can become nonviable. This is especially the case with voluntary standards.

Consultative committees and standards bodies do not have strong enough ties to science and technology institutions. Even when the law requires the participation of academia, this participation frequently does not affect the relevant standard. Academics have demonstrated an increasing interest in standards, but there are currently few incentives to encourage their involvement.

There are no training programs for standards specialists. Most people learn about standards development by actually participating in the process. This lack of training programs creates inefficiencies in the process. In some cases, the agency that issues the standard can be biased toward a particular sector. As a result, the overall interests of society suffer.

A mechanism to conduct cost-benefit analyses of standards has not been developed. As a result, the mandatory review of standards every five years often occurs without any information about the impact of standards, and the review becomes merely administrative.

Finally, the DGN does not have sufficient resources to carry out all of its mandated functions. There is a tendency on the part of both producers and sectoral authorities to generate standards that can serve as trade barriers. DGN's role is to prevent this, but the agency is not effectively performing that function.

Metrology and Calibration

Mexico has developed a robust set of measurement standards, but there are some gaps. CENAM has developed 63 national measurement standards to date, which are used as references to ensure that all measurements in the country are uniform, reliable, and in line with international standards. The National Nuclear Research Institute (ININ) is in charge of another three standards. Although these standards collectively cover a large part of the measurement requirements of the country, there remain some areas that require development. One example is the measurement of high gas flows in view of the increasing importance of natural gas. Another

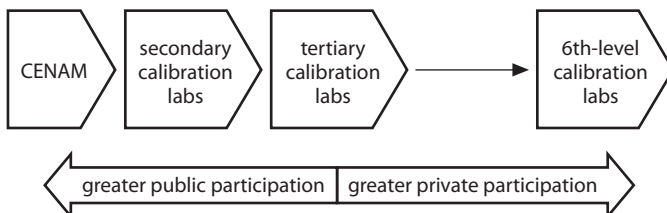
is the production of certified reference materials; these have a long way to go. Unfortunately, budgetary limitations make it difficult for CENAM to respond flexibly and rapidly to new measurement challenges.

Calibration involves determination of the relationship between an instrument's input and the magnitude or response of its output. It serves to establish the accuracy and precision of a measuring instrument. Secondary calibration laboratories constitute the primary market for calibration from the national institute. They calibrate their own equipment to the national institute's and diffuse their measurements to the downstream market for calibration, which includes industrial producers, testing laboratories, inspection bodies, research laboratories, universities, and other final users. Many conformity assessment bodies require that equipment and measurement reference systems be calibrated, or traceable, to other widely accepted metrological references before they issue a product or system certificate.

Mexico's metrology and calibration services serve as a public good, and the country needs to develop them further. Because the costs to develop high-level metrology services significantly outweigh the income received from providing such services in Mexico, public funding is necessary. However, low-level metrology services can be attractive to the private sector. In general, the higher the level in the chain of calibration services, the greater the involvement of the public sector because profitability decreases as one moves up the chain (figure A1). In Mexico, this chain of services is not yet fully developed because there is a shortage of participants in different segments, and there are technical calibration deficiencies. In March 2005, 299 calibration labs were registered with the EMA.

Secondary calibration services have insufficient capacity in Mexico. As mentioned above, secondary metrology and calibration services (one step down from CENAM) are not profitable, due to the technical requirements of labs, specialized equipment, and highly trained personnel. Secondary laboratories in Mexico include research center labs, centers in the

Figure A1 Metrology Services Chain in Mexico



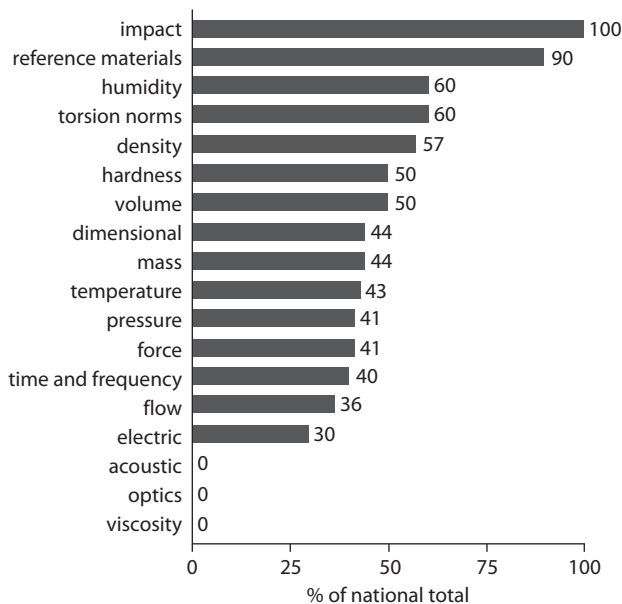
Source: CENAM.

SEP-CONACYT network overseen by the Secretariat of Public Education and the National Council on Science and Technology, academic labs (instrument centers of the National Autonomous University of Mexico and the National Polytechnic Institute, among others), the materials testing lab of the CFE, and other private sector labs.

The secondary service capacity is adequate in some areas, such as electricity, while more development is required in others, such as volume and firmness. Geographic coverage of secondary services is also lacking. About 44 percent of calibration labs are located in Mexico City, Jalisco, and Nuevo León (figure A2). Currently, some fifth- or sixth-level institutions are forced to calibrate their measurements directly with CENAM because there are no secondary or tertiary labs in their area that are accredited or have the necessary level of measurement accuracy and precision. This substantially increases the time and costs of the calibration procedures, causing consumers to suffer and ultimately eroding competitiveness.

More inter-laboratory comparisons and proficiency tests are needed. To have a reliable Mexican metrology system, inter-laboratory comparisons and proficiency tests with calibration labs that are integrated in the traceability chain are required. This is a common practice in all developed countries; it consists of appointing a recognized, prestigious lab or regional

Figure A2 Concentration of Calibration Labs in Mexico City, Jalisco, and Nuevo León



Source: CENAM.

organization to circulate between different labs to test their measurements against known standard values. In Mexico, this activity is not sufficiently established. Inter-lab comparisons and proficiency tests occur only infrequently, meaning that in some cases the performance of accredited labs is not reliable. More comparisons are required to maintain the confidence of third parties and comply with international standards.

Participation in international inter-laboratory comparisons is a requirement for maintaining membership in mutual recognition agreements (MRAs). An MRA in metrology provides for the formal recognition of national measurement standards and calibration capabilities. Through measurement comparisons, an MRA establishes the degree of equivalence of national measurement standards maintained by national metrology institutes and thereby guarantees acceptance by the other MRA signatories of measurement results that are traceable to the national metrology institute. Mexico is a member of international accreditation organizations such as ILAC (International Laboratory Accreditation Cooperation) and APLAC (Asia-Pacific Laboratory Accreditation Cooperation), which require the EMA to demand that laboratories participate in national and international inter-lab comparisons and aptitude tests to be accredited.

Policies to strengthen the existing Mexican metrology system should do the following:

- Identify deficiencies in the metrology system, including an evaluation of the measurement instruments and other metrology equipment necessary for the future. Once detected, priorities to correct the deficiencies will have to be determined.
- Create an interinstitutional body to unite the Mexican metrology system and make uniform the criteria that apply to legal metrology.
- Prepare a legal metrology framework that reflects the current national and international environment.
- Develop the national calibration system, which is barely outlined in current applicable regulation.

Accreditation

Accreditation is defined as the procedure by which an authoritative body gives formal recognition that an organization or person is competent to carry out specific tasks. Accreditation is sought on a voluntary basis as a proof of competence in a given area. Accreditation provides certification and inspection bodies, as well as testing and calibration laboratories, with

a means to signal that they are conducting their work to appropriate standards and that they are able to provide reliable services to support quality in firms. The accreditation body evaluates the personnel and supporting management system of the candidates for accreditation and can request practical tests for laboratories when relevant. These tests take the form of proficiency testing schemes through which the measurement results of different laboratories are compared (that is, inter-laboratory comparison).

The Mexican Accreditation Body is the first and, so far, the only private organization in Mexico with responsibility for accrediting organizations that assess conformity. The EMA accredits testing and calibration labs and certification, verification, and inspection bodies. Before the creation of the EMA, the DGN had responsibility for accreditation. Reforms to the Federal Metrology and Standardization Law in 1992 and 1997 opened the door for a private, third-party organization to take over these responsibilities. EMA began operating in January 1999.

Mexico's market size and subsidies to the EMA have discouraged the emergence of competitors. The EMA is a nonprofit organization whose principal financing sources are fees for accreditation services, dues from associates, use of the EMA brand, training courses, and donations from federal and state agencies and from regional and international organizations. While most other developed countries have a single public institution in charge of accreditation, Mexico has adopted the U.S. accreditation model in which a number of private accreditation bodies fiercely compete on the basis of price and service quality. However, subsidies from the public sector give the EMA a significant advantage over potential competitors; hence it has remained a monopoly. It is unlikely that another accreditation body will emerge because of Mexico's market size, sizeable investment requirements, and opposition from the EMA.

High accreditation costs have led to unaccredited competitors. Costs associated with accreditation from the EMA are substantially higher than U.S. and international prices, and this has led to the emergence of testing establishments that are not accredited but compete with EMA-accredited labs. Such testing establishments are authorized or recognized by different agencies, including the Secretariat of Agriculture and the Secretariat of Health. As a result, they act as *de facto* accredited labs.

The EMA's mix of public and private origins has led to a complex governance structure and slow decision making. The board of directors comprises four sectors, each of which has nine votes: the federal government (various secretariats); business (represented by various groupings of private sector organizations); users and clients (labs, certification and

inspection bodies); and academia and consumer organizations. Given that these four sectors often have conflicting interests, the decision-making process can be slow, and there have been delays in reaching agreements that would ultimately benefit the end users, that is, businesses that need conformity assessment services. However, the involvement of the different sectors leads to greater transparency and impartiality.

Besides the board, the EMA has a general assembly, executive commission, executive management, and 11 departments. The departments include certification, inspection, testing and calibration labs, technical and relationships, administration, systems, quality assurance, new projects, operations, promotion and diffusion, and human resources. The organization's size and complexity is another deterrent to the emergence of potential competitors.

To minimize technical barriers to trade, national conformity assessment procedures should be harmonized across countries. Complying with a standard or a technical regulation is only useful if compliance can be demonstrated to the buyer or the government at reasonable cost. Demonstrating compliance through conformity assessment itself is only useful if the testing and certification requirements are similar in the exporting country and the importing country. If testing laboratories are not recognized abroad, tests on products carried out in an exporting country have to be repeated by a recognized laboratory in each of the importing countries. An adverse test report in the importing country can result in the rejection of an entire shipment. Likewise, if certification in one country is not recognized abroad, domestic firms requiring quality system and environmental management certification for export purposes—for example, ISO 9000 and ISO 14000 registration—need to be certified by organizations in each of the importing countries. To promote the recognition of conformity assessment procedures, many accreditation bodies base their organizational structure and their accreditation decisions on well-recognized international guides and standards.

Mutual recognition of accreditation procedures promotes trade by decreasing transaction costs and eliminating technical barriers. When accreditation in one country is recognized by other countries, the work performed by that country's certification bodies, inspection bodies, and calibration and measurement laboratories will be accepted in other countries.

The EMA has been recognized by the main international accreditation bodies, IAF and ILAC. Membership in these two organizations enhances an accreditation body's prospect of gaining international credibility. Accreditation bodies must demonstrate that they operate at high

international standards to join the IAF or ILAC. In this sense, IAF and ILAC membership is a form of assurance that accreditation bodies are competent to undertake their work and are not subject to conflicts of interest. Furthermore, these international organizations facilitate technology transfer in areas related to quality assessment and provide a forum for learning from other experienced accreditation systems.

The EMA is a signatory to various MRAs. For full recognition, accreditation bodies must establish agreements with other countries, based on mutual evaluation and acceptance of each other's accreditation systems. Membership in an MRA at the bilateral level (with one other country) or at the regional or international level (with many other countries) is critical to guaranteeing the credibility of the national conformity assessment system. MRAs are based on peer evaluation processes through which signatories evaluate each other's compliance with the agreed-upon requirements and evaluate the performance of assessment staff. They usually cover specific accreditation types (for example, quality management system certifiers) or products. Mexico has signed the IAF's Quality Management System (2001), Environment Management System (2004), and Product (2004) multilateral recognition agreements.

The EMA needs to take the following steps in the short term:

- Obtain international recognition for the accreditation of laboratories and verification units, with the aim of having tests conducted in Mexican labs (country of origin) recognized in the destination country.
- Fulfill the new ISO/IEC 17011 standard. Beginning in 2005, the new 17011 standard was applied to all accreditation entities in the world, and its completion became obligatory in 2006.
- Increase domestic promotion of the EMA. The accreditation process is largely unknown in Mexico, hence priority should be given to promoting the importance of accreditation throughout the country. Strategic alliances with all three levels of the government and with the private sector in all regions will be necessary to ensure compliance with the appropriate standards.
- Broaden and strengthen the EMA's structure so that it can provide accreditation services in areas of high future demand.

Certification, Testing, and Inspection

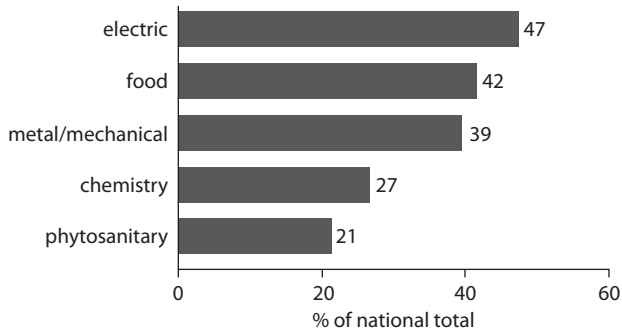
Third-party certification consists of the provision of assurance by an independent body that a product, service, system, process, or material

conforms to one or more standards or specifications. For many standards, especially quality and safety standards, the incentives for self-enforcement are low and producers have much to gain by claiming that a noncompliant product or process adheres to a certain standard. Furthermore, the highly technical content of some standards may render it difficult for producers to know whether they have appropriately complied with a standard. If there is no means of differentiating products that conform to a standard from those that do not, standards are of limited use.

Certification provides benefits for producers of goods and services, consumers, and government regulators and for international trade. Manufacturers and service providers can have their products or their management systems certified to particular standards to distinguish themselves from less reputable suppliers. Buyers benefit from certification because it allows them to compare and differentiate products and services in terms of quality, safety, or other desirable characteristics. It avoids the costs of having each buyer independently validate the characteristics of the products and services of a supplier and reduces the risk of purchasing faulty products or services. By reducing search costs for global suppliers, certification reduces technical barriers to trade. Certification by third-party organizations is increasingly included in trade contracts (Schuurman 1997). Finally, regulators benefit from certification because it provides them with a system to enforce governmental health, safety, and environmental legislation. In March 2005, there were 38 certification bodies accredited by the EMA.

