Integration and Growth in East Asia

Sanghoon Ahn and Jong-Wha Lee

This paper empirically analyzes the experience of East Asia's economic growth with data both at aggregate-economy and micro-firm levels, focusing on the role of international integration through trade and direct investment. The analysis within a framework of cross-country panel regression shows that trade openness and foreign direct investment (FDI) inflows have a positive effect on GDP growth—particularly in the 1970s and 1980s—while FDI outflows appear to have a negative effect on GDP growth. Micro-level evidence based on manufacturing data in the Republic of Korea (Korea) confirms the positive effect of trade and investment integration on plant-level productivity growth. It also suggests that the relationship between FDI outflows and productivity growth depends on the characteristics of a recipient economy. We find that FDI to the People's Republic of China tends to reduce productivity growth of firms in Korea, while FDI to the United States or Japan works in favor of productivity growth.

Keywords: Integration; Growth; Trade; Foreign direct investment; East Asia
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Sanghoon Ahn: Korea Development Institute
Jong-Wha Lee: Asian Development Bank (Corresponding author; e-mail: jwlee@adb.org)

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I. Introduction

During the past four decades, East Asian economies showed impressive growth. Nine East Asian economies grew extremely rapidly, averaging growth of more than 4.6 percent in per capita terms between 1970 and 2005 (Table 1).[1] Economic performance in the People's Republic of China (hereafter, China) has been most remarkable, with the average annual growth rate surpassing 7 percent, raising the level of real per capita GDP by almost 12 times.

The impressive performance was interrupted by the 1997–98 Asian financial crisis. The average per capita GDP growth rate for the nine East Asian economies dropped from 5.5 percent in 1990–95 to 2.8 percent in 1995–2000. The five crisis-affected East Asian countries—Indonesia, the Republic of Korea (hereafter, Korea), Malaysia, the Philippines, and Thailand—recorded an average growth rate of less than 2.0 percent. While they managed rapid recoveries, there seems to have been a permanent decline in the potential growth rate. The average per capita GDP growth rate remained at 3.0 percent over 2000–05.

The purpose of this paper is to empirically assess the East Asian growth performance over the last four decades, focusing on the role of international integration through trade and investment on East Asia's economic growth. Many researchers have paid attention to the potential causal link between trade openness and high growth in Asia. For example, Lucas (1993) explains the "East Asian miracle" by focusing on the fact that those East Asian miracle economies have become "large scale exporters

Table 1 Growth Performance in East Asia

Economy	GDP per capita			Average annual per capita GDP growth (percent)								
	1970	2005	2005/1970	1960–70	1970–75	1975–80	1980–85	1985–90	1990–95	1995–2000	2000–05	1970–2005
China	500	5,826	11.7	1.09	3.27	4.82	8.25	7.80	9.61	7.85	7.51	7.02
Hong Kong	6,967	31,537	4.5	7.41	4.32	8.77	3.58	6.29	4.07	0.23	2.93	4.31
Indonesia	1,273	4,237	3.3	1.73	6.16	3.69	1.25	5.49	4.77	0.36	2.33	3.44
Korea	2,552	19,072	7.5	5.60	5.64	5.69	6.22	8.94	6.53	3.32	3.89	5.75
Malaysia	2,529	13,215	5.2	3.40	7.63	5.80	2.61	4.00	6.13	3.95	2.94	4.72
Philippines	2,431	4,072	1.7	1.76	3.39	2.81	–2.57	1.96	0.38	3.11	1.25	1.48
Singapore	6,838	30,518	4.5	4.83	6.18	6.72	2.32	5.71	5.66	2.61	0.72	4.27
Taipei,China	2,846	21,626	7.6	6.79	6.72	8.07	4.90	7.80	5.98	4.70	2.40	5.80
Thailand	1,734	7,937	4.6	4.93	3.32	5.60	4.31	7.40	6.49	–0.77	4.08	4.35
East Asia 9 Avg.	3,074	15,338	5.0	4.17	5.18	5.77	3.43	6.15	5.51	2.82	3.12	4.57
Brazil	4,026	7,530	1.9	4.21	6.60	3.81	–0.74	0.90	0.18	0.85	0.91	1.79
Japan	11,391	25,290	2.2	9.27	2.91	3.28	2.27	4.43	1.05	0.93	1.07	2.28
India	1,155	3,432	3.0	2.59	0.42	2.68	3.18	3.67	2.08	4.54	5.22	3.11
United States	17,321	37,015	2.1	2.96	1.78	2.64	2.42	2.11	1.53	3.22	1.49	2.17

Note: Per capita GDP levels and growth rates are based on 2000 international (purchasing power parity adjusted) prices, based on the Penn World Tables 6.2. The average is unweighted average for the nine East Asian economies.

