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Closing Development Gaps: Challenges and Policy Options

Douglas H. Brooks, Rana Hasan, Jong-Wha Lee, Hyun H. Son, and Juzhong Zhuang

Human Capital Development

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Asia's Post-Global Financial Crisis Adjustment: A Model-Based Dynamic Scenario Analysis

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Closing Development Gaps: Challenges and Policy Options

DOUGLAS H. BROOKS, RANA HASAN, JONG-WHA LEE, HYUN H. SON,
AND JUZHONG ZHUANG

There are significant income and nonincome development gaps around the world. Closing these gaps will require not only increasing and sustaining economic growth in low-income regions, but also policies that close nonincome development gaps directly. Governments need to support private investment and entrepreneurship by investing in human capital and infrastructure; developing the financial sector; improving governance; and eliminating other impediments created by market, institutional, or policy failures. Policy makers should improve access to and quality of health, education, and other social services. This means better targeting and increased public spending on social services that directly benefit the poor; innovative delivery mechanisms informed by rigorous evaluation; and social protection systems. The experience of developing Asia and others has shown that external trade and finance—including foreign direct investment, remittances, and aid—play a critical role. It is therefore imperative that governments continue to promote globalization and regional integration.

JEL classification: D60, F10, F21, F35, O10, O15, O16, O20, O24

I. INTRODUCTION

Even though many low-income economies have expanded strongly in recent years, catching up significantly to more developed regions, global development gaps remain large. In 2007, for instance, sub-Saharan Africa's average per capita income (in 2005 purchasing power parity [PPP] terms) was only 5%, life expectancy at birth 63%, and adult literacy 70% that of members of the Organisation for Economic Co-operation and Development (OECD). Income poverty, whether measured by the \$1.25-a-day or \$2-a-day poverty lines, also varies considerably across regions.

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In developing Asia, a major engine of global economic growth in recent years, closing these development gaps remains a major challenge. Some 40% of South Asians, for example, still live in extreme poverty, while developing Asia's progress on the nonincome targets of the Millennium Development Goals (MDGs) has been slow. The recent global economic crisis has made progress even harder.

This paper aims to highlight important dimensions of these development gaps and to examine the policy options for closing them. It argues that sustaining rapid economic growth is necessary, but not enough. Closing the gaps requires policies that not only increase and sustain economic growth, but also reduce the nonincome development gaps directly through investment in education and health, and provision of social protection. In this regard, the challenge is to provide sufficient finance as well as better governance in the delivery of public services. These goals are in keeping with the Asian Development Bank's (ADB) Strategy 2020, which among other things, reaffirms ADB's support for reducing poverty and helping countries improve living standards, including through inclusive growth.¹

This paper focuses largely on the requirements for inclusive growth (Zhuang 2010). In Section II, we first discuss development gaps in various regions, focusing on per capita income, life expectancy at birth, adult literacy, net primary school enrollment, under-5 survival, and proportion of births attended by skilled personnel,² using the OECD as a benchmark. In particular, we look at the number of years required to close these gaps based on the historical relationship between economic growth and development outcomes. Section III then looks at the key policy elements of a strategy for sustained growth to close these gaps, including human capital, infrastructure, financial sector development, and governance and institutions. Section IV discusses the nonincome development gaps and how these can be closed. Section V looks at the role of social protection in closing income and nonincome development gaps. Section VI examines the role of external trade and finance—including foreign direct investment (FDI), remittances, and foreign aid—in supporting economic growth. Finally, Section VII highlights possible elements of the development agenda for the global community.

¹ADB's Strategy 2020 explains inclusive growth as having two mutually reinforcing strategic focuses: (i) high, sustainable growth that will create and expand economic opportunities; and (ii) broader access to these opportunities that will ensure members of society can participate in and benefit from growth. Proper attention and planning are necessary for growth to reach the impoverished who have remained excluded by circumstance, poor governance, and other market-resistant obstacles (ADB 2008).

²These indicators capture key dimensions of income and nonincome development gaps.

II. KEY DIMENSIONS OF DEVELOPMENT GAPS

While the growth of gross domestic product (GDP) is a popular measure of economic growth, it is not a sufficient yardstick for development. Development is about many different things, including command over resources, choice of livelihood, human capabilities, living in a healthy and safe environment, adequate housing and food, political freedom, and many others. In other words, economic growth is important to, but not the only driver of, development. Sen (1985, 28) points out, “Ultimately, the focus has to be on what we can or cannot do, can or cannot be.” Thus, development must be defined by an individual’s achievements and by the means that the individual possesses.

While there are many ways to measure development gaps and achievements, this section focuses on eight indicators; namely, \$1.25-a-day poverty, \$2-a-day poverty, per capita GDP at 2005 PPP, life expectancy at birth, net primary enrollment, adult literacy, under-5 survival, and births attended by skilled health personnel. From these indicators, one can gauge people’s command over resources, nutritional levels, use of health and education services, access to clean water and sanitation, and others.³

As shown in Table 1, there is considerable disparity in the level of development across regions, and the disparity in per capita income is far greater than in other indicators. Sub-Saharan Africa is the poorest region, with more than half of its population living in extreme poverty, and with a per capita GDP at only 19.8% of the world average in 2007. Its life expectancy at birth, the world’s lowest, is 74.5% of the world average and 65.1% that of OECD countries.

In 2007, about half of developing Asia’s population lived below the \$2-a-day poverty line. Developing Asia’s per capita income was only 10% that of OECD countries, and life expectancy was 10 years shorter. Some 41.4 more children below 5 years old per 1,000 population die in developing Asia than in OECD countries every year. Within developing Asia, there is also significant disparity in both income and nonincome development indicators. About 74% of South Asians lived below \$2 a day in 2007, compared to about 40% in East Asia and the Pacific and in Central Asia. South Asia’s per capita income was less than 7% of the OECD average. Among nonincome indicators, South Asia’s life expectancy at birth was 63.8 years, compared to East Asia and the Pacific’s 71.3 years; its proportion of births attended by skilled health personnel was 39.9%, compared to Central Asia’s 95.4%; and its adult literacy was 61.1%, compared to Central Asia’s 98.5%.

³The selected eight indicators are closely related to the MDGs. More specifically, these indicators are reflected in MDGs 1, 2, 4, 5, and 6 (see UNDP 2000).

Table 1. Key Development Indicators, 2007

| Region/Subregion | Headcount Index (%) | | GDP per Capita at 2005 PPP (US\$) | Life Expectancy at Birth (year) | Adult Literacy (%) | Net Primary Enrollment (%) | Under-5 Survival (per 1000) | Births Attended by Skilled Personnel (%) |
|------------------------------------|------------------------|---------------------|-----------------------------------|---------------------------------|--------------------|----------------------------|-----------------------------|------------------------------------------|
| | (\$1.25-a-day poverty) | (\$2-a-day poverty) | | | | | | |
| Developing Asia | 27.0 | 53.9 | 3,060.9 | 68.1 | 79.1 | 89.2 | 948.4 | 69.2 |
| Eastern Europe | 0.7 | 3.0 | 9,932.2 | 68.8 | 99.2 | 92.5 | 983.1 | 99.4 |
| Latin America and Caribbean | 8.2 | 17.1 | 7,719.3 | 72.1 | 90.1 | 94.2 | 973.7 | 89.2 |
| Middle East and North Africa | 3.6 | 16.9 | 8,255.6 | 70.5 | 73.6 | 89.7 | 962.6 | 79.7 |
| Sub-Saharan Africa | 50.9 | 72.9 | 1,698.1 | 50.8 | 61.2 | 67.1 | 851.9 | 46.5 |
| OECD | — | — | 29,607.6 | 78.0 | 93.2 | 96.6 | 989.8 | 97.2 |
| World | 25.2 | 47.0 | 8,588.8 | 68.2 | 78.8 | 86.8 | 948.5 | 74.1 |
| Within Developing Asia | | | | | | | | |
| East Asia and Pacific ^a | 16.8 | 38.7 | 3,857.7 | 71.3 | 91.7 | 94.0 | 968.9 | 90.0 |
| South Asia | 40.3 | 73.9 | 1,959.9 | 63.8 | 61.1 | 82.6 | 920.3 | 39.9 |
| Central Asia | 19.2 | 40.2 | 3,551.5 | 67.1 | 98.5 | 90.4 | 954.1 | 95.4 |

— means not available.

^a Includes East Asia (but excluding Japan and Republic of Korea), Southeast Asia, and the Pacific.

OECD = Organisation for Economic Co-operation and Development; PPP = purchasing power parity.

Note: Poverty rates (in 2005 PPP) are for 2005 and are based on PovcalNet Database (World Bank 2010b).

Sources: Authors' calculations based on World Development Indicators Online Database (World Bank 2010c), PovcalNet Database (World Bank 2010b).

Another way to understand the magnitude of development gaps is to calculate the number of years required for the regions to catch up with OECD countries on selected development indicators. To do this, we first calculate the elasticity of the selected development indicators to economic growth for each country.⁴ Based on this elasticity and historical economic growth performance, we can estimate a country's progress. Table 2 presents estimates of growth elasticity of well-being using data for 177 countries. We find that a 1% growth in the global economy increases the world's life expectancy at birth by 0.04%, that is, the average person will live 11 days longer. On the other hand, a 1% growth will increase average lifespan by 21 days in sub-Saharan Africa where, given its current low life expectancy, even a small increase will improve life expectancy more substantially. Likewise, a 1% growth in South Asia will increase the average lifespan in the region by 14 days. Table 2 shows that higher incomes in developing countries will help relax resource constraints that may be impeding the effective delivery of health services, especially among the poor. Moreover, the impact of economic growth on well-being is greater in poorer than in richer countries, indicating the possibility for closing the gaps.

Table 2. Average Growth Elasticity of Well-being, 2007

| Region/Subregion | Life Expectancy at Birth | Adult Literacy | Net Primary Enrollment | Under-5 Survival Rate | Births Attended by Skilled Personnel |
|------------------------------------|--------------------------|----------------|------------------------|-----------------------|--------------------------------------|
| Developing Asia | 0.04 | 0.10 | 0.03 | 0.02 | 0.21 |
| Eastern Europe | 0.04 | 0.02 | 0.02 | 0.01 | 0.02 |
| Latin America and Caribbean | 0.03 | 0.04 | 0.02 | 0.01 | 0.06 |
| Middle East and North Africa | 0.04 | 0.13 | 0.03 | 0.01 | 0.12 |
| Sub-Saharan Africa | 0.11 | 0.23 | 0.13 | 0.06 | 0.53 |
| OECD | 0.02 | 0.03 | 0.01 | 0.00 | 0.01 |
| World | 0.04 | 0.10 | 0.04 | 0.02 | 0.16 |
| Within Developing Asia | | | | | |
| East Asia and Pacific ^a | 0.03 | 0.03 | 0.02 | 0.01 | 0.05 |
| South Asia | 0.06 | 0.23 | 0.06 | 0.03 | 0.70 |
| Central Asia | 0.05 | 0.02 | 0.03 | 0.02 | 0.02 |

^a Includes East Asia (but excluding Japan and Republic of Korea), Southeast Asia, and the Pacific.

OECD = Organisation for Economic Co-operation and Development.

Source: Authors' calculations.

⁴The elasticity is calculated by regressing the achievement function of a country with a given indicator of well-being (for instance, life expectancy at birth) on the logarithm of countries' per capita GDP. This model, proposed by Kakwani (1993), takes into account countries' initial levels of well-being, which implies that the elasticity decreases as a country achieves higher well-being. The use of the achievement function as a dependent variable captures the important nonlinearity characteristics of indicators of well-being.

Using these elasticities and future growth paths—based on historical performance for 2000–2007—we can estimate a country’s progress in these indicators. Assuming these average growth rates can be sustained, we can estimate the years it will take to catch up with current OECD income and living standards.⁵ Table 3, columns 3–8, present these estimates.

Table 3. **Convergence toward Levels of Well-being in OECD Countries**

| Region/Subregion | Average Annual Growth Rate (2000–2007, %) | Number of Years for Convergence | | | | | |
|------------------------------------|-------------------------------------------|---------------------------------|--------------------------|----------------|------------------------|-----------------------|--------------------------------------|
| | | GDP per Capita at 2005 PPP | Life Expectancy at Birth | Adult Literacy | Net Primary Enrollment | Under-5 Survival Rate | Births Attended by Skilled Personnel |
| Developing Asia | 6.82 | 34.5 | 31.7 | 20.0 | 27.2 | 29.5 | 33.0 |
| Eastern Europe | 6.11 | 18.4 | 33.5 | 0.0 | 20.7 | 10.2 | 5.5 |
| Latin America and Caribbean | 2.24 | 60.7 | 66.0 | 20.1 | 38.1 | 52.3 | 56.4 |
| Middle East and North Africa | 2.91 | 44.5 | 60.8 | 55.9 | 60.8 | 55.2 | 63.7 |
| Sub-Saharan Africa | 3.09 | 93.9 | 128.4 | 67.6 | 117.3 | 107.1 | 89.4 |
| OECD | 1.50 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| World | 5.01 | 25.3 | 42.7 | 27.2 | 43.2 | 40.0 | 41.6 |
| Within Developing Asia | | | | | | | |
| East Asia and Pacific ^a | 7.82 | 27.1 | 20.8 | 3.1 | 11.6 | 17.6 | 15.2 |
| South Asia | 5.43 | 51.3 | 50.3 | 38.5 | 48.0 | 46.8 | 52.9 |
| Central Asia | 8.13 | 27.1 | 28.3 | 0.0 | 20.4 | 22.9 | 5.7 |

^a Includes East Asia (but excluding Japan and Republic of Korea), Southeast Asia, and the Pacific.

OECD = Organisation for Economic Co-operation and Development; PPP = purchasing power parity.

Source: Authors’ calculations.

As seen in Table 3, column 3, it will take the world 25.3 years to catch up with the current OECD per capita income (in 2007); sub-Saharan Africa, 93.9 years; and developing Asia, 34.5 years.⁶ Applying the growth elasticities of nonincome well-being to the above economic growth estimates, results suggest that it will take decades for developing Asia to catch up with the OECD’s development indicators achieved in 2007. It will take developing Asia 20 years to catch up with the current OECD level in terms of adult literacy, 27 years in terms of primary enrollment, 30 years in terms of under-5 survival, 32 years in terms of life expectancy, and 33 years in terms of births attended by skilled personnel. The data also show that it may not be possible to achieve universal primary education by 2015 (that is, Goal 2 of the MDGs); even in East Asia and the Pacific it will

⁵Note that these calculations take into account the fact that the elasticity of well-being indicators decreases as countries achieve higher well-being over time, which means that the countries cannot go on increasing their well-being at the same rate.

⁶The results are based on the assumption that countries in the different regions will have constant economic growth rates over time based on their trend growth rate for 2000–2007. The number of years is calculated for converging to the “current” level (i.e., 2007 in this case) of OECD economies.

take 11.6 years to achieve this goal, while it will take South Asia almost half a century. Within developing Asia, South Asia has the largest development gaps in all the dimensions.

Note that these calculations assume that while per capita GDP grows over time, other factors that may influence standards of living—such as technology or public policy—remain constant. As such, our calculations estimate how long it will take for trickle-down economics to improve living standards. We have shown that income and standards of living are strongly associated, particularly in low-income countries. Thus, promoting rapid economic growth will help close the development gaps.

However, although economic growth alone can improve standards of living, the results also suggest that it will take an exceptionally long time for some countries to close the development gaps if growth rates remain at 2000–2007 levels. Therefore, governments in developing countries will need to implement policies that promote growth and broaden access to the opportunities that growth creates.

III. ECONOMIC GROWTH AS A MEANS TO CLOSING DEVELOPMENT GAPS

While economic growth is not an end in itself, it enables the achievement of basic development goals. It expands economic opportunity for individuals and societies; frees people from hunger, poverty, and misery; and creates the resources required for health care, education, and social protection. In other words, though not a sufficient condition for broad-based development, it is a necessary condition (Commission on Growth and Development 2008). Indeed, many empirical studies find that economic growth is the most effective way toward sustained poverty reduction (Ravallion 2001).

But experience varies significantly. Some countries have sustained growth for considerable periods of time, some have experienced growth spurts but failed to sustain them, and others have been trapped in low-growth trajectories. While our understanding of the determinants of these cross-country differences is far from complete, there are a number of important policy ingredients of a strategy for sustained growth. This section focuses on the role of human capital, infrastructure, financial sector development, and governance and institutions in fostering economic growth and closing development gaps. An examination of cross-country data suggests that there are huge differences in all these dimensions around the world.

A. Human Capital

It is widely accepted that directly improving well-being, health, and education has intrinsic value. But it also has instrumental value. Barro and Lee (2010b) show that the rate of return from an additional year of schooling, for example, ranges from 5% to 12%. Using data on cognitive skills provided by schooling, Hanushek and Woessmann (2008) argue that there is a robust association between cognitive skills and economic growth, and that this is driven by a causal impact from cognitive skills. Similarly, Jamison, Jamison, and Hanushek (2006), using a 62-country dataset at 10-year intervals from 1960 to 2000, show that the quantity of schooling has a strong positive effect on growth once one incorporates information on the quality of schooling. Their estimates show that a 1 standard deviation increase in test scores can increase annual growth in per capita income by 0.5–0.9 percentage point.

Education improves labor productivity, facilitates technological innovation, increases returns to capital, and helps improve health outcomes. Furthermore, studies show that access to basic education enables farmers to switch from traditional to more productive modern techniques, and from farming to nonfarming activities (Foster and Rosenzweig 1996).

Similarly, good health can improve growth by boosting human capital accumulation—healthy individuals have a greater capacity to learn skills and to exploit them economically, and are more productive because they are able to work longer hours. Indeed, empirical studies find that better health leads to higher economic growth. Weil (2006) estimates that eliminating health gaps between countries would reduce the variance of log GDP per worker by 9.9% and would reduce the ratio of GDP per worker at the 90th percentile to that of the 10th percentile from 20.5 to 17.9. Moreover, Bloom and Canning (2005) find that when the adult survival rate increases by 1 percentage point, labor productivity increases by about 2.8%.

B. Infrastructure

No country has sustained economic growth without also keeping up an impressive rate of investment in infrastructure. Roads, water supply, sewerage systems, power grids, and telecommunications are vital inputs to the production of goods and services; and facilitate trade and factor mobility, reduce business costs, allow the exploitation of economies of scale, and improve efficiency and productivity.

There is strong empirical evidence that infrastructure development contributes significantly to economic growth. Using data covering over 100 countries during 1960–2000, Calderon and Servén (2004) find that an increase of 1 standard deviation in the index of infrastructure stocks would raise per capita

income growth by 2.9 percentage points. A similar increase in the infrastructure quality index would raise growth by 0.68 percentage point.

But the data on infrastructure investment are rather patchy. Available data suggest that in fast-growing Asian countries such as the People's Republic of China (PRC), Thailand, and Viet Nam, total infrastructure investment exceeds 7% of GDP. But many developing countries invest only 2% of GDP (Commission on Growth and Development 2008). The Global Competitiveness Report (World Economic Forum 2008) also shows the considerable disparity in infrastructure across regions in 2008–2009: the overall infrastructure score was highest for the OECD countries at 5.32 out of a maximum score of 7, and lowest in sub-Saharan Africa at 3.24 (Table 4).

Table 4. **Infrastructure Indicators**

| Region/ Subregion | Overall Infra- structure Score, ^a 2008/09 | Roads | | | Electricity | | Telecom- munication |
|---------------------------------------|------------------------------------------------------------------|---------------------------------------------|----------------------------------------------|--------------------------------|---------------------------------------------------------|----------------------------------------------------|----------------------------------------------------|
| | | Road Density, Latest (km/sq km) | Quality of Roads, ^a 2008/09 | Paved Roads, 2006 (%) | Electricity Consumption, 2006 (kWh/ capita) | Quality of Electricity, ^a 2008/09 | Phone Lines, 2007/08 (per 100 population) |
| Developing Asia | 3.90 | 0.369 | 3.99 | 54.91 | 1,976 | 4.02 | 66.42 |
| Eastern Europe | 3.40 | 0.772 | 3.25 | 81.70 | 3,459 | 4.56 | 130.42 |
| Former Soviet Union ^b | 3.87 | 0.070 | 3.25 | 76.09 | 3,047 | 4.29 | 87.80 |
| Latin America and Caribbean | 3.75 | 0.158 | 3.59 | 37.45 | 1,630 | 4.34 | 91.56 |
| Middle East | 4.99 | 0.116 | 5.00 | 82.38 | 7,600 | 5.39 | 111.31 |
| North Africa | 3.84 | 0.069 | 3.72 | 44.28 | 1,235 | 5.08 | 88.60 |
| OECD | 5.32 | 0.082 | 5.05 | 77.25 | 9,469 | 6.11 | 150.54 |
| Sub-Saharan Africa | 3.24 | 0.495 | 3.17 | 20.45 | 418 | 3.23 | 38.12 |
| Within Developing Asia | | | | | | | |
| Central and West Asia ^c | 3.20 | 0.114 | 3.70 | 47.33 | 480 | 2.20 | 36.21 |
| East Asia | 4.60 | 0.321 | 4.50 | 83.00 | 2,505 | 5.18 | 106.79 |
| Pacific | 2.30 | 0.057 | 1.90 | — | — | 2.00 | 48.16 |
| South Asia | 3.00 | 1.095 | 3.00 | 48.70 | 282 | 2.73 | 49.94 |
| Southeast Asia | 4.29 | 0.274 | 4.28 | 49.05 | 2,661 | 4.58 | 76.78 |

^aRanges from 1 (extremely underdeveloped) to 7 (extensive and efficient by international standards).

^bFormer Soviet Union includes Belarus, Moldova, Russian Federation, and Ukraine.

^cCentral and West Asia includes Afghanistan, Armenia, Georgia, Kazakhstan, Kyrgyz Republic, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan.

km/sq km = kilometers per square kilometer, kWh = kilowatt-hour,

OECD = Organisation for Economic Co-operation and Development.

Note: Figures are weighted averages, except those pertaining to scores and quality, which are simple averages.

Source: World Development Indicators Online Database (World Bank 2010c), Global Competitiveness Report 2009–2010 (World Economic Forum 2008).

Road density also varies significantly, ranging from 0.772 kilometers per square kilometer in Eastern Europe, to about 0.069 in North Africa. The percentage of paved roads is also very low in some countries: only 20.45% of roads are paved in sub-Saharan Africa, compared with 82.38% in the Middle East, 81.70% in Eastern Europe, and 77.25% in OECD. Overall road quality is highest in the OECD with an average score of 5.05 (out of a highest possible score of 7), closely followed by the Middle East (5.00), and lowest in sub-Saharan Africa (3.17).

In electricity supplies and services, per capita electricity consumption ranged from 9,469 kilowatt-hours in the OECD to just 418 kilowatt-hours in sub-Saharan Africa. For developing Asia and North Africa, per capita electricity consumption is only 20.9% and 13%, respectively, that of the OECD. Overall quality of electricity services also varies: it is highest in the OECD at 6.11, 4.02 in developing Asia, and just 3.23 in sub-Saharan Africa. In telecommunications, the number of telephone lines per 100 people was highest in OECD countries (150.54) and lowest in sub-Saharan Africa (38.12).

Within developing Asia, the gaps in infrastructure stock and quality are also significant. East Asia has the highest overall infrastructure score at 4.60 (next only to the OECD and Middle East), followed by Southeast Asia at 4.29, Central and West Asia at 3.20, South Asia at 3.00, and the Pacific at only 2.30 (lower than sub-Saharan Africa). East Asia performs best in most categories of infrastructure, except for road density and electricity consumption. Southeast Asia ranks second in all subcategories of infrastructure, except for road density, where it ranks third, and electricity consumption, where it ranks first. South Asia ranks first in road density, third in telecommunication, quality of electricity and paved roads, but fourth in electricity consumption and quality of roads. The Pacific has the lowest score in all indicators, except telecommunications.

C. Financial Sector Development

A well-developed financial sector supports economic growth by mobilizing and pooling savings; effectively transmitting information to enhance resource allocation; exerting influence to improve corporate governance; facilitating trading, diversification, and management of risks; and promoting exchange of goods and services. There is also a consensus that financial sector development contributes to poverty reduction directly by broadening the access of poor and vulnerable groups to credit, and indirectly through economic growth (see Zhuang et al. 2009 for a review of literature). However, rapid financial market deregulation and liberalization, which are often essential elements for financial sector development and innovation, may expose economies to external shocks and crises, which can hurt growth. It is therefore essential to maintain sound macroeconomic management, and put in place an effective regulatory and

supervisory framework while carrying out structural reforms in developing the financial sector.

A large number of empirical studies have provided evidence on the positive contribution of financial sector development to growth. King and Levine (1993a and 1993b) show that increasing financial depth (measured by the ratio of liquid liabilities to GDP) from the mean of the slowest-growing quartile of countries to the mean of the fastest-growing quartile would increase a country's per capita income growth rate by almost 1 percentage point per year. Given that the difference in average annual growth rate between these sets of countries is about 5 percentage points over 1960–1989, they argue that the difference in the depth of the financial sector alone could explain about 20% of this growth difference. A more recent study shows that such relationships hold true even after controlling for simultaneity bias (Levine, Loayza, and Beck 2000). Mavrotas and Son (2006) further find that the effect of financial sector development on economic growth in developing countries is more persistent and larger than in developed countries.

Financial sector development also contributes to poverty reduction indirectly through economic growth. Ravallion and Chen (1997) show that a 10% increase in the mean standard of living leads to an average reduction of 31% in the proportion of the population below the poverty line, indicating that economic growth leads to a reduction in poverty incidence. A number of empirical studies find a more direct relationship between financial sector development and poverty and inequality reduction. For example, Honohan (2004) shows that a 10 percentage point increase in the ratio of private credit to GDP would lead to a 2.5–3.0 percentage point reduction in poverty incidence.

Measured in terms of the ratio of money supply to GDP (Table 5), developing Asia had the greatest financial depth in 2007 at 116%, even exceeding OECD at 100%. However, this was mainly due to East Asia at 153%. Other subregions of developing Asia lag far behind: it was only 39% for Central and West Asia, 49% for the Pacific, 66.5% for South Asia, and 76.5% for Southeast Asia. An alternative measure, ratio of domestic credit to private sector to GDP, provides a similar picture. The only difference is that the ratio for OECD (157.3%) is much higher than that of developing Asia and of East Asia.

Table 5. **Financial Development Indicators**

| Region/Subregion | Money Supply, M2 (% of GDP) | Domestic Credit to Private Sector (% of GDP) |
|------------------------------------|--------------------------------|-------------------------------------------------|
| | 2007 | 2007 |
| Developing Asia | 115.9 | 87.1 |
| Eastern Europe | 48.7 | 88.4 |
| Former Soviet Union ^a | 37.8 | 40.7 |
| Latin America and Caribbean | 45.7 | 42.0 |
| Middle East | 60.0 | 59.7 |
| North Africa | 67.4 | 36.4 |
| Sub-Saharan Africa | 38.0 | 68.3 |
| OECD | 100.1 | 157.3 |
| Within Developing Asia | | |
| Central and West Asia ^b | 39.0 | 38.8 |
| East Asia | 152.8 | 112.3 |
| Pacific | 49.0 | 31.6 |
| South Asia | 66.5 | 46.4 |
| Southeast Asia | 76.5 | 40.5 |

^aFormer Soviet Union includes Belarus, Moldova, Russian Federation, and Ukraine.

^bCentral and West Asia includes Afghanistan, Armenia, Georgia, Kazakhstan, Kyrgyz Republic, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan.

Source: World Development Indicators Online Database (World Bank 2010c).

Nevertheless, for many of the region's poor, access to some form of formal financial services is still uncommon. A large part of Asia's adult population remains financially excluded. Yet, it is for these same people in which access to financial services is critical. Empirical evidence suggests that improved financial access can reduce poverty and income inequality. The availability of financing can jumpstart the process of escaping poverty, but it remains a key constraint for many developing countries.

D. Governance and Institutions

The long-run positive association between governance and institutional quality on one hand, and economic growth and income levels on the other, is strong both conceptually and empirically. The two-way causal link between the two is now well recognized. Institutions and governance are factors that drive economic growth because the enforcement of property rights and contracts allows market exchange, investment, and innovation over wider economic spheres and geographical areas through lower transaction costs (Acemoglu et al. 2001, North 1990). Conversely, economic growth can lead to better institutions because rising incomes and education levels create a demand for better governance and accountability.

Accountability, rule of law, political stability, bureaucratic capability, property rights protection and contract enforcement, and control of corruption are now regarded as crucial, mutually reinforcing aspects of growth-enhancing

institutions. A recent study of the links between institutional quality and economic growth finds that developing Asian economies with above-average scores (after controlling for per capita income) in government effectiveness, regulatory quality, and rule of law in 1998 grew faster during 1998–2008 by 1.6, 2.0, and 1.2 percentage points per year on average, respectively, compared with the economies that scored below average in these dimensions⁷ (Zhuang, de Dios, and Lagman-Martin 2010).

The World Bank's latest worldwide governance indicators show that, in 2008, OECD countries had the highest average score in all six dimensions of governance⁸ (Table 6). Developing Asia scored lower than the OECD grouping and Eastern Europe in all six dimensions, and lower than Latin America and Caribbean in all dimensions except government effectiveness and rule of law. On the other hand, developing Asia scored higher than sub-Saharan Africa in all dimensions except voice and accountability, higher than the former Soviet Union in all dimensions except political stability, and higher than the Middle East and North Africa in all dimensions except control of corruption and political stability. Across the six dimensions of governance, developing Asia scored relatively high in government effectiveness and rule of law, but relatively low in political stability and in voice and accountability.

Compared with the OECD and Eastern Europe, developing Asia still has a lot of room to catch up on all governance dimensions. In 1998–2008, however, a large number of developing Asian economies saw their governance scores improve in various dimensions, although a large number of economies also slipped. Many developing Asian economies improved their scores in the areas of rule of law and control of corruption, suggesting that significant improvements in governance do and can occur within a relatively short period of time.

⁷This analysis excludes oil- and gas-rich countries.

⁸Scores ranging from –2.5 (worst) to 2.5 (best) are based on about 30 opinion/perception-based surveys and are classified into six dimensions: (i) voice and accountability; (ii) political stability and absence of violence; (iii) government effectiveness; (iv) regulatory quality; (v) rule of law; and (vi) control of corruption (Kaufmann, Kraay, and Mastruzzi 2009).

Table 6. Worldwide Governance Indicators

| Region/ Subregion | Voice and Accountability | Political Stability | Government Effectiveness | Regulatory Quality | Rule of Law | Control of Corruption |
|---------------------------------------|-----------------------------|------------------------|-----------------------------|-----------------------|----------------|--------------------------|
| Developing Asia | -0.72 | -0.78 | -0.05 | -0.35 | -0.27 | -0.43 |
| Eastern Europe | 0.46 | 0.20 | 0.03 | 0.05 | -0.03 | -0.35 |
| Former Soviet Union ^a | -0.77 | -0.43 | -0.43 | -0.65 | -0.84 | -0.89 |
| Latin America and Caribbean | 0.17 | -0.41 | -0.15 | 0.25 | -0.51 | -0.17 |
| Middle East and North Africa | -1.21 | -0.77 | -0.39 | -0.63 | -0.31 | -0.28 |
| OECD | 0.95 | 0.49 | 1.25 | 1.10 | 1.14 | 1.21 |
| Sub-Saharan Africa | -0.63 | -1.05 | -0.75 | -0.70 | -0.83 | -0.80 |
| Within Developing Asia | | | | | | |
| Central and West Asia ^b | -1.12 | -1.93 | -0.69 | -0.74 | -0.94 | -0.87 |
| East Asia | -1.64 | -0.27 | 0.24 | -0.26 | -0.30 | -0.31 |
| Pacific | 0.11 | -0.37 | -0.75 | -0.54 | -0.74 | -0.57 |
| South Asia | 0.29 | -1.09 | -0.13 | -0.41 | 0.00 | -0.36 |
| Southeast Asia | -0.66 | -0.83 | -0.25 | -0.24 | -0.53 | -0.72 |

^aFormer Soviet Union includes Belarus, Moldova, Russian Federation, and Ukraine.

^bCentral and West Asia includes Afghanistan, Armenia, Georgia, Kazakhstan, Kyrgyz Republic, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan.

OECD = Organisation for Economic Co-operation and Development.

Source: Means of each region/subregion are computed from the Worldwide Governance Indicators (World Bank 2010d) and weighted by population based on the World Development Indicators Online Database (World Bank 2010c).

E. Strategy for Sustaining Economic Growth

The above discussions show that there are significant gaps in the availability and quality of infrastructure and human capital, in the depth of the financial sector, and in the governance and institutional quality across regions around the world. Narrowing and ultimately eliminating these gaps are necessary steps for addressing broader development gaps, and hence should be among the key policy ingredients of the development strategies of all developing countries and their development partners.

Government, public sector, and public-private partnerships will play important roles. Although growth will largely have to be driven by a dynamic private sector, there is a crucial role for the government in providing the business-friendly environment and levelling the playing field, especially in instances where the market fails to function efficiently. Government can support private investment and entrepreneurship by eliminating impediments created by market, institutional, or policy failures. This requires the government and public sector to invest in public goods and human capital, build institutional capacity, maintain macroeconomic stability, adopt market-friendly policy, protect property rights,

and maintain rule of law. In setting policy and reform priorities, the government should identify the binding constraints to growth, and target its efforts and resources at relaxing them.⁹ Partnerships with the private sector in diversifying the production structure of economies and creating productive jobs should also be part of the policy package. The government should pay attention not only to the pace, but also to the pattern of growth, and make it “broad-based” (Ianchovichina and Lundstrom 2009).

IV. CLOSING NONINCOME DEVELOPMENT GAPS

A. A Snapshot of Selected Gaps

Nonincome development gaps across and within countries are disturbingly large. Various nonincome development indicators suggest the living standard of developing Asia falls far below that of the OECD and the gaps are substantial in many subregions. In 2008, mortality rates among children under 5 years of age were over six times higher in developing Asia as compared to the OECD—46 per 1,000 children versus a little under 8, respectively (Table 7). However, sub-Saharan Africa suffered from far higher mortality rates (almost 140). Within developing Asia, the highest mortality rates were recorded in Central and West Asia (95) while the lowest were found in East Asia (21) and Southeast Asia (37). Mortality rates in South Asia and the Pacific were in between these extremes (i.e., 63–66).

These wide differences in a key health outcome reflect, among others, differences in the quality of health systems across regions and within countries. One way in which the quality of the health system may be captured is through its ability to immunize young children from deadly and infectious diseases. There are considerable regional differences in immunization rates of children between the ages of 12–23 months. For example, as Table 7 shows, 96% of young children have been vaccinated against diphtheria, pertussis, and tetanus in the OECD. The corresponding immunization rates in developing Asia were more than 10 percentage points lower on average. They were still lower for sub-Saharan Africa.

Another variable that can reflect quality differences in health systems is the number of hospital beds available, adjusted for the size of a country’s population. In 2007, the former Soviet Union provided the largest number of hospital beds, at about 95 per 10,000 people, followed by Eastern Europe (58.4), OECD (53.7), developing Asia (15.3), and sub-Saharan Africa (9.1). Within developing Asia,

⁹For example, a recent growth diagnostic study on the Philippines by ADB (2007) found that the critical bottlenecks faced by the country in moving toward high and sustained economic growth included (i) tight fiscal space due to weak revenue generation; (ii) inadequate infrastructure, particularly in electricity and transport; (iii) weak investor confidence due to governance concerns, particularly corruption and political instability; and (iv) failure to address market failures responsible for a small and narrow industrial base.

South Asia provided less than seven beds per 10,000 people—the lowest of any subregion (see Table 7)—while East Asia provided 24, fairly similar to the cases of Central and West Asia and the Pacific (21.1 and 22.7, respectively). Southeast Asia provided a significantly lower number of beds (12.8) than East Asia, though this was still well above the South Asian average.

The OECD countries had on average almost 11 years of schooling, while Eastern Europe, former Soviet Union, East Asia, and Latin America and Caribbean were not far behind. Developing Asia's average of 6.8 years of schooling is on the lower side, but well above that of sub-Saharan Africa where countries had on average only 5.2 years of schooling. Repeating a familiar pattern, the average for developing Asia masks considerable regional variation. South Asia's average years of schooling is as low as that of sub-Saharan Africa and as much as 3 years lower than that of East Asia (8.2 years).

To make matters worse, the quality of education is generally lower in lower-income countries than in higher-income countries. While comparisons of the quality of education across countries are not easy to make, especially when large numbers of countries spanning the different regions of the world are concerned, surveys of employers' assessments of the educational systems from which their employees come can provide a useful benchmark. Based on such a survey of employers, it may be seen from Table 7 that while OECD countries score on average 4.6 (out of 7) on a measure of the quality of education, many developing regions scored much lower (3.7 for developing Asia, 3.4 for sub-Saharan Africa, and 3.2 for Latin America and Caribbean).

Within developing Asia, even though South Asia had the lowest average years of schooling, the quality of its educational system was not the poorest. On average, the lowest quality scores are found in the Pacific and in Central and West Asia (2.9 and 3.1 out of 7, respectively). The highest is in Southeast Asia (4.1) with East Asia close behind (3.9).

Significantly, there can also be large nonincome development gaps *within* countries. Differences of educational attainments and access to health facilities across the poor and nonpoor are an important reason. Such differences occur everywhere, but can be exceedingly high in some countries. Gender-based disparities are a second reason. Indeed, in some developing regions, the average years of schooling in the population described in Table 7 can mask significant differences in average years of schooling across males and females. For example, while the average years of schooling for females is slightly *higher* than that for males in Central Asia, the average years of schooling for females tends to be between 1–2 years less than that for males in South Asia and sub-Saharan Africa.

Table 7. **Education and Health**

| Region/ Subregion | Health | | | Education | |
|-------------------------------------------------------|-----------------------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------|
| | Mortality Rate, under 5 (per 1,000 population) 2008 | DPT Immunization (% of children ages 12–23 months) 2008 | Hospital Beds (per 10,000 population) 2008 | Average Years of Schooling ^a 2010 | Quality of the Education System ^b 2008 |
| Developing Asia | 46.2 | 83.7 | 15.3 | 6.8 | 3.7 |
| Eastern Europe Former Soviet Union ^c | 14.0 | 90.8 | 58.4 | 10.0 | 3.8 |
| Latin America and Caribbean | 13.9 | 96.1 | 94.6 | 9.2 | 3.9 |
| Middle East | 22.8 | 90.2 | 20.7 | 8.0 | 3.2 |
| North Africa | 32.1 | 86.9 | 18.0 | 7.7 | 4.0 |
| Sub-Saharan Africa | 29.4 | 96.7 | 16.8 | 6.6 | 3.1 |
| OECD | 139.4 | 71.9 | 9.1 | 5.2 | 3.4 |
| OECD | 7.6 | 95.7 | 53.7 | 10.9 | 4.6 |
| Within Developing Asia | | | | | |
| Central and West Asia ^d | 94.6 | 80.2 | 21.1 | 6.0 | 3.1 |
| East Asia | 21.1 | 96.9 | 24.0 | 8.2 | 3.9 |
| Pacific | 62.7 | 60.2 | 22.7 | 5.7 | 2.9 |
| South Asia | 65.9 | 70.3 | 6.8 | 5.2 | 3.6 |
| Southeast Asia | 36.5 | 85.9 | 12.8 | 6.8 | 4.1 |

^aRefers to number of years per person aged 15 and above.

^bRanges from 1 (not well) to 7 (very well).

^cFormer Soviet Union includes Belarus, Moldova, Russian Federation, and Ukraine.

^dCentral and West Asia includes Afghanistan, Armenia, Georgia, Kazakhstan, Kyrgyz Republic, Pakistan, Tajikistan, Turkmenistan, and Uzbekistan.

OECD = Organisation for Economic Co-operation and Development.

Note: Figures are weighted averages, except when pertaining to quality.

Sources: Barro-Lee Educational Attainment Dataset (Barro and Lee 2010a); Global Competitiveness Report 2008–2009 (World Economic Forum 2008); World Health Statistics (WHO 2010); World Development Indicators Online Database (World Bank 2010c).

B. Investing in Health and Education

Investing in health and education are crucial for closing nonincome development gaps. Yet, simply making such investments may not be enough to ensure that the health and educational/learning outcomes of the poor actually improve.

While the specifics depend on country circumstances, some broad policy lessons may be drawn. First, the public sector's role is indispensable for financing the required investments. While public financing for health and education is often lower (as a proportion of GDP) the lower national income is, there is nevertheless room in some low-income countries for raising the resources available, especially for the poor.

For example, where public finance for education has been skewed toward supporting higher education, equity and efficiency considerations demand a

rebalancing of priorities toward expenditures on basic education. More generally, better targeting and increased spending on services that directly benefit the poor (and the disadvantaged, such as females) can be powerful tools for reducing development gaps. This is because the largest deficiencies in health and education occur at the bottom end of the income distribution. Governments will therefore produce the biggest marginal gains in national averages by better targeting and focusing expenditures on areas the poor are more likely to use (for example, primary health care facilities in rural areas rather than tertiary hospitals in cities, and primary education rather than tertiary education).

Second, while public finance need not imply public provision of services, the reality is that the public sector is dominant. And, unfortunately, evaluation seems to show more instances of ineffective public provision of health and education services. This appears to be partly the result of financial constraints—for example, the World Health Organization (WHO 2003) found health systems to be largely ineffective below a certain amount of expenditure, even after controlling for government-related effects. A failure of government accountability seems to be an important part of the story.

Significantly, both governments and their development partners would do well to consider more innovative delivery mechanisms coupled with rigorous impact evaluations as they design and implement programs for health and education services. Recent mechanisms holding considerable promise include conditional cash transfers, the use of nongovernment organizations in service contracting, and the use of vouchers and contract teachers in delivering basic education services.

Clearly, the success of a particular delivery mechanism in one country does not imply success in others. Local conditions matter a great deal. However, with an experimental mindset and a commitment to rigorous impact evaluation, there is considerable scope for improving the effectiveness of interventions required for closing development gaps.

V. THE ROLE OF SOCIAL PROTECTION IN CLOSING INCOME AND NONINCOME DEVELOPMENT GAPS

Traditionally, social protection has been synonymous with social assistance provided to vulnerable groups with no other means of support, such as victims of natural disasters or civil conflict, victims of health shocks, handicapped people, or the destitute. As such, it has essentially been viewed as a coping mechanism. This rationale remains important. For example, longitudinal studies of rural households clearly show that illness can have a dramatic impact on a household's

poverty status over long periods of time.¹⁰ But social protection entails much more than this. A growing body of evidence indicates that social protection systems serve two additional purposes: (i) they extend capabilities by allowing individuals to take advantage of economic activities, and (ii) they can help improve efficiency in the labor market. In this way, social protection has a role to play in closing income-related development gaps.

A. Seizing Economic Opportunities

By allowing individuals to better manage risks, social protection systems can enable vulnerable individuals to invest in potentially high-return activities. This is particularly important in an increasingly competitive and market-oriented environment where new but often riskier technologies and opportunities are available. Enabling vulnerable households to take advantage of these would not only improve their welfare but also stimulate economic growth through more productive use of assets and higher human capital accumulation.

Vulnerability to income shocks can lead individuals and households to underinvest in risky activities that can maximize productivity or profits. This is most clearly documented in agriculture: faced with uncertainties in weather and technology, households engaged in agriculture resort to suboptimal choices to cope with risk due to limited insurance and lack of access to credit. Some households are forced to make decisions to reduce their income risk by making production or employment decisions designed to smoothen income flows rather than maximize expected profits. On the other hand, households smoothen their consumption to deal with the effects of income shocks, resulting in a suboptimal level of lifetime consumption due to high precautionary savings.

Moreover, risk aversion and vulnerability to income shocks can curtail other kinds of investments with potentially high returns. Vulnerable households tend to highly discount the future, which is likely to negatively affect long-term investment decisions. Households can hesitate to invest in the education of their children, or may pull them out of school, because of economic shocks. This can have a detrimental impact on the economy in the long run because human capital investment decisions at the household level are suboptimal. In addition, these kinds of decisions can lead to an entrapment effect where vulnerability and poverty perpetuate further vulnerability and poverty due to lack of education.

¹⁰For example, a study of villages in rural India demonstrates that because of the illness of a key income earner of the household, which occurred for as long as 25 years ago, a household could fall into and remain in both a poverty trap (due to loss in earnings) and a debt trap (resulting from the need to cover treatment expenses, while having to meet the household's consumption needs) (Krishna 2006).

B. Labor Market Efficiency

A related benefit of well-designed social protection systems is that they can enable labor markets to match workers with jobs efficiently, particularly in the formal sector. In many countries, existing mechanisms for coping with risks are provided through firms (e.g., health insurance, disability benefits, pension programs, etc.). In other countries, such as India, regulations that provide job security have allowed the government to avoid providing workers with social protection. In these cases, it is natural to expect workers in the formal sector, as well as the government, to strongly resist layoffs, even if circumstances make them necessary. However, if workers could count on systems of social protection to provide (i) some basic protection from the loss of income and other job-related benefits (such as health insurance), (ii) efficient labor exchanges that increase the speed and quality of matching job seekers with available jobs, and (iii) subsidized retraining programs, it is likely that workers and governments would take a more nuanced view of layoffs and provide firms with greater flexibility in making hard decisions. Likewise, such social protection systems can allow job seekers to have more time in looking and waiting for appropriate work that match their skills, instead of having to accept the first job offer that comes along.

VI. THE ROLE OF EXTERNAL TRADE AND FINANCE IN CLOSING DEVELOPMENT GAPS

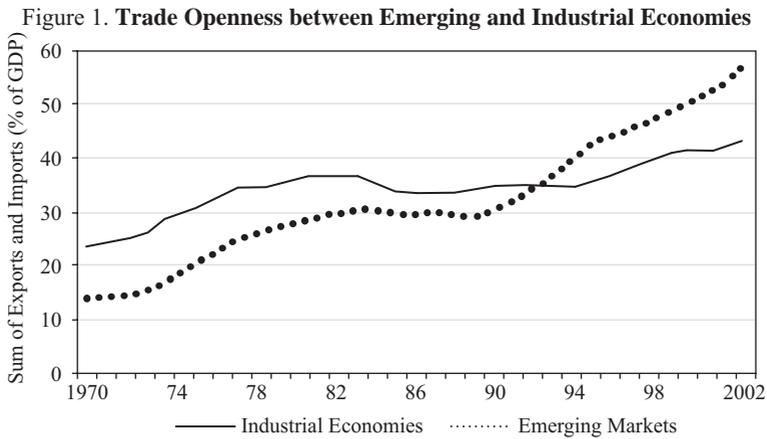
As exemplified by the experience of East Asia in the 1980s and 1990s, international trade, foreign direct investment, and remittances can help a country achieve rapid economic growth and better living standards. Foreign trade expands or complements domestic markets while foreign investment and remittances fill the savings-investment gap. Both, in turn, spur economic growth. Moreover, they bring positive externalities to the domestic economy in the form of technology transfer, economies of scale and scope, and market access that further strengthens the growth process. Market-driven flows can thereby complement and sometimes substitute for official development assistance.