Testing and inspection help demonstrate that a product or process satisfies certain technical requirements. Testing involves determining the characteristics or performance of a product or process according to a specified procedure. Inspection is another form of assessment that relies on less sophisticated instruments than does testing. Independent testing laboratories and inspection bodies can be contracted by a firm to obtain a test or inspection certificate as evidence that a product or process conforms to certain characteristics. In certain cases, testing and inspection are required for firms to implement a quality control system, such as ISO 9000. The first testing labs in Mexico were created roughly 35 years ago, and by March 2005 there were 362 accredited testing labs and 791 accredited inspection bodies.

There are internationally accepted standards guiding the operation of certification entities, testing laboratories, and inspection bodies.¹ To play a credible role in the conformity assessment system, testing laboratories and inspection bodies must display many of the same characteristics as

Figure A3 Concentration of Testing Labs in Mexico City, Jalisco, and Nuevo León

Source: CENAM.

certification bodies, notably impartiality, objectivity, and confidentiality. Objectivity relies heavily on the procedures guiding the evaluation process, the equipment used, and the skills and qualifications of staff.

There is a high geographic concentration of testing labs and inspection bodies in Mexico. Nearly 40 percent of Mexico's testing labs are located in Mexico City, Jalisco, and Nuevo León (figure A3). This has translated into price differences between services in the big metropolitan zones and those in the rest of the country. Inspection bodies are also concentrated, with 50 percent of them located in Mexico City, Estado de México, Jalisco, and Nuevo León. The only exception is inspection bodies associated with energy efficiency and natural gas, which are linked to CFE and PEMEX distribution locations. The concentration of inspection bodies creates particular problems in areas such as auto transport, industrial parks, hydraulics, animal health, telecommunications, tourism, and others, where 100 percent of inspectors are located in the above four regions while demand is spread throughout the country.

Prices for conformity evaluation services are relatively high. Given that there are relatively few accredited firms in relation to demand, prices are essentially determined in a monopolistic fashion, with price differentials based on type of client and service. Normally travel costs are paid by the client, which puts businesses located outside of Mexico City, Guadalajara (capital of Jalisco), and Monterrey (capital of Nuevo León) at a disadvantage. Even though accredited domestic firms consider themselves to be cheaper than international competitors within Mexico, conformity evaluation prices are three to four times greater on average than prices in the United States and the European Union. High costs are linked to accreditation costs for certification and inspection bodies.

Conformity evaluation bodies are regulated by several organizations. Certification, inspection, and testing bodies are regulated by EMA, CENAM, and the DGN through the accreditation process. A great number of businesses are also certified by the Standards Board and other entities such as ANCE (Association for Standards and Certification, a domestic group) and AENOR (Spanish Association for Standardization and Certification).

There are several problems in Mexico's conformity evaluation process. First, current legislation allows people who are being evaluated to be part of the accreditation decision-making process and to be responsible for their own evaluation activities. This creates an inherent conflict of interest. The situation was justified by the lack of qualified people when the accreditation system was initiated, but now there are plenty of experts from academia, research centers, and CENAM. Hence, the functional separation of the evaluators and those evaluated is viable and necessary.

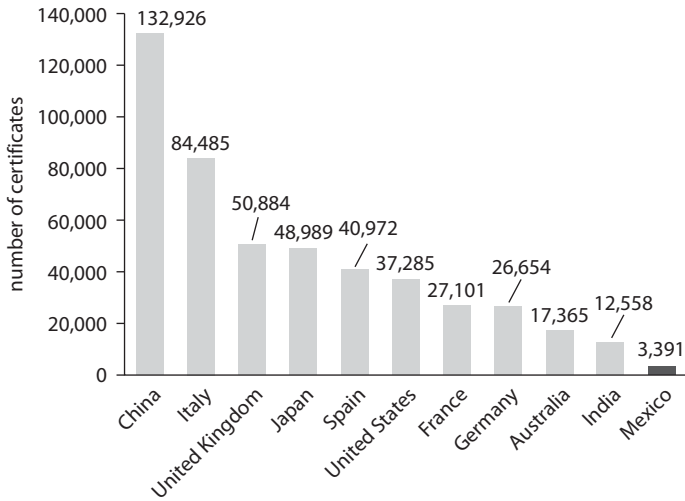
Second, those responsible for evaluation activities often do not have sufficient technical competence in a given specialty, meaning that their results lack credibility. This weakness has been identified and is being addressed. Finally, federal agencies have not been very active in demonstrating the conformity assessment criteria for the standards that they issue.

Demand for conformity assessment services is relatively narrow, meaning that Mexico has a low number of ISO certificates. Demand has been limited to the following four sectors:

- Mexican exporters that need a recognized certificate of quality for their products
- Foreign firms that export products to Mexico
- Providers of goods and services to the public sector in Mexico
- Giant firms and firms listed on the Mexican stock market

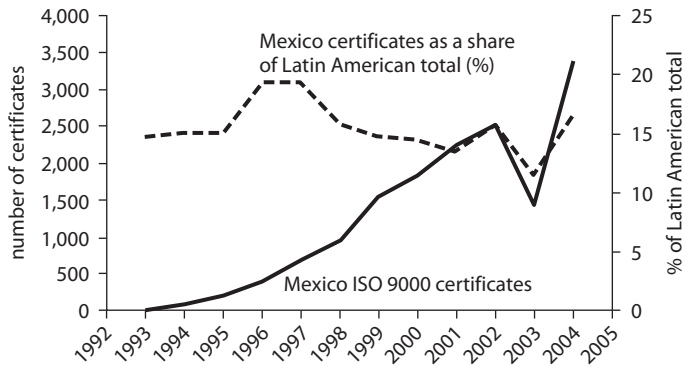
This universe encompasses a very small share of the total formal businesses in the country. For example, only 34,000 export-oriented companies are officially registered, which represents barely 2 percent of the country's total. One manifestation of this is the relatively low, albeit increasing, number of ISO 9000 certificates in Mexico (figure A4). Mexico's ISO 9000 certificates as a share of the Latin American and Caribbean region's total—roughly 17 percent in 2004—has not grown appreciably over the last decade (figure A5). As a reference, Mexico's share of total GDP in the region was roughly 30 percent in 2004. Mexico's certificates as a share of the world total increased during the 1990s but then stagnated during the early 2000s (figure A6).

Figure A4 ISO 9000 Certificates, 2004



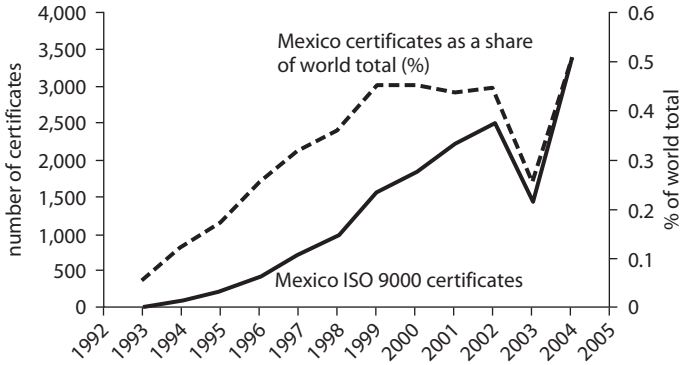
Source: ISO 2004.

Figure A5 Mexican ISO 9000 Certificates and Share of Latin American Total



Source: ISO 2001, 2003a, 2005.

Figure A6 Mexican ISO 9000 Certificates and Share of World Total



Sources: ISO 2001, 2003a, 2005.

Note: The apparent drop in the number of ISO 9000 certificates in Mexico in 2003 is due to the transition from the old ISO 9000:1994 standard to the new ISO 9000:2000 standard. In the 2003 survey, the ISO 9000:1994 standard was officially replaced by the ISO 9000:2000 standard and Mexico did not report ISO 9000:1994 certificates in the survey, only ISO 9000:2000 certificates. However, in 2003 both ISO 9000:1994 and ISO 9000:2000 certificates were reported in many other countries in the survey, thus giving the impression that there was a drop in the relative number of certificates in Mexico in 2003.

The conformity evaluation culture may be less widespread in Mexico than elsewhere due to high market concentration and informality. Relatively high concentration in many goods and services markets means that there are few firms in each sector that have an incentive to get certified—either to compete in international markets or to deter the entrance of new competitors. The country’s large informal sector means that there is no potential demand for certification or testing from a large portion of the economy.

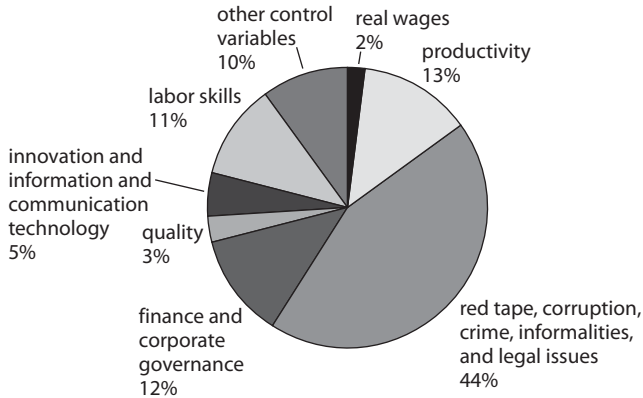
APPENDIX B

An Evaluation of Turkey's National Quality System

This appendix describes and evaluates the state of Turkey's national quality system and its implications for the diffusion of standards and quality in the productive sector. It discusses the concept of a national quality system and its structure in Turkey; the adoption and diffusion of quality standards in Turkey, from both the supply and demand perspectives in the certification market; the accreditation activities and infrastructure, along with their impact on the diffusion of quality in the private sector and European Union (EU) integration; the state of Turkish metrology; and finally, the standards development system in Turkey, again in the context of EU integration and international trade.

In Turkey, firm-level data show statistically significant relationships between quality certification and both exports and employment. There is not much information about quality variables in the Turkey Investment Climate Survey. Manufacturing firms are asked in general terms whether they have a quality certification. The econometric results reveal that quality certification has a positive effect on employment and on the probability of being an exporter (Escribano et al. 2006). More specifically, it is estimated that surveyed firms with quality certification employ on average 44.8 percent more permanent workers than firms without certification.¹ Because the estimates control for general size categories (large, medium, and small firms) and for age, this result implies that among Turkish firms of similar size and age, those that are concerned enough with quality issues to invest in quality certification end up employing more personnel, probably as a consequence of higher demand for and appreciation of their products. Figure B1 shows the percentage of

Figure B1 Contribution of Investment Climate Variables to Average Employment by Turkish Firms



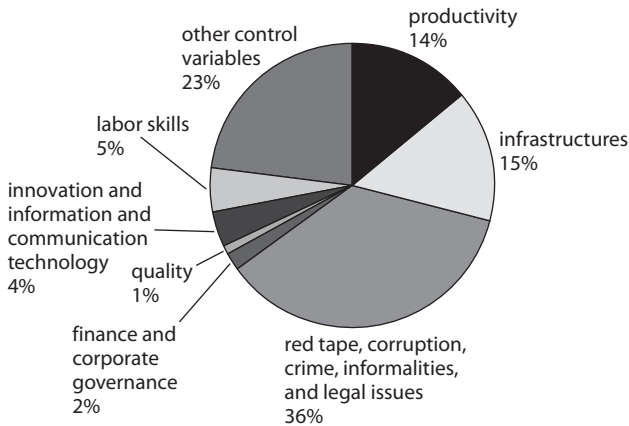
Source: Turkey Investment Climate Survey.

contribution to average log-employment of each set of investment climate variables.² Most categories incorporate a set of several variables, whereas the quality category only contains information on quality certification. Still, this single variable contributes 3 percent to average employment.

Quality certifications also help increase the probability that nonexporting manufacturing firms will become exporters. More specifically, firms with quality certifications have a 6 percent greater probability of being exporters than other firms. Certified suppliers provide buyers with a signal that they are able to produce goods and services of consistent quality, and thus they increase their chances of being selected by the market as exporters. The percentage contribution of quality certification among all other investment climate variables to the probability of becoming an exporter is, however, modest—only 1 percent, as figure B2 shows.

A country's national quality system is supported by a multidimensional infrastructure of organizations whose activities help to evaluate whether a product, process, or service fulfills specified technical requirements.³ The evaluation activities include the actual conformity assessment procedures, which consist of any combination of testing, inspection, calibration, and certification and differ according to the product or process. Certification bodies, inspection bodies, testing laboratories, and calibration laboratories evaluate the characteristics, quality, and performance of products and processes in enterprises and their conformance to specific standards. Accreditation bodies are used to assess the competence of these conformity assessment bodies and to increase the public's and trade partners' confidence in their services. Metrology institutes ensure the accuracy and

Figure B2 Contribution of Investment Climate Variables to a Turkish Firm's Probability of Becoming an Exporter



Source: Turkey Investment Climate Survey.

precision of the measurements transmitted by the calibration laboratories to other conformity assessment bodies and to enterprises. Finally, standards bodies develop the technical specifications used to define the requirements against which conformity assessment is performed.

Turkey has, in principle, all of the necessary institutions for a complete national quality system:

- *A metrology institute.* The National Metrology Institute (UME) is responsible for scientific metrology. It was created in 1986 as part of TÜBİTAK (Scientific and Technical Research Council of Turkey), a public agency.
- *A standardization system.* The Turkish Standards Institution (TSE) is the national standards body and is responsible for the development of all voluntary standards. It is an independent public organization governed by private law and operates according to an Establishment Law (Law 132) created in 1960. Government ministries are responsible for the development of mandatory standards and sometimes use TSE standards as a basis for these mandatory standards.
- *A national accreditation system.* The Turkish Accreditation Agency (TÜRKAK) is the national accreditation body. It was established by law in 1999 and started its operations in Ankara in 2001. TÜRKAK is a public autonomous agency affiliated with the Prime Ministry and governed according to private law. It is responsible for accrediting certification bodies, inspection bodies, and laboratories according to

Box B1**Conformity Assessment and Access to the EU Market**

The quality infrastructure plays an important role in European integration. To participate in the EU free market and implement the *acquis communautaire*, a country needs a conformity assessment infrastructure adapted to harmonized EU legislation.

