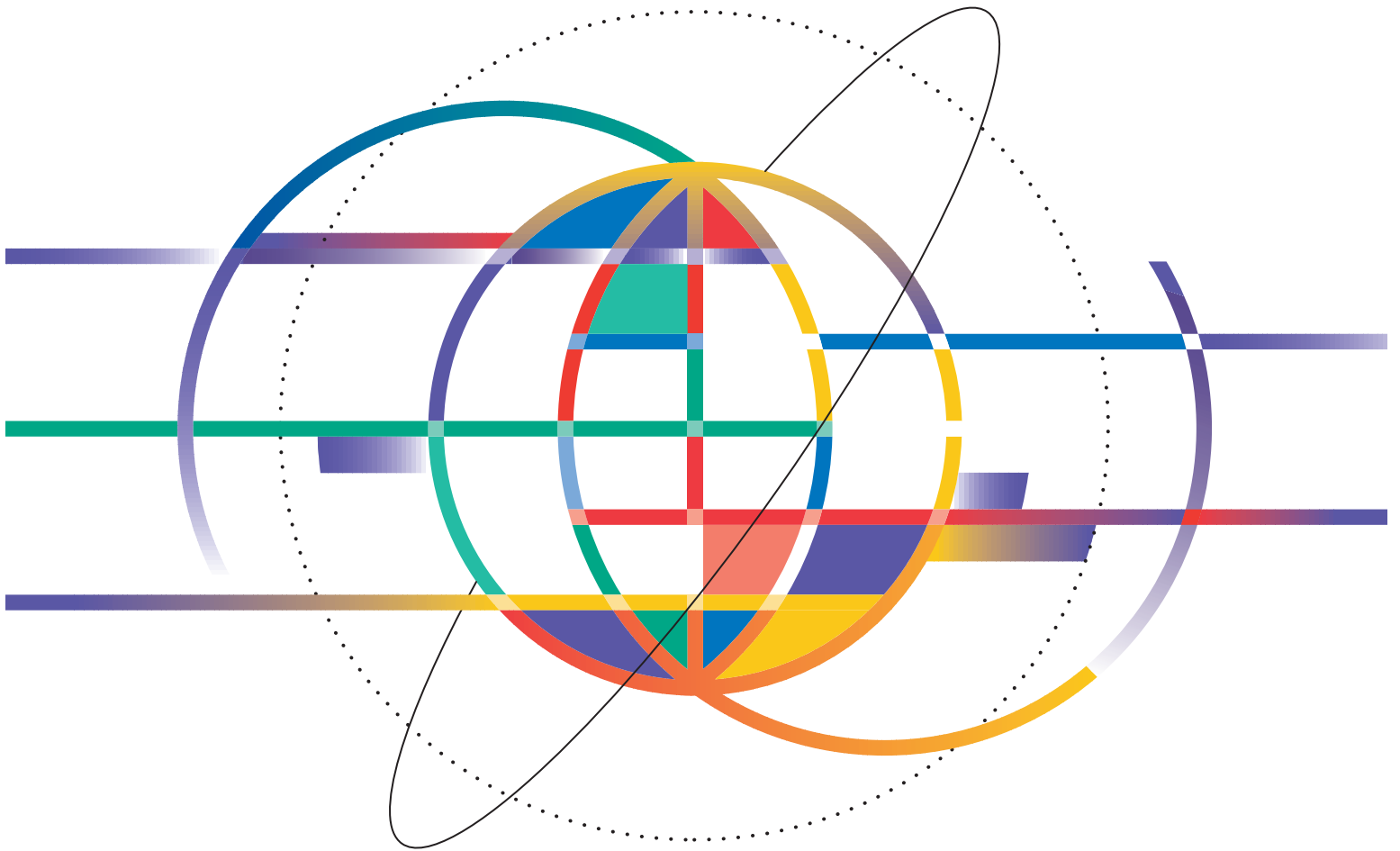


World
Development
Report

Knowledge for Development



PUBLISHED FOR THE WORLD BANK
OXFORD UNIVERSITY PRESS

1998/99

Oxford University Press

OXFORD NEW YORK ATHENS AUCKLAND BANGKOK BOGOTA
BUENOS AIRES CALCUTTA CAPE TOWN CHENNAI DAR ES SALAAM
DELHI FLORENCE HONG KONG ISTANBUL KARACHI
KUALA LUMPUR MADRID MELBOURNE MEXICO CITY MUMBAI
NAIROBI PARIS SÃO PAULO SINGAPORE TAIPEI TOKYO
TORONTO WARSAW

and associated companies in

BERLIN IBADAN

© 1999 The International Bank for Reconstruction and
Development / The World Bank
1818 H Street, N.W., Washington, D.C. 20433, U.S.A.