A. International Trade

Trade openness has risen significantly over time in both industrial and emerging economies, but even more so in the latter. Trade openness in emerging markets has grown from 15% to nearly 60% of GDP, bypassing the share in industrial economies in 1994 (Figure 1). Developing Asia's share in world exports has been steadily increasing. Exports from developing Asia rose from 8% of the total in 1980 to over 20% in 2005, overtaking the Euro zone, Japan, and

the US. The strong increase in international trade has helped reduce the development gap between developed and developing countries.

But in closing the development gap, emerging countries face poor financial intermediation and other problems that limit their investments. In recent years, the share of investment has typically been lower than that of savings in developing economies, resulting in a surge of capital flows to rich countries. Developing more efficient methods to channel such flows to poorer countries, where capital is more scarce, and presumably its returns can be higher on average, can help address global development gaps and inequalities.



Source: Bracke et al. (2008, Chart 16), based on *World Economic Outlook* (IMF 2006).

B. Foreign Direct Investment

Foreign direct investment has become a significant source of external finance in developing countries, acting as a useful means of integrating countries into the global market, but it fluctuates both in total and across regions (Table 8 and Figure 2).

Table 8. Net Inflows of Foreign Direct Investment (percent of GDP)

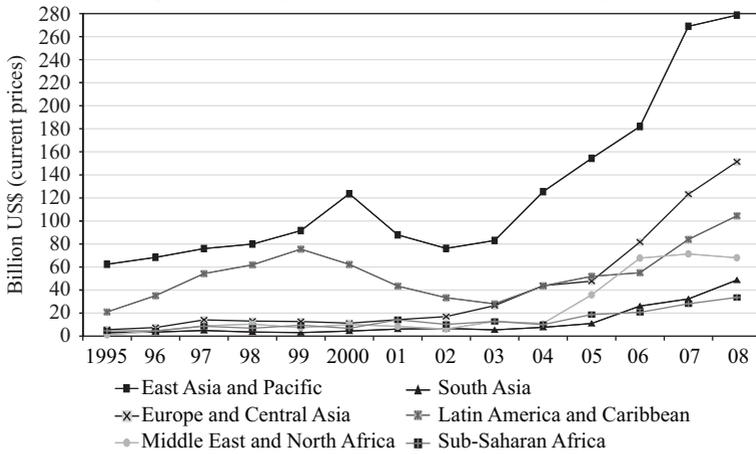
| Region/Subregion | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |
|------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| Developing Asia | 3.49 | 3.41 | 3.69 | 3.77 | 3.97 | 4.96 | 3.48 | 2.83 | 2.67 | 3.49 | 3.80 | 4.06 | 4.74 | 4.30 |
| Europe and Central Asia | 0.89 | 1.17 | 2.10 | 2.40 | 2.87 | 2.25 | 2.51 | 2.64 | 3.31 | 4.16 | 3.58 | 4.84 | 5.63 | 5.44 |
| Latin America and Caribbean | 1.44 | 2.25 | 3.25 | 3.75 | 5.56 | 4.28 | 3.21 | 3.00 | 2.35 | 3.05 | 2.87 | 2.52 | 3.20 | 3.35 |
| Middle East and North Africa | 0.17 | 0.66 | 1.29 | 1.53 | 1.01 | 1.27 | 1.08 | 0.79 | 1.47 | 1.10 | 2.99 | 4.97 | 4.47 | 4.27 |
| Sub-Saharan Africa | 1.44 | 1.32 | 2.45 | 2.09 | 2.88 | 2.00 | 4.27 | 2.83 | 2.96 | 1.89 | 2.94 | 2.80 | 3.31 | 3.47 |
| World | 1.13 | 1.26 | 1.59 | 2.37 | 3.59 | 4.83 | 2.54 | 2.27 | 1.76 | 1.82 | 2.55 | 3.11 | 4.28 | 3.07 |
| Within Developing Asia | | | | | | | | | | | | | | |
| East Asia and Pacific ^a | 4.47 | 4.28 | 4.59 | 4.80 | 5.09 | 6.27 | 4.23 | 3.35 | 3.27 | 4.29 | 4.63 | 4.59 | 5.48 | 4.54 |
| South Asia | 0.62 | 0.69 | 0.91 | 0.65 | 0.53 | 0.72 | 0.99 | 1.03 | 0.71 | 0.86 | 1.08 | 2.26 | 2.24 | 3.31 |

^a Includes East Asia (but excluding Japan and Republic of Korea), Southeast Asia, and the Pacific.

GDP = gross domestic product.

Source: World Development Indicators Online Database (World Bank 2010c).

Figure 2. Foreign Direct Investment across Regions



Source: World Development Indicators Online Database (World Bank 2010c).

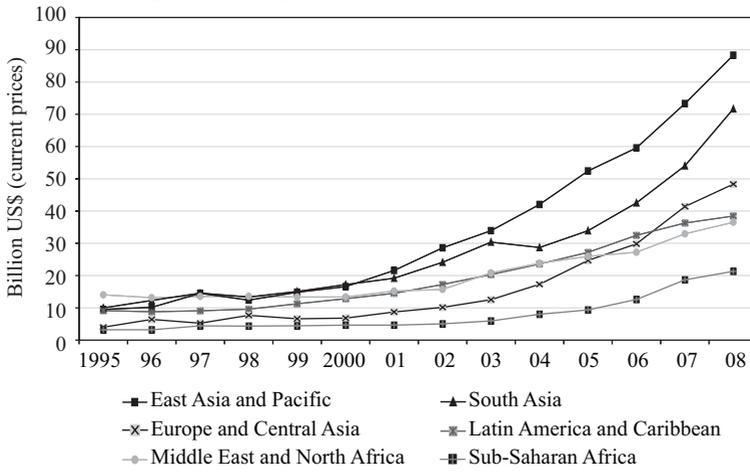
C. Remittances

International remittance flows complement FDI and other flows while displaying greater stability (Figure 3). Among developing countries, most remittances have been received by middle-income countries,¹¹ while the share of remittances into low-income countries¹² has been low due to the relatively high cost of migration. In this context, maintaining openness in the labor market may help reduce global imbalances, while supporting development.

¹¹Middle-income countries are those in which 2004 gross national income (GNI) per capita was \$826–10,065.

¹²Low-income countries are those in which 2004 GNI per capita was \$825 or less. The following countries are included: Bangladesh; Benin; Bhutan; Burkina Faso; Burundi; Cambodia; Cameroon; Central African Republic; Chad; Comoros; Democratic Republic of Congo; Republic of Congo; Cote d’Ivoire; Eritrea; Ethiopia; Gambia; Ghana; Guinea; Guinea-Bissau; Haiti; India; Kenya; Kyrgyz Republic; Lao People’s Democratic Republic; Lesotho; Liberia; Madagascar; Malawi; Mali; Mauritania; Moldova; Mongolia; Mozambique; Myanmar; Nepal; Nicaragua; Niger; Nigeria; Pakistan; Papua New Guinea; Rwanda; Sao Tome and Principe; Senegal; Sierra Leone; Solomon Islands; Somalia; Sudan; Tajikistan; Tanzania; Togo; Uganda; Uzbekistan; Viet Nam; Republic of Yemen; Zambia; and Zimbabwe.

Figure 3. Receipt of International Remittance Flows



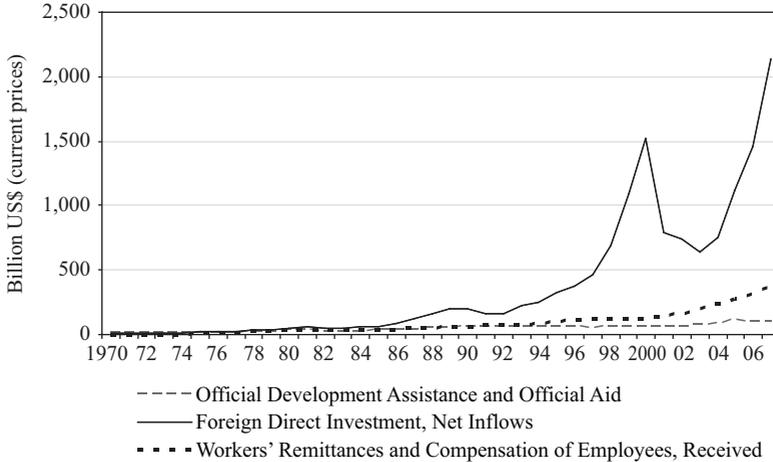
Source: World Development Indicators Online Database (World Bank 2010c).

D. Role of Development Aid

The role of official development assistance (ODA) in closing development gaps has been mixed and at times controversial.

Compared to others, aid flows are relatively small (Figure 4). They are also relatively stagnant, except for aid to African countries.

Figure 4. Total Aid, Foreign Direct Investment, and Remittance Flows



Source: World Development Indicators Online Database (World Bank 2010c).

Aid flows generally have specific purposes, but ODA played a positive countercyclical role for developing countries during previous financial crises. After the 1982 Mexican debt crisis, for instance, commercial lending was significantly reduced for about a decade, yet ODA rose slightly to maintain capital flows to Latin America. However, the global economic recession in the early 1990s produced large fiscal deficits in donor countries that led to deep cuts in ODA, which fell from 0.33% of gross national income (GNI) in 1992 to 0.22% in 1997.

More long-term and less volatile development finance is needed to reduce the development gap by investing in infrastructure and social protection. In particular, ADB is strongly supporting the development of efficient and liquid local currency and regional debt markets through the ASEAN+3¹³ Asian Bond Markets Initiative (ABMI). The ABMI is important because it will help avert a double mismatch of maturity and currency for Asian borrowers. Without ABMI, debt is commonly short-term and issued in foreign currency, and upon maturity, countries need to come up with foreign currency to repay loans. The ABMI allows countries to issue debts in their local currency, thereby reducing the need to accumulate large foreign reserves. The ABMI will also facilitate the rechanneling of Asian savings effectively and efficiently into Asian investment, providing an alternative financing vehicle for companies or large projects. The ABMI also promotes regional financial harmonization and integration across the ASEAN+3 economies.

It is also important for countries, especially poorer ones, to enhance their access to international capital by improving their macroeconomic performance, investment climate, and use of aid. This is important since the poorest countries have been hit hard by the current crisis. Their exports have dropped 5–10%; private capital flows are to decline nearly 50%; remittances are likely to fall 5–7%; and those depending on tourism for their foreign exchange and jobs will experience a drop in tourism receipts of an estimated 8% (World Bank 2010a).

VII. CONCLUDING REMARKS

There are significant income and nonincome development gaps around the world. While closing them will require raising economic growth in low-income regions and sustaining it, this paper has shown that these are not enough. Authorities must go beyond policies that simply increase economic growth, to include policies that close nonincome development gaps directly.

To promote high and sustainable economic growth, governments need to support private investment and entrepreneurship by investing in human capital

¹³ASEAN+3 includes the 10 members of the Association of Southeast Asian Nations (ASEAN), plus the PRC, Japan, and Republic of Korea.

and infrastructure; developing the financial sector; improving governance; and eliminating other impediments created by market, institutional, or policy failures.

To close the nonincome development gaps, attention should be on improving access to and quality of health and education services. This can be achieved by better targeting and increasing public spending on social services that directly benefit the poor, and considering innovative delivery mechanisms informed by rigorous evaluation of their effectiveness.

Significantly, recent policy discussions stress that social protection systems have a vital role to play in closing development gaps, in both income and nonincome dimensions. This is especially so in the context of globalization, where external shocks, competition, and restructuring can raise risks and vulnerabilities to livelihoods.

Developing Asia's experience, as in other regions, has shown that external trade and finance—including FDI, remittances, and aid—play a critical role in closing development gaps. Growth in recent years in South–South trade and FDI flows, especially those originating from developing Asia, highlight an important avenue for mutual benefit between and within developing regions. This reemphasizes the imperative of continuing efforts to promote globalization and regional integration.

As the world transits from the crisis to the postcrisis period, the global community needs to address the development issues raised above. Thus the development agenda for the global community must include the following elements.

- (i) Reducing poverty through higher and more inclusive growth.
- (ii) Substantially increasing investment in human capital and infrastructure, including science and technology investment to boost productivity and reduce negative environmental impacts.
- (iii) Diversifying the structure of economies by moving toward promoting activities where value added is greater and productivity growth faster.
- (iv) Creating an environment for growth and development by strengthening governance, economic management, and conflict resolution.
- (v) Maintaining open trade and stable long-term financial flows by strengthening regional and global cooperation.

This paper focused largely on the requirements for inclusive growth. Apart from being inclusive, however, the development agenda must ensure that growth in the postcrisis world is balanced and sustainable. While these two latter topics are not thoroughly discussed here, the publication on *Rebalancing for Sustainable Growth: Asia's Postcrisis Challenge* (ADB-ADBI forthcoming) addresses these issues comprehensively.

REFERENCES

- Acemoglu, D., S. Johnson, and J. A. Robinson. 2001. "The Colonial Origins of Comparative Development: An Empirical Investigation." *American Economic Review* 91(5):1369–401.
- ADB. 2007. *Philippines: Critical Development Constraints*. Asian Development Bank, Manila.
- . 2008. *Strategy 2020*. Asian Development Bank, Manila.
- ADB-ADBI. Forthcoming. Rebalancing for Sustainable Growth: Asia's Postcrisis Challenge.
- Barro, R., and J. W. Lee. 2010a. Barro-Lee Educational Attainment Dataset. Available: www.barrolee.com/.
- . 2010b. A New Data Set of Educational Attainment in the World, 1950–2010. NBER Working Paper No. 15902, National Bureau of Economic Research, Cambridge.
- Bloom, D. E., and D. Canning. 2005. Health and Economic Growth: Reconciling the Micro and Macro Evidence. CDDRL Working Paper No. 42, Center on Democracy, Development, and the Rule of Law, Stanford Institute on International Studies, Palo Alto.
- Bracke, T., M. Bussière, M. Fidora, and R. Straub. 2008. A Framework for Assessing Global Imbalances. Occasional Paper Series No. 78, European Central Bank, Frankfurt.
- Calderon, C. A., and L. Serven. 2004. The Effects of Infrastructure Development on Growth and Income Distribution. World Bank Policy Research Working Paper No. 3400, Washington, DC.
- Commission on Growth and Development. 2008. The Growth Report: Strategies for Sustained Growth and Inclusive Development. The World Bank on behalf of the Commission on Growth and Development, Washington, DC.
- Foster, A. D., and M. R. Rosenzweig. 1996. "Technical Change and Human-Capital Returns and Investments: Evidence from the Green Revolution." *American Economic Review* 86(4):931–53.
- Hanushek, E. A., and L. Woessmann. 2008. "The Role of Cognitive Skills in Economic Development." *Journal of Economic Literature* 46(3):607–88.
- Honohan, P. 2004. "Financial Development, Growth and Poverty: How Close Are the Links?" In E. C. Goodhard, ed., *Financial Development and Economic Growth: Explaining the Links*. London: Palgrave.
- Ianchovichina, E., and S. Lundstrom. 2009. "What is Inclusive Growth?" A note requested by donors supporting the Diagnostic Facility for Shared Growth. Available: siteresources.worldbank.org/INTDEBTDEPT/Resources/468980-1218567884549/WhatIsInclusiveGrowth20081230.pdf.
- IMF. 2006. *World Economic Outlook*. International Monetary Fund, Washington, DC.
- Jamison, E. A., D. T. Jamison, and E. A. Hanushek. 2006. The Effects of Education Quality on Income Growth and Mortality Decline. NBER Working Paper No. 12652, National Bureau of Economic Research, Cambridge.
- Kakwani, N. 1993. "Performance in Living Standards: An International Comparison." *Journal of Development Economics* 41:307–36.
- Kaufmann, D., D. Kraay, and M. Mastruzzi. 2009. "Governance Matters 2009: Learning from over a Decade of the Worldwide Governance Indicators." The Brookings Institution, Washington, DC. Available: <http://www.brookings.edu/opinions/2009>.
- King, R. G., and R. Levine. 1993a. "Finance and Growth: Schumpeter Might be Right." *The Quarterly Journal of Economics* 108(3):717–37.
- . 1993b. "Finance, Entrepreneurship and Growth: Theory and Evidence." *Journal of Monetary Economics* 32(3):513–42.

- Krishna, A. 2006. "Pathways Out of and Into Poverty in 36 Villages of Andhra Pradesh, India." *World Development* 34(2):271–88.
- Levine, R., N. Loayza, and T. Beck. 2000. "Financial Intermediation and Growth: Causality and Causes." *Journal of Monetary Economics* 46(1):31–77.
- Mavrotas, G., and S. Son. 2006. "Financial Sector Development & Growth: Re-examining the Nexus." In M. Bagella, L. Becchetti, and I. Hasan, eds. *Transparency, Governance and Markets*. Oxford: Elsevier Publishers.
- North, D. C. 1990. *Institutions, Institutional Change, and Economic Performance*. New York: Cambridge University Press.
- Ravallion, M. 2001. "Growth, Inequality and Poverty: Looking Beyond Averages." *World Development* 29(11):1803–16.
- Ravallion, M., and S. Chen. 1997. "What Can New Survey Data Tell Us about Recent Changes in Distribution and Poverty?" *World Bank Economic Review* 11(2):357–82.
- Sen, A. K. 1985. *Commodities and Capabilities*. Amsterdam: North-Holland.
- UNDP. 2000. "Millennium Development Goals." United Nations Development Programme, New York. Available: www.undp.org/mdg/basics.shtml.
- Weil, D. 2006. "Accounting for the Effect of Health on Economic Growth." Brown University and National Bureau of Economic Research, Cambridge. Processed.
- World Economic Forum. 2008. *The Global Competitiveness Report 2008–2009*. Geneva.
- World Bank. 2010a. "Understanding the Crisis." Available: www.worldbank.org/financialcrisis/. Downloaded 3 May 2010.
- _____. 2010b. PovcalNet Database. Available: iresearch.worldbank.org/PovcalNet/povDuplic.html. Downloaded 29 April 2010).
- _____. 2010c. World Development Indicators Online Database. Available: ddp-ext.worldbank.org/ext/DDPQQ/member.do?method=getMembers&userid=1&queryId=6. Downloaded 29 April 2010.
- _____. 2010d. Worldwide Governance Indicators. Available: <http://info.worldbank.org/governance/wgi/index.asp>. Downloaded 29 April 2010.
- WHO. 2003. How Much Should Countries Spend on Health? Discussion Paper No. 2, World Health Organization, Geneva.
- _____. 2010. World Health Statistics Database. Available: <http://www.who.int/whosis/>. World Health Organization, Geneva.
- Zhuang, J., H. Gunatilake, Y. Niimi, M.E. Khan, Y. Jiang, R. Hasan, N. Khor, A. Lagman-Martin, P. Bracey, and B. Huang. 2009. Financial Sector Development Economic Growth, and Poverty Reduction: A Literature Review. ADB Economics Working Paper No. 173. Asian Development Bank. Manila.
- Zhuang, J., ed. 2010. *Poverty, Inequality, and Inclusive Growth in Asia: Measurement, Policy Issues, and Country Studies*. London: Anthem Press for the Asian Development Bank.
- Zhuang, J., E. de Dios, and A. Lagman-Martin. 2010. "Governance and Institutional Quality and the Links with Growth and Inequality: How Asia Fares". In J. Zhuang, ed., *Poverty, Inequality, and Inclusive Growth in Asia: Measurement, Policy Issues, and Country Studies*. London: Anthem Press for the Asian Development Bank.

Human Capital Development

HYUN H. SON

This paper has two main objectives. First, it assesses and measures the gaps in the stock of human capital across the world. It presents how effectively different regions are improving their stock of human capital, and how long it will take for developing countries to catch up with the current level of human capital in industrialized countries. Second, it revisits the contribution of human capital to economic growth, proposing a decomposition method to account for employment growth—which is also impacted on by human capital growth—in explaining growth in total output per worker. The proposed methodology introduces employment growth in the growth decomposition through the employment growth elasticity. It is conjectured that as human capital increases, employment growth elasticity will decrease, making the economy less labor-intensive, resulting in higher economic growth. The proposed method points to the importance of the micro linkage between human capital and the labor market.

JEL classification: J24, O4, O15

I. INTRODUCTION

According to modern growth theory, the accumulation of human capital is an important contributor to economic growth. Numerous cross-country studies extensively explore whether educational attainment can contribute significantly to the production of overall output in an economy. Although macro studies have produced inconsistent and controversial results (Pritchett 1996), several micro studies that look into the same problem have shown a consistently positive relationship between the education of the workforce and their labor productivity and earnings (Trostel, Walker, and Woolley 2002; Psacharopoulos and Patrinos 2004a). The general finding is that individuals with more education tend to have better employment opportunities, greater earnings, and produce more output than those who are less educated. These findings provide a strong rationale for governments and households to invest substantial portions of their resources in education, with the expectation that higher benefits will accrue over time. In this context, education is deemed an investment, equipping individuals with

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knowledge and skills that improve their employability and productive capacities, thereby leading to higher earnings in the future.

This study has two main objectives. The first is to measure the gaps in human capital attainment across the world. The second is to explore the issues on how human capital affects labor productivity and earnings for the workforce. The paper is organized as follows. Section II discusses issues surrounding the definition and measurement of human capital. Section III measures the current level of human capital accumulation across the world. Section IV discusses how effectively different regions are improving their stock of human capital and how long it will take for developing countries to catch up with the current level of human capital in industrialized countries. Section V touches upon the role of human capital in determining economic growth. Sections VI and VII tackle the microeconomic aspects of human capital, with Section VI discussing micro-level empirical findings on returns to education, and Section VII dealing with the issue of labor market mismatch. Section VIII discusses the education policy debate between education for all versus education for highly skilled elite students, and Section IX concludes with some policy recommendations emerging from the findings of the paper.

II. WHAT IS HUMAN CAPITAL?

Human capital plays a critical role in economic growth and poverty reduction. From a macroeconomic perspective, the accumulation of human capital improves labor productivity; facilitates technological innovations; increases returns to capital; and makes growth more sustainable, which, in turn, supports poverty reduction. Thus, human capital is regarded at the macro level as a key factor of production in the economywide production function. From a microeconomic perspective, education increases the probability of being employed in the labor market and improves earnings capacity. Thus, at the micro level, human capital is considered the component of education that contributes to an individual's labor productivity and earnings while being an important component of firm production. In other words, human capital refers to the ability and efficiency of people to transform raw materials and capital into goods and services, and the consensus is that these skills can be learned through the educational system. That said, human capital development is important for development for its intrinsic value as a development goal in its own right, not only because of its instrumental value.

Although the conceptual definition of human capital is clear, its measurement is difficult because it is practically impossible to observe individual skill, and even harder to design a metric that is comparable across individuals and countries. Thus, various proxy measures of human capital have been proposed in

the empirical literature, such as literacy rates (Azariadis and Drazen 1990); school enrollment rates (Barro 1991, Mankiw et al. 1992); years of schooling (Barro and Lee 1996, 2001, and 2010; Cohen and Soto 2007); and test scores (Hanushek and Kimko 2000, Hanushek and Woessmann 2009). While the literacy rate, which measures the proportion of the population who can read and write, is an important measure of well-being, it does not measure the educational attainment or skill level of the workforce. On the other hand, school enrollment rate is a relevant metric only for school-age children and has little relevance for the workforce. Although years of schooling can reasonably capture the human capital stock of the workforce, this only reflects the quantity of human capital; it does not give an indication of the skill level of the workforce. This brings us to test scores, an indicator of human capital suggested by Hanushek and Kimko (2000), which reflects the quality of education and is closely related to individual skill. However, a problem with test scores is that it is very difficult to get a measurement that can be reliably extrapolated for the entire workforce. In fact, the country-level measures of average cognitive skills in Hanushek and Kimko (2000), and later Hanushek and Woessmann (2009), are not based on a random selection of schools or students, and may therefore not be nationally representative of the skill level of students, much less of the workforce.

Thus, for this study, we adopt average years of schooling as the measure of human capital because (i) this can be measured for the entire workforce in most countries, (ii) it is fairly comparable across countries, and (iii) it is the most commonly used measure of human capital in the literature. Despite its limitations, average years of schooling is still the most consistent and comparable country-level measure of human capital. It should be noted, however, that an ideal measure would be to combine years of schooling with test scores (as a measure of skill and cognitive ability) and construct an index that reflects both quantity and quality of human capital. Nonetheless, as discussed earlier, this data is not available at this time.

III. THE STOCK OF HUMAN CAPITAL IN THE WORLD

This section measures the current stock of human capital in the world using internationally comparable data from Barro and Lee (2010) on average years of schooling among the population aged 15 years old and over. The data set covers 146 countries over 1950–2010.¹ Table 1 presents average years of schooling in

¹ Industrialized countries include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States. South Asia includes Afghanistan, Bangladesh, India, the Maldives, Nepal, Pakistan, and Sri Lanka. In addition, East Asia and the Pacific includes Brunei Darussalam; Cambodia; the People's Republic of China; the Fiji Islands; Hong Kong, China; Indonesia; the Republic of Korea; the Lao People's Democratic Republic; Macao, China; Malaysia; Mongolia; Myanmar; Papua New Guinea; the Philippines; Singapore; Taipei, China; Thailand; Tonga; and Viet Nam.

eight different regions and by gender. The gender disparity in the table is defined as the ratio of female and male average years of schooling. Thus, if this index is less than 1, then females are deemed to suffer deprivation due to the shortfall in their years of schooling relative to males.

Table 1. Average Years of Schooling and Gender Disparity, 2010

| Region | Male | Female | Total | Gender Disparity |
|---------------------------------|-------|--------|-------|------------------|
| Central Asia | 9.35 | 9.99 | 9.69 | 1.07 |
| East Asia and the Pacific | 8.47 | 8.01 | 8.24 | 0.95 |
| Eastern Europe | 10.24 | 9.95 | 10.09 | 0.97 |
| Industrialized Countries | 10.92 | 10.71 | 10.81 | 0.98 |
| Latin America and the Caribbean | 8.63 | 8.33 | 8.48 | 0.97 |
| Middle East and North Africa | 8.05 | 7.28 | 7.65 | 0.90 |
| South Asia | 6.41 | 4.79 | 5.62 | 0.75 |
| Sub-Saharan Africa | 5.98 | 4.89 | 5.43 | 0.82 |
| World | 8.41 | 7.84 | 8.12 | 0.93 |

Source: Author's calculation based on Barro and Lee's (2010) data set.

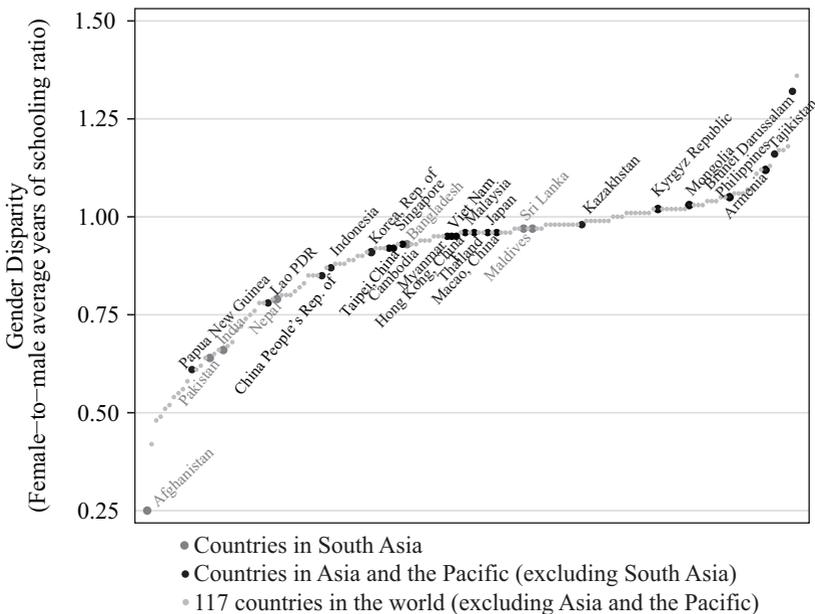
The average number of years of schooling in the world is 8.12 years, with males having 8.41 years of schooling and females 7.84 years of schooling. A person in an industrialized country has the highest length of schooling at 10.81 years, while a person in sub-Saharan Africa has an average length of schooling equal to only 5.43 years. The situation in South Asia, with average years of schooling equal to 5.62, is not much better than in sub-Saharan Africa. Moreover, gender disparity is highest in South Asia (0.75) followed by sub-Saharan Africa (0.82). It is interesting to note that females have a slightly higher average number of years of schooling than males in Central Asia, although this difference may not be statistically significant. Figure 1 presents average years of schooling in individual countries. The countries have been arranged in ascending order in terms of gender disparity. Gender disparity is highest in Afghanistan, where females, on average, have only a quarter of the years of schooling of their male counterparts. Similarly, the gender disparity is high in most of South Asia, including Afghanistan, India, Nepal, and Pakistan. On the other hand, Sri Lanka performs far better than the other countries in South Asia on this front: the average years of education in Sri Lanka are 8.56 for males and 8.30 for females.

Gender disparities in South Asia have been repeatedly observed and documented. Das Gupta (1987) notes that South Asia is known to have higher mortality rates among females than males due to gender discrimination, and she documents persistent bias for sons and discrimination against daughters in Punjab despite the region's relative prosperity. Likewise, Filmer, King, and Pritchett (1998) report lower human capital outcomes for females in South Asia in various measures of human capital such as mortality rates, medical treatment, school enrollment, and literacy. The gender disparities may be caused by various

intertwined reasons ranging from discrimination and cultural beliefs to biological differences and economic conditions, and this study will not attempt to disentangle these reasons. However, it could be argued that school systems and teachers in South Asia, by reflecting society’s biases and prejudices, can aggravate inequities in human capital, making it very difficult for the region to achieve gender parity. In fact, even in a relatively progressive society such as Israel, teachers’ gender biases can lead to measurable and significant differences in educational outcomes (Lavy 2008). On the other hand, well-ingrained notions of traditional gender roles can lead to the persistence of disparities in human capital investments and labor market participation even if socioeconomic conditions have changed, as observed by Vella (1994) in Australia.

Thus, a strong policy thrust is needed if discrimination and disparities in human capital are to be addressed within a reasonable amount of time. In fact, it is possible that the egalitarian educational policies of the former Soviet Union could have caused countries in Central and West Asia—such as Armenia, Kazakhstan, the Kyrgyz Republic, and Tajikistan—to show a high degree of gender parity in years of schooling. Likewise, it is useful to study the human capital policies implemented by Brunei Darussalam, which is the best performing country in terms of gender parity, with females having 2.1 more years of schooling than males on average.

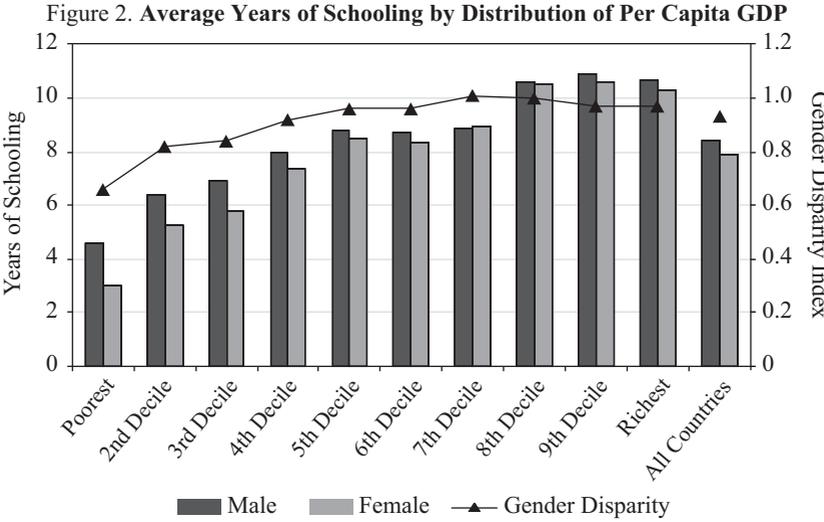
Figure 1. Gender Gap in Average Years of Schooling, 2010



Source: Author’s calculation based on Barro and Lee’s (2010) data set.

The relationship between economic growth and human capital can be seen in Figure 2, which groups countries into deciles based on their per capita gross domestic product (GDP) and plots average years of schooling by decile. Figure 2 shows that gender disparity is worse in the lower deciles than in the higher deciles, indicating that gender equality in human capital is correlated with income. A similar finding was observed by Klasen (2002), who argues that gender disparity in education can slow down economic growth. He estimates that annual economic growth in South Asia could have been 0.49 percentage point higher in the 1970s and 0.45 point in the 1980s if its gender parity in education were the same as in East Asia and the Pacific.

It can also be seen in Figure 2 that average years of schooling increases from 3.78 among the poorest 10% of countries to 10.50 among the richest 10% of countries, indicating a positive relationship between per capita GDP and years of schooling. However, it is unclear how the causality runs: it is plausible that human capital achievement can lead to higher economic growth by increasing productivity, but it is also plausible that high economic growth improves human capital by relaxing budget constraints and creating more opportunities to invest in human capital.



Source: Author’s calculation based on Barro and Lee’s (2010) data set.

IV. CAN DEVELOPING COUNTRIES CATCH UP WITH INDUSTRIALIZED COUNTRIES IN INCREASING HUMAN CAPITAL?

After observing that there is a wide gap between industrialized and developing countries in terms of years of schooling, we now consider whether we can expect to close this gap in the future. Data on average years of schooling are available in 5-year intervals from 1950 to 2010, thus the exponential trend method is used to calculate the yearly growth rate in average years of schooling for each of the 146 countries and eight regions. Table 2 shows that the average years of schooling in the world has been increasing at an annual rate of 1.69% during 1950–2010, with a higher growth rate for females at 1.88% versus 1.53% for males. This suggests that the gender disparity in schooling has been declining rapidly over the past 60 years. However, while gender disparity still exists in 2010, the gap is far smaller than that observed in 1950.

It can be noted from Table 2 that the world's poorer regions—such as sub-Saharan Africa and South Asia—which initially had very low human capital in 1950, have made remarkable progress in increasing average years of schooling over the last 6 decades, growing at an annual rate of 2.89% and 2.26%, respectively. Average years of schooling have been increasing at the fastest rate in the Middle East and North Africa, growing at an annual rate of 3.05%. On the other hand, the growth rate in human capital in industrialized countries is measured at 0.98%, which is the slowest growth rate among the eight regions. This suggests that further increases in years of schooling are harder for countries that have already achieved high levels of education because the quantity of human capital cannot go on increasing and thus, its growth has to eventually slow. Convergence in human capital can thus be expected because the time spent for schooling has an upper limit—people cannot study forever.

Table 2. Annual Growth Rate in Years of Schooling, 1950–2010 (percent)

| Region | Male | Female | Total |
|---------------------------------|------|--------|-------|
| Central Asia | 1.24 | 1.67 | 1.46 |
| East Asia and the Pacific | 1.38 | 2.28 | 1.76 |
| Eastern Europe | 1.05 | 1.40 | 1.23 |
| Industrialized Countries | 0.90 | 1.06 | 0.98 |
| Latin America and the Caribbean | 1.64 | 1.81 | 1.72 |
| Middle East and North Africa | 2.66 | 3.72 | 3.05 |
| South Asia | 2.00 | 2.75 | 2.26 |
| Sub-Saharan Africa | 2.67 | 3.18 | 2.89 |
| World | 1.53 | 1.88 | 1.69 |

Source: Author's calculation based on Barro and Lee's (2010) data set.

Rich industrialized countries have much higher stocks of human capital than developing countries, so the next pertinent question is whether or not past performance in human capital accumulation indicates eventual convergence. The good news is that convergence in human capital has been observed in the past decades, as can already be gleaned from Table 2, in which developing countries have experienced faster growth rates. Many previous studies have observed that there is a trend toward eventual convergence in human capital, and this finding seems to be robust to methodology. Whether the research measures the coefficient of variation over time (Babini 1991); uses the perpetual inventory method (Ahuja and Filmer 1996); or performs a three-stage least square regression (Cohen 1996, Sab and Smith 2002), data over the past few decades point to eventual convergence in human capital. If convergence will happen, how many years will it take the developing countries to catch up with the current level of human capital of the industrialized countries?

To calculate time to convergence, it is assumed that countries will continue the human capital growth rates set over the past 6 decades. Note that this assumption may not always hold because the growth rate in human capital may slow when a country achieves a higher level of human capital, as illustrated by the slow growth rates in industrialized countries, as already discussed. As such, the estimated years for convergence in Table 3 may underestimate the required time and may be better interpreted as the lower limit for years for convergence.

Table 3 shows that it will take at least 3 decades for South Asia and almost a quarter century for sub-Saharan Africa to catch up with the current level (in 2010) of industrialized countries in average years of schooling. On the other hand, Central Asia and Eastern Europe will take less than 10 years to do so. It is also interesting that, in general, it will take fewer years for females (16.8 years) in developing countries to catch up with their counterparts in developed countries than males (17.2 years), mainly due to the higher growth rate in females' years of schooling in the past 60 years. This is especially true in Central Asia, where it will only take 4.2 years for females to catch up with the current level of education of their counterparts in industrialized countries, compared with 12.7 years for males in Central Asia to do the same. On the other hand, it will take longer for females than males in South Asia and sub-Saharan Africa to catch up with their counterparts in industrialized countries due to the high level of gender disparity in these regions.

Table 3. Years to Catch Up with the Current Level of Industrialized Countries

| Region | Male | Female | Total |
|---------------------------------|------|--------|-------|
| Central Asia | 12.7 | 4.2 | 7.6 |
| East Asia and the Pacific | 18.6 | 12.9 | 15.6 |
| Eastern Europe | 6.2 | 5.3 | 5.6 |
| Industrialized Countries | 0.0 | 0.0 | 0.0 |
| Latin America and the Caribbean | 14.5 | 14.0 | 14.3 |
| Middle East and North Africa | 11.6 | 10.6 | 11.5 |
| South Asia | 26.9 | 29.7 | 29.3 |
| Sub-Saharan Africa | 22.8 | 25.1 | 24.2 |
| World | 17.2 | 16.8 | 17.0 |

Source: Author's calculation based on Barro and Lee's (2010) data set.

Table 4, on the other hand, presents figures on schooling for selected Asian countries. It can be seen that there is a wide variation in average schooling between Asian countries, ranging from 5.1 years in India to 9.0 years in the Philippines. Moreover, in most of these countries females have less schooling than males. The only exception to this observation is the Philippines, where females, on average, have half a year more schooling than males. Estudillo, Quisumbing, and Otsuka (2001) attribute this gender differential to the perceived comparative advantage of sons in farm activities and that of daughters in nonfarm activities, so parents in rural areas bequeath land to sons while daughters receive investments in education. On the other hand, females in South Asia generally receive less schooling than males, with the schooling differential being more than 2 years in India and Pakistan.

Over the past 60 years there has been a wide variation in schooling growth across countries, ranging from 1.2% annual growth in Sri Lanka to 3.5% in Bangladesh (Table 4). Thus, despite Bangladesh's low average schooling as of 2010 (5.8 years), if it can sustain its schooling growth it is estimated to converge with industrialized countries even faster than Sri Lanka. Furthermore, Table 4 shows that schooling for females in South Asia has been growing much faster than that for males over the last 60 years, with Bangladesh and Pakistan having the widest growth differential. Thus, females in Bangladesh, Pakistan, and Sri Lanka are estimated to converge with their counterparts in industrialized countries earlier than males, despite females having less schooling at present.

Table 4. Years of Schooling for Selected Asian Countries

| Country | Average Years of Schooling in 2010 | | | Annual Growth Rate in Years of Schooling, 1950–2010 | | | Years Needed for Convergence | | |
|--------------------------|------------------------------------|------|-------|-----------------------------------------------------|------|-------|------------------------------|------|-------|
| | Female | Male | Total | Female | Male | Total | Female | Male | Total |
| China, People's Rep. of | 7.6 | 8.7 | 8.2 | 3.5 | 2.2 | 2.7 | 9.9 | 10.3 | 10.5 |
| Indonesia | 5.6 | 6.6 | 6.1 | 3.6 | 2.3 | 2.8 | 18.2 | 22.1 | 20.7 |
| Philippines | 9.2 | 8.7 | 9.0 | 2.0 | 1.5 | 1.8 | 7.6 | 14.8 | 10.6 |
| Thailand | 7.3 | 7.7 | 7.5 | 1.7 | 1.0 | 1.3 | 22.5 | 37.1 | 28.7 |
| Viet Nam | 6.3 | 6.6 | 6.4 | 1.9 | 0.9 | 1.3 | 28.3 | 55.2 | 38.9 |
| Bangladesh | 5.6 | 6.0 | 5.8 | 6.0 | 2.6 | 3.5 | 11.2 | 23.3 | 18.2 |
| India | 4.1 | 6.1 | 5.1 | 4.3 | 2.6 | 3.1 | 23.1 | 22.3 | 24.6 |
| Pakistan | 4.3 | 6.7 | 5.6 | 5.1 | 1.9 | 2.9 | 18.4 | 25.5 | 23.4 |
| Sri Lanka | 8.3 | 8.6 | 8.4 | 1.7 | 0.9 | 1.2 | 14.9 | 27.3 | 20.3 |
| Industrialized Countries | 10.7 | 10.9 | 10.8 | 1.1 | 0.9 | 1.0 | 0 | 0 | 0 |

Source: Author's calculations based on Barro and Lee's (2010) data set.

However, while years of schooling has an upper limit and can be expected to converge, the quality of human capital may not have such an upper limit, and in the future, vast inequalities in quality of education may be seen, rather than in years of schooling. It would be interesting to study whether or not convergence is happening with regard to quality of schooling, and if this has any implications for the impact of human capital on economic growth, and whether or not per capita incomes will eventually converge.

V. HUMAN CAPITAL AND ECONOMIC GROWTH

Education has been considered a key determinant of economic growth since the introduction of Solow's (1956) growth model. Although Solow did not explicitly factor in education in his growth theory, the central role of technology in his model provided the impetus for the focus on education; after all, an educated population was necessary for technological innovation. Nelson and Phelps (1966) made the link explicit in what they termed "investment in humans": workers needed education in order to utilize new technologies (the development of which is considered exogenous), thereby increasing total factor productivity and spurring economic growth. A few decades later, the endogenous growth models played the central role of human capital in technological development and economic growth. According to these new growth theories—such as Lucas (1988); Romer (1990); Mankiw, Romer, and Weil (1992); Barro and Sala-i-Martin (1997)—the accumulation of human capital through education and on-the-job training fosters economic growth by improving labor productivity, promoting technological innovation and adaptation, and reducing fertility.

Numerous cross-country empirical studies have established the positive correlation between human capital and economic growth. Azariadis and Drazen (1990) find that a country's literacy rate in 1960 is a significant determinant of per capita GDP growth for 1960–1980, and literacy rates and initial per capita GDP in 1960 together account for 38% of the variation in economic performance in the 20-year period. On the other hand, using school enrollment as the measure of human capital, Barro (1991) finds that primary and secondary school enrollment rates are positively linked with economic growth and investments while being negatively linked with fertility rates.

Similarly, Mankiw, Romer, and Weil (1992) find that the elasticity of per capita GDP to enrollment rate is 0.66 for non-oil exporting countries and 0.76 in OECD countries; moreover, they show that differences in enrollment rates can explain nonconvergence in incomes during 1960–1985. On the other hand, applying the Mincerian specification, Barro and Lee (2010) estimate that increasing average years of schooling by 1 year increases per capita GDP by 1.7% to 12.1%, depending on specification (i.e., random vs. fixed effects regressions); while Cohen and Soto (2007) calculate returns to years of schooling at 12.3% to 22.1%. Testing the impacts of schooling quality on growth, Hanushek and Woessmann (2009) find that a unit increase in a country's average cognitive test scores increases its per capita GDP growth rate by 1.2–2.0 percentage points. Moreover, increasing average math and science scores by one unit increases per capita GDP growth rates by 2.0 points, and by 2.3 points for low-income countries. Overall, these studies find that education is significantly and positively correlated with economic growth and argue that causation runs from education to growth in line with human capital growth models.

However, as pointed out by Bils and Klenow (2000) and Krueger and Lindahl (2001), the causation can run in the reverse—i.e., economic growth increases returns to education and thus causes people to attain more education—and they argue that the data seem to be stronger in this direction. Bils and Klenow (2000) show that the schooling-to-growth effect accounts for less than one third of the observed correlation between schooling and growth, arguing that the findings in previous studies are mainly due to omitted variable bias. Likewise, Krueger and Lindahl (2001) argue that, compared with micro-level studies, cross-country macro-level studies suffer more from reverse causation (i.e., it is difficult to find valid instrumental variables in cross-country data) and omitted variable bias (such as policies that are nonstationary and which country dummy variables will not resolve). As such, micro-level analysis, where these problems can be plausibly resolved, might be more appropriate in studying the economic impacts of education. Krueger and Lindahl mention that natural experiments such as the different education policies of states in the United States or twins can more accurately measure the rates of return on education.

Another issue regarding studies on the relationship between education and economic growth is the lack of consistency between human capital theory and empirical testing. While the Solow and Nelson-Phelps models defined the basis of human capital theory, testing them in practice has been a problem. Mincer (1974) tested this relationship by measuring human capital as years of schooling, and derived a log-linear specification for output and schooling, respectively. This has been the traditional way returns to education have been measured, as can be seen in the papers earlier mentioned. However, Hanushek and Kimko (2000) argue out that cognitive ability, as measured by achievement test scores, is a more relevant measure of human capital, since cognitive ability directly relates to the ability of a worker to implement technology, as required by the Nelson-Phelps model. They also point out that length of schooling is not comparable across countries because a year of schooling in, say, Japan is not comparable with a year of schooling in, say, Bangladesh. On the other hand, Schady (2003) argues that the log-linear specification—i.e., the assumed Mincerian model of human capital—may be flawed, showing that returns to years of education features significant convexities and sheepskin effects.

An alternative way to derive the contribution of human capital to economic growth is through the growth accounting method, which assigns the contribution of various inputs such as labor, physical capital, and factor productivity toward outputs. An advantage of this approach is that it avoids the ambiguities of measuring human capital and is internally consistent (Stevens and Weale 2004). Recently, Bosworth and Collins (2003) proposed a growth accounting method that is an exact decomposition quantifying the contribution of growth in factors—including human capital, physical capital, and factor productivity—to growth in labor factor productivity. In this study, this growth accounting methodology is modified to explain growth in output per worker in terms of growth in four contributors, namely, employment, physical capital, human capital, and factor productivity (see Appendix for a discussion of the methodology).