The Old Approach and the New Approach are the two strategies used for technical harmonization in the EU. Member states are obliged to transpose the directives related to the Old and New Approaches into their legislation. The Old Approach directives contain detailed technical specifications for individual products. Under the New Approach, legislative harmonization is limited to essential requirements, which are stated in general terms and mostly concern the areas of safety, public health, consumer protection, and environmental protection. The development of technical specifications necessary for the implementation of New Approach directives is requested from the different European standards bodies (CEN, CENELEC, and ETSI, the European Telecommunications Standardization Institute). These “harmonized standards” retain their status as voluntary European standards but national authorities are obliged to recognize products manufactured according to these standards as conforming to the essential legal requirements of the directives. Since 1985, the New Approach has been the har-

national and international standards. Moreover, since 2003 it has signed protocols with a number of ministries to assess the qualifications of conformity assessment bodies applying to become notified bodies (see box B1 for the role of conformity assessment in EU integration).

- *Certification, testing, calibration, and inspection bodies.* There are a number of certification and inspection bodies, as well as testing and calibration laboratories operating in both the private and public sectors. TSE also hosts all of these services and holds most of the market in certification and testing.

Certification, Testing, and Inspection***Adoption of quality system standards in Turkish firms***

Relative to the number of firms and organizations with ISO 9000 certification, Turkey lags behind other Organisation for Economic Co-operation and Development (OECD) countries. In Turkey, 80 percent of ISO 9000

monization method used for most industrial products. In 2001, 36 percent of manufactured goods (by value) exported from Turkey to the EU were covered by either the Old Approach or the New Approach (Hoekman and Togan 2005).

The Global Approach to certification and testing establishes European Community policy on conformity assessment. The CE marking on a product symbolizes conformity to all the obligations required by the applicable New Approach directives. In Turkey, most products that are covered by New Approach directives can be CE-marked through self-declaration of the manufacturer. However, for some products, third-party conformity assessment and delivery of the CE marking must be conducted by notified bodies. These bodies must be nominated by member states and accepted by the European Commission.

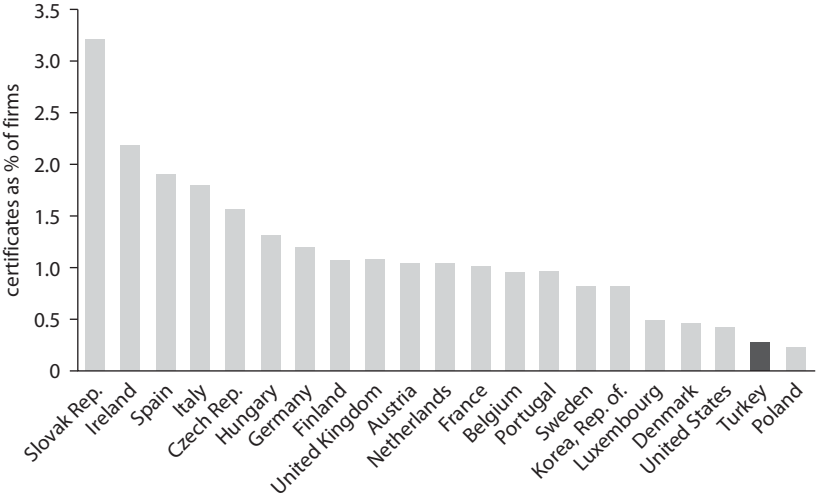
Along with international standards, regional standards represent a growing share of the standards stock of many countries. In Europe, CEN, CENELEC, and ETSI develop regional voluntary standards. The standardization process in these organizations is based on consensus and is similar to that followed by their international counterparts.

In Europe, the standards bodies produce European standards, or ENs. Member organizations are obliged to adopt European standards and withdraw conflicting national standards. CEN has an agreement with ISO through which many of the standards are developed in common. As a result, about 30 percent of European standards are identical to ISO standards (CEN 2004).

certificates belong to firms in the manufacturing, wholesale and retail trade, real estate, and rental sectors. Comparing the number of certificates to the number of enterprises in these sectors shows that Turkey lags behind all other OECD countries except Poland (figure B3). There are only three ISO 9000 certificates for every 1,000 establishments in Turkey, six times fewer certificates than in Spain on a per-firm basis. Figure B4 shows that Turkey performed below the level predicted by OECD averages.

By contrast, if only manufacturing is considered, Turkey performs much better than predicted by OECD averages in ISO 9000 adoption. ISO 9000 diffusion in Turkey is much more prevalent in manufacturing than in other sectors. Only three other OECD economies surpass Turkey with respect to ISO 9000 adoption on a per-firm basis in manufacturing (figure B5). Turkey also performs much above its predicted level of ISO 9000 adoption based on OECD averages (figure B6). In manufacturing, certification is mostly fueled by exports to the EU, where ISO 9000 is often a buyer or regulatory requirement.

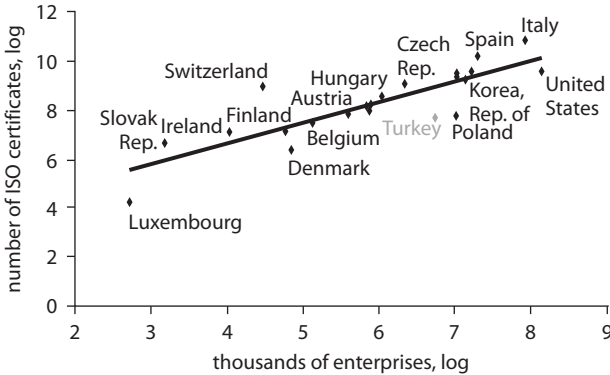
Figure B3 Number of ISO 9000 Certificates as a Percentage of the Number of Firms in Manufacturing, Wholesale and Retail Trade, Business Services, and Real Estate in Selected OECD Countries



Source: ISO 2005; OECD 2005.

Note: Number of establishments used for Korea and Turkey; number of enterprises for others. Certificate data are December 2004; enterprise data are 2002 (except United States, 2001). Certificate data include financial intermediation; enterprise data do not.

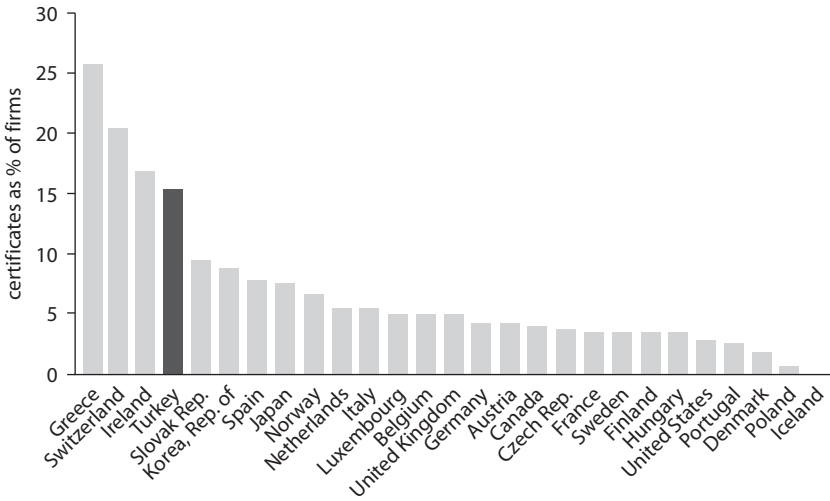
Figure B4 Number of ISO 9000 Certificates vs. Number of Enterprises in Manufacturing, Wholesale and Retail Trade, Business Services, and Real Estate in Selected OECD Countries



Sources: ISO 2005; OECD 2005.

Note: Number of establishments used for Korea and Turkey; number of enterprises for others. Certificate data are December 2004; enterprise data are 2002 (except United States, 2001). Certificate data include financial intermediation; enterprise data do not. Australia, Greece, Mexico, and New Zealand omitted.

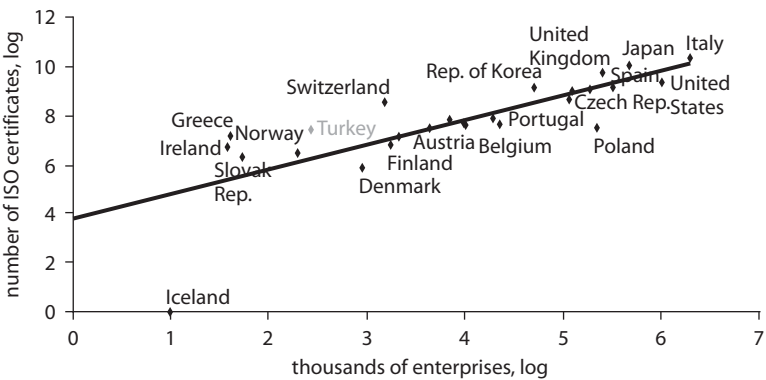
Figure B5 Number of ISO 9000 Certificates as a Percentage of the Number of Manufacturing Firms in OECD Countries



Sources: ISO 2005; OECD 2005.

Note: Number of establishments used for Canada, Japan, Korea, and Turkey; number of enterprises for others. Certificate data are December 2004; enterprise data are 2002 (except United States, 2001).

Figure B6 Number of ISO 9000 Certificates vs. Number of Manufacturing Firms in OECD Countries



Sources: ISO 2005; OECD 2005.

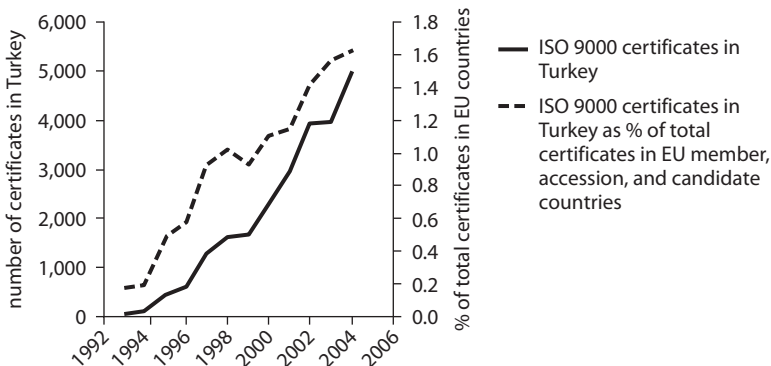
Note: Number of establishments used for Canada, Japan, Korea, and Turkey; number of enterprises for others. Certificate data are December 2004; enterprise data are 2002 (except United States, 2001). Australia, Mexico, and New Zealand are not included.

ISO 9000 adoption rates are increasing faster in Turkey than in the rest of the world. There are now about 5,000 ISO 9000 certificates in Turkey (figure B7). While Turkey accounted for 0.18 percent of ISO 9000 certificates in the current group of EU member, accession, and candidate countries in 1993,⁴ its share increased to 1.63 percent in 2004. During the 1993–2004 period the number of certificates grew, on average, by 62 percent in Turkey, versus 22 percent in the EU-25 group of member countries.

Turkey's four largest manufacturing export sectors have very high ISO 9000 adoption rates. In fact, these adoption rates are higher than in similar sectors in Spain. Figure B8 displays the number of certificates per establishment in manufacturing sectors that account for a large share of exports in Turkey. Turkey's performance is better or comparable to that of Spain in sectors that are important for its exports. Romania only outperforms Turkey in two sectors where Romanian exports play a more important role.

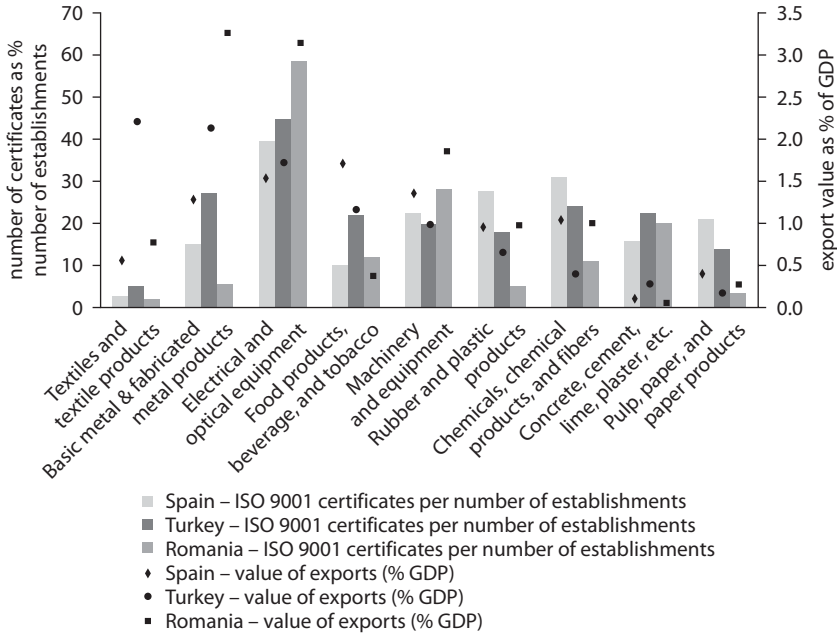
ISO 9000 adoption rates among smaller firms still lag far behind adoption rates among larger firms in Turkey. The 2005 Turkey Investment Climate Survey found that large manufacturing firms were more than twice as likely to be certified as small firms. While 24.2 percent of small firms and 45.4 percent of medium firms were certified, 64.1 percent of large firms were certified.⁵ This pattern can be found in most other countries as well. Turkey's KOSGEB (Small and Medium Industry Development Organization) currently offers technical assistance programs for quality certification in small and medium enterprises (SMEs).

Figure B7 Growth of the Number of ISO 9000 Certificates in Turkey



Sources: ISO 2001, 2003b, 2005.

Figure B8 Number of ISO 9001 Certificates per Number of Establishments in Turkey, Spain, and Romania in Different Manufacturing Sectors



Sources: ISO 2005; UNCTAD 2006; UNIDO INDSTAT 4 (Industrial Statistics Database), Rev. 3, 2005.

Note: Turkey export data are 2003; Spain export data, 2002; ISO 9001 data, 2004; establishment data 2000.

The supply of certification services

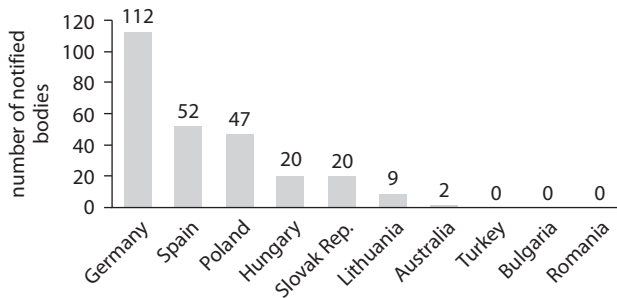
Although the market for certification services in Turkey shows a reasonable number of suppliers, the competence of some has been questioned and their practices may be anticompetitive. Of the estimated 82 certification bodies in Turkey, only 19 have been accredited by the national accreditation body, TÜRKAK. Although some other Turkish certification bodies are accredited in Europe, many have no accreditation, and this affects the quality of some of the services in the market. As of March 2002, up to 700, or 18 percent, of certificates in Turkey were delivered by nonaccredited bodies.⁶ Moreover, some local stakeholders, both national and foreign, question the business ethics of some of the smaller certification bodies active in the Turkish market, some of them subsidiaries of European bodies accredited in their home countries. They appear to be performing poor audits and granting certificates quickly and cheaply, and they may not be adequately monitored by foreign accreditation bodies.⁷ Many of the clients of these certification bodies appear to be services

companies seeking to satisfy certification requirements for government procurement purposes. It is difficult for certification bodies accredited by TÜRKAK or by other reliable foreign accreditation bodies to compete under these circumstances.