Published by Oxford University Press, Inc.
200 Madison Avenue, New York, N.Y. 10016

Oxford is a registered trademark of Oxford University Press.

All rights reserved. No part of this publication may be reproduced,
stored in a retrieval system, or transmitted, in any form or by any
means, electronic, mechanical, photocopying, recording, or
otherwise, without the prior permission of Oxford University Press.

Cover and part opener design by
Communications Development Incorporated, Washington, D.C.,
with Grundy & Northedge of London.
Inside design and typesetting by
Barton Matheson Willse & Worthington, Baltimore.

Manufactured in the United States of America
First printing September 1998

This volume is a product of the staff of the World Bank, and the
judgments made herein do not necessarily reflect the views of its Board of
Executive Directors or the countries they represent. The World Bank
does not guarantee the accuracy of the data included in this publication
and accepts no responsibility whatsoever for any consequence of their
use. The boundaries, colors, denominations, and other information
shown on any map in this volume do not imply on the part of the World
Bank any judgment on the legal status of any territory or the
endorsement or acceptance of such boundaries.

ISBN 0-19-521119-7 clothbound
ISBN 0-19-521118-9 paperback
ISSN 0163-5085



Text printed on recycled paper that conforms to the American Standard
for Permanence of Paper for Printed Library Material Z39.48-1984.



Foreword

THIS YEAR'S *World Development Report*, the twenty-first in this annual series, examines the role of knowledge in advancing economic and social well-being. It begins with the realization that economies are built not merely through the accumulation of physical capital and human skill, but on a foundation of information, learning, and adaptation. Because knowledge matters, understanding how people and societies acquire and use knowledge—and why they sometimes fail to do so—is essential to improving people's lives, especially the lives of the poorest.

The information revolution makes understanding knowledge and development more urgent than ever before. New communications technologies and plummeting computing costs are shrinking distance and eroding borders and time. The remotest village has the possibility of tapping a global store of knowledge beyond the dreams of anyone living a century ago, and more quickly and cheaply than anyone imagined possible only a few decades ago. And distance education offers the potential to extend learning opportunities to millions who would otherwise be denied a good education.

But with these opportunities come tremendous risks. The globalization of trade, finance, and information flows is intensifying competition, raising the danger that the poorest countries and communities will fall behind more rapidly than ever before. In our enthusiasm for the information superhighway, we must not forget the villages and slums without telephones, electricity, or safe water, or the primary schools without pencils, paper, or books. For the poor, the promise of the new information age—knowl-

edge for all—can seem as remote as a distant star. To bring that promise closer to reality, the implications of the information revolution must be thought through with care and made part of the development agenda.

As part of its contribution to such a daunting task, this *World Development Report* considers two sorts of knowledge: technical knowledge (for example, about farming, health, or accounting) and knowledge about attributes (the quality of a product, the credibility of a borrower, or the diligence of a worker). The Report calls the unequal distribution of technical know-how *knowledge gaps* and the uneven knowledge about attributes *information problems*. It argues that both types of problems are worse in developing than in more technologically advanced countries, and that they especially hurt the poor. This analysis suggests three lessons of particular importance to the welfare of the more than 4 billion people in developing countries:

First, developing countries must institute policies that will enable them to narrow the knowledge gaps that separate them from rich countries. Examples of such policies include making efficient public investments in lifelong education opportunities, maintaining openness to the world, and dismantling barriers to competition in the telecommunications sector.

Second, developing-country governments, bilateral donors, multilateral institutions, nongovernmental organizations, and the private sector must work together to strengthen the institutions needed to address information problems. As societies become more complex, mechanisms for reducing information problems, such as accounting standards, disclosure requirements, and credit

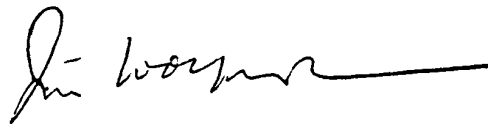
rating agencies, and for enforcing contract performance, through effective laws and courts, become increasingly important.