Economic growth takes place due mainly to two factors: labor productivity growth and employment growth. In the method proposed by Bosworth and Collins, growth in employment is assumed to be exogenous, but in the proposed method in this paper, growth in employment is endogenous. Using this proposed decomposition, we are able to quantify the direct impact of growth in human capital on the growth rate of total output. However, it should be noted that growth in human capital indirectly affects growth in both productivity and employment, apart from its direct impacts on growth. Although previous studies have measured the impact of human capital on productivity growth, relatively fewer studies have analyzed the impact of human capital on employment growth. This study attempts to fill the gap.

Another interesting idea behind the proposed decomposition method is that human capital affects growth in output per worker through the employment

growth elasticity, which measures how much employment is generated by growth in output. Our conjecture is that as human capital increases, employment growth elasticity will decrease, making the economy less labor-intensive and resulting in higher economic growth. The proposed method is applied to Bosworth and Collins's dataset, and the empirical results are presented in Tables 5–7.

As can be seen in Table 5, world output grew at an average annual rate of 3.8% during 1960–2003. Using our proposed decomposition method, in which growth in output is explained by four components, our results show that almost 40% of growth in global output is explained by growth in employment. Table 5 also shows that growth in physical capital per worker contributes to growth in world output by 26.3%; growth in factor productivity is the third largest source contributing to world output by 23.7%; and growth in human capital makes only a 7.9% contribution to world output growth. These results are consistent with previous empirical studies—such as Bosworth and Collins (2003) and Collins (2007)—pointing to a weak correlation between growth in human capital and economic growth. It should be pointed out that the small magnitude for the contribution of human capital relative to the other three factors does not suggest that human capital is insignificant for output growth. The figures for the contribution of human capital in Table 5 only capture its direct impact on growth through labor productivity, and do not reflect its indirect impact through changes in the employment rate. Once we take this indirect channel into consideration, human capital, indeed, plays a major role in explaining growth in output per worker.

Table 5. Sources of Growth in the World, 1960–2003

| Region | Annual Growth Rate | Percentage Contribution of | | | |
|-----------------------------|--------------------------|----------------------------|---------------------|------------------|------------------------|
| | | Employment | Physical Capital | Human Capital | Factor Productivity |
| Industrialized Countries | 3.4 | 35.3 | 29.4 | 8.8 | 29.4 |
| East Asia | 6.5 | 41.5 | 33.8 | 7.7 | 15.4 |
| Latin America | 3.7 | 73.0 | 13.5 | 10.8 | 2.7 |
| South Asia | 4.6 | 45.7 | 23.9 | 6.5 | 23.9 |
| Sub-Saharan Africa | 3.2 | 81.3 | 12.5 | 9.4 | –3.1 |
| Middle East | 4.6 | 58.7 | 21.7 | 10.9 | 8.7 |
| World | 3.8 | 39.5 | 26.3 | 7.9 | 23.7 |

Source: Author's calculations based on Bosworth and Collins's (2003) data set.

Growth in total output has been quite impressive in East Asia as a whole; however, growth in human capital has not played a major role in explaining its output growth. Indeed, Table 5 suggests that the contribution of human capital growth to output growth has been around 5% to 10% for 4 decades. Rather, it is the growth in physical capital that has been the main contributor to rapid growth in East Asia.

The Philippines, however, presents an interesting case. As can be seen in Table 6, more than 75% of output growth stems from employment growth, suggesting that its pattern of growth is highly labor-intensive. This finding is consistent with the structure of the Philippine economy where the service sector accounts for almost 53% of its GDP and employs as much as 48% of the labor force during 2000–2008. On the other hand, the contribution of growth in physical capital is the lowest in the region (21%), which hinders improvements in factor productivity. This can be seen from the fact that growth in factor productivity has been negative. Unlike its neighboring economies, the direct contribution of human capital to output growth is rather large for the Philippines, accounting for as high as 10% of growth. In contrast, the Republic of Korea's pattern of growth is more balanced, with employment and physical capital each contributing about 36% to its total output growth.

Table 6. Sources of Growth in East Asia, 1960–2003

| Economies | Annual Growth Rate | Percentage Contribution of | | | |
|-------------------------|--------------------|----------------------------|------------------|---------------|---------------------|
| | | Employment | Physical Capital | Human Capital | Factor Productivity |
| China, People's Rep. of | 6.9 | 28.1 | 26.9 | 5.2 | 38.8 |
| Indonesia | 5.5 | 47.1 | 32.0 | 8.9 | 11.6 |
| Republic of Korea | 7.4 | 36.5 | 36.6 | 9.5 | 16.6 |
| Malaysia | 6.6 | 49.6 | 31.0 | 8.2 | 10.8 |
| Philippines | 3.9 | 75.3 | 20.8 | 10.0 | -6.4 |
| Singapore | 7.9 | 42.6 | 36.3 | 5.8 | 14.6 |
| Thailand | 6.7 | 37.1 | 35.0 | 5.7 | 21.6 |
| Taipei, China | 8.4 | 31.7 | 36.1 | 6.4 | 24.6 |

Source: Author's calculations based on Bosworth and Collins's (2003) data set.

Compared to East Asia, growth rates of countries in South Asia are generally far lower, although employment remains the main source of total output growth (Table 7). Growth in Bangladesh is the most labor-intensive in the region, with almost two-thirds of total output growth contributed by employment growth. However, its growth in physical capital is the lowest of all the countries in the region, suggesting that this could be a binding constraint to achieving higher growth for Bangladesh. In all of South Asia, the contribution of human capital accounts for around 7%, with the exception of Pakistan where it is merely 6%.

Table 7. Sources of Growth in South Asia, 1960–2003

| Countries | Annual Growth Rate | Percentage Contribution of | | | |
|------------|--------------------------|----------------------------|---------------------|------------------|------------------------|
| | | Employment | Physical Capital | Human Capital | Factor Productivity |
| Bangladesh | 3.4 | 66.5 | 15.5 | 7.0 | 10.8 |
| India | 4.6 | 43.9 | 25.3 | 7.4 | 25.8 |
| Sri Lanka | 4.5 | 48.9 | 26.7 | 7.2 | 16.8 |
| Pakistan | 5.4 | 51.6 | 25.9 | 6.1 | 16.2 |

Source: Author's calculations based on Bosworth and Collins's (2003) data set.

These findings are similar to the earlier findings of Collins (2007). Calculating the contribution of human capital to growth in output per worker for 84 countries over 1960–2003, she finds that although human capital is a significant contributor to growth in per capita outputs, this contribution is still much less compared with physical capital and total factor productivity. These results suggest that despite the positive contributions of human capital, investment levels and overall efficiency in the economy are mainly attributable to growth in output per worker. It is also worth noting from Collins (2007) that over 1960–2003, the contribution of human capital to labor productivity growth has changed little, despite the fact that educational attainment has nearly doubled during the period, particularly for developing countries. This is true when one looks at regional averages or individual country experiences in East Asia and South Asia.

The empirical studies show that the difference in growth across countries is not primarily due to educational attainment or growth in human capital. Rather, cross-country differences in growth in output per worker are largely attributable to changes in physical capital and total factor productivity over time. These findings suggest that while human capital matters for output growth or productivity at the aggregate level, future research at the micro level is needed to explore the link between the education of working individuals and their labor productivity and earnings. Households make important decisions on schooling and employment; as such, it is most logical to use a micro-level approach to look into the relationship between education, labor productivity, and earnings. It is at the micro level—the individuals, households, and firms—and the labor market where the skills learned through education are translated into outputs, and it is thus necessary to study these micro linkages if one is to make sense of macro observations.

VI. SOCIAL AND PRIVATE RETURNS TO EDUCATION

One of the primary benefits of education is increasing a person's chances of employment and being paid wages—other things being equal, a firm will hire the job applicant with more education. Moreover, workers with more education are able to command a higher wage. While this seems straightforward enough, the underlying mechanism behind this phenomenon is subject to much debate. A central question is whether or not education actually improves the productivity of workers. On one hand, the human capital theorists (e.g., Becker 1962, Schultz 1963) argue that education increases productivity by imparting skills—such as the 3Rs and problem-solving skills—needed for the workplace, resulting in higher employability and wages. On the other hand, the market signaling theorists pioneered by Spence (1973) argue that education may not actually increase worker productivity, but rather reflect it, with innately high-ability workers using education to separate themselves from low-ability workers. While the debate may seem academic, understanding the mechanism between wages and education has serious policy implications. If education does improve productivity, then it makes economic sense to promote basic education for all. If, on the other hand, sheepskin effects dominate, then the educational system should be calibrated such that there will be more efficient matching of skills in the classroom and in the workplace.

Most of the empirical literature on the private benefits of education are grounded on the human capital school, estimating the returns from educational attainment through regressions on wages and schooling. Despite wide variations in data sources, locations, and methodologies, Psacharopoulos and Patrinos (2004a) find that pre-2000 estimates of rates of return to an additional year of education in 73 countries revolved around 10%, with rates of return falling between 5% and 15% for 62 of these countries. This is still true even for the following studies after 2000:

- (i) developed countries such as the United Kingdom (Harmon, Oosterbeek, and Walker 2003), Germany (Ammermueller and Weber 2005), the United States (Turner et al. 2007), and various countries in the European Union (Strauss and de la Maisonneuve 2007);
- (ii) developing countries like India (Duraismy 2002), the People's Republic of China (Li et al. 2005, Zhang et al. 2005), and Bangladesh (Asadullah 2006); and
- (iii) various African countries (Schultz 2004).

On the other hand, Trostel, Walker, and Woolley (2002) estimate the overall return to education at 5% for a panel of 28 countries during 1985–1995, with country estimates ranging from 2.4% in Norway to 16.0% in Northern

Ireland. In general, these findings are fairly consistent with the rates of return calculated from cross-country studies.

Whether one looks at micro or macro data, the correlation between human capital and productivity is clear: more education is better than less education. However, there seems to be a discrepancy between the findings of micro-level studies and macro-level studies on returns to education by level of schooling. While cross-country macro studies show increasing rates of return from higher levels of education (for example, Lange and Topel 2006, Barro and Lee 2010), micro-level studies show decreasing social returns and U-shaped private returns as one goes from primary to tertiary education (Table 8). This discrepancy can be reconciled when one considers the different methodologies in calculating returns to education at the micro and macro levels. In cross-country studies, one only looks at the contribution of additional education to output or growth; macro-level regression analysis does not take into account the costs that go into producing education services. On the other hand, micro-level analysis takes into account the private and social costs of education, illustrating that at the tertiary level the private benefits of education outweigh the social benefits. These two approaches can have very different policy prescriptions: while macro-level studies will advocate the accumulation of human capital up to the tertiary level, micro-level studies will argue that public spending on education must stop at secondary school.

Table 8. Returns to Investment in Education by Level (percent)

| | Social Returns | | | Private Returns | | |
|----------------------------------------|----------------|-----------|--------|-----------------|-----------|--------|
| | Primary | Secondary | Higher | Primary | Secondary | Higher |
| Per Capita Income Group | | | | | | |
| Low income | 21.3 | 15.7 | 11.2 | 25.8 | 19.9 | 26.0 |
| Middle income | 18.8 | 12.9 | 11.3 | 27.4 | 18.0 | 19.3 |
| High income | 13.4 | 10.3 | 9.5 | 25.6 | 12.2 | 12.4 |
| Region | | | | | | |
| Asia | 16.2 | 11.1 | 11.0 | 20.0 | 15.8 | 18.2 |
| Europe/Middle East and North Africa | 15.6 | 9.7 | 9.9 | 13.8 | 13.6 | 18.8 |
| Latin America and the Caribbean | 17.4 | 12.9 | 12.3 | 26.6 | 17.0 | 19.5 |
| Industrialized Countries | 8.5 | 9.4 | 8.5 | 13.4 | 11.3 | 11.6 |
| Sub-Saharan Africa | 25.4 | 18.4 | 11.3 | 37.6 | 24.6 | 27.8 |
| World | 18.9 | 13.1 | 10.8 | 26.6 | 17.0 | 19.0 |

Note: Industrialized countries include Japan and exclude the Republic of Korea.

Source: Psacharopoulos and Patrinos (2004b).

Psacharopoulos and Patrinos (2004a) also observe that in 1992–2004, while average years of schooling increased, the average returns to schooling declined by 0.6%, which indicates decreasing marginal returns to education—an

observation predicted by human capital models. Trostel, Walker, and Woolley (2002) find a similar phenomenon in their data, with average rates of return in 28 countries falling between 1985 and 1995, although trends vary widely across countries. In Cambodia, Sakellariou (2008) finds that the supply of more educated workers exceeds demand in the labor market, leading to a decline in the returns to tertiary education. A similar phenomenon is observed by Son (2009) in the Philippines: between 1997 and 2003 returns decreased for all levels of education from primary to tertiary. However, she attributes this to something different—the decrease in returns from education is due to poor job creation and low investment. This lack of job opportunities forces educated workers to take low-skill jobs, decreasing the returns from their education, and depressing overall labor productivity in the economy.

In other words, the expansion of education in recent decades does not always lead to higher productivity and economic growth as predicted in neoclassical growth models. As Pritchett (1996) observes, all the expansion in education since the 1960s has not resulted in the expected expansion in economic growth, especially for developing countries. Pritchett thus argues that a study of human capital will also have to consider educational quality and institutions: staying in school will not build human capital if the quality of education is very low, while bad institutions can lead to a situation where human capital is used for counterproductive rent-seeking activities. And this is where micro-level analysis can make an important contribution. While macro-level studies can only see average correlations between education and economic growth, micro-level studies will be able to see what is happening in the educational system and the labor market as well as how human capital is used and who actually benefits from education. If investments in human capital are to bear fruit, one also needs to consider the supply and demand conditions in the labor market.

VII. HUMAN CAPITAL AND THE LABOR MARKET

The link between education and economic development is realized through the labor market. Skills learned in the educational system should be used by firms in the production of goods and services so that workers will be paid wages commensurate with their productivity. Without this link, however, even educated workers will not realize the returns from their education reflected in their wages, and the economy will not reap investments in education through higher productivity. This unfortunate situation is observed by Son (2009) in the Philippines during 1997–2003. Looking at the educational attainment of the working age population at the household level, she finds that the proportion of employed household members with secondary and tertiary education increased, while the proportion of those employed with only primary education decreased.

This indicates that attaining secondary or tertiary education is an important factor for employability; however, this also means that the opportunities for those with low educational attainment have been diminishing.

There are two possible reasons for this observation: the Philippine labor market is demanding more workers with high educational attainment; or workers with secondary or tertiary education are crowding out less-educated workers in getting low-productivity jobs. If the latter is true, then one should observe that the productivity of educated workers is on the decline. Son (2008) observes a structural shift in employment from agriculture to the service sector especially among female workers. The service sector, however, includes low-productivity jobs like housemaids and drivers as well as high-productivity jobs like lawyers and financial advisers. Son (2009) then calculates that real labor productivity declined by 4.76% in 1997–2000 and by 1.42% in 2000–2003. In terms of returns to education, this results in a 23.5% decline in the real returns from secondary education (from P6.75 per hour in 1997 to P5.16 per hour in 2003), and a 16.3% decline in returns from tertiary education (from P19.80 per hour in 1997 to P16.57 per hour in 2003). Therefore, workers with secondary or tertiary education are increasingly accepting low-productivity jobs, resulting in lower productivity and rates of return to education.

The above observations clearly show that the labor market in the Philippines is not able to effectively utilize the country's increasingly educated workforce. Despite having a greater proportion of workers with secondary or tertiary education, the average productivity of workers is on the decline. This means that the labor market is not generating enough quality jobs for the educated workers, so they end up taking up low-productivity jobs. Alternatively, this also indicates that the educational system is not teaching the skills needed by the labor market, either because of a mismatch between skills supplied and demanded, or because of poor quality of education. Either way, this suggests that educational attainment is not leading to high productivity, and therefore economic growth remains slow.

For human capital theorists, overeducation in the labor market implies market inefficiencies—either the economy is not generating enough quality jobs for workers or there is overinvestment in education. However, proponents of job market signaling would see it a different way: overeducation is natural and should be expected to persist. As argued by Sicherman (1991), overeducation in the market can be explained by the trade-off between schooling and experience (so young workers use education to compensate for lack of experience), and the labor market mobility that overeducation eventually allows. However, from a policy perspective, overeducation implies a misallocation of already strained resources. Thus, for developing countries, going beyond universal coverage in education is imperative because economic development requires an expansion of the supply of the right kind of skills. Unfortunately, the reality is that labor market mismatches

remain a challenge faced by many other developing countries, including Cambodia (Sakellariou 2008); the People's Republic of China (Li, Morgan and Ding 2008); Mongolia (Pastore 2009); and Taipei, China (Hung 2008).

Governments in developing Asia need to address these mismatches in order to accelerate and sustain economic growth. Given their limited resources for providing education, a pertinent policy question is whether the education policy of a country ought to be geared toward the lowest or highest achievers, which is discussed in the next question.

VIII. EDUCATION POLICY: BASIC SKILLS VERSUS HIGHLY SKILLED LABOR

Indeed, an important policy consideration is whether to concentrate education resources toward gifted students or to spread resources to achieve universal basic education. On one hand, allocating more resources toward developing the skills of high-aptitude students can provide an economy with a pool of highly skilled managers and scientists and increase the likelihood of generating technological innovations. However, this will mean a greater proportion of the workforce is poorly educated and unskilled, making them unlikely to utilize technology into production. On the other hand, spreading resources equally in basic education will ensure a workforce with at least basic skills that can implement existing technologies, but this will lessen the likelihood of growth-spurring technological innovations. In other words, should a country devote significant resources to developing an elite group of “rocket scientists”, or should these resources instead be used to teach basic skills to all students?

To answer this question, Hanushek and Woessman (2009) test how the share of high-aptitude students—those with cognitive test scores of 600 or higher—and the share of students with basic literacy skills—those with cognitive test scores of 400 or higher—affect a country's growth path. They find that both “rocket scientists” and “basic-skills students” contribute positively to growth; but “rocket scientists” have a much stronger impact on economic growth. Increasing the share of students who are “rocket scientists” by 10 percentage points will lead to 1.3 percentage points higher annual economic growth, while increasing the share of “basic-skills students” by the same amount will raise annual growth by just 0.3 percentage point. Moreover, the impact of the share of “rocket scientists” is significantly stronger for countries that have a long way to catch up with developed countries. Thus, developing countries with a high share of “rocket scientists” but with low initial GDP per capita are able to converge faster on industrialized countries, as can be seen in the experiences of the Republic of Korea; Singapore; and Taipei, China.

On the other hand, Hanushek and Woessman also find that the interaction variable for shares of “rocket scientists” and “basic-skills students” has the strongest correlation with economic growth—its coefficient is more than four times higher than the coefficient for the share of “rocket scientists” alone. This means that a country needs to have both an elite pool of “rocket scientists” to generate technological innovation as well as a workforce with basic literacy skills that can use this technology in production. Moreover, teaching basic literacy skills to all students may be a prerequisite to finding those few “rocket scientists” in the population.

IX. SUMMARY AND POLICY RECOMMENDATIONS

Human capital, as the name suggests, represents the productive capacity of the people. Just like land or machinery, workers are an essential requirement for production. As such, human capital denotes the skill of the labor force, how well and efficiently workers can transform raw materials and capital into goods and services. These skills—such as literacy, numeracy, cognitive, and analytical skills—can be learned and honed through education; thus, any discussion of human capital has to touch upon education.

Various proxy measures of human capital have been proposed, such as literacy rates, enrollment rates, and test scores, but so far the most available, comparable, and consistent measure of human capital is years of schooling. Analyzing data for 146 countries over 60 years (1950–2010), we have seen that there is still a wide gap in human capital accumulation between industrialized and developing countries, with the average working-age adult in industrialized countries having 11 years of schooling compared with less than 6 years in South Asia and sub-Saharan Africa. The good news is that human capital has been converging over the past 60 years, with human capital accumulation being faster in developing countries than in industrialized countries.

However, estimates of time to convergence indicate that it may take decades for poor countries to catch up with the 2010 levels of human capital of rich countries. In South Asia, it will take almost 30 years for the region to catch up with the 2010 levels of human capital in industrialized countries, based on its historical performance during 1950–2010. Moreover, it will take longer for females than males in South Asia to catch up with their counterparts in industrialized countries due to the persistence of gender disparity in the region. Note, however, that regional averages can hide significant variations across countries. For example, higher growth rates in schooling for females in Bangladesh and Sri Lanka over the past 60 years mean that females are estimated to converge with the schooling of their counterparts in industrialized countries more than 12 years before males do. Likewise, despite females in Pakistan

currently having 2.4 years less schooling than males, convergence for females is estimated to come more than 7 years before that for males.

Although the findings on convergence may be reassuring, this is mainly due to there being a natural upper limit on the amount of schooling—an average individual cannot be expected to accumulate schooling endlessly. Thus, growth rates in countries with high levels of schooling will slow down and convergence will occur. On the other hand, there is no natural limit on the quality of education: teachers can receive more training, equipment can be upgraded, and classroom conditions can be improved. Thus, while we can expect convergence between industrialized and developing countries in terms of years of schooling, the gap in their quality of education may still widen in the future.

This study has also proposed a decomposition method to account for the role of human capital in explaining growth in total output per worker. In addition to growth in human capital, physical capital, and factor productivity, the proposed methodology attempts to explain growth in total output per worker in terms of employment growth. This methodology introduces the contribution of employment growth to output growth through the employment growth elasticity. Unlike the conventional method, employment growth is endogenous in explaining growth in output in this methodology.

Applying our proposed method, our empirical results suggest that the direct contribution of human capital to output growth per worker varies between 5% and 10%. However, this does not suggest that human capital is unimportant for growth. Of the many potential reasons for the relatively small contribution of human capital, two are worth pointing out. First, the measure of human capital in this study—i.e., years of schooling—may not be able to capture its direct contribution to output growth in an economy. As pointed out in Section II, a better measure of human capital that reflects both quantity and quality of human capital may be needed to be able to quantify its precise effect on economic growth. Second, our estimates do not account for the indirect contribution of human capital in increasing output growth per worker through the generation of employment. This brings us to the next point pertaining to the micro linkage between human capital and the labor market.

Human capital impacts economic growth only if it is utilized in the labor market: those who have attained schooling need to be employed so that their skills can be used to produce goods and services. However, there may be a mismatch between the skills taught by the educational system and the skills needed by the labor market, so highly educated workers may end up doing low-productivity jobs. Thus, despite a country's achievements in accumulating human capital through the education system, this achievement may not lead to economic growth and poverty reduction if the labor market is not considered.

This is where education policy becomes very important. While each country's needs and conditions are different, a general recommendation arising

from this study is that education policy must be closely tied with labor and economic policy. The educational system must not exist in a vacuum; rather, decisions on priorities, curricula, and budget allocation need to be made in line with medium- and long-term development plans. If the country seeks to develop its information technology sector, then the quality of math and science education will need to be improved. Likewise, if a country needs to improve governance and institutions, then civics and history cannot be eliminated from the curriculum. Likewise, development institutions will need to hone education sector strategies to the needs and situation of individual countries rather than propose sweeping one-size-fits-all strategies.

Country-specific micro-level studies are needed if one wants to make sensible and relevant policy recommendations. Although the generalizations afforded by macro-level cross-country studies are interesting, they can seldom be applied to specific countries because policy recommendations need to deal with the within-country variations rather than the smoothed aggregates. A comprehensive study of human capital and economic development will need to consider the skills taught in the educational system, the dynamics of the labor market, and the institutions governing the means of production.

APPENDIX: GROWTH ACCOUNTING METHODOLOGY

Growth accounting measures the contribution of human capital to economic growth by assigning the contribution of various inputs towards outputs. As has been discussed in the study, human capital has direct and indirect impacts on total output growth. For this section, we first discuss one of the ways by which human capital affects the employment growth elasticity. We show that higher levels of human capital leads to more capital-intensive (and hence less labor-intensive) growth in output, and thus a lower employment growth elasticity. This is followed by an exposition of the growth accounting methodology, which applies the concept of employment growth elasticity, used in Section V of the study.

Human Capital and Employment Growth Elasticity

To begin the discussion, let us define the following identities:

$y = \Delta \ln(Y)$ is the growth rate of output, where Y is total output

$p = \Delta \ln\left(\frac{Y}{E}\right)$ is the growth rate of output per worker, i.e., the growth rate of labor productivity

where E is total employment

$e = \Delta \ln(E)$ is the growth rate of employment

$\varepsilon = \frac{e}{y}$ is the employment growth elasticity

Using the above definitions, we can rewrite the growth rate of output as;

$$y = \frac{p}{(1 - \varepsilon)} \quad (A1)$$

which shows that economic growth is a function of productivity growth and employment growth elasticity. The employment growth elasticity measures the extent to which a growth process is labor-intensive; the larger its value, the greater the degree of labor intensiveness. The growth process in developing countries is generally highly labor-intensive, suggesting that the value of employment growth elasticity is closer to 1; while the elasticity in industrialized countries, where growth is highly capital-intensive, is likely to be less than 0.5.

As can be seen in equation (A1), growth in human capital affects both productivity growth and the employment growth elasticity. The impact of human capital growth on the growth rate of labor productivity (p) can be traced through the production function. While many studies have attempted to measure the impact of human capital on labor productivity (e.g., Trostel, Walker, and Woolley 2002; Psacharopoulos and Patrinos 2004a), few studies have tried to capture the impact of human capital on employment growth elasticity. Our conjecture is that as human capital increases, employment growth elasticity will decrease, making the economy less labor-intensive and resulting in higher economic growth.

Employment growth elasticity tells us how much employment will be generated by growth in economic output. Jobless growth, which rapidly increases total output without generating enough jobs, increases the income of those who are employed at the cost of those who are unable to find work, thereby being bypassed by economic growth. Thus, employment growth elasticity is clearly an important indicator of economic development because it has implications for both inequality and poverty in a country.

Measuring the Direct Impact of Human Capital on Economic Growth

We can measure the impact of human capital on growth through the growth accounting model. For simplicity, let us assume a constant returns to scale production function:

$$Y = AK^\alpha [EH]^{1-\alpha} \quad (\text{A2})$$

where H is a measure of educational attainment, K is physical capital stock, and A is the level of technology. In addition, we can define the following growth rates:

$k = \Delta \ln(K/E)$ is the growth rate of physical capital per worker

$h = \Delta \ln(H)$ is the growth rate of human capital

$a = \Delta \ln(A)$ is the growth rate of total factor productivity due to technological advancement

From the production function in equation (A2), we can obtain:

$$p = \alpha k + (1 - \alpha)h + a \quad (\text{A3})$$

Using equations (A1) and (A3), we can derive $y = \varepsilon y + \alpha k + (1 - \alpha)h + a$, which on dividing by y gives the four sources of economic growth:

$$1 = \varepsilon + \frac{\alpha k}{y} + \frac{(1 - \alpha)h}{y} + \frac{a}{y} \quad (\text{A4})$$

Therefore, the total growth in output can be explained by four factors:

(i) ε measures the contribution of employment to growth: the larger its value, the more labor-intensive the pattern of growth is

(ii) $\frac{\alpha k}{y}$ measures the contribution of physical capital per worker

(iii) $\frac{(1 - \alpha)h}{y}$ measures the contribution of human capital

(iv) $\frac{a}{y}$ measures the contribution to growth due a change in total factor productivity

Using this proposed decomposition, we are able to quantify only the direct impact of growth in human capital on the growth rate of total output. Indirectly, human capital can impact the employment growth elasticity, but this decomposition is unable to capture this indirect impact. Our conjecture is that growth in human capital will reduce the magnitude of employment growth elasticity. This suggests that the net contribution of human capital to growth in total output will be less than the direct contribution of human capital as measured by the third term of equation (A4). It is also very likely that human capital will impact growth in total factor productivity, which occurs due to technological diffusion. An economy endowed with a highly skilled workforce is likely to have larger growth in total factor productivity. This is another indirect impact of human capital to growth that has not been researched in the literature.

REFERENCES

- Ahuja, V., and D. Filmer. 1996. "Educational Attainment in Developing Countries: New Estimates and Projections Disaggregated by Gender." *Journal of Economic Planning and Administration* 10(3):229–54.
- Ammermueller, A., and A. M. Weber. 2005. Educational Attainment and Returns to Education in Germany. Centre for European Economic Research Discussion Paper 05-017, Mannheim.
- Asadullah, M. 2006. "Returns to Education in Bangladesh." *Education Economics* 14(4):453–68.
- Azariadis, C., and A. Drazen. 1990. "Threshold Externalities in Economic Development." *Quarterly Journal of Economics* 105(2):501–26.
- Babini, A. M. 1991. "Convergence and Divergence of Education Systems in Today's World." *Prospects* 21(3):330–39.
- Barro, R. 1991. "Economic Growth in a Cross Section of Countries." *Quarterly Journal of Economics* 106(2):407–43.
- Barro, R., and J. W. Lee. 1996. "International Measures of Schooling Years and Schooling Quality." *American Economic Review* 86(2):218–33.
- _____. 2001. "International Data on Educational Attainment: Updates and Implications." *Oxford Economic Papers* 53(3):541–63.
- _____. 2010. A New Data Set of Educational Attainment in the World, 1950-2010. National Bureau of Economic Research Working Paper No. 15902, Massachusetts.
- Barro, R., and X. Sala-i-Martin. 1997. "Technological Diffusion, Convergence, and Growth." *Journal of Economic Growth* 2(1):1–26.
- Becker, G. 1962. "Investment in Human Capital: A Theoretical Analysis." *Journal of Political Economy* 70(5):9–49.
- Bils, M., and P. Klenow. 2000. "Does Schooling Cause Growth?" *American Economic Review* 90(5):1160–83.
- Bosworth, B., and S. Collins. 2003. "The Empirics of Growth: An Update." *Brookings Papers on Economic Activity* 2:113–207.
- Cohen, D. 1996. "Tests of the 'Convergence Hypothesis': Some Further Results." *Journal of Economic Growth* 1(3):351–61.
- Cohen, D., and M. Soto. 2007. "Growth and Human Capital: Good Data, Good Results." *Journal of Economic Growth* 12:51–76.
- Collins, S. 2007. "Economic Growth in South Asia: A Growth Accounting Perspective." In S. Ahmed and E. Ghani, eds., *South Asia: Growth and Regional Integration*. World Bank, Washington, DC.
- Das Gupta, M. 1987. "Selective Discrimination against Female Children in Rural Punjab, India." *Population and Development Review* 13(1):77–100.
- Duraisamy, P. 2002. "Changes in Returns to Education in India, 1983-94: By Gender, Age-Cohort and Location." *Economics of Education Review* 21(6):609–22.
- Estudillo, J., A. Quisumbing, and K. Otsuka. 2001. "Gender Differences in Land Inheritance and Schooling Investments in the Rural Philippines." *Land Economics* 77(1):130–43.
- Filmer, D., E. King, and L. Pritchett. 1998. Gender Disparity in South Asia: Comparisons between and within Countries. World Bank Research Paper. Available: www.worldbank.org/html/prddr/prdhome/projects/gender/sasgdis.pdf.

- Hanushek, E., and D. Kimko. 2000. "Schooling, Labor Force Quality, and the Growth of Nations." *American Economic Review* 90(5):1184–208.
- Hanushek, E., and L. Woessmann. 2009. Do Better Schools Lead to More Growth? Cognitive Skills, Economic Outcomes, and Causation. NBER Working Paper No. 14633, National Bureau of Economic Research, Massachusetts.
- Harmon, C., H. Oosterbeek, and I. Walker. 2003. "The Returns to Education: Microeconomics." *Journal of Economic Surveys* 17:115–56.
- Hung, C-Y. 2008. "Overeducation and Undereducation in [Taipei,China]." *Journal of Asian Economics* 19(2):125–37.
- Klasen, S. 2002. "Low Schooling for Girls, Slower Growth for All? Cross-Country Evidence on the Effect of Gender Inequality in Education on Economic Development." *World Bank Economic Review* 16(3):345–73.
- Krueger, A., and M. Lindahl. 2001. "Education for Growth: Why and For Whom?" *Journal of Economic Literature* 39(4): 1101–36.
- Lange, F., and R. Topel. 2006. "The Social Value of Education and Human Capital." In E. Hanushek and F. Welsh, eds., *Handbook of the Economics of Education*, Volume 1. Amsterdam: Elsevier.
- Lavy, V. 2008. "Do Gender Stereotypes Reduce Girls' or Boys' Human Capital Outcomes? Evidence from a Natural Experiment." *Journal of Public Economics* 92:2083–105.
- Li, F., W. J. Morgan, and X. Ding. 2008. "The Expansion of Higher Education, Employment, and Overeducation in China." *International Journal of Educational Development* 28:678–97.
- Li, H., P. Liu, N. Ma, and J. Zhang. 2005. Does Education Pay in Urban China? Estimating Returns to Education Using Twins. Discussion Papers 00013, Department of Economics, Chinese University of Hong Kong, Hong Kong, China.
- Lucas, R. 1988. "On the Mechanics of Economic Development." *Journal of Monetary Economics* 22(1):3–42.
- Mankiw, N. G., D. Romer, and D. Weil. 1992. "A Contribution to the Empirics of Economic Growth." *The Quarterly Journal of Economics* 107(2):407–37.
- Mincer, J. 1974. *Schooling, Experience, and Earnings*. National Bureau of Economic Research, Massachusetts.
- Nelson, R., and E. Phelps. 1966. "Investment in Humans, Technological Diffusion, and Economic Growth." *American Economic Review* 56(1):69–75.
- Pastore, F. 2009. "School-to-Work Transitions in Mongolia." *European Journal of Comparative Economics* 6(2):245–64.
- Pritchett, L. 1996. Where Has All the Education Gone? World Bank Policy Research Working Paper 1581, Washington, DC.
- Psacharopoulos, G., and H. Patrinos. 2004a. "Returns to Investment in Education: A Further Update." *Education Economics* 12(2):111–34.
- _____. 2004b. "Human Capital and Rates of Return." In G. Johnes and J. Johnes, eds., *International Handbook on the Economics of Education*. Cheltenham: Edward Elgar Publishing, Inc.
- Romer, P. 1990. "Endogenous Technological Change." *Journal of Political Economy* 98(5):S71–102.
- Sab, R., and S. Smith. 2002. "Human Capital Convergence: A Joint Estimation Approach." *IMF Staff Papers* 49(2):200–11.

- Sakellariou, C. 2008. Demand for Skills, Supply of Skills, and Returns to Schooling in Cambodia. Economic Growth Centre, Nanyang Technological University Working Paper No. 2008/05, Singapore.
- Schady, N. 2003. "Convexity and Sheepskin Effects in the Human Capital Earnings Function: Recent Evidence for Filipino Men." *Oxford Bulletin of Economics and Statistics* 65(2):171–96.
- Schultz, T. P. 2004. "Evidence of Returns to Schooling in Africa from Household Surveys: Monitoring and Restructuring the Market for Education." *Journal of African Economies* 13(Suppl.1):ii95–148.
- Schultz, T. W. 1963. *The Economic Value of Education*. New York: John Wiley.
- Sicherman, N. 1991. "Overeducation in the Labor Market." *Journal of Labor Economics* 9(2): 101–22.
- Solow, R. 1956. "A Contribution to the Theory of Economic Growth." *Quarterly Journal of Economics* 70(1):65–94.
- Son, H. H. 2008. Explaining Growth and Inequality in Factor Income: The Philippines Case. ADB Economics Working Paper Series No. 120, Economics and Research Department, Asian Development Bank.
- _____. 2009. "Human Capital." In D. Canlas, M. E. Khan, and J. Zhuang, eds., *Diagnosing the Philippine Economy: Toward Inclusive Growth*. London: Anthem Press.
- Spence, M. 1973. "Job Market Signaling." *Quarterly Journal of Economics* 87(3):355–74.
- Stevens, P., and M. Weale. 2004. "Education and Economic Growth." In G. Johnes and J. Johnes, eds., *International Handbook on the Economics of Education*. Cheltenham: Edward Elgar Publishing, Inc.
- Strauss, H., and C. de la Maisonneuve. 2007. The Wage Premium on Tertiary Education: Micro-data Evidence for 21 OECD Countries. OECD Economics Department Working Papers No. 256, Paris.
- Trostel, P., I. Walker, and P. Woolley. 2002. "Estimates of the Economic Return to Schooling for 28 Countries." *Labour Economics* 9:1–16.
- Turner, C., R. Tamura, S. Mulholland, and S. Baier. 2007. "Education and Income of the States of the United States: 1840–2000." *Journal of Economic Growth* 12(2):101–58.
- Vella, F. 1994. "Gender Roles and Human Capital Investment: The Relationship between Traditional Attitudes and Female Labour Market Performance." *Economica* 61(242):191–211.
- Zhang, J., Y. Zhao, A. Park, and X. Song. 2005. "Economic Returns to Schooling in Urban China, 1988 to 2001." *Journal of Comparative Economics* 33(4):730–52.

Asian Regional Income, Growth, and Distribution to 2030

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As Asia consolidates the economic gains and policy lessons of two generations, it can look to a bright future of sustained growth. More effective policies will even accelerate this growth, provided they recognize the essential agents of trade and productivity growth, as well as the importance of promoting domestic regional demand. Rising incomes promise greater homegrown demand for domestic producers and essential diversification for regional exporters.

This study surveys historical income distribution data from 22 Asian economies, projects the emergence of middle classes in the next 20 years, and examines its role in Asian economies. The study also examines the drivers of growth over this period using a dynamic computable general equilibrium (CGE) model to forecast GDP and consumption trends.

The findings suggest that Asia can sustain and even accelerate current patterns of poverty reduction and livelihood advancement beyond poverty. Over the next 20 years, about 1 billion people will be added to the 2.7 billion Asian middle class (based on \$2-a-day PPP standard). The rate of middle class emergence will be uneven across the region and will depend mostly on initial conditions.

The results also suggest that energy price vulnerability is a critical risk to regional growth—and calls for energy efficiency measures to insure against this risk. The agricultural productivity growth can improve both the incomes of the majority of Asia's rural poor and the purchasing power of urbanites. Policies that reduce both energy and food costs can therefore be a potent source of new demand for products and services as well as jobs.

Finally, given the importance of labor resources to Asian growth, skills development is the most critical prerequisite for realizing the vast economic potential of Asia. Higher incomes, a larger middle class, and self-sustaining prosperity can only be built on the foundation of a skilled and productive labor force that captures significant value added and channels higher incomes into sustained long-term expenditure, savings, and investment.

JEL classification: O15, O4, O53

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I. INTRODUCTION

Asia's fast economic progress over the last five decades, i.e., from 1960-2010, has firmly established Asia as a model for growth and prosperity as driven by multilateral trade. The rest of the world now looks at the many facets of the "Asian Miracle" for essential lessons in entrepreneurship, savings-driven enterprise development, public sector fiscal responsibility, public goods provision, industrial leadership and, above all, effective trade promotion for growth and modernization. These successes have now matured in some Asian economies, where middle class majorities are facilitating post-industrial transition to more service-oriented economies.

Over the next two decades, the prospects for emerging Asia remain bright, and this continued success will pose new challenges and opportunities as sustained economic growth fosters changing patterns of economic activity and resource use. Here we focus on the forthcoming developments that are related to middle class emergence.

The middle class, which in western Organisation for Economic Co-operation and Development (OECD) economies was the primary driver of historical Asian export growth, has now begun to offer new and rapidly emerging home markets for local producers. In addition, other new developments have emerged. First, homegrown demand changes the nature of macroeconomic management, especially the fiscal and monetary characteristics of aggregate demand management.

Second, the demographic scale of the middle class in emerging Asia may grow far beyond that of the previous generation. This means that Asian markets will further become more attractive not only to the firms in the region, but also to a growing number of multinationals that have established themselves in western markets. Thus, multilateralism from an Asian perspective will be as much about granting market access as about gaining it, and about new directions in supply chain partnerships, cross holdings, and joint ventures.

Third, the new middle class will fundamentally change the demands of their own societies, with growing emphasis on durables, services, and accumulation of assets. To accommodate these changes, the economic structures of Asian economies will have to adapt significantly. It may require a shift to post-industrial, higher value-added enterprise systems using more skill-intensive technologies that can sustain higher long-term wages.

Finally, rising regional incomes will build deeper reserves of aggregate savings, which will, in turn, require more extensive and diverse placement to yield reasonable rates of return. Until now, a significant portion of this allocation burden has fallen on western financial markets, sometimes with unwelcome consequences. In the long run, Asia must more effectively use its own investment resources and provide the infrastructure and private investment needed to support

broader regional development and sustained growth. This will require a dramatically larger capacity for bond and equity finance, which will ultimately be embedded in a new universe of more highly articulated Asian financial services.

The potential of all these developments for raising living standards is great, particularly for the majority of Asia's population that remains poor today. Inequality, both within and between Asian countries, has risen along with average incomes in this first phase of regional emergence, as early growth paragons, especially large cities, has captured the leading edge of globalization.

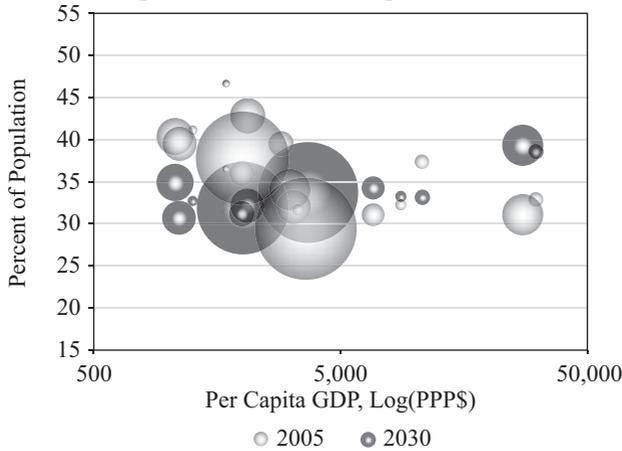
Asia now recognizes that more determined commitments to regionalism offer more opportunities for diversification in production, as well as superior economic gains from regionalism. With the aging population, and fiscal and financial uncertainties that challenge its traditional export markets, Asia needs a new source of trade growth. Fortunately, its economies have sustained the highest growth rates in the world for over a decade since the Asian financial crisis in 1997/98. With the right policy environment, the emergence of a regional middle class will accelerate this growth and diversify its markets in valuable ways.

Stronger commitments to open multilateralism are required, as access to Asian market becomes as valuable to Asian economies as its access to western market. If policy makers can deliver the right combination of hard and soft infrastructure, vast economic potential can be realized. Many of the pillars of the regional growth sources will be from the poorest Asian economies. More open multilateralism across Asia will be more inclusive, and this will propagate growth dividends where they are needed most, facilitating the economic convergence necessary to underwrite long-term economic and political stability.

In this study, the role of the middle class in Asia's economy is examined. In particular, historical income distribution data from 22 countries are surveyed and fitted econometrically to lognormal distributions to study how the income landscape has evolved in recent decades. These data are then calibrated to a dynamic global computable general equilibrium (CGE) model to project regional economic growth out to 2030 under different scenarios. In each scenario, the role of and effects on the middle class are examined in detail.

As this empirical work will demonstrate, innovation, diffusion, and adoption or investment in technologies that promote skill-intensive development and growth are essential elements of Asia's strategy to sustain its strong growth. The current challenge for Asia's lower and middle income economies is to recruit a large rural labor force into the formal sector, with an emphasis on creating a large number of jobs. This emphasis must shift toward job quality, value added, and development of skills and productivity that can sustain higher incomes as populations age because of declining birth rates and rising longevity. This poses an important challenge for most of the region's economies (Figure 1).

Figure 1. **Aging Asia: Age-Income Profiles across Asia**
Dependent Share of the Population (%)

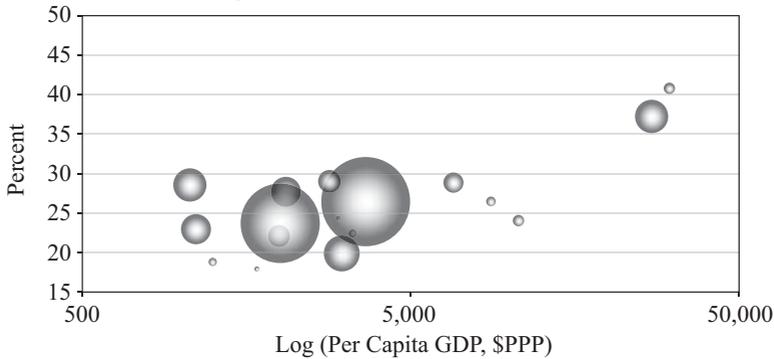


GDP = gross domestic product, PPP = purchasing power parity.

Note: Based on percent and log GDP per capita, respectively. The bubble diameter is proportional to national population.

Source: Authors' calculations from official data.

Figure 2. **Share of Skilled Workers**



GDP = gross domestic product, PPP = purchasing power parity.

Source: Authors' calculations from GTAP 7 database.

In a world where capital is internationally mobile, the only long-run justification for higher wages is higher labor productivity. This underlies much of Asia's success in income growth (Ravallion and Chen 2008). It also highlights the importance of education and human capital skills development to become the priority of the economies in the region. At the same time, human capital investments are needed to facilitate poverty reduction and reduce inequality. The literature on poverty shows that labor market access is the primary gateway to sustainable, higher living standards for the majority of the world's poor (Bardhan

1997, Carter and Barrett 2006, Dollar and Kraay 2001, Jalan and Ravallion 1998, Morduch 1998). Moreover, as country conditions improve substantially, a consensus emerges against extremes of inequality (Rawls 1971, Hirschman and Rothschild 1973, Atkinson 1995, Roemer 1998, and Persson and Tabellini 1994).

The next section presents a brief historical survey of regional income distribution and lessons learned. This is followed by a presentation of baseline projections in Section III and the regional forecast analysis in Section IV. Section V introduces the simulation scenarios, while Section VI discusses their results. The concluding section synthesizes discussions and presents policy implications.

II. RECENT HISTORY OF REGIONAL INCOME DISTRIBUTION

By nearly every economic or social indicator, Asia is an extremely diverse region. While diversity can support more effective market competitiveness and resource allocation efficiency, greater similarities are more desirable in other aspects.

Economies with sustained records of livelihood improvement can become good models for others. In the long run, divergence in per capita GDP growth can also lead to unwelcome regional disparities. Spatial economic integration has many advantages (Rodrik 2008, World Bank 1990); the challenge is to identify and promote the right facilitating policies to capture, sustain, and propagate such benefits across diverse regions.

On the supply side, enlargement of the market encourages competition and confers growth externalities between neighbors. Although Asia has been very competitive in shipping goods to western markets, a more complete regional integration toward greater market access and economic convergence will require investments in physical infrastructure, such as the Greater Mekong Subregion (GMS) corridor system, to overcome remaining trade and transport barriers. Since these barriers mostly affect low-income countries in the region, removing them will greatly benefit these countries.

Meanwhile, in addition to the spillovers effects of domestic growth (i.e., increased foreign direct investment and proliferation of regional supply chains), with greater labor mobility in the region, many low-income Asian economies will reap greater employment, income, and saving opportunities through migration and remittances (Adams 1991).