Turkey still does not have any notified bodies for the certification of products subject to the New Approach directives of the EU. To participate in the EU free market and implement the body of EU law known as the *acquis communautaire*, Turkey and other EU countries are obliged to recognize products manufactured according to certain essential legal requirements set out in the directives. In particular, they need to harmonize their legislation by adopting the technical specifications contained in the New Approach directives. Products covered by the directives must be “CE-marked” by a designated entity called a notified body to prove that they satisfy such requirements. These bodies must be nominated by member states and accepted by the European Commission.

The Turkish government has selected three notified bodies on the basis of an assessment by TÜRKAK, the national accreditation body, but the European Commission has not accepted the proposal and has been conducting its own assessment of the candidate notified bodies since 2004.⁸ A final decision has not yet been made. As is evident from the number of notified bodies in other EU countries, Turkey will need to notify more bodies to serve the needs of its economy (figure B9). Until now, Turkish firms have had to use the services of the subsidiaries of organizations notified in other European countries. Two European subsidiaries share most of this market for CE marking. The presence of domestic notified bodies in Turkey would increase supply for CE marking services and thus increase competition and expand the market to other parts of the country.

Figure B9 Number of National Notified Bodies Recognized by the EU in Selected Countries, February 2006



Policy recommendations

The Turkish government should continue supporting quality management certification programs. SMEs have lower certification rates than large firms. Continued government support articulated through matching grants and administered by entities closely related to the private sector will ensure that certification becomes more diffused among SMEs. The overall support framework should be designed so as to replicate schemes with the highest impact, avoid overlap among providers, promote collaboration between the implementing institutions and the funding ministries, streamline administrative hurdles throughout the financial process, and neutralize the risk-averse fund allocation approach usually taken by implementing institutions. Special attention should be dedicated to supporting quality management certification in the services sector. Service sector enterprises and organizations have adopted far fewer certificates on a per-firm basis in Turkey than in other OECD countries. The services sector provides valuable inputs to Turkey's manufacturing export sector and should not be neglected.

The Turkish government should support training and technical consultancy services for conformity assessment bodies wishing to become notified bodies. Notified bodies are essential to the integration of Turkey in the EU because they enable Turkish products to comply with EU legislation and provide access to the European market.

The Turkish government should promote the creation of an organization for quality management consultants. It is difficult for firms and organizations to identify skilled consultants to prepare them for certification. A business association of consultants could promote the development of this market and improve quality in firms.

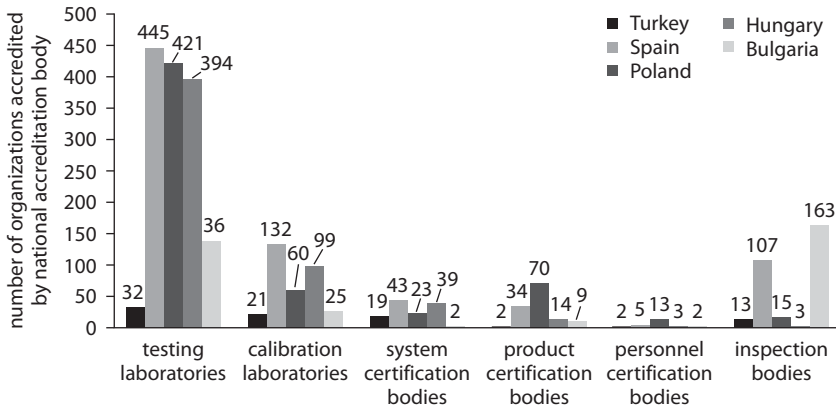
Government procurement rules for ISO 9000 certification should ensure that certificates from bodies with questionable practices are not recognized. The government is an important driver of certification and should refuse certificates issued by bodies that do not conform to ethical practices.

Accreditation

Accreditation activities in Turkey

Accreditation activities in Turkey remain rather limited, especially in product certification. TÜRKAK accredits organizations according to the most widely used and recognized European and international standards.⁹ Currently, 89 organizations have been accredited (figure B10) and 80

Figure B10 Number of Organizations Accredited by the National Accreditation Body in Selected Countries, March 2006



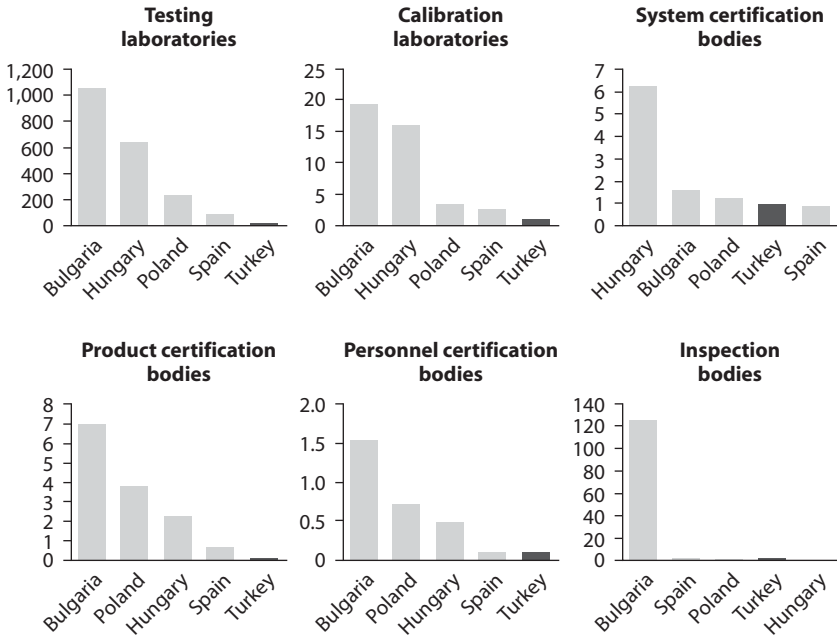
Source: Authors' research.

applications are in process. Despite its large economy, Turkey has accredited far fewer conformity assessment bodies than many other European countries, except in the case of system certification bodies (for process standards). Most worryingly, TÜRKAK has only accredited two product certification bodies (for product standards) since the start of its operations; these are in the areas of cement and organic foods. In relative terms, when value added in manufacturing and services is used to standardize the comparisons of accredited institutions, Turkey ranks in the last position among the selected comparator countries in all areas except system certification and inspection (figure B11).

The number of accreditations has increased in Turkey since 2001, but the rate of increase has stagnated in the past two years. The number of annual accreditations has risen from four to 32 since the start of TÜRKAK's operations in 2001, but there was no growth in accreditation activities between 2004 and 2005 (figure B12). TÜRKAK estimates that it will have accredited 400 laboratories by 2010, about the same number as currently are accredited in Spain or Poland. However, at the current rate, only 150 laboratories will be accredited by 2010, falling short of the infrastructure necessary to support high-quality products for exports.

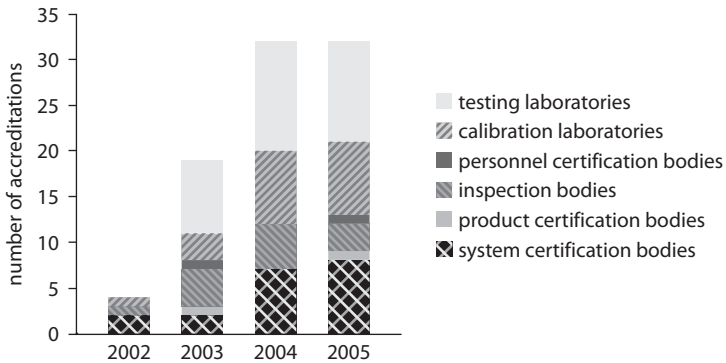
The demand for TÜRKAK's accreditation services has been low. Few of the current potential accreditation candidates have sought to be accredited by TÜRKAK. Of the estimated 82 system certification bodies in Turkey, only 19 are accredited. Of the estimated 50 calibration

Figure B11 Number of Organizations Accredited by the National Accreditation Body in Selected Countries, Standardized by Value Added in Manufacturing and Services, March 2006



Source: Authors' research.

Figure B12 Number of Accreditations Granted Each Year by TÜRKAK



Source: TÜRKAK Web site.

laboratories, only 21 are accredited. Many certification bodies do not seek accreditation from TÜRKAK because they are accredited by foreign signatories to the multilateral recognition arrangement of the European Cooperation for Accreditation (EA MLA), accreditation that is recognized both in Turkey and abroad. Calibration laboratories, which need calibration certificates from the National Metrology Institute in order to become accredited, are discouraged from applying by the high prices that UME charges to provide the required traceability of measurements.

The institutional structure of accreditation

The state plays a large role in the governance of accreditation in Turkey. The public sector is represented to a much greater extent than the private sector in the national accreditation body, holding more than half the seats in the general assembly and on the board of directors. This is not the norm in other countries with more mature accreditation systems, where the private sector plays a more important role in the governance of the accreditation body (table B1).

TÜRKAK's Establishment Law (Law 4457) is too constraining and does not provide TÜRKAK with sufficient administrative autonomy. This law creates a rigid organizational structure by establishing the different service units and administrative departments within TÜRKAK. The law also prescribes the staff titles and number of employees, including a maximum limit on the number of staff. The law does not allow TÜRKAK to adequately reorganize itself according to market demand or to improve the efficiency of its services to the private sector. TÜRKAK

Table B1 Organization of Accreditation in Selected Countries

<i>Country</i>	<i>Legal status</i>	<i>General assembly</i>	<i>Consultative council</i>	<i>Share of executive council members appointed by government (%)</i>	<i>Executive director appointed by government</i>
Bulgaria	public	yes	yes	20	yes
Chile	private	no	no	100	no
Hungary	public	yes	yes	33	no
Mexico	private	yes	no	28	no
Poland	public	yes	yes	100	yes
Spain	private	yes	yes	0	yes
Turkey	public	yes	yes	71	yes

Source: Authors' research.

also has a large number of nontechnical staff relative to the size of its operations. Turkey has one of the largest accreditation bodies in Europe in absolute terms and relative to the number of accredited bodies (figure B13). It appears that the administrative and personnel structure imposed on TÜRKAK by its Establishment Law requires more permanent staff than are necessary for Turkey's current accreditation market.

TÜRKAK depends on high service fees to remain financially sustainable. In 2005, TÜRKAK's budget was TRY 3,800,000, equivalent to about \$2.5 million and comparable to the budgets of the Polish and Chilean national accreditation bodies (figure B14). The budget was financed almost entirely (95 percent) by accreditation fees. TÜRKAK's Establishment Law states that it should receive assistance from the general budget, but it has not received this funding from the government since 2004. Young accreditation bodies such as TÜRKAK typically need government support to develop their customer base. To remain financially sustainable, TÜRKAK is charging service fees that are much higher than the norm in EU accession and candidate countries (figure B15). This can act as a disincentive for conformity assessment bodies to seek accreditation from TÜRKAK.

Until recently, Turkish accreditations had not achieved a high degree of international recognition. Unlike all other EU member states and OECD countries, Turkey is not a member of the International Accreditation Forum (IAF). However, Turkey is a full member of the EA and was accepted to the EA MLA for quality management systems, testing, calibration, and inspection in April 2006. Up to that date, TÜRKAK's lack of international recognition placed important constraints on Turkish

Figure B13 Number of Accreditations per Permanent Staff Person in the Accreditation Body, Selected Countries

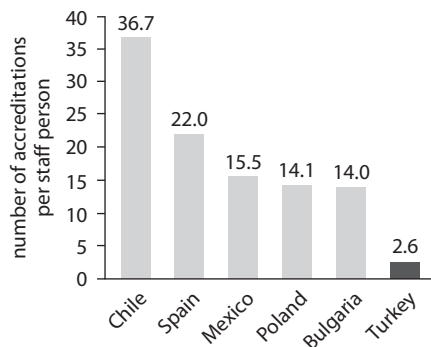
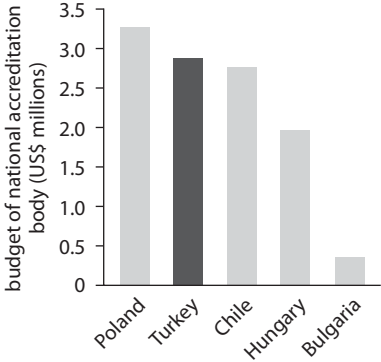
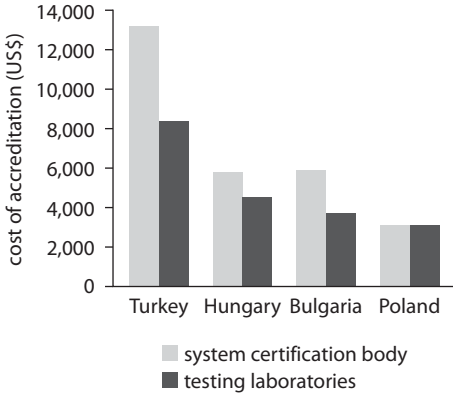


Figure B14 Budget of the National Accreditation Body, Selected Countries



Source: National accreditation bodies.
 Note: 2005 data except Chile, 2002.

Figure B15 Average Cost of an Accreditation, Selected Countries



Source: National accreditation bodies.

exporters seeking services from domestically accredited organizations because their certificates and test results were not recognized abroad.

Policy recommendations

TÜRKAK’s general assembly and board of directors should include a greater share of representatives from the private sector. TÜRKAK serves mainly the private sector and should include more industry representatives, particularly of associations of conformity assessment bodies such as TÜRKLAB.

TÜRKAK’s Establishment Law should be less prescriptive and should allow the organization more autonomy. TÜRKAK’s structure is too

rigid and it may have too many administrative personnel for its current needs. As a result, it cannot adapt itself to changing market requirements. The Establishment Law should not outline the organizational structure of TÜRKAK by defining the different service units and administrative departments, nor should it prescribe staff titles and number of employees. These issues are addressed in a draft of the revised Establishment Law.

The government should provide financial and technical support for accreditation activities. This will help strengthen the infrastructure and human capacities of the conformity assessment entities operating locally and foster competition in the market for accredited conformity assessment services. Local capacity will allow Turkey to become less dependent on foreign assessors, reducing costs, and will help develop TÜRKAK's customer base, an important requisite for international recognition.