Third, no matter how effective we are in these endeavors, problems with knowledge will persist. We cannot eliminate knowledge gaps and information failures, but by recognizing that knowledge is at the core of all our development efforts, we will sometimes discover unexpected solutions to seemingly intractable problems.

Putting knowledge at the center of our development efforts will bear fruit in two areas. The first is in increased social benefits—the more effective provision of public goods, including better air and water quality, greater educational attainment and higher enrollments, improved health and nutrition, and expanded access to essential infrastructure. These benefits will accrue to the poor as well as to others in society. The second is in better-functioning markets—for credit, education, housing, and land—that more efficiently coordinate resources and allocate opportunities across society. These improvements will benefit the poor the most, because they bear more than their share of the burden of information failures.

The widening access to knowledge brought about by the knowledge and information revolution is transform-

ing relationships between expert and amateur, government and citizen, aid donor and recipient. Knowledge cannot be static, nor can it move in one direction only. Instead, it must flow constantly back and forth across an ever-changing web, involving all who create and use it. This is no less true of knowledge at the World Bank, and of this Report. Even as we attempt to share what we have learned, we know that there is much we do not know. Nonetheless, we hope that this Report will help to increase understanding of the complex relationship between knowledge and development. And that this understanding in turn will help us better apply the power of knowledge to the great challenge of eradicating poverty and improving people's lives.



James D. Wolfensohn
President
The World Bank

July 27, 1998

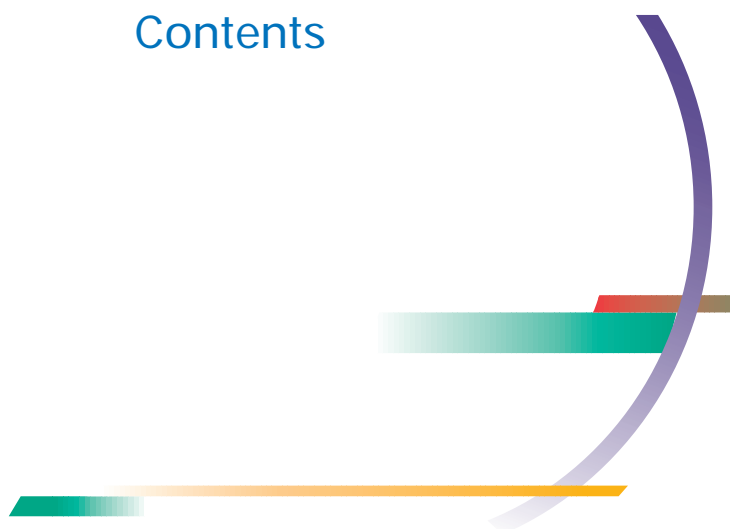
This Report has been prepared by a team led by Carl Dahlman with the support of Tara Vishwanath, who, along with Auguste Tano Kouame, served as a full-time team member. Other team members included Irfan Aleem, Francisco Ferreira, Yevgeny Kuznetsov, and Govindan Nair. Major contributions to chapters were made by Abhijit Banerjee, Jere Behrman, Gerard Caprio, Raffaello Cervigni, Stephen Denning, Samuel Fankhauser, Karla Hoff, Patrick Honohan, Emmanuel Jimenez, Lant Pritchett, Debraj Ray, Halsey Rogers, and David Wheeler. Valuable contributions were made by Harold Alderman, Carlos Braga, William Easterly, David Ellerman, Deon Filmer, Charles Kenny, Elizabeth King, Sanjaya Lall, Lawrence MacDonald, Saha Meyanathan, Sonia Plaza, Martin Ravallion, Francisco Sagasti, Claudia Paz Sepulveda, and Michael Walton. The team was assisted by Jesse Bump, Vajeera Dorabawila, Iyabode Fahm, Peter Lagerquist, Rohit Malhotra, Ambar Narayan, and Stratos Safioleas. Bruce Ross-Larson was the principal editor. The work was carried out under the general direction of Joseph Stiglitz and Lyn Squire.

Many others inside and outside the World Bank provided useful comments, wrote background papers and other contributions, and participated in consultation meetings. The Development Data Group contributed to the Appendix and was responsible for the Selected World Development Indicators.

The production staff of the Report included Jamila Abdelghani, Anne Hinterlong Dow, Joyce Gates, Stephanie Gerard, Jeffrey Lecksell, Brenda Mejia, Jenepher Moseley, Margaret Segears, Alison Smith, Michael Treadway, and Michael Zolandz. Rebecca Sugui served as executive assistant to the team, and Pansy Chinthia, Paulina Flewitt, and Thomas Zorab as staff assistants. Maria Dolores Ameal served as administrative officer.