On the demand side, the emergence of the middle class in Asia could support the benefits from open regionalism that accrue due to both diversity and homogeneity of its economies. This is the opposite of the classical Ricardian supply-side case for expanding trade. As incomes rise, consumers diversify their tastes. Enlarging markets across more diverse economies will help satisfy these tastes more cost effectively. Also, even if regional economies are homogenous, as

in the European Union, an enlargement of the market offers economies of scale that can make product differentiation cost effective.

Table 1. Descriptive Statistics on Income Distribution in Asia (US \$)

| Country | Year | Mean | Mode | Median | Std. Dev. |
|-------------------------------------------|------|-------|-------|--------|-----------|
| Armenia | 1990 | 2,340 | 1,185 | 1,865 | 1,772 |
| | 1995 | 2,679 | 1,363 | 2,139 | 2,022 |
| | 2000 | 3,155 | 1,613 | 2,523 | 2,369 |
| | 2005 | 4,513 | 2,323 | 3,617 | 3,368 |
| Azerbaijan (Baku) | 1990 | 6,051 | 4,618 | 5,530 | 2,688 |
| | 1995 | 3,852 | 3,004 | 3,546 | 1,635 |
| | 2000 | 4,000 | 3,110 | 3,678 | 1,709 |
| | 2005 | 7,228 | 5,817 | 6,723 | 2,853 |
| Azerbaijan (Other Urban) | 1990 | 3,613 | 2,837 | 3,333 | 1,511 |
| | 1995 | 2,392 | 1,895 | 2,213 | 980 |
| | 2000 | 2,481 | 1,962 | 2,294 | 1,020 |
| | 2005 | 4,502 | 3,447 | 4,119 | 1,987 |
| Azerbaijan (Rural) | 1990 | 2,761 | 2,194 | 2,557 | 1,123 |
| | 1995 | 1,809 | 1,465 | 1,687 | 703 |
| | 2000 | 1,884 | 1,519 | 1,754 | 740 |
| | 2005 | 3,332 | 2,655 | 3,089 | 1,347 |
| Bangladesh | 1990 | 669 | 302 | 513 | 560 |
| | 1995 | 706 | 327 | 546 | 579 |
| | 2000 | 760 | 362 | 594 | 608 |
| | 2005 | 1,009 | 500 | 798 | 781 |
| Brazil (Major Cities) | 1990 | 6,077 | 866 | 3,174 | 9,924 |
| | 1995 | 6,777 | 987 | 3,565 | 10,954 |
| | 2000 | 6,941 | 1,025 | 3,669 | 11,146 |
| | 2005 | 7,454 | 1,149 | 3,997 | 11,733 |
| Brazil (Other Urban) | 1990 | 4,947 | 628 | 2,486 | 8,508 |
| | 1995 | 5,268 | 674 | 2,654 | 9,033 |
| | 2000 | 5,317 | 683 | 2,683 | 9,098 |
| | 2005 | 5,596 | 755 | 2,870 | 9,365 |
| Brazil (Rural) | 1990 | 3,449 | 422 | 1,712 | 6,033 |
| | 1995 | 3,618 | 444 | 1,798 | 6,320 |
| | 2000 | 3,710 | 455 | 1,844 | 6,479 |
| | 2005 | 3,974 | 511 | 2,006 | 6,793 |
| Cambodia | 1990 | 705 | 274 | 514 | 661 |
| | 1995 | 806 | 307 | 584 | 767 |
| | 2000 | 954 | 373 | 698 | 891 |
| | 2005 | 1,552 | 691 | 1,185 | 1,313 |
| People's Republic of China | 1990 | 810 | 229 | 532 | 930 |
| | 1995 | 1,174 | 294 | 740 | 1,446 |
| | 2000 | 1,685 | 406 | 1,049 | 2,118 |
| | 2005 | 2,723 | 644 | 1,683 | 3,461 |
| People's Republic of China (Major Cities) | 1990 | 1,257 | 314 | 792 | 1,549 |
| | 1995 | 1,797 | 457 | 1,139 | 2,195 |
| | 2000 | 2,564 | 662 | 1,632 | 3,106 |
| | 2005 | 4,183 | 1,001 | 2,596 | 5,282 |
| People's Republic of China (Other Urban) | 1990 | 1,003 | 274 | 650 | 1,176 |
| | 1995 | 1,379 | 365 | 885 | 1,647 |
| | 2000 | 1,856 | 514 | 1,210 | 2,159 |
| | 2005 | 2,877 | 777 | 1,859 | 3,396 |

Continued.

Table 1. *Continued.*

| Country | Year | Mean | Mode | Median | Std. Dev. |
|------------------------------------|-------------|-------------|-------------|---------------|------------------|
| People's Republic of China (Rural) | 1990 | 692 | 220 | 472 | 741 |
| | 1995 | 981 | 271 | 639 | 1,142 |
| | 2000 | 1,368 | 363 | 879 | 1,633 |
| | 2005 | 2,065 | 567 | 1,342 | 2,414 |
| Georgia | 1990 | 4,670 | 1,438 | 3,154 | 5,101 |
| | 1995 | 2,115 | 677 | 1,446 | 2,255 |
| | 2000 | 3,056 | 957 | 2,075 | 3,304 |
| | 2005 | 4,672 | 1,438 | 3,155 | 5,105 |
| India | 1990 | 1,044 | 444 | 785 | 915 |
| | 1995 | 1,121 | 474 | 842 | 987 |
| | 2000 | 1,336 | 586 | 1,015 | 1,142 |
| | 2005 | 1,799 | 759 | 1,349 | 1,587 |
| Indonesia | 1990 | 1,356 | 609 | 1,039 | 1,138 |
| | 1995 | 1,835 | 839 | 1,414 | 1,518 |
| | 2000 | 1,928 | 895 | 1,493 | 1,576 |
| | 2005 | 2,634 | 1,234 | 2,046 | 2,137 |
| Kazakhstan | 1990 | 6,566 | 3,182 | 5,157 | 5,173 |
| | 1995 | 4,837 | 2,321 | 3,787 | 3,845 |
| | 2000 | 4,944 | 2,365 | 3,867 | 3,940 |
| | 2005 | 6,035 | 2,897 | 4,725 | 4,794 |
| Lao People's Democratic Republic | 1990 | 1,014 | 512 | 807 | 771 |
| | 1995 | 1,184 | 592 | 940 | 908 |
| | 2000 | 1,107 | 553 | 878 | 849 |
| | 2005 | 1,335 | 657 | 1,054 | 1,038 |
| Malaysia | 1990 | 4,452 | 1,247 | 2,913 | 5,146 |
| | 1995 | 5,296 | 1,510 | 3,485 | 6,057 |
| | 2000 | 5,060 | 1,422 | 3,314 | 5,838 |
| | 2005 | 6,158 | 1,781 | 4,073 | 6,985 |
| Mongolia | 1990 | 1,790 | 589 | 1,236 | 1,876 |
| | 1995 | 1,372 | 442 | 940 | 1,457 |
| | 2000 | 1,761 | 572 | 1,210 | 1,860 |
| | 2005 | 1,846 | 599 | 1,268 | 1,952 |
| Nepal | 1990 | 687 | 221 | 471 | 731 |
| | 1995 | 696 | 222 | 476 | 742 |
| | 2000 | 784 | 246 | 532 | 846 |
| | 2005 | 909 | 284 | 617 | 983 |
| Pakistan | 1990 | 1,622 | 894 | 1,330 | 1,132 |
| | 1995 | 1,864 | 1,038 | 1,533 | 1,288 |
| | 2000 | 1,921 | 1,068 | 1,580 | 1,331 |
| | 2005 | 2,745 | 1,525 | 2,257 | 1,902 |
| Papua New Guinea | 1990 | 824 | 213 | 524 | 997 |
| | 1995 | 768 | 202 | 492 | 921 |
| | 2000 | 735 | 196 | 473 | 875 |
| | 2005 | 1,095 | 276 | 692 | 1,343 |
| Philippines | 1990 | 2,012 | 563 | 1,316 | 2,326 |
| | 1995 | 2,089 | 587 | 1,369 | 2,409 |
| | 2000 | 2,131 | 600 | 1,397 | 2,456 |
| | 2005 | 2,520 | 693 | 1,639 | 2,942 |

Continued.

Table 1. *Continued.*

| Country | Year | Mean | Mode | Median | Std. Dev. |
|------------------------------|-------------|-------------|-------------|---------------|------------------|
| Sri Lanka | 1990 | 2,703 | 1,470 | 2,206 | 1,914 |
| | 1995 | 1,993 | 1,083 | 1,627 | 1,412 |
| | 2000 | 2,261 | 1,237 | 1,849 | 1,591 |
| | 2005 | 3,852 | 2,060 | 3,127 | 2,771 |
| Tajikistan | 1990 | 2,294 | 1,144 | 1,819 | 1,763 |
| | 1995 | 961 | 455 | 749 | 773 |
| | 2000 | 1,234 | 622 | 982 | 939 |
| | 2005 | 1,578 | 815 | 1,266 | 1,174 |
| Thailand | 1990 | 3,102 | 1,137 | 2,220 | 3,027 |
| | 1995 | 3,890 | 1,438 | 2,792 | 3,776 |
| | 2000 | 4,050 | 1,491 | 2,903 | 3,940 |
| | 2005 | 4,967 | 1,912 | 3,613 | 4,686 |
| Timor-Leste | 1990 | 712 | 314 | 542 | 607 |
| | 1995 | 950 | 458 | 745 | 752 |
| | 2000 | 668 | 296 | 509 | 568 |
| | 2005 | 805 | 354 | 612 | 688 |
| United States (Major Cities) | 1990 | 19,641 | 11,769 | 16,558 | 12,529 |
| | 1995 | 19,976 | 12,263 | 16,978 | 12,386 |
| | 2000 | 20,863 | 13,623 | 18,099 | 11,960 |
| | 2005 | 21,510 | 14,707 | 18,949 | 11,553 |
| United States (Other Urban) | 1990 | 18,320 | 10,100 | 15,022 | 12,789 |
| | 1995 | 18,890 | 10,795 | 15,676 | 12,701 |
| | 2000 | 19,762 | 12,005 | 16,737 | 12,407 |
| | 2005 | 20,374 | 12,881 | 17,486 | 12,182 |
| United States (Rural) | 1990 | 17,575 | 9,291 | 14,211 | 12,789 |
| | 1995 | 18,103 | 9,858 | 14,783 | 12,795 |
| | 2000 | 19,033 | 10,983 | 15,846 | 12,665 |
| | 2005 | 19,650 | 11,819 | 16,587 | 12,481 |
| Uzbekistan | 1990 | 1,218 | 716 | 1,021 | 794 |
| | 1995 | 743 | 422 | 615 | 503 |
| | 2000 | 991 | 586 | 832 | 642 |
| | 2005 | 1,270 | 755 | 1,068 | 817 |
| Viet Nam | 1990 | 989 | 427 | 747 | 857 |
| | 1995 | 1,037 | 452 | 786 | 892 |
| | 2000 | 1,146 | 522 | 882 | 951 |
| | 2005 | 1,815 | 853 | 1,411 | 1,469 |
| World | 1990 | 4,816 | 173 | 1,589 | 13,781 |
| | 1995 | 4,779 | 221 | 1,716 | 12,423 |
| | 2000 | 5,029 | 267 | 1,889 | 12,407 |
| | 2005 | 5,705 | 411 | 2,374 | 12,466 |

Note: Std. Dev = standard deviation of income.

Source: Canback-Dangel, 2010.

The demand of the expanding middle class in the region will compete with the exports demand, and will eventually become the main driver of growth in the region, as well as a key determinant of economic structure. To better understand how this transition will occur, the historical and projected future trends in Asian income distribution in 22 economies in the region are analyzed and summarized in this section.

We look at recent history, which is most relevant given the rapid economic changes that have taken place in Asia. Therefore, to analyze the reciprocal links between economic growth and income distribution, historical data on income distribution by decile in 22 economies from 2010 to 2030 for Asian and other prominent economies and regions were drawn from the World Bank’s Global Income Distribution Database (GIDD) and fitted econometrically to continuous lognormal distributions. Parameter estimates were then used to estimate income distribution trends by country and calibrated to a CGE model to predict middle class emergence trends across Asia. The estimation technique is described in Box 1.

Box 1. Estimation Technique

Using data from the Canback-Dangel Global Income Distribution Database (GIDD) we econometrically estimated the parameters of lognormal distributions of 34 Asian and other related economies.¹ The lognormal distribution has a continuous distribution function

$$F(x) = 1 - N\left(\frac{\ln x - m}{v}\right) \tag{1}$$

where m and v are mean and variance parameters, each positive, for positive random variable (income per capita) $x > 0$. The probability density function is

$$f(x) = \frac{1}{x\sqrt{2\pi v^2}} e^{-\frac{(\ln x - m)^2}{2v^2}} \tag{2}$$

The likelihood function for a sample of observations x is specified as the product of the densities for each observation (weighted where relevant for grouping), and is maximized using a nonlinear solution algorithm in STATA program.

The formulas used to derive the distributional summary statistics are as follows. The r -th moment about the origin is given by

$$m_r = e^{\left(m + \frac{r^2 v}{2}\right)}. \tag{3}$$

Hence, $mean = m_1 = e^{\left(m + \frac{v^2}{2}\right)}$ and $variance = m_2 = p(p-1)e^{(2m)}$, where $p = e^{v^2}$ from which the standard deviation and half of the squared coefficient of variation can be derived. The mode is $mode = e^{(m-v^2)}$.

The quantiles q_i are derived by inverting the distribution function:

$$x_i = e^{\left(m + vN^{-1}(q_i)\right)} \text{ for each } q_i = F(x_i). \tag{4}$$

The Gini coefficient of inequality is given by

$$Gini = 2N\left(\frac{v}{\sqrt{2}}\right) - 1. \tag{5}$$

¹The information from this database are proprietary.

III. BASELINE PROJECTIONS OF INCOME DISTRIBUTIONS

This section looks at how income distributions in Asian economies are expected to shift with growth and structural change in Asia over the next 20 years, with focus on middle class emergence.

We calibrate a global CGE forecasting model with a 2005 reference global database obtained from the Global Trade Analysis Project (GTAP) Version 7 to a business-as-usual baseline policy environment. The baseline comprises forecasts for real gross domestic product (GDP) growth by country over 2010–2030, as assembled by the World Bank and presented in its annual Global Economic Prospects reports. We focus on 16 countries, 5 regions, and 10 sectors listed in Table 2².

Table 2. **Classifications of Countries, Regions, and Sectors**

| Country | |
|----------------|-----------------------------------|
| 1 | Australia and New Zealand |
| 2 | Bangladesh |
| 3 | People's Republic of China |
| 4 | Georgia |
| 5 | Indonesia |
| 6 | India |
| 7 | Kazakhstan |
| 8 | Cambodia |
| 9 | Lao People's Democratic Republic |
| 10 | Sri Lanka |
| 11 | Malaysia |
| 12 | Pakistan |
| 13 | Philippines |
| 14 | Thailand |
| 15 | United States |
| 16 | Viet Nam |
| Region | |
| 1 | Europe-27 |
| 2 | High Income Asia |
| 3 | Latin America and the Caribbean |
| 4 | Rest of Asia |
| 5 | Rest of the World |
| Sector | |
| 1 | Crops |
| 2 | Livestock and Fishery |
| 3 | Energy Extraction and Exploration |
| 4 | Other Minerals and Mining |
| 5 | Processed Food |
| 6 | Textiles and Apparel |
| 7 | Light Manufacturing |
| 8 | Heavy Manufacturing |
| 9 | Utilities |
| 10 | Services |

²The GTAP database contains detailed information on the economic structure and trade flows for 57 sectors in 118 countries and regions.

Using our parameters estimates in the previous section and our calibrated global CGE model we forecast the emergence of the middle classes in our sample economies over the next two decades.

Estimates of absolute and relative sizes of the middle classes in our sample countries, corresponding to each of the following four alternative definitions of middle class threshold are presented in Figures 3, 4, and 5:

1. Mean – population whose per capita incomes are greater than 75% of the national mean.
2. Median – population whose per capita incomes are greater than 75% of the national median.³ For a lognormal distribution such as the one used to model income composition in this exercise, the median threshold qualifies approximately 80% of the domestic population (at different poverty lines in different countries).⁴
3. >\$2-a-day PPP (Purchasing Power Parity) Standard – population whose per capita daily income exceeds \$2-a-day.
4. >\$4-a-day PPP Standard – population whose per capita daily income exceeds \$4-a-day.

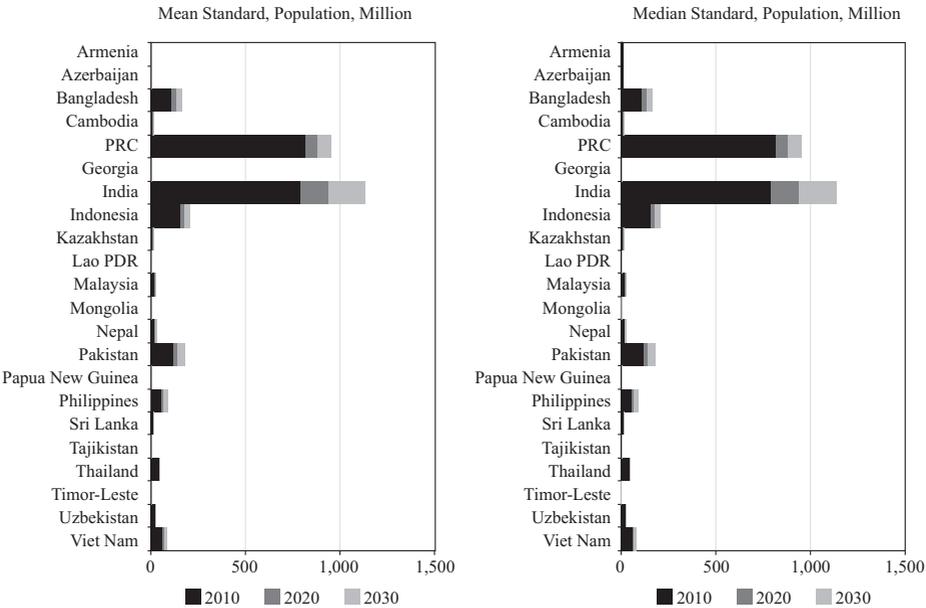
As these figures suggest, consensus growth estimates for Asia are relatively optimistic, not only for aggregate real growth but also in terms of the scope of growth's benefits. If middle class status can be interpreted as exiting poverty, then approximately 1 billion more people in Asia will be above the \$2-a-day poverty threshold by 2030, adding to the 2.7 billion people above this level in 2010.

The mean and median thresholds are measured relative to each country's income distribution. As such, these represent fairly constant proportions of own population. Nonetheless, the total number of people above 75% of either income milestone gives a concrete idea about the distribution of middle-income status across the region. As would be expected, because mean income is usually above median, the income group below the mean is uniformly larger, and for demographic reasons, the People's Republic of China (PRC) and India dominate regional emerging middle class status (see Figure 3).

³The first two standards are variants of poverty lines defined by Birdsall, Graham, and Pettinato (2000).

⁴The 20th percentile threshold was popularized first by Kuznets (1966) and more recently by Easterley (2001).

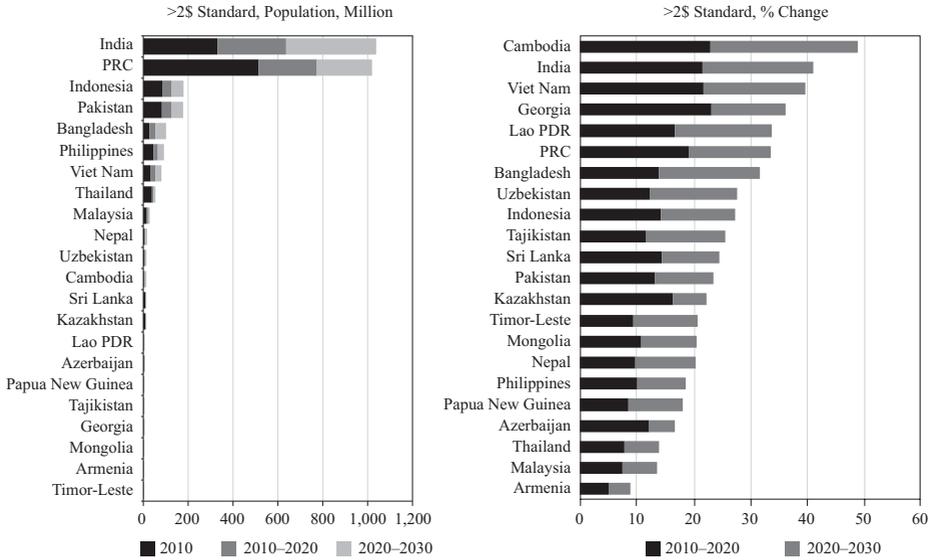
Figure 3. Middle Class Emergence to 2030 based on Mean and Median Standards



PRC = People’s Republic of China, Lao PDR = Lao People’s Democratic Republic, PNG = Papua New Guinea. Source: Authors’ estimates.

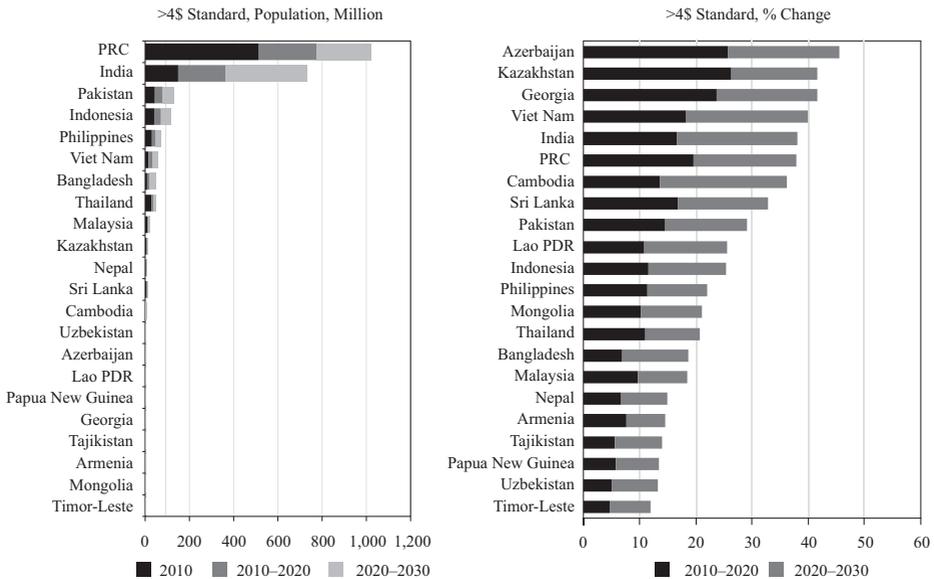
In contrast, absolute income thresholds can be compared across countries in terms of population share. As Figures 4 and 5 show, Asian Development Bank’s (ADB) developing member countries (DMCs) are at various stages of middle class emergence. In some countries, now approaching middle-income majorities, over 75% of their population will be in this category by 2030, even after accounting for inflation. Between now and 2030, under the baseline scenario, the baseline gross domestic product (GDP) growth is expected to more than double the share of those with income of \$2 or more per day in the largest countries (i.e. PRC and India). Some lower income countries, such as Cambodia and Lao People’s Democratic Republic, will see an even greater share in income growth for the middle income group—evidence of the pro-poor nature of the regional economic growth and integration process. However, other countries, such as Timor-Leste and Uzbekistan, will likely see only a modest enlargement of the middle class unless complementary policies are put in place, such as more extensive infrastructure development and trade facilitation.

Figure 4. Middle Class Emergence to 2030 based on >\$2-a-day Standard (Million)



PRC = People’s Republic of China, Lao PDR = Lao People’s Democratic Republic, PNG = Papua New Guinea. Source: Authors’ estimates.

Figure 5. Middle Class Emergence to 2030 based on \$4-a-day Standard (Million)



PRC = People’s Republic of China, Lao PDR = Lao People’s Democratic Republic, PNG = Papua New Guinea. Source: Authors’ estimates.

Countries with higher levels of per capita energy resource endowments can expect to benefit substantially from sustained regional growth. Countries with majorities already at \$2-a-day PPP or above (Malaysia and Thailand) will manage a sustained enlargement of these groups, on that modestly outpaces population growth.

Table 3 shows the emergence of the Asian middle class in the next 20 years, in terms of the four thresholds described earlier. Both the mean and median standards are relative to domestic economic conditions, and therefore merely reflect absolute demographic size of Asia in global population. The absolute (2005 PPP) middle class thresholds, however, can be used for international comparisons.

Table 3. **Percentage of Emerging Asian Population in the Global Higher Income**

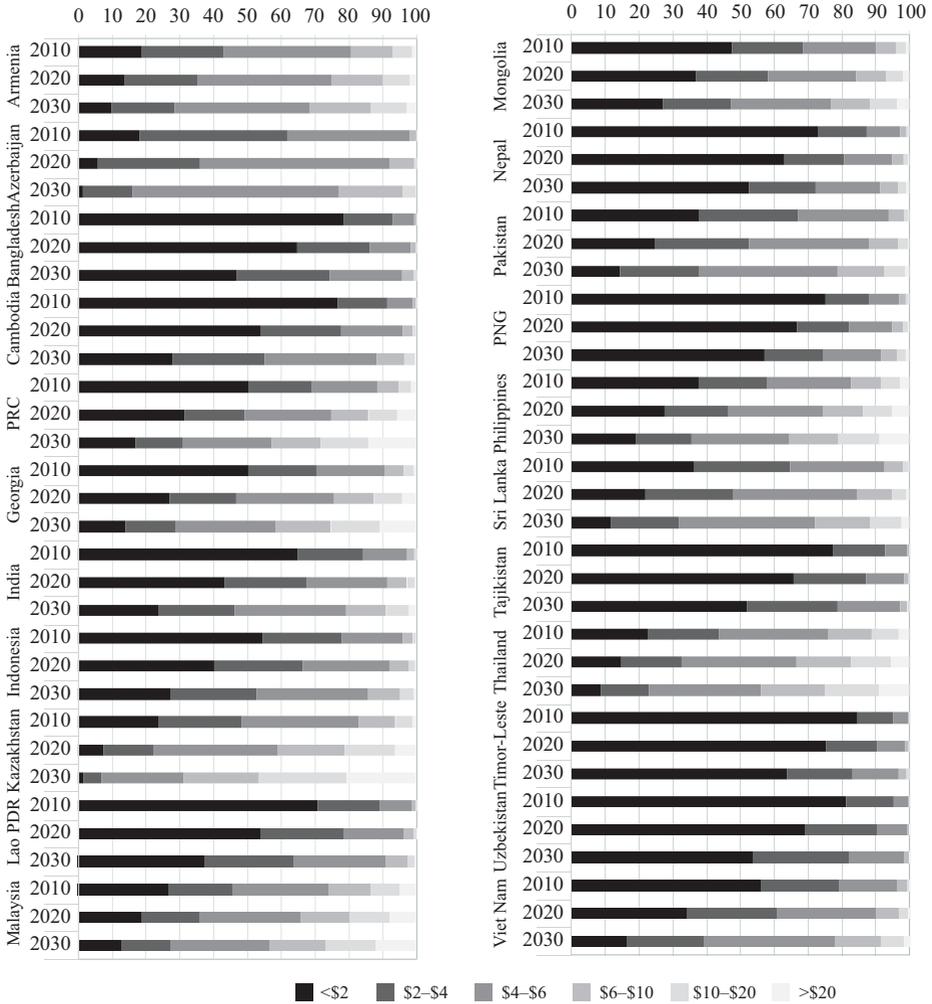
| Standard | 2010 | 2020 | 2030 |
|-----------------|-------------|-------------|-------------|
| Mean | 60 | 63 | 67 |
| Median | 52 | 55 | 60 |
| >\$2.00 | 25 | 39 | 55 |
| >\$4.00 | 11 | 22 | 39 |

Source: Authors' estimates.

The table shows that the share the global middle class in emerging Asia will more than double by 2030 for the \$2-a-day threshold and will more than triple for the \$4-a-day threshold. The basic message of these estimates is that Asia will have the majority of (i) total population, (ii) non-poor population, and (iii) over one-third of the world's population with incomes exceeding \$4-a-day.

Finally, Figure 6 presents the projected income distributions in 2010, 2020, and 2030 for all countries analyzed. These bars estimate changes in domestic and global income distribution by country and globally, using absolute 2005 PPP income per day milestones of \$1.25, \$2, \$4, \$6, \$10, and \$20. Based on the World Bank consensus baseline growth rates, we see a steady but varied progress across the Asian region.

Figure 6. Baseline Income Distributions for Consensus Real GDP Growth Trends (percent of population in each income group)



GDP = gross domestic product, PRC = People’s Republic of China, Lao PDR = Lao People’s Democratic Republic, PNG = Papua New Guinea.
 Source: Authors’ estimates.

IV. REGIONAL GROWTH, INCOME DISTRIBUTION, AND STRUCTURAL CHANGE TO 2030

This section reports the results of economic forecasts that extend the baseline trends discussed earlier, to consider a variety of external events that might affect the level and composition of Asian economic growth over the next two decades.

An economic forecasting model is no crystal ball, but it does capture a broad array of structural relationships that can affect long-term patterns of demand, supply, and resource use. The complexities of today's global economy make it unlikely that policy makers relying on intuition or rules-of-thumb will achieve optimality in either the international or domestic arenas. Market interactions are so pervasive, and market forces so powerful in determining economic outcomes that more sophisticated empirical research tools are needed to help both public and private sector decision makers. CGE models are the preferred tool for detailed empirical analysis of an economic policy. They are ideally suited to trade-related analysis because they can detail the structural adjustments within national economies, as well as the interactions of domestic markets with international markets. The model is more extensively discussed in van der Mensbrugge (2008), but a few general comments will facilitate discussion and interpretation of the scenario results that follow.⁵

The CGE model is a system of simultaneous equations that simulate price-directed interactions between firms and households in commodity and factor markets. The roles of government, capital markets, and other trading partners are also specified, with varying degrees of detail and passivity, to close the model and account for economy-wide resource allocation, production, and income determination.

The role of markets is to mediate exchange, usually with a flexible system of prices, the most important endogenous variables in a typical CGE model. As in a real market economy, commodity and factor price changes induce changes in the level and composition of supply and demand, production and income, and the remaining endogenous variables in the system. In CGE models, an equation system is solved for prices that correspond to equilibrium in markets and satisfy the accounting identities governing economic behavior. If such a system is precisely specified, equilibrium always exists and such a consistent model can be calibrated to a base period data set. The resulting CGE model is then used to simulate the economy-wide (and regional) effects of alternative policies or external events.

The distinguishing feature of a general equilibrium model, applied or theoretical, is its closed-form specification of all activities in the economic system

⁵The model used here is typical of modern global models and is based on the LINKAGE model developed at the World Bank (van der Mensbrugge, 2008).

under study. This can be contrasted with more traditional partial equilibrium analysis, where links to other domestic markets and agents are deliberately excluded. A large and growing body of evidence suggests that indirect effects (e.g., upstream and downstream production links) arising from policy changes are not only substantial, but may in some cases even outweigh direct effects. Only a model that consistently specifies economy-wide interactions can fully assess the implications of economic policies or business strategies. In a multi-country model, such as the one used in this study, indirect effects include the trade links between countries and regions, which themselves can have policy implications.

The present global modeling facility has been constructed according to generally accepted specification standards, implemented in the General Algebraic Modeling System (GAMS) programming language, and calibrated to Version 7 of the GTAP global economic database.⁶ The result is a 20-country or region, 10-sector global CGE model, calibrated over a 25-year time path from 2005 to 2020. Apart from its traditional neoclassical roots, an important feature of this model is product differentiation, where it is specified that imports are differentiated by country of origin and exports are differentiated by country of destination. This feature allows the model to capture the pervasive phenomenon of intra-industry trade, where a country is both an importer and exporter of similar commodities, and avoids tendencies toward extreme specialization.

Using this aggregation, the dynamic CGE model is calibrated to a baseline time series reflecting a business-as-usual scenario over 2006–2030. This baseline comprises consensus forecasts for real GDP obtained from independent sources (e.g., International Monetary Fund, Data Resources International, and Cambridge Econometrics). The model is then run forward to meet these expected growth targets, calculating the implied productivity levels in each year, country, and region. This calibration yields productivity growth that would be needed to attain the macro trajectories, and these are then held fixed in the model under other policy scenarios. Other exogenous macro forecasts could have been used and compared, but this is the standard way to calibrate these models.

Once baseline trend forecasts for all the regional economies have been determined, their implied income distributions can be calculated, and the size of the middle and other classes assessed. This was done using independent initial year data and lognormal distribution.

⁶See e.g., Hertel et al (2008) for GTAP.

V. COUNTERFACTUAL SCENARIOS

To better understand the role of the middle class in the Asian regional growth process, it is useful to see how baseline trends could change depending upon external influences or policy actions on the level and composition of economic growth in the next two decades. We consider the following two growth scenarios that are likely to evolve over 2010–2030:

Scenario G1 (Baseline 1) – Business-as-usual growth trend based on World Bank’s consensus GDP growth rates.

Scenario G2 (Baseline 2) – Lower growth rates, i.e., 50% of GDP growth rates in G1.

Baselines for regional growth under business-as-usual (G1 and G2). In addition to the consensus growth baseline used in the previous section, a referent baseline with less optimistic growth rates, equal for each country to half the baseline growth rates projected by the World Bank, is considered. The lower rates are intended less to reveal the direct effect of pessimistic baseline growth than to show how the same policies (below) affect the regional economy in a lower growth environment.

1. **Energy price escalation (P).** Emerging Asian growth has been accompanied by very strong dynamics in global energy markets, and long-term conventional energy prices are subject to considerable uncertainty. To shed light on the region’s growth vulnerability to more pessimistic price trends, we include a counterfactual scenario in which increases in global fossil fuel prices will be sustained and increase by 50% in 2030.
2. **Energy efficiency (E).** Improvements in energy efficiency have been shown to be a potent catalyst for economic growth, as well as an important mitigation strategy against higher energy costs and greenhouse gas emissions. We consider a scenario with 1% average annual energy efficiency improvements across economies.
3. **Agricultural productivity growth (A).** Agrofood products are critical to both basic livelihoods and economic growth potential (see e.g., Boucher, et al 2008, and Datt and Ravallion 1998) because they are tied directly to the income of the majority of the world’s rural poor and they dominate the poor’s expenditures. We include a counterfactual with total factor productivity growth in agriculture of 1% per year from 2010 to 2030.
4. **Skill intensive growth (S).** Increasing labor productivity is the key not only to superior aggregate growth, but also to more extensive growth benefits across the population (Ravallion and Chen 2007). To assess these

benefits, this counterfactual assumes a 1% annual labor productivity growth up to 2030.

5. **Combined scenario (PEAS).** This is a combination of all the above factors.

VI. SIMULATION RESULTS

Table 4 summarizes the macroeconomic results for G1. The three most salient features of these estimates are: (i) the varied nature of the results across countries, (ii) strong synergies with the combined policies, and (iii) consistent pro-poor impact. Overall, simulation results are robust with respect to these differences in alternative values around the median parameters, and what variation they exhibit is consistent with economic intuition and the results interpretation that follows.

Table 4. **GDP Results by Country**
(percent change from baseline in 2030)

| Item | GIP | GIPE | GIPA | GIPS | GIPEAS |
|------------------|--------|--------|--------|-------|--------|
| Bangladesh | -9.37 | -8.66 | -7.34 | 11.66 | 17.50 |
| PRC | -6.73 | -4.28 | -4.96 | 10.70 | 17.69 |
| Georgia | -1.61 | -2.04 | -1.23 | 2.90 | 3.06 |
| High Income Asia | -0.97 | -0.13 | -0.64 | -0.82 | 0.46 |
| Indonesia | -7.51 | -5.38 | -5.16 | 13.19 | 22.75 |
| India | -9.00 | -5.57 | -6.35 | 11.13 | 21.29 |
| Kazakhstan | -14.37 | -10.75 | -12.53 | 6.66 | 14.62 |
| Cambodia | -10.50 | -9.06 | -6.70 | 9.38 | 20.54 |
| Lao PDR | -11.39 | -10.42 | -4.84 | 11.34 | 33.26 |
| Sri Lanka | -5.84 | -4.96 | -2.91 | 12.63 | 24.65 |
| Malaysia | -7.10 | -4.75 | -6.66 | 16.12 | 20.98 |
| Pakistan | -9.35 | -8.06 | -6.67 | 7.50 | 17.08 |
| Philippines | -6.04 | -4.31 | -3.39 | 11.01 | 21.05 |
| Thailand | -6.48 | -1.60 | -4.13 | 6.50 | 19.00 |
| Viet Nam | -9.45 | -9.02 | -7.32 | 7.88 | 15.57 |
| Rest of Asia | -7.18 | -5.76 | -5.64 | 11.75 | 17.70 |
| Total | -5.39 | -3.38 | -3.93 | 6.83 | 12.54 |

GDP = gross domestic product, Lao PDR = Lao People's Democratic Republic,

PRC = People's Republic of China.

Note: High income Asia includes Japan; Republic of Korea; Taipei, China; and Singapore.

Source: Author estimates.

Sustained increases in energy prices have clearly an adverse impact across all economies, even when two decades are allowed for adjustment. Lower growth hits the entire region, including oil exporters because of fuel substitution (to domestic coal) by leading importers like the PRC and India. Unfortunately, the impact of lower growth is most adverse in lower income economies, that are less competitive and are only on the early stage of integration with the rest of the world.

Energy efficiency mitigates these adverse affects, but only partially. The extent of this benefit depends on the country's prior energy intensity and its domestic energy substitution capacity. For example, both the PRC and Thailand initially have high energy intensity, but the PRC has ample alternative fuel supplies. Thailand, by contrast, benefits more from energy efficiency because it has fewer or higher cost alternative supplies.

Unlike in more advanced countries, improving agricultural productivity in emerging Asia only has limited benefits against higher fuel prices since agricultural mechanization, and therefore energy intensity, is only limited.

Labor productivity, on the other hand, can have a strong offsetting effect on higher energy prices. There are two primary reasons for this. Firstly, labor is arguably still the most important factor of production (in terms of value added) in most of Asia, and productivity growth in this factor can offset higher costs for just about any other factor. Second, the Keynesian benefits of labor productivity growth, in terms of direct income increases for households with high expenditure propensities, have a strong growth dividend in what is still a region of low average incomes and commensurately high expenditure propensities.

Strong synergies are apparent when the three factors are taken together for every economy. This effect results from combining savings in two essential commodity categories, food and fuel, with higher real incomes from a wage stimulus. The effects, aggregated over 20 years, more than compensates for higher energy prices and yields double digit growth dividends in most of the region's economies over 2030 GDP values.

Finally, the pro-poor aspect of the combined policies is both strong and consistent with intuition. Although every country benefits from rising labor productivity, those with the lowest initial levels of productivity and real wages benefit the most. These countries see the greatest relative benefit because their human capital is most in need of improvement and because their competitiveness improves most as a result of increased labor productivity as a result of policies that augment human capital development. It has long been recognized that labor is the prime resource of the emerging Asian economies, and skill-intensive development is clearly the superior strategy to realize its growth potential.

For the sake of comparison, Table 5 presents analogous scenario results for real aggregate household consumption. The most significant insight from this table has to do not with the qualitative results, which mirror GDP in sign across every country and scenario, but with the magnitudes. Both the negative and positive effects have wider extremes in terms of real consumption, which would make the events examined here much more politically sensitive. Negative energy price effects on GDP can be offset by structural adjustment that transfers resources from other activities, but they hit purchasing power more directly. At the other extreme, the benefits of higher wages may accelerate aggregate growth through the compounding of multiplier effects, but the original impetus for this is

higher disposable income and a very direct increase in expenditure. Because productivity growth also lowers domestic real prices, and more so when initial productivity is lower, poorer countries benefit more in terms of real purchasing power.

Table 5. **Real Aggregate Consumption Results by Country**
(percent change from baseline in 2030)

| Item | G1P | G1PE | G1PA | G1PS | G1PEAS |
|------------------|---------------|--------------|--------------|-------------|---------------|
| Bangladesh | -13.20 | -11.89 | -10.20 | 10.88 | 19.01 |
| PRC | -15.38 | -10.71 | -11.79 | 8.60 | 22.44 |
| Georgia | -9.04 | -8.44 | -6.25 | 0.01 | 2.91 |
| High Income Asia | -3.29 | -1.31 | -2.74 | -2.40 | 0.33 |
| Indonesia | -7.13 | -5.66 | -3.96 | 17.41 | 26.86 |
| India | -14.20 | -8.65 | -10.45 | 10.37 | 25.36 |
| Kazakhstan | -13.34 | -11.11 | -11.06 | 12.06 | 19.36 |
| Cambodia | -18.73 | -16.12 | -12.84 | 5.18 | 23.63 |
| Lao PDR | -9.93 | -10.22 | -0.73 | 20.59 | 44.09 |
| Sri Lanka | -7.56 | -5.06 | -3.04 | 15.83 | 30.09 |
| Malaysia | -11.95 | -9.47 | -10.72 | 18.83 | 27.47 |
| Pakistan | -12.42 | -9.70 | -9.03 | 6.27 | 17.09 |
| Philippines | -9.42 | -5.83 | -5.99 | 11.40 | 23.51 |
| Thailand | -8.70 | -1.51 | -5.87 | 7.84 | 21.95 |
| Viet Nam | -7.83 | -9.63 | -4.54 | 13.37 | 19.66 |
| Rest of Asia | -8.07 | -7.17 | -5.47 | 16.80 | 23.63 |
| Total | -10.03 | -6.54 | -7.57 | 5.62 | 15.08 |

Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Note: High income Asia includes Japan; Republic of Korea; Taipei, China; and Singapore.

Source: Author estimates.

Tables 7 and 8 presents the simulation results under the alternative scenario—lower growth baseline (G2). The GDP results under the low growth scenario (Table 7) are clearly similar to the results under the business-as-usual scenario (Table 5). As can be seen in Table 8, while halving consensus growth rates sharply reduces aggregate income growth over the next 2 decades, the compositional and relative effects of external shocks and policy responses are similar under the two scenarios. In other words, structural (as opposed to cyclical or monetary) policy responses remain effective even when aggregate long-term growth trends shift. The conclusions of the previous paragraphs thus apply whether growth expectations are bullish or more temperate. Risk due to energy price hikes remains substantial, and energy efficiency, agricultural productivity growth, and skill development can work together to offset this risk and accelerate regional growth substantially.

The most significant difference between consensus and sub-consensus baseline results are its pro-poor effects. While pro-poor effects are significant under both growth scenarios, it is strongest under the low-growth scenario. The same observation applies to aggregate consumption results, perhaps even more important to lower income countries. These facts imply that affirming policies

such as those studied here is even more important when there is uncertainty regarding aggregate growth potential. When adversity threatens to lower expectations, even more policy determination is justified to protect and enhance livelihoods.

**Table 6. Real GDP Results by Country
(percent change from baseline in 2030)**

| Item | G2P | G2PE | G2PA | G2PS | G2PEAS |
|------------------|--------------|--------------|--------------|-------------|---------------|
| Bangladesh | -8.08 | -7.31 | -5.87 | 15.00 | 21.15 |
| PRC | -4.46 | -2.11 | -2.87 | 18.42 | 25.21 |
| Georgia | -6.23 | -5.77 | -3.40 | 9.37 | 16.77 |
| High Income Asia | -0.63 | 0.22 | -0.34 | -0.43 | 0.75 |
| Indonesia | -6.61 | -4.70 | -4.21 | 16.52 | 26.53 |
| India | -7.33 | -3.67 | -4.81 | 14.86 | 26.17 |
| Kazakhstan | -10.81 | -6.33 | -9.32 | 11.37 | 19.80 |
| Cambodia | -8.87 | -7.44 | -5.19 | 14.47 | 26.79 |
| Lao PDR | -12.18 | -11.40 | -4.60 | 14.28 | 41.19 |
| Sri Lanka | -5.82 | -4.96 | -2.13 | 15.83 | 30.40 |
| Malaysia | -6.36 | -4.01 | -5.88 | 18.81 | 23.80 |
| Pakistan | -8.86 | -7.54 | -5.86 | 10.01 | 19.96 |
| Philippines | -4.80 | -3.14 | -2.22 | 13.89 | 23.93 |
| Thailand | -4.55 | 0.52 | -2.25 | 9.67 | 22.31 |
| Viet Nam | -8.99 | -8.77 | -6.32 | 10.90 | 20.28 |
| Rest of Asia | -5.76 | -4.38 | -4.16 | 15.08 | 21.14 |
| Total | -3.48 | -1.66 | -2.26 | 9.27 | 14.42 |

GDP = gross domestic product, Lao PDR = Lao People's Democratic Republic,

PRC = People's Republic of China.

Note: High Income Asia includes Japan; Republic of Korea; Taipei,China; and Singapore.

Source: Author estimates.

**Table 7. Real Aggregate Consumption Results by Country
(percent change from baseline G2 in 2030)**

| Item | G2P | G2PE | G2PA | G2PS | G2PEAS |
|------------------|--------------|--------------|--------------|-------------|---------------|
| Bangladesh | -12.08 | -10.72 | -8.86 | 14.52 | 23.50 |
| PRC | -11.57 | -7.08 | -8.34 | 20.73 | 34.54 |
| Georgia | -13.35 | -11.30 | -8.85 | 6.42 | 18.05 |
| High Income Asia | -2.73 | -0.87 | -2.20 | -1.82 | 0.79 |
| Indonesia | -6.28 | -5.03 | -3.29 | 21.12 | 30.45 |
| India | -12.21 | -6.84 | -8.50 | 15.63 | 31.36 |
| Kazakhstan | -9.20 | -5.99 | -7.16 | 19.15 | 27.64 |
| Cambodia | -15.63 | -13.27 | -9.95 | 11.87 | 30.70 |
| Lao PDR | -13.11 | -12.76 | -3.65 | 19.36 | 45.32 |
| Sri Lanka | -8.08 | -5.83 | -3.39 | 17.56 | 31.98 |
| Malaysia | -12.06 | -9.41 | -10.28 | 23.66 | 33.90 |
| Pakistan | -12.34 | -9.84 | -8.73 | 8.31 | 19.70 |
| Philippines | -8.17 | -4.90 | -5.06 | 13.98 | 25.19 |
| Thailand | -7.58 | -0.38 | -5.12 | 9.52 | 23.10 |
| Viet Nam | -7.73 | -8.79 | -4.29 | 15.85 | 23.57 |
| Rest of Asia | -7.35 | -5.86 | -4.88 | 20.18 | 27.74 |
| Total | -7.16 | -4.08 | -5.12 | 9.10 | 17.51 |

Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Note: High Income Asia includes Japan; Republic of Korea; Taipei,China; and Singapore.

Source: Author estimates.

How far can the policies go to offset lower growth trends? Table 7 gives some insight on this question, comparing G2 counterfactual outcomes with the higher G1 baseline. As is apparent in the first column, halving annual baseline growth rates exacts a heavy toll on the economies of the Asian region, discounting real GDP by between 25% and 50% by 2030.