Turkey should seek membership in the IAF. Most EA members are also full members of the IAF, allowing them to gain more international recognition and to become involved in technical cooperation with countries outside of Europe. Given that Turkey has already satisfied all the conditions for membership in the EA, gaining admission to the IAF should be relatively straightforward once membership fees are paid.

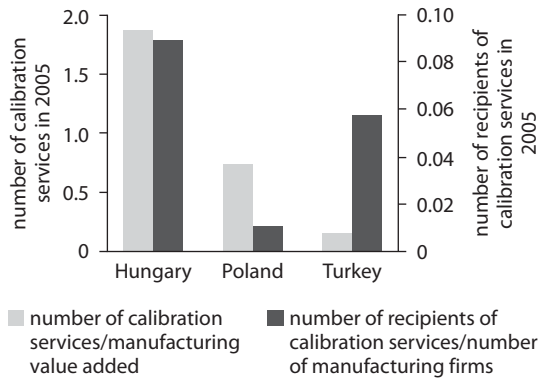
The government should support TÜRKAK's application for product certification and environmental management systems in the EA MLA. Unless TÜRKAK becomes a signatory of the MLA in these areas, the market for product certification and environmental management certification will remain underdeveloped in Turkey. Without access to accredited certification bodies in these areas, local and international recognition of the quality and environmental impact of locally produced goods will suffer.

Metrology and Calibration

Metrological activities in Turkey

Compared to NMIs in other European countries, the National Metrology Institute of Turkey offered few calibration services in 2005, and most were provided to end users. The national metrology institute of Hungary, for example, provided 10 times as many calibration services and served 10 times as many clients as Turkey's UME (figure B16). Moreover, only 9 percent of all of UME's calibrations were performed for commercial calibration laboratories (primary calibrations); the rest were performed for final industrial users (secondary calibrations). As a result, UME dominates the secondary calibration market, providing more calibrations than all other laboratories combined. This is in stark contrast to what is seen

Figure B16 Number of Calibration Activities Relative to Manufacturing Value Added, and Number of Calibration Customers Relative to Number of Manufacturing Firms, in NMIs of Selected Countries, 2005



Sources: National metrology institutes; World Bank 2006b; OECD 2005.

Note: 2002 data for number of firms; 2003 data for manufacturing value added.

in most other industrial countries, where commercial calibration laboratories account for the vast majority of NMI clients.

The number of calibration laboratories using UME's services is insufficient to ensure an adequate diffusion of traceable measurement among Turkish firms. UME's high share of secondary calibrations is partly caused by the lack of high-quality calibration laboratories in Turkey. Furthermore, the market for calibration services is developing very slowly because industrial users prefer UME's more reputable services over those of private laboratories, even for simple calibrations that are well below UME's technical capabilities. Without access to a network of commercial calibration laboratories traceable to UME, industrial firms will not be able to obtain the levels of production accuracy and precision needed to produce high-quality goods.

The institutional framework of metrology

UME has a fairly large and technically competent staff, but these personnel are underutilized. UME employs 200 staff members, 113 of whom work in the laboratories. UME offers competitive salaries and is able to attract highly qualified staff. All of the scientific metrology personnel have at least a university degree in science or engineering, and a large proportion have postgraduate education. UME is not making the most of its technical personnel to provide calibration services to the private sector. Relative to the size of its metrology staff, UME provides very few calibrations. For example, in 2005 the annual number of calibrations per metrologist in the

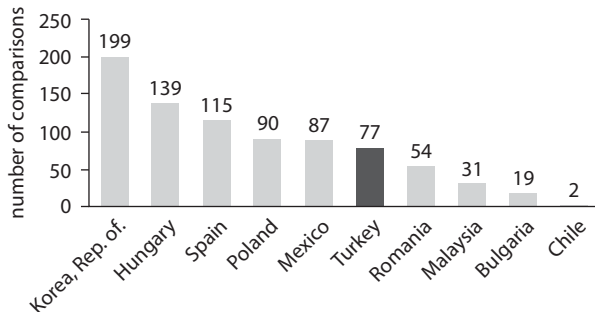
national metrology institute was 36 in Turkey, compared to 173 and 698 in Poland and Hungary respectively. Furthermore, UME's laboratories are underutilized because of higher staff turnover than expected and difficulties in recruiting technical staff due to government ceilings.

Turkey participates in few international inter-laboratory comparisons. The MRA of the International Committee of Weights and Measures (CIPM) is the most comprehensive multilateral agreement for the recognition of measurements between NMIs. The measurement comparisons required by the CIPM MRA have become the principal reference for information on the technical capabilities of NMIs. Turkey has signed the CIPM MRA, but UME needs to participate in international comparisons of measurements so that these measurements will be recognized abroad. Turkey registers more “key comparisons”¹⁰ than the two other EU candidate countries, Romania and Bulgaria, but still lags behind EU member states such as Poland, Hungary, and Spain, and far behind the Republic of Korea (figure B17). TÜRKAK, like all other signatories of the EA MLA, requires measurement traceability to accredit calibration laboratories. Without access to internationally recognized measurements, Turkish calibration laboratories cannot gain accreditation and cannot disseminate the accurate and precise measurements needed in Turkey's export industries.

Policy recommendations

Turkey's National Metrology Institute should formulate a strategy for its transition from the secondary calibration market to the primary calibration market. To ensure that it is not stifling competition in the market for secondary calibrations, UME should gradually disengage itself from the secondary calibration market as private metrology institutions appear in this market.

Figure B17 Number of Key and Supplementary Measurement Comparisons by Signatories of the CIPM MRA



Sources: CIPM online database, appendix B, 2006.

Turkey should participate in more key comparisons to extend the scope of measurements covered by the CIPM MRA. International and regional metrology organizations, such as the BIPM and EUROMET (European Collaboration in Measurement Standards), provide the institutional framework to organize international and regional comparisons of national laboratories. UME needs to participate in more international inter-laboratory comparisons to provide Turkish candidates for accreditation with traceable measurements that are accepted nationally and internationally.

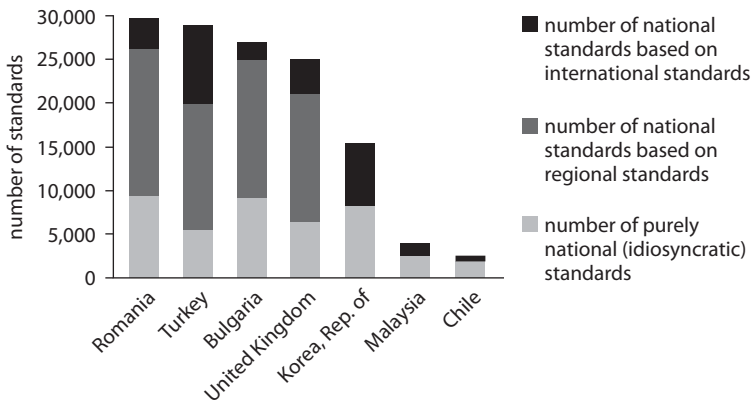
Turkey should use its advanced technical infrastructure to cooperate with neighboring countries that wish to develop a recognized national metrology institute. In addition to increasing scientific ties and exchanges with other countries, this could provide additional sources of income to UME as it leaves the secondary calibration market to the private sector.

Standardization

Standards development in Turkey

Turkey has a large and rapidly growing standards stock. As of 2006, the standards catalogue of the Turkish Standards Institution lists 28,848 standards, slightly fewer than in Romania but more than in most other countries, including the United Kingdom and Korea (figure B18). The standards stock has significantly grown in the past few years (up from 14,616 stan-

Figure B18 Number of National Standards, Selected Countries



Sources: Web sites of the national standards bodies (ASRO, TSE, BDS, BSI, KATS, DSM, INN).

Note: January 2006 data for Romania, Turkey, and Bulgaria; December 2004 data for Malaysia; December 2003 data for the United Kingdom; December 2002 data for Chile and Korea. Regional standards correspond to ENs in the case of Turkey.

dards in 2000), and 1,122 standards were adopted in 2005 alone.¹¹ As in other countries, most standards in Turkey concern particular products, but there are also a number of process standards, such as ISO 9000 standards.

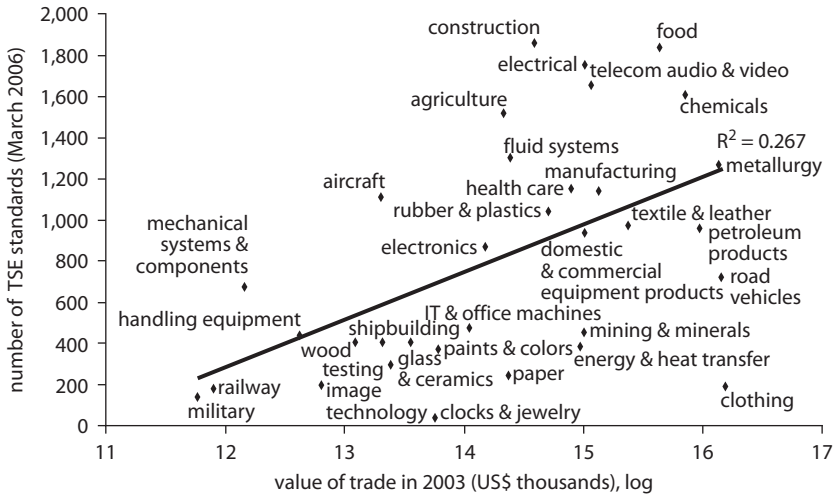
European standards (EN) constitute a growing share of Turkey's standards stock, more than 50 percent as of January 2006 (figure B18). Turkey has now adopted more than 90 percent of the European standards. However, approximately 5,000 ENs, or one-third of total ENs, have been adopted in English only, without a Turkish translation. These standards will only be translated if they are included in standards preparation work programs at the request of stakeholders. Given the limited level of English proficiency in Turkey, this may constitute a major constraint to stakeholders' access and their ability to export to the EU.

Turkey continues to implement EU directives and to eliminate existing technical regulations. The Old Approach and New Approach directives incorporate the technical product and process specifications that a country must adopt in national legislation to participate in the EU free market. The government ministries are transposing and integrating the European legislation related to the Old Approach and the New Approach into the Turkish legal system and removing conflicting technical regulations. Approximately 80 to 90 percent of EU legislation has been adopted and transposed into Turkish law, including 25 of 29 New Approach directives.

Besides European standards, Turkey continues to actively pursue a policy of adopting international standards. Turkey has adopted more than 9,000 ISO and IEC standards. These represent approximately 31 percent of its standards stock, a comparable or higher share than in most other countries (figure B18).

Turkey is adopting standards in sectors that are important for trade, but a few of these sectors have an unusually high number of idiosyncratic standards. Figure B19 shows a roughly linear relationship between the standards stock and the value of trade in each sector. Because most Turkish standards are international or regional, this pattern of standardization should decrease barriers to trade in the most relevant sectors.

Nonetheless, figure B19 shows that some sectors have many more standards than predicted by their relevance to trade. First, as expected, sectors that are more technology-intensive are generally also standards-intensive. Second, some sectors, such as construction, have a much larger standards stock than predicted by Turkish trade levels. This is because Turkey has adopted almost 15,000 European standards to support its EU candidacy, and many, such as in the construction sector, are not relevant to the Turkish economy. Third, three sectors that play an important role in both imports

Figure B19 Standards Stock vs. Value of Trade in Turkey

Sources: UNCTAD 2005; TSE Web site.

and exports—food technology, chemical technology, and agriculture—are heavily standardized, but most of these standards (65–82 percent) are purely idiosyncratic, that is, they are country-specific standards not shared with any other country.¹² Turkey's large share and absolute number of idiosyncratic standards in these sectors could generate technical barriers to trade. These standards can have a negative impact on imports if other countries must bear the additional costs of modifying their products specifically for the Turkish market, and they could even have a negative impact on exports by placing Turkey at a comparative disadvantage in relation to international standards.

The institutional standardization framework

TSE is de facto a voluntary standards organization, although the legislation also gives it a role in mandatory standards. According to its Establishment Law, TSE recommends to the ministries standards that are to be made mandatory. This role has created confusion and represents an obstacle to its membership in the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC). As a result, TSE's technical board has not recommended that any standards be made mandatory since 2002.

TSE's administrative structure is dominated by representatives of the public sector. Contrary to many other standards bodies, TSE is not an open membership organization but operates according to a representa-

Table B2 Governance of the National Voluntary Standards Bodies, Selected Countries

<i>Country</i>	<i>General assembly</i>	<i>Consultative council</i>	<i>Share of executive council reserved for government appointees (%)</i>	<i>Executive director appointed by government</i>
Bulgaria	no	yes	100	yes
Hungary	yes	no	33	no
Korea, Rep. of	no	yes	100	yes
Mexico	yes	yes	0	no
Romania	yes	yes	5	no
Spain	yes	no	0	no
Turkey	yes	no	55	no
United Kingdom	yes	yes	0	no

Source: National standards bodies.

tive system (table B2). Slightly more than half of the seats in the general assembly, the highest authority, are allocated to representatives of relevant government ministries and public agencies; the rest are reserved for representatives of universities and the productive sector.

Remunerated experts participate in the preparation of standards in TSE, an uncommon practice in standards bodies. National standards organizations typically implement a work program and delegate the technical aspects of standards development to technical committees made up of representatives from government agencies, the productive sector, consumer associations, academia, and research institutions. Each technical committee is responsible for developing standards in a specific area and may be formed and dissolved by the standards body as the need arises. In other countries, members of technical committees are usually volunteers who do not receive remuneration from the standards body for their work, but they may be sponsored by their organizations. In Turkey, standards preparatory groups (SPG) develop draft standards in particular sectors through technical experts appointed by TSE, who receive compensation for their work.¹³ To conform to international best-practice and consensus-driven standardization, TSE is changing this practice in favor of open voluntary committees, and SPGs will be eliminated by 2007.

TSE has been granted institutional autonomy from the government in a number of areas but faces restrictions on its workforce. Since January 2006, a new budgetary implementation law for public entities imposes restrictions and delays on contracting outside experts and purchasing equipment. As a result, TSE has become less autonomous than other

national standards bodies. This could make TSE less effective at delivering the services needed to finance the standards development process, particularly in areas that require very specialized technical skills.

Turkey is a full member of the major international standards organizations but does not have full membership in the European standards bodies. Participation in the international and regional standardization process ensures that the needs of the private sector are reflected in standards that are shared by Turkey and its trade partners. Turkey is a full member of ISO, IEC, and ITU, but is only an affiliate member of the regional standards bodies CEN and CENELEC. As an affiliate member, Turkey has limited input in the standards development process, can only participate as an observer in the technical committees, and has no voting rights on standards in the general assemblies.

