ADBI Working Paper Series

Navigating a Changing World Economy: ASEAN, the People's Republic of China, and India

Peter A. Petri and Fan Zhai

No. 404
January 2013

Asian Development Bank Institute

Peter A. Petri is the Carl J. Shapiro Professor of International Finance at Brandeis University, a senior fellow of the East-West Center in Honolulu, and a visiting fellow of the Peterson Institute for International Economics in Washington. Fan Zhai is acting head and managing director of Asset Allocation and Strategy Research Department at China Investment Corporation (CIC).

This paper is part of the Asian Development Bank Institute study on The Great Transformation: ASEAN, the PRC, and India.

The Working Paper series is a continuation of the formerly named Discussion Paper series; the numbering of the papers continued without interruption or change. ADBI's working papers reflect initial ideas on a topic and are posted online for discussion. ADBI encourages readers to post their comments on the main page for each working paper (given in the citation below). Some working papers may develop into other forms of publication.

Suggested citation:

Petri, P.A. and F. Zhai. 2013. Navigating a Changing World Economy: ASEAN, the People's Republic of China, and India. ADBI Working Paper 404. Tokyo: Asian Development Bank Institute. Available: http://www.adbi.org/working-paper/2013/01/22/5457.navigating.changing.world.economy/

Please contact the authors for information about this paper.

Email: ppetri@brandeis.edu; zhaifan@china-inv.cn

Asian Development Bank Institute
Kasumigaseki Building 8F
3-2-5 Kasumigaseki, Chiyoda-ku
Tokyo 100-6008, Japan

Tel: +81-3-3593-5500
Fax: +81-3-3593-5571
URL: www.adbi.org
E-mail: info@adbi.org

Abstract

Most projections envision continued rapid growth in the members of the Association of Southeast Asian Nations (ASEAN), the People's Republic of China (PRC), and India (collectively, ACI) over the next two decades. By 2030, they could quadruple their output, virtually eliminate extreme poverty, and dramatically transform the lives of their more than 3 billion citizens. The impact will be felt across the world. This study—a background paper to an Asian Development Bank report—used a Computable General Equilibrium model to examine the likely effects of the region's growth on trade, resources and the environment, as well as the implications of the many risks the region's growth path faces from its internal and external environment.

JEL Classification: F02, F13, F33, F53

Contents

1. INTRODUCTION: ANALYZING THE GREAT TRANSFORMATION

The Association of Southeast Asian Nations (ASEAN), the People's Republic of China (PRC), and India (collectively, ACI) have become the world's principal growth engine. They avoided or recovered robustly from the Asian Financial Crisis in the late 1990s and have been the world's most dynamic economies since the Global Financial Crisis. Over the past decade, their real gross domestic products (GDPs) grew by 5.5, 9.6, and 7.1%, respectively (ABD 2009). By 2030, the ACI countries are poised to quadruple their output. If they realize these extraordinary projections, they will dramatically transform the lives of their more than 3 billion people and indeed the structure of the world economy.

ADB's *Asia 2050* study argues that the prospects of the ACI economies remain very favorable (ADB 2011). But the report also emphasizes that continued success cannot be taken for granted; Asia in general and the ACI economies in particular face daunting risks. This study analyzes those risks and potential policy responses in quantitative detail. This is an inherently speculative undertaking—even with a shorter time limited to 2030—since the world economy is likely to change dramatically over the next two decades, including in ways that we cannot anticipate. The paper models probable structural changes in regional and industry detail and illustrates the wider range of possible developments with scenario analysis.

Our central thesis is that ACI economies are now embarked on a major transformation of their economies and role in the world economy—a development that the ACI study describes as the "great transformation." Their growth is likely to develop indigenous drivers, based on the demand and production dynamics of the region's middle income countries. Dynamism on the demand side is likely to be driven by exceptional growth in the discretionary incomes of the region's vast middle income populations, and by related investment expenditures. Dynamism on the production side should be led by high rates of investment, technological catch-up, economies of scale and vigorous domestic, regional and international competition.

Any such vast transition involves risks. This study will consider potential shocks to the ACI growth path associated with: (i) the viability of the new growth engines; (ii) structural issues associated with the region's food and energy requirements, environment impact and social needs; and (iii) changes in the region's international trade environment. Each of these areas might be subject to shocks that adversely affect the region's prospects. But growth also offers tools for addressing these risks—it improves the possibilities for fund adjustments to challenges in these and other areas of policy. The results suggest that despite the possibility of large variations around our baseline projection, some key features of the "great transformation"—including sizable improvements in the ACI region's standard of living and in its global impact—are reasonably robust.

What is certain is that navigating the transition will be difficult. The ACI economies will have to find ways to grow despite the prospects of slow growth in advanced economies, which are important destinations for their exports. The shift to internal drivers of growth, in turn, will raise challenges in macroeconomics, microeconomics, finance, and politics. It will require rapid technical progress in different industries and it will place new demands on asset markets and financial systems. Meanwhile, the footprint of the ACI economies is becoming larger in many dimensions of economic activity—in trade, finance, resources, and the environment—and thus ACI policies face greater scrutiny and pressures from abroad.

The ACI economies face a sea change in their domestic and international economic environment. Do they risk falling into a "middle income trap"? Will their growth prospects be dampened by high food prices, energy shocks, tighter environmental regulations, or rising social spending? Will they fall prey to protectionism or can they improve their prospects through regional integration? We develop quantitative evidence to assess these threats and potential solutions to them.

2. METHODOLOGY

We conduct this analysis through the lens of computable general equilibrium analysis. The approach allows us to examine predictable structural changes as well as shocks that could jolt economic progress. The foundation for the study is a recently-developed computable general equilibrium (CGE) model of the world economy which enables us to translate growth assumptions into detailed sectoral and regional projections for the ACI region and other regions of the world economy. The model incorporates established features of such modeling efforts, as well as recent innovations in the economics of international trade based on the theory of heterogeneous firms. Developed by Zhai (2008), the model has been used in several major studies of Asian economic integration (Roland-Holst et al. 2005; Kawai and Zhai 2010; Petri, Plummer and Zhai 2010; and Petri, Plummer, and Zhai 2012).

2.1 Simulation strategy

The model is not used to generate projections, in the sense of likely future outcomes, but rather to analyze what developments could derail growth and what policies might keep it on track. We hope to gain insight into sources of risk, their probabilities and importance, and the timing and cost of the tools required to address them. We begin with projections based largely on the work of others (including *Asia 2050*) and attempt to assess what actions, now and in the future, will permit the great transformation to continue.

Our approach yields a cone of trajectories that describes how the regional and world economies might evolve over the next two decades. Some paths assume favorable developments (such as deeper integration of regional and global markets) while others examine tighter constraints involving greenhouse gas emissions and resource supplies. Still others explore policy strategies that could mitigate the impact of adverse developments.

Thus, we chart the future much as a mariner might prepare for a long, uncertain journey. The wise mariner would not plan a single, rigid course, knowing that that much will depend on the winds and other obstacles encountered. He would consider several possible routes, identifying the shoals that have to be avoided along each of them. He would prepare his vessel for a range of conditions and would be ready for course corrections that allow the voyage to proceed despite inevitable surprises.

2.2 Scenarios

We pursue this strategy by constructing four types of scenarios:

- Baseline. Building on ADB GDP projections we develop a consistent scenario of regional and global growth. The resulting sectoral and regional details enable us to identify structural changes implied by the baseline (they are substantial) and risks associated with them. Risks arise, for example, from sustaining high productivity growth and investment over unusually long periods of time, from adjustments required in the ACI

economies and in trade partners, and from tightening global resource and environmental constraints.

- Productivity slowdown scenarios. In the wake of the global financial crisis, there is wide-spread concern about the possibility of a long-term, sustained deceleration of advanced economies. There is also concern that the ACI economies will fall into the "middle income trap." These alternatives are examined with simulations that hypothesize the deceleration in productivity growth and lower investment rates in various combinations of economies.
- Structural policy scenarios. Adverse developments might also selectively affect specific sectors of vulnerability to ACI economies. For example, we explore the implications of higher food prices, higher energy prices and the need to undertake substantially higher environment and social expenditures.
- International trade environment scenarios. Finally, the global environment of ACI economies could experience worsening protectionism or, on the other hand, more progressive policy responses, involving both the liberalization of trade and reductions in current account imbalances.

Taken together, the simulations provide an overview of the trends, risks, and policy responses that will shape the prospects of the ACI economies in the intermediate future. Of course, they cannot cover all uncertainties. But scenarios can be framed in terms of general assumptions—say, about negative productivity and resource shocks—that would be consistent with multiple causes, including some that cannot be anticipated now.

One implication of the uncertain environment explored in this paper is the value of flexibility and the ability to adjust to shocks. Important contributions can be made by competitive product, labor, and capital markets, and by robust international linkages that enable economies to share risks to demand and supply. Strong financial positions and adequate reserves also help. As the world economy becomes more complex, resilience becomes a powerful asset.

2.3 Modeling framework

The CGE model tracks the evolution of demand, output, trade, technology, costs and prices in 26 sectors in 11 world regions over the next two decades (see Appendix 1). Sectors and regions are linked through trade and capital flows and reflect optimizing decisions based on incomes and prices. Labor endowments and productivity growth assumptions are set exogenously (based on United National projections), but the model generates investment endogenously and thus builds future capital stocks.

We solve the model under various assumptions to explore the effects of slowing or accelerating productivity growth in regions and sectors, to study the impact of changing trade relations, and to analyze policies affecting resources and pollution emissions. These analyses require, in some cases, refinements in the structure and/or data of the basic model. For example, in the simulations addressing energy issues, additional information needs to be introduced on energy savings and on the technological profiles of low-carbon energy alternatives. Further iterations may be needed to refine such aspects of the model based on the sectoral components of the ACI study.

The model is solved year-by-year, allowing for gradual changes in parameters and policies, and for capturing the cumulative impact of investment decisions. Foreign assets can be accumulated and resource stocks depleted. As is usual in such general equilibrium studies, the model does not provide information on business cycles or bouts of unemployment. Once the recovery from

the global crisis is complete (as reflected in the IMF's medium term projections), full employment levels are maintained.

The structure of the model (Zhai 2008) follows a long tradition of multi-country, applied general equilibrium models (Van der Mensbrugghe 2005; Shoven and Whalley 1992; Hertel 1997) but also incorporates recent innovations in heterogeneous-firms trade theory, which account for the exporting decisions of firms and the resulting intra-industry reallocation of resources. Thus, the model can capture changes in both the intensive and extensive margin of trade. The approach generates large impacts from trade integration than do conventional models, and are more consistent with long-term historical experience.

The model is designed to address issues in economic integration and long-term development. Its industrial structure tracks how changes in production patterns, production networks, and market impediments lead to additional varieties of goods and to productivity gains associated with growth. It also tracks how competitive pressures shift sales from relatively unproductive firms to relatively productive ones in each regional economy. Thus, the model accounts for several types of economic gains involved in the development process, including access to broader varieties of products, economies scale, and changing intra-industry distributions of productivity. The regions and sectors of the model are listed in Appendix 1 and its full specification is discussed in Appendix 2.

The model was supplemented with an income distribution module to allocate total consumption to four consumption classes: extremely poor (consumption below $1.25 per day in 2005 dollars), low (between $1.25 and $10 per day), middle (between $10 and $100 per day) and high (above $100 per day). This module takes as its input the country or region per capita consumption level generated by the CGE model. It then determines the percentage of the population at various consumption levels. The consumption levels—selected as absolute consumption levels for defining extremely poor, middle income, and wealthy consumers, respectively—are those used in ADB (2011), which appear to be based on Kharas (2010).

The distribution module provides plausible projections for the distribution of income along the baseline of this study and permits the results of scenarios to be translated into effects on the incidence of poverty and the emergence of the middle class. Although single-point poverty and middle class estimates are available from other studies (e.g., ADB 2011), they do not always provide plausible estimates or a way to estimate how distributions might be affected if the projection trajectory changes. Future adaptations—not implemented at this time—could also establish connections between the income distribution and growth, as recently proposed in theoretical models.

3. PROJECTIONS OF ACI GROWTH

The GDP baseline projections were developed by ADB for this study. They show sustained and relatively rapid growth for ACI economies. The methodology is based on the expected evolution of the labor force, savings rates, and productivity growth based on historical statistical patterns. Considerable work has been done by ADB on long-term growth projections (Lee and Hong 2010) and the details of the present methodology are explained in Box 1. The projections are summarized in terms of the two measures commonly used in international comparisons:

constant market prices in Table 1, and purchasing power parity (PPP) in Table 2[1]. Scenarios that challenge some of the assumptions of the baseline are presented later in the chapter.

Box 1: GDP Growth Projections

Economic growth projections are normally generated using production functions that incorporate assumptions about the evolution of several factors of production and their rates of productivity. The projections used in this study were developed by ADB for 171 countries, based on a two-factor (capital and labor) Cobb-Douglas production function and an overall total factor productivity index (Zhuang 2011). The methodology for projects productivity gains based on the convergence approach, as discussed for example in Goldman Sachs (2003). It was implemented with the World Bank's *World Development Indicators* dataset. The base year represents 2010 GDP levels converted into U.S. dollars at market exchange rates. Some base year data points were adjusted after the completion of these simulations to achieve consistency with ADBI's ongoing *ASEAN 2030* study. The adjustments involve small economies and are unlikely to affect significantly the aggregate results reported in this paper.

The three drivers of growth were modeled as follows:

Labor force projections were based on International Labor Organization population growth and labor force participation rate forecasts to 2020, extrapolated by ADB to 2030.

The capital stock was modeled by adding investments over time and subtracting depreciation. Investment was projected forward by multiplying income with an investment rate and subtracting the projected current account surplus. The investment rate is the critical element of this calculation and was estimated and forecast using a cross-country regression model with explanatory variables consisting of income, growth and demographic factors.

Total factor productivity growth in advanced economies was assumed to be 1.3% per year. To project future values of total factor productivity, emerging economies were divided into eight convergence classes. The convergence rate for each class was determined from past data, based on the annual reduction in the gap between the country's total factor productivity and that in the United States (taken to represent the frontier). The convergence factors ranged from 0 to 1.8% per year and were assumed to remain fixed over the 2010-2030 period. Some baseline growth rates were also adjusted later to reflect judgments from the ongoing *ASEAN 2030* study but are unlikely to affect significantly the results reported in this paper.

The projection methodology yields relatively rapid rates of growth for ACI economies, reflecting the continuation of relatively high convergence speeds in recent decades. The methodology essentially assumes "convergence as usual"—that is, that the process of technological catch-up will suffer neither setbacks nor find opportunities for acceleration in the future. By construction, growth rates decline as economies approach the technological frontier.

Source: Authors' description based on Zhuang (2011).

[1] A third measure that is sometimes used, GDP at market exchange rates, is not reported here. That measure accounts for the tendency of the real exchange rates of emerging economies to rise, and hence yields more rapid estimates of their growth over time.

Market price and purchasing power parity (PPP) measures provide somewhat different pictures of the importance of ACI economies in the global economy (for an analytical description, see Deaton and Heston 2010). The market price measure calculates real output with goods and services priced at actual 2010 market prices. The PPP measure calculates real output in terms of goods and services priced at 2010 "international dollar prices," that is, with every country's output valued in terms of common prices. Since the market prices of non-traded goods and services—the textbook example is haircuts—tend to be low in emerging economies compared to those in advanced economies, market price estimates tend to yield lower GDP values for emerging economies than PPP estimates. (By construction, the market price and PPP measures are the same for the United States.) For the ACI region, for example, the market price GDP in 2010 is only 55% as high as the PPP GDP. However, the real growth rates of the two measures tend to be close.

Table 1: Population and Output (Market Prices), 2010–2030

	2010				2030				2010–30
	Population	GDP	World Share	GDP/capita	Population	GDP	World Share	GDP/capita	GDP growth
ACI	3,167.0	8,781	14.80	2,773	3,631.8	33,287	27.72	9,165	6.9
ASEAN	593.4	1,566	2.64	2,639	706.0	4,634	3.86	6,564	5.6
Brunei Dar.	0.4	11	0.02	27,277	0.5	23	0.02	43,587	3.8
Cambodia	14.1	12	0.02	826	17.4	56	0.05	3,244	8.2
Indonesia	239.9	571	0.96	2,380	279.7	1,700	1.42	6,080	5.6
Lao PDR	6.2	6	0.01	989	7.8	28	0.02	3,575	7.8
Malaysia	28.4	204	0.34	7,166	37.3	593	0.49	15,912	5.5
Myanmar	48.0	21	0.03	431	54.3	117	0.10	2,149	9.0
Philippines	93.3	170	0.29	1,828	126.3	660	0.55	5,224	7.0
Thailand	69.1	277	0.47	4,008	73.3	711	0.59	9,702	4.8
Singapore	5.1	193	0.32	37,849	6.0	324	0.27	54,206	2.6
Viet Nam	87.8	102	0.17	1,160	101.5	420	0.35	4,136	7.3
PRC	1,348.9	5,711	9.63	4,233	1,402.3	22,083	18.39	15,748	7.0
India	1,224.6	1,504	2.54	1,229	1,523.5	6,570	5.47	4,312	7.6
Korea; Taipei,China	71.2	1,266	2.13	17,785	73.3	2,459	2.05	33,539	3.4
Japan	126.5	5,118	8.63	40,444	120.2	6,341	5.28	52,749	1.1
US	310.4	14,431	24.32	46,494	361.7	22,772	18.97	62,961	2.3
Europe	511.3	17,635	29.72	34,491	527.8	25,997	21.65	49,252	2.0
World	6,641.1	59,327	100.00	8,933	7,932.8	120,065	100.00	15,135	3.6

Brunei Dar. = Brunei Darussalam; Korea = The Republic of Korea.

Population: millions; GDP: billions of 2009 U.S. dollars; GDP/capita: 2009 U.S. dollars.

Note: ADB projections as of 16 July 2011. The ASEAN aggregate includes Timor Leste, which is not an official member at this time. The projections were subsequently revised slightly.

Source: ADB.