The effects of adverse energy shocks and policy regimes are as expected from the previous results. In no case do remedial policies achieve aggregate growth benefits that could compensate for 50% lower baseline, but it should be noted that countries with relatively low skill development per capita will enjoy the largest offsets against lower regional growth. Bangladesh, Indonesia, Lao People's Democratic Republic, Sri Lanka, and Pakistan all offset a large fraction of their growth disadvantage. Meanwhile, countries with significant agrofood potential, such as Indonesia, Thailand, the Philippines, also find substantial growth insurance in the policy package considered here.

VII. CONCLUSIONS AND POLICY IMPLICATIONS

The growth experience often referred to as the “Asian Miracle” has redefined the modern global economy with new models of international specialization and dramatically changed geographic patterns of production and trade. On the demand side, maturity of this regional growth experience has established new middle class markets in many Asian cities and even entire nations. Despite this rapid progress, however, Asian regional growth and prosperity remain works in progress. Significant poor populations exist in most countries and comprise majorities in many, and income inequality within and between many regional economies continues to increase.

If Asia can sustain two generations of positive growth trend, how can this growth be shared across populations within the region? This report examines this question, with focus on the emerging middle class in the ADB's DMCs. The general findings are optimistic, suggesting that Asia can continue and even accelerate established patterns of poverty reduction and livelihood advancement beyond poverty. For example, by a \$2-a-day PPP standard, Asia will move from 25% of the 2010 middle class to a majority (55%) in 2030. Even by a higher standard of \$4-a-day, Asia will represent 39% of global middle class income.

The first part of the estimation assessed the changing composition of national incomes across 22 Asian countries, assuming baseline growth rates at established consensus levels. The results suggest that over the next 20 years, about 1 billion people will be added to the 2.7 billion Asian middle class (based on \$2-a-day PPP standard). Depending mostly on initial conditions, the rate of change will be uneven across the region. The PRC and India will provide the largest number of additional middle class population, and this will reshape

regional and global markets in their image. At the same time, however, smaller countries will see faster or slower middle class emergence depending on the eligibility of their resource base and labor forces for recruitment into higher value added supply chains.

To a significant extent, the differences in the emergence of a middle class across Asia will then depend on external events and policy responses. The second half of this study examined the drivers of regional growth and change using a global forecasting model. The results are consistent with other previous studies in suggesting that energy price vulnerability is a critical risk to regional growth. The study also sheds light on how energy efficiency measures can provide insurance against this risk. Agricultural productivity growth, which can improve both the incomes of the rural poor Asian majority and the purchasing power of urbanites, was also considered. Policies that reduce both energy and food costs, saving households and enterprises money, can be a potent source of new demand and job creation.

Finally, in light of the importance of labor resources to the Asian growth experience, developing skills across the lower income regional economies is considered. The basic finding supports the view that this is the most critical prerequisite for realizing the vast economic potential of the Asian region. Higher incomes, a larger middle class, and the self-sustaining prosperity they generate, can only be built on the foundation of a skilled and productive labor force that captures significant value added and channels this into sustained long term expenditure, saving, and investment.

REFERENCES

- Adams, R. 1991. *The Effects of International Remittances on Poverty, Inequality, and Development in Rural Egypt*. Research Report No. 86. Washington, D.C.: International Food Policy Research Institute.
- Atkinson, A. 1995. *Incomes and the Welfare State: Essays on Britain and Europe*. New York: Cambridge University Press.
- Bardhan, P. 1996. "Efficiency, Equity, and Poverty Alleviation: Policy Issues in Less Developed Countries." *Economic Journal* 106(438): 1344–56.
- Birdsall, N, C. Graham, and S. Pettinato. 2000. *Stuck in the Tunnel: Is Globalization Muddling The Middle Class?* Center on Social and Economic Dynamics Working Paper No. 14. Washington, D.C.: The Brookings Institution.
- Boucher, S., M. Carter, and C. Guirkinger. 2008. "Risk Rationing and Wealth Effects in Credit Markets: Theory and Implications for Agricultural Development." *American Journal of Agricultural Economics* 90(2): 409–423.
- Carter, M, and C. Barrett. 2006. "The Economics of Poverty Traps and Persistent Poverty: An Asset-Based Approach." *Journal of Development Studies* 42(2): 178–199.
- Datt, G., and M. Ravallion. 1998. "Farm Productivity and Rural Poverty in India." *Journal of Development Studies* 34(4): 62–85.

- Dollar, D., and A. Kraay. 2001. *Growth is Good for the Poor*. World Bank Policy Research Working Paper No. 2587. Washington, D.C.: World Bank.
- Easterly, W. 2001. *The Elusive Quest for Growth: Economists' Adventures and Misadventures in the Tropics*. Cambridge: MIT Press.
- Hertel, T.W., ed. 2008. *Global Trade Analysis: Modeling and Applications*. New York: Cambridge University Press.
- Hirschman, A., and M. Rothschild. 1973. "The Changing Tolerance for Income Inequality in the Course of Economic Growth." *Quarterly Journal of Economics* 87(4): 544–66.
- Jalan, J., and M. Ravallion. 1998. "Determinants of Transient and Chronic Poverty: Evidence from rural China." *Journal of Development Studies* 36(6): 82–99.
- Kuznets, S. 1966. *Modern Economic Growth*. New Haven: Yale University Press.
- Morduch, J. 1998. "Growth, Poverty, and Average Exit Time." *Economics Letters* 59(3): 385–390.
- Persson, T., and G. Tabellini. 1994. "Is Inequality Harmful for Growth?" *American Economic Review* 84(1994): 600–621.
- Ravallion, M., and S. Chen. 2007. "China's (Uneven) Progress Against Poverty." *Journal of Development Economics* 82(1): 1–42.
- _____. 2008. The Developing World is Poorer than We Thought, But No Less Successful in the Fight Against Poverty. *World Bank Policy Research Working Paper No. 4703*. Washington, D.C.: World Bank.
- Rawls, J. 1971. *A Theory of Justice*. Cambridge: Harvard University Press.
- Rodrik, D. 2008. *One Economics, Many Recipes: Globalization, Institutions, and Economic Growth*. New Jersey: Princeton University Press.
- Roemer, J. 1998. *Equality of Opportunity*. Cambridge: Harvard University Press.
- van der Mensbrugge, D. 2008. *Linkage Technical Reference Document*. Washington, D.C.: World Bank. <http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTDECPROSPECTS/0,,contentMDK:20357492~menuPK:681018~pagePK:64165401~piPK:64165026~theSitePK:476883,00.html>
- World Bank. 1990. *World Development Report 1990: Poverty*. Washington, D.C.: World Bank.

The Growth Locomotive of the People's Republic of China: Macro and Terms-of-Trade Impacts on Neighboring Countries

YINHUA MAI, PHILIP ADAMS, PETER DIXON, AND JAYANT MENON

This paper analyzes the impact that terms of trade (TOT) are likely to have on the growth of the People's Republic of China's (PRC) neighboring countries. Two scenarios employing a dynamic computable general equilibrium (CGE) framework are considered: (i) a convergence scenario, where historical trends are projected; and (ii) a baseline scenario, where technological progress in the PRC is placed in line with that of the United States (US). The results show that the PRC's technological convergence leads to increased world prices for mining products, and lower world prices for manufactures, especially those exported extensively by the PRC. On the whole, however, the effects on the growth and TOT of the PRC's neighboring countries are relatively small. The modelling framework used in this study explicitly captures the various offsetting effects that dampen the impact on TOT and contribute to the small impact on growth. Furthermore, the additional capital required to finance the PRC's growth comes predominantly from domestic savings, placing little pressure on the global supply of capital. Thus, an awakening PRC is unlikely to make a dramatic entrance despite the country's overall positive impact on the region – although there is nothing to fear, there is also only little to gain.

JEL classification: F17, F47, C68

I. INTRODUCTION

The People's Republic of China's (PRC) economy is now the biggest in Asia. As its role increases, its impact on neighboring economies is also likely to increase. Therefore, the issue as to whether Asia is a locomotive for growth depends—to some degree—on how the PRC grows and how this growth affects the region. This paper analyzes the impact of an awakening PRC on the terms of

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trade (TOT) and growth of its neighbors. This paper focuses on TOT because a number of studies¹ have already examined growth spillovers.²

Issues associated with a country's TOT have been a longstanding concern in development economics. In the 1950s and 1960s, the concern was about deteriorating primary commodity prices relative to manufactured goods, which harmed developing countries (Prebisch 1950; Singer 1950). In the 1970s, the concern shifted to relative prices within manufactured goods. Since manufactured exports from developing countries typically have a lower technological content, the concern was that their prices would fall relative to the prices of exports from developed countries (Singer 1971; Wood 1997; Maizels, Palaskas, and Crowe 1998).

Since the mid-1990s, the impact of an awakening PRC on the world has become a prominent topic in economic discussions. The PRC became a net importer of crude oil in the early 1990s. Since then it has relied heavily on energy from overseas, importing one-third of its consumption of crude oil in recent years. The rapid growth of its manufacturing industries also brought about increased demand for primary commodities such as iron ore and base metal products. The PRC's increasing demand for energy and primary inputs, as well as the rapid growth of its manufactured exports, has raised concerns about the impact of TOT on the growth of both developing and developed countries.

To analyze the impact of the PRC's rapid development on the growth and TOT of its neighboring countries, a global dynamic computable general equilibrium (CGE) model that assesses 11 countries³ individually and the rest of the world (ROW) collectively is used. The advantage of using a CGE framework is that it represents in detail the structures of the economies under review. With the rapid globalization of the past 3 decades, the links between the world's economies have become more sophisticated, thereby increasing the complexity of analyzing TOT issues in particular. For example, if the PRC's demand for energy contributes to higher energy prices, then energy exporters' TOT are likely to enjoy a favorable change, while energy importers' TOT may deteriorate. The same would apply to primary products. Higher energy and commodity prices could lead to higher prices for manufactured goods as well, however, and these effects need to be considered. It follows that the effects of the PRC's increasing demand for energy and primary products on the TOT of its neighboring countries will depend to a large degree on the economic structures of these economies. The structural details contained within the CGE model used in this paper accommodate the sophisticated nature of the issues at hand.

¹See, for instance, Eichengreen, Rhee, and Tong (2004); Fujiwara, Otsu, and Saito (2008); McKibbin and Woo (2003); Mai, Horridge, and Perkins (2003); Phelps (2004); and Sachs and Woo (2003).

²Exceptions include Kaplinsky (2006) and Phelps (2004), although neither of these two studies uses a multi-country modeling approach.

³The nine largest Asian economies (PRC, India, Indonesia, Japan, Republic of Korea, Malaysia, Philippines, Singapore, and Thailand) plus Australia and the United States (US).

The paper is organized into six sections. Section II discusses the methodology and data. Section III introduces how the PRC's technological convergence with developed countries is simulated. The effects of the PRC's convergence on neighboring countries are presented in Sections IV and V, with Section IV analyzing the TOT effects and Section V assessing income and industry effects, as well as the results of sensitivity tests. A final section concludes.

II. METHODOLOGY AND DATA

The PRC's increasing demand for energy and primary inputs is placed in the context of its convergence in per capita income with developed countries, achieved through technological progress. Improved technological progress underlies rapid economic growth in the PRC, and hence rapid growth in the PRC's demand for energy and other primary inputs. Historical simulation was conducted to estimate the degree to which the PRC had to catch up with technological developments during 1997–2005. The purpose of the historical simulation is to calibrate the model with historical data, and to estimate quantitatively the PRC's technological progress relative to developed countries. The estimated speed of technological progress during the historical period is then used to simulate the effects of the PRC's technological convergence with developed countries, and to analyze the effects of the convergence on the PRC and its neighboring countries from 1999 to 2010. Finally, the robustness of the analysis was tested by supplementing the simulation of the PRC's convergence in technology with two other simulations: (i) a change in user preferences toward imported goods, especially manufactured goods that affect prices of manufactured exports; and (ii) an alternative scenario of the PRC's energy efficiency that affects its demand for energy and therefore world prices for energy products.

The simulations were conducted using the MONASH Multi-Country (MMC) model. The MMC model is a global dynamic CGE model of 11 countries and ROW. The model is described in detail in Mai (2004).

A. Historical Simulation

The most important data for this analysis has been unobserved—technological convergence. Historical simulation operates in reverse fashion to standard policy simulation. In a standard policy simulation, quantities and prices of production outputs and inputs, consumption, and international trade are typical endogenous variables, while production technology and consumer preferences are typical exogenous variables. In these simulations, the model is informed of a change in a technology or policy variable (such as a deterioration in agricultural

productivity or a tariff cut), and the model calculates the resulting changes to gross domestic product (GDP), consumption, output, employment, and other endogenous variables.

In a historical simulation, the model operates in a reverse fashion—with GDP, production, consumption, and international trade as the exogenous variables, and the corresponding technical and preference change variables (such as multi-factor productivity) as the endogenous variables. The model is informed of changes in GDP, consumption, investment, and other observed variables during a historical period. It can then impute the necessary changes in technology and preferences.⁴

B. Data Sources and Related Issues

The main sources of data for the macroeconomic variables are the World Bank's World Development Indicators and the United Nation's UNSTATS. These two sources are supplemented by country sources, such as the PRC National Statistical Bureau, the Singapore Department of Statistics, and the US Bureau of Economic Analysis (see the list of statistical references at the end of this paper). The GTAP version 5 database (Dimaranan and McDougall 2002) is the main source of input–output and international trade data for the MMC model.

Table 1 presents the growth rates of key macroeconomic variables during 1997–2005 for each country in the model. The data from various sources have been adjusted to be consistent with each other and with the model database for 1997. The table shows that the PRC enjoyed high GDP growth of about 9% per year from 1997 to 2005. Within gross national expenditure (GNE), real investment (or gross fixed capital formation) grew much faster than real private and government consumption, indicating a high savings rate in the PRC. Both export and import volumes grew at double-digit rates, much faster than real GDP and GNE. The volume of exports grew faster than the volume of imports, contributing to the PRC's current account surplus during the period.

⁴The historical simulation technique using a CGE model is described in detail in Dixon and Rimmer (2002). Applications to trade that use this technique to estimate technology and preference changes include Dixon, Menon, and Rimmer (2000); and Mai, Horridge, and Perkins (2003).

Table 1. Historical Simulation: Growth of Real GDP and Components, Population, Employment, and GDP Price Index (average annual growth rates 1997–2005, %)

| | Real GDP | Real Consumption | Real Investment | Government Expenditure | Export Volumes | Import Volumes | Population | Employment | GDP Price Index |
|----------------|-------------|---------------------|--------------------|---------------------------|-------------------|-------------------|------------|------------|--------------------|
| PRC | 8.9 | 5.8 | 10.1 | 7.0 | 16.7 | 14.8 | 0.7 | 0.9 | 0.9 |
| India | 6.4 | 5.5 | 7.2 | 5.9 | 14.9 | 12.9 | 1.6 | 1.6 | 1.0 |
| Indonesia | 1.8 | 1.6 | 0.5 | 2.5 | 3.7 | 2.3 | 1.4 | 2.1 | -0.5 |
| Thailand | 2.8 | 3.0 | 0.6 | 4.3 | 6.3 | 5.6 | 0.9 | 1.0 | -1.7 |
| Malaysia | 3.7 | 3.9 | -0.8 | 6.4 | 5.4 | 4.5 | 2.1 | 2.8 | -1.0 |
| Philippines | 3.8 | 4.5 | -0.7 | 0.5 | 3.1 | 1.9 | 1.9 | 3.0 | -1.1 |
| Singapore | 4.4 | 2.1 | -0.5 | 2.5 | 4.3 | 2.5 | 1.7 | 1.4 | -1.8 |
| Australia | 3.4 | 3.8 | 6.0 | 2.7 | 3.5 | 6.9 | 1.2 | 2.0 | 2.8 |
| Korea, Rep. of | 4.1 | 2.4 | 1.8 | 3.3 | 10.2 | 7.2 | 0.6 | 1.0 | 1.3 |
| Japan | 1.0 | 0.8 | 0.1 | 2.3 | 2.9 | 1.6 | 0.2 | -0.4 | -0.4 |
| US | 3.2 | 3.8 | 4.6 | 2.5 | 3.1 | 7.1 | 1.0 | 1.1 | 2.1 |
| ROW | 2.4 | 2.4 | 2.1 | 2.4 | 2.1 | 1.8 | 1.4 | 1.8 | -0.1 |

GDP = gross domestic product, PRC = People's Republic of China, ROW = rest of the world, US = United States.
Source: Historical simulation.

C. The PRC's Technological Progress During 1997–2005

Table 2 summarizes employment and output data for the PRC and the US. It also shows estimates of technological progress during 1997–2005, based on results from the historical simulation.⁵ The table shows that the PRC's total primary-factor-augmented productivity grew rapidly during this period. At the aggregate level, the PRC's total primary-factor-augmented productivity grew by 4.4% per year during 1997–2005, much faster than the 1.3% annual growth rate for the US. By industry, technological progress for all sectors was faster in the PRC than in the US, except for agriculture and communications.

From the estimations, the mining sector in the PRC substantially improved. The historical simulation covers a period during which the PRC overhauled its oil and gas industry to create vertically integrated oil giants that can compete with international rivals (Yan 1998; Mai 2002). Because of reforms, however, employment in the mining industry significantly fell during the period.

Table 2. **Historical Simulation: Output, Employment, and Technology**
(average annual growth rates 1997–2005, %)

| Item | Output | | Employment | | Technology* | |
|--------------------------------|------------|------------|------------|------------|-------------|-------------|
| | PRC | US | PRC | US | PRC | US |
| Total | 8.9 | 3.2 | 0.9 | 1.1 | -4.4 | -1.3 |
| Agriculture | 3.7 | 4.6 | -0.1 | -4.8 | -3.4 | -7.3 |
| Mining | 5.4 | -0.2 | -3.4 | -0.2 | -7.0 | 0.3 |
| Manufacturing | 10.7 | 1.6 | 0.3 | -2.8 | -5.2 | -2.7 |
| Utilities | 10.3 | 2.4 | 0.5 | -2.7 | -3.1 | -2.5 |
| Construction | 10.0 | 3.7 | 1.0 | 3.5 | -6.0 | 0.0 |
| Trade | 11.3 | 4.0 | 0.7 | 1.6 | -5.5 | -1.8 |
| Transport and communication | 11.5 | 5.3 | 0.3 | -2.5 | -4.6 | -5.7 |
| Other Services | 8.7 | 3.3 | 3.6 | 2.3 | -1.8 | -0.4 |

PRC = People's Republic of China, US = United States.

* Negative numbers means technological improvement.

Source: The source for technology progress is the historical simulation. See discussion in Section 2.1 and statistical references, at the end of the paper, for the sources of the output and employment data. The data from various sources were adjusted for data consistency.

III. THE PRC'S TECHNOLOGICAL CONVERGENCE

This section explains how the PRC's technological convergence with developed countries was simulated, as well as the effects of the convergence on the PRC's real GDP, GNP, and TOT.

⁵In this study, technological progress is defined as an improvement in total primary-factor-augmented productivity, which is defined as an increase in output relative to a weighted average of all primary-factor inputs.

A. Simulating the PRC's Convergence

The historical simulation outlined in Section 2 represents a “real” scenario from 1997–2005, in which the PRC continued its convergence in technology with developed countries—a journey that began in 1978. To analyze the effects of the technological convergence during 1997–2005, the “real” scenario was compared with a baseline in which the PRC does not catch up technologically. To obtain this baseline, it was assumed that, on average, the PRC’s productivity improves in line with that of the US, as estimated for 1997–2005.

In the baseline, the PRC’s national productivity was assumed to be growing at 1.3% that of the US, while the sectoral pattern of productivity improvement estimated in the historical simulation was maintained. In simulating the PRC’s convergence, total average annual productivity growth was assumed to be 3.1%, and broken down as follows: 2.4% productivity growth for agriculture, 5.0% for mining, 3.7% for manufacturing, and 2.7% for services. The “real” scenario is extended to 2010 through a forecast simulation to see the effects in the long-term. The same forecast simulation from 2005–2010 has been done for the economies in the model. In this simulation, it was assumed that the PRC and the US continued their growth trend in 1997–2005. The trend rates of growth during 2005–2010 for countries affected by the 1997/98 Asian financial crisis were assumed to resemble those of 1990–2005 (Table 3).

Table 3. Forecast Simulation: Growth of Real GDP and Components
(average annual growth rates 2005–2010, %)

| Item | Real GDP | Real Consumption | Real Investment | Government Expenditure | Export Volumes | Import Volumes |
|----------------|-------------|---------------------|--------------------|---------------------------|-------------------|-------------------|
| PRC | 8.9 | 5.5 | 9.5 | 6.6 | 15.7 | 13.9 |
| India | 6.4 | 5.2 | 6.9 | 5.6 | 14.3 | 12.3 |
| Indonesia | 3.0 | 3.0 | 2.0 | 2.4 | 4.8 | 3.9 |
| Thailand | 3.7 | 3.5 | 1.0 | 4.4 | 6.6 | 5.5 |
| Malaysia | 4.8 | 4.5 | 1.6 | 6.3 | 6.6 | 6.0 |
| Philippines | 3.9 | 4.5 | 0.8 | 1.5 | 4.7 | 3.9 |
| Singapore | 5.3 | 2.4 | 1.0 | 2.8 | 4.8 | 3.1 |
| Australia | 3.4 | 3.8 | 6.1 | 2.7 | 3.5 | 7.0 |
| Korea, Rep. of | 4.8 | 2.4 | 1.8 | 3.3 | 10.0 | 7.0 |
| Japan | 1.2 | 1.1 | 0.2 | 2.4 | 2.8 | 1.8 |
| US | 3.2 | 3.9 | 4.7 | 2.5 | 3.2 | 7.2 |
| ROW | 2.4 | 2.4 | 2.1 | 2.4 | 2.0 | 1.8 |

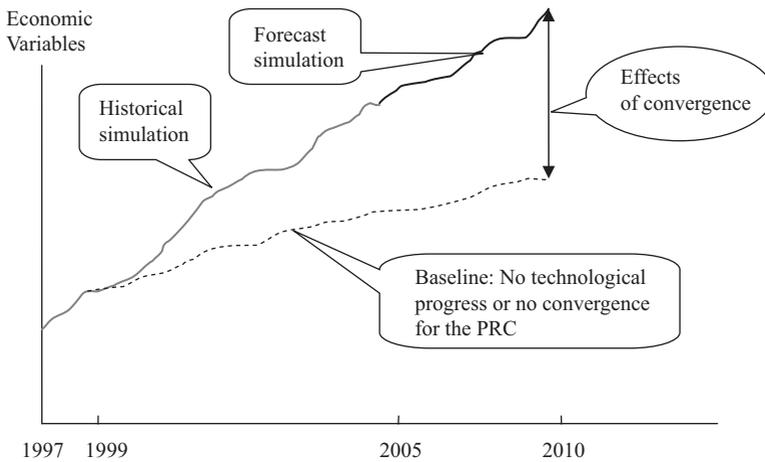
GDP = gross domestic product, PRC = People’s Republic of China, ROW = rest of the world,
US = United States.

Source: Simulation results.

The “real” scenario, consisting of the historical simulation for 1997–2005 and the forecast simulation for 2005–2010, forms the convergence scenario. By removing the annual technological progress for 2000–2010, the baseline is derived—a scenario where the PRC does not catch up with developed countries.

Figure 1 shows that the effects of the convergence are measured by the difference between the convergence scenario and the baseline, or the deviations of economic variables from their baseline levels in 2010. Table 4 presents a summary of the growth trend for key macroeconomic variables in the baseline scenario for the economies in the model.

Figure 1. **Historical, Forecast, and Baseline Simulations**



PRC = People's Republic of China.
 Source: Authors' calculations.

B. Effects of the Convergence on the PRC's Real GDP and GNP

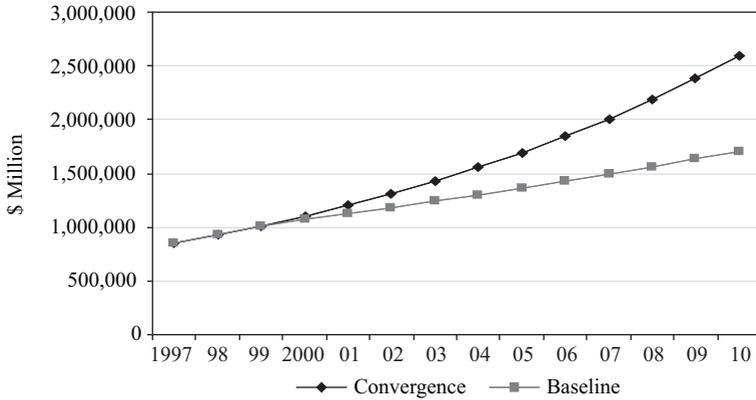
During 1997–2005, the PRC's average annual growth rate in real GDP was 8.9%. During the forecast period of 2005–2010, it was assumed that the PRC continued its historical growth trend of 8.9% per year. Table 4 shows that without technological convergence, the PRC's real GDP would grow at a rate of only 4.8% per year, much lower than the convergence rate of 8.9%. Figure 2 illustrates the different growth path the PRC would take with and without the technological convergence. With technological convergence, the PRC's GDP is likely to be over 50% higher in 2010 (Table 5).

Table 4. Baseline: Real GDP and Components, Population, Employment, and GDP Price Index
(average annual growth rates 1999–2010, %)

| | Real GDP | Real Consumption | Real Investment | Government Expenditure | Export Volumes | Import Volumes | Population | Employment | TOT |
|----------------|-------------|---------------------|--------------------|---------------------------|-------------------|-------------------|------------|------------|------|
| PRC | 4.8 | 2.3 | 3.9 | 3.4 | 11.8 | 10.1 | 0.7 | 0.8 | 0.7 |
| India | 6.5 | 5.4 | 7.3 | 5.8 | 14.3 | 12.8 | 1.5 | 1.8 | 0.4 |
| Indonesia | 3.0 | 2.9 | 1.9 | 2.3 | 4.9 | 3.9 | 1.3 | 1.8 | -0.3 |
| Thailand | 3.7 | 3.6 | 1.1 | 4.6 | 6.7 | 5.7 | 0.9 | 0.9 | -1.0 |
| Malaysia | 4.8 | 4.5 | 1.6 | 6.3 | 6.7 | 6.1 | 1.9 | 2.6 | -0.2 |
| Philippines | 3.9 | 4.6 | 0.5 | 1.5 | 4.9 | 4.0 | 1.8 | 2.7 | -1.1 |
| Singapore | 5.2 | 2.3 | 0.8 | 2.8 | 4.9 | 3.1 | 1.5 | 1.4 | -0.5 |
| Australia | 3.4 | 3.8 | 5.9 | 2.7 | 3.5 | 6.8 | 1.1 | 1.5 | 2.2 |
| Korea, Rep. of | 4.7 | 2.3 | 1.6 | 3.2 | 9.9 | 6.9 | 0.5 | 0.7 | 0.3 |
| Japan | 1.2 | 1.1 | 0.1 | 2.4 | 2.6 | 1.5 | 0.1 | -0.8 | -1.0 |
| US | 3.2 | 3.8 | 4.5 | 2.5 | 3.1 | 7.0 | 1.0 | 0.9 | 0.2 |
| ROW | 2.3 | 2.3 | 1.9 | 2.3 | 2.0 | 1.6 | 1.4 | 1.6 | 0.0 |

GDP = gross domestic product, PRC = People's Republic of China, ROW = rest of the world, US = United States.
Source: Simulation results.

Figure 2. PRC's Real GDP: With and Without Technology Convergence (1999–2010, USD million)



GDP = gross domestic product, PRC = People's Republic of China.
 Source: Simulation results.

Table 5. The PRC's Convergence: Effects on the PRC's Macroeconomic Indicators (%)

| Item | Baseline: Average Annual Growth Rates 1999–2010 | The PRC's Convergence: Average Annual Growth Rates 1999–2010 | The PRC's Convergence: Percentage Deviation from Baseline 2010 |
|-----------------------------------|-------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Real GNP | 5.2 | 8.8 | 44.2 |
| Real GDP (Y) | 4.8 | 8.9 | 52.1 |
| Productivity* (A) | -1.3 | -4.4 | -29.6 |
| Aggregate capital stock (K) | 7.6 | 10.2 | 30.1 |
| Aggregate employment (L) | 0.8 | 0.8 | 0.0 |
| Real consumption | 2.3 | 5.5 | 40.1 |
| Real investment | 3.9 | 9.5 | 78.4 |
| Export volumes | 11.8 | 15.7 | 45.8 |
| Import volumes | 10.1 | 13.9 | 44.6 |
| Real wage | 3.2 | 6.3 | 38.2 |
| TOT | 0.7 | -0.3 | -10.4 |
| GDP price index (P _g) | 1.6 | 0.9 | -7.9 |
| Rental price (Q) | -0.3 | 0.5 | 8.6 |

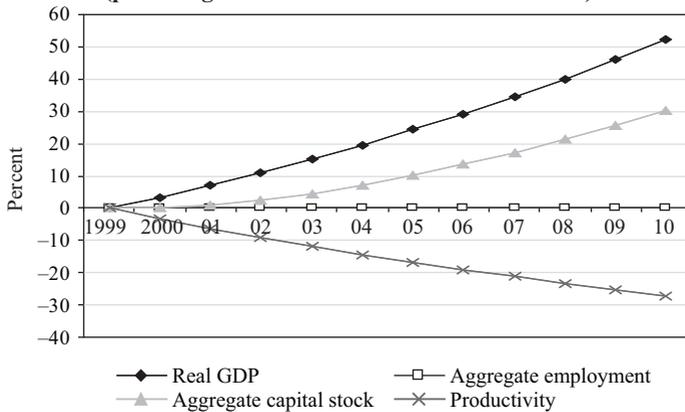
GDP = gross domestic product, GNP = gross national product, PRC = People's Republic of China,
 TOT = terms of trade.

* Negative numbers represent productivity improvements.

Source: Simulation results.

In a long-run simulation such as this, it is assumed that aggregate employment (L) is determined by demographic factors and thus is not affected by the extra technical progress in the PRC. Accordingly, aggregate employment does not deviate from its baseline value,⁶ and so does not contribute to the positive deviation in real GDP (Figure 3).

Figure 3. The PRC’s Convergence: GDP, Capital, Employment, and Productivity (percentage deviation from baseline 1999–2010)



GDP = gross domestic product, PRC = People’s Republic of China.
 Note: Negative productivity numbers mean productivity improvements.
 Source: Simulation results.

A positive deviation in capital stock, however, does contribute to the positive deviation in real GDP. The positive deviation in capital stock can be explained by the following capital market equilibrium condition:

$$\frac{Q}{P_g} = \frac{1}{A} * F_k(K/L) \tag{1}$$

The technical progress boosts the average capital rental (Q), reduces production costs (and thus P_g), and thereby generates increases in (Q/P_g). However, this effect is weak relative to the increase in 1/A, the technological progress. This also implies an increase in K/L. It is assumed that technical progress in the PRC does not affect aggregate employment (L). Thus, K must increase.

Table 5 shows that the 44.2% increase in real GNP is smaller than that of real GDP following the PRC’s convergence. This is mainly due to two factors. The first relates to the increase in capital income that partly underlies the increased GDP that accrues to foreigners, while the second relates to the decline in the TOT. All else being equal, deterioration in the TOT reduces the price of

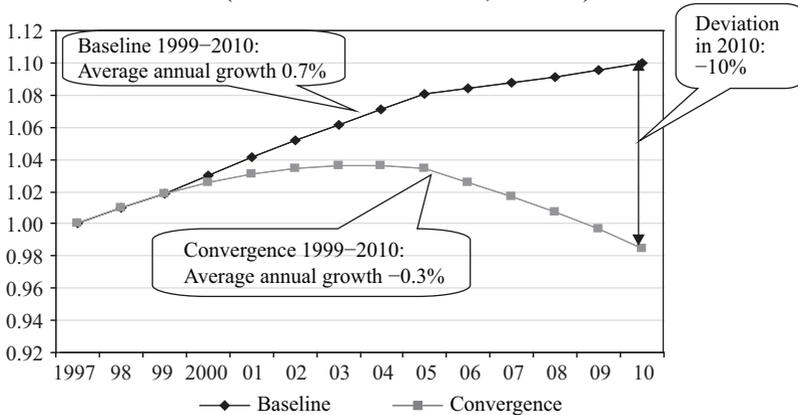
⁶Although aggregate employment is exogenous, employment by industries is endogenous as labor is mobile between industries and/or sectors within the PRC.

output, which includes exports but not imports, relative to the price of expenditure, which includes imports but not exports. Reductions in the price of output (or GDP) relative to the price of expenditure (or GNE), in most cases, cause real GDP to increase relative to real GNP.

C. Effects of the Convergence on the PRC's TOT

The simulation results show that the PRC's TOT declines significantly as a result of the technological convergence (Figure 4). Starting from the same level in 1999, the PRC's TOT is about 10% lower by 2010 with the technological convergence than without it. In the baseline (without the PRC's convergence), the PRC's TOT grows at an average annual rate of 0.7% from 1999 to 2010. With technological convergence, the PRC's TOT declines at an average annual rate of 0.3% during the same period.

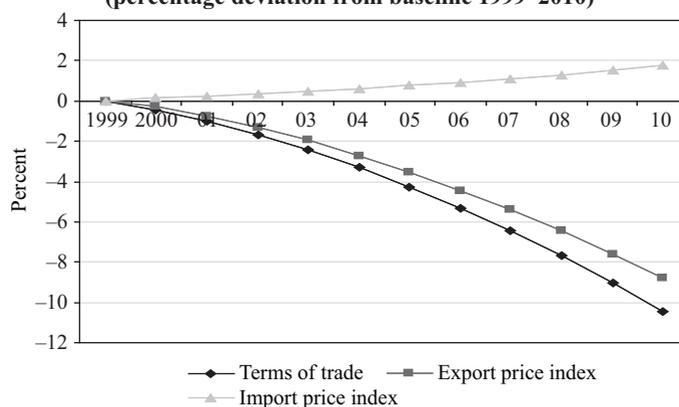
Figure 4. The PRC's TOT Declines Due to Technological Convergence (index of TOT 1999–2010, 1997 = 1)



PRC = People's Republic of China, TOT = terms of trade.
 Source: Simulation results.

Figure 5 shows that the decline in the PRC's TOT is caused by a strong decline in its export price index, combined with a moderate increase in its import price index. More specifically, in 2010, the 10% decline in the TOT is caused by a decline in the export price index of nearly 9% and an increase in the import price index of nearly 2% (Table 6). The main factor that influences the PRC's export prices is the strong technological progress in the convergence scenario relative to the baseline. The improvement in the total primary-factor-augmented productivity in the PRC reduces production costs, leading to reduced output and export prices.

Figure 5. The PRC's Technology Convergence: Export and Import Price Indexes (percentage deviation from baseline 1999–2010)



PRC = People's Republic of China.

Source: Simulation results.

Table 6. The PRC's Technological Convergence: Effects on the PRC's Export and Import Prices

| Item | GTAP Database: | Baseline Simulation: | PRC's Convergence: |
|--------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------------|
| | Shares of Exports or Imports by Commodity Groups (%) 1997 | Shares of Exports or Imports by Commodity Groups (%) 2010 | Percentage Deviation of Export or Import Prices from Baseline (%) 2010 |
| Total exports | 100.0 | 100.0 | -8.8 |
| Agriculture | 2.5 | 1.2 | -1.2 |
| Mining | 1.9 | 0.5 | -4.4 |
| Coal | 0.5 | 0.4 | -8.3 |
| Manufacturing | 86.1 | 91.3 | -9.0 |
| Wearing apparel | 11.0 | 10.6 | -10.5 |
| Electronic equipment | 13.0 | 17.9 | -10.9 |
| Other manufactures | 9.3 | 9.2 | -10.4 |
| Services | 9.4 | 7.0 | -7.6 |
| Total imports | 100.0 | 100.0 | 1.8 |
| Agriculture | 2.9 | 2.7 | 4.4 |
| Plant-based fibers | 0.6 | 0.4 | 4.6 |
| Wool, silkworm cocoons | 0.2 | 0.1 | 4.2 |
| Mining | 3.4 | 4.0 | 14.2 |
| Oil | 2.1 | 3.5 | 16.7 |
| Manufacturing | 83.4 | 77.9 | 0.6 |
| Petroleum, coal products | 2.4 | 1.6 | 14.3 |
| Services | 10.3 | 15.4 | 1.4 |

Source: Simulation results.

The decline in the export price index for agriculture products is less than that for manufactured goods (Table 6). This is because improvement of productivity in the agriculture sector is estimated to be slower than that in the manufacturing sector in the historical simulation. Furthermore, the agricultural sector uses land as a primary-factor input. In these simulations, additional technological progress was not allowed to affect the amount of land available for producers. Fixing the availability of land limits the agricultural sector's ability to reduce costs.

Although the improvement of productivity in the mining sector was larger than that in the manufacturing sector, the sector's production is significantly limited by the availability of resources, especially with regard to the oil industry. In the simulation, it was assumed that the PRC's technological convergence had little influence on its oil production. Even though the convergence brings about a higher demand for oil, the PRC's oil production continues its resource-limited growth of 2% per year.⁷ This means that the PRC's oil price rises with the strong increase in demand caused by the technological convergence.

The decrease in the export price index for the mining sector is due to a decline in the export price for coal. Continuing its historical trend, coal becomes dominant in the PRC's mining exports by 2010 in the baseline (Table 6). With technological convergence, the PRC's export price for coal is lower than in the case of no technological progress. The limited availability of resources for coal is less of a constraint in the PRC than that for oil and gas.

The shares of mining and agricultural products in the PRC's total exports, however, are insignificant compared with that of manufactured goods. Manufactured goods comprise the bulk of the PRC's total exports.⁸ The 9-percentage-point fall in the export price index is therefore mainly attributable to the fall in the export price index for manufactures (Table 6).

The 2-percentage-point rise in the PRC's import price index is mainly attributable to large increases in the prices for agricultural and mining products. As a result of the PRC's convergence, the import price index for manufactured goods rises only slightly by about 0.5%. The import price index of agriculture rises significantly by 4%, and mining rises by 14%. This is because the PRC's convergence leads to increased demand for imported energy and primary inputs such as oil, iron ore, wool, and cotton.

⁷The PRC's self-sufficiency policy meant that the country reached its domestic-resource limit before it turned to imports on a large scale in the early 1990s.

⁸The service exports presented in Table 4 include only cross-border transactions, or the first two modes of trade in services. The bulk of the services trade involves movement of people and capital across borders—the third and fourth modes of service trade, which are not explicitly discussed in this study. Trade in services therefore appears to be insignificant compared to the merchandise trade in Table 6.

Oil, in particular, registers the largest rise in the import price as a result of the PRC's technological convergence. In the simulation, the PRC's convergence is assumed not to have a significant impact on oil production in the PRC and in other countries. Oil production is assumed to be mainly determined by supply-side factors such as resource constraints in the PRC and monopolistic production behavior in the Middle East.

D. Effects of Convergence on the PRC's Economic Structure

As a result of the technological convergence, the PRC's exports increase by about 46% and imports by about 45% relative to their respective baseline levels in 2010. Imports and exports of all commodities and services rise relative to their baseline levels (Table 7). On the export side, the increase in manufactured exports is larger than those in agricultural and mining exports. By contrast, the increase in manufactured imports is smaller than those in agricultural and mining imports.

The deviation from the baseline of value-added by industries shows a similar pattern to that of the export volumes. Table 7 shows that, following the technological convergence, value-added in all sectors expands. However, value-added of the manufacturing and services sectors rise more than that of the agricultural and mining sectors.

In the convergence scenario, the PRC's productivity is assumed to improve in all sectors relative to the baseline. The improvement in the agricultural sector is, however, slower than that in the manufacturing and services sectors. Furthermore, the agricultural sector has land as a fixed factor, limiting its scope to expand production. Although the mining sector experiences the largest increase in productivity, its production is significantly limited by resource constraints, as discussed in Section III.C. Thus, technological convergence causes the PRC to increase its specialization in manufacturing. Due to resource constraints, the PRC becomes more dependent on imports for agricultural and mining products.

Table 7. The PRC's Convergence: Effects on the PRC's Trade Volumes and Value-Added by Industries

| Item | The PRC's Convergence: Effects on the PRC's Trade Volumes and Value-Added by Industries (%) | | | | | | | | | |
|------------------------------------|---------------------------------------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------|--|--|--|
| | Baseline Shares of Exports by Commodity Groups 2010 | Percentage Deviation of Export Volumes from Baseline 2010 | Baseline Shares of Imports by Commodity Groups 2010 | Percentage Deviation of Import Volumes from Baseline 2010 | GTAP Database: Percentage Shares of Value Added by Industries 1997 | Baseline Simulation: Percentage Shares of Value Added by Industries 2010 | The PRC's Convergence: Percentage Deviation from Baseline 2010 | | | |
| Total | 100.0 | 45.8 | 100.0 | 44.6 | 100.0 | 100.0 | 52.1 | | | |
| Agriculture | 1.2 | 11.0 | 2.7 | 53.1 | 20.9 | 16.3 | 36.2 | | | |
| Mining | 0.5 | 9.3 | 4.0 | 81.4 | 4.4 | 0.9 | 39.9 | | | |
| Manufacturing | 91.3 | 47.0 | 77.9 | 43.3 | 37.5 | 39.6 | 57.2 | | | |
| Meat products | 0.0 | 49.7 | 0.3 | 7.1 | 0.1 | 0.0 | 39.5 | | | |
| Other meat products | 0.2 | 22.0 | 0.6 | 35.4 | 0.2 | 0.1 | 40.5 | | | |
| Vegetable oils and fats | 0.1 | 18.0 | 0.8 | 39.7 | 0.1 | 0.0 | 35.6 | | | |
| Dairy products | 0.0 | 30.2 | 0.1 | 27.4 | 0.0 | 0.0 | 38.4 | | | |
| Processed rice | 0.1 | 22.6 | 0.1 | 14.9 | 1.5 | 0.9 | 27.3 | | | |
| Sugar | 0.0 | 7.5 | 0.1 | 38.6 | 0.0 | 0.0 | 21.9 | | | |
| Food products nec | 1.0 | 13.9 | 1.1 | 42.4 | 0.7 | 0.4 | 31.5 | | | |
| Beverages and tobacco products | 0.4 | 37.8 | 0.6 | 26.3 | 0.9 | 0.6 | 47.5 | | | |
| Textiles | 5.3 | 25.0 | 10.0 | 36.6 | 3.3 | 2.5 | 40.6 | | | |
| Wearing apparel | 10.6 | 38.1 | 0.7 | 26.5 | 2.0 | 3.0 | 41.9 | | | |
| Leather products | 6.3 | 22.6 | 1.7 | 27.4 | 1.0 | 1.2 | 27.6 | | | |
| Wood products | 2.6 | 55.5 | 0.9 | 30.6 | 0.7 | 1.0 | 61.2 | | | |
| Paper products, publishing | 0.7 | 52.1 | 3.5 | 37.6 | 1.5 | 1.1 | 66.7 | | | |
| Petroleum and coal products | 0.3 | 44.6 | 1.6 | 36.2 | 0.6 | 0.5 | 55.8 | | | |
| Chemical, rubber, plastic products | 6.8 | 35.4 | 13.1 | 46.9 | 4.2 | 3.3 | 51.1 | | | |

Continued.

Table 7. Continued.

| Item | Baseline Shares of Exports by Commodity Groups 2010 | Percentage Deviation of Export Volumes from Baseline 2010 | Baseline Shares of Imports by Commodity Groups 2010 | Percentage Deviation of Import Volumes from Baseline 2010 | GTAP Database: Percentage Shares of Value Added by Industries 1997 | Baseline Simulation: Percentage Shares of Value Added by Industries 2010 | The PRC's Convergence: Percentage Deviation from Baseline 2010 |
|-------------------------------|-----------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------|
| Other mineral products | 2.8 | 66.2 | 2.1 | 27.1 | 4.1 | 3.8 | 75.0 |
| Ferrous metals | 2.3 | 65.7 | 4.9 | 38.2 | 1.7 | 1.7 | 81.1 |
| Nonferrous metals | 1.3 | 63.4 | 2.9 | 47.0 | 0.5 | 0.6 | 76.3 |
| Metal products | 3.7 | 54.8 | 1.7 | 35.3 | 1.5 | 1.7 | 65.1 |
| Motor vehicles and parts | 0.8 | 65.4 | 1.6 | 45.2 | 0.9 | 0.7 | 75.7 |
| Other transport equipment | 1.9 | 74.2 | 1.5 | 38.4 | 0.8 | 0.8 | 77.9 |
| Electronic equipments | 17.9 | 58.2 | 11.7 | 51.3 | 1.9 | 4.4 | 63.9 |
| Other machinery and equipment | 17.0 | 55.8 | 15.3 | 48.9 | 6.4 | 7.2 | 67.7 |
| Other manufactures | 9.2 | 33.4 | 1.2 | 43.8 | 2.8 | 4.0 | 43.5 |
| Services | 7.0 | 39.6 | 15.4 | 42.3 | 37.3 | 43.1 | 58.3 |

nec = not elsewhere classified, GTAP = Global Trade Analysis Project, PRC = People's Republic of China.

Source: Simulation results

IV. TOT EFFECTS OF THE PRC'S CONVERGENCE ON NEIGHBORING COUNTRIES

In Section III, the effects of the PRC's rapid economic growth from 1999 to 2010 is simulated by its technological convergence. As a result, the prices of agricultural and mining products in the PRC rise relative to their levels without convergence, while the price of manufactures fall relative to their no-convergence levels. Consequently, the PRC, as a net importer of agricultural and mining products, and a net exporter of manufactures, experiences a significant fall in its TOT. This section analyzes the effects of PRC's technological convergence on the TOT of neighboring countries.

Table 8 shows that, as a result of the PRC's technological convergence, the TOT of countries rich in resources—such as Australia, Indonesia, and the ROW—improve. The TOT for the US also improves. India, having an endowment and production pattern similar to that of the PRC, suffers the second largest deterioration in its TOT after the PRC.

The magnitude of the TOT effects, however, is generally small for neighboring countries because the PRC's convergence has both positive and negative influences on export and import price indexes. The outcome for neighboring countries is examined in more detail.

Table 8. **The PRC's Technological Convergence: Impact on Other Countries**
(percentage deviation from baseline in 2010, %)

| Item | TOT | Export Price Index | Import Price Index |
|----------------|-------|--------------------|--------------------|
| PRC | -10.4 | -8.8 | 1.8 |
| India | -3.5 | -1.2 | 2.3 |
| Indonesia | 2.8 | 4.4 | 1.6 |
| Thailand | -1.5 | -0.3 | 1.2 |
| Malaysia | -0.1 | -0.2 | -0.1 |
| Philippines | -0.9 | 0.0 | 0.9 |
| Singapore | -0.2 | 1.1 | 1.3 |
| Australia | 1.4 | 1.7 | 0.4 |
| Korea, Rep. of | -0.7 | 1.1 | 1.8 |
| Japan | -0.8 | 0.1 | 0.9 |
| US | 0.5 | 0.7 | 0.3 |
| ROW | 2.1 | 2.9 | 0.8 |

PRC = People's Republic of China, ROW = rest of the world, TOT = terms of trade, US = United States.