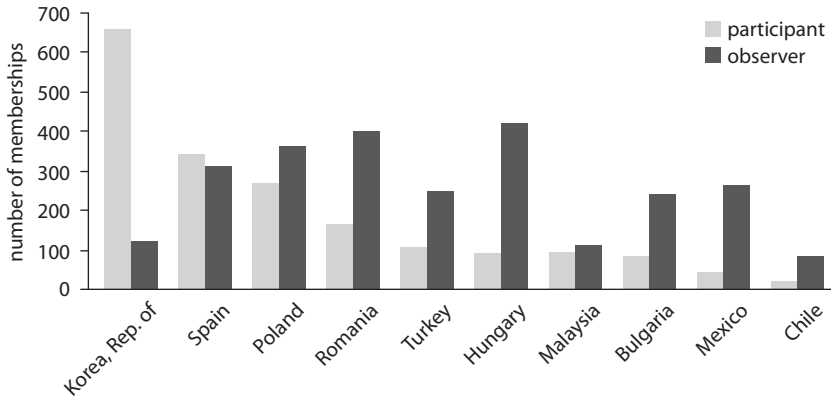
Most of the current barriers to full CEN membership are being addressed in new Turkish legislation under preparation. This legislation will abolish TSE's role in mandatory standards, will eliminate the SPGs so that standards are developed through consensus, and will clearly separate the standardization and commercial functions of TSE to avoid conflicts of interest.

At the international level, Turkey does not participate very actively in the development of standards. There are important benefits to participating in the international standardization process. Active participation increases the chance that national concerns will be reflected in international standards. It also enables the compatibility of national standards with international standards. Participation in international standards development can also provide a forum for exchange of technical information with representatives from international industrial and scientific organizations. As of December 2004, Turkey was a participant member in only 107 ISO technical committees out of a total of 734. This is far fewer than Romania, which has a much lower GDP than Turkey (figure B20). Turkey's limited participation in international standards development is partly due to a lack of interest in the private sector. Moreover, travel costs make it expensive to participate in international technical committees and working groups.

Policy recommendations

TSE should ensure that its standardization and commercial activities are administratively, physically, and financially separated. There are many countries, such as the United Kingdom, Spain, and Korea, where the national standards body also offers a number of commercial services, such as certification and testing, but the separation of functional areas in the standards body is typically made explicit by law or in government agreements. In the

Figure B20 Participant and Observer Memberships in ISO Technical Committees and Subcommittees



Source: ISO Web site.

Note: January 2006 data for Bulgaria, Hungary, Malaysia, Poland, Romania, and Turkey; October 2005 data for Chile, Korea, Mexico, and Spain.

United Kingdom, the memorandum of understanding between BSI British Standards, the national standards body, and the UK government requires that management decisions concerning the standards division should not be influenced by other BSI business activities. The memorandum also subjects any collaboration of the standards division and other commercial divisions to competition law. Such an arrangement, if implemented in Turkey, would guarantee the absence of conflicts of interest in TSE's functions. This issue is currently being addressed by TSE. If TSE does not clearly separate its standardization and commercial activities, it is recommended that the commercial branch of TSE be privatized and that the government provide full funding for TSE's standardization activities.

As an autonomous public body providing commercial services to the private sector, TSE should not be subject to government procurement and hiring legislation. To be competitive in the certification and testing services market, TSE needs to be able to independently set its salaries, select its workforce, hire external contractors, and purchase technical equipment. In most EU countries, the national standards bodies have been granted full autonomy from the government to allow them to remain competitive in their nonstandardization activities.¹⁴

TSE's administration should include more private sector representatives. In particular, TSE's general assembly should include a majority of private sector representatives and at least one consumer association.

TSE should ensure that its role in the development of mandatory standards is not ambiguous. Currently, TSE's Establishment Law states that it can recommend mandatory standards to the government ministries. This issue is currently being addressed in the draft of the revised TSE Establishment Law.

TSE should continue to replace the SPGs with voluntary technical committees for the development of national standards. TSE should ensure that the new technical committees use the consensus principle and include representatives from all stakeholder groups.

Turkey should continue removing obsolete standards and standards that conflict with EN standards. Many Turkish standards were not developed through an open voluntary participation process and may not represent the needs of stakeholders.

Turkey should continue adopting the remaining European and international standards and should ensure that ENs are properly translated into Turkish. Turkey should ensure that its most important trade sectors do not become overstandardized and should make full use of available international and European standards.

Turkey should intensify its efforts to obtain full membership in CEN and CENELEC and should increase its participation in technical committees. Membership in the European standards bodies and active participation in the work of technical committees will allow Turkey to provide its inputs to the regional standards that it adopts. The Turkish government should support participation of the private sector in European and international standardization activities. Many of the European standards are harmonized standards and effectively support Turkish legislation transposed from European directives. It can be difficult for firms, especially SMEs, to represent Turkish interests in CEN, CENELEC, ISO, and IEC technical committees due to high travel costs. Turkish participation in these organizations should be supported by government funding.

Conclusion

Turkey has made significant progress toward establishing a modern, market-based quality standards regime that will facilitate its accession to the EU and entry into other international markets. Turkey has a functioning national quality system in place, comprising a national standards institution, an accreditation agency, and a national metrology institute, as well as a fair number of testing and calibration laboratories and certification and inspection entities. Quality awareness among Turkish firms

Table B3 Turkey's National Quality System: Deficiencies, Ongoing Actions, and Recommendations

<i>Area</i>	<i>Deficiencies, based on the diagnostic</i>	<i>Recent and ongoing government activities and initiatives planned for the short term (6 months)</i>	<i>Recommended actions for the medium term (6 months to 3 years)</i>
Certification	ISO 9000 certification rates are low among small firms and in nonmanufacturing sectors. Poor business practices exist among certain certification bodies. There are no national notified bodies.	Technical assistance programs for quality certification are provided by KOSGEB. Turkish notified bodies are being designated and presented to the European Commission.	Continue support for quality certification among SMEs and in the services sector through matching grant programs. Government procurement rules should ensure that quality certificates are issued by organizations with ethical practices.
Accreditation	There are high accreditation fees and low demand for TÜRKAK accreditation. International recognition of Turkish accreditation is low.	A draft of a revised Establishment Law provides TÜRKAK with more autonomy over its administration and personnel. TÜRKAK has been accepted in the EA MLA.	The government should support building up local capacity for advisory and consultancy services, mostly through training. TÜRKAK should seek membership in the IAF.
Metrology	Demand is low for UME's primary calibrations, which mostly cater to the secondary market. Not enough of UME's measurements are comparable internationally.		Develop a strategy for UME to transition from the secondary to the primary calibration market. Participate in more comparisons of calibration laboratories. Use advanced metrological infrastructure for regional cooperation.
Standardization	Turkey has a very large standards stock. EN standards have not all been translated into Turkish. TSE's role in mandatory standards is ambiguous. The standards development process is not open and voluntary. Turkish participation is limited in the development of regional and international standards.	TSE is gradually reviewing and removing obsolete standards. A draft Establishment Law eliminates TSE's role in mandatory standards, creates open voluntary committees, includes consumer representation in TSE's governance structure, and separates TSE's different functions. Turkey is applying for full membership in CEN and CENELEC.	Develop a strategy to translate EN standards into Turkish. Increase participation in international standards development technical committees.

seems to be improving, as shown by the increasing rate of growth of quality certificates, although in absolute terms Turkey is still far from relevant comparator countries. The country has already replaced almost all national technical standards with EU and international standards and has significantly reduced the number of mandatory standards. The recently created accreditation body, TÜRKAK, was accepted into the EA MLA for quality management systems, testing, calibration, and inspection in April 2006. UME, the metrology institution, is well equipped and has highly qualified staff. It already offers reliable measurement traceability, which is needed for the proper functioning of the Turkish quality infrastructure.

Nonetheless, policy and institutional changes are still needed to further improve Turkey's national quality system and foster adoption of quality standards at the firm level. Furthering international recognition of the main institutions of the national quality system is crucial to remove constraints faced by Turkish producers and exporters. UME needs to participate in more international comparisons of measurements, and TÜRKAK has to broaden its participation in the recently signed EA MLA by applying to also become a signatory in the areas of product certification and environmental management systems certification. Legislation regulating the functioning of these institutions needs to be revisited to clarify responsibilities, increase flexibility, and facilitate the adoption of more efficient and transparent practices with increased participation of the private sector. Finally, it is necessary to increase Turkish labs' and firms' requests for accreditation and certification. Matching grants have proven successful in encouraging adoption of quality standards in several countries. See table B3 for a summary.

Notes

Chapter 1

1. Manufacturing refers to the industries belonging to ISIC Rev. 3.1, divisions 15 through 37.

Chapter 2

1. The height-to-width ratio of the A4 format is such that if two pages are placed next to each other, the resulting double page will have the same height-to-width ratio as a single page. This makes scaling multiple sheets onto a single sheet through photocopying extremely efficient, because two or more sheets can be scaled down by a multiple of two to fit exactly on a single sheet, without loss of space or onerous scaling factor calculations.
2. From the history section of the BSI Group Web site, <http://www.bsi-global.com/News/History/index.xalter>.
3. *United States of America v. Microsoft Corporation. Findings of Fact.* United States District Court for the District of Columbia, November 5, 1999.
4. In U.S. dollars, \$180,390, \$1,288, and \$3,092,400, respectively.
5. The terms “mandatory standards,” “obligatory standards,” and “technical regulations” all refer to government-enforced standards.
6. See chapter 5 for discussion of mutual recognition agreements.
7. The best examples of buyer-driven chains are in the United States apparel industry. In 1995, the top five largest national apparel retailers accounted for 68 percent of all apparel sales in publicly held retail outlets (Gereffi 1999).

Chapter 3

1. There is still some debate about the merits of the QWERTY keyboard in the literature.
2. The terms “standards body,” “standardization body,” “standardizing body,” “standards development organization,” and “standardization organization” are all commonly used to refer to the same type of entity.
3. The consensus principle aims to protect minority interests. Often a pure form of unanimity is not required to adopt a standard, but a demonstrated attempt is made to reconcile negative votes for a draft standard and a significant majority is required to approve the standard.

Chapter 4

1. “Certification” refers to the issuance of a written assurance and “registration” refers to the recording of the certification in the certification body’s client register. The terms are used interchangeably in many countries.
2. The quality management system certification bodies with the largest global market shares are BSI British Standards (UK), Perry Johnson Registrars (U.S.), URS (UK), QMI (Canada), ABS (U.S.), SGS (Switzerland), DNV (Norway), Underwriters Limited (U.S.), LRQA (UK), and INTERTEK (U.S.). See the QSU Publishing Company Web site, <http://www.qsuonline.com/BodyPages/BigTen.html>.
3. These guidelines are documented in ISO/IEC Guides 62, 65, and 66.
4. Relying exclusively on reputation may have anticompetitive effects, because it favors incumbents at the expense of new entrants.
5. Guidelines for testing and calibration laboratories are documented in the ISO/IEC 17025 standard; guidelines for inspection bodies are documented in the IOS/IEC 17020 standard.
6. Examples include ISO/IEC Guide 58, the ISO/IEC 17011 standards, and the IAF Code of Conduct.
7. Standards used to assess laboratories include the ISO/IEC 17025; those used to assess quality systems include the ISO/IEC 9001:2000.

Chapter 5

1. For example, ISO 9000 and ISO 14000 registration.
2. Legitimate objectives include those concerned with national security requirements; prevention of deceptive practices; and protection of human health or safety, animal or plant life or health, or the environment.

3. The Code of Good Practice is a section of the WTO TBT agreement that outlines principles for the development and application of standards and is open to acceptance by the standardizing bodies of member states. It includes specific recommendations regarding transparency and the involvement and consultation of interested parties throughout the standards development process. The WTO is to be notified of work programs concerning standards on a periodic basis. The code prohibits the use of standards as barriers to trade. It commits standardization bodies to using international standards as a basis for national standards, unless these are ineffective or inappropriate. The Code of Good Practice has been accepted by 152 standardization bodies in 111 countries.
4. The ITU uses the term “recommendations” instead of “standards.”
5. In free trade areas, countries agree to eliminate tariffs and quotas but each country maintains an independent external trade policy, making this a weaker form of economic integration than other RTAs such as customs unions.
6. Such as ISO/IEC 17025 for calibration and testing laboratories.
7. For example, ISO/IEC 17011:2004 specifies general requirements for accreditation bodies tasked with assessing and accrediting conformity assessment bodies. It is also used as a requirements document for the peer evaluation process for mutual recognition arrangements between accreditation bodies.
8. When MRAs cover accreditation in the areas of product certification, testing, or calibration, they usually cover the entire range of possible subareas—that is, accreditation for all types of products, all types of tests, or all types of calibrations, respectively—rather than only one specific subarea.
9. OIML members are required to comply with the OIML international recommendations regarding metrological performance and testing procedures. These recommendations are used as a basis for EU directives, and EU member states are legally obliged to adopt them in their regulations. Hence, adhering to the recommendations can facilitate trade with the EU.
10. OIML certification provides the manufacturer with the possibility of obtaining an OIML certificate and test report confirming that the instrument type complies with relevant international recommendations. The certificates and test reports are delivered by issuing authorities in OIML member states and are accepted in other countries on a voluntary basis, thereby eliminating the costly duplication of

application and test procedures for measurement instruments. The OIML issued 112 certificates in the first 10 months of 2005. The OIML is currently establishing a mutual acceptance arrangement for test reports of type evaluation.

Chapter 6

1. Referred to as ISO 9001:1994, ISO 9002:1994, and ISO 9003:1994.
2. Rao, Ragu-Nathan, and Solis's survey data measured a number of factors that underlie quality practices and results, including leadership, information and analysis, strategic quality planning, human resources development, quality assurance, supplier relationships, and customer orientation.
3. The South African survey was confined to agribusiness firms, which may account for cost differences.
4. Grajek (2004) uses a gravity equation for international trade, which predicts that the volume of trade between two countries will be proportional to their economic mass and inversely proportional to the distance between them and other trade barriers. This equation is combined with an international diffusion equation in which ISO 9000 adoption in one country is influenced by ISO 9000 adoption in close trade partners. Trade barriers are defined to be a decreasing function of bilateral adoptions of ISO 9000, that is, ISO 9000 certification in both trade partners should establish a common language that decreases trade barriers.
5. Sectoral proclivities for certification also occur in highly globalized sectors where a large portion of the output is destined for exports or where transnational production networks are dominant (Schuurman 1997).
6. Guler, Guillén, and Muir Macpherson ruled out the possibility of reverse causation by measuring all independent variables with a one-year lag.

Chapter 7

1. In Peru, a single entity, INDECOPI, is responsible for an exceptionally large number of tasks. These include not only national standards development, metrology, and accreditation, but also intellectual property registration, consumer protection, and enforcement of policies on competition.
2. A notable exception is INDECOPI in Peru, where the government is responsible for more than half of the standardization budget.