Table 2: Population and Output (Purchasing Power Parity), 2010–2030

	2010				2030				2010–30
	Population	GDP	World Share	GDP/capita	Population	GDP	World Share	GDP/capita	GDP growth
ACI	3,167.0	15,905	23.98	5,022	3,631.8	61,392	39.28	16,904	7.0
ASEAN	593.4	2,755	4.15	4,643	706.0	8,475	5.42	12,004	5.8
Brunei Dar.	0.4	18	0.03	46,362	0.5	39	0.02	74,082	3.8
Cambodia	14.1	28	0.04	1,968	17.4	134	0.09	7,729	8.2
Indonesia	239.9	926	1.40	3,862	279.7	2,760	1.77	9,868	5.6
Lao PDR	6.2	14	0.02	2,292	7.8	64	0.04	8,286	7.8
Malaysia	28.4	368	0.56	12,971	37.3	1,073	0.69	28,801	5.5
Myanmar	48.0	71	0.11	1,485	54.3	403	0.26	7,409	9.1
Philippines	93.3	313	0.47	3,354	126.3	1,211	0.77	9,587	7.0
Thailand	69.1	517	0.78	7,476	73.3	1,327	0.85	18,096	4.8
Singapore	5.1	242	0.37	47,629	6.0	408	0.26	68,212	2.6
Viet Nam	87.8	256	0.39	2,913	101.5	1,054	0.67	10,388	7.3
PRC	1,348.9	9,373	14.13	6,948	1,402.3	36,421	23.30	25,972	7.0
India	1,224.6	3,778	5.70	3,085	1,523.5	16,497	10.55	10,828	7.7
Korea; Taipei,China	71.2	2,000	3.02	28,093	73.3	3,893	2.49	53,097	3.4
Japan	126.5	3,824	5.77	30,220	120.2	4,738	3.03	39,414	1.1
US	310.4	13,104	19.76	42,220	361.7	20,678	13.23	57,172	2.3
Europe	511.3	14,452	21.79	28,266	527.8	21,682	13.87	41,077	2.1
World	6,641.1	66,329	100.00	9,988	7,932.8	156,308	100.00	19,704	4.4

Brunei Dar. = Brunei Darussalam; Korea = The Republic of Korea.

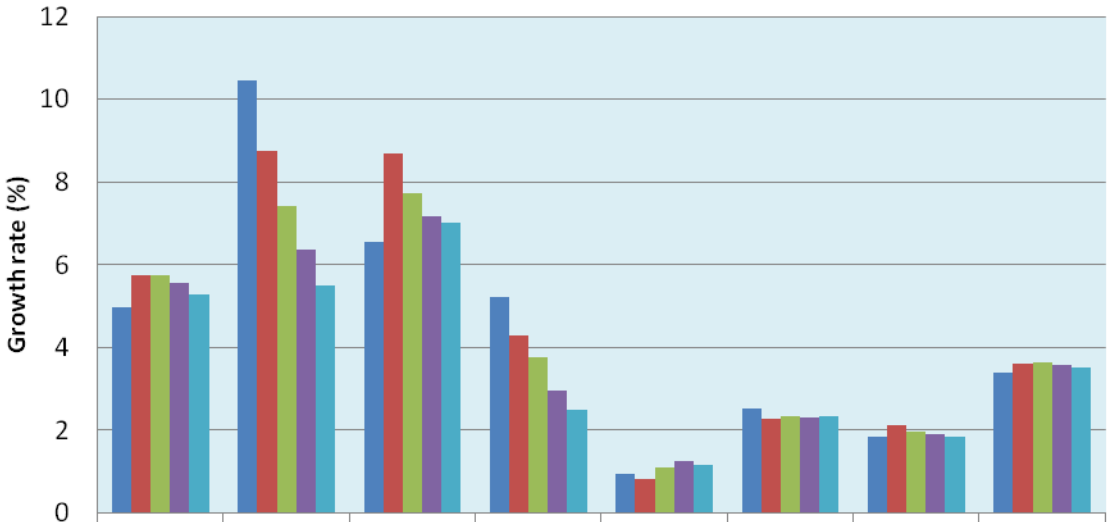
Population: millions; GDP: billions of 2009 international dollars; GDP/capita: 2009 international dollars.

Notes: ADB projections as of 16 July 2011. The ASEAN aggregate includes Timor Leste, which is not an official member at this time. The projections were subsequently revised slightly.

Source: ADB.

By 2030, the output of ACI countries will have grown roughly four-fold by either measure. In market prices, ACI output will be larger than that of the United States or the European Union. In PPP terms it will be larger than the two combined. These long term average growth rates conceal gradual changes in the pace of growth over time (Figure 1). Interestingly, world economic growth is projected to *accelerate* in coming decades, notwithstanding the aftereffects of the global financial crisis, aging populations, and diminished prospects in advanced economies. The reason is not faster growth in individual countries, but the great transformation. More and more, world averages reflect rapidly growing emerging economies, including especially the ACI countries, whose weight in global aggregates is already large and continues to increase.

Figure 1: ACI Growth Rates will Slow but Stay High



	ASEAN	PRC	India	NIEs	Japan	USA	Europe	World
1990-2010	5.0	10.4	6.5	5.2	0.9	2.5	1.9	3.4
2010-2015	5.7	8.7	8.7	4.3	0.8	2.3	2.1	3.6
2015-2020	5.7	7.4	7.7	3.8	1.1	2.3	2.0	3.6
2020-2025	5.6	6.4	7.2	3.0	1.2	2.3	1.9	3.6
2025-2030	5.3	5.5	7.0	2.5	1.2	2.3	1.8	3.5

Source: ADB projections.

The PRC's growth rate is projected to be the highest initially among major countries and groups. But the PRC is projected to decelerate—even after the effects of the current slowdown dissipate—due to the slower growth and eventual decline of the PRC's labor force, as well as moderating productivity growth. Deceleration is inevitable given the PRC's successful growth trajectory and does not imply that the PRC will sink into a "middle income trap." That term is reserved for a more drastic, and hopefully avoidable, productivity slowdown that will be examined as a special scenario.

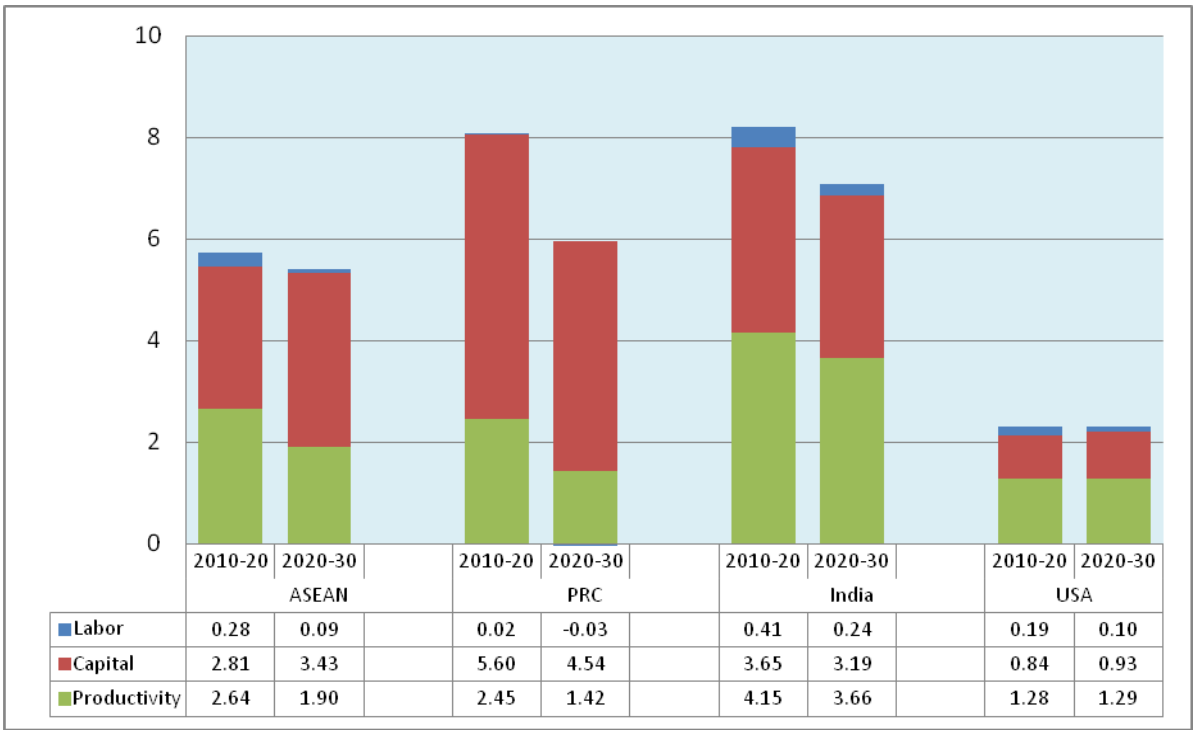
India's growth rate is projected to rise above past averages as the country emerges from the current slowdown and embarks on full-speed catch-up. The acceleration that the projections anticipate is based in part on solid labor force growth and progress in transferring workers from agriculture to industry and services. In this scenario, India's growth rate would overtake that of the PRC sometime between 2015 and 2020. The NIEs are projected to decelerate as their

income levels approach those of advanced economies, and the advanced economies themselves are projected to grow at rates similar to long-term historical averages.

ASEAN's growth is projected to remain relatively fast: low- and middle-income countries are projected to grow in the 5–9% range. Growth rates are projected to be relatively high for the least-developed countries (Cambodia, Laos, Myanmar and Vietnam), averaging above 7%. Middle-income countries (Indonesia, Malaysia, the Philippines and Thailand) would expand with growth rates in the 5–7% range. Only high-income Brunei Darussalam and Singapore are projected to grow more slowly, at rates under 4%.

Investment and productivity improvements are likely to be the principal drivers of growth. Figure2 shows that productivity growth will be the largest contributor to growth in India, while capital will be more important in other ACI countries. The role of investment relative to productivity growth will increase in all countries over time. The contribution of labor force growth will be the least important, and will decline over time, actually tuning negative in the PRC toward the end of the projection period.

Figure 2: Growth will be Driven by Investment and Productivity



	2010-20	2020-30		2010-20	2020-30		2010-20	2020-30		2010-20	2020-30
	ASEAN			PRC			India			USA	
Labor	0.28	0.09		0.02	-0.03		0.41	0.24		0.19	0.10
Capital	2.81	3.43		5.60	4.54		3.65	3.19		0.84	0.93
Productivity	2.64	1.90		2.45	1.42		4.15	3.66		1.28	1.29

Source: Authors' calculations.

The prospects for sustaining growth consistent with historical experience are reasonably good, but this path nevertheless represents an ambitious scenario. Such growth rates require continued improvements in productivity and high rates of investment. Meanwhile, the demographic dividend—the economic benefits of having a large working-age population relative to young and aged populations—which played a role in some countries in the past, will turn negative in many countries by 2030. But success also generates momentum; the ACI region is seen, and is likely to remain, a propitious location for economic activities and investments that benefit from scale and proximity to investment and consumption growth.

4. ANALYSIS OF THE BASELINE: DIMENSIONS OF TRANSFORMATION

Structural detail is useful for understanding the varied consequences of growth, ranging from the demand for resources to international relationships through trade and finance. The model is used to explore four major themes:

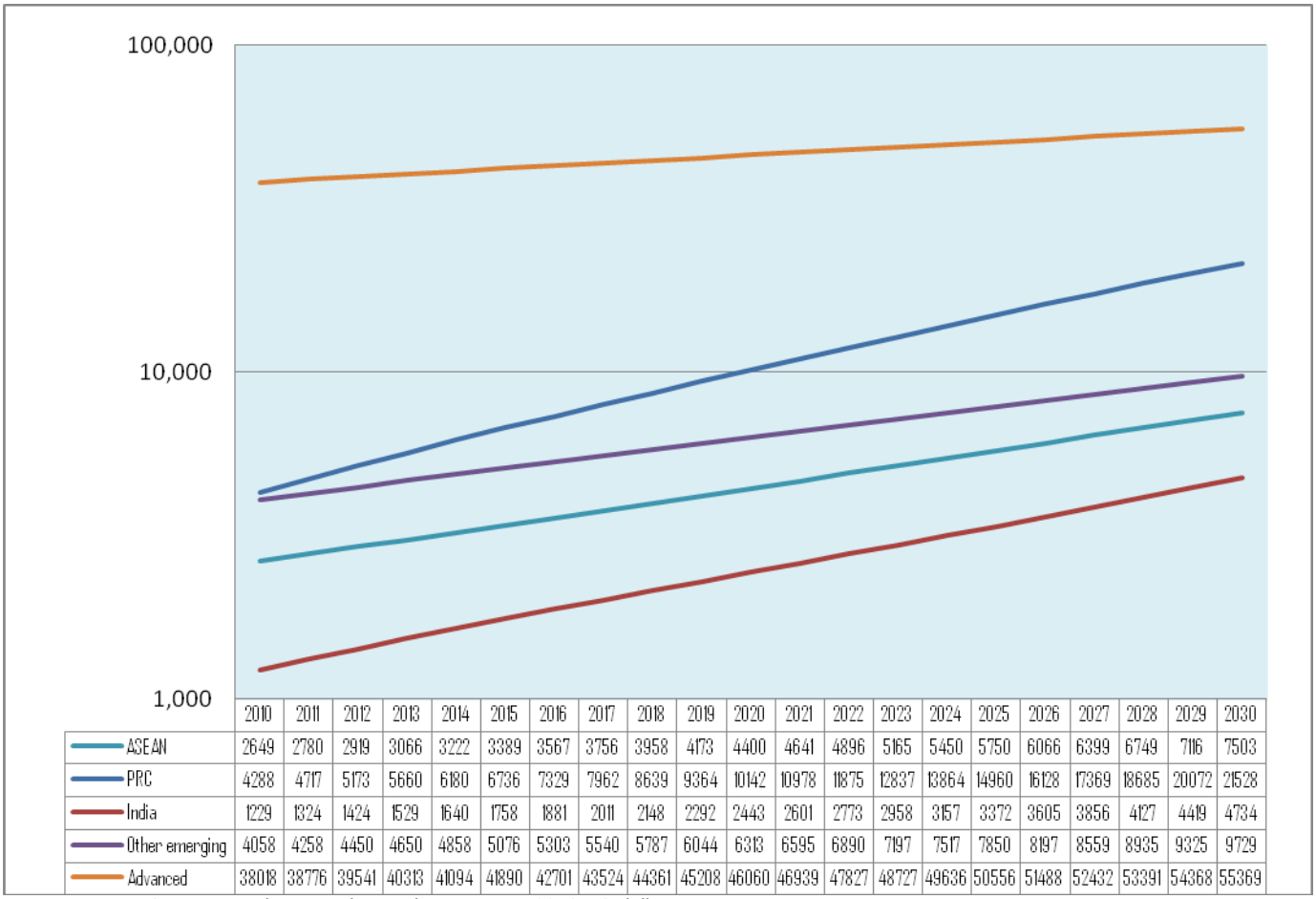
- how economic growth will transform the lives of the ACI citizens,
- how ACI economies will transition to new drivers of growth,
- how ACI growth will affect global resource and environmental constraints, and
- how the region's role will change in the world economy.

The next sections probe these themes by considering alternative scenarios for ACI growth. the global economic environment, and policies adopted in the region and beyond.

4.1 A leap in the quality of life

The baseline runs of the simulation model are calibrated to the ADB growth projections and help to work out their detailed implications. These show, most importantly, that the region is poised for an historic improvement in the quality of life. The ACI economies are converging toward the world technology frontier and their incomes are rising accordingly (Figure 3). A detailed look at country-level projections suggests that low- and middle-income ACI countries will grow faster than the world average and outperform peers elsewhere at corresponding income levels.

Figure 3: The Income Gap between ACI and Advanced Countries will Continue to Close



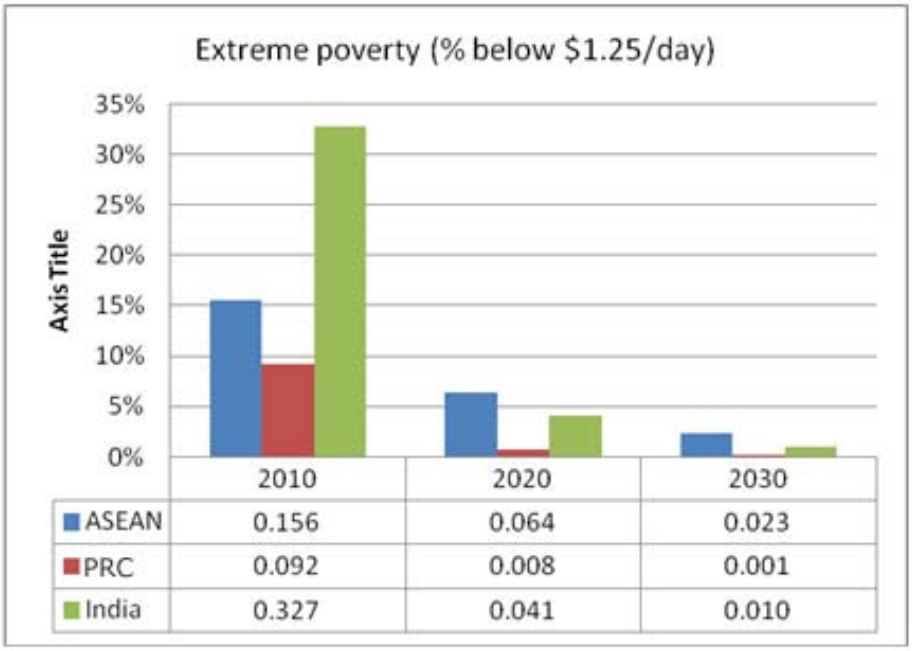
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
ASEAN	2649	2780	2919	3066	3222	3389	3567	3756	3958	4173	4400	4641	4896	5165	5450	5750	6066	6399	6749	7116	7503
PRC	4288	4717	5173	5660	6180	6736	7329	7962	8639	9364	10142	10978	11875	12837	13864	14960	16128	17369	18685	20072	21528
India	1229	1324	1424	1529	1640	1758	1881	2011	2148	2292	2443	2601	2773	2958	3157	3372	3605	3856	4127	4419	4734
Other emerging	4058	4258	4450	4650	4858	5076	5303	5540	5787	6044	6313	6595	6890	7197	7517	7850	8197	8559	8935	9325	9729
Advanced	38018	38776	39541	40313	41094	41890	42701	43524	44361	45208	46060	46939	47827	48727	49636	50556	51488	52432	53391	54368	55369

Note: GDP per capita at market exchange rates, 2010 US dollars.

Source: ADB projections.

Such sustained income gains should reach most segments of the ACI population. A sub-model of expenditure distributions was used to translate average gains into estimates for various points of subgroups of the income distribution. Most importantly, the model shows that the incidence of poverty is poised to decline precipitously in the ACI region (Figure 4). By 2030 the percentage of the ACI population below the $1.25 per day poverty line will have fallen from more than 600 million across the region today to a little more than 30 million, accounting for only one% of the region's population. This also means that with modest-scaled targeted policies—explored in more detail below—the region could fully eradicate extreme poverty by that time.