Contents



OVERVIEW	1
PART ONE NARROWING KNOWLEDGE GAPS	
1 The Power and Reach of Knowledge	16
2 Acquiring Knowledge	26
3 Absorbing Knowledge	40
4 Communicating Knowledge	56
PART TWO ADDRESSING INFORMATION PROBLEMS	
5 Information, Institutions, and Incentives	72
6 Processing the Economy's Financial Information	81
7 Increasing Our Knowledge of the Environment	99
8 Addressing Information Problems That Hurt the Poor	117
PART THREE POLICY PRIORITIES	
9 What Can International Institutions Do?	130
10 What Should Governments Do?	144
Technical Note	157
Bibliographical Note	159
Appendix: International Statistics on Knowledge	178
SELECTED WORLD DEVELOPMENT INDICATORS	183
BOXES	
1.1 Institutional innovations to diffuse health knowledge in Costa Rica	18
1.2 Knowledge in the East Asian miracle—an ongoing debate	21
1.3 Growing faster with knowledge	23

2.1	ISO 9000: Signaling quality and improving productivity	28
2.2	How to attract technical knowledge through trade and foreign investment—and how not to	29
2.3	Korea: The success of a strong interventionist state	32
2.4	TRIPs in a nutshell	33
2.5	IPRs, investment, and technology transfer.	34
2.6	Providing local compensation when bioprospecting strikes gold	35
2.7	Changing the way Brazil does research	37
2.8	Building a better bean: How women farmers in Colombia and Rwanda outdid the researchers	38
2.9	Why better biomass stoves sold in Rwanda	39
3.1	Raising the potential for children to learn	42
3.2	Mathematics, science, and engineering studies may spur growth	43
3.3	Korea's heavy investment in human capital.	44
3.4	Grading the teachers: Varying perceptions of school quality in Vietnam.	50
3.5	From providing training to providing information	51
3.6	Income-contingent loans for tertiary education in Australia and New Zealand	53
3.7	The African Virtual University	55
4.1	From the transistor to the integrated digital network	58
4.2	How information technology helped control river blindness	60
4.3	How Singapore became the world's most efficient port	62
4.4	Teleconferencing to raise awareness of the year 2000 problem	63
4.5	Telecommunications liberalization receives a global push.	65
4.6	Pressure to reform accounting rates for international calls	66
4.7	Competition before privatization in Ghana's telecommunications services	68
5.1	Addressing information failures in India's milk market	73
5.2	The credit market in Chambar, Pakistan.	75
5.3	Is sharecropping associated with lower yields?	77
6.1	Technology eases credit decisions	84
6.2	Value-at-risk: An approach to risk assessment	85
6.3	Trading without banks: Money surrogates in the Russian Federation	87
6.4	Shareholders' rights and enterprise efficiency in the Czech privatization	92
6.5	Deposit insurance and risk taking.	94
6.6	Better bank regulation in Argentina	96
7.1	The slow evolution of knowledge about climate change.	102
7.2	Uncertainty, irreversibility, and the value of information	103
7.3	Public information for pollution control in Indonesia	106
7.4	Integrated pest management in Indonesia	108
7.5	Strengthening environmental management to boost performance.	109
7.6	Building on local knowledge to monitor and understand deforestation.	110
7.7	Creating markets: The U.S. sulfur dioxide permit trading program	111
7.8	Information and pollution control incentives from capital markets.	113
7.9	Information, community pressure, and adoption of clean technology in Ciudad Juárez, Mexico	114
7.10	Disseminating knowledge on sustainable irrigation in Brazil	115
8.1	Education and the mass media: A powerful combination.	120
8.2	Trust and health services in Brazil's Ceará State	122
8.3	Why are poor farmers slow to adopt new technologies?	123
8.4	Mutual insurance.	124

8.5	Addressing information problems to provide credit to the poor in southern India	125
8.6	Delivering pensions to the poor in South Africa	127
9.1	Plow ahead or prune back? The challenges facing the CGIAR	131
9.2	Can contingent lending spur efforts toward an AIDS vaccine?	132
9.3	Knowledge and institutions for managing the environment	133
9.4	Maintaining roads by building institutions in Africa	135
9.5	The African Economic Research Consortium: A successful experiment in capacity building	137
9.6	Bilateral-multilateral cooperation to promote global knowledge sharing	139
9.7	Knowledge management at the World Bank	140
9.8	Sharing knowledge at OneWorld Online	141
9.9	Knowledge partnerships for the environment	143