3. ISO has 190 technical committees, 544 technical subcommittees, and 2,188 working groups.
4. The four priority objectives are (a) align domestic standards in APEC economies with international standards; (b) achieve recognition of conformity assessment, including mutual recognition arrangements in regulated and voluntary sectors; (c) promote cooperation for technical infrastructure development to facilitate broad participation in mutual recognition arrangements in both regulated and voluntary sectors; and (d) ensure the transparency of the standards and conformity assessment of APEC economies.
5. Resolution 502 of the Andean Community.
6. Resolution 2/92 of Mercosur.

Chapter 8

1. QS 9000 is an older standard established by the top three U.S. automakers and used worldwide, along with other regional standards. ISO/TS 16949 is a newer uniform standard developed by all of the world's major automakers. Most automakers set deadlines for their suppliers to upgrade to ISO/TS 16949 between 2004 and 2006.
2. This could be due to a high certification rate in Mexico, but it may be also due to the fact that some manufacturers in Germany and Japan are registered to standards other than QS 9000.
3. These statistics only consider the formal sectors.

Chapter 9

1. The autonomy index ($\text{min}=0$, $\text{max}=1$) is calculated as the fraction of the following statements that are true: The national accreditation body has the autonomy to (a) set its fees; (b) set the salaries of its workforce; (c) hire its personnel; (d) grant and revoke accreditations; (e) join international organizations and sign international agreements; (f) set its own budget; (g) create new administrative divisions; (h) offer new services.

Chapter 11

1. The Inter-American Development Bank has proclaimed CYGA to be one of the best enterprise development programs of its type in Latin America (COPANT 2005).

2. Workshops are offered in the areas of process re-engineering, continual improvement, customer service, basic process integration, logistics, and model change optimization. Firms wishing to participate are first screened through a free prediagnostic process that establishes the feasibility of a workshop.

Appendix A

1. Guidelines for testing and calibration laboratories are documented in the ISO/IEC 17025 standard; guidelines for inspection bodies are documented in the IOS/IEC 17020 standard.

Appendix B

1. The semi-elasticity of employment with respect to quality certification is 0.448.
2. The percentage contributions are constructed by dividing the product of the average value of the investment climate variables and the corresponding elasticity or semi-elasticity by the average value of log-employment, all multiplied by 100. Using log-employment instead of employment allows us to take advantage of the additive properties of logarithms.
3. These include the requirements described in voluntary and mandatory standards.
4. In addition to Turkey, accession and candidate countries include Bulgaria, Croatia, the Former Yugoslav Republic of Macedonia, and Romania.
5. Firm size is defined by number of employees: small, 1–49; medium, 50–249; large, 250+.
6. This number reflects the difference between the number of certificates registered through The ISO Survey of Certifications 2004 (ISO 2005), which only includes accredited certification bodies, and the total number of certificates estimated in a separate local survey reported in *Support to the Quality Infrastructure in Turkey* (CEN 2003).
7. These bodies are said to deliver certificates in as little as a week, while it usually takes a few months to conduct a proper audit and register a company.

8. This may be due to the lack of international recognition of the Turkish accreditation system. TÜRKAK has just signed the European Cooperation for Accreditation Multilateral Recognition Arrangement (see the next section).
9. ISO/IEC 17025, ISO/IEC 17020, EN 45012, EN 45011, ISO/IEC 17024, Guide 66.
10. The recognition of national measurements by signatories of the CIPM MRA relies on a database of “key comparisons” of national measurement standards, based on participation in international and regional inter-laboratory comparisons.
11. Turkey has also been engaged in a strategy of removing all obsolete standards. In 2005, more than 9,000 standards prepared before 2000 were reviewed in consultation with stakeholder groups. It is evident that many of the standards are not useful. For example, TSE, the national standards body, found 1,800 standards whose documentation had not been sold to a single user during a three-year period.
12. Turkey is using more of its own agricultural and food standards than France, Belgium, and Italy, even though these sectors represent a relatively similar share of trade in all these countries. In the case of chemicals, idiosyncratic standards represent twice the proportion of the standards stock as they do in Italy, where they account for a larger share of trade.
13. SPGs also examine international documents to make proposals for ISO and IEC votes.
14. Moreover, in some countries the national standards body is explicitly allowed to cross-subsidize the standardization activities with the proceeds of other commercial activities. For example, the memorandum of understanding between BSI British Standards and the UK government states that BSI must apply profits from its nonstandardization activities to its standardization activities.

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- BIPM (International Bureau of Weights and Measures): <http://www.bipm.fr>
- CITAC (Cooperation on International Traceability in Analytical Chemistry): <http://www.citac.cc>
- CODEX: http://www.codexalimentarius.net/web/index_en.jsp
- COMPITE: <http://www.compite.org.mx>
- Contactopyme: <http://www.contactopyme.gob.mx>
- COPANT (Pan American Standards Commission): <http://www.copant.org>
- EA (European Co-operation for Accreditation): <http://www.european-accreditation.org>
- European Commission, Nando Information System: <http://europa.eu.int/comm/enterprise/nando-is>
- IAAC (InterAmerican Accreditation Cooperation): <http://iaac-accreditation.org>
- IAF (International Accreditation Forum): <http://www.iaf.org>
- IEC (International Electrotechnical Commission): <http://www.iec.ch>
- ILAC (International Laboratory Accreditation Cooperation): <http://www.ilac.org>
- INN (Instituto Nacional de Normalización): <http://www3.inn.cl/>
- IRCA (International Register of Certified Auditors): <http://www.irca.org>

- ISO (International Organization for Standardization): <http://www.iso.ch>
- ITU (International Telecommunication Union): <http://www.itu.int>
- Macaws SRL: <http://www.macaws.net/>
- Mexican Ministry of the Economy: <http://www.economia-iso9000.gob.mx>
- OAS Foreign Trade Integration System (SICE): <http://www.sice.oas.org>
- OIML (International Organization of Legal Metrology): <http://www.oiml.org>
- PAC (Pacific Accreditation Cooperation): <http://www.apec-pac.org>
- QSU Publishing Co.: <http://www.qsuonline.com/>
- SADC Web site on Standardisation, Quality Assurance, Accreditation, and Metrology: <http://www.sadc-sqam.org>
- SADCA (SADC Accreditation): <http://www.sadca.org>
- TSE (Turkish Standards Institution): <http://www.tse.org.tr>
- TÜRKAK: <http://www.turkak.org.tr>
- WTO (World Trade Organization): <http://www.wto.org>

Index

Citations to material in the endnotes are italicized.

A

accreditation, 14, 66, 69–74, 204–207
activities, 173, 177–180, 243–246
budget, 248
confidence, 82
costs, 71, 225, 248
establishing, 70–71
function of, 69–70
governance and autonomy, 172–175, 265*n.1*
government support, 205–207
guidance, 70
institutions, 14, 69–70, 70–74, 171–177, 204, 219, 246–248
international integration, 180–182
international recognition, 92–94, 207
Latin America, 171–184
legal status, 172
markets, 205–206
Mexico, 219, 224–228
organization, 171–172, 204–205, 244, 245, 246
policy recommendations, 248–249
private sector participation, 173
process, 71
regional cooperation, 72
resources, 175–177
scope, 70
staff, 174, 247
time required, 176–177
Turkey, 234–235, 243–249, 259
acquis communautaire, 242

adaptation, 43–44
costs, 33, 261*n.4*
advocacy, 214, 202
Africa, horticultural market, 44, 45
American National Standards Institute (ANSI), 57–59
APEC, 142, 144, 265*n.4*
application programming interfaces (APIs), 25–26
Argentina
certification costs, 112
quality promotion initiatives, 199
assessment
second-party, 64, 65
third-party, 64, 65, 68
assessors, 175
auditors, 161, 213
automobile sector, 157–158
certification, 158, 265*nn.1,2*
autonomy
accreditation institutions, 172–175, 265*n.1*
standards-setting institutions, 131–132

B

best practices, accreditation bodies, 181
Bolivia, leather PDA covers, 7
Brazil
certification, 109, 112
footwear, 5, 43
quality promotion programs, 193–194
British internationalization, 89
budget, 60, 202
business environment indicator, 167
certification rates and, 168

buyer-driven value chains, 41–42, 42–43, 44–45

C

calibration, 10, 68–69, 189–190, 262*n*.5
certificates, 95
demand for, 212–215
laboratories, 13, 92, 178–179, 180, 263*n*.6

Mexico, 219, 222
number offered, 190
Turkey, 236

see also measurement; testing

Canada, legal metrology, 79–80

Center for Quality, Safety and Productivity (QSP), 193–194

certification, 10, 65–68, 82, 262*n*.1
accreditation, 204
barriers, internal firm-level, 105–114
benefits, 66, 68, 228
bodies, 12, 65, 92, 262*n*.2, 263*n*.6
consulting services, external, 109
costs, 110–113, 264*n*.3
demand for, 212–215
financial performance and, 102–103
firm performance and, 108
market share, 160
Mexico, 219, 228–232
objectivity, 66, 69, 73–74
organizational performance and, 100–102, 264*n*.2
performance, 153–155
policy recommendations, 243
principles, 65–66
prior, certification and, 120
quality, 160
services, 241–243, 159–161, 266*n*.6
time-series studies, 101–120
Turkey, 233, 234, 236–243, 259, 266*nn*.1,4,5
why firms get certified, 99–100

certified pesticide-residue tests, 47

CERTIpyme, 196

Chile

quality promotion initiatives, 198–199
wine market, 5

Chilean Economic Development Agency (CORFO), 198–199

China, certification and export performance, 106–107

Code of Good Practice, 84, 263*n*.3

coffee, quality Uganda, 20–21

Colombia, quality promotion programs
CYGA, 194–195
other, 195–196

Colombian Fund for the Modernization and Technological Development of Micro, Small and Medium Enterprises (FOMIPYME), 195, 196

Committee for Standardization (CEN), 87, 89

Committee on Standards-Related Measures (CSRSM), 146

communication, 214

compatibility 16–17, 18, 20–21

competition, 3–4, 6, 203, 216

constraints to, 25–26

increased, 21–24

ISO 9000 and, 99–105

mobile phones, first- and second-generation, 22–23

quality and, 4

compliance, 215

evaluation, 63–80

Mexico, 226

concept modeling, 126

confidentiality, certification bodies, 66

conflicts of interest, 73

Conformity Assessment Framework, 63–80

conformity assessment, 10, 81–96, 236–237

incompatible procedures, 81–82

Mexico, 230, 232 cost, 229

consolidation, national quality system, 203–204

Consorcio del Jamón Serrano Español, quality control, 67

coordination failures, 214

COPANT, 144–145, 265*n*.5

costs, 19, 80

accreditation, 71, 225, 248

adaptation, 33, 261*n*.4

certification, 68, 110–113, 264*n*.3

conformity evaluation, 229

consulting, 112

Latin America, 139

measurement activities, 27

metrology, 78, 80

Mexico, 229

reductions, 24

regional coordination, 91
 registration, 112–113
 standards, 53, 90, 139
 trade, 34
 credibility, metrology, 95
 cultural factors, certification and, 123,
 125–126

D

decentralized approach, 202
 de facto standards, 51
 de jure standards, 52
 disputation, legal metrology and, 79
 diversification, 6
 duplication, certification and testing, 82

E

economic environment
 certification and, 119–126
 ISO 9000 diffusion and, 165–170
 economic growth, standards and, 28–32
 economies of scale, 17
 education
 certification and, 120–126
 ISO 9000 diffusion and, 170
 efficiency, productive and innovative,
 17–18
 EMA, 225–227
 engineering tolerances, 76
 environment, 79
 environmental management systems
 (EMSs), 182
 certificates, 149–151
 equivalence, 83
 EurepGAP certification, 47, 48
 European Union
 food safety 36
 grapes, 46
 market, access to, 236–237
 New Approach directives and
 Turkey, 242
 standards, 88–89
 evaluation, 203–204, 215
 export performance
 certification and, 105, 106–107
 ISO 9000 diffusion, 163–165, 265*n*.3
 exports
 certification and, 162
 GDP and, 3, 162
 quality and, 40

F

feedback, 20–21
 fees. *See* costs
 financial performance, certification and,
 102–103
 financial resources, limited, 109–113
 first-party assessment, 64
 flexibility, 83, 262*n*.2
 food standards, 35–36
 footwear, 5, 43
 foreign bodies
 accreditation, 241, 266*n*.7
 certification, 159–160, 181
 foreign direct investment, 163
 foreign markets, standards and, 35
 foreign multinationals, 119, 264*n*.6
 foreign technical regulations, 34
 formal standards, 52
 functional upgrading, 42
 funding, standardization, Latin America,
 132–134

G

GDP, exports and, 3, 162
 Genera Bureau of Standards (DGN), 129
 Germany
 economic growth, 31–32
 standards, 36, 38
 globalization, 2, 216
 global production networks, 6
 governance, standards-setting institutions,
 131–132
 government, 8
 accreditation, 205–207
 agency or unit, single, 202
 certification, 119, 120, 243
 fiscal functions, 79
 metrology, 208
 regulations, 119
 role, 213–215, 119, 243
 standardization, 54–56
 standards bodies, 60
 Turkey, 243
 withdrawal, 202
 grapes, market requirements, 46–49