Figure 4: Extreme Poverty can be Eradicated

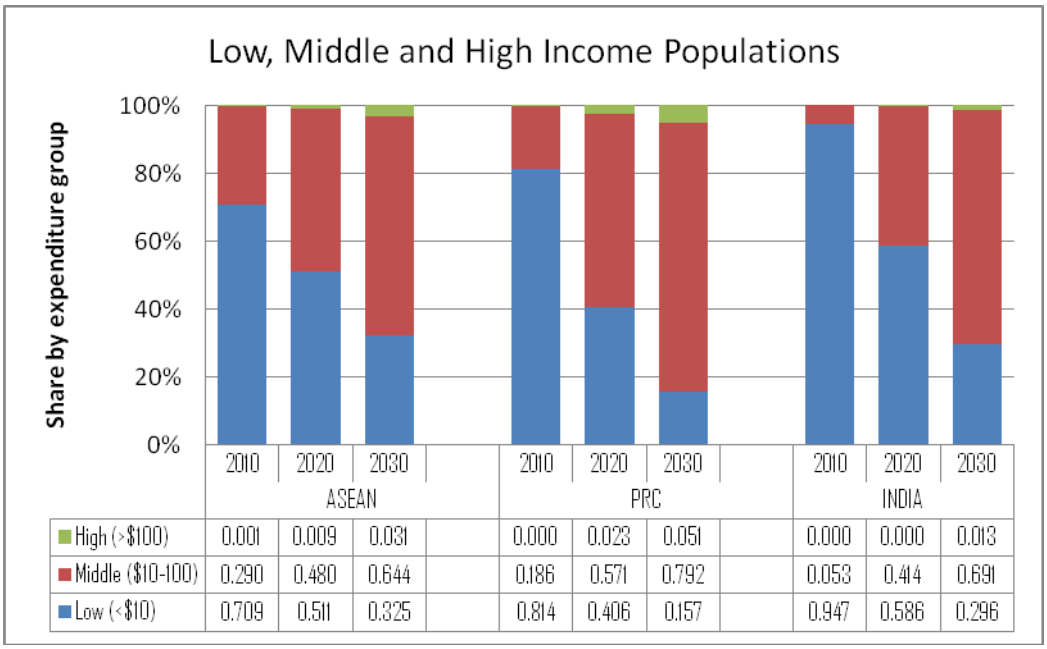


Note: Percentage of population with consumption below $1.25/day (2005 US$).

Source: authors' calculations.

Progress will be also dramatic higher up in the income distribution. By 2030, 64% of the population of ASEAN, 79% of the population of the PRC, and 69% of the population of India should move into the middle income brackets, defined as consumption expenditures between $10/day to $100/day (Figure 5). As highlighted in Chapter 1, two billion ACI citizens will join the ranks of middle income consumers over the next 20 years. These extraordinary developments will double the size of the global middle class and by 2030, when about half of the world's middle class population will live in ACI. The ranks of the region's truly affluent consumers—those with consumption in excess of $100/day per person—will also swell; by 2030, more than 100 million people in ACI countries could enjoy such prosperity.

Figure 5: Middle Income Groups will Become Dominant



Source: authors' calculations.

However, large changes in private incomes and expenditures tell a partial story. They do not accurately measure improvements in the quality of life, which also depend on goods and services not provided by markets. That dimension is explored in Chapter 3. Critical public services include education, health care, sanitation and transportation; measures to ensure public safety in its many dimensions; and the protection of the environment. The simulations cannot provide details on specific policies for managing these objectives, but they do show that sufficient resources will be available to fund them. Governments will have ample incentives to provide effective services: The quality of life is a compelling objective in its own right, and making progress on it is also essential for sustaining support for leaders.

Urbanization is a systematic byproduct of rapid growth, and ACI cities will be among the principal engines driving the transformation. According to United Nations (2012) estimates, between 2010 and 2030 the ranks of urban dwellers in ACI countries will expand by 658 million people and by 2030 a majority of the region's population will be living in cities (Table 3). The region has lagged world urbanization levels in the past, but the trends are now poised to push ACI cities into the forefront of world development in the next two decades. Despite the region's relatively slow population growth, the United Nations estimates that its share of the world's urban population will rise from 37% to 39%.

As so many other dimensions of the transformation, urbanization has potentially positive and negative implications. Cities are extremely productive: Incomes are typically high compared to other places; scale advantages facilitate many kinds of production and innovation; cities are good places to study and work and therefore attract talent and entrepreneurship; and dense populations make it possible to offer private and public services in greater variety at lower cost. But cities are also demanding and tough to manage: without good infrastructure and public services, cities can become harsh places to live and even seedbeds of disease, dissatisfaction, and violence.

Table 3: Most ACI Citizens will Live in Cities

	2010			2030		
	Population	Urban	%	Population	Urban	%
ACI	3,166	1,308	41	3,630	1,966	54
ASEAN	592	262	44	704	393	56
Brunei Dar.	0	0	76	1	0	82
Cambodia	14	3	20	17	5	26
Indonesia	240	120	50	280	176	63
Lao PDR	6	2	33	8	4	52
Malaysia	28	20	72	37	30	81
Myanmar	48	15	32	54	24	44
Philippines	93	45	49	126	71	56
Thailand	69	23	34	73	32	44
Singapore	5	5	100	6	6	100
Viet Nam	88	27	30	101	44	43
PRC	1,349	668	50	1,402	967	69
India	1,225	379	31	1,523	606	40
Korea; Taipei,China	71	57	80	73	62	84
Japan	127	115	91	120	116	97
US	310	255	82	362	311	86
Europe	511	391	76	528	429	81
World	6,641	3,559	54	7,933	4,984	63

Brunei Dar. = Brunei Darussalam;
Korea = The Republic of Korea.

Source: United Nations (2012).

In short, the ACI region is on the cusp of a giant advance in living standards—potentially freeing hundreds of millions of people from poverty and building a huge middle class. The region's economic gains should generate solid increases in private consumption and living conditions. They will also enable governments to fund major improvements in public services. In turn, the region's wide-ranging requirements and expenditures will create massive demand and opportunities for investment and entrepreneurship. These trends should produce—given a conducive economic environment—solid, indigenous foundations for growth.

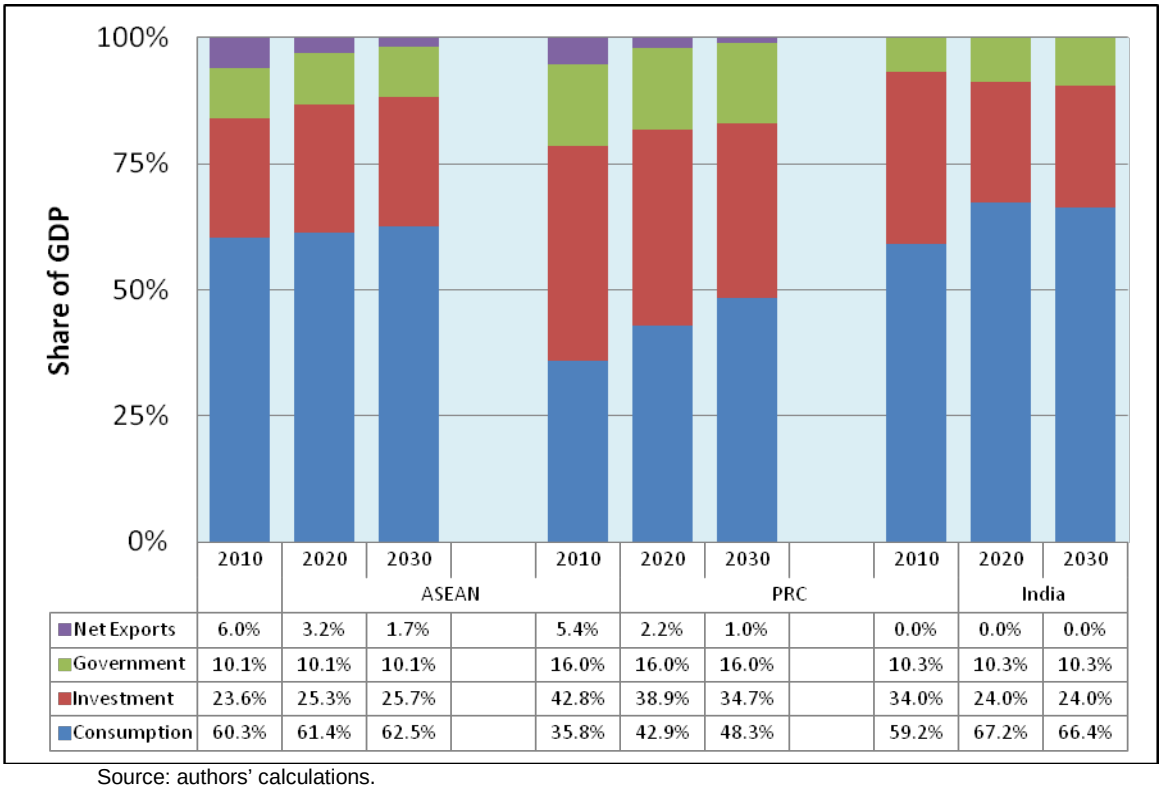
4.2 New drivers of growth

For ACI growth rates to remain above world rates, the region's output structure will have to shift away from exports to advanced economies toward regional and domestic demand. An indirect implication is that productivity gains can no longer depend on export-oriented production, which is often associated with easy access to foreign technologies, partners and investors. Regional innovation systems and markets will have to become the new drivers of ACI growth, providing technology to expand output and markets to sell it. These shifts will be reinforced as the current account surpluses of ACI economies continue to decline relative to GDP, due to the effects on the financial crisis on expected returns abroad.

New drivers of growth will be needed on both the demand and supply sides of the ACI growth equation. They are likely to emerge. The principal engines on the demand side will be rising wages and policy shifts that direct a larger share of income toward private and public

consumption expenditures. These effects will of course differ across the region. India's current account, for example, has been in balance or in deficit, and cannot be expected to decline. But the current account surpluses have been high, and investment relatively low in several ASEAN countries (relative to levels in the 1990s as well as international experience), so investment represents a logical target for demand growth. Consumption increases are likely to be especially important in the PRC, where the share of consumption expenditures is unusually low. The components associated demand in ACI economies are illustrated in Figure 6. The net effect: ACI producers will have ample opportunity to accelerate domestic and regional sales, including especially of products that target the regional demand patterns.

Figure 6: Demand will Shift toward Consumption



	2010	2020	2030		2010	2020	2030		2010	2020	2030
	ASEAN				PRC				India		
Net Exports	6.0%	3.2%	1.7%		5.4%	2.2%	1.0%		0.0%	0.0%	0.0%
Government	10.1%	10.1%	10.1%		16.0%	16.0%	16.0%		10.3%	10.3%	10.3%
Investment	23.6%	25.3%	25.7%		42.8%	38.9%	34.7%		34.0%	24.0%	24.0%
Consumption	60.3%	61.4%	62.5%		35.8%	42.9%	48.3%		59.2%	67.2%	66.4%

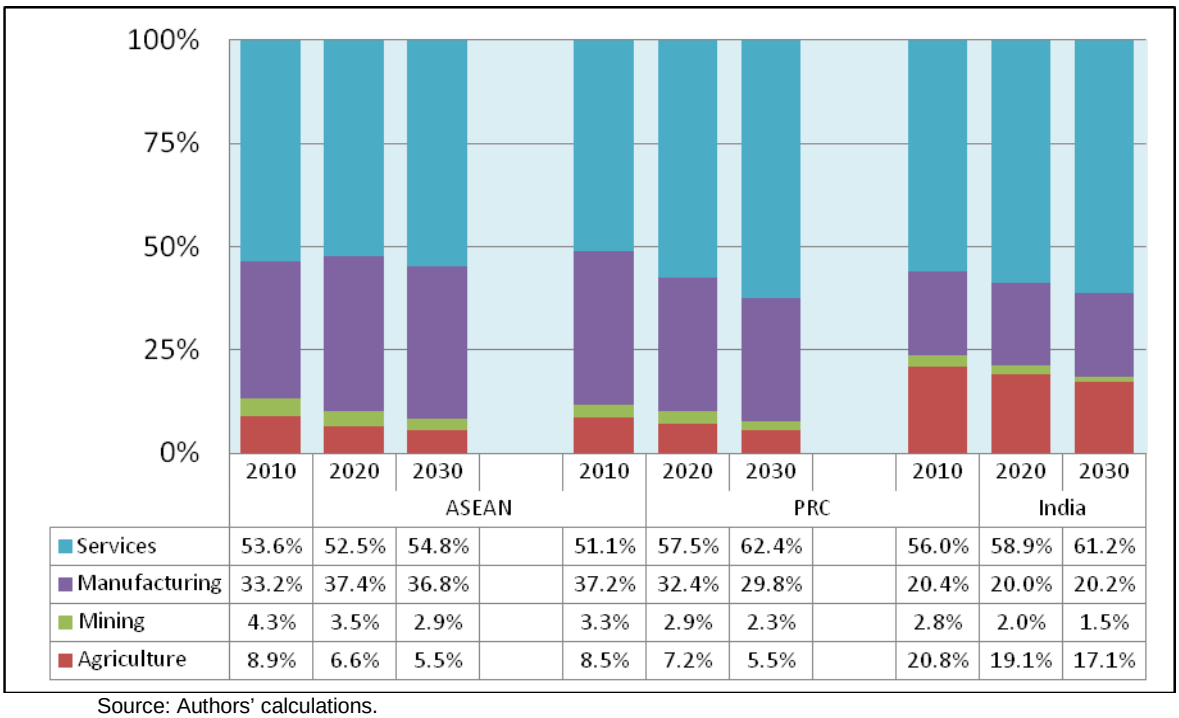
Source: authors' calculations.

Research by McKinsey & Co. (2011) has examined the opportunities in discretionary spending in large ACI countries such as India and the PRC, and has singled out lucrative markets associated with more prosperous urban lifestyles. Consider, for example, the implications of an estimated 30 million people in ACI countries that will be added to urban populations each year. This annual increase equals the population of the world's largest city today and will generate requirements for an additional 75 million square meters of housing and corresponding opportunities in residential construction and in equipping and servicing these new residences and their occupants. These sectors could alone add $100 billion to regional expenditures every year.

Baseline simulations show similar results—more systematically generated by a multi-regional and multi-sectoral general equilibrium model—suggest similar, large transformations. Services will be an especially important component of rising demand; service inputs play a larger rule in production in higher income economies, and consumer budgets have a large service component relative to other demand components, such as exports and investment (Figure 7). On a more micro-economic level, a range of new products will be required by middle-class households with incomes still well below those in high-income countries. These "frugal

innovations" could serve markets ranging from food products and clothing to motor scooters and automobiles. ACI producers have a pole position in the race for these markets.

Figure 7: Production will Shift toward Services



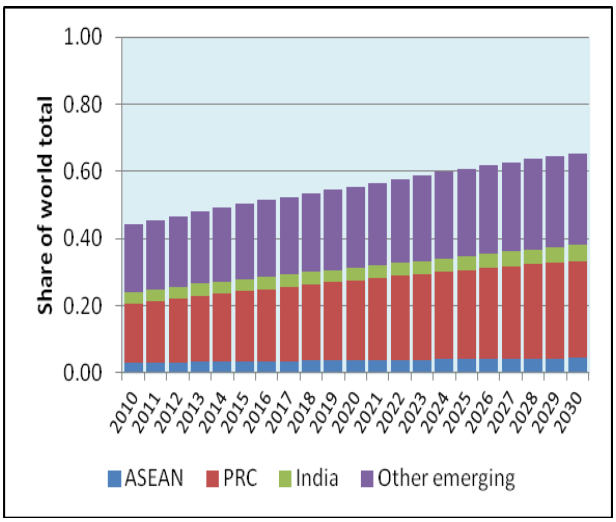
	2010	2020	2030		2010	2020	2030		2010	2020	2030
	ASEAN				PRC				India		
Services	53.6%	52.5%	54.8%		51.1%	57.5%	62.4%		56.0%	58.9%	61.2%
Manufacturing	33.2%	37.4%	36.8%		37.2%	32.4%	29.8%		20.4%	20.0%	20.2%
Mining	4.3%	3.5%	2.9%		3.3%	2.9%	2.3%		2.8%	2.0%	1.5%
Agriculture	8.9%	6.6%	5.5%		8.5%	7.2%	5.5%		20.8%	19.1%	17.1%

Source: Authors' calculations.

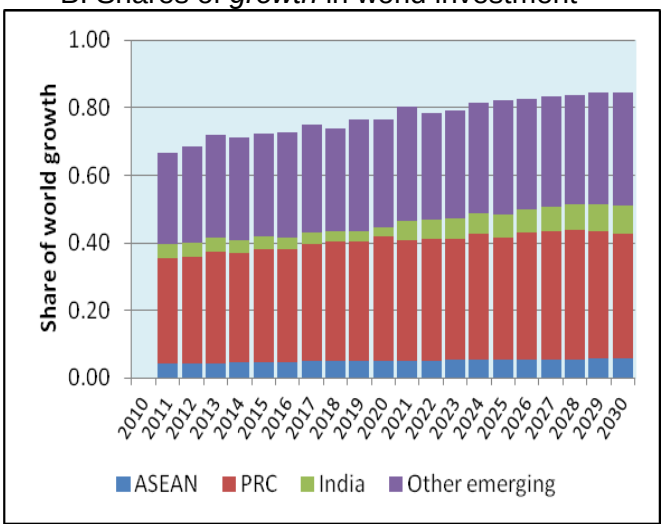
The simulations suggest sharp increases in the share of ACI economies in global expenditures on consumption and investment across a wide range of sectors. These results (summarized in Figure 8 for consumption and investment) will reinforce the within-economy demand shifts described above. The markets that drive demand within ACI economies will become more important also internationally. Located at the epicenter of world growth in several key sectors, ACI producers have excellent opportunities to identify the goods and services that are best suited for the region's—and world's—largest new markets.

Figure 8: ACI's Rising Shares of Global Expenditures

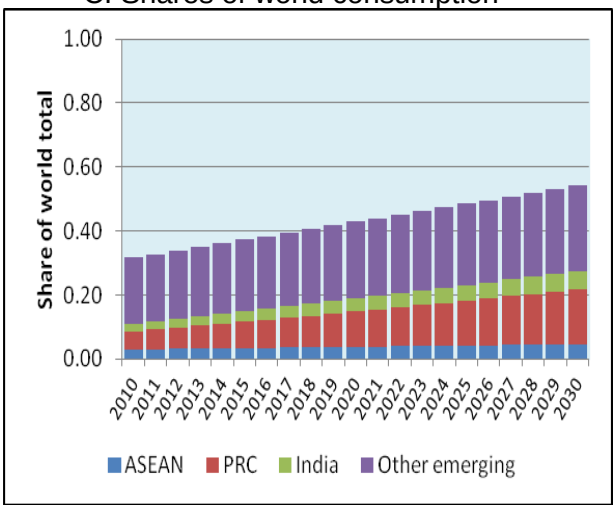
A. Shares of world investment



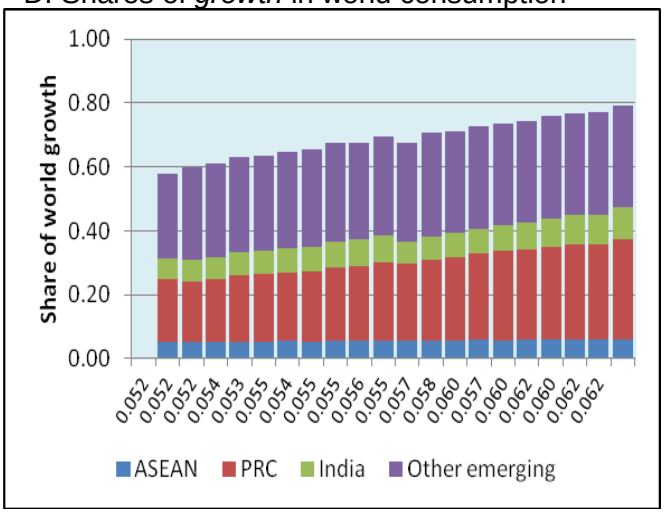
B. Shares of *growth* in world investment



C. Shares of world consumption



D. Shares of *growth* in world consumption



Source: Authors' calculations.