FIGURES

1	R&D spending and GDP per capita	2
2	Cost trends in optical fiber transmission	3
3	Cereal yields by developing region	4
4	Growth in yields for principal cereals	5
5	Cropland planted with new wheat varieties	6
1.1	Infant mortality and real income per capita	17
1.2	Trends in real GDP per capita in Ghana and the Republic of Korea	22
1.3	Real semiconductor content of the U.S. economy	24
2.1	Productive efficiency in firms in three African countries	27
2.2	Goods in international trade by level of technological intensity	28
2.3	Trends in FDI flows in developing countries	30
3.1	Child mortality by educational attainment of the mother	41
3.2	Illiteracy by gender and level of income	46
3.3	Shares of public educational subsidies received by rich and poor households in two African countries	46
3.4	GNP per capita and mathematics test scores	47
3.5	Ratios of private to public education costs and test score achievement in four countries	47
3.6	Public sector shares of primary and secondary enrollments	48
3.7	Public education spending and mathematics test scores	49
4.1	Economies ranked by share of the telephone network digitized	59
4.2	Telephone density and mobile phone penetration	59
4.3	Telephone density, queuing for telephone service, and income per capita	64
4.4	Growth in telephone main lines under differing market conditions in Latin America	67
4.5	Ratios of urban to rural telephone density, by region	69
6.1	Financial structure of economies by income level	83
6.2	Factors leading to financial development and growth	90
6.3	Accounting standards and GNP per capita	90
7.1	The pressure-state-response framework	104
7.2	Genuine saving in Ecuador	105
7.3	Genuine saving in selected world regions	105
7.4	Deviations from normal weather patterns and crop yields in Latin America	107
7.5	Acid deposits above critical loads in Asia: The RAINS model	110
8.1	Poverty by developing region	118

8.2	Share of the poor in consumption of knowledge goods in Bulgaria and South Africa	120
8.3	Distribution of welfare benefits by household income in Jamaica	121
8.4	Grameen Bank lending and schools run by Grameen Bank groups	128
9.1	Aid flows and GDP per capita in Vietnam	136
10.1	Trends in GDP in six former Soviet republics	155

TABLES

1.1	Household spending per capita by level of education in Peru	18
1.2	Decomposition of cross-country variance in growth rates	19
1.3	Gross enrollment rates in primary school in selected economies	20
1.4	Share of high-technology goods in manufacturing value added and exports in high-income economies	24
4.1	Product and geographical composition of the world information technology market	58
4.2	Selected indicators of information and telecommunications penetration by country income level	63
5.1	Assets and income of borrowers and nonborrowers in Nakhon Ratchasima Province, Thailand	79
6.1	Ranking of legal systems on strength of protections and enforcement	91

APPENDIX TABLES

A.1	Tertiary enrollments by field of study	179
A.2	Assessment of legal infrastructure	181

Definitions and data notes

The countries included in regional and income groupings used in this Report are listed in the Classification of economies table at the end of the Selected World Development Indicators. Income classifications are based on GNP per capita; thresholds for income classifications in this edition may be found in the Introduction to Selected World Development Indicators. Group averages reported in the figures and tables are unweighted averages of the countries in the group unless noted to the contrary. While this Report was in preparation, the income classifications of some economies changed, most notably that of China. Statistics reported for low-income economies may therefore include, and those for middle-income economies may exclude, data for China.

The use of the word “countries” to refer to economies implies no judgment by the World Bank about the legal or other status of a territory. The term “developing countries” includes low- and middle-income economies and thus may include economies

in transition from central planning, as a matter of convenience. The term “advanced countries” may be used as a matter of convenience to denote the high-income economies.

Dollar figures are current U.S. dollars unless otherwise specified. “Billion” means 1,000 million; “trillion” means 1,000 billion.

The following abbreviations are used:

AIDS	Acquired immune deficiency syndrome
FDI	Foreign direct investment
GDP	Gross domestic product
GNP	Gross national product
IPRs	Intellectual property rights
NIE	Newly industrializing economy
NGO	Nongovernmental organization
OECD	Organisation for Economic Co-operation and Development
PPP	Purchasing power parity
R&D	Research and development