Source: Simulation results.

A. Japan

The PRC's technological convergence has a small negative impact on Japan's TOT. The deviation of Japan's TOT from its baseline level in 2010 is – 0.8%, or about 14 times less than that for the PRC (Table 8).

On the export side, the deviation from the baseline of the export price index is 0.1%. This is due to the off-setting effects caused by a fall (negative deviation from baseline) in the export price index for manufactures and a rise (positive deviation from baseline) in the export price index for services (third column of Table 9). Japan's export price index for services rises because the services trade in the model includes transport and insurance margins demanded by international trade transactions. With the PRC catching up in technology, total world trade expands, leading to increased demand for transportation and insurance services.

Table 9. The PRC's Technological Convergence: Effects on Japan's Trade

| Item | GTAP Database: Shares of Exports or Imports by Commodity Groups (%) 1997 | Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%) 2010 | The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline (%) 2010 |
|-----------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Total exports | 100.0 | 100.0 | 0.1 |
| Agriculture | 0.1 | 0.1 | 3.1 |
| Mining | 0.0 | 0.0 | n.a. |
| Manufacturing | 84.3 | 81.6 | –0.3 |
| Petroleum, coal products | 0.2 | 0.5 | 13.3 |
| Services | 15.6 | 18.2 | 1.6 |
| Total imports | 100.0 | 100.0 | 0.9 |
| Agriculture | 5.1 | 3.5 | 2.0 |
| Mining | 12.0 | 15.4 | 11.2 |
| Oil | 7.12 | 11.0 | 16.3 |
| Manufacturing | 58.9 | 59.5 | –2.2 |
| Petroleum, coal products | 2.0 | 2.3 | 14.1 |
| Electronic equipment | 9.7 | 11.4 | –5.1 |
| Services | 24.0 | 21.6 | 1.7 |

GTAP = Global Trade Analysis Project, n.a. = not applicable, PRC = People's Republic of China, ROW = rest of the world, TOT = terms of trade, US = United States.

Sources: GTAP database and simulation results.

With the very small deviation in the export price index, the negative deviation of Japan's TOT is mainly attributable to a positive deviation in the imports price index of 0.9%. The positive deviation in Japan's import price index, in turn, is caused by a significant rise in import prices for agricultural and mining

products. In particular, the price index of Japan's mining imports rises by 11% due to the PRC's catching-up (column [b] of Table 10).

Table 10. **The PRC's Technological Convergence: Effects on Japan's Import Prices (contribution by commodity groups to the deviation of import price index, 2010)**

| Item | Baseline Shares in Total Imports by Commodity Groups (a) | Percentage Deviation in Import Prices by Commodity Groups (b) | Contribution to the Percentage Deviation in the Total Import Price Index by Commodity Groups (c) = (a)*(b)/100 |
|----------------------|-------------------------------------------------------------------|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|
| Total imports | 100.0 | 0.9 | 0.9 |
| Agriculture | 3.5 | 2.0 | 0.1 |
| Mining | 15.5 | 11.2 | 1.7 |
| Manufacturing | 59.4 | -2.2 | -1.3 |
| Services | 21.6 | 1.7 | 0.4 |

PRC = People's Republic of China.

Source: Simulation results.

However, the effects on Japan's import price index of the rise in prices for mining imports are largely offset by the fall in prices for manufactured imports (column [c] of Table 10). Prices for manufactured imports fall mainly due to a fall in the price of manufactured imports from the PRC. Although the rise in prices of mining imports exceeds in absolute terms the fall in prices of manufactured imports, manufactured imports have a dominant share in Japan's total imports (column [a] of Table 10). Thus, overall, Japan's import price index rises moderately, leading to a small fall in the TOT.

B. The Republic of Korea

The Republic of Korea also experiences a small negative deviation in its TOT due to the PRC's technological convergence. The deviation in the Republic of Korea's TOT from baseline in 2010 is -0.7%, similar to that for Japan. However, both the Republic of Korea's import and export price indexes increase more than those for Japan (Table 9).

Table 11. The PRC's Technological Convergence: Effects on the Republic of Korea's Trade

| Item | GTAP Database: Shares of Exports or Imports by Commodity Groups (%) 1997 | Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%) 2010 | The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline (%) 2010 |
|-----------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Total exports | 100.0 | 100.0 | 1.1 |
| Agriculture | 0.4 | 0.3 | 2.3 |
| Mining | 0.0 | 0.0 | n.a. |
| Manufacturing | 80.5 | 87.4 | 0.9 |
| Petroleum, coal products | 2.5 | 3.6 | 14.9 |
| Services | 19.1 | 12.3 | 2.3 |
| Total imports | 100.0 | 100.0 | 1.8 |
| Agriculture | 3.6 | 2.2 | 2.5 |
| Mining | 13.6 | 14.8 | 13.0 |
| Manufacturing | 67.9 | 69.6 | -0.8 |
| Services | 14.8 | 13.4 | 1.3 |

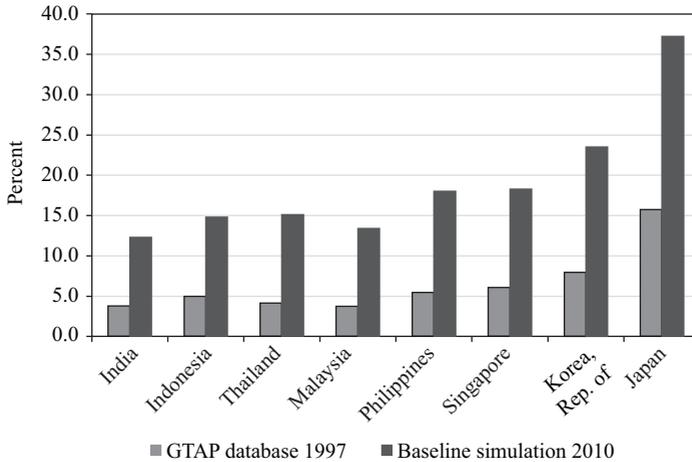
GTAP = Global Trade Analysis Project, n.a. = not applicable.

Sources: GTAP database and simulation results.

Although the PRC's convergence tends to bring down the worldwide price for manufactures, the Republic of Korea's export price index for manufactures rises because its manufactured exports are oil-intensive. As the PRC's convergence pushes up prices for mining products (especially crude oil), the prices for petroleum and coal products that use mining products as the main intermediate input also rise significantly. Since petroleum products comprise a significant share of the Republic of Korea's total exports (compared with Japan), this leads to a small rise in the Republic of Korea's export price index for manufactures.

The import price index for manufactures falls less in the Republic of Korea than in Japan because the Republic of Korea imports a smaller proportion of manufactures from the PRC than Japan does (Figure 6). The PRC's export price index for manufactures falls significantly as it catches up with developed countries in production technology. Consequently, Japan, importing a larger proportion of manufactures from the PRC, experiences a larger fall in its import price for manufactures.

Figure 6. Share of Manufactured Imports from the PRC in Total Manufactured Imports (1997 and 2010, %)



GTAP = Global Trade Analysis Project, PRC = People's Republic of China.
Sources: GTAP database and simulation results.

C. India

The PRC's convergence leads to an overall fall in export prices and to a rise in import prices in India. As a result, India's TOT falls relative to its value in the baseline by 3.5% in 2010. This is a larger change than those simulated for other neighboring countries of the PRC (Table 8).

On the import side, the import price index for mining rises in India as in Japan and the Republic of Korea. However, unlike for Japan and the Republic of Korea, the rise in the import price index for mining is not offset by a fall in the import price index for manufactures (third column, Table 12). In India's case, two factors contribute to a rise in the import price index for manufactures: a significant share of petroleum and coal products in total imports, and a small share of manufactured imports from the PRC in total manufactured imports.

Table 12. The PRC's Technological Convergence: Effects on India's Trade

| Item | GTAP Database: | Baseline Simulation: | The PRC's Convergence: |
|----------------------|------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------|
| | Shares of Exports or Imports by Commodity Groups (%) | Shares of Exports or Imports by Commodity Groups (%) | Percentage Deviation of Export or Import Prices from Baseline (%) |
| | 1997 | 2010 | 2010 |
| Total exports | 100.0 | 100.0 | -1.2 |
| Agriculture | 6.4 | 2.8 | 0.6 |
| Mining | 2.4 | 0.8 | 4.8 |
| Manufacturing | 70.6 | 80.5 | -1.8 |
| Services | 20.5 | 15.9 | 0.7 |
| Total imports | 100.0 | 100.0 | 2.3 |
| Agriculture | 3.6 | 6.4 | 2.7 |
| Mining | 10.4 | 7.0 | 12.2 |
| Manufacturing | 69.4 | 70.7 | 1.3 |
| Services | 16.5 | 15.9 | 0.9 |

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.

Source: Simulation results.

India has the largest share of petroleum and coal products in total imports among the nine economies that are analyzed in detail in this paper. The large rise in the import price for petroleum and coal products following the PRC's convergence therefore places significant upward pressure on India's import price index for manufactured goods.

Furthermore, India imports less manufactured goods from the PRC than the other economies presented in Figure 6. The large fall in the price of manufactured imports from the PRC is therefore not sufficient to offset the upward pressure on India's import price index for manufactured goods discussed earlier.

On the export side, the downward pressure that the PRC's convergence places on the export price index for manufactured goods plays a more significant role for India than for the other countries analyzed in this paper. This is because India's exports concentrate on labor-intensive manufactures, such as clothing and other wearing apparel. As a result of the PRC's convergence, these products have larger price declines than do the capital-intensive ones, such as motor vehicles and nonferrous metals (Table 13).

Table 13. The PRC's Convergence: Effects on Export Prices for the PRC and India

| Item | GTAP Database: | | Baseline Simulation: | | PRC's Convergence: | |
|-------------------------|-----------------|-------|----------------------|-------|-------------------------|-------|
| | Shares in Total | | Shares in Total | | Percentage Deviation of | |
| | Exports by | | Exports by | | Export Prices from | |
| | Commodities | | Commodities | | Baseline | |
| | 1997 | | 2010 | | 2010 | |
| | PRC | India | PRC | India | PRC | India |
| Manufactures | 86.1 | 70.6 | 91.3 | 80.5 | -8.8 | -1.2 |
| Meat products | 0.0 | 0.4 | 0.0 | 0.1 | -9.2 | -3.1 |
| Other meat products | 0.5 | 0.0 | 0.2 | 0.0 | -4.3 | -0.7 |
| Vegetable oils and fats | 0.2 | 2.3 | 0.1 | 1.0 | -2.9 | 0.1 |
| Dairy products | 0.0 | 0.0 | 0.0 | 0.0 | -5.8 | -0.5 |
| Processed rice | 0.1 | 1.8 | 0.1 | 1.1 | -5.9 | -2.6 |
| Sugar | 0.1 | 0.5 | 0.0 | 0.3 | -1.0 | -0.5 |
| Food products nec | 1.8 | 4.0 | 1.0 | 2.3 | -3.0 | -1.1 |
| Beverages and tobacco | | | | | | |
| products | 0.4 | 0.1 | 0.4 | 0.1 | -6.1 | -1.0 |
| Textiles | 8.6 | 13.4 | 5.3 | 9.5 | -6.6 | -1.1 |
| Wearing apparel | 11.0 | 8.9 | 10.6 | 15.5 | -10.5 | -4.4 |
| Leather products | 8.8 | 2.9 | 6.3 | 4.4 | -8.8 | -3.2 |
| Wood products | 1.7 | 0.4 | 2.6 | 0.6 | -7.9 | -1.3 |
| Paper products, | | | | | | |
| publishing | 0.7 | 0.3 | 0.7 | 0.3 | -8.3 | -0.3 |
| Petroleum and coal | | | | | | |
| products | 0.5 | 0.5 | 0.3 | 0.8 | 6.4 | 14.1 |
| Chemical, rubber, | | | | | | |
| plastic products | 6.8 | 8.6 | 6.8 | 7.1 | -4.9 | 1.1 |
| Other mineral products | 2.2 | 1.4 | 2.8 | 2.4 | -9.3 | -1.5 |
| Ferrous metals | 1.8 | 2.2 | 2.3 | 3.5 | -9.2 | -1.1 |
| Nonferrous metals | 1.0 | 0.8 | 1.3 | 0.9 | -7.2 | -0.2 |
| Metal products | 2.9 | 2.2 | 3.7 | 5.9 | -8.7 | -2.7 |
| Motor vehicles and | | | | | | |
| parts | 0.5 | 1.2 | 0.8 | 2.2 | -5.4 | -0.8 |
| Other transport | | | | | | |
| equipment | 1.4 | 0.9 | 1.9 | 1.2 | -7.2 | -1.6 |
| Electronic equipment | 13.0 | 1.4 | 17.9 | 1.3 | -10.9 | -3.4 |
| Other machinery and | | | | | | |
| equipment | 12.9 | 4.3 | 17.0 | 5.1 | -9.0 | -2.0 |
| Other manufactures | 9.3 | 12.1 | 9.2 | 14.9 | -10.4 | -3.9 |

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.

Sources: GTAP database and simulation results.

To summarize, India's TOT worsens mainly due to the following characteristics in its trade structure: (i) a significant share of mining products in total imports, (ii) a large share of petroleum and coal products in total imports, (ii) a small share of manufactured imports from the PRC in total manufactured imports, and (iii) a concentration of labor-intensive manufactures in its total exports.

D. Indonesia

The story is quite different for Indonesia. As a result of the PRC's convergence, Indonesia's TOT improves by 2.8% in 2010 (Table 8). Table 14 shows that the improvement in TOT for Indonesia is mainly attributable to a large rise in its export price index. Indonesia's export price index rises by 4.4% in 2010, much more than the rise in its import price index of 1.6% (Table 14). For Indonesia, the rise in the export price index of mining products following the PRC's convergence plays a significant role. Compared with other countries, Indonesia has a significant share of mining products in its total exports.

Table 14. The PRC's Technological Convergence: Effects on Indonesia's Trade

| Item | GTAP Database: Shares of Exports or Imports by Commodity Groups (%) 1997 | Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%) 2010 | The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline (%) 2010 |
|----------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Total exports | 100.0 | 100.0 | 4.4 |
| Agriculture | 3.9 | 2.6 | 2.0 |
| Mining | 20.7 | 26.2 | 12.6 |
| Manufacturing | 63.8 | 59.0 | 0.4 |
| Services | 11.6 | 12.3 | 2.5 |
| Total imports | 100.0 | 100.0 | 1.6 |
| Agriculture | 5.3 | 6.3 | 2.1 |
| Mining | 2.6 | 4.9 | 13.5 |
| Manufacturing | 70.7 | 65.5 | 1.1 |
| Services | 21.4 | 23.3 | 0.6 |

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.

Source: Simulation results.

E. Malaysia

The simulation results show that the PRC's convergence has little impact on Malaysia's TOT, which is down 0.1% in 2010 (Table 8). For Malaysia, changes are small to both the export (-0.2%) and import (-0.1%) price indexes (Table 15).

Table 15. The PRC's Technological Convergence: Effects on Malaysia's Trade

| Item | GTAP Database: | Baseline Simulation: | The PRC's Convergence: |
|----------------------|------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------------------|
| | Shares of Exports or Imports by Commodity Groups (%) | Shares of Exports or Imports by Commodity Groups (%) | Percentage Deviation of Export or Import Prices from Baseline (%) |
| | 1997 | 2010 | 2010 |
| Total exports | 100.0 | 100.0 | -0.2 |
| Agriculture | 1.8 | 1.7 | 5.3 |
| Mining | 4.3 | 4.9 | 12.5 |
| Manufacturing | 78.6 | 77.7 | -1.5 |
| Services | 15.3 | 15.7 | 0.4 |
| Total imports | 100.0 | 100.0 | -0.1 |
| Agriculture | 2.2 | 2.5 | 1.8 |
| Mining | 0.9 | 1.7 | 10.6 |
| Manufacturing | 81.6 | 70.8 | -0.5 |
| Services | 15.3 | 24.9 | 0.1 |

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.

Source: Simulation results.

On the export side, electronic equipment comprises the dominant share in Malaysia's total exports.

Following the PRC's convergence, prices for electronic equipment fall significantly. Malaysia's export price index for manufactures also falls as a result (Table 15). On the other hand, mining products comprise a significant share of total exports in Malaysia—although not as large as in Indonesia. As a result, the effects of the rise in the export price indexes for agriculture, mining, and services almost completely offset the effects of the fall in the export price index for manufactures. Thus, the PRC's convergence leads to a very small change in Malaysia's export price index.

Similarly, on the import side, a small fall in the import price index for manufactures combined with a dominant share of manufactures in total imports has a negative effect on Malaysia's import price index. However, this negative effect is almost completely offset by the effect of the rise in the import price indexes for agriculture, mining, and services (Table 15).

F. Singapore

The PRC's convergence has little impact on Singapore's TOT (Table 8), with both the export and import price indexes rising relative to baseline values by similar amounts (Table 16).

Table 16. The PRC's Technological Convergence: Effects on Singapore's Trade

| Item | GTAP Database: Share of Exports or Imports by Commodity Groups (%) 1997 | Baseline Simulation: Share of Exports or Imports by Commodity Groups (%) 2010 | The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline 2010 |
|--------------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Total exports | 100.0 | 100.0 | 1.1 |
| Agriculture | 0.5 | 0.4 | 1.3 |
| Mining | 0.0 | 0.0 | 1.8 |
| Manufacturing | 75.4 | 76.6 | 0.6 |
| Petroleum and coal products | 5.6 | 8.8 | 15.8 |
| Electronic equipment | 44.9 | 42.4 | -3.1 |
| Services | 24.0 | 22.9 | 2.1 |
| Total imports | 100.0 | 100.0 | 1.3 |
| Agriculture | 1.3 | 1.0 | 1.4 |
| Mining | 5.5 | 9.5 | 16.1 |
| Manufacturing | 82.7 | 74.4 | -0.8 |
| Petroleum and coal products | 3.7 | 5.3 | 13.6 |
| Electronic equipment | 33.2 | 29.4 | -3.7 |
| Services | 10.5 | 15.1 | 0.7 |

GTAP = Global Trade Analysis Project, n.a. = not applicable, PRC = People's Republic of China.
Source: Simulation results.

Petroleum and coal products have a significant share in Singapore's manufactured exports (Table 16). The large rise in the export prices for petroleum and coal products therefore places upward pressure on Singapore's export price index for manufactures. This upward pressure is, however, largely offset by a fall in export price for electronic equipment. The result is a small rise in the export price index for manufactures. The small rise in the export price index for manufactures reinforces the rise in the export price for services,⁹ leading to an increase in Singapore's overall export price index.

On the import side, the downward pressure placed on the import price index for manufactures by the fall in the import price for electronic equipment more than offsets the upward pressure caused by the rise in import prices for petroleum and coal products. This leads to a small fall in the import price index for manufactures (Table 16). The fall in the import price index for manufactures offsets the effects of a large rise in the import price index for mining products, leading to only a small rise in the overall import price index for Singapore.

To summarize, the positive factors that have a strong influence on Singapore's TOT are (i) a significant share of petroleum and coal products in

⁹As discussed, the PRC's convergence leads to increased world trade (Table 19) that, in turn, leads to increased demand for international trade margins such as transport and insurance services. The export price index for services therefore rises.

total exports combined with a large rise in the export price index for these products, (ii) a dominant share of electronic equipment in total imports combined with a fall in the import price index for these products, and (iii) a large share of services in total exports combined with a rise in the export price index for services. The negative factors that have a strong influence on Singapore's TOT are (i) a significant share of mining products in total imports combined with a large rise in the import price index for these products, (ii) a significant share of petroleum and coal products in total imports combined with a large rise in the import price index for these products, and (iii) a dominant share of electronic equipment in total exports combined with a fall in the export price for these products.

These offsetting factors of more or less equal strength result in a small overall effect of the PRC's convergence on Singapore's TOT.

G. Thailand

As a result of the PRC's convergence, Thailand's TOT falls relative to its baseline value by -1.5% in 2010 (Table 8). The export price index falls by a relatively small -0.3% , while the import price index rises by 1.2% in 2010 (Table 17).

For Thailand, a dominant share of electronic equipment and other machinery and equipment in total exports combined with a fall in the export prices for these products leads to a fall in the export price index for manufactures. This negative effect on Thailand's export price index is largely offset by the effect of a rise in the export price index for services. The result is a very small decline in the overall export price index for Thailand (Table 17).

Similarly, on the import side, a dominant share of electronic equipment and other machinery and equipment in total imports combined with a fall in the import prices for these products leads to a fall in the import price index for manufactures. This negative effect on Thailand's import price index offsets partially the effect of a large rise in the import price index for mining products. The result is a moderate rise in the import price index of 1.2% .

Table 17. PRC's Technological Convergence: Effects on Thailand's Trade

| Item | GTAP Database: Shares of Exports or Imports by Commodity Groups (%) 1997 | Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%) 2010 | The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline 2010 |
|-------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| Total exports | 100.0 | 100.0 | -0.3 |
| Agriculture | 1.9 | 1.5 | 3.8 |
| Mining | 0.3 | 0.5 | 16.3 |
| Manufacturing | 77.4 | 76.7 | -1.1 |
| Electronic equipment | 25.1 | 25.0 | -3.3 |
| Other machinery, equipment | 10.5 | 13.4 | -1.9 |
| Services | 20.5 | 21.3 | 1.5 |
| Total imports | 100.0 | 100.0 | 1.2 |
| Agriculture | 2.2 | 2.5 | 2.7 |
| Mining | 7.1 | 7.4 | 15.0 |
| Manufacturing | 75.5 | 64.9 | -0.6 |
| Electronic equipment | 16.6 | 12.9 | -3.3 |
| Other machinery, equipment | 20.5 | 13.3 | -1.4 |
| Services | 15.2 | 25.2 | 0.7 |

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.

Source: Simulation results.

H. Philippines

The simulation results show that the PRC's convergence results in a fall of -0.9% in the Philippines' TOT (Table 6). The fall in TOT is attributable to a rise in the import price index of 0.9% (Table 18), with the export price index changing little.

On the export side, a dominant share of electronic equipment in total exports combined with a fall in the export prices for these products leads to a fall in the export price index for manufactures. This negative effect on the Philippines' export price index is offset by the effect of a rise in the export price index for services (Table 18).

On the import side, a dominant share of electronic equipment in total imports combined with a fall in the import prices for these products leads to a fall in the import price index for manufactures. This negative effect on the Philippines' import price index partially offsets the effect of a large rise in the import price index for mining products. The result is a rise in the import price index of 0.9%.

To summarize, the two positive factors that have a strong influence on the Philippines' TOT are (i) a dominant share of electronic equipment in total imports combined with a fall in the import price for these products, and (ii) a rise in the

export price index for services. The two negative factors that have a strong influence on the Philippines' TOT are (i) a dominant share of electronic equipment in total exports combined with a fall in the export price for these products, and (ii) a large rise in the import price index for mining products.

Table 18. The PRC's Technological Convergence: Effects on the Philippines' Trade

| Item | GTAP Database: Shares of Exports or Imports by Commodity Groups (%) 1997 | Baseline Simulation: Shares of Exports or Imports by Commodity Groups (%) 2010 | The PRC's Convergence: Percentage Deviation of Export or Import Prices from Baseline (%) 2010 |
|-------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Total exports | 100.0 | 100.0 | 0.0 |
| Agriculture | 1.6 | 1.5 | 4.7 |
| Mining | 0.8 | 0.7 | 3.1 |
| Manufacturing | 62.2 | 56.6 | -1.2 |
| Electronic equipment | 37.2 | 32.6 | -2.4 |
| Services | 35.5 | 41.3 | 1.1 |
| Total imports | 100.0 | 100.0 | 0.9 |
| Agriculture | 2.4 | 2.6 | 1.8 |
| Mining | 5.6 | 7.6 | 13.9 |
| Manufacturing | 69.7 | 60.3 | -1.1 |
| Electronic equipment | 23.9 | 18.6 | -3.0 |
| Services | 22.4 | 29.5 | 0.7 |

GTAP = Global Trade Analysis Project, PRC = People's Republic of China.

Source: Simulation results.

V. THE GROWTH EFFECTS OF THE PRC'S CONVERGENCE ON NEIGHBORING COUNTRIES

A. Effects on Export Volumes and Production Mix

The PRC's convergence leads to small changes in the total export volumes of its neighboring countries (Table 19). While the neighboring countries export less to their traditional markets such as the US, Japan, and the ROW, they export more to the PRC (Table 20).

Table 19. **The PRC's Convergence: Effects on Export Volumes by Commodity Groups**
(percentage deviation from baseline 2010)

| Item | India | Indonesia | Thailand | Malaysia | Philippines | Singapore | Korea, Japan Rep. of | Japan |
|----------------------|------------|-------------|-------------|-------------|-------------|-------------|-------------------------|------------|
| Total exports | 0.0 | -1.8 | -0.3 | -1.1 | -1.8 | -0.5 | 0.7 | 2.6 |
| Agriculture | 6.2 | 2.6 | 2.8 | 6.8 | 9.4 | 0.4 | 2.8 | 7.7 |
| Mining | 8.5 | 2.5 | 3.3 | 2.0 | 3.4 | n.a. | n.a. | n.a |
| Manufactures | -1.7 | -4.1 | -1.8 | -3.1 | -6.3 | -2.0 | 0.0 | 1.2 |
| Services | 7.3 | 2.0 | 4.9 | 8.2 | 3.6 | 4.8 | 6.0 | 8.6 |

n.a. = not applicable, PRC = People's Republic of China.

Source: Simulation results.

Table 20. **The PRC's Convergence: Effects on Imports into the US, Japan, ROW,**
and the PRC
(percentage deviation from the baseline 2010)

| Item | Import volumes into | | | |
|---------------------------------|---------------------|------------|------------|-------------|
| | US | Japan | ROW | PRC |
| Total (from all sources) | 1.8 | 3.2 | 1.4 | 44.6 |
| PRC | 42.7 | 39.0 | 51.2 | n.a. |
| India | -6.6 | -6.2 | -1.6 | 47.6 |
| Indonesia | -10.7 | -8.8 | -6.1 | 42.9 |
| Thailand | -7.5 | -9.9 | -2.3 | 49.1 |
| Malaysia | -8.8 | -9.5 | -2.0 | 51.1 |
| Philippines | -9.7 | -15.8 | -4.1 | 42.6 |
| Singapore | -10.1 | -12.5 | -4.4 | 46.8 |
| Korea, Rep.of | -14.1 | -17.5 | -9.0 | 36.7 |
| Japan | -7.0 | n.a. | -3.8 | 44.7 |

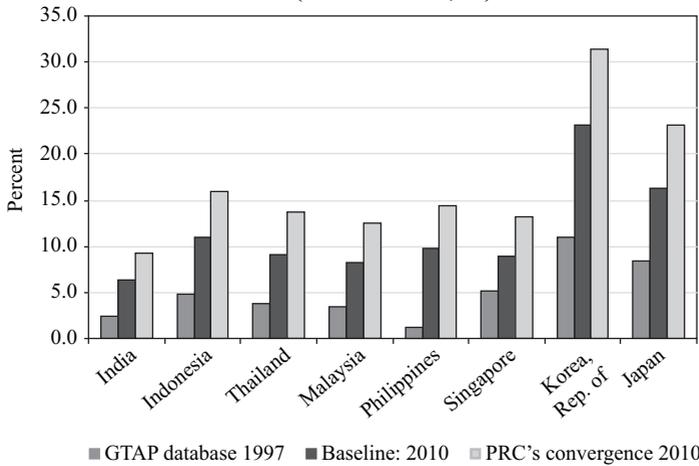
PRC = People's Republic of China, ROW = rest of the world, US = United States.

Source: Simulation results.

Table 20 shows that in the US, Japan, and the ROW markets, the PRC's convergence leads to a large increase in imports from the PRC, while imports from all other countries and/or regions fall. However, for the PRC's neighboring countries, this negative impact on their exports is greatly softened by a large increase in their exports to the PRC.

For the Republic of Korea and Japan, which send a larger proportion of their exports to the PRC than other countries presented in Figure 7, the fall in their exports to other markets is more than compensated for by the increase in their exports to the PRC, leading to an increase in their total export volumes. In terms of commodity composition, exports of manufactures fall for most of the PRC's neighboring countries, except the Republic of Korea and Japan. Exports of agricultural and mining products and services, on the other hand, rise as a result of the PRC's convergence (Table 19).

Figure 7. The Share of Exports to the PRC in Total Exports (1997 and 2010, %)



PRC = People's Republic of China, GTAP = Global Trade Analysis Project.
 Source: GTAP database and simulation results.

Again, the decline in the export of manufactures is due to declining exports of these products to non-PRC markets. The neighboring countries' exports of manufactures to the PRC market increase as a result of the convergence. Indeed, the PRC's convergence not only leads to a large increase in its export of manufactures, convergence also leads to a large increase in its import of manufactures, primarily electronic equipment, other machinery and equipment, and chemical-rubber-plastic products.

Table 21 shows that electronic equipment, other machinery and equipment, and chemical-rubber-plastic products comprise large shares of both the PRC's total exports and imports. For these products, the PRC is part of a production network. For example, the production in the PRC of electronic equipment requires imports of electronic equipment from its neighboring countries as intermediate inputs.

Table 21. The PRC's Convergence: Effects on the Exports and Imports of Manufactures (percentage deviation from the baseline 2010)

| Item | Electronic Equipment | | Machinery and Other Equipment | | Chemical, Rubber, and Plastic Products | | Electronic Equipment | | Machinery and Other Equipment | | Chemical, Rubber, and Plastic Products | |
|----------------|----------------------|--------------------|-------------------------------|--------------------|----------------------------------------|--------------------|------------------------|----------------------|-------------------------------|----------------------|----------------------------------------|----------------------|
| | Exports to the World | Exports to the PRC | Exports to the World | Exports to the PRC | Exports to the World | Exports to the PRC | Imports from the World | Imports from the PRC | Imports from the World | Imports from the PRC | Imports from the World | Imports from the PRC |
| PRC | 58.2 | n.a. | 55.8 | n.a. | 35.4 | n.a. | 51.3 | n.a. | 48.9 | n.a. | 46.9 | n.a. |
| India | -6.6 | 62.7 | 0.8 | 61.3 | 5.0 | 57.8 | -1.8 | 57.0 | -4.3 | 56.4 | -2.1 | 33.7 |
| Indonesia | -10.4 | 64.5 | -1.9 | 61.7 | 2.1 | 53.7 | 3.3 | 58.8 | 0.1 | 65.4 | -1.4 | 36.1 |
| Thailand | -5.3 | 66.7 | 0.4 | 59.5 | 8.1 | 50.9 | -3.6 | 56.3 | -0.7 | 60.7 | -0.3 | 38.4 |
| Malaysia | -7.6 | 63.5 | 1.8 | 61.0 | 8.0 | 59.2 | -3.5 | 62.3 | -0.1 | 57.8 | -0.6 | 38.3 |
| Philippines | -9.4 | 52.8 | -2.2 | 53.0 | 6.4 | 43.9 | -5.8 | 61.8 | 1.1 | 51.1 | -1.8 | 34.8 |
| Singapore | -5.0 | 62.5 | -0.8 | 53.9 | 4.7 | 52.4 | -3.4 | 53.1 | -0.3 | 51.4 | 0.8 | 39.0 |
| Korea, Rep. of | -8.3 | 47.1 | 0.1 | 44.0 | 8.2 | 35.5 | -1.7 | 51.7 | -2.5 | 61.0 | 4.4 | 41.4 |
| Japan | -3.7 | 48.5 | 0.7 | 49.4 | 4.9 | 48.6 | 13.0 | 57.2 | 8.5 | 45.8 | 0.2 | 32.8 |

PRC = People's Republic of China, n.a. = not applicable.

Source: Simulation results.

The technological convergence intensifies the PRC's role in these networks. The convergence leads to a large increase in the neighboring countries' exports (imports) of electronic equipment, other machinery and equipment, and chemical–rubber–plastic products to (from) the PRC; on the other hand, the neighboring countries' total exports (imports) of these products to the world either fall or increase at slower rates (Table 21). Therefore, as a result of the PRC's convergence, the neighboring countries reduce their trade in such products with non-PRC partners and trade more with the PRC.

Table 22 shows that for neighboring countries, the PRC's convergence leads to a pattern of change in the production mix similar to that for exports. Other than a few exceptions, value-added for manufactures contract, while that for the primary and services sectors expand for the neighboring countries.

Table 22. **The PRC's Convergence: Effects on Value Added by Sector**
(percentage deviation from baseline 2010)

| Item | India | Indonesia | Thailand | Malaysia | Philippines | Singapore | Korea, Japan Rep. of | |
|--------------|-------------|------------|-------------|------------|-------------|------------|-------------------------|------------|
| GDP | -1.1 | 0.0 | -0.2 | 0.2 | 0.0 | 0.6 | 0.5 | 0.0 |
| Agriculture | 0.2 | 0.2 | 0.8 | 1.5 | 0.0 | 0.5 | 0.1 | 0.1 |
| Mining | 1.9 | 0.6 | 0.4 | 1.4 | 0.7 | n.a. | -0.2 | 0.1 |
| Manufactures | -1.9 | -1.9 | -2.1 | -3.2 | -2.5 | -2.4 | -0.4 | -0.8 |
| Services | -0.9 | 0.5 | 0.1 | 3.2 | 0.6 | 1.4 | 0.4 | 0.2 |

GDP = gross domestic product, , n.a. = not applicable, PRC = People's Republic of China.

Source: Simulation results.

B. Why are the GDP Effects Small?

The impact of the PRC's convergence on the real GDP of neighboring countries is mixed, but overall very small—less than one percentage point for all but India. India's real GDP decreases by about 1.0% as a result of the PRC's technological convergence (Table 23).

Table 23. **The PRC's Convergence: Effects on Macroeconomic Variables**
of Neighboring Countries
(percentage deviation from baseline 2010)

| Item | India | Indonesia | Thailand | Malaysia | Philippines | Singapore | Korea, Japan Rep. of | |
|--------------------|-------|-----------|----------|----------|-------------|-----------|-------------------------|------|
| Real GNP | -1.7 | 1.1 | -1.1 | 0.4 | -0.6 | 1.0 | 0.5 | -0/1 |
| Real GDP | -1.1 | 0.0 | -0.2 | 0.2 | 0.0 | 0.6 | 0.5 | 0.0 |
| Capital stock | -1.5 | 0.0 | -0.7 | -0.4 | 0.1 | 0.1 | 0.2 | -0.1 |
| Employment | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| GDP price index | -2.8 | 1.6 | -2.0 | -1.1 | -0.6 | -1.2 | -0.1 | -0.9 |
| Capital rental | -3.6 | -0.9 | -2.2 | -1.8 | -0.7 | -1.0 | 0.2 | -1.1 |
| Real wage | -3.0 | -2.1 | -2.5 | -2.5 | 0.1 | 0.7 | 0.0 | -0.5 |
| TOT | -3.5 | 2.8 | -1.5 | -0.1 | -0.9 | -0.2 | -0.7 | -0.8 |
| Rates of return | -0.8 | -0.1 | -0.4 | 0.4 | 0.2 | 0.7 | 0.9 | 0.1 |

GDP = gross domestic product, GNP = gross national product, TOT = terms of trade,

PRC = People's Republic of China,.

Source: Simulation results.

Output can expand only when there are increases in production factors employed (an increase in L or K) or improvement in productivity (a reduction in A). In the simulation of the PRC's convergence, the following assumptions are made: (i) aggregate employment is determined by long-run factors, such as population growth and labor force participation rates, and therefore is exogenous in the simulation of the PRC's convergence in technology; and (ii) productivity of the neighboring countries is also exogenous. Thus, the changes in output mainly come from changes in capital stock employed.

From the equilibrium condition in the capital market, or equation (1), with the L and A exogenous, changes in capital stock (K) are mainly determined by changes in rental price relative to output price (Q/P_g). Q/P_g , in turn, is a function of the rate of return on capital and TOT.¹⁰

Table 23 shows that the PRC's convergence also leads to small changes in the neighboring countries' rate of return on capital. This is because the PRC has a high savings rate, as is well known. Foreign capital accounts for a very small proportion of the PRC's total capital stock. When the PRC converges with developed countries in technology, the additional capital required to finance the increase in GDP comes mainly from domestic savings.

The small changes in rates of return to capital and TOT lead to small changes in the Q/P_g term, and thus to small changes in capital stock. As a result, the PRC's convergence leads to small changes in real GDP for the neighboring countries.¹¹

It is natural to raise the question that if the PRC can finance its high growth out of domestic savings, why is it important for the PRC to open its economy to foreign investment? The answer lies in the spillover effects of foreign investment. Foreign investment brings about more advanced production technology as well as management skills. The key benefit of foreign investment is improvement in productivity as other players in the host industry catch up with the performance standards set by foreign investors (Mai 2004; Menon 1998).¹² The fact that domestic, rather than foreign, savings will fuel most of the PRC's future growth should also allay the fears of some of its neighbors that compete for similar types of foreign direct investment (FDI). Some of the member countries of the Association of Southeast Asian Nations (ASEAN), in particular, have expressed concern that the PRC's growth has occurred at the expense of FDI flowing into

¹⁰The terms Q/P_g can be expanded to $\frac{Q}{P^2} \frac{P_2}{P_g}$ where P_2 is asset price. The first term is the rate of return on capital. The second term is a function of TOT because P_2 includes import prices but not export prices, and P_g includes export prices but not import prices.

¹¹Changes in indirect taxes will also affect real GDP. That effect is small in this simulation and is therefore ignored in the discussion.

¹²It would be interesting to see how the simulation results would change if productivity in the PRC and its neighboring countries responded endogenously to flows of FDI. While there are many theories about why FDI would improve productivity, empirical estimates of such productivity improvement are scarce. Further modelling research on this issue is important, but beyond the scope of this paper.

their home countries. The results presented here suggest that even if this were true in the past, it is unlikely to be the case in the future.

C. Effects on GNP

The effects of the PRC's convergence on real GNP in neighboring countries are presented in the first row of Table 23. For the PRC, the convergence leads to a much smaller increase in real GNP than in real GDP. For the neighboring countries, the results vary.

The difference between the effects on real GDP and GNP can be largely explained by each country's respective TOT. As discussed earlier, an improvement (deterioration) in the TOT increases (reduces) the price of output, which includes exports but not imports, relative to the price of expenditure, which includes imports but not exports. Increases in the price of output (or GDP) relative to the price of expenditure (or GNE) will, in most cases, cause real GNP to increase relative to real GDP. Such is the case for the PRC and most of the countries under review.

Another factor that explains the difference between real GDP and GNP is net income from abroad. As a result of the PRC's convergence, the PRC's rental price for capital rises significantly, while rental prices for capital in other countries either fall slightly or remain largely unchanged. Those countries that hold a larger proportion of their outward investment stock in the PRC therefore benefit more from its convergence.

For Singapore, real GNP rises notably more than real GDP, even though Singapore's TOT declines as a result of the PRC's convergence. This is because Singapore is among the 10 largest source countries for foreign investment in the PRC. Furthermore, Singapore's outward stock of foreign investment is very large relative to its GDP.

Finally, two sensitivity tests were conducted to check the robustness of the results. Changes of assumptions about user preferences in favor of imports and the PRC's energy efficiency did not affect the main findings to any significant degree.

VI. CONCLUDING COMMENTS

The PRC's rapid economic growth generates both positive and negative effects on the TOT of neighboring countries. Simulations using the MMC model show that technological convergence and the resulting rapid economic growth in the PRC leads to (i) an increase in the world price for energy and primary inputs; (ii) a decrease in the world price for manufactured goods; and (iii) expanded

world trade and therefore an increase in the world price for services exports such as transportation and financial services.

These changes in world prices have positive and negative effects on the TOT of neighboring countries, depending on each country's respective economic structure (Table 24).

Table 24. **Positive and Negative Effects on Neighboring Countries' TOT**

| Item | Positive Effects on TOT for: | Negative Effects on TOT for: |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------|
| Increase in the world price for energy and primary inputs | Net exporters of energy and primary inputs such as Australia and Indonesia | Net importers of energy and primary inputs such as Japan and the Republic of Korea |
| Decrease in the world price for manufactured goods | Importers of manufactured goods, especially imports from the PRC, such as Japan and the Republic of Korea | Exporters of manufactured goods, especially those exporting similar goods to the PRC, such as India |
| Increase in the world price for services exports | The PRC's neighboring countries ^a | |

TOT = terms of trade, PRC = People's Republic of China.

^aNeighboring countries include India, Indonesia, the Republic of Korea, Japan, Malaysia, the Philippines, Singapore, and Thailand.

Source: Simulation results.

The historical simulation demonstrated that neighboring countries responded to the rapid growth of the PRC by expanding their trade and investment linkages with it (e.g., the network of production for electronic and other goods in the region). This, in turn, strengthened the positive effects on their TOT, leading to an overall small improvement in the TOT, despite the increase in the world price for energy and primary inputs.

The overall impact on exports of neighboring countries is also small. While the PRC replaced some of the neighboring countries' exports in their traditional markets, in the process, the PRC itself became an important export destination for these neighboring countries. As part of production networks involving neighboring countries, its convergence increases imports into the PRC of not only agricultural and mining products, but also manufactures and services.

The impact of the PRC's convergence on the real GDP of its close neighbors is also small. There are two main reasons for this. The first is that the additional capital required to finance the increase in the PRC's real GDP comes mainly from domestic savings. Foreign capital constitutes a very small proportion of the PRC's total capital stock. While rapid growth in the PRC places significant pressure on the world's supply of natural resources, it places little pressure on the global supply of capital. This should also allay the fears of some of its neighbors which compete for similar types of FDI (e.g., ASEAN countries) that future growth in the PRC may occur at the expense of FDI flowing into their countries. The second reason relates to the fact that any productivity improvements induced by an expansion in trade and investment flows have not been taken into account

in this study. If this factor is taken into account, the PRC's convergence could have led to a larger positive impact on the real GDP of neighboring countries.

The impact of the PRC's convergence on neighboring countries' real GNP—a better welfare measure than real GDP—is small. There are two reasons for this as well. The first is that the overall impact of the PRC's convergence on neighboring countries' real GDP is small. The second is that the overall TOT impact on neighboring countries is also small.

In summary, the macro and TOT effects of the PRC growth locomotive are positive, supporting the view that the PRC's growth presents more opportunities than risks. But almost all of these effects are small. If this appears counter-intuitive, then it could be because the framework employed here takes into account the offsetting effects. Therefore, although an awakening PRC will have an overall positive impact on the region, its entrance is unlikely to be dramatic.

REFERENCES

- Dimaranan, B.V. and R.A. McDougall. 2002. "Global Trade, Assistance, and Production: The GTAP 5 Data Base." In: Purdue University Centre for Global Trade Analysis. West Lafayette, Indiana.
- Dixon, P.B., J. Menon and M.T. Rimmer. 2000. "Changes in Technology and Preferences: A General Equilibrium Explanation of Rapid Growth in Trade." *Australian Economic Papers* 39(1):31–55.
- _____. 2002. *Dynamic General Equilibrium Modelling for Forecasting and Policy: A Practical Guide and Documentation of MONASH*. Amsterdam: North-Holland Publishing Company.
- Eichengreen, B., Y. Rhee, and H. Tong. 2004. The Impact of China on the Exports of Other Asian Countries. NBER Working Paper No.10768. September. Washington, DC: National Bureau of Economic Research.
- Fujiwara, I., K. Otsu, and M. Saito. 2008. The Global Impact of Chinese Growth. IMES Discussion Paper Series 2008-E-22. Tokyo: Bank of Japan.
- Kaplinsky, R. 2006. "Revisiting the Revised TOT: Will PRC Make a Difference?" *World Development*. 34(6): 981–95.
- Mai, Y. 2002. "The Petroleum Sector After PRC's Entry Into the WTO." *PRC Perspectives* 8(41): 24–32.
- Mai, Y. 2004. The Monash Multi-Country Model. CoPS Working Paper No. G-150. Melbourne: Centre of Policy Studies, Monash University.
- Mai, Y., M. Horridge, and F. Perkins. 2003. Estimating the Effects of PRC's Accession to the World Trade Organisation. Paper presented at the 6th Annual Conference on Global Economic Analysis. Scheveningen, The Hague, The Netherlands, 12–14 June.
- Maizels, A., T. Palaskas, and T. Crowe. 1998. "The Prebisch-Singer hypothesis revisited." In D. Sapsford, and J. Chen (eds.) *Development Economics and Policy: The Conference Volume to Celebrate the 85th Birthday of Professor Sir Hans Singer*. Basingstoke: Macmillan.
- McKibbin, W. and W. T. Woo. 2003. "The Consequences of China's WTO Accession on its Neighbours." *Asian Economic Papers* 2(2): 1–38.
- Menon, J. 1998. "Total Factor Productivity Growth in Foreign and Domestic Firms in Malaysian Manufacturing." *Journal of Asian Economics* 9(2): 251–80.
- Phelps, E. S. 2004. "Effects of PRC's Recent Development in the Rest of the World with Special Attention to Latin America." *Journal of Policy Modeling* 26: 903–10.
- Prebisch, R. 1950. "The Economic Development of Latin America and its Principal Problems." *Economic Bulletin for Latin America* 7. New York: United Nations.
- Sachs, J.D. and W. T. Woo. 2003. "China's Growth After WTO Membership." *Journal of Chinese Economics and Business Studies* 1(1): 1–33.
- Singer, H. 1950. "The Distribution of Gains between Investing and Borrowing Countries." *American Economic Review* 40(2)15: 473–85.
- Singer, H. 1971. "The distribution of gains revisited." In A. Cairncross, and M. Puri, (eds.) *The Strategy of International Development*. London: Macmillan.
- Wood, A. 1997. "Openness and Wage inequality in Developing Countries: the Latin American Challenge to East Asian Conventional Wisdom." *World Bank Economic Review* 11(1): 33–57.

Yan, X., (ed). 1998. *Zhong Guo Shi You Da Cong Zu* (Petroleum Overhaul). Beijing: Shi You Gong Ye Chu Ban She (Petroleum Industry Publishing House).