Consider, for example, the interesting implications for investment and the sectors that provide capital goods and services for it. ACI shares in world investment will rise from 24% in 2010 to 38% two decades later (Figure 8A). But what is still more remarkable is that the region's share of the *growth* of world investment—the new investment markets that will emerge in that period. Figure 8B shows that ACI's share in the growth of investment will rise from 40% in 2010 to 51% in 2030. Further, if ACI results are combined with those of other emerging market economies, which are also expected to grow at above average rates, the "South" will account for fully 85% of the growth of world investment by that 2030. A vast majority of the new markets for investment goods—for construction equipment, high-speed rail, energy plants, and so on—will be created in emerging markets and especially in ACI. This will be true also for related services, ranging from engineering and architecture to finance.

Especially important among investment sectors are those linked to infrastructure, such as roads, ports, urban transport, communications, power generation, and a wide range of utilities and amenities. The infrastructure needs in ACI economies range into trillions of US dollars. The role of infrastructure in the transformation is important enough to warrant detailed analysis in

Chapter 4. Infrastructure affects the prospects of the region not only through demand, but also through contributions to productivity and innovation. In some countries—notably India, Indonesia, and Philippines—infrastructure requirements are especially urgent since they already appear to constrain growth.

As market opportunities and demand pull firms and resources into new sectors, so rising costs and wages and international competition will help to push them. The trade effects of structural change are shown in Table 4. The simulations suggest substantial migration of labor-intensive processes from high- to low-wage economies, including from the PRC to India and Southeast Asia. In turn, the PRC will move up the technology ladder into industries and segments now served primarily by Japan, the Republic of Korea, and Western countries. Japan and the Republic of Korea, in turn, will move into more advanced manufacturing and especially service activities. But all of these activities are likely to be even more interconnected than now, with production processes split into many steps and services. Asian production networks—as examined in detail in Chapter 4—will facilitate these shifts and establish the linkages needed to achieve minimum-cost production. These networks are powerful "clearing houses" for organizing the deployment of technology and capital, designed to yield efficient systems and secure niches in the global economy.

Table 4: Sectoral Shifts in ACI Output

	2010			2030		
	ASEAN	PRC	India	ASEAN	PRC	India
Agriculture	**8.9**	**8.5**	**20.8**	**5.5**	**5.5**	**17.1**
Rice	1.9	0.7	3.2	1.0	0.3	1.5
Other grains	0.3	0.3	2.2	0.1	0.2	0.9
Crops	3.2	3.6	11.4	2.1	1.5	10.2
Livestock	1.1	2.4	2.1	0.7	2.7	2.2
Forestry, fisheries	2.4	1.5	2.0	1.7	0.8	2.2
Mining	**4.3**	**3.3**	**2.8**	**2.9**	**2.3**	**1.5**
Coal	0.4	0.8	0.3	0.4	0.5	0.2
Oil	1.9	0.5	0.6	0.9	0.2	0.2
Gas	0.9	0.0	0.3	0.7	0.0	0.3
Minerals	1.1	1.9	1.6	0.9	1.6	0.7
Manufacturing	**33.2**	**37.2**	**20.4**	**36.8**	**29.8**	**20.2**
Food, beverages	3.9	3.0	5.6	2.6	2.8	5.7
Textiles, apparel	3.0	3.0	2.3	3.0	2.2	2.7
Petroleum products	0.4	0.3	0.1	0.3	0.3	0.2
Chemicals	4.9	5.0	2.2	5.4	3.1	1.9
Metals	3.0	9.9	3.6	2.8	6.8	3.0
Machinery	4.8	6.3	2.3	7.5	5.9	2.5
Electrical equipment	7.2	2.3	0.3	9.0	1.8	0.1
Transport equipment	2.4	2.4	1.4	2.2	2.3	1.1
Other manufactures	3.7	5.0	2.5	3.9	4.5	3.0
Services	**53.6**	**51.1**	**56.0**	**54.8**	**62.4**	**61.2**
Electricity	1.2	1.0	1.8	1.2	1.0	2.0
Gas	0.4	0.0	0.0	0.3	0.0	0.0
Construction	6.1	6.7	9.2	9.6	7.9	9.2
Trade	13.1	6.0	12.7	9.4	6.4	14.6
Transport, communications	6.8	7.9	8.2	6.3	6.1	7.6
Financial services	4.3	4.9	5.0	3.1	4.7	4.5
Other services	12.5	9.0	8.6	12.9	9.8	10.1
Government services	9.3	15.7	10.4	12.0	26.5	13.1
GDP	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

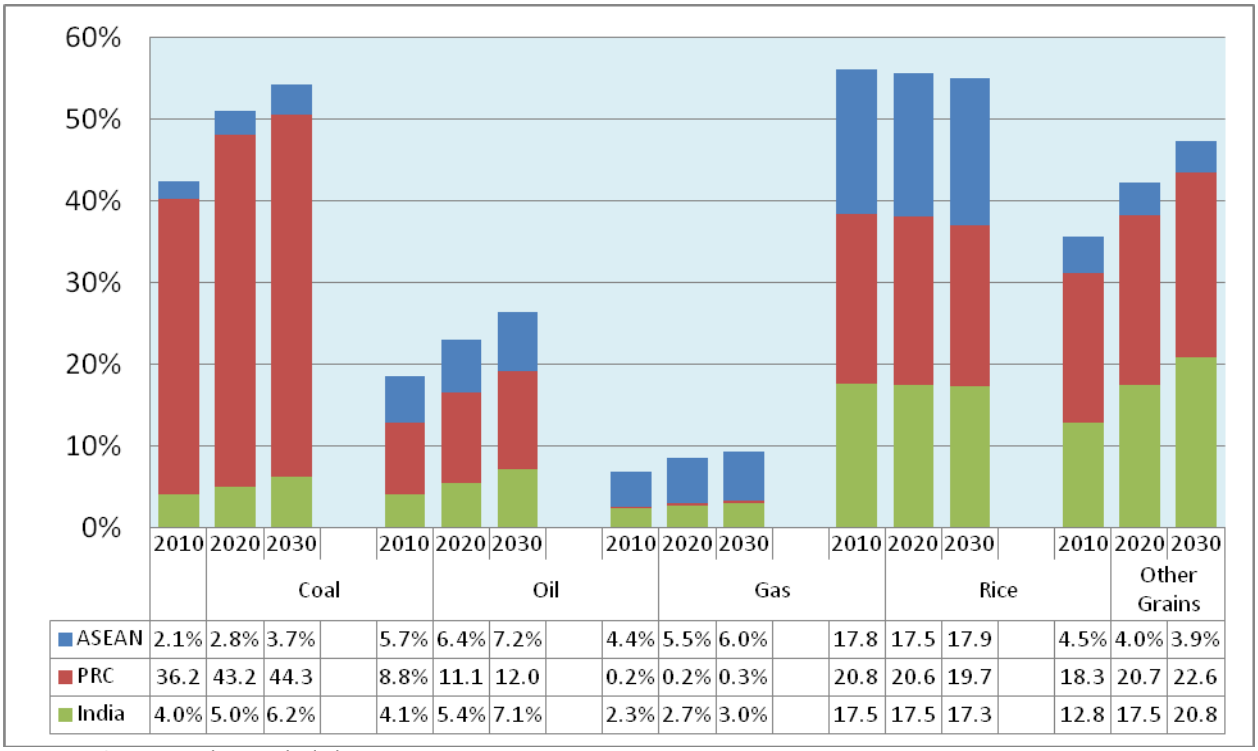
Source: Authors' calculations.

The changes should help to sustain increases in productivity, derived increasingly from productivity gains within sectors rather than shifts of resources among them. Competition and wage increases provide incentives for such gains, and the national policy environment can reinforce them by stimulating innovation and entrepreneurship. Key elements include a labor force educated to levels consistent with intermediate-term skill requirements, the protection of intellectual property, and financial markets that provide access to resources and reward risk-taking. ACI's urban centers will be a fundamental asset in the transformation; they attract talent, encourage the acquisition of skills, facilitate competition and the exchange of ideas, and serve as incubators for new products and business strategies.

4.3 Resource and environmental challenges

The ACI economies are so large that their growth will inevitably affect the resource sectors of the world economy (Figure 9). The simulations suggest that world food and energy demand, and thus prices, are likely to rise (Figure 10) in part due to ACI's scale and growth. The ACI economies are intense resource users because their economic structures are still weighted toward basic materials and heavy industry, because their consumers still spend a relatively large share of their income on food and fuel, and because they are (of course with notable exceptions) densely populated and resource poor. Moreover, ACI consumers appear to be following developed-country precedents in consumer demand, including motor vehicle purchases. As ACI economies increasingly depend on international trade for food and energy, their self-sufficiency rates will likely decline. International linkages will be important for ACI's continued development and their firms and governments can be expected to remain active in global resource investments.

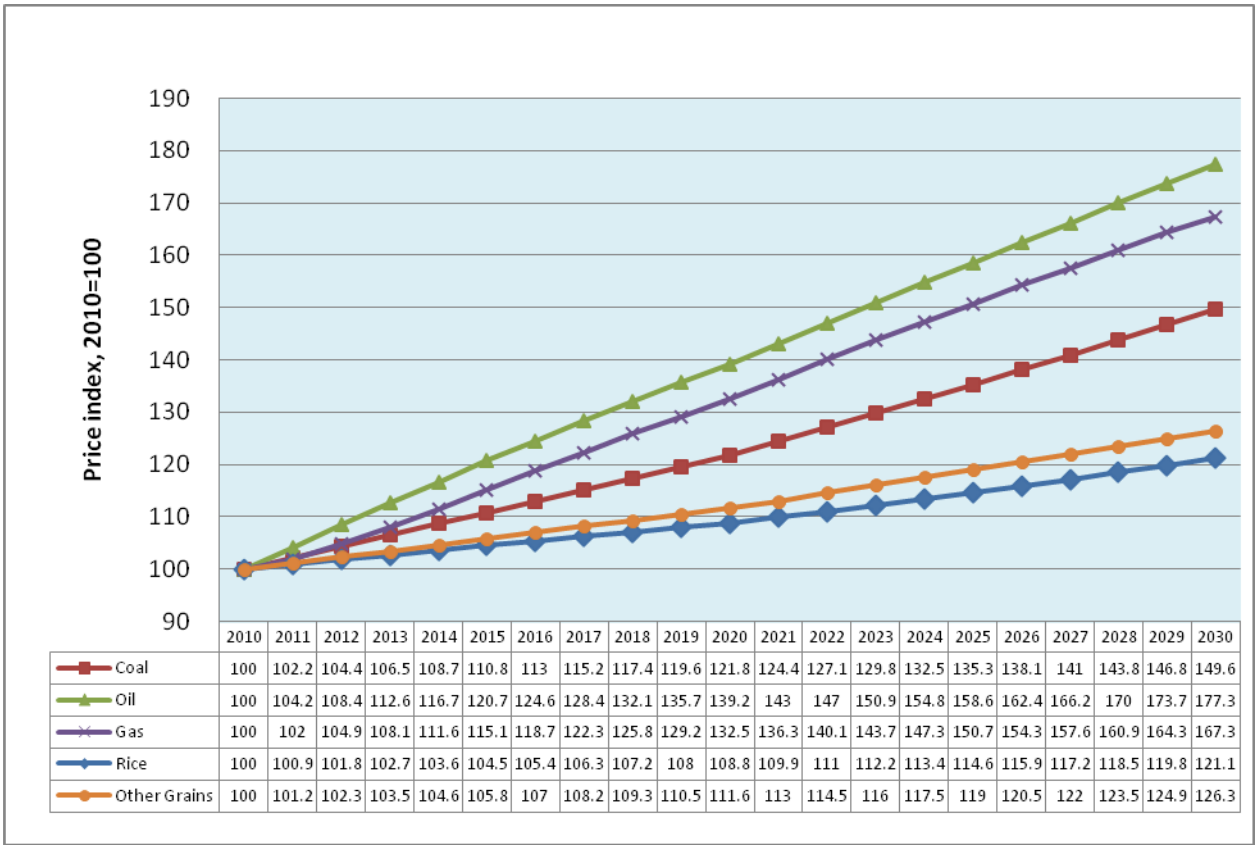
Figure 9: ACI's Rising Share of Commodities Demand



	Coal				Oil				Gas				Rice				Other Grains		
	2010	2020	2030		2010	2020	2030		2010	2020	2030		2010	2020	2030		2010	2020	2030
ASEAN	2.1%	2.8%	3.7%		5.7%	6.4%	7.2%		4.4%	5.5%	6.0%		17.8	17.5	17.9		4.5%	4.0%	3.9%
PRC	36.2	43.2	44.3		8.8%	11.1	12.0		0.2%	0.2%	0.3%		20.8	20.6	19.7		18.3	20.7	22.6
India	4.0%	5.0%	6.2%		4.1%	5.4%	7.1%		2.3%	2.7%	3.0%		17.5	17.5	17.3		12.8	17.5	20.8

Source: Authors' calculations.

Figure 10: Rising Commodity Prices



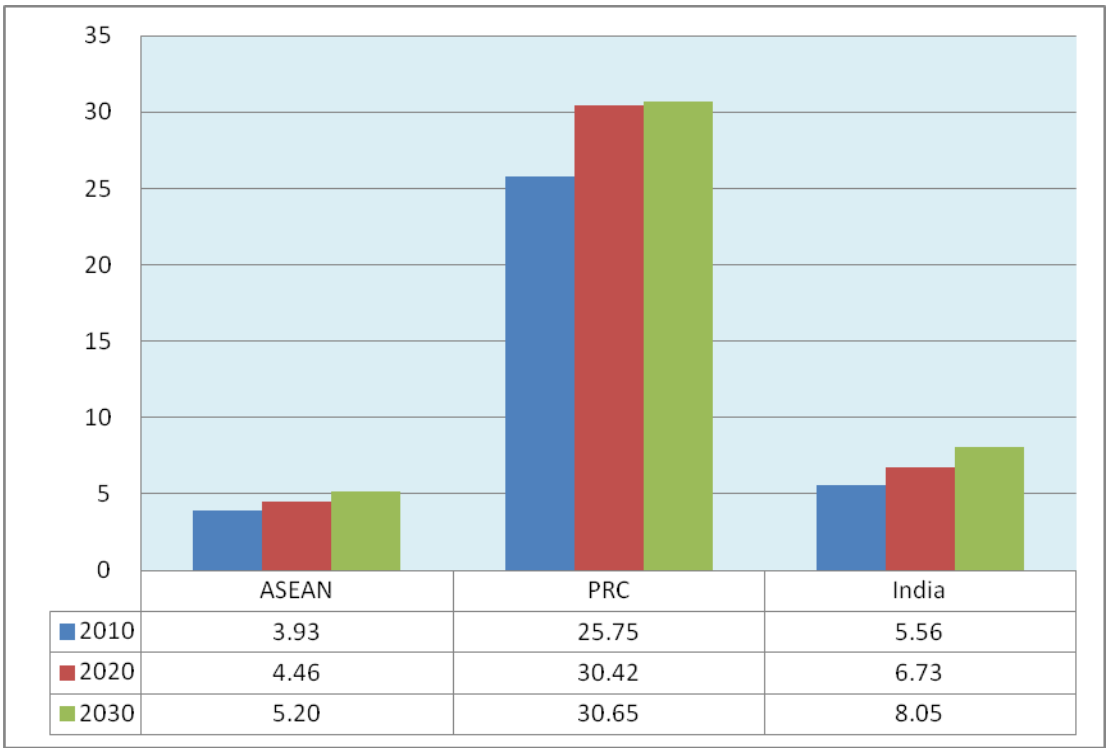
	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Coal	100	102.2	104.4	106.5	108.7	110.8	113	115.2	117.4	119.6	121.8	124.4	127.1	129.8	132.5	135.3	138.1	141	143.8	146.8	149.6
Oil	100	104.2	108.4	112.6	116.7	120.7	124.6	128.4	132.1	135.7	139.2	143	147	150.9	154.8	158.6	162.4	166.2	170	173.7	177.3
Gas	100	102	104.9	108.1	111.6	115.1	118.7	122.3	125.8	129.2	132.5	136.3	140.1	143.7	147.3	150.7	154.3	157.6	160.9	164.3	167.3
Rice	100	100.9	101.8	102.7	103.6	104.5	105.4	106.3	107.2	108	108.8	109.9	111	112.2	113.4	114.6	115.9	117.2	118.5	119.8	121.1
Other Grains	100	101.2	102.3	103.5	104.6	105.8	107	108.2	109.3	110.5	111.6	113	114.5	116	117.5	119	120.5	122	123.5	124.9	126.3

Source: Authors' calculations

Rising primary goods prices would signal the end of an era—for many decades, energy and food prices have been on a long declining trend. But in recent years they have begun to rise, even spiking to much higher levels for shorter periods. The demand for primary materials is bound to be robust as long as the world's rising economies remain intensive users of resources. Nevertheless, primary materials play a more limited role in economic growth now than in the past, and potentially important supply and demand responses—including new technologies for extracting natural gas and renewable energy—are also beginning to take shape. On the whole, these trends are likely to limit the effects of tight primary goods markets on growth.

The effects of ACI growth on the environment are significant and potentially more damaging. Because ACI energy supplies continue depend heavily on coal, the region has become an unusually important source of greenhouse gases. ACI's CO_2 emissions accounted for one-third of global emissions in 2010, roughly equal to those of advanced economies. Over the next two decades, its emissions are projected to increase 2.5 times and would account for an increasing share of global emissions (Figure 11). These large changes would occur despite significant advances in reducing the carbon intensity of ACI output.