H

ham, cured, 67
 harmonization, 36, 37, 40, 83, 88–89,
 89–90

- Hazard Analysis and Critical Control Point (HACCP), 195
- health, 79
- health care, metrology, 77
- horticultural value chain, upgrading, 44–45
- human capital, 202
- accreditation, 205, 247
 - metrology, 208
 - standards, 135
- I**
- incentives, 213–214
- INDECOPI, 129, 264*nn.1,2*
- independence, certification bodies, 66
- India
- grapes, market requirements, 46–49
 - software, certification, 120–126
- indirect network externalities, 20–21
- industrialization, 41, 261*n.7*
- industry
- consortia, 51
 - standards and, 39
- information, 16, 55
- asymmetries, 19
 - certification and, 124
 - imperfect, 19
 - program, 202
 - provision, 28
- infrastructure, metrology, 78
- innovation
- constraints, 24–25
 - diffusion of, 18
 - growth and, 31
 - standardization and, 28
- inspection, 10, 68–69, 219, 228–232
- bodies, 13, 92, 179, 263*n.6*
 - Mexico, 219
 - number of accreditation, 179
 - Turkey, 236–243
- institutional environment
- certification rates and, 169
 - indicator, 168
 - ISO 9000 diffusion and, 167–168
- InterAmerican Accreditation Cooperation (IAAC), 182, 207
- InterAmerican Metrology System (SIM), 191
- interchangeability 16, 261*n.1*
- International Organization for Standardization (ISO), 83, 84, 86, 92, 93, 263*n.7*
- guides and standards for accreditation bodies, implementation, 182
- ISO 9000, 97–126
- barriers, internal firm-level, 105–114
 - benefits, 99
 - certifications, 161
 - competitive advantage and, 99–105
 - diffusion, 114–126, 162–170
 - firm size, 166
 - function of, 97–99
 - global adoption, 98
 - Latin America and the Caribbean, 149–150, 151–153
 - manufacturing, 156
 - Mexico, 166, 231, 232
 - regional shares, 114
 - role, 103–105
 - standardized, 155, 156
 - Turkey, 237–241, 243, 266*nn.4,5*
- ISO 14000, 155
- Latin America and the Caribbean, 150, 151–153
 - manufacturing and services, 156
 - number, 157
- ISO/TS 16949:2002, 158, 265*n.1*
- standards development, participation in, 142
- International Accreditation Forum (IAF), 93, 181, 182, 207
- membership, 92
- International Bureau of Weights and Measures (BIPM), 191
- International Committee of Weights and Measures (CIPM), 95–96, 251, 267*n.10*
- international cooperation, 84–91, 182–184
- International Electrotechnical Commission (IEC), 83, 84, 86, 92, 93, 263*n.7*
- international integration, 81–96, 180–182
- accreditation, 207
 - Latin America, 139–147
 - metrology, 209
 - standardization, 211
- International Laboratory Accreditation Cooperation (ILAC), 93, 181, 182, 207
- membership, 92

- international laboratory comparisons, 191–192
 - International Organization of Legal Metrology (OIML), 96, 293–294*nn.9,10*
 - international organizations
 - membership, 184, 192
 - MRAs, 183
 - international recognition, 202
 - international standards, 84
 - accreditation, 180–182
 - Latin America, 139–141
 - membership, 139
 - national standards and, 140
 - participation, 141–142
 - process, 87
 - International Telecommunication Union (ITU), 84, 86
 - international trade, standards and, 32–41
 - investment climate, Turkey, 234, 235, 266*n.2*
- J**
- jurisdiction, 51–61
- L**
- labor productivity, UK, 30
 - laboratories
 - accreditation process, time required, 177
 - international comparison, 191–192
 - Latin America
 - accreditation, 171–184
 - certification, 149–170
 - metrology, 185–192
 - registration costs, 113
 - standardization, 127–147
 - law
 - rule of, 203
 - NMI, 78
 - leather personal digital assistants (PDA)
 - covers, 7
 - legal metrology, 78–80
 - benefits, 79–80
 - institutions, 185–189
 - international cooperation, 96
 - organization, 80, 185–189
- M**
- management system certification bodies,
 - number of accreditations, 178
 - mandatory standards, 33, 52, 56, 60–61, 211, 261*n.5*
 - Latin America, 135–136
 - Mexico, 220
 - manufacturing, 2–4, 261*n.1*
 - calibration, 250
 - exports, global vs regional, 3, 4
 - ISO 9000 diffusion, 165
 - ISO 9001 certificates, number, 155
 - Turkey, 240, 250
 - value added, 154–155
 - market factors
 - certification, 115–119
 - ISO 9000 diffusion, 162–165
 - markets, 6
 - failures, 55
 - forces, 53
 - player types, 118–119
 - requirements, changing, 46–49
 - sponsored standards, 52
 - standards, 51–52
 - measurement standards, 13, 16, 26–27, 74
 - key and supplementary, 251
 - laboratories, 92, 263*n.6*
 - traceability, 64, 75, 208, 262*n.7*
 - see also* calibration
 - Measurement Canada, 79–80
 - Mercosur, 145–146, 265*n.6*
 - metrology, 74–80, 207–209
 - activities, 189–190
 - costs, 78
 - government support, 208
 - health care, 77
 - infrastructure, 76
 - institutional framework, 250–251
 - international cooperation and recognition, 190–192
 - international integration, 209
 - Latin America, 185–192
 - legal, 78–80, 96, 185–189
 - manufacturing, 250
 - Mexico, 219, 222, 224
 - organization, 207–208
 - policy recommendations, 251–252
 - scientific, 74–78, 185–189
 - Turkey, 234–235, 249–250, 259
 - see also* national metrology institutes
 - Mexico
 - accreditation 219, 224–228
 - certification, testing, calibration, and inspection, 219, 228–232
 - framework, 219–220

Mexico—*continued*

- ISO 9001 adoption and firm size, 166
- metrology, 219
- national quality system, evaluation, 219–232
- quality promotion initiatives, 197–198
- standardization, 219
- Microsoft, 25–26
- Middle East, grapes, 46
- minimum quality standards, 17
- minimum safety standards 17, 19
- mobile phones, 22–23, 84–85
- multilateral recognition arrangements (MLA), 93, 94
- mutual recognition agreements (MRAs), 83, 93, 94, 95–96, 181–184, 207, 263*n.8*
 - membership, 184
 - metrology, 209
 - Mexico, 224, 227
 - separate and individual, 96

N

- NAFTA, 146
- National Committee on Productivity and Technological Innovation (COMPITE), 197, 266*n.2*
 - participation and subsidies, 198
- National Metrology Center (CENAM), 219, 222, 223
- national metrology institutes (NMIs), 13, 74–76, 185–192, 207–208
 - accreditation, 187–188
 - costs, 78
 - funding, 77–78
 - international recognition, 95–96
 - metrology, 209
 - scope, 76
 - see also* metrology
- national metrology laboratories
 - accreditation, 188
 - number of measurement areas, 189
- National Program for Quality Assurance (PNAC), 195
- national quality systems
 - components, 12–14
 - consolidating, 203–204
 - establishment, 1–2
 - organization of the book, 11, 14
 - overview, 9–11

- principles for implementation and reform, 201–203
- schematic, 11
- see also* quality
- National Standardization Institute (INN), 129
- National Training Service (SENA), 195–196
- network effects, exploitation of, 19–20
- nondiscrimination, 83
- notified bodies, Turkey, 242

O

- organizational performance, certification and, 100–102, 105, 264*n.2*
 - time-series studies, 101–102
- output growth, UK, 30
- oversight, 215

P

- pallets, country-specific standards and cost, 34
- Peru
 - quality promotion initiatives, 196–197
 - standards-setting institutions, 264*m.1,2*
- physical realization, 74–75
- policies, 193–199
 - metrology, 208
- political commitment, 202
- PRECISO, 196, 197
- prices
 - developing country vs developed country, 4
 - manufactures, 3
 - quality and, 5
- primary standard, 74–75
- private sector, 10, 202
 - accreditation, 173, 204–205
 - standards, 131
- process upgrading, 42
- producers
 - national quality system, 9–10
 - standardization, 55
- product upgrading, 42
- production
 - elasticities, 32
 - networks, 216
- productivity
 - quality standards and, 32
 - labor, 30

property rights, 203
 public and nonprofit institutions, 10
 public safety, 79
 PYMEvaluación, 196

Q

QS 9000, 158, 265*nn.1,2*
 quality, 2, 8
 awareness and understanding, 105–107,
 109, 258, 260
 certification and, 104, 122–124
 competition and, 4
 control, 67
 defining, 9
 economic impact and effect, 15–49
 market crises, 4
 producers, 43
 SMEs, 8
 standards, 20–21
 support services, 113–114
 Turkey, 258, 260
 see also national quality systems
 quality management, 97
 certification and, 105, 181
 consultants, Turkey, 243
 standards, 97–126
 quality management systems (QMSs), 98,
 264*n.1*, 182
 efficiency and effectiveness, 98
 implementation, 217
 reform, 216
 requirements, 98
 standards, 118, 237–241
 Turkey, 237–241
 Quality and Environmental Management
 Program (CYGA), 194–195,
 265*n.1*
 QWERTY keyboard, 25, 54, 262*n.1*

R

recommendations, 201–217
 accreditation, 248–249
 certification, 243
 standardization, 256–258
 Turkey, 243, 249, 250, 251–252, 257–258
 reference 16, 186, 202
 regional accreditation bodies, 205
 regional agreements, 143
 regional cooperation and coordination, 91,
 182–184
 standards upgrading and, 142–147

regional organizations, 143
 MRAs, 183
 regional standards, 84, 87–89, 211–212
 regional trade agreements (RTAs), 90–91,
 263*n.5*
 registration costs, 112–113
 registry of firms, 213
 regulators, certification and, 68
 reproduction, 75
 reputation, 66, 68, 262*n.4*
 research and development (R&D), 76,
 124–125
 resources, standardization, 210
 risk reduction, 70
 regional coordination, 91

S

safety standards, 17, 19
 school enrollment, certification rates
 and, 169
 scientific capabilities, 188–189
 scientific metrology, 74–78
 activities, 187
 organization, 185–189
 scientists and technologists,
 standardization, 210
 search costs, 19
 sectors, certification, 116–118, 264*n.5*
 services, 6
 supply, limited, 113–114
 value added, 154–155
 SGS, Peru, 196–197
 shoe industry, 5, 43
 small and medium enterprises (SMEs), 6,
 8, 202, 214–215
 certification and, 104
 cost reductions, 24
 GDP and certification rate, 166
 ISO 9000 diffusion, 165
 Peru, 196–197
 quality and 8
 standards and quality as an entry point,
 41–49
 Turkey, 240, 243
 software sector, certification and, 120–126
 South Africa, timber 88
 Southern African Development
 Community (SADC),
 accreditation, 72
 Spain, cured ham, 67
 specialized services model, 126

- SPS, implementation, 147
- staff. *See* human capital
- standardization, 209–212
- development activities, 211
 - innovation and, 28
 - institutional framework, 254–256
 - international integration, 211
 - Latin America, 127–147, 264*n.2*
 - Mexico, 219, 220
 - organization, 209–210
 - participation, 212
 - policy recommendations, 256–258
 - process, 18
 - resources for, 132–134, 264*n.2*
 - stakeholders, 55, 73
 - subsidizing, 267*n.14*
 - Turkey, 235, 252–259
- standards, 2, 6, 8
- accreditation, 180–182
 - age, 28
 - British vs German, 36, 38
 - constraints, 28–29
 - coordinated approach, 90
 - cost, 139, 221
 - country-specific, 33, 34
 - defining, 9
 - diffusion of, 138–139
 - economic effects, negative, 24–27
 - economic effects, positive, 17–24
 - economic growth and, 28–32
 - functions of, 15–17
 - idiosyncratic, 36, 37
 - international, 84, 87, 139–142, 180–182
 - international differences, 81
 - international trade and, 32–41
 - Latin America, 138–141
 - mandatory, 33, 52, 56, 60–61, 135–136, 211, 220, 261*n.5*
 - membership, 139
 - Mexico, 220
 - national, 140
 - number of, 40–41, 86, 137, 138, 252, 267*n.11*
 - obsolete, 25, 211
 - participation, 141–142
 - process, 87
 - regional coordination, 142–147
 - shared, 38–39
 - SMEs, 8, 41–49
 - stock, 137, 254, 267*n.12*
 - time-series investigation, 29
 - Turkey, Europe vs, 253
 - upgrading, 89–91, 142–147, 211
 - voluntary, 52, 54, 55, 60–61, 128, 220, 255
- Standards and Quality Accreditation Program (ProCal), 199
- standards-setting institutions, 12, 56–61, 262*n.2*
- autonomy, 267*n.14*
 - centralized approach, 56–57
 - decentralized approach, 57–59
 - development, 56, 136–138, 252–254
 - funding sources, 132–134
 - government support, 60
 - Latin America, 128–138
 - legal status, 59
 - members, 57, 59
 - organization, 128
 - performance, 136–139
 - principles, 59
 - procedures, 59–60, 262*n.3*
 - regional, 84, 87–89, 211–212
 - staff, 135
 - Turkey, 252–254
- standards preparatory groups (SPGs), Turkey, 255, 267*n.13*
- subcomponents, 6
- support programs, 193–199
- T**
- technical barriers to trade (TBT), 34–35
- implementation, 147
 - notifications, 146
 - WTO and, 83–84
- technical capabilities, 188–189
- technical committees and subcommittees, 86–87, 141, 265*n.3*
- membership, 257
- technical experts, number, 176
- technical regulations, 52
- Latin America, 135
- technology
- adoption, coordination mechanisms, 52–54
 - diffusion, 29
- telephony, 22–23, 84–85
- terms-of-trade index, 3–4
- testing, 10, 68–69, 262*n.5*
- costs, 229
 - demand for, 212–215
 - Mexico, 219, 228–232
 - Turkey, 236–243

testing laboratories, 12–13, 229, 266*n.1*
 accreditation, 178–179, 180
 third-party assessment, 64, 65, 68
 timber, South Africa, 88
 timing, 25, 109
 TNC, ISO 9000 diffusion, 163
 total factor productivity (TFP), 29
 total quality management (TQM),
 103–104, 105
 traceability, 64, 75, 208, 262*n.7*
 trade, 1
 agreements, membership, 143
 barriers, 33, 81, 83, 226
 certification and, 115–116, 264*n.4*
 costs, country-specific 34
 ISO 9000 diffusion, 162–165
 standards and, 39–40
 Traditional Specialty Guaranteed
 (TSG), 67
 training, 195
 Mexico, 221
 Turkey, 243
 transaction costs, 19, 79
 transnational corporations (TNC), 6, 43,
 118–119
 transparency, 83–84
 TSE, 254–256
 recommendations, 257–258
 TÜRKAK, 242, 244, 246–249, 260, 266*n.8*
 accreditations granted, 245
 Turkey
 accreditation, 234–235, 243–249, 259
 calibration, 236
 certification, 233, 234, 236–243, 259
 inspection, 236–243
 metrology, 234–235, 249–252, 259
 national quality system, evaluation,
 233–260 266*n.3*
 national quality system, summary
 table, 259

policy recommendations, 243, 249,
 250, 251–252, 257–258
 standardization, 235, 252–258, 259
 testing, 236–243

U

Uganda, coffee industry, 20–21
 United Kingdom, 36, 38
 grapes, 46
 horticultural market, 44
 labor productivity, 30
 output growth, 30
 United States, accreditation,
 73, 262*n.6*
 upgrading, 42
 functional, 42
 process and product, 42
 standards upgrading, 89–91,
 142–147, 211
 value chain, 44–45

V

value chain
 buyer-driven, 41–42, 42–43
 certification and, 121–126
 horticultural, 44–45
 variety reduction, 16, 17, 261*n.1*
 verification, 190
 voluntary standards, 52, 60–61
 bodies, 54, 55, 128, 255
 Latin America, 128
 Mexico, 220
 Turkey, 254–256

W

wine, Chile, 5
 World Trade Organization (WTO), TBT,
 83–84, 147

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