STATISTICAL REFERENCES

- BP. <http://www.bp.com> (accessed October 2006).
- National Bureau of Statistics of China. *PRC Statistical Yearbook*. Various years. CD ROM from Monash University Library.
- Chinese Ministry of Commerce. Data provided through joint projects.
- Food and Agriculture Organisation. <http://www.fao.org> (accessed August and September 2006).
- International Energy Agency. <http://www.iea.org> (accessed September 2006).
- International Labour Organisation. <http://www.ilo.org> (accessed October 2006).
- Singapore Department of Statistics. <http://www.singstat.gov.sg> (accessed September 2006).
- State Information Centre, People's Republic of China. Data provided through joint projects.
- United Nations, UNSTATS. <http://unstats.un.org/unsd/databases.htm> (accessed July to December 2006).
- United Nations Conference on Trade and Development (UNCTAD). *World Investment Report 2004, 2005, and 2006*.
- United Nations Industrial Development Organisation. *International Yearbook of Industrial Statistics 2006*.
- United States Bureau of Economic Analysis. <http://www.bea.gov> (accessed October 2006).
- World Bank. WDI (accessed through Monash University Library on-line databases in 2006).

Asia's Post-Global Financial Crisis Adjustment: A Model-Based Dynamic Scenario Analysis

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Using a dynamic global general equilibrium model, the paper assesses the short- and medium-term impacts of the global financial crisis for Asian economies and the implications of post-crisis adjustment in East Asia for the world economy. The analysis suggests that East Asia may not be severely hit permanently by the global financial crisis, and that a worldwide fiscal stimulus could play an important role in stabilizing the global economy in crisis. East Asia's efforts toward strengthening regional and domestic demand, in conjunction with more flexible exchange rate regimes, will promote more balanced regional growth, facilitating an orderly global rebalancing. However, despite the growing size of emerging East Asia in the global economy, the region's growth rebalancing has only modest spillover effects on the rest of the world. Emerging East Asia can contribute to global growth, but it alone cannot become the sole engine leading post-crisis growth in the world economy.

JEL classification: C68, E62, F32, F47, G01

I. INTRODUCTION

Since the outbreak of the global financial crisis in the fall of 2008, Asian economies have experienced substantial growth swings. In the initial stages of the crisis, as global aggregate demand dropped due to the falling consumer and investor confidence, exports from all major East Asian economies declined sharply. Imports from these countries also plummeted at almost similar rates to those of export declines, reflecting the tightly knit regional production networks and supply chains in Asia. Given the high trade dependence in most Asian economies, the slump in trade significantly dragged down their economic growth in the fourth quarter of 2008 and the first quarter of 2009.

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But the Asian economies rebounded strongly beginning in the second quarter of 2009. The extraordinarily massive economic stimulus provided by governments and central banks across major advanced and emerging economies—including those in Asia—in response to the crisis helped stabilize financial markets, improved the confidence of investors and consumers, and fostered the recovery of economic activity.¹ As a result, the inventory cycle turned from depleting to rebuilding in most parts of the world and global trade rebounded. The improved external environment, together with stronger domestic demand spurred by these policy stimulus measures, led to a dramatic V-shaped recovery in Asian economies. By the end of 2009, most Asian economies resumed their pre-crisis growth levels. Some of them have begun to moderate their macroeconomic stimulus policies in the face of the increasing risks of overheating, inflation, and asset price bubbles.

The global recovery now remains on track but faces considerable downside risks. The recent unfolding of the European sovereign debt crisis has highlighted the risks arising from the rapid accumulation of public debt, suggesting that the positive effects of fiscal stimulus could be more than offset by the markets' concerns over long-term debt sustainability. With most advanced economies embracing fiscal consolidation in the coming years and inventory restocking gradually running its course, the future pace of global recovery will be largely contingent on the degree to which the sources of demand are able to shift from the public to the private sector. However, given that the reconstruction of the financial sector and the deleveraging of private balance sheets could take a long time to resolve and that the unemployment rate remains high in major advanced economies, we expect to observe a slower global economic growth and consequently an extended shortfall in global aggregate demand in the years to come.

The slower growth of aggregate demand in advanced economies will pose significant challenges for Asian economies. With an export-oriented development strategy, emerging Asian economies have maintained not only high growth, but also large current account surpluses in the past decade, contributing to the global current account imbalance. As economic growth in advanced economies remains slow, in order to sustain growth, Asian economies need to change the source of their growth from exports to extraregional markets to regional and domestic. The reorientation of growth toward Asia's internal demand can contribute to the orderly correction of the global imbalance. In fact, the ongoing crisis has indeed

¹Immediately after the eruption of the global financial crisis, governments and central banks around the world responded swiftly to deal with liquidity and solvency problems of affected financial institutions through easing monetary policy and recapitalizing or restructuring troubled financial institutions. In addition to such measures, fiscal stimulus packages have been implemented around the world to boost demand. The IMF estimated that the total amount of fiscal stimulus in the G-20 countries amounts to \$692 billion in 2009, about 1.4% of their combined GDP. The US, People's Republic of China, Japan, and Germany are the key contributors of global fiscal stimulus, with stimulus packages worth approximately 2% of their respective GDP.

induced a partial and disorderly correction of the global imbalance, with a large contraction of demand in the United States (US), a sharp increase in US household savings and an improvement in its current account. This adjustment has not been accompanied by the collapse of the US dollar, however, as was feared by many experts and policymakers before the outbreak of the financial crisis; it has been accompanied by a global collapse of trade and output, and a rise in unemployment. The ongoing ultra-expansionary monetary policy—including quantitative easing—could lead to a sharp US dollar depreciation, which may exert significant adjustment pressures on Asian economies.

The aim of this paper is to provide a model-based analysis of the adjustment of Asian economies in the wake of the global financial crisis. Specifically, it attempts to answer the following questions: What are the macroeconomic impacts of the global financial crisis on Asian economies? What are the effects of global fiscal stimulus, and how would it contribute to mitigate the impacts of the ongoing crisis? What are the roles of East Asia in the rebalancing of global demand following the crisis? How much will emerging East Asia's efforts at currency appreciation and structural reforms for its own growth rebalancing contribute to sustained global economic growth? We use a multi-region, intertemporal dynamic general equilibrium model of the world economy to simulate different scenarios for the global financial crisis. Our quantitative simulations suggest that East Asia is unlikely to be severely damaged permanently by the global financial crisis, and a worldwide fiscal stimulus could play an important role in stabilizing the global economy in crisis. East Asia's efforts toward strengthening regional and domestic demand, in conjunction with more flexible exchange rate regimes in the region, will promote more balanced regional growth, facilitating an orderly global rebalancing. However, despite the growing size of emerging East Asia in the global economy, Asia-led growth rebalancing has only modest spillover effects on the rest of the world. Even though emerging East Asia can contribute to global growth, it alone cannot become the global engine driving post-crisis growth in the world economy.

The paper is organized as follows. Section II describes the model used in the analysis. Section III discusses the design of the simulation scenarios, reports their results, and provides our interpretation. Finally Section IV offers conclusions.

II. THE MODEL

The model used in this study is a version of a multi-country dynamic general equilibrium model for the world economy inspired by the new open economy macroeconomics literature (Obstfeld and Rogoff 1995 and 1996). It combines the long-run properties of neoclassical models with short-run dynamics

arising from nominal rigidities *à la* new Keynesian macroeconomics. The structure of the model closely follows the global integrated monetary and fiscal model (GIMF) developed by the International Monetary Fund (IMF) Research Department (Kumhof and Laxton 2007; Laxton 2008).² Agents in the model are forward looking, endowed with perfect foresight and subject to the dynamic budget constraints. The model features overlapping generations agents with finite economic lifetime. This leads to the non-Ricardian feature of the model and makes it suitable for fiscal policy analysis. Countries and regions in the model are linked through trade and financial markets. Nominal price and wage stickiness, as well as real frictions in investment, are incorporated to generate more realistic adjustment dynamics. The presence of nominal price and wage rigidity allows monetary policy to play a key role. Different from the GIMF, our model is deterministic, excluding stochastic shocks or other uncertainties. The model is in annual frequency and calibrated to the Global Trade Analysis Project (GTAP) (version 7) global database with 2004 as the base year. This section outlines the basic structure of the model and discusses its parameterization. The detailed specifications of the model are described in the Appendix.

A. Model Structure

The world economy in the model consists of four economic blocs: the US, Japan, emerging East Asia (EEA), and the rest of the world (ROW). There are four agents in each region, namely, households, unions, firms, and government. Households have finite lives, facing a constant probability of survival, as in the perpetual youth model in line with Blanchard (1985) and Yaari (1965). Households consume a basket of goods and services and exhibit habit persistence in their consumption. The model distinguishes two types of households: forward-looking ones and liquidity-constrained ones. The former own the portfolio of domestic firms. They also hold two types of nominal bonds: domestic bonds issued by the domestic government denominated in domestic currency, and international bonds issued by the US and denominated in US dollars. International bonds are traded only bilaterally with the US and issued in zero net supply worldwide. The liquidity-constrained households do not have access to domestic or international capital markets. They finance their consumption exclusively with current disposable labor and transfer incomes. Firms' investment is subject to adjustment costs, which allow for the variation in Tobin's q and generate plausible investment dynamics.

²See Zhang, Zhang, and Han (2010) for a recent application of the GIMF model to evaluating the impacts of the US credit crisis on Asia.

The model assumes a continuum of unions in each economic bloc which purchase labor services from households and sell labor to firms.³ Unions are monopolistic suppliers of differentiated labor inputs to domestic firms and face nominal rigidities in wage setting. They set nominal wages according to constant-elasticity downward-sloping demand schedules and quadratic costs of wage adjustment as in Rotemberg (1982).

The production activity is characterized by monopolistic competition. There is a continuum of firms in the production sector which produce differentiated varieties of products. They set the nominal prices of their products in domestic and exporting markets to maximize the present discounted value of profits. Similar to wage setting, price changes are subject to adjustment costs, which give rise to nominal price rigidities. When exporting, firms set prices in terms of the export-market currency, i.e., traded goods are invoiced in the currencies of the importing economic bloc.

Production technology in each sector is modeled using nested constant elasticity of substitution (CES) and Cobb-Douglas functions. At the top level, the output is produced as a combination of public capital and an aggregate private input using Cobb-Douglas technology. At the second level, the aggregate private input is split into an intermediate input and a bundle of private capital and labor inputs. At the third level, the bundle of capital and labor inputs is further disaggregated into capital and aggregate labor. Finally, at the bottom level, aggregate labor is decomposed into the differentiated labor input by each union. At each level of production, there is a unit cost function that is dual to the CES aggregation function and demand functions for corresponding inputs. The top-level unit cost function defines the marginal cost of sectoral output. The stock of public capital is identical for all firms and provided free of charge to them. As the production function exhibits decreasing returns to scale for private inputs, the return to public capital is distributed to firms as profits.

International trade is modeled using a nested Armington structure, in which domestic absorption is allocated between domestic goods and aggregate imports, and then aggregate imports are allocated across sourcing countries, which determine bilateral trade flows. Demand for domestic and imported goods is expressed as a composite good defined by the Dixit-Stiglitz aggregator over domestic and imported varieties, respectively.

The government collects tax and issues debt to finance its budget deficit. There are five types of tax in the model: labor income tax, capital income tax, sales tax, import tariff, and lump-sum tax on households. Government consumption and investment are exogenous and the lump-sum tax on households is endogenously adjusted to achieve a target path for the desired government debt-to-gross domestic product (GDP) ratio. The monetary policy rule in the

³The introduction of unions is for model simplification, as aggregation across generations would be difficult if nominal rigidities were faced by households rather than unions.

model follows a Henderson-McKibbin-Taylor rule in which the nominal interest rate depends on the lagged nominal interest rate, the inflation gap and the output growth gap (see Appendix equation A52).⁴ For EEA, the monetary policy rule is augmented with the gap between the actual and desired values of the bilateral nominal exchange rate against the US dollar, reflecting the dollar stabilization regimes in some EEA economies.⁵

B. Model Calibration

The calibration of a dynamic model with the assumption of perfect foresight involves finding a set of data that covers all periods of the model and is consistent with the intra-period and intertemporal equilibria. This set of data needs to replicate the data of the base year and could serve as the dynamic benchmark equilibrium of the model. There could be two alternative calibration strategies here. The first one, the so-called steady state calibration, would consider the base year as a steady state equilibrium and the dynamic benchmark equilibrium of the model as a steady state growth path. The second one would assume that the economy in the base year is a temporal equilibrium along a dynamic adjustment path, that is, the dynamic benchmark equilibrium of the model is a transitional dynamic path to a final steady state (Knudsen et al 1998; Wendner 1999). Here we follow the second approach and calibrate the model for a non-steady state situation.

The model is calibrated to GTAP database (version 7), with 2004 as the base year. The GTAP database contains a set of consistent input-output tables and bilateral trade data with detailed country and sector disaggregation. For most elasticity parameters and dynamic adjustment parameters, we draw on the Global Integrated Monetary and Fiscal Model (GIMF) and other dynamic general equilibrium models in determining their values.

In calibrating the household sector, we assume that in the US, Japan, and the ROW the share of liquidity-constrained consumers is 25%. In EEA the share is higher at 40%, reflecting the underdeveloped nature of financial markets in this region. The households are assumed to have a finite planning horizon of 20 years, implying a constant yearly death rate of 5%. In addition, the labor productivity of each generation is assumed to decline throughout his lifetime at an annual rate of 5%. The value of the intertemporal elasticity of substitution is 0.33, slightly higher than those chosen in the GIMF model. The habit persistence parameter for consumption is set to 0.4 as in Kumhof and Laxton (2007). We set the weight parameters of leisure and consumption in the household's utility function in such a way that on aggregate 33% of available time endowment during work years is

⁴Inflation rate target is set at 2% per annum across all regions. Output target is set equal to exogenous labor-augmented productivity growth.

⁵EEA's target nominal exchange rate is set at its base year level.

spent at work in the base year. The rate of time preference in each economic bloc is set to obtain a reasonable net foreign asset position in the steady state.

In the supply side, elasticity of substitution between capital and labor is set at 0.8. The substitution elasticity between labor varieties, which determines the markup in the labor market, is assumed to be 7.3 in the US, Japan, and EEA and 6.0 in ROW. This assumption implies relatively competitive labor markets in the US, Japan, and EEA. The depreciation rate of capital is assumed to be 8% per year. The data for capital stock in each economic bloc is taken from the GTAP database. The ratio of public capital to GDP is assumed to be 30% in the base year and the elasticity of GDP with respect to public capital is assumed to be 0.1.

Following the literature of business cycle models, the substitution elasticities between imports and domestic goods, i.e. the Armington elasticities, are set equal to 2.0.⁶ The substitution elasticity of imports across economic blocs is 2.5. Elasticity of substitution between varieties of goods ranges from 4.3 to 6.0, implying a markup of 20% to 30%. Japan and ROW have relatively high markups while the markups in the US and EEA are lower.

The parameters for nominal rigidity and real adjustment costs that govern the dynamics of the model are drawn from the GIMF and the Global Economic Model (GEM) of the IMF. In the monetary policy rule, the weights for the inflation gap and for the output growth gap are both set at 0.5. For EEA, the weight on the changes in exchange rate is set to 1. In the simulations for fiscal stimulus below in Section III, an alternative accommodative monetary policy rule is used with the weight of 0.5 for the inflation gap and a zero weight for the output growth gap.

In the baseline scenario for model calibration, EEA is assumed to have a higher growth rate of productivity in initial periods. Its labor-augmented productivity grows at 10% in the base year and gradually declines to the global average growth trend of 3% after 25 years. In contrast, productivity growth in Japan is assumed to rise from 1.6% in the base year to 3% in the period after 25 years. The consumer price index (CPI) inflation target is set to 2% per annum for all regions. Time preference rates in the base year are endogenously determined in the baseline scenario to match the base year consumption in each economic bloc. These base year time preference rates are assumed to gradually converge to their long-run values within 40 years. Similarly, a constant adjustment parameter for Tobin's q is added to the arbitrage equation for each sector's q to reproduce the baseline-scenario investment level in the base year.⁷

⁶The trade literature on empirical estimation of the Armington elasticity usually found a high value ranging from about 6 to 15, and these estimates are typically used in applied general equilibrium models for trade policy analysis (see, e.g. Hertel et al. 2004). See Ruhl (2003) for a reconciliation of the low elasticity value found in aggregate high frequency time series data with the high elasticity found in cross-section data.

⁷This constant adjustment parameter can be interpreted as risk premium. See McKibbin and Wilcoxen (1998) for a similar treatment in their multi-sectoral, intertemporal G-Cubed model.

III. SIMULATION SCENARIOS

To explore the implications of the global financial crisis for East Asia, we simulate five scenarios. All these scenarios are simulated in a cumulative fashion, so that the second scenario includes the first as well as the second shocks; the third includes the first, second, and third shocks, and so on.

The first scenario examines the effects of a global financial crisis. It assumes a world-wide temporary drop in final demand triggered by the financial crisis. In the US, households are assumed to be more concerned about their future—their desire to save increases and their consumption declines. In the model this is represented by lowering forward-looking households' time preference by two percentage points per annum permanently. The risk premium of investors in the US is assumed to rise by five percentage points for the next three years and gradually decline after that until it vanishes in another three years. In addition to the US, all other regions also experience a fall in consumption and investment due to the contagion through financial and confidence channels. The shocks in non-US regions are assumed to be half of that in the US, i.e., a one percentage point reduction in households' time preference rate and a 2.5 percentage points rise of investor's risk premium.

The second scenario considers the effects of globally concerted expansionary fiscal policies to deal with the global financial crisis. We assume a global fiscal stimulus package under which all countries increase government spending by 2% of GDP over a two-year period. Such government spending is assumed to be distributed evenly between government consumption and investment. The fiscal stimulus is assumed to be temporary, as in the period following the expenditure expansion, lump-sum taxes adjust to return the government debt-to-GDP ratio back to its baseline value over time. As monetary policy can play an important role in determining the effects of fiscal expansion, the simulations here explore two types of a monetary policy rule for the two years of fiscal stimulus, that is, the standard interest rate rule in our benchmark model and an accommodative interest rate rule. The standard interest rate rule has equal weights on the inflation gap and the output growth gap, while the accommodative interest rate rule has a zero weight on the output growth gap. Given that fiscal expansion tends to raise both output and inflation, the interest rate hikes are smaller in the latter policy rule, suggesting a more accommodative monetary policy in the face of fiscal stimulus.

The final two scenarios look at the impact of other types of policy measures designed to rebalance growth in EEA. The third scenario examines the role of exchange rate policy. It assumes that EEA allows large currency movements against the US dollar by putting a zero weight on the exchange rate gap in its monetary policy reaction function. The fourth scenario postulates that, in addition to greater exchange rate flexibility, EEA boosts its domestic

consumption and investment through structural reforms. Instead of specifying the exact nature for these structural reforms, we capture their effects using a permanent one percentage point increase in the time preference rate of EEA's forward-looking households and a one percentage point reduction of its investors' risk premium. These two scenarios simulate a partial global rebalancing initiative led by the adjustment in EEA.

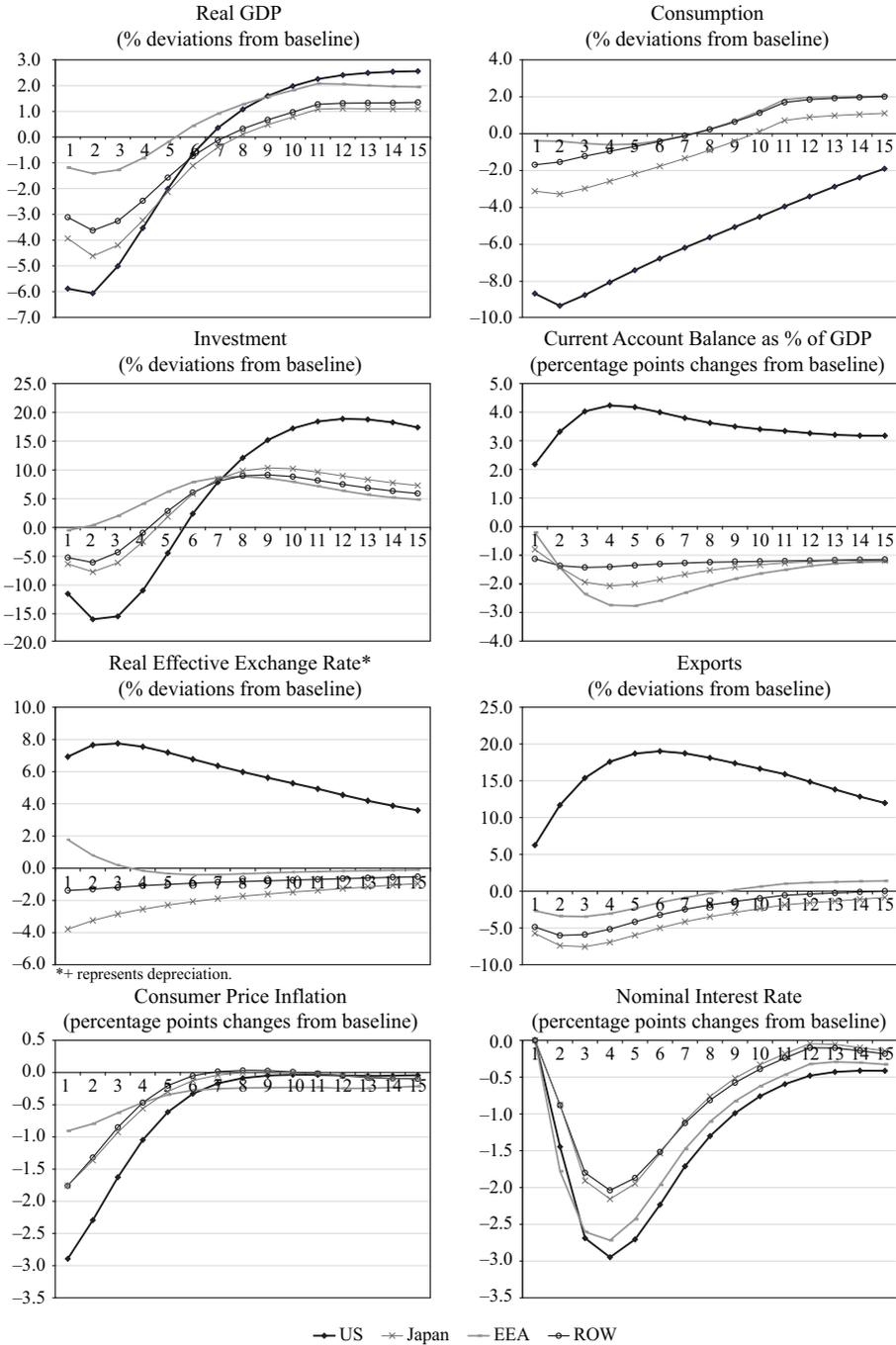
A. A Global Financial Crisis

The results of the scenario of the global financial crisis are reported in Figure 1. The global financial crisis leads to a sharp output loss in the US, with real GDP falling by 6% in the first two years compared with the baseline. The GDP reduction is tempered after that and output begins to expand after seven years, driven by stronger net external demand and the recovery in investment. As to the components of domestic demand, investment exhibits greater volatility than consumption. It contracts by around 15% in the initial years and then jumps up by nearly 20% along with the diminished investment risk premium after 12-15 years. In comparison with investment, the change in private consumption is more modest, but still significant. The consumption of US households declines by 9% in the first three years, but begins to increase after fifteen years because of the expanded output and income.

As the shrinking domestic absorption significantly drags down imports, the US current account as a ratio to GDP improves by around 3-4 percentage points in the first five years. This improvement in the current account gradually diminishes to 3% of GDP in the medium-term. The falling US demand depresses US domestic prices relative to foreign prices, leading to a real depreciation of the US dollar. The real effective exchange rate of the US dollar weakens by 7-8% initially relative to the baseline. The US dollar depreciation moderates to 4% in fifteen years. The more rapid recovery of domestic demand relative to supply implies an excess demand in the medium term, thereby moderating the pace of US dollar depreciation.

The dynamics of prices are driven by supply and demand conditions, the degree of nominal rigidities, and monetary policy reactions. In tandem with the initial demand collapse, inflation falls by two percentage points initially. After five years, the drop in the inflation rate narrows to less than half of a percentage point. Lower inflation leads to a lower interest rate—through the Taylor rule-based monetary policy—causing larger interest differentials between the US and other economic blocs, which reinforces the initial US dollar depreciation. Nominal exchange rate changes are the major channel to achieve real exchange rate adjustment, reflecting the sluggish price responses, and the effects of inflation targeting and flexible exchange rates.

Figure 1. Impacts of the Global Financial Crisis



EEA = emerging East Asia, GDP = gross domestic product, ROW = rest of the world, US = United States. Source: Authors' calculations.

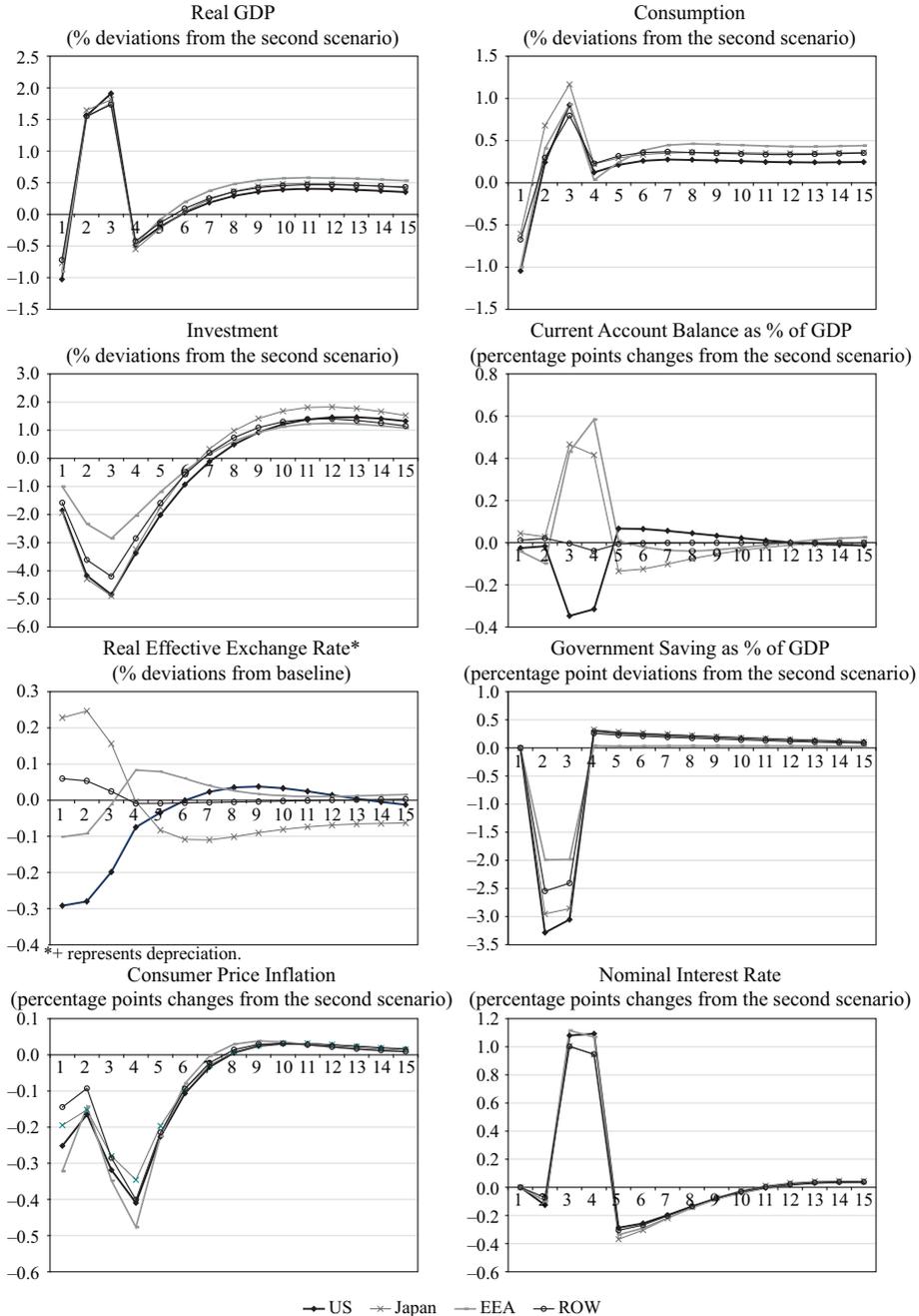
For other regions, the contagion-induced demand drops cause significant impacts on their domestic economy. Both consumption and investment fall in initial years in comparison with the baseline in Japan and ROW, leading to a sharp contraction in their real GDP. CPI inflation drops by as much as two percentage points initially in these two regions. In EEA, despite a larger drop in the nominal interest rate in response to lower inflation, consumption hardly expands in the first six years and investment increases only by 2% or so initially. As a result, EEA real GDP shrinks by 1% in the first three years in comparison with the baseline.

Exchange rate policy plays an important role in determining the impact of a global financial crisis. This is evident from the divergent movements in real exchange rates in initial years between Japan (and ROW) and EEA. As shown in Figure 1, while both Japan and ROW experience large real appreciation initially, the real exchange rate of EEA depreciates in the first three years because of the non-zero weight on the gap of the nominal exchange rate against the US dollar in its monetary policy rule. Consequently, the export and current account balance of EEA only decline slightly in the initial two years, in contrast to those in Japan and ROW.

B. Global Fiscal Expansion with Alternative Monetary Policy Rules

The second scenario assumes that all economic blocs in the world increase government spending—by 2% of GDP—for two years, while following their respective monetary policy rules. Figure 2A presents the dynamic impacts of globally concerted fiscal stimulus packages under the benchmark monetary policy rule, which are plotted as changes from the second scenario—i.e., the scenario of a global financial crisis. The benchmark monetary policy rule follows the standard Taylor rule, except in EEA where the interest rate responds positively to the exchange rate gap as well as the inflation and output growth gaps. With the temporary fiscal expansion all over the world, real GDP, consumption and investment all rise during the period of fiscal stimulus and beyond. The increase in real GDP during the two years of fiscal expansion is around 1.5%, suggesting fiscal multipliers of 0.75. GDP drops by around 0.2% after the completion of fiscal stimulus, but begins to expand by around 0.5% after six years, largely due to the larger stock of public capital. Increased fiscal expenditures lead to more employment and higher wages, boosting private consumption. EEA experiences the largest rise in private consumption during the period of fiscal expansion, reflecting its higher share of liquidity-constrained households. During the years of fiscal stimulus, private investment drops by around 4% in the US, Japan, and ROW, and more than 2% in EEA reflecting the crowding-out effects through rises in interest rates. However, private investment enjoys larger gains in the medium- and long-term, thanks to the long term crowding-in effect of public investment.

Figure 2A. Impacts of Global Fiscal Expansion under the Benchmark Monetary Policy Rule



EEA = emerging East Asia, GDP = gross domestic product, ROW = rest of the world, US = United States.
 Source: Authors' calculations.

Current account balances and real exchange rates are generally little impacted by the world-wide fiscal expansion. Fiscal deficits in the two expansion years widen by 1.7-1.8% of GDP, as government spending of 2% of GDP is offset by additional tax revenues due to faster economic growth. Consequently, the ratio of government debt to GDP rises only by two to three percentage points in the fourth year, then gradually falls to the baseline level with increases in household lump-sum tax.

Figure 2B presents the effects of global fiscal stimulus under the accommodative monetary policy rule, where the interest rate responds only to the inflation gap (and the exchange rate gap in EEA). With monetary accommodation, inflation is generally higher and the real interest rate is lower, which facilitates the expansion of consumption and investment. As a result, there is almost no crowding out of fiscal spending. This is in sharp contrast to the simulation results under the benchmark monetary policy rule (as shown in Figure 2A), where private investment during the years of fiscal expansion is negatively affected, showing evidence of strong crowding-out effects of public expenditure.

To deepen our analysis of the impact of globally concerted fiscal stimulus, we have run separate simulations under which each economic bloc alone engages in fiscal stimulus. Table 1 summarizes the fiscal multipliers of individual regions' fiscal actions and of worldwide fiscal actions. Several interesting observations can be made.

Table 1. Comparison of Fiscal Multipliers by Economic Bloc

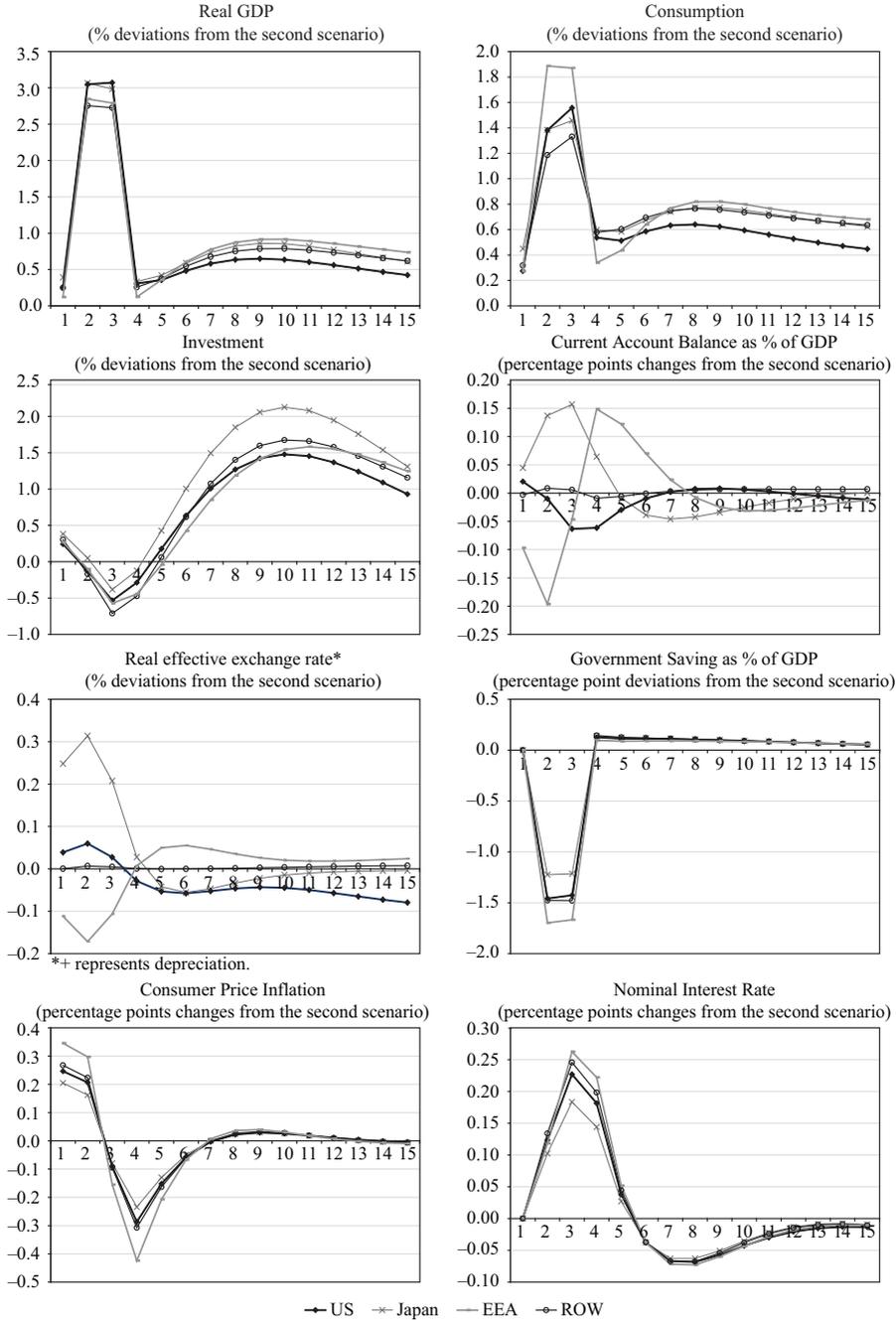
| | Stimulus in | | | | |
|------------------------------------|-------------|-------|------|------|-------|
| | US | Japan | EEA | ROW | World |
| Benchmark monetary policy rule | | | | | |
| US | 0.61 | 0.02 | 0.03 | 0.15 | 0.81 |
| Japan | 0.08 | 0.55 | 0.06 | 0.12 | 0.81 |
| EEA | -0.30 | 0.06 | 0.80 | 0.24 | 0.80 |
| ROW | 0.10 | 0.02 | 0.04 | 0.62 | 0.78 |
| World | 0.20 | 0.08 | 0.11 | 0.40 | 0.79 |
| Accommodative monetary policy rule | | | | | |
| US | 1.42 | 0.13 | 0.15 | 0.28 | 1.65 |
| Japan | 0.18 | 1.37 | 0.21 | 0.23 | 1.64 |
| EEA | 0.23 | 0.14 | 1.01 | 0.33 | 1.48 |
| ROW | 0.15 | 0.09 | 0.12 | 1.30 | 1.45 |
| World | 0.52 | 0.25 | 0.23 | 0.80 | 1.53 |

EEA = emerging East Asia, GDP = gross domestic product, ROW = rest of the world, US = United States.

Note: Fiscal multiplier is defined as a percentage change in GDP induced by fiscal expansion of 1% of GDP.

Source: Authors' model simulations.

Figure 2B. Impacts of Global Fiscal Expansion under the Accommodative Monetary Policy Rule



EEA = emerging East Asia, GDP = gross domestic product, ROW = rest of the world, US = United States.
 Source: Authors' calculations.

First, the fiscal multipliers rise significantly by moving from the benchmark monetary policy rule to the accommodative monetary policy rule in every region of the world. Under the benchmark rule, the fiscal multipliers are in the range of 0.55 (Japan) to 0.80 (EEA), while under the accommodative rule they rise to the range of 1.01 (EEA) to 1.42 (US). This can be explained by the change in the interest rate rule from the one that responds to the output growth gap (benchmark rule) to the one that does not (accommodative rule). Under the benchmark rule, the interest rate rises in response to both the inflationary pressure and output expansion (and the exchange rate gap in EEA) arising from fiscal stimulus, while under the accommodative rule the interest rate rises less responding only to the inflationary pressure (and the exchange rate gap in EEA). In other words, the smaller interest rate increase makes the fiscal multipliers larger under the accommodative rule than under the benchmark monetary policy rule.

Second, the extent of the rise in fiscal multipliers, associated with a move from the benchmark to the accommodative policy rule, varies across regions in the world; fiscal multipliers rise the least in EEA (from 0.80 to 1.01) while those in other regions rise much more substantially (e.g., from 0.61 to 1.42 in the US). This can be explained by the specific interest rate rule chosen for EEA, i.e., the inclusion of the exchange rate gap, as well as this region's large trade leakage from its imports. Under either monetary policy rule, EEA's interest rate would rise the least among the four regions in the world because the interest rate rise resulting from the positive inflationary gap (and the output growth gap under the benchmark rule) associated with fiscal expansion would be partly offset by the interest rate decline resulting from the real currency appreciation pressure. Under the benchmark monetary policy rule—even though the impact of fiscal expansion would leak out most substantially in EEA to other regions due to its having the highest ratio of imports to GDP—the favorable effect of the interest rate change dominates the unfavorable trade leakage effect, thereby making EEA's fiscal multiplier the largest in the world. Under the accommodative monetary policy rule, however, EEA's own fiscal multiplier is 1.01, the smallest among the four economic blocs. This is explained by the fact that the favorable interest rate effect is more than offset by the unfavorable trade leakage effect. That is, although EEA's interest rate rises the least, in response to its own fiscal expansion, among the four regions in the world, the large trade leakage effect dominates the interest rate effect, thereby making EEA's fiscal multiplier the smallest in the world.

Finally, under the accommodative monetary policy rule, nearly 30% of the impact of the global financial expansion on the EEA's fiscal multiplier effect comes from the stimulus in other regions. This suggests that, under an accommodative global monetary policy environment, a globally coordinated fiscal stimulus action will be desirable for EEA (as well as for other economic blocs in the world).

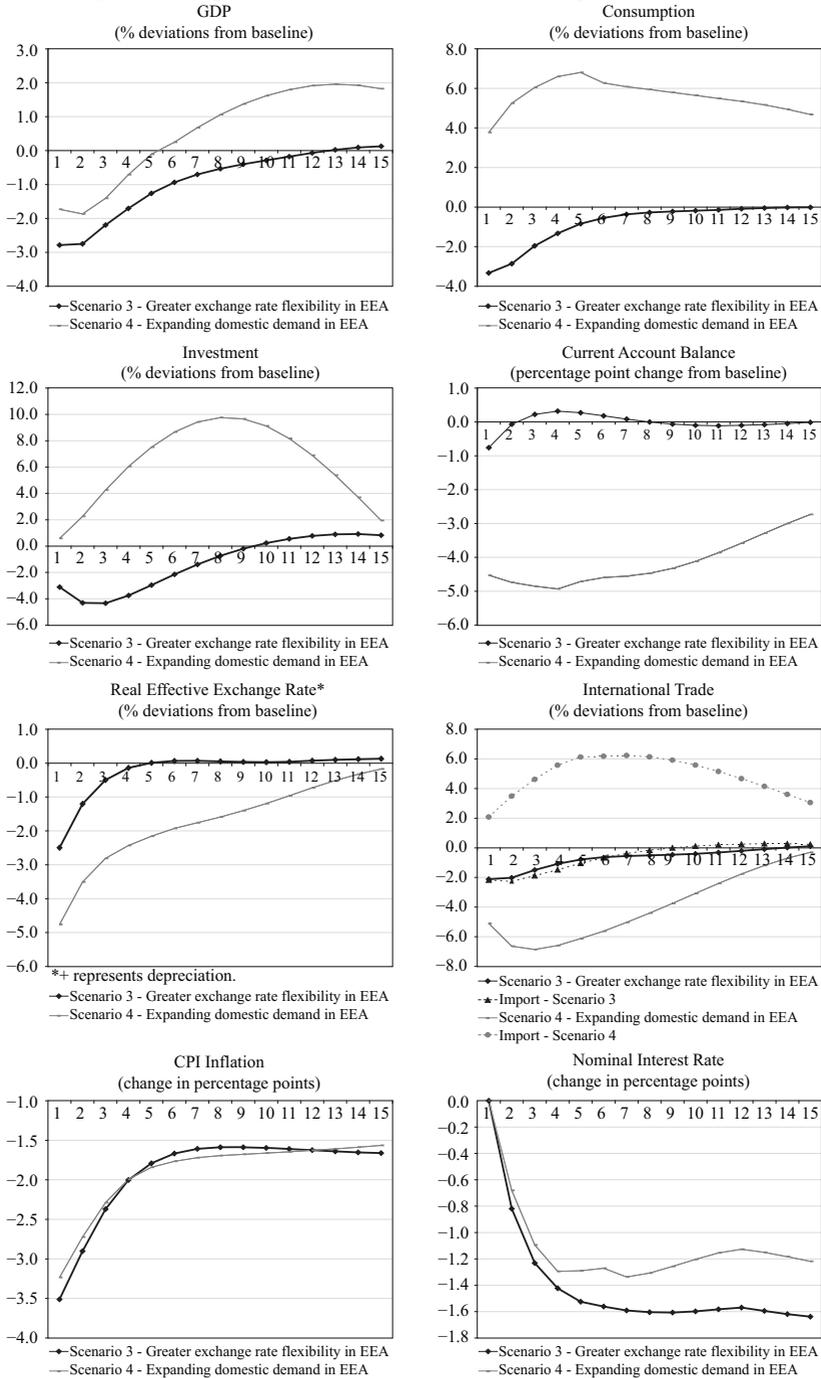
C. Greater Exchange Rate Flexibility in Emerging East Asia

The results of the third scenario—impacts of increasing exchange rate flexibility of the EEA currency vis-à-vis the US dollar—are presented in Figure 3A. As a result of dropping the exchange rate target in its monetary policy rule, EEA's nominal exchange rate appreciates against the US dollar by 7.3% and 4.8% respectively in the first and second years. An appreciating exchange rate leads to falling exports and, consequently, shrinking aggregate demand. With excess supply over demand, CPI inflation falls by around three percentage points in the initial two years. Because of differential inflation rates between EEA and other regions in the world, EEA's real effective exchange rate appreciates 2.5% and 1.2% in the first and second years.

EEA's exports fall by 2% in the first two years after introducing full exchange rate flexibility, then gradually recover and begin to expand in the fifteenth year. It might be surprising that EEA's imports also decline at around the same pace as exports, despite currency appreciation inducing a substitution toward cheaper imports. The falling income associated with output contraction, as well as the rising real interest rate due to lower inflation, lead to weaker domestic demand. As shown in Figure 3A, EEA's investment and consumption fall by 3-4% in the initial two years, dampening demand for imports. As a result, EEA's current account surplus declines only by 0.8% of GDP in the first year. Reflecting the importance of export demand in EEA economies, this economic bloc experiences a large and sustained GDP contraction in the wake of its currency appreciation.

Despite the relatively large effect on its own economy, EEA's currency appreciation has only modest effects on other regions (left panel of Figure 3B). Given its strong economic linkage with EEA, Japan experiences the largest contraction in trade, with a 0.8% decline in exports and a 0.5% decline in imports in the initial two years. The US is less affected and ROW is the least affected, consistent with their limited respective export dependence on EEA. As both exports and imports shrink, the current account balances of the US, Japan, and ROW change little following EEA's introduction of full exchange rate flexibility and currency appreciation. Consequently, the effects on their real GDP range from 0.20% to 0.35% in the initial years and are less than 0.1% annually afterwards.

Figure 3A. Impacts of EEA's Growth Rebalancing Policies on EEA



CPI = consumer price index, EEA = emerging East Asia, GDP = gross domestic product.