Figure 11: ACI's Rising Share of World Carbon Emissions



	ASEAN	PRC	India
2010	3.93	25.75	5.56
2020	4.46	30.42	6.73
2030	5.20	30.65	8.05

Source: Authors' calculations.

The implications of these trends are explored in scenarios below, but clearly greenhouse gas emissions represent a fundamental risk to ACI growth. Business as usual—even with steady improvements in the energy intensity of production—will be no longer viable if perceptions of the global threat increase and/or the mitigation of emissions becomes a high priority for either the region's own citizens or other segments of the global community. Given ACI's political and economic interdependence with the global economy, conflict over the environment is an important source of risk—arguably greater than the risks and costs involved in implementing an early, efficient strategy to reduce the region's carbon footprint.

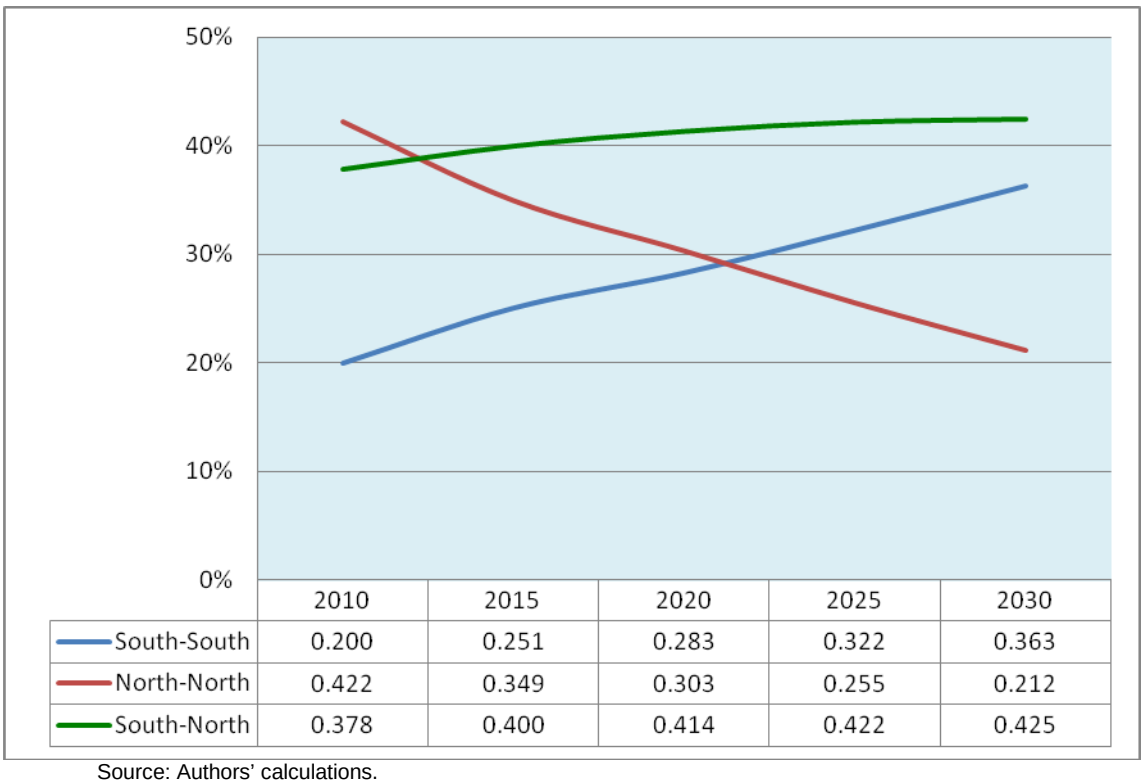
4.4 Expanding global role

As the share of ACI economies in world GDP roughly doubles over the next twenty years, the region's global footprint will expand proportionately across a wide range of variables, including consumption, investment, and resource requirements (as demonstrated in Figure 8). In turn, these developments will reshape the region's role in trade, finance, and the management of the global economy. Due to the relatively slow growth of the region's external markets, trade will increase, albeit more modestly relative to ACI GDP than in the past. Since the composition of the region's economy will shift toward the PRC and India, which have relatively low trade/output ratios due to their size, the overall ACI trade/GDP ratio will stay roughly constant at 2/3.

The structure of this trade, however, will be quite different. The bulk of the increase in world trade over the next two decades will consist of South-South trade—trade among ACI partners and other emerging economies. The share of these flows will expand from 20% to 36% of world trade between 2010 and 2030 (Figure 12). Meanwhile, the share of North-North trade will decline from 42% to 21% of world trade, while the share of North-South trade will rise slowly

from 38% to 43% of the total. This also implies that South -North connections will remain critical also for at least the next two decades.

Figure 12: World Trade will Turn South



	2010	2015	2020	2025	2030
South-South	0.200	0.251	0.283	0.322	0.363
North-North	0.422	0.349	0.303	0.255	0.212
South-North	0.378	0.400	0.414	0.422	0.425

Source: Authors' calculations.

The rise of the ACI economies implies perhaps even stronger global connections through financial flows. ACI have substantially higher savings rates than the rest of the world, so the growing share of ACI economies in world GDP will mean an expansion in share of world income devoted to savings and investment—increasing the world savings rate from 22 to 25%. These high world savings are needed, of course, to drive ACI growth itself, but they will inevitably affect global capital markets and transform the ACI's economic role from "factory floor" to "banker." And as ACI countries become increasingly important issuers and owners of financial assets, their regional institutions are also bound to play a larger role in intermediating financial flows. Chapter 6 will assess the likely speed and implications of this shift, but among other things, it should lead to the development of stronger Asian financial centers. These should thrive not only because of the sheer size of their potential market, but also because institutions closer to home often have an advantage in assessing regional information and serving the needs of regional clients.

5. THREATS TO THE TRANSFORMATION

Steady, uninterrupted progress—as projected in the baseline—cannot be taken for granted and is in fact unlikely. To achieve even the baseline results, the regional and international environment will have to support the projected development trajectory in many ways, as it generally has in the last several decades. The road to success is most likely narrow, but there are many paths that could lead to less favorable outcomes. This section examines various threats and their implications for ACI development and policy.

Risks that threaten the transformation process could originate in ACI countries or in the global environment; they could involve economic constraints or political conflict; and they could affect variables ranging from market access to productivity change. It is impossible to address all such risks, but selected "stress tests" involving key elements of the projections can provide insight into the sensitivity of the results. The issues explored include:

- A major slowdown in productivity growth in ACI and/or other countries
- Rising food prices and food security concerns
- Rising energy costs
- Rising environmental concerns
- Rising distributional concerns
- Protectionism in ACI's principal export markets

The following pages examine how these developments would affect ACI growth. The assumptions of the scenarios are presented in Table 5. Aside from the baseline, they fall into three groups. A first set (scenarios 2–4) explores alternative types of productivity deceleration. A second set (scenarios 5–8) addresses structural issues affecting key sectors or types of expenditure. The last set (scenarios 9–12) examines changes in the ACI region's external trade and capital flows. Given the uncertain outlook, more scenarios deal with adverse developments (this is the case with scenarios 2–9) than with favorable ones (scenarios 10–12).

Table 5: Alternative Scenarios

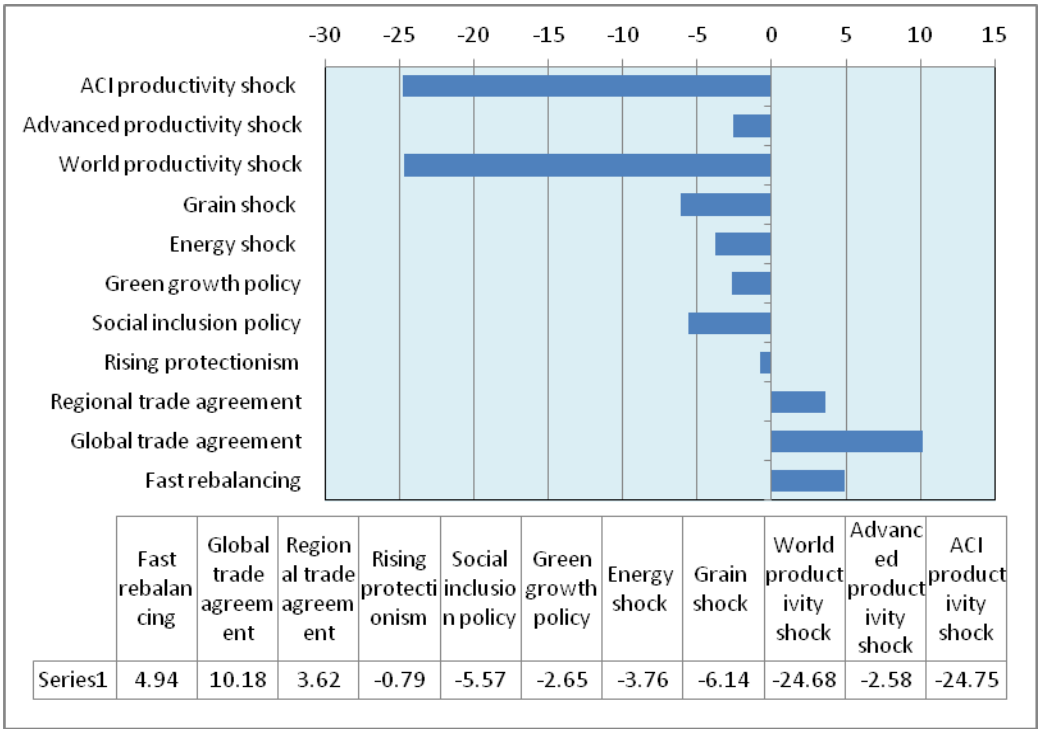
No.	Description	Parameter changes
1	Baseline	• ILO population and labor force projections • ADB projections of investment rates, productivity growth • Sectoral productivity growth expectations based on history • Capital flows fixed at 2010 nominal level
2	ACI productivity shock	• TFP growth rate reduced by 25% in ACI countries • Investment rate reduced by 10% in ACI countries and 2% in advanced countries
3	Advanced economies productivity shock	• TFP growth rate reduced by 25% in advanced countries • Investment rate reduced by 10% in advanced countries and 2% in ACI countries
4	Worldwide productivity shock	• TFP growth rate reduced by 25% worldwide • Investment rate reduced by 10% worldwide
5	Agriculture shock	• Agricultural productivity reduced worldwide to generate annual agricultural price increases of 2% above baseline
6	Energy shock	• Energy productivity reduced worldwide so as to generate annual energy price increases of 2% above baseline
7	Green growth policy	• Carbon taxes set to \$90/ton CO_2 in advanced countries and \$60/ton CO_2 in emerging economies • Government expenditures increased as estimated in the International Energy Agency's "450" scenario, financed by reduced private consumption and investment
8	Social inclusion policy	• ACI government expenditures increased by 2% of GDP, financed by reduced private consumption and investment • Expenditures result in 5%age point reduction in the Gini coefficient
9	Rising protection	• MFN tariffs and NTBs doubled in advanced countries
10	Regional trade agreement	• Intra-regional tariffs reduced 75% in ACI region • Intra-regional NTBs reduced 50% in ACI region
11	Global trade agreement	• MFN tariffs reduced 75% worldwide • MFN NTBs reduced 50% worldwide
12	Fast rebalancing	• All net capital flows reduced linearly to zero by 2020

Notes: All parameter changes assumed to be phased in 5 equal steps 2010–2020 period.

Source: Authors' assumptions.

Each of the adverse scenarios would reduce the income gains projected on the baseline. A summary of the results is presented in Figure 13 for incomes in the ACI group under the scenarios of Table 5. The most serious setback would result from a prolonged productivity slowdown in the ACI economies, in the region alone or in combination with such slowdowns worldwide. This "middle income trap" scenario would lower ACI incomes by nearly 25% in 2030. Other shocks—to agriculture, energy, or environmental or social spending requirements—would have smaller negative effects, in the order of 5% of incomes in 2030. In turn, improvements in the regional and global trading system would raise incomes by 5–10%. Taken in combinations, these results can be also used to develop a rough probability distribution of the possible range of outcomes (presented later in Figures 14 and 15). The threats warrant attention individually and in combination—much is at stake in preventing them or mitigating their effects.

Figure 13: Effects of Shocks on ACI Incomes in 2030



	Fast rebalancing	Global trade agreement	Regional trade agreement	Rising protectionism	Social inclusion policy	Green growth policy	Energy shock	Grain shock	World productivity shock	Advanced productivity shock	ACI productivity shock
Series1	4.94	10.18	3.62	-0.79	-5.57	-2.65	-3.76	-6.14	-24.68	-2.58	-24.75

Source: Authors' calculations.

The analysis shows not only the effects of possible shocks, but also that the main elements of the transformation of ACI economies would persist under varied shocks. The convergence results of the baseline are reasonably robust. Even under unfavorable assumptions, per capita incomes in the ACI economies would grow at an annual rate that is 2% faster than the rest of the world economy, and would become more important in world output, trade, and finance. Major structural changes within the ACI economies—in living standards and drivers of production—would also likely persist. To be sure, the detailed results show that the harsher outcomes would lead to much hardship and disappointment. The incentives to prevent or mitigate such outcomes are great. But the relative rise of the ACI economies, with some allowance for variations in its exact speed and scale, is likely to be a fixture of coming decades—it is *not* a product of optimistic assumptions alone.

5.1 The threat of the middle income trap

The risk of a substantial slowdown in the ACI economies—the middle-income trap—is now widely recognized, if poorly defined (see Box 2). The possibility that growth rates slow once countries reach middle income levels has been widely discussed in the recent empirical literature with the possibilities for deceleration attributed to a wide range of causes (see for example Rodrik 1999, Ros 2005). The baseline projections of this study of course incorporate deceleration in several of the region's fastest-growing economies as their productivity gaps relative to the global frontier narrow. But to be useful, the concept of the middle income trap has to mean more than that. As argued in Chapter 1, a useful version of the concept refers to impediment to changes in the drivers of growth, which imply that growth has to slow until those impediments are rectified (which may take a long time).

The detailed risks that lead to a middle income trap will vary across countries. In some countries the trigger for deceleration might be the end of resource transfers from agriculture to industry, coupled with the absence of capacity to generate within-sector productivity growth in industry. In other countries the problem may be the lack of domestic or regional demand, once the economy can no longer rely on low-wage exports to drive demand. In still others, it may mean that human capital, or legal and economic institutions to permit industrial development, are insufficient to enable an economy's growth strategy to shift to more sophisticated industry. Later chapters examine these risks in more detail; this discussion focuses on their overall implications.

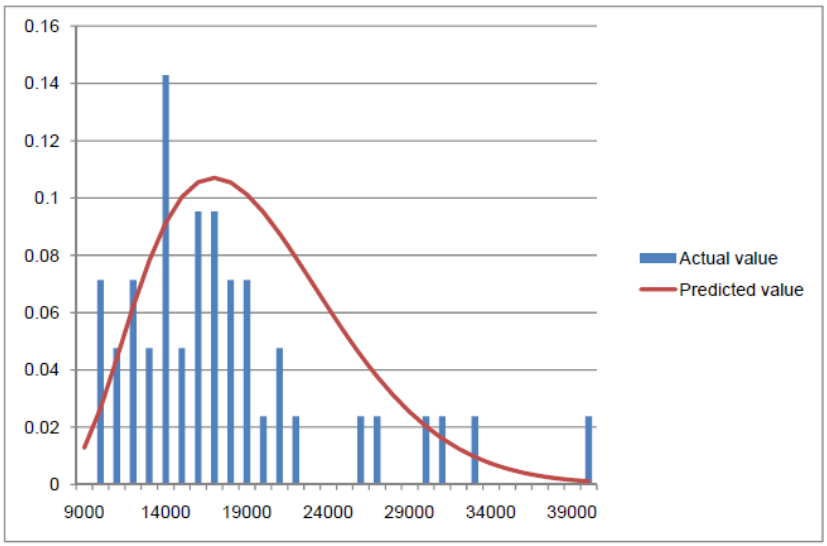
Scenarios 2–4 examine the middle income trap effect by varying two key drivers of growth: productivity and investment. These factors are often affected in parallel; a productivity shock, for example, may both cause and be aggravated by lower returns on investment and diminished entrepreneurial activity. The simulations assume that productivity growth declines by 25% and investment by 10% in the economies assumed to enter the middle income trap. Three versions of this deceleration are examined: deceleration in ACI economies (Scenario 2), deceleration in advanced economies (Scenario 3), and deceleration worldwide (Scenario 4). Since such shocks also spill over into the global economy—though the channels of global investment returns and investor confidence—the scenarios further assume a 2% reduction in investment rates even economies not directly affected by the assumed shock. Results are reported in Table 6.

Box 2: Understanding and Avoiding the Middle Income Trap

Policy makers in many rapidly developing countries are concerned that their economies might fall into what Gill and Kharas (2007) and others have described as the "middle income trap." Although the term is now widely used, it is not well defined, and appears to be more an empirical possibility rather than a theoretical necessity. The anecdotal examples of the middle income trap that are often mentioned include Latin American economies such as Argentina and Brazil, and Middle Eastern economies such as Egypt and Iran. Yet many East Asian economies, including notably Japan, the Republic of Korea, and Singapore, have moved beyond middle income levels without significant deceleration.

The middle income trap is sometimes described as the inability to from middle income to high income levels. But this definition includes countries that reached middle income status slowly, as well as those that are continuing to advance, albeit slowly. A more useful definition will isolate cases that have more distinctive trajectories and more in common with the prospects of Asia's rapidly developing economies. One such definition involves substantial *deceleration* from fast growth once middle income levels are reached. In the most extensive empirical study so far, Eichengreen et al. (2011) found that the probability of growth deceleration (of at least 2%age points from an sustained prior per capita income growth rate of at least 3.5%) rises at a per capita income levels of around $10,000 and peaks at around $17,000 (see Figure B1-1). Since several ACI economies will be in this range in the next two decades, it is useful to ask what causes such deceleration and how they might prevent it.

Figure B1.1: Probability of Growth Deceleration by Income Level



Source: Eichengreen et al. (2011).

Even if the empirical regularities of deceleration are well established, a theoretical structure is needed to make the concept of the middle income trap useful for policy planning. The term evokes earlier theoretical models of the "low income trap" identified in the development literature (Nelson 1956, Leibenstein 1954). Those models were based on a clear theoretical insight: at low income levels countries have to use their income to meet survival requirements and cannot accumulate capital to raise productivity. Hence countries with very low incomes are stuck at those levels until foreign aid, a harsh government investment or birth control program, or a fortuitous technological breakthrough creates surplus to permit capital accumulation to begin.

There appears to be no such common, model-based insight associated with the middle income trap in the literature. Rather, discussions attribute slowdowns to multiple causes, typically including a wide range of factors. As an economy's development moves past the middle-income level, the factors driving growth have to change. If a country has the newly required factors in place, it continues to grow rapidly, but if it does not, growth decelerates.

But there is an important common thread that emerges from this perspective—one that could lead to a more rigorous, operational definition of the middle income trap. The factors and institutions required for growth have to be updated from time to time, and since it may take a long time to develop the required factors, the process of updating them has to be launched with a lead time, much as a manual automobile may need to shift gears before attempting to climb a hill. Yet policy or market failures may prevent action in advance. By the time a country experiences deceleration it is too late to fill the gaps without losing momentum and possibly decades of progress. A smooth transition requires that countries anticipate shifts in growth models and take early steps—that is, correct policy and market failures—to enable growth to continue beyond middle income levels in the future. In this view, long institutional lead times are the crucial problem that policy makers have to address to avoid future deceleration.

The transition from low-income to post-middle-income growth has been identified in various ways. Some writers identify this point in terms of wages: once wages are high enough to make labor-intensive production no longer competitive internationally, continued rapid growth

requires the production of capital- or technology-intensive products. Others describe it as the end of "easy" productivity gains achieved by transferring labor from agriculture to industry, reached at the so-called "Lewis turning point," when the supply of agricultural surplus labor is exhausted. At that point, productivity gains have to be generated from productivity improvements within sectors rather than inter-sectoral resource transfers.

The pre-requisites of post-middle-income growth have been also described in multiple ways. High on the list are factors that support total factor productivity growth, including human capital, and institutions such as efficient financial markets, and robust systems of entrepreneurship and innovation. Also important may be income distribution and demand policies that generate domestic demand once foreign demand for labor-intensive exports dries up. Still other writers focus on deeper institutions (property rights, financial markets, competition) that provide incentives and opportunities for transferring resources from low- to high-productivity activities. Urbanization may be important too; it facilitates productivity growth through information exchange, economies of scale, and the easy movement of resources among activities.

As an example, Kharas (2009) has compiled a "short list" of policies that he believes will help to avoid the middle income trap in the PRC (see Table B1-1). These include supporting the continued transfer of resources from agriculture to industry by eliminating impediments to migration, and stimulating productivity growth in industry by investing in human capital and innovation.

Table B1-1: Policies for Avoiding the Middle Income Trap in the PRC

1. Gradually appreciate the exchange rate to raise real wages.
2. Pursue fiscal reform to shift profits to the household sector.
3. Increase agricultural productivity to permit greater flow of migrants to urban areas.
4. Eliminate the *hukou* system as a disincentive for migration.
5. Provide high quality junior high school education in rural areas to support migration.
6. Strengthen city governance to improve urban social and environmental conditions.
7. Expand access to finance for small and medium enterprises.
8. Remove political obstacles to internal market integration.
9. Reduce logistical barriers to internal market integration.
10. Accelerate innovation by firms and creation of high skilled jobs.

Source: Kharas (2009).

Table 6: Productivity Simulations

	Baseline GDP		Effects of productivity deceleration (%) Scenario 2	Scenario 3	Scenario 4
	2010	2030	In ACI countries	In advanced countries	Worldwide
Real GDP ($bill.)					
ASEAN	1,566	4,634	-17.8	-1.7	-18.4
PRC	5,711	22,083	-20.4	-2.8	-20.6
India	1,504	6,570	-20.9	-1.5	-21.3
ACI	8,781	33,287	-20.2	-2.3	-20.4
World	59,327	120,065	-6.0	-5.6	-14.0
Income/capita ($)					
ASEAN	2,639	6,564	-22.4	-2.6	-23.3
PRC	4,233	15,748	-26.2	-3.0	-25.9
India	1,229	4,312	-22.4	-1.4	-22.3
ACI	2,773	9,165	-24.8	-2.6	-24.7
World	8,933	15,135	-7.0	-6.4	-16.4
Extremely poor (mill.)					
ASEAN	109	22	70.9	4.8	74.9
PRC	126	1	158.3	8.6	154.8
India	400	22	163.2	3.9	162.2
ACI	635	45	117.9	4.5	119.3
World	1,134	341	12.5	1.9	34.4
Middle income (mill.)					
ASEAN	145	413	-13.4	-1.1	-14.0
PRC	212	1,104	-8.5	-0.5	-8.4
India	64	941	-19.8	-0.6	-19.8
ACI	421	2,458	-13.9	-0.7	-13.9
World	2,129	4,909	-7.5	0.1	-9.6
Affluent (mill.)					
ASEAN	0.2	7	-9.5	-1.0	-9.9
PRC	0.1	42	-24.2	-3.2	-23.9
India	0.0	3	-72.2	-4.4	-72.1
ACI	0.3	52	-29.7	-3.0	-29.5
World	168	417	-7.1	-9.0	-19.3
Total trade ($bill.)					
ASEAN	2,377	10,141	-15.9	-1.8	-16.4
PRC	2,833	15,377	-15.0	-4.6	-17.7
India	724	3,713	-17.8	-2.3	-20.0
ACI	5,934	29,231	-15.7	-3.3	-17.6
World	35,628	105,320	-5.1	-5.7	-13.7
Commodity prices (2010=100)					
Grains	100	121	-3.7	-1.9	-7.0
Coal	100	150	-2.5	-1.5	-4.7
Oil	100	177	-6.3	-3.1	-13.0
Gas	100	167	-2.2	-3.5	-11.0
Energy	100	175	-5.7	-3.1	-12.4
CO2 emissions (2010=100)					
ASEAN	100	214	-11.4	1.0	-7.4
PRC	100	192	-10.1	-0.1	-8.4
India	100	234	-13.7	1.0	-11.3
ACI	100	201	-10.9	0.2	-8.8
World	100	161	-3.9	-1.1	-6.3

Source: Authors' calculations.

These messages emerge from the simulations:

- A deceleration of ACI economies would have the largest adverse effects; per capita incomes would fall by 25% in 2030, representing a 1.5 percentage point reduction in the growth between 2010 and 2030. The scale of this effect warrants serious attention to factors that could lead to a middle-income trap, including insufficient institutional progress, technological upgrading and innovation, and threats to regional and global integration.
- A deceleration affecting advanced economies would have milder effects on ACI growth.[2] Although the world incomes would be 6% smaller in 2030 under these assumptions, ACI economies would experience per capita income losses of under 3%. In effect, the simulation projects that ACI economies could replace lost markets in advanced countries by depending more fully on their own and other emerging markets.
- A worldwide deceleration would result in a 14% reduction in world incomes, but the effects for ACI economies would be similar to those of its own middle-income trap. In this case, the losses that might be expected due to the deceleration in external markets would be offset by the one positive side-effect of a global slowdown: declining costs of imported energy and other raw materials.
- All three scenarios would have significant effects on the size of population consumption groups. For example, productivity deceleration in the ACI economies or worldwide would reduce the size of the ACI middle class by 14% and more than double the number of people in extreme poverty (albeit from a small base in 2030).
- While deceleration would be costly, it is unlikely to change general qualitative trends. Even if the shocks originated in the ACI economies, by 2030 ACI per capita incomes would rise considerably, increasing by a factor of 2.6, rather than 3.3 in the baseline. While the incidence of poverty would rise relative to the baseline, it would remain far below levels in 2010. The international trade of the ACI economies would be still 4.2 times as large as in 2010, compared to 4.9 times under the baseline.
- Nor would deceleration significantly reduce the challenges of rising energy demands and carbon emissions. These side-effects of growth would of course diminish with lower output, but would still threaten sustained growth. Pressures on grain and energy prices would ease, but still follow an upward trend. Deceleration would only postpone—perhaps by no more than a few years—issues that will have to be addressed sooner or later with targeted policy responses.

The middle-income-trap scenario (ACI productivity growth deceleration) poses the most severe threat to ACI development among those examined in this study. All three types of deceleration would impose new hardships on the poor and significantly impact all income classes in the region. Moreover, growth would not slow enough to solve environmental sustainability issues, nor ease significantly the scale of the transformation required in ACI economies.

[2] In these simulations, the deceleration takes hold slowly, by reducing investment and annual productivity gains. Thus countries have time to shift their trade to more robust markets. The results of such a slow transition are quite different from those under a sudden, large unexpected shock, as experienced during the global financial crisis.

5.2 Structural shocks and policy alternatives

The ACI economies also face specific structural challenges. These risks, explored in Scenarios 5–8, include adverse developments in global food markets, new energy price shocks, and increasingly severe environmental stress of social inequality which require significant new policy actions.

The baseline projections already incorporate economic adjustments and policy changes on these fronts. For example, the projections envision rising food and energy prices that result in conservation. They incorporate "new policies" (as defined in International Energy Agency [2011] studies of climate change mitigation) to generate cleaner energy and reduce carbon emissions. And they build in rising government expenditures on social programs, as reflected in recent data. But these baseline changes may still understate the adjustments that would become necessary given earlier or larger technological, production or social challenges than are now expected. Such developments, or policy responses to them, could adversely affect the structure and pace of the region's economic growth.

The first major risk involves adverse developments in agricultural markets. Continuing pressures on food production could lead to much less favorable agricultural prospects than represented in the baseline scenario. The pressures include meat-rich diets that require additional agricultural inputs, declining supplies of arable land that result from the growth of non-agricultural activities, and perhaps adverse effects from climate change. Scenario 5 simulates these risks by assuming deceleration in agricultural productivity growth large enough to increase agricultural prices by an extra 2% per year over the baseline. Over the 20-year horizon of our analysis, this would mean that agricultural prices would rise by 93% instead of 30% in the baseline solution. Experts disagree on how agricultural prices are likely to evolve; some supporting an upward drift of prices (McKinsey Global Institute 2011), but others are more optimistic that long-term trends in productivity increases will resume and offset demand pressures (Anderson and Strutt 2011).

The effects of an upward agricultural price shock are shown in Table 7. Since ACI are net importers of agricultural products and downstream products in the food manufacturing sectors, the rise in agricultural prices would lead to a deterioration in their terms of trade and a 6% decline in real incomes. The effects on income would be modest because, as noted above, by 2030 agriculture is projected to account for only 6% of output in ASEAN and the PRC and 17% in India. As the most food-import-dependent economy among the three, the PRC would experience the largest losses. The losses would shift income distributions downward, increasing the number of people in low-income groups, including those in extreme poverty.

Table 7: Structural Policy Simulations

	Baseline GDP		Effects of structural policies (%)			
			Scenario 5	Scenario 6	Scenario 7	Scenario 8
	2010	2030	Agriculture shock	Energy shock	Green economy	Social inclusion
Real GDP ($bill.)						
ASEAN	1,566	4,634	-1.5	-2.1	-1.7	-3.2
PRC	5,711	22,083	-2.8	-2.3	-2.1	-3.8
India	1,504	6,570	-3.7	-3.1	-2.0	-3.0
ACI	8,781	33,287	-2.8	-2.4	-2.0	-3.5
World	59,327	120,065	-1.4	-2.1	-1.5	-1.0
Income/capita ($)						
ASEAN	2,639	6,564	-3.0	-4.1	-2.5	-5.3
PRC	4,233	15,748	-7.0	-3.4	-2.8	-6.1
India	1,229	4,312	-5.9	-4.5	-2.3	-4.4
ACI	2,773	9,165	-6.1	-3.8	-2.7	-5.6
World	8,933	15,135	-2.5	-2.8	-2.2	-1.5
Extremely poor (mill.)						
ASEAN	109	22	7.5	10.6	6.1	-71.0
PRC	126	1	27.5	13.4	11.3	-92.5
India	400	22	25.8	19.3	10.5	-76.1
ACI	635	45	16.9	14.8	8.4	-74.2
World	1,134	341	5.1	4.9	5.8	-6.2
Middle income (mill.)						
ASEAN	145	413	-1.7	-2.3	-1.3	10.6
PRC	212	1,104	-1.8	-0.9	-0.7	8.5
India	64	941	-4.0	-3.1	-1.7	8.6
ACI	421	2,458	-2.7	-2.0	-1.2	8.9
World	2,129	4,909	-1.8	-1.4	-1.2	4.6
Affluent (mill.)						
ASEAN	0.2	7	-1.6	-2.1	-1.3	-23.6
PRC	0.1	42	-7.8	-4.5	-3.9	-21.7
India	0.0	3	-24.1	-19.0	-11.1	-81.9
ACI	0.3	52	-9.4	-6.5	-4.7	-32.5
World	168	417	-3.2	-4.1	-3.0	-7.0
Commodity prices (2010=100)						
Grains	100	121	21.1	1.4	-0.9	-0.7
Coal	100	150	-1.1	46.2	-11.5	-0.4
Oil	100	177	-1.7	48.1	-8.6	-1.1
Gas	100	167	-1.4	46.3	-21.7	-0.4
Energy	100	175	-1.6	47.8	-10.2	-1.0
Grain demand (2010=100)						
ASEAN	100	149	-9.8	-1.0	-0.5	-1.6
PRC	100	209	-13.0	-1.7	-1.4	-3.1
India	100	261	-14.9	-2.3	-1.0	-2.0
ACI	100	216	-13.4	-1.9	-1.1	-2.4
World	100	176	-9.9	-1.5	-1.1	-1.3
Energy demand (2010=100)						
ASEAN	100	173	-0.3	-35.1	-3.4	-1.4
PRC	100	178	-2.4	-27.5	-22.0	-1.9
India	100	221	-2.0	-33.8	-8.1	-2.1
ACI	100	185	-1.8	-30.7	-14.5	-1.9
World	100	135	-0.3	-29.6	-8.1	-0.2
CO2 emissions (2010=100)						
ASEAN	100	214	-0.7	-30.3	-16.7	-2.1
PRC	100	192	-2.6	-25.2	-40.0	-2.1
India	100	234	-1.7	-33.7	-44.0	-2.4
ACI	100	201	-2.2	-27.3	-38.0	-2.2
World	100	161	-1.0	-25.4	-26.1	-0.8

Source: Authors' calculations.

A second important risk involves energy. The baseline suggests that energy prices will rise in the future, reversing historical downward trends. These increases will lead to energy conservation and greater energy efficiency, that is, declining energy use per dollar of output. Even so, energy demand is projected to increase by 85% in ACI and by 35% worldwide between 2010 and 2030. Ultimately, these large increases and resulting growth in import dependence set the stage for serious risks to energy security. If conservation and supply turn out less favorably than expected—or if access to supplies becomes difficult—sharp rises could occur.

Scenario 6 represents a shock in the world energy sector by assuming a decline in productivity in energy production that is large enough to raise prices by an extra 2% per year above the baseline projection. The effects are again moderate, increasing energy prices by an additional 15% over the baseline and reducing world output by 0.3%. ACI economies would be clearly—both not severely—affected, since they have relatively high energy/GDP ratios and are still in the energy-intensive stage of their industrialization process. Income losses in 2030 would range from 2% for ASEAN to 3% for India (Table 7).

A third source of risk is the environment. By 2030 ACI economies will account for 43% of global carbon emissions under baseline assumptions, which include the International Energy Agency's (IEA 2011) "new policies" for mitigating emissions. These policies will substantially reduce the carbon intensity of GDP. But they fall short of limiting absolute emissions to the extent required by the climate-stabilizing "450 scenario." Should internal and external political pressure require ACI to limit emissions to the levels required by this scenario, ACI will need to adopt more intensive policy changes and investments.

Scenario 7 simulates "green" policies based on IEA analysis. It sets carbon taxes to $90 per ton of CO_2 in advanced economies and $60 per ton of CO_2 in emerging economies. It also assumes substantial investments in energy conservation and alternative energy supplies. By diverting investment from the non-energy sectors of the economy, the scenario forecasts reductions in real incomes as conventionally measured. The results show that real incomes in ACI economies would fall by 3%. The losses are lower than the cost of the mitigation strategies, because the investments would be offset by energy savings and some decline in energy prices. The scenario shows that global energy demand would decline by 8% and lower the cost of various fuels (prior to carbon taxes) by 9 to 22%, helping to offset the cost of green policies.

Green policies would reduce CO_2 emissions relative to the baseline by 38% in the ACI economies and by 26% for the world as a whole and, if the underlying IEA analysis is correct, they would help to stabilize the climate. These reductions in CO_2 emissions would be considerably greater than those observed in the energy shock scenario or the growth deceleration scenarios—the mitigation of climate change would be achieved at a lower cost with green growth. Put another way, any level of climate benefits can be achieved far more efficiently by policies that broadly target, and selectively reduce, emissions rather than policies that attempt to bring emissions under control indirectly, through piecemeal initiatives or slow growth. Similar messages have also emerged from previous simulations of Asian climate change policies (Van der Mensbrugghe 2010).

The fourth structural risk considered involves income inequalities. Since market-based growth does not automatically produce equitable incomes, strategies to pursue inclusive growth—examined in Chapter 3—also involve initiatives such as targeted health and education services, and robust safety nets. The strategy also prioritizes investments in transport and communications to help link disadvantaged areas to centers of economic growth, Given the

spread of modern communications technologies, citizens increasingly expect—and often effectively demand—governments to deliver these services.

As noted below, most ACI governments are steadily strengthening programs to help close income gaps and planning is underway on a wide range of strategies that could generate further progress. Since the baseline solution projects rapid growth in government expenditures, it implicitly supports an expansion in the implementation of inclusive growth initiatives. Nevertheless, given adverse market developments and/or mounting political pressures, or if the strategies prove to be less effective than expected, governments may need to undertake more intensive efforts. These initiatives may also include targeted transfers to the poor.

Scenario 8 quantifies an intensive "inclusive growth" strategy by increasing government expenditures by 2% of GDP for related investments and services in each ACI economy. Since government expenditures account for 12% of GDP for ACI countries as a group, this increment represents a substantial addition to the resources that the public sector can direct toward social expenditures. (These expenditures are assumed to be financed half by taxes and half by borrowing.) Aside from simulated economic effects, we assume that these efforts could reduce a country's projected Gini coefficient by 5 percentage points, or approximately by one half of a standard deviation of the distribution of Gini coefficients in World Bank statistics.

Since social policies are assumed to be financed in part by borrowing—which imply reductions in investments in conventional production—their effects include a decline of 6% in ACI real incomes in ACI by 2030. Despite these lower average consumption levels, successful policies to combat inequality are likely to produce gains for many people. For example, the simulations suggest that the number of those living in extreme poverty will decline by 74%—a result that essentially means the eradication of extreme poverty. The numbers of those in the middle class would increase by 9%. The negative effects would be felt only in the upper tail of the income distribution: The number of affluent consumers would decrease by 33%.[3] These are large changes in inequality at relatively low overall costs. Nevertheless, the output effects are significant—for example, they are greater than those calculated for an energy shock. Yet they are much lower than losses associated with the middle-income trap—so if social cohesion can help countries avoid the middle-income trap, say by allowing governments to undertake greater market liberalization, their cost would be amply repaid.