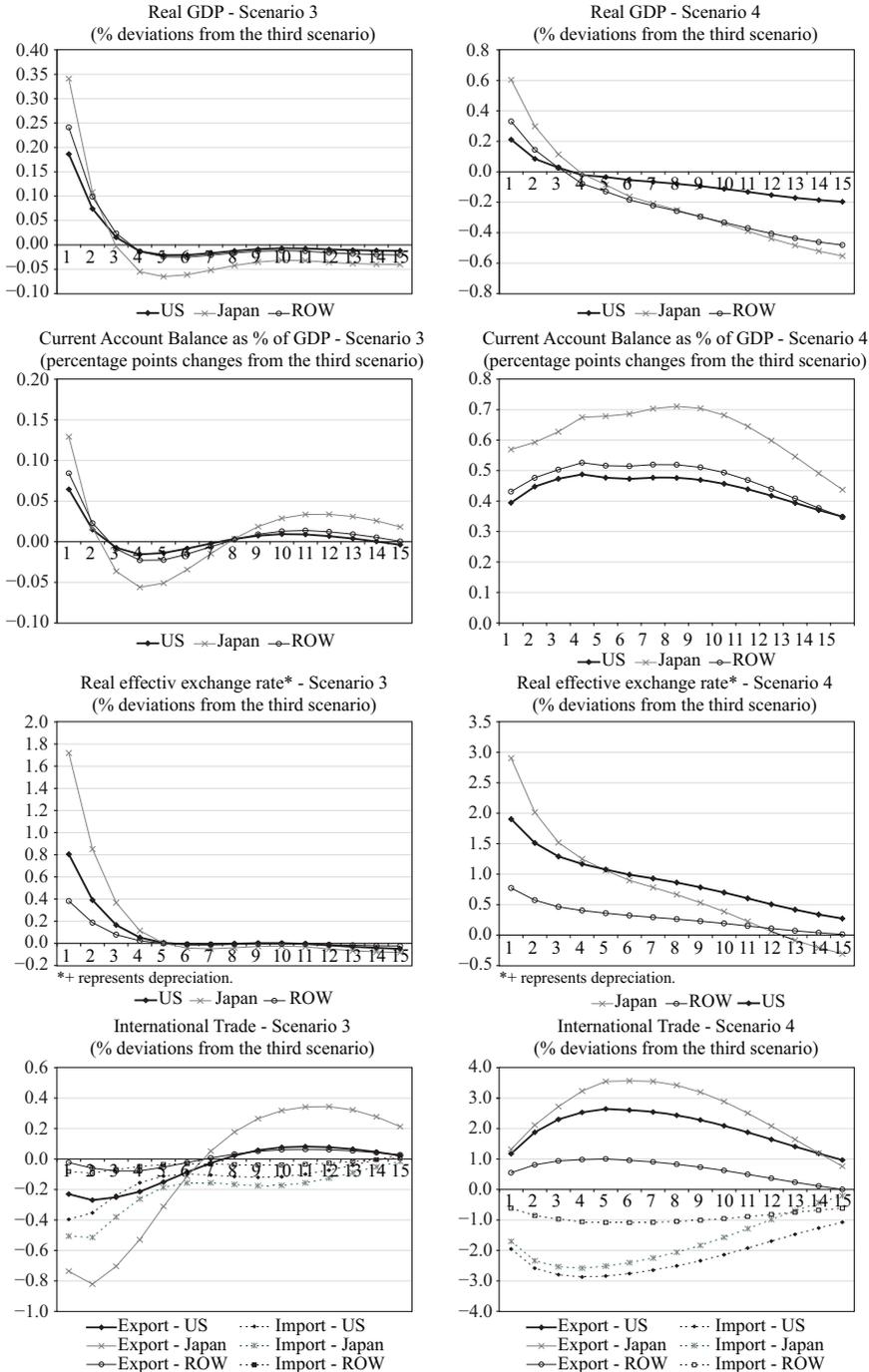
Source: Authors' calculations.

D. Expanding Domestic Demand in Emerging East Asia

The results of our fourth scenario—EEA's domestic demand expansion in addition to its full exchange rate flexibility—are plotted in Figure 3A and the right panel of Figure 3B. As shown in Figure 3A, the rise in domestic consumption and investment partly offsets the negative effects of currency appreciation on EEA's output, resulting in a smaller initial loss in GDP compared with the fourth scenario. As stronger domestic demand sucks more imports and discourages exports, the imports of EEA rise by 2-6% and its exports fall by around 6% initially. As a result, the current account surplus of EEA declines by 5% of GDP over a period of decade. Reflecting the changes in relative prices induced by the demand expansion in EEA, the real effective exchange rate of the EEA currency appreciates much more—by around 4% initially—than in the fourth scenario.

The deterioration in EEA's current account balance is mirrored in the improvement in the current account balances in other regions of the world. As shown in the right panel of Figure 3B, the current account balances of the US, Japan, and ROW improve by 0.4-0.6% of their respective GDP. Although US experiences larger export expansion in comparison to ROW, its gain in the current account balance is smaller due to its lower trade dependence. Rising net exports in non-EEA regions stimulate their GDP growth in the short-run, but declining domestic demand soon dominates the improvement in net exports, resulting in GDP contraction from the fourth year onwards. The reason is that rising domestic demand in EEA reduces its trade surplus and, hence, net capital outflows, pushing up real interest rates globally. With the negative effect of higher real interest rates on investment and consumption dominating the improvement in net exports, GDP contracts in the US, Japan, and ROW over the medium-term. This result highlights the importance of the general equilibrium impacts on international capital flows in analyzing the long-term implications of adjustment in global current account imbalances.

Figure 3B. Impacts of EEA's Growth Rebalancing Policies on Other Regions



EEA = emerging East Asia, GDP = gross domestic product, ROW = rest of the world, US = United States.
 Source: Authors' calculations.

IV. CONCLUSIONS

This paper examined the implications of the global financial crisis, emanating from the US, and of a global fiscal stimulus package as well as EEA's dynamic adjustment toward global rebalancing. Specifically, using a calibrated global dynamic general equilibrium model, we have simulated the scenarios of a US recession, a global recession, worldwide expansion in fiscal spending, and EEA's rebalancing policies—such as introducing full exchange rate flexibility and expansion in regional demand. Simulation results of the first scenario suggest that a global financial crisis, which spreads demand contraction from the US to other regions in the world, would cause a slowdown in economic growth and trade all over the world. But the negative impacts are not evenly distributed across regions. Because of its exchange rate regime that stabilizes the currency against the US dollar, EEA is least impacted by a financial crisis, whether in the US alone or world-wide, in terms of output.

We have also investigated the effects of global fiscal stimulus in response to the crisis. With a global fiscal stimulus package of 2% of GDP for two years, world GDP is likely to be lifted by 2.0% and 3.0% during the period of fiscal expansion under the benchmark and accommodative monetary policy rules, respectively. This result suggests that fiscal stimulus combined with an appropriate monetary policy rule can serve as an important stabilizer for the world economy during the crisis. For EEA economies, given their high level of trade dependence, globally coordinated fiscal stimulus would be much more desirable than acting just on its own.

With its large current account surplus and increasing importance in the world economy, EEA's growth rebalancing policy is an important component of the global effort to unwind the global current account imbalance. The exchange rate inflexibility in EEA is widely regarded as a major impediment to global rebalancing. Our simulation results show that exchange rate flexibility alone in EEA would not contribute much to the correction of EEA's current account imbalance. Given EEA's highly export-dependent growth pattern, its currency appreciation would lead to large output and income losses, depressing its appetite for imports and reducing its current account surplus by only 2% of GDP. Other types of policies—particularly of a structural reform nature—to boost regional demand, supported by greater flexibility in the regional currency, would be needed to have a much larger and persistent impact on EEA's current account.

Indeed, an appreciation of 5% in EEA's real effective exchange rate, driven by its domestic demand expansion and nominal currency appreciation, is likely to reduce its own current account balance by 5% of GDP. However, without any adjustment in any other country, this change in EEA's current account will be largely evenly distributed among other regions of the world. The simulation results show that the US current account deficit narrows only by 0.5%

of GDP under this scenario, hardly correcting the US and, hence, global imbalances. Although the global economic impact of EEA is growing, its rebalancing policy has limited impact globally, suggesting the need for policy actions on the part of the US in reducing its own current account deficit. Essentially, both the current-account surplus and deficit economies should implement policies in order to reduce the global imbalance and achieve sustained global economic growth.

Several important limitations of our modeling exercises should be mentioned. First, our model does not explicitly incorporate the linkages through global financial markets and the mechanisms of co-movements in asset prices. As they are important transmission channels through which the US recession may drag down the world economy and East Asia, our results likely underestimate the impacts of the US and global financial crises on the Asian economies. Second, the global financial crisis and the need for global rebalancing would require Asian economies to shift demand from external to internal sources. Using a static multi-sectoral general equilibrium model, our previous work has shown that, given the different product composition in domestic and external demand, this would involve substantial structural shifts in their production activities (Kawai and Zhai, 2009). Without sectoral disaggregation, our model does not fully capture the role of structural adjustment and the associated adjustment costs required for growth rebalancing. A dynamic general equilibrium model incorporating detailed sectoral disaggregation—including tradables and non-tradables sectors—and inter-sectoral labor adjustment frictions would better serve the detailed analysis of dynamic impacts of the global financial crisis. Finally, recent advances in trade theory have emphasized the importance of the extensive margin in trade adjustment. Incorporating firm heterogeneity and dynamics of firm entry and exit into the traditional framework of new open economy macroeconomics model may somewhat alter the analytical results, and provide new insights about the implications of global financial crisis and rebalancing.⁸

⁸See Bilbiie, Ghironi, and Melitz (2007) and Kumhof, Laxton, and Naknoi (2009) for the incorporation of firm dynamics into dynamic stochastic general equilibrium models. Corsetti, Martin, and Pesenti (2008) analyzed the exchange rate adjustment to correct the global imbalance in consideration of endogenous firm entry and new varieties of exports of goods and services, suggesting milder exchange rate adjustments for closing US current account deficits.

APPENDIX: MODEL SPECIFICATION

A. Basic Setup

The model economy consists of four regional blocs which are indexed by r or s . Each region is populated by overlapping generations households with finite planning horizons as in Blanchard (1985). Households are indexed by age a . In each region there are a continuum of firms and a continuum of labor unions, which are indexed by $n \in [0,1]$ and $\mu \in [0,1]$, respectively. The time index in the model is t .

The model assumes the presence of an exogenous trend in labor productivity growth (at rate g). For a clear separation of an endogenous dynamic from an exogenous trend, we present all variables in detrended form through division by g . In each region the CPI is the numéraire of the economy and all national prices are expressed in terms of domestic consumption units.

In the model described below, subscripts denote region and/or time. The time index, t , is omitted when all variables in an equation are with the same time index. Regional subscript, r , is also omitted where doing so does not lead to confusion.

B. Demand and Trade

Domestic demand in each region comprises consumption and investment by households, firms and government. A composite good, XA , is used for final and intermediate demand. This composite good is a constant elasticity of substitution (CES) aggregation of domestic goods, XD , and aggregate imports, XM .

$$XA = \left((\alpha^d)^{1/\sigma^m} (XD)^{(\sigma^m-1)/\sigma^m} + (\alpha^m)^{1/\sigma^m} (XM)^{(\sigma^m-1)/\sigma^m} \right)^{\sigma^m/(\sigma^m-1)} \quad (A1)$$

where σ^m is the elasticity of substitution between imports and domestic goods. The Armington share parameters α^d and α^m reflect the preference of agents biased for home or imported products. The sales price for composite good, PA , is tax-included dual price index defined over the prices of domestic and imported goods, PD and PM , respectively:

$$PA = (1 + \tau^s) \left(\alpha^d (PD)^{1-\sigma^m} + \alpha^m (PM)^{1-\sigma^m} \right)^{1/(1-\sigma^m)} \quad (A2)$$

where τ^s is the sales tax rate.

The demand functions generated from (A1) and (A2) are:

$$\frac{XD}{XA} = \alpha^d \left(\frac{PA}{(1 + \tau^s)PD} \right)^{\sigma^m} \quad (A3)$$

$$\frac{XM}{XA} = \alpha^m \left(\frac{PA}{(1 + \tau^s)PM} \right)^{\sigma^m} \quad (A4)$$

Aggregate import demand, XM , is a CES aggregation of imports from each region, i.e.:

$$XM_s = \left(\sum_{r \in R} (\alpha_{rs})^{1/\sigma_s^*} (XE_{rs})^{(\sigma_s^*-1)/\sigma_s^*} \right)^{\sigma_s^*/(\sigma_s^*-1)} \quad (A5)$$

where α_{rs} is the preference of agents in region s biased for goods imported from region r ; XE_{rs} represents the quantity of goods produced in region r and sold in (or exported to) the

market of region s ; and σ^w is the second-level Armington elasticity of substitution among imports from different regions. The dual price index of aggregate import, PM_s , is defined over the prices of each import supplier or export goods producer, PE_{rs} :

$$PM_s = \left(\sum_{r \in R} \alpha_{rs} \left(\frac{\varepsilon_s}{\varepsilon_r} (1 + \tau_{rs}) PE_{rs} \right)^{1 - \sigma^w} \right)^{1 / (1 - \sigma^w)} \quad (A6)$$

where τ_{rs} is the tariff rate imposed on imports from region r and ε_r is the CPI-based real exchange rate of region r , expressed as the price of one unit US consumption in terms of domestic consumption in region r .

The demand function generated from (A5) and (A6) is:

$$\frac{XE_{rs}}{XM_s} = \alpha_{rs} \left(\frac{\varepsilon_s (1 + \tau_{rs}) PE_{rs}}{\varepsilon_r PM_s} \right)^{\sigma^w} \quad (A7)$$

Each firm is assumed to produce a differentiated product and each variety is an equally imperfect substitute for all others across all varieties. The goods produced are either domestically demanded or exported. The aggregate demand for domestic goods, XD , and aggregate exports, XE , are further decomposed into demand for variety provided by each firm, following the standard Dixit-Stiglitz framework:

$$\frac{xd_{n,s}^n}{XD_s} = \left(\frac{pd_{n,s}}{PD_s} \right)^{\sigma^d} \quad (A8)$$

$$\frac{xe_{n,rs}^n}{XE_{rs}} = \left(\frac{pe_{n,rs}}{PE_{rs}} \right)^{\sigma^d} \quad (A9)$$

where $xd_{n,s}^n$ represents the demand in region s for domestic good variety n produced in region s ; $xe_{n,rs}^n$ represents the demand in region s for export variety n produced in region r ; $pd_{n,s}$ is the price of domestic good variety n set by the firm in region s ; $pe_{n,rs}$ is the price of export variety n in market s set by the firm located in region r ; and σ^d is the substitution elasticity among varieties of each firm.

C. Firms

The production technology of firms is modeled using a nested CES function. At the top level, the output is produced as a combination of public capital and an aggregate private input using Cobb-Douglas technology. At the second level, the aggregate private input is split into an intermediate input and an aggregate primary factor. At the third level, the aggregate primary factor is further disaggregated into a bundle of private capital and aggregate labor. Finally, at the bottom level, aggregate labor is decomposed into the differentiated labor input by each union. The stock of public capital is identical for all firms and provided free of charge to them. As the production function exhibits decreasing returns to scale for private inputs, the return to public capital is distributed to firms as profits.

Each firm produces a different variety and sets the price of its product facing isoelastic demand functions in both domestic and foreign markets, as shown in (A8) and (A9). There is an adjustment cost for price setting, which, expressed as a proportion of total sales, is assumed to be given by the following functions:

$$\Gamma_{n,r,t}^{pd} = \frac{\phi_r^p}{2} \left(\pi_{r,t} \frac{pd_{n,r,t} / pd_{n,r,t-1}}{\bar{\pi}_{r,t}} - 1 \right)^2 \quad (\text{A10})$$

$$\Gamma_{n,r,s,t}^{pe} = \frac{\phi_s^p}{2} \left(\pi_{r,t} \frac{\varepsilon_{t,s} \varepsilon_{t-1,r} pe_{n,r,s,t} / pe_{n,r,s,t-1}}{\varepsilon_{t,r} \varepsilon_{t-1,s} \bar{\pi}_{s,t}} - 1 \right)^2 \quad (\text{A11})$$

where ϕ_r^p and ϕ_s^p are respectively adjustment cost coefficients in region r and region s ; and $\pi_{r,t}$ is the inflation rate in region r at time t . These adjustment cost functions indicate that the cost is related to changes in nominal prices of products relative to the contemporaneous inflation target for the CPI, shown by $\bar{\pi}_{r,t}$. (A11) indicates that the export price is set in the currency of the destination market, i.e., local-currency pricing.

A firm n is assumed to maximize the discounted value of current and future profits, denoted as div_n , which are distributed as dividends to shareholders:

$$\begin{aligned} \max \sum_{t=0}^{\infty} \left(\prod_{\tau=0}^t \frac{g_{\tau,r}}{1+i_{\tau,r}} \right) div_{n,r,t} \\ div_{n,r,t} = (1-\tau_r^k) R_{r,t} K_{n,r,t} - I_{n,r,t}^n + R_{r,t}^g K_{n,r,t}^g \\ + (pd_{n,r,t} - PX_{r,t}) x d_{n,r,t} (1 - \Gamma_{n,r,t}^{pd}) + \sum_{s \in R} (pe_{n,r,s,t} - PX_{r,t}) x e_{n,r,s,t}^n (1 - \Gamma_{n,r,s,t}^{pe}) \end{aligned} \quad (\text{A12})$$

subject to CES production technology, the demand functions of (A8) and (A9), and the adjustment costs in price setting of (A10) and (A11), and given the price of aggregate output, PX , and the law of motion of capital:

$$K_{n,t+1} g_{t+1} = (1-\delta) K_{n,t} + \Gamma_{n,t}^I K_{n,t} \quad (\text{A13})$$

where $K_{n,r,t}$ and $I_{n,r,t}^n$ are respectively private capital stock and investment of firm n in region r at time t ; $K_{n,r,t}^g$ is the stock of public capital; $R_{r,t}$ and $R_{r,t}^g$ are respectively the prices of private and public capital; δ is the depreciation rate of capital. Γ_n^I is the adjustment cost of investment, which is a function of the investment-to-capital ratio and takes on value zero in the steady state:

$$\Gamma_{n,t}^I = \frac{I_{n,t}^n}{K_{n,t}} - \frac{\phi^I}{2} \left(\frac{I_{n,t}^n}{K_{n,t}} - \frac{I_{t-1}^n}{K_{t-1}} \right)^2 \quad (\text{A14})$$

As shown in (A12), the firm's profits (or dividends) include the after-tax return to its private capital, the return to public capital captured, and the gains the firm obtains from selling products in the domestic and foreign markets. The optimization problem of the firm is to set its levels of investment, the labor input, the intermediate input, and the nominal prices of its products in domestic and exporting markets in order to maximize the discounted present value of its profits (or dividends). The resulting first order conditions with respect to I and K are:

$$\frac{1}{q_t} = 1 - \phi^I \left(\frac{I_{n,t}^n}{K_{n,t}} - \frac{I_{t-1}^n}{K_{t-1}} \right) \quad (\text{A15})$$

$$(1-\tau_t^k) R_t + q_t (1-\delta + \Gamma_{n,t}^I) - \frac{I_t}{K_t} - q_{t-1} \frac{1+i_t}{\pi_t} = 0 \quad (\text{A16})$$

where q is the shadow price of private capital, i.e., Tobin's q .

The resulting first order conditions with respect to pd and pe are:

$$(1 - \Gamma_{n,r,t}^{pd}) (pd_{n,r,t}(1 - \sigma_r^f) + PX_{r,t}\sigma_r^f) = (pd_{n,r,t} - PX_{r,t})\phi_r^p \left(\frac{\pi_{n,r,t}^{pd}}{\bar{\pi}_{r,t}} - 1 \right) \frac{\pi_{n,r,t}^{pd}}{\bar{\pi}_{r,t}} \\ - \frac{g_{t+1}\pi_{t+1}}{1 + i_{t+1}} \frac{XD_{r,t+1}}{XD_{r,t}} (pd_{n,r,t+1} - PX_{r,t+1})\phi_r^p \left(\frac{\pi_{n,r,t+1}^{pd}}{\bar{\pi}_{r,t+1}} - 1 \right) \frac{\pi_{n,r,t+1}^{pd}}{\bar{\pi}_{r,t+1}} \quad (A17)$$

$$(1 - \Gamma_{n,r,s,t}^{pe}) (pe_{n,r,s,t}(1 - \sigma_s^f) + PX_{r,t}\sigma_s^f) = (pe_{n,r,s,t} - PX_{r,t})\phi_s^p \left(\frac{\pi_{n,r,s,t}^{pe}}{\bar{\pi}_{s,t}} - 1 \right) \frac{\pi_{n,r,s,t}^{pe}}{\bar{\pi}_{s,t}} \\ - \frac{g_{t+1}\pi_{t+1}}{1 + i_{t+1}} \frac{XE_{r,s,t+1}}{XE_{r,s,t}} (pe_{n,r,s,t+1} - PX_{r,t+1})\phi_s^p \left(\frac{\pi_{n,r,s,t+1}^{pe}}{\bar{\pi}_{s,t+1}} - 1 \right) \frac{\pi_{n,r,s,t+1}^{pe}}{\bar{\pi}_{s,t+1}} \quad (A18)$$

where $\pi_{n,r,t}^{pd}$ is the inflation rate of variety n in domestic market and $\pi_{n,r,s,t}^{pe}$ is the inflation rate of variety n produced in country r and sold in region s .

The first order conditions with respect to production inputs lead to the following demand functions and price indices of aggregate inputs:

$$XN = \alpha^n \cdot X \cdot PX / PN \quad (A19)$$

$$K^g = (1 - \alpha^n) \cdot X \cdot PX / R^g \quad (A20)$$

$$X^\square = A \cdot (K^g)^{1-\alpha^n} XN^{\alpha^n} \quad (A21)$$

$$VA = \alpha^v \cdot XN \quad (A22)$$

$$XI = \alpha^n \cdot XN \quad (A23)$$

$$PN = \alpha^v PV + \alpha^n PI \quad (A24)$$

$$L = \alpha^l \left[\frac{PV}{W} \right]^{\sigma^v} VA \quad (A25)$$

$$K = \alpha^k \left[\frac{PV}{R} \right]^{\sigma^v} VA \quad (A26)$$

$$PV = \left[\alpha^l (W)^{1-\sigma^v} + \alpha^k (R)^{1-\sigma^v} \right]^{1/(1-\sigma^v)} \quad (A27)$$

where α^n and α^v are respectively the share parameters for the aggregate primary factor and the intermediate input in the production function of aggregate private input; α^l and α^k are respectively the share parameters for the aggregate labor input and private capital in the production function of the aggregate primary factor; X , K^g , XN , VA , XI , L , K represent output, public capital, aggregate private input, aggregate primary factor, intermediate input, aggregate labor and private capital, respectively; and PX , R^g , PN , PV , PI , W and R are their corresponding price indices. σ^v is elasticity of substitution between labor and capital.

Firms have the CES aggregator of the differentiated labor varieties provided by labor unions. As firms are assumed to be identical, the aggregate labor demand, L , can be expressed as:

$$L = \left[\int_0^1 (l_\mu)^{\frac{\sigma^l-1}{\sigma^l}} d\mu \right]^{\frac{\sigma^l}{\sigma^l-1}} \quad (A28)$$

where l_μ is the quantity of labor provided by union μ and σ' is the elasticity of substitution across labor varieties. Cost minimization of firms implies that demand for labor μ is a function of the relative wage:

$$\frac{l_\mu}{L} = \left[\frac{w_\mu}{W} \right]^{-\sigma'} \quad (\text{A29})$$

where w_μ is the wage paid to union μ and the region's wage, W , is defined as:

$$W = \left[\int_0^1 (w_\mu)^{1-\sigma'} d\mu \right]^{\frac{1}{1-\sigma'}} \quad (\text{A30})$$

D. Households

In each period, $m_r(1-\theta)$ individuals are born in region r and they face a constant probability of death $(1-\theta)$ after their birth. This implies that the total number of population is m_r in region r . We distinguish two types of households, forward-looking ones denoted by *FL*, and liquidity-constrained ones denoted by *LC*. For a representative household of age a , its period utility in time t , $u_{a,t}$, is a function of its (detrended) consumption c and labor effort l^h .

$$u_{a,t}(c_{a,t}, l_{a,t}^h) = \frac{1}{1-\sigma} \left[(c_{a,t} / (\tilde{c}_{t-1})^\nu)^\eta (1 - l_{a,t}^h)^{1-\eta} \right]^{1-\sigma} \quad (\text{A31})$$

where σ is the inverse elasticity of intertemporal substitution and η is the weight of consumption in the utility function. The term \tilde{c}_{t-1} represents past per capita consumption of household h 's peers, i.e. *FL* households or *LC* households. ν parameterizes the degree of habit persistence. This exhibits the ‘‘catching up with the Joneses’’ type of external habit formation.

The lifetime utility of age a household at time t , $U_{a,t}$, is the sum of discounted period utility:

$$U_{a,t} = \sum_{\tau=0}^{\infty} (g^{1-\sigma} \beta \theta)^\tau u_{a+\tau,t+\tau} \quad (\text{A32})$$

where β is the subjective discount rate, possibly time-variable but converging to a steady state constant in the long run.

The decision problem of a forward-looking household is to maximize its lifetime utility (32) subject to the following sequences of period budget constraints:

$$\begin{aligned} \theta (B_{a+1,t+1} \pi_{t+1} + \varepsilon_t B_{a+1,t+1}^* \pi_{t+1}^* + V_{t+1} z_{a,t+1} \pi_{t+1}) g_{t+1} &= (1+i_t) B_{a,t} \\ + (1+i_t^*) (1-\zeta_t) \varepsilon_t B_{a,t}^* + (V_{t+1} \pi_{t+1} g_{t+1} \theta + Div_t) z_{a,t} & \\ + TR_{a,t}^{FL} + (1-\tau_t) w_t^h \phi_a^h l_{a,t}^h - c_{a,t} - TT_{a,t} & \end{aligned} \quad (\text{A33})$$

In the above expression, B_a is the amount of domestic government bonds held by the representative household at age a , denominated in domestic currency; B_a^* is the amount of international bonds held by household a , denominated in the US dollar; V denotes the value of a claim to firm profits in current and all future periods; z_a is the share of firms owned by the represent household at age a ; π and π^* are respectively domestic and US CPI inflation rates; i and i^* are respectively the domestic and US nominal interest rates; ζ is the risk premium on international bonds; Div is the total dividends paid by all firms to households; TR_a^{FL} represents revenue from unions' profits rebated to forward-looking household a in a lump-sum way; and

TT_a is the lump-sum net tax for household a . Labor incomes $w^h \phi_a l_a^h$ are taxed at the rate τ^l . And ϕ_a is the labor productivity of age a household, given by:

$$\phi_a = \frac{1 - \theta \chi}{1 - \theta} \chi^a \quad (\text{A34})$$

where θ is the constant probability of survival in each period and $\chi (< 1)$ determines the speed of decline of an individual household's labor productivity throughout his lifetime.

The first order conditions of the forward-looking household's optimization problem with respect to B , B^* , c , l and z yield the following arbitrage equations:

$$\frac{\pi_{t+1}}{1 + i_{t+1}} = \frac{\pi_{t+1}^*}{(1 + i_{t+1}^*)(1 - \zeta)} \frac{\varepsilon_t}{\varepsilon_{t+1}} \quad (\text{A35})$$

$$J_{t+1} = \frac{g_{t+1} c_{a,t+1}}{c_{a,t}} = \left(\frac{(1 + i_t) \beta_{t+1}}{\pi_{t+1}} \right)^{1/\gamma} \left(\frac{w_{t+1}^h}{w_t^h} \chi \right)^{(1-\eta)(1-1/\gamma)} \left(\frac{c_t}{c_{t-1}} g_{t+1} \right)^{\eta(1-1/\gamma)} \quad (\text{A36})$$

$$\frac{c_{a,t}}{1 - l_{a,t}^h} = \frac{\eta^{FL}}{1 - \eta^{FL}} w_t^h \phi_a \quad (\text{A37})$$

$$V_t \square (1 + i_t) = Div_t + V_{t+1} g_{t+1} \pi_{t+1} \quad (\text{A38})$$

With some algebraic derivations, the aggregate consumption of all forward-looking households can be expressed as a fraction of the sum of their financial wealth, FW , and human wealth, HW . Human wealth is composed of two parts, the expected present discounted value of future labor income, HWL , and the expected present discounted value of future transfer incomes, HWT .

$$C_t^{FL} \Theta_t = (1 + i_t)(HW_t + FW_t) \quad (\text{A39})$$

$$FW_t = B_t + \varepsilon_{t-1} B_t^* + V_t \quad (\text{A40})$$

$$HW_t = HWL_t + HWT_t \quad (\text{A41})$$

$$HWL_t (1 + i_t) = w_t^h L_t^{FL} + HWL_{t+1} g_{t+1} \pi_{t+1} \theta \chi \quad (\text{A42})$$

$$HWT_t (1 + i_t) = TR_t^{FL} + HWT_{t+1} g_{t+1} \pi_{t+1} \theta \quad (\text{A43})$$

Θ^{-1} is the marginal propensity to consume out of total wealth. This inverse of the marginal propensity of consume evolves according to,

$$\Theta_t = \frac{1}{\eta^{FL}} + \frac{\theta J_{t+1} \pi_{t+1}}{1 + i_{t+1}} \Theta_{t+1} \quad (\text{A44})$$

where J is already defined in (36).

A liquidity-constrained household has no access to capital markets. Its decision problem is purely static, confined to the choices of labor supply. Its budget constraint is:

$$c_{a,t} = (1 - \tau^l) w_t^h \phi_a l_{a,t}^h + TR_{a,t}^{LC} - TT_{a,t} \quad (\text{A45})$$

where $TR_{a,t}^{LC}$ is the lump-sum revenue from union's profits rebated to the liquidity-constrained household a . The first order conditions with respects to consumption and labor supply yield the following relationship between aggregate consumption and labor supply:

$$\frac{c_t^{LC}}{m \cdot s^{LC} - L_t^{LC}} = \frac{\eta^{LC}}{1 - \eta^{LC}} w_t^h \quad (\text{A46})$$

where s^{LC} is the share of liquidity-constrained agents in total households and L^{LC} is the effective aggregate labor supply of liquidity-constrained households.

E. Unions

In each region, there is a continuum of unions which buy labor from households and sell labor to firms. They are perfectly competitive in their input markets and monopolistically competitive in their output market. Each union has power to set the nominal wage of the labor they provide. Similarly to the price setting by firms, wage changes are subject to adjustment costs. The adjustment cost function of nominal wage change is assumed as follows:

$$\Gamma_{\mu,t}^w = \frac{\phi^w}{2} \left(\pi_t \frac{w_{\mu,t}/w_{\mu,t-1}}{\bar{\pi}_t} - 1 \right)^2 \quad (\text{A47})$$

The decision problem of each union is to maximize the present discounted value of nominal wages paid by firms, $w_{\mu,t}$, minus nominal wages paid out to households, w^h , minus wage change adjustment cost, by setting the nominal wage:

$$\max \sum_{t=0}^{\infty} \left(\prod_{\tau=0}^t \frac{g_{\tau} \pi_{\tau,r}}{1 + i_{\tau,r}} \right) (w_{\mu,t} (1 - \Gamma_{\mu,t}^w) - w^h) l_{\mu,t} \quad (\text{A48})$$

subject to the demand function (29). The resulting wage setting equation is:

$$\begin{aligned} \square \frac{w_t^h \sigma^l}{(1 - \tau^w) w_{\mu,t}} &= (\sigma^l - 1)(1 - \Gamma_{\mu,t}^w) + \phi^w \left(\frac{\pi_{\mu,t}^w}{\bar{\pi}_t} - 1 \right) \frac{\pi_{\mu,t}^w}{\bar{\pi}_t} \\ &- \frac{g_{t+1} \pi_{t+1}}{1 + i_{t+1}} \frac{L_{t+1}}{L_t} \phi^w \left(\frac{\pi_{\mu,t+1}^w}{\bar{\pi}_{t+1}} - 1 \right) \left(\frac{\pi_{\mu,t+1}^w}{\bar{\pi}_{t+1}} \right)^2 \end{aligned} \quad (\text{A49})$$

where $\pi_{\mu,t}^w = \pi_t \cdot w_{\mu,t}/w_{\mu,t-1}$ is the wage inflation rate.

F. Government

Government in region s has the following budget constraint:

$$\begin{aligned} B_{s,t+1} g_{t+1} \pi_{t+1} &= (1 + i_{s,t}) B_{s,t} + G_{s,t}^C + G_{s,t}^I - \tau_s^k R_{s,t} K_{s,t} - \tau_s^l W_{s,t} L_{s,t} \square - TT_{s,t} m_s \\ &- \tau_s^s P A_{s,t} X A_{s,t} - \sum_r (\tau_{rs} P E_{rs,t} X E_{rs,t} \varepsilon_{s,t} / \varepsilon_{r,t}) \end{aligned} \quad (\text{A50})$$

where G^C and G^I are government consumption and investment, respectively. The accumulation of public capital follows:

$$K_{t+1}^g g_{t+1} = (1 - \delta) K_t^g + G_t^I \quad (\text{A51})$$

The central bank in each region is assumed to set the nominal interest rate by employing the following monetary policy rule:

$$i_t = i_{t-1} + \omega_{\pi} (\pi_{t-1} - \bar{\pi}_{t-1}) + \omega_y (\Delta GDP_{t-1} - \Delta \overline{GDP}_{t-1}) + \omega_e (\Delta \varepsilon_{t-1} - \Delta \bar{\varepsilon}_{t-1}) \quad (\text{A52})$$

where ω_{π} , ω_y and ω_e are the weights for the inflation gap, the output growth gap and the exchange rate gap, respectively. The variables with bars are target values of the respective

variables. Note that $\omega_e > 0$ for the emerging East Asian central bank, while $\omega_e = 0$ for the central banks in other regions of the world.

G. Equilibrium

The equilibrium condition in the composite good market is that the supply of the composite good, XA , is equal to the sum of household consumption demand, government demand for consumption and investment, and private demand for intermediate inputs:

$$XA = C^{FL} + C^{LC} + G^C + G^I + I \quad (\text{A53})$$

The equilibrium condition in the labor market in each region is:

$$L = L^{FL} + L^{LC} \quad (\text{A54})$$

The international bond is in zero net supply internationally. The market clearing condition for international bonds requires:

$$0 = \sum_r B_r^* \quad (\text{A55})$$

REFERENCES

- Blanchard, O. J. 1985. "Debt, Deficits, and Finite Horizons." *Journal of Political Economy* 92(2): 223–247.
- Bilbiie, F., F. Ghironi, and M. Melitz. 2007. Monetary Policy and Business Cycles with Endogenous Entry and Product Variety. NBER Working Paper 13199, National Bureau of Economic Research, Cambridge.
- Corsetti, G., P. Martin, and P. Pesenti. 2008. Varieties and the Transfer Problem: the Extensive Margin of Current Account Adjustment. NBER Working Paper No. 13795, National Bureau of Economic Research, Cambridge.
- Freedman, C., M. Kumhof, D. Laxton, and J. Lee. 2009. The Case for Global Fiscal Stimulus. IMF Staff Position Note SPN/09/0, International Monetary Fund, Washington, DC.
- Hertel et al.
- Hertel, T., D. Hummels, M. Ivanic and R. Keeney. 2007. "How Confident Can we be of CGE-based Assessments of Free Trade Agreements?" *Economic Modelling*, 24(4): 611–635.
- Kawai, M. and F. Zhai. 2009. "China-Japan-United States Integration amid Global Rebalancing: A Computable General Equilibrium Analysis." *Journal of Asian Economics*, 20(6): 688–99.
- Knudsen, M., L. H. Pedersen, T. W. Petersen, P. Stephensen, and P. Trier. 1998. "Dynamic Calibration of a CGE-Model with a Demographic Application." Mimeographed, Statistics Denmark, Copenhagen.
- Kumhof, M. and D. Laxton. 2007. "A Party without a Hangover? On the Effects of U.S. Fiscal Deficits." IMF Working Paper 07/202 (August), International Monetary Fund, Washington, DC.
- Kumhof, M., D. Laxton and K. Naknoi. 2009. "Does the Exchange Rate Belong in Monetary Policy Rules: New Answers from a DSGE Model with Endogenous Tradability and Trade Frictions." Forthcoming in Proceedings from the *ECB Conference on Globalization and the Macroeconomy*, Frankfurt, European Central Bank.

- Laxton, D. 2008. "Getting to Know the Global Economy Model and Its Philosophy." *IMF Staff Papers*, 55(2): 213–242.
- McKibbin, W. J. and P. J. Wilcoxon. 1998. "The Theoretical and Empirical Structure of the G-Cubed Model." *Economic Modelling*, 16(1): 123–148.
- Obstfeld, M. and K. Rogoff. 1995. "Exchange Rate Dynamics Redux." *Journal of Political Economy*, 103(3): 624–60.
- _____. 1996. *Foundations of International Macroeconomics*. Cambridge: MIT Press.
- _____. 2005. "Global Current Account Imbalances and Exchange Rate Adjustments." *Brookings Papers on Economic Activity* 2005(1): 67–123.
- Rotemberg, J. 1982. "Sticky Prices in the United States." *Journal of Political Economy* 90(6): 1187–1211.
- Ruhl, K. 2003. Solving the Elasticity Puzzle in International Economics. Mimeographed, University of Texas, Austin.
- Wendner, R. A. 1999. "Calibration Procedure of Dynamic CGE Models for Non-Steady State Situations Using GEMPACK." *Computational Economics* 13(3): 265–87.
- Yaari, M. E. 1965. "Uncertain Lifetime, Life Insurance, and the Theory of the Consumer." *Review of Economic Studies* 32(2) 137–150.
- Zhang, W., Z. Zhang, and G. Han. 2010. "How Does the US Credit Crisis Affect the Asia-Pacific Economies?—Analysis Based on a General Equilibrium Model." *Journal of Asian Economics* 21(3): 280–92.

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By Joel Mangahas

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This book argues that structural change (reallocation of resources across sectors and higher diversification and sophistication of production and exports) is the key to sustained and fast growth in developing Asia. However, fast structural change often leads to higher unemployment. For this reason, the book details a host of policy prescriptions—taken collectively to produce “inclusive growth”—aimed at fostering full employment, as the most direct way of improving the well-being of the people, especially the most disadvantaged. To achieve inclusive growth, governments must commit efforts and resources to pursue full employment. The latter delivers great benefits, including higher income and taxes; and reduces poverty and misery.

NEW ADB TITLES

ATTAINING ACCESS FOR ALL: PRO-POOR POLICY AND REGULATION FOR WATER AND ENERGY SERVICES

\$35.00 plus courier charges / ISBN: 978-92-9092-139-4

Universal access to safe, reliable energy is a necessary condition for providing the poor with safe water and sanitation, for maintaining adequate standards of living, and for achieving any of the Millennium Development Goals. The Asian Development Bank recognizes the importance of electricity and water access for the poor and has committed to providing such access by establishing the Energy for All and Water for All initiatives. While broad efforts aimed at regulatory reform and increasing energy and water access may be helpful, targeted interventions, measures, and approaches are often needed to ensure that the poor benefit from these efforts. This publication identifies specific infrastructure and utility service reform measures that can be taken to advance the interests of the poor.

ACCESS TO JUSTICE FOR THE URBAN POOR: TOWARD INCLUSIVE CITIES

\$28 plus courier charges / ISBN: 978-92-9092-044-1

This publication suggests solutions that can be built into the design of urban development projects undertaken by the Asian Development Bank (ADB) to address the common problems and grievances of the urban poor, and to improve urban governance overall.

It also identifies successful or promising community-based approaches to dispute resolution that can be useful in urban project design.

It uses ADB's Governance Policy as a framework for analyzing key findings of Access to Justice for the Urban Poor, a regional technical assistance grant to four developing member countries in Asia and the Pacific—Bangladesh, Indonesia, the Philippines, and Thailand. The findings consist of case studies illustrating typical problems encountered by the poor in connection with access to urban assets and services, and identifies the types of grievances or disputes that may arise because of these issues. The publication reproduces key case studies to illustrate significant concepts.

NEW ADB TITLES

POVERTY AND SUSTAINABLE DEVELOPMENT IN ASIA: IMPACTS AND RESPONSES TO THE GLOBAL ECONOMIC CRISIS

\$38.00 plus courier charges / ISBN: 978-971-561-900-4

On 28-30 September 2009, the Asian Development Bank, the governments of the People's Republic of China and Viet Nam, and the ASEAN Secretariat jointly organized a high-level Asia-wide conference in Ha Noi on the social and environmental impact of the global economic crisis on Asia and the Pacific, especially on the poor and vulnerable. The conference also served as the 3rd China-ASEAN Forum on Social Development and Poverty Reduction and as the 4th ASEAN+3 High-Level Seminar on Poverty Reduction. It was supported by various development partners. This book features selected papers from the Ha Noi conference. It is designed with the needs of policy makers in mind, utilizing field, country, and thematic background studies to cover a large number of countries and cases. It is complemented by a webpage comprising more information about the conference, and all the papers presented there.

This publication suggests that the crisis is an opportunity to rethink the model of development in Asia for growth to become more inclusive and sustainable. Issues that need to be more carefully considered include:

- Closing the gap of dualistic labor markets
- Building up social protection systems
- Rationalizing social expenditures
- Addressing urban poverty through slum upgrading
- Promoting rural development through food security programs in pro-poor growth potential areas
- Concentrating climate change interventions on generating direct benefits for the environments of the poor

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ECONOMICS TITLES FROM ADB

INDONESIA: CRITICAL DEVELOPMENT CONSTRAINTS (2010)

ISBN: 978-92-9092-076-2

Indonesia, despite steady economic growth in recent years, faces formidable challenges going forward. Economic growth has not returned to the level that prevailed before the 1997 Asian financial crisis. Progress toward reducing poverty and inequalities too has been slow during the recent years. Moreover, economic growth in the last decade has not been accompanied by significant employment generation. The country diagnostic study *Indonesia: Critical Development Constraints* presents a diagnosis of the critical development constraints the country faces. The report proposes policy options to help overcome constraints and to set the country on a path of high and sustained inclusive economic growth in the medium term.

THE ECONOMICS OF CLIMATE CHANGE IN SOUTHEAST ASIA: A REGIONAL REVIEW

\$40.00 plus courier charges / ISBN: 978-971-561-788-8

This report provides a review of the economics of climate change in the Southeast Asian region. It confirms that the region is highly vulnerable to climate change and demonstrates that a wide range of adaptation measures are already being applied. The report also shows that the region has a great potential to contribute to greenhouse gas emission reduction, and that the costs to the region and globally of taking no early action against climate change could be very high. The basic policy message is that efforts must be made to apply all feasible and economically viable adaptation and mitigation measures as key elements of a sustainable development strategy for Southeast Asia. It also argues that the current global economic crisis offers Southeast Asia an opportunity to start a transition toward a climate-resilient and low-carbon economy by introducing green stimulus programs that can simultaneously shore up economies, create jobs, reduce poverty, lower carbon emissions, and prepare for the worst effects of climate change.

RESEARCH STUDY ON POVERTY-SPECIFIC PURCHASING POWER PARITIES FOR SELECTED COUNTRIES IN ASIA AND THE PACIFIC

\$35.00 plus courier charges / ISBN: 978-971-561-659-1

This methodological study presents a detailed account of the activities undertaken to estimate poverty purchasing power parities (PPP) using the recommended methodology of the Poverty Advisory Group of the World Bank, as well as alternative PPPs derived from poverty-specific price surveys. The study established that poverty-specific prices would make a difference in the numerical values of the poverty PPPs. The study is expected to provide significant input into the development and further refinement of methodologies for compiling PPPs specific to poverty measurement.

ECONOMICS TITLES FROM ADB

PURCHASING POWER PARITIES AND REAL EXPENDITURES

\$35.00 plus courier charges / ISBN: 978-971-561-640-9

This publication presents the final results on estimates of purchasing power parities (PPPs) of currencies of the participating economies in the 2005 International Comparison Program in Asia Pacific. These include estimates of “real” gross domestic product and its major components, namely, household consumption, government consumption, gross capital formation, and net external trade. The estimates of PPPs are more robust in this round through improvements in methodology, data collection, data review, and data processing.

POVERTY IMPACT ANALYSIS: SELECTED TOOLS AND APPLICATIONS

Edited by Guntur Sugiyarto

\$40.00 plus courier charges / ISBN: 978-971-561-628-7

This book is written for at least four different groups of audiences. Firstly, it is for policymakers and planners, who decide how poverty impact analysis (PIA) should be conducted and, more importantly, how public resources should be allocated across competing needs. Secondly, it is intended for project managers or project economists, who can use PIA to critically improve their current and future projects' performance. Thirdly, it is for PIA practitioners, who are directly responsible for the development and applications of poverty impact evaluation tools. Lastly, it can be useful for researchers working in the area of impact analysis and other interested parties that could use the information in their various endeavors to help reduce poverty.

LABOR MARKETS IN ASIA: ISSUES AND PERSPECTIVES

Edited by Jesus Felipe and Rana Hasan

£70.00 (hardbound) / ISBN: 0-230-00791-0

(Copublished with and available from Palgrave Macmillan)

Unemployment and underemployment are developing into Asia's most important long-term problems. By conservative estimates, the region is home to at least 500 million workers who are either unemployed or underemployed. For this reason, helping people as workers is critical for poverty reduction. A question being widely asked is why countries in the region manage to achieve high growth rates of gross domestic product but the corresponding growth rates of employment are somewhat disappointing. Are supposedly rigid labor markets the reason? This volume argues that while labor market reforms may be necessary in some specific cases, by no means are labor market policies the main explanation for the widespread increase in unemployment and underemployment across Asia and country specific studies undermine the case for across-the-board labor market reforms.

ECONOMICS TITLES FROM ADB

COMPETITION POLICY AND DEVELOPMENT IN ASIA

Edited by Douglas H. Brooks and Simon J. Evenett

£65.00 (hardbound) / ISBN: 1-4039-9632-6

(Copublished with and available from Palgrave Macmillan)

This book looks at the experiences of six Asian countries in terms of developing and implementing domestic competition policy. It analyzes how the choice of development policies affects the state of competition in each country and how competition contributes to development. The considerable variation in policies and experiences across the countries provides a rich source of information from which lessons and best practices can be drawn.

MANAGING FDI IN A GLOBALIZING ECONOMY

Edited by Douglas H. Brooks and Hal Hill

£60.00 (hardbound) / ISBN: 1-4039-3655-2

(Copublished with and available from Palgrave Macmillan)

The rapid growth of developing Asia has attracted, and been facilitated by, foreign direct investment (FDI). Potential benefits of FDI inflows extend far beyond financial resources, but costs may be involved as well. Governments throughout the region have been striving to find an appropriate policy mix for FDI that will maximize the net benefits for their economies. There is considerable variation in policies and experiences with FDI across countries. This study looks at FDI flows, consequences, and policies in developing Asia. It focuses on a diverse set of six Asian countries and draws lessons from their experiences in managing FDI.

POVERTY, GROWTH, AND INSTITUTIONS IN DEVELOPING ASIA

Edited by Ernesto M. Pernia and Anil B. Deolalikar

£60.00 (hardbound) / ISBN: 1-4039-1806-6

(Copublished with and available from Palgrave Macmillan)

The theme of this book is that economic growth is key, but institutions and other national and subnational attributes matter as well. They are critical to explaining differences in social development and poverty reduction across countries and subnational areas that cannot be accounted for by growth alone. The book concludes that a more complete strategy needs to consider various institutional factors at the national and subnational levels to achieve rapid and sustained poverty reduction. Indeed, paying attention to these factors will benefit both growth and poverty reduction.

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About the Journal

The *Asian Development Review* is the professional journal of the Asian Development Bank (ADB) that aims to disseminate the results of economic and development research carried out by ADB staff and external scholars. The *Review* seeks high-quality papers with relevance to policy issues and operational matters done in an empirically rigorous way. Articles are intended for readership among economists and social scientists in government, private sector, academia, and international organizations.

About the Asian Development Bank

ADB's vision is an Asia and Pacific region free of poverty. Its mission is to help its developing member countries substantially reduce poverty and improve the quality of life of their people. Despite the region's many successes, it remains home to two-thirds of the world's poor: 1.8 billion people who live on less than \$2 a day, with 903 million struggling on less than \$1.25 a day. ADB is committed to reducing poverty through inclusive economic growth, environmentally sustainable growth, and regional integration.

Based in Manila, ADB is owned by 67 members, including 48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

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