5.3 International linkages and cooperation

ACI's future growth depends on deeper international trade and investment linkages. These linkages are crucial to shifting demand from advanced economies to domestic and regional sources; for sustaining the region's central role in global manufacturing; and for meeting ACI's rising external energy, food, and resource requirements. These linkages, in turn, will require vigorous intra-regional trade; strong ties with the emerging markets elsewhere, and sustained trade, financial, and technology flows with advanced economies. From a policy perspective, these intense trade relationships could lead either to greater cooperation or new tensions. The risks would be exacerbated if growth in advanced economies remains sluggish, and especially if global trade rules fail to be strengthened. These risks are assessed in Scenarios 9–12 (Table 8).

[3] The largest negative effects are projected for India, where a significant part of the high income population is projected to be close to the cutoff limit of the middle consumption group, and therefore moderate changes in incomes have a large effect on shifting individuals from one group into the other.

Table 8: Trade and Capital Flow Simulations

	Baseline GDP		Effects of international policies (%)			
			Scenario 9	Scenario 10	Scenario 11	Scenario 12
	2010	2030	Rising protection	Regional agreement	Global agreement	Fast rebalancing
Real GDP ($bill.)						
ASEAN	1,566	4,634	-0.4	14.4	22.1	6.8
PRC	5,711	22,083	-0.7	1.8	8.4	5.3
India	1,504	6,570	-0.1	6.1	17.9	-3.4
ACI	8,781	33,287	-0.5	4.7	12.7	3.5
World	59,327	120,065	-1.8	1.0	7.7	0.1
Income/capita ($)						
ASEAN	2,639	6,564	-1.1	15.3	22.2	8.7
PRC	4,233	15,748	-1.0	1.3	7.6	7.2
India	1,229	4,312	0.0	2.2	9.3	-3.6
ACI	2,773	9,165	-0.8	3.6	10.2	4.9
World	8,933	15,135	-1.5	0.8	6.5	0.5
Extremely poor (mill.)						
ASEAN	109	22	2.7	-30.0	-39.6	-19.9
PRC	126	1	3.8	-4.5	-23.1	-23.4
India	400	22	0.1	-8.8	-31.9	17.9
ACI	635	45	1.5	-19.0	-35.3	-2.0
World	1,134	341	0.9	-1.6	-16.0	4.0
Middle income (mill.)						
ASEAN	145	413	-0.6	7.5	10.2	4.8
PRC	212	1,104	-0.2	0.2	1.2	1.2
India	64	941	0.0	1.5	5.8	-2.9
ACI	421	2,458	-0.2	2.0	4.6	0.2
World	2,129	4,909	0.0	1.0	3.9	-0.5
Affluent (mill.)						
ASEAN	0.2	7	-0.6	9.0	13.5	5.3
PRC	0.1	42	-1.9	2.8	16.7	16.9
India	0.0	3	-0.1	11.2	53.6	-17.8
ACI	0.3	52	-1.3	5.5	-7.9	8.6
World	168	417	-2.4	1.0	0.4	1.0
Total trade ($bill.)						
ASEAN	2,377	10,141	-1.6	19.5	21.5	5.8
PRC	2,833	15,377	-5.4	10.9	36.7	3.9
India	724	3,713	-1.7	24.3	66.2	-2.7
ACI	5,934	29,231	-3.6	15.6	35.1	3.7
World	35,628	105,320	-6.0	3.6	19.4	0.9
Terms of trade (2010=100)						
ASEAN	100	122	-0.3	5.2	7.2	-0.4
PRC	100	95	-0.8	0.6	2.5	-0.5
India	100	88	-0.2	-0.5	0.9	0.1
ACI	100	103	-0.5	1.9	3.8	-0.3
			-	-	-	-
World	100	100				
Commodity prices (2010=100)						
Grains	100	121	-0.9	0.7	0.8	0.6
Coal	100	150	-1.3	0.7	1.0	0.6
Oil	100	177	-2.0	1.3	4.7	0.7
Gas	100	167	-1.8	0.8	4.3	0.1
Energy	100	175	-2.0	1.2	4.5	0.7

Source: Authors' calculations.

Scenario 9 considers the possibility of increased protectionism in advanced economies. Such policies would represents a costly, self-defeating response to challenges faced by the world economy, but unfortunately cannot be ruled out as political reactions to increase economic stress. They would reduce world trade by 6% and world real GDP by 2%, with the costs disproportionately falling on those protectionist economies themselves. Such policies would also generate losses for the ACI economies and especially the PRC, given its strong linkages with advanced economies. The PRC's trade would fall by 6%. Estimated global losses would be around $2 trillion, with more than 90% falling on non-ACI economies. The stakes are high for the world as whole; it would be hard to find significant groups of consumers or workers anywhere who would benefit from such adverse developments in the global trading system.

At the other extreme, steps that reduce barriers and strengthen trade rules would benefit ACI economies as well as other regions. Scenario 10 examines free trade among ACI economies, and Scenario 11 hypothesizes substantial liberalization of world trade. In reviewing these results, it is necessary to recognize that a global model produces only rough estimates of the effects of trade liberalization. Its parameters are not sufficiently detailed on trade barriers and the possibilities for reducing them. Yet such models provide useful estimates of overall effects, and in this case the scenarios point to the possibility of large benefits.

A regional agreement that connects ACI economies would generate especially large income gains for ASEAN and India, estimated at 15% and 2%, respectively. The trade effects would be particularly large (suggesting a 24 increase) for India, which is now less closely connected with the ACI region's trading system. The results confirm a central theme of international economics, that broad global liberalization is more beneficial than an effective regional agreement, even one covering a large, dynamic economic zone. A global trade agreement would raise world incomes by 7% and ACI incomes by11%. World trade would increase by 19%, with India increasing its total trade by 66%. The results confirm a central theme of international economics, that broad global liberalization is more beneficial than an effective regional agreement, even one covering a large, dynamic economic zone.

Much attention has focused in recent years on the linkages of ACI economies to the global economy through gross and net capital flows. The current account surpluses of ACI countries and corresponding deficits in the United States, although they have diminished sharply since the onset of the global financial crisis, have come under particular scrutiny. As many observers have noted, it is difficult to justify a large "uphill" flow of capital from rapidly growing, capital-poor economies to slowly-growing, capital-abundant ones. This report and other recent policy studies have emphasized the benefits of "rebalancing" economies in ways that put capital to greater use within emerging economies themselves, either to stimulate investment or raise living standards directly. The baseline itself assumes that rebalancing efforts will be successful enough to keep imbalances stable in nominal terms at 2010 levels, thus declining steadily and substantially relative to GDP and other economic magnitudes.

To simulate the implications of rapid rebalancing, Scenario 12 imposes a faster adjustment path on capital accounts that would eliminate all imbalances by 2020. This rebalancing program would have a modest positive effect on ACI economies, yielding a 4% increase in GDP for the region. The scenario generates increases for ASEAN and PRC, which have positive capital flows along the baseline and so would have more resource available domestically under a faster rebalancing scenario. It generates decreases for India, which has negative capital flows along the baseline and would therefore have to reduce expenditures under stricter current account balances. The results for economies that are initially in surplus are positive: Applying more resources domestically—as opposed to low-interest foreign investments—would increase welfare directly through consumption and indirectly through investment and growth. The opposite is true for economies that are initially in deficit: Reduced domestic expenditures would

lead to lower consumption and/or lower growth. At the micro-economic level, production in surplus economies would shift from manufacturing to services, and vice versa in deficit economies. Despite the considerable policy attention focused on rebalancing, the results show modest effects on the size and structure of ACI economies in the long run.

The international simulations suggest more opportunities than threats. A turn toward protectionism in advanced economies, to be sure, would reduce world output and negatively affect ACI growth prospects, but the effects would be felt primarily in the protectionist economies themselves. On the other hand, new liberalization measures, within the ACI region, but especially those with global scope, could raise world incomes dramatically. And as in the past rounds of global liberalization, the effects are likely to extend beyond the direct economic gains to such indirect benefits as increased investor confidence, possibly more innovation, and an improved climate for economic and political cooperation. More refined analyses are needed to develop precise estimates, but the results confirm the continued importance of an effective global trading system and the value of global negotiations. Renewed progress on global economic integration could go a long way toward offsetting the effects of many possible negative shocks in other dimensions of the world economy.

6. COMBINATIONS OF RISKS

The results of individual scenarios confirm the concerns of analysts and policymakers that the region faces serious vulnerabilities. Yet they also show that most shocks could be managed at moderate cost if addressed with timely policy. But the implications of shocks could be more severe if they occurred suddenly and in combination—for example, if an unexpected deceleration in productivity growth followed a sudden energy shock. Such interactions among shocks are not unusual. An energy shock and a productivity shock combined to create a long-lasting global economic slowdown in the late 1970s. In the current economic cycle, financial, macroeconomic, food and energy shocks appear to be acting in combination. Thus, it is important to assess not just the possibility of specific adverse developments, but also the possibility that they might combine into “perfect storms” with severe impacts on growth.

Assessing the probability of combined shocks requires further, and necessarily speculative, analysis. Are shocks independent of each other, with each following a separate probability distribution? Or do shocks interact, so that a cluster of negative shocks, for example, is more likely than the probability that they happen together by chance? The interaction hypothesis represents the theory that “perfect storms” do not merely happen randomly—that adverse developments raise the probability of other negative events (and in contrast favorable developments tend to raise the probably of other positive ones). There are various mechanisms that could lead to such results—for example, a system under pressure may put further stress on weak components and thus fail in multiple ways. Positive results, too, can reinforce each other: a generally strong economy will generate resources and good will that can be helpful in avoiding problems.

The implications of multiple shocks are bracketed by two assumptions: full independence, which implies that shocks occur according to separate probability distributions and interact only by chance, and partial interdependence, which assumes that “like” shocks are more likely to occur jointly. Even the assumption independence, of course, will give rise to rare “perfect storms” with multiple negative or positive effects. The more worrisome assumption, however, is partial interdependence, which implies that multiple shocks in the same direction—and hence larger overall effects—have greater joint probability than mere coincidence would suggest. Although the arguments for such correlations are familiar now, they were not widely analyzed in the run-

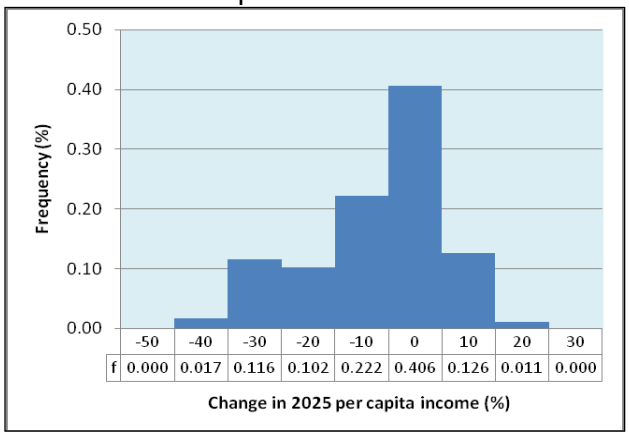
up to the global financial crisis and may have contributed to pervasive underestimation of financial risks by financial markets and governments.

Both possibilities were examined in simulations that combined the effects of the scenarios. This exercise statistically simulated 10,000 future growth paths of the global economy with the baseline subjected to various combinations of 10 of the shocks listed in Table 5 and Figure 13. A probability of 25% was assigned to any of the shocks occurring independently. A benchmark "independent" simulation was calculated by using a random draw to determine which particular shocks occurred on each of the 10,000 paths. The results for each path were also calculated by adding the effects of the active shocks to the baseline.

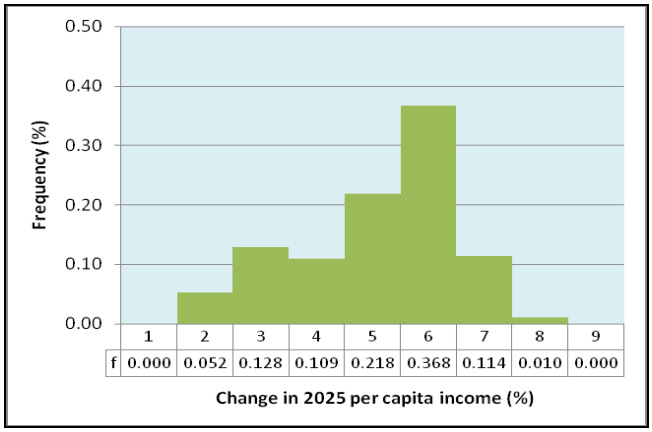
Under the benchmark simulations, the possibility that none of the 10 shocks would occur is small—around 5% (0.7510). There is an even smaller chance, approximately one in a million, that all 10 shocks would occur together (0.2510). Most results are in between, and there is a large probability (around 40%) that the sum of the shocks turns out to be small, in the range reported as "0" column in Figure 14A. These paths involve cases with either few shocks, or more likely combinations of positive and negative ones. The probability rises to around 75% for a somewhat wider range of outcomes, spanning minus 10% to 10% in income deviations from the baseline. These middle outcomes have small shocks as well as combinations with canceling positive and negative shocks.

Figure 14: Frequency of Combined Shocks

A. Independent shocks



B. Interdependent shocks



Source: Authors' calculations.

Despite the "regression toward the mean" that is characteristic of statistical phenomena, around 25% of the distribution falls into the tails, representing significant deviations from the baseline. Of this, only 1% is in the "right tail" of significant positive shocks, and 24% is in the "left tail," describing significant negative ones. Outcomes on the downside dominate those on the upside because the scenarios considered cannot offer a positive counterpart to the middle income trap. In the risky context of the current world economy, the plausible alternatives to baseline are on the negative side. The net effect is an approximately one-in-four chance that ACI income levels will fall well short of the baseline, with long-term growth rates at least one percentage point lower.

The frequency of outcomes changes if the assumption of statistical independence is replaced by partial interdependence—the expectation that similar shocks are likely to occur together. The simulations described above were repeated under the assumption that four or more shocks in the same direction were four times as likely to occur as their joint independent probabilities would suggest. The new results in Figure 14B show a wider distribution of outcomes, with

higher frequencies for both less and more favorable extremes. But while the more positive extreme rises only slightly, significant negative shocks increase to 29%. This also pushes the expected value of outcomes 2% below the baseline. Under the assumption of interdependence, unfavorable shocks that dominate alternatives to the baseline now combine with greater frequency.

These results are highly speculative—they attempt to attach probabilities to mostly unknowable future events. Nevertheless, they offer some insight into the risks the surround the baseline projections. They show, first, that in a dominant subset of cases (ranging perhaps from two-thirds to three-quarters) the results would not differ significantly from the baseline, not because all will go as projected, but because positive and negative deviations will often cancel each other. Second, the results suggest that there is a relatively small chance of substantially better outcomes, mainly because the outlook at this writing suggests more scenarios that lead to worse than projected outcomes rather than better ones. Finally, the results show a modest, but significant chance of significantly worse outcomes than the baseline indicates. Yet even these adverse outcomes provide for substantial improvements in the quality of life in the ACI region. In short, these stress tests of the projection suggest that while ACI economies face serious threats, and could fall short of projections by significant margins, they are generally large and diversified enough to withstand many of the shocks that are hypothesized, even if they occur in adverse combinations.

This is not an argument for complacency: Downside risks are significant and their effect implies substantial losses for all and great hardship for some. There are powerful reasons to prepare for and to mitigate the shocks examined in this chapter, and especially to avoid the middle income trap. Such policies are insurance against adverse outcomes, and given the frequency and cost of adverse outcomes, they offer high expected return. But an important second message is that even in unfavorable environments the ACI economies will make substantial progress. The great transformation of the ACI economies is subject to risk, but is likely to withstand much turbulence in its environment.

7. CONCLUSIONS

The baseline prospects of ACI economies are generally positive and are likely to lead to major improvements in their citizens' quality of life. Moreover, the region's growth trajectory is likely to fuel the engines that drive growth, generating new types of demand and greater competition, innovation, and regional integration. Yet given the region's scale, its projected growth will also strain resources and the environment. These opportunities and risks were examined in this chapter with several simulated alternatives.

The baseline growth path for the next two decades, based on a general equilibrium model and ADB growth projections, suggests major changes in the region's economy and in its role in the world economy. ACI incomes are likely to increase around four fold. The region is already the most populous in the world, and by many measures it will become the world's largest economy as well. In some markets—including especially investment goods—it will account for more than half of global aggregates. The region's standard of living will improve dramatically not just in terms of per capita income, but also in terms of indicators such as the declining incidence of poverty and the growth of the middle class.

As its growth continues, ACI's interdependence with the world economy will deepen and evolve in new directions. Trade will expand with the continued growth of production chains, increased imports of primary products, and shifting patterns of comparative advantage within the region and beyond. Intra-regional and South-South trade will be the most rapidly growing components

of ACI trade, but North-South trade will remain important. Accordingly, trade liberalization regionally and globally could generate major benefits to ACI and the world, raising incomes by 5–10% of GDP.

Taken together, these changes will also help to create new engines for ACI growth. The growth in global investment and consumption goods markets will be led by the ACI region, and shaped by the tastes and expectations of ACI investors and especially middle income consumers. Global financial transactions will gravitate toward ACI's large pools of savings and investment, helping to give rise to deeper regional capital markets. And high rates of investment will enable the region to create and adopt new technologies to build greener and more energy-efficient infrastructure and industry.

This generally optimistic outlook is nevertheless subject to significant risks, involving factors within the region as well as others in its international environment. There are few ways to meet all of the requirements of rapid growth, but many ways to fall short, so numerous adverse scenarios can be envisioned. Each could have a substantial impact on ACI growth, and especially the region's more vulnerable populations. The most negative among these could depress ACI growth rates by 5 percentage points (below the 6.9% on the baseline scenario). Simulations suggest that the chances for falling short of the baseline's long-term growth rate by at least 1 percentage point are in the neighborhood of 25–30%.

Significant decelerations in productivity growth—the middle income trap—pose the single most important threat to the growth of ACI economies. (This threat is substantial in all ACI economies, but takes different forms depending on their levels of development.) The costs of a prolonged slowdown warrant wide-ranging preventive investments. Other risks—higher food prices, higher energy costs, the need for substantial new expenditures to address climate change or inequality—have significant sectoral implications, but have more modest overall effects. The greatest threats involve combinations of shocks—"perfect storms" that increase strains on economic systems and raise the probability of additional shocks or policy failures.

Despite the serious risks to the baseline, the simulations generally predict more moderate deviations from the baseline. The growth of ACI incomes and their rising role in the world economy remain salient features of all scenarios. Even scenarios with economic growth rates substantially below that of the baseline yield large increases in ACI living standards and in ACI shares of most important global aggregates. The scale and speed of the great transformation are subject to risk, but their scope and directions appear robust.

As all economic results, these conclusions depend on the underlying model and the scenarios examined. The general equilibrium model used in this study, as others of its type, is built on assumptions of market interactions and represents the myriad of ways in which producers, consumers, and traders adjust production and investments to price signals. When markets work properly, these signals and market reactions enable economies to conquer adverse developments at relatively low cost. Markets can of course fail, as financial markets have done so spectacularly in recent years. But in the two-decade time horizon of this analysis, most failures are likely to be corrected—or put another way, can be counted among the many risks already captured in productivity deceleration scenarios. Serious downside risks that have *not* been considered in this study include wars, epidemics, or the collapse of governance in major countries, which lie beyond the scope of economic analysis.

The ACI economies face strong prospects and large challenges. They are embarking on a new stage of development with unprecedented momentum, but in midst of great global uncertainty. Reasonable projections indicate that their growth will continue and is, indeed, likely to be self-fueling. This growth is likely to lead to major advances in the region's standard of living and in its global role. At the same time, wide-ranging structural changes will be required, in economies

that are already large relative to the world economy. These changes imply significant, multiple risks. This chapter has identified scenarios that could produce much less progress than expected on the baseline, but has also found that the outline of the coming transformation of ACI economies is robust, despite uncertainties about its timing and speed.

REFERENCES

Anderson, K. and A. Strutt, 2011. Agriculture and Food Security in Asia by 2030. Background paper prepared for this study.

Asian Development Bank. 2011. *Asia 2050: Realizing the Asian Century.* Manila: ADB.

Deaton, A. and A. Heston, 2010. Understanding PPPs and PPP-based national accounts. *American Economic Journal: Macroeconomics* 2(4): 1–35. October.

Goldman Sachs, 2003. Dreaming with BRICs: the Path to 2050. Global Economics Paper No. 99. New York: Goldman Sachs.

International Energy Agency. 2011. *World Energy Outlook 2011.* Paris: International Energy Agency.

Kawai, M. and F. Zhai, 2010. Asia's Post-Global Financial Crisis Adjustment: A Model-Based Dynamic Scenario Analysis. *Asian Development Review* 27(2): 122–151.

Kharas, H. 2009. China's Transition to A High Income Economy: Escaping the Middle Income Trap. Processed. Washington, DC: Brookings Institution.

———2010. The Emerging Middle Class in Developing Countries. Working Paper No. 285. Paris: OECD Development Centre.

Lee, J. W., and K. Hong. 2010. Economic Growth in Asia: Determinants and Prospects. ADB Economics Working Paper Series No. 220. Manila: Asian Development Bank.

Leibenstein, H., 1954. *A Theory of Economic Demographic Development.* Princeton, NJ: Princeton University Press.

McKinsey & Co. 2011. *New Frontiers of Growth: 2011 Annual Chinese Consumer Study.* Shanghai: McKinsey & Co.

McKinsey Global Institute, 2011. *Resource Revolution: Meeting the world's energy, materials,*

Melitz, M. J. 2003. The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica* 71(6): 1695–1725.

Nelson, R. R., 1956. A Theory of the Low-Level Equilibrium Trap in Underdeveloped Economies. *The American Economic Review* 46(5): 894–908. December.

Petri, P. A. and F. Zhai, 2012. Navigating change: Prospects and Challenges of ASEAN, the PRC and India, 2010–2030. Background paper for this study.

Petri, P. A., M. G. Plummer and F. Zhai, 2012. The ASEAN Economic Community: A General Equilibrium Analysis. *Asian Economic Journal* 26(2): 93–118.

Pinkovskiy, M. and X. Sala-i-Martin. 2009. Parametric Estimation of the World Distribution of Income. NBER Working Paper No. 15433. October. Cambridge: NBER.

Rimmer, M. T. and A. A. Powell, 1996. An implicitly additive demand system. *Applied Economics* 28(12): 1613–1622.

Rodrik, D., 1999. Where Did All the Growth Go? External Shocks, Social Conflict and Growth Collapses. *Journal of Economic Growth* 4: 385–412.

Ros, J. 2005. Divergence and Growth Collapses: Theory and Empirical Evidence. In: *Beyond Reforms: Structural Dynamics and Macroeconomic Vulnerability*, edited by J.-A. Ocampo. Stanford, CA: Stanford University Press.

Roland-Holst, D., J.-P. Verbiest, and F. Zhai, 2005. Growth and Trade Horizons for Asia: Long-term Forecasts for Regional Integration. ERD Working Paper No. 74. Manila: ADB.

United Nations, Department of Economic and Social Affairs. 2012. *World Urbanization Prospects: The 2011 Revision.* New York: United Nations.

Van der Mensbrugghe, Dominique. 2010. Climate Change Policy Options for Asian Economies: Findings from an Integrated Assessment Model. *Asian Economic Policy Review* 2010: 63–83.

Yu, W., T. W. Hertel, P. V. Preckel, and J. S. Eales. 2004. Projecting world food demand using alternative demand systems. *Economic Modelling* 21(1)(January): 99–129.

Zhai, F. 2008. Armington Meets Melitz: Introducing Firm Heterogeneity in a Global CGE Model of Trade. *Journal of Economic Integration* 23(3): September.

Zhuang, J., 2011. ASEAN, PRC and India Growth Projections 2010–2030. Powerpoint presentation. Manila: ADB.

APPENDIX 1: REGIONS AND PRODUCTION SECTORS

Regions	Production sectors
1. ASEAN 2. PRC 3. India 4. Latin America 5. Other emerging economies 6. Japan 7. Rep. of Korea and Taipei,China 8. Australia and New Zealand 9. Canada 10. US 11. Europe	1. Rice 2. Other grains 3. Other crops 4. Livestock 5. Forestry and fisheries 6. Coal 7. Oil 8. Natural gas 9. Other minerals 10. Food processing 11. Textiles 12. Apparel 13. Chemicals 14. Metals 15. Machinery 16. Electrical equipment 17. Transportation equipment 18. Other manufacturing 19. Utilities 20. Gas distribution and transport 21. Construction 22. Wholesale and retail trade 23. Transport and communications 24. Finance 25. Private services 26. Government services

Source: Authors' specification.

APPENDIX 2: TECHNICAL DESCRIPTION OF THE CGE MODEL

The CGE model used in this study is a version of a global general equilibrium model developed by Van der Mensbrugghe (2009) and Zhai (2008). The model incorporates recent heterogeneous-firms trade theory into an empirical global CGE framework. It features intra-industry firm heterogeneity in productivity and fixed cost of exporting, which enables us to investigate the intra-industry reallocation of resources and the exporting decision by firms, and thereby capture both the intensive and extensive margin of trade. The model also incorporates a greenhouse gas (GHG) emissions module and mitigation policies. The model is calibrated to the GTAP (version 8 pre-release) global database with 2007 base year and implemented in GAMS programming language. It includes 11 country/region and 26 sectors.

Dynamics of the model are driven by exogenous population and labor growth, capital accumulation driven by savings and exogenous technological progress. Within each time period a full equilibrium is achieved given the fixed regional endowments, technology and consumer preferences. Production technology in each sector is modeled using nested constant elasticity of substitution (CES) functions. At the top level, the output is produced as a combination of aggregate intermediate demand and value added. At the second level, aggregate intermediate demand is split into each commodity according to Leontief technology. Value added is produced by a capital-land bundle and aggregate labor. Finally, at the bottom level, aggregate labor is decomposed into unskilled and skill labor, and the capital-land bundle is decomposed into capital and land (for the agriculture sector) or natural resources (for the mining sector). At each level of production, there is a unit cost function that is dual to the CES aggregator function and demand functions for corresponding inputs. The top-level unit cost function defines the marginal cost of sectoral output.

Agriculture, mining and government services sectors are assumed to have perfect competition. In each of these sectors, there is a representative firm operated under constant returns to scale technology. Trade is modeled using Armington assumption for import demand. The manufacturing and private services sectors are characterized by monopolistic competition, and their structure of production and trade follows Melitz (2003). Each sector with monopolistic competition consists of a continuum of firms which are differentiated by the varieties they produce and their productivity. Firms face fixed production cost, resulting in increasing returns to scale. There is also a fixed cost and a variable cost associated with the exporting activities.

On the demand side, the agents are assumed to have Dixit-Stiglitz preference over the continuum of varieties. As each firm is a monopolist for the variety it produces, it sets the price of its product at a constant markup over its marginal cost. A firm enters domestic or export markets if and only if the net profit generated from its domestic sales or exports in a given country is sufficient to cover the fixed cost. This zero cutoff profit condition defines the productivity thresholds for firm's entering domestic and exports markets, and in turn determines the equilibrium distribution of non-exporting firms and exporting firms, as well as their average productivities. Usually, the combination of a fixed export cost and a variable (iceberg) export cost ensures that the exporting productivity threshold is higher than that for production for domestic market, i.e., only a small fraction of firms with high productivity engages in exports markets. These firms supply for both domestic and export markets.

Incomes generated from production accrue to a single representative household in each region. A household maximizes utility using An Implicitly Direct Additive Demand System (AIDADS) (Rimmer and Powell 1996). AIDADS is a demand system which allows the marginal budget

shares to vary as a function of total expenditure. Empirical work by Yu et al. (2004) has demonstrated the superiority of AIDADS over other demand systems in projecting food demand, especially for long-term projections involving a wide range of countries. Investment demand and government consumption are specified as a Leontief function. In each sector a composite good defined by the Dixit-Stiglitz aggregator over domestic and imported varieties is used for final and intermediate demand.

All commodity and factor markets are assumed to clear through price adjustment. There are five primary factors of production. Capital, agricultural land and two types of labor (skilled and unskilled) are fully mobile across sectors within a region. In natural resource sectors of forestry, fishing and mining, a sector-specific factor is introduced into the production function to reflect the resource constraints. For all primary factors, their stocks are fixed.

There are three macro closures in the model: the net government balance, the trade balance, and the investment and savings balance. We assume that government consumption and saving are exogenous in real terms. Any changes in the government budget are automatically compensated by changes in income tax rates on households.

The second closure concerns the current account balance. In each region, the foreign savings are set exogenously. With the price index of OECD manufacturing exports being chosen as the numéraire of the model, the equilibrium of foreign account is achieved by changing the relative price across regions, i.e., the real exchange rate.

Domestic investment is the endogenous sum of household savings, government savings and foreign savings. As government and foreign savings are exogenous, changes in investment are determined by changes in the levels of household saving. This closure rule corresponds to the “neoclassical” macroeconomic closure in the CGE literature.

Emissions of CO2 have three drivers. Most are generated through consumption of goods—either in intermediate of final demand. Some are driven by the level of factor input. And the remainder is generated by aggregate output. The model has a flexible system of mitigation policies. The simplest is a country or region specific carbon tax—that also allows for exemptions for designated sectors or households. An alternative is to provide a cap on emissions at either a country, regional or global level. The model will then produce the shadow price of carbon, i.e., the carbon tax, as a model outcome. If a global cap is imposed, a single uniform tax will be calculated. This type of regime assumes no trading. A final option is to have a regional or global cap with trading and assigned quotas. Similar to the previous regime, a uniform carbon tax will be calculated (and would be nearly identical to the no-trade carbon tax), but emissions trading would occur depending on the initial quotas and the shape of the individual marginal abatement curves for each member of the trading regime.

APPENDIX 3: CONSUMPTION DISTRIBUTION SIDE MODEL

The distribution side model permits the results of CGE simulations to be used to determine impacts on the incidence of poverty and the emergence of the middle class. The side model takes as its input the regional consumption levels generated by the CGE model. Its output consists of the allocation of the population into four consumption classes: those that consume less than $1.25 per day in 2005 dollars (extremely poor), those that consume between $1.25 and $10 per day (low); those that consume between $10 and $100 per day (middle), and those with high consumption levels (more than $100 per day). These cutoffs are those used in ADB (2011), which appears to be based on Kharas (2010). There is much variation in the literature with respect to such groupings; some studies calculate divisions based on absolute measures while others rely on relative measures, and there are differences in the cutoff values used to define different groups. The $10–$100 is justified by Kharas (2010) and has the advantage of representing absolute consumption levels that appear to be relevant across a wide range of economies.

The distribution side model was built from the World Bank's *World Development Indicators* data on consumption shares, the source also used by most other studies. These data have been translated into 20 percentile groups by Pinkovskiy and Sala-i-Martin (2009) for some 133 countries. These authors also report that the log-normal functional form appears to perform better than alternatives. Therefore, population distributions by consumption level were modeled with a log-normal function fitted to the World Bank data. The log-normal function has the cumulative density function:

$$P(c) = \Phi\left(\frac{\ln c - \mu}{\sigma}\right)$$

where c is per-capita consumption, μ is the mean of the log-normal distribution, σ is its standard deviation, and Φ is the cumulative distribution function of the standard normal distribution. Maximum likelihood estimates of the crucial standard deviation parameter σ can be easily computed from distribution data:

$$\sigma^2 = \frac{\Sigma_k(\ln[c - \mu)]^2}{n}$$

where n is the number of income groups in the region (20 for a single economy). Estimates of σ for regions that include more than one country include both intra- and inter-country variations, and hence tend to be larger than for single countries, especially smaller ones. Due to the apparent increase in inequality in many countries in recent observations, future values of σ were increased by 0.5% per year (approximately 5% per decade).

An interesting feature of the log-normal distribution is that the Gini coefficient associated with a distribution depends solely on the parameter σ:

$$G = 2\Phi\left(\frac{\sigma}{\sqrt{2}}\right) - 1$$

Estimated σ, μ, and Gini coefficients are reported in Table A3.1.

While the log-normal function performs well in the middle of an income or consumption distribution, it systematically underestimates the probabilities of being of extremely poor or extremely prosperous. We therefore made corrections to both the left- and right-hand tails of the distribution. We corrected the left-hand tail (the incidence of very low consumption) by calibrating the model to actual poverty statistics from World Bank data. Specifically, we

assumed that extremely poor individuals have access to *k* times the income predicted by the log-normal distribution, perhaps due to transfers and non-reported income. The factor *k* was found as the income level that would generate the observed poverty rate under the log-normal function. Its estimated value hovers around 2 for emerging economies and is also reported in Table A3.1. The factor (and hence correction) was assumed to diminish at higher consumption levels to 1 at the low end of the middle consumption class. We corrected the right-hand tail (incidence of very high consumption) by assuming that once the distribution reaches consumption levels at the 95th percentile, the probability density function declines at half its normal rate until the resulting probability density is equal to 5 times the density predicted by the log-normal model (this occurs roughly at the 99.5th percentile).

The results of the model for the baseline are reported in absolute numbers and population shares in Tables A3.2 and A3.3.

Table A3.1. Consumption Distribution Parameters

	σ	*μ*	Gini	*k*
ASEAN	0.74	-0.28	0.40	2.51
PRC	0.76	-0.29	0.41	1.49
India	0.52	-0.13	0.29	2.74
Latin America	1.23	-0.75	0.61	1.27
Other emerging	1.04	-0.54	0.54	2.55
Japan	0.73	-0.27	0.39	1.00
Korea; Taipei,China	0.73	-0.27	0.39	1.00
Australia, New Zealand	0.73	-0.26	0.39	1.00
Canada	0.68	-0.23	0.37	1.00
United States	0.82	-0.34	0.44	1.00
Europe	0.73	-0.27	0.39	1.00

Korea = The Republic of Korea.

Source: Authors' calculations.

Table A3.2: Population Numbers by Consumption Level

	Consumption/Capita (PPP $2005)		2010 population by consumption/day (mill.)					2030 population by consumption/day (mill.)				
	2010	2030	Total	<$1.25	$1.25-$10	$10-$100	>$100	Total	<$1.25	$1.25-$10	$10-$100	>$100
ASEAN	3,196	8,179	593	93	328	172	0	706	16	213	454	22
PRC	2,474	13,197	1,349	124	974	251	0	1,402	1	220	1,110	71
India	1,805	7,148	1,225	400	759	65	0	1,523	16	435	1,053	20
Latin America	8,011	15,359	534	34	227	251	22	636	25	214	336	60
Other emerging	4,014	8,243	1,860	465	772	585	38	2,509	319	882	1,207	101
Japan	18,052	22,952	127	0	4	111	12	120	0	4	97	20
Korea; Taipei,China, Australia, New Zealand	20,666	44,957	71	0	2	61	9	73	0	0	41	32
	21,510	33,305	27	0	1	22	4	33	0	0	23	10
Canada	23,923	32,864	34	0	0	28	6	40	0	0	28	12
United States	28,553	35,246	310	0	6	230	74	362	0	7	242	113
Europe	15,108	20,900	511	0	29	453	30	528	0	20	435	72
World (sum)	6,161	12,337	6,641	1,116	3,102	2,229	194	7,933	378	1,996	5,026	533
Memorandum: ACI	2,351	9,684	3,167	617	2,061	488	1	3,632	34	868	2,618	113

Korea = The Republic of Korea.

Source: Authors' calculations.

Table A3.3: Population Shares by Consumption Level

	Consumption/Capita (PPP $2005)		2010 population share by consumption/day					2030 population share by consumption/day				
	2010	2030	Total	<$1.25	$1.25-$10	$10-$100	>$100	Total	<$1.25	$1.25-$10	$10-$100	>$100
ASEAN	3,196	8,179	1.00	0.16	0.55	0.29	0.00	1.00	0.02	0.30	0.64	0.03
PRC	2,474	13,197	1.00	0.09	0.72	0.19	0.00	1.00	0.00	0.16	0.79	0.05
India	1,805	7,148	1.00	0.33	0.62	0.05	0.00	1.00	0.01	0.29	0.69	0.01
Latin America	8,011	15,359	1.00	0.06	0.43	0.47	0.04	1.00	0.04	0.34	0.53	0.09
Other emerging	4,014	8,243	1.00	0.25	0.42	0.31	0.02	1.00	0.13	0.35	0.48	0.04
Japan	18,052	22,952	1.00	0.00	0.03	0.87	0.09	1.00	0.00	0.03	0.81	0.16
Korea; Taipei,China	20,666	44,957	1.00	0.00	0.02	0.85	0.13	1.00	0.00	0.00	0.55	0.44
Australia, New Zealand	21,510	33,305	1.00	0.00	0.02	0.84	0.14	1.00	0.00	0.01	0.69	0.30
Canada	23,923	32,864	1.00	0.00	0.01	0.82	0.17	1.00	0.00	0.00	0.69	0.30
United States	28,553	35,246	1.00	0.00	0.02	0.74	0.24	1.00	0.00	0.02	0.67	0.31
Europe	15,108	20,900	1.00	0.00	0.06	0.89	0.06	1.00	0.00	0.04	0.82	0.14
World (sum)	6,161	12,337	1.00	0.17	0.47	0.34	0.03	1.00	0.05	0.25	0.63	0.07
Memorandum: ACI	2,351	9,684	1.00	0.19	0.65	0.15	0.00	1.00	0.01	0.24	0.72	0.03

Source: Authors' calculations.