1. Throughout this paper, "East Asia" refers to the nine emerging economies in the region for which we have complete data: the People's Republic of China (hereafter, China); the Hong Kong Special Administrative Region of China (hereafter, Hong Kong); Indonesia; the Republic of Korea (hereafter, Korea); Malaysia; the Philippines; Singapore; Taipei,China; and Thailand. "South Asia" refers to Bangladesh, India, Pakistan, and Sri Lanka.

of manufactured goods of increasing sophistication." Viewing these as productivity miracles, he offered the following explanation: (1) the main engine of growth is the accumulation of human capital, especially in the form of on-the-job training; (2) for this to persist, workers and managers should continue to take on new tasks; and (3) for such learning to continue on a large scale, the economy must be a large-scale exporter. The role of foreign direct investment (FDI) in East Asian growth is also emphasized in the literature. It is a long-standing argument that FDI flows contribute to an economy's technology spillover and thereby to economic growth.[2]

The rapid integration into global markets has been one of the most salient features in the Asian growth process. Figure 1 shows that both trade volumes and FDI flows have grown very fast in the region. The share of trade in GDP increased continuously from 21 percent in 1970 to 95 percent in 2005 for the nine East Asian economies. FDI inflows and outflows also increased rapidly, reaching peaks of 5 percent and 3 percent of GDP, respectively, in 2000. Figure 2 shows that the share of East Asian GDP in world GDP has almost doubled during the last 35 years, approaching 10 percent in 2005. The share of East Asian trade has grown more than fourfold, currently reaching 20 percent of world trade volume. The share of East Asia's FDI inflows has also increased more than threefold over the same period.

In view of this rapid international integration coupled with fast income growth, this paper conducts an analysis of the empirical relationships between international trade and direct investment integration and long-term income growth, utilizing both macro- and micro-level data.

First, we begin the analysis with a general framework of cross-country regression that allows us to assess East Asia's growth performance in a broad international context, by comparing it with other developing regions. This empirical framework helps identify the factors that have been critical to economic growth for the broad sample of countries over 1970–2005. We then extend the analysis to investigate the role of trade and FDI flows on economic growth.

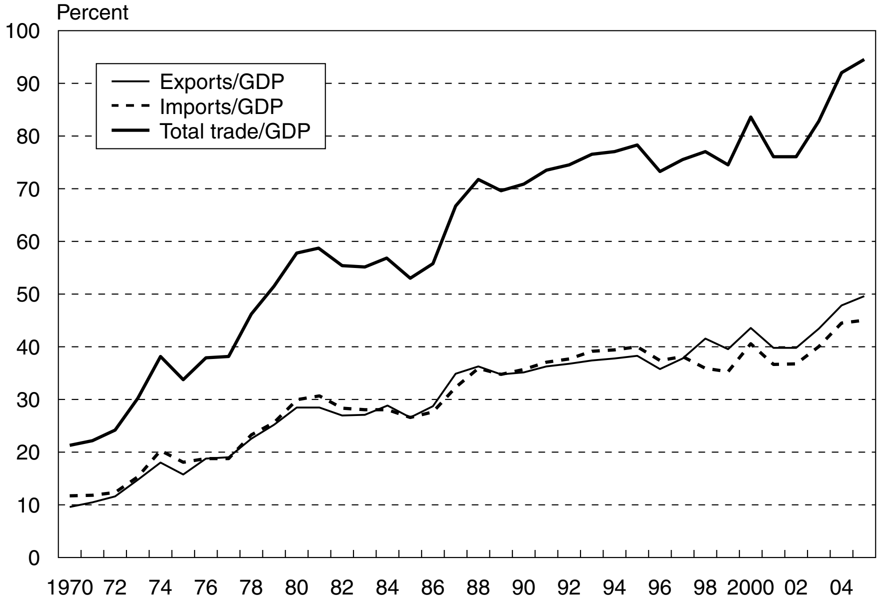
Second, we examine the role of trade and FDI on firm-level productivity growth by using plant-, firm-, and industry-level micro data from the Korean manufacturing sector for the period 1990–2003. Within the same country, the advance of international integration varies from industry to industry. The effect of trade and investment integration on productivity growth may occur through technology spillovers at firm level or industry level. A micro data analysis is needed to shed more light on empirical links between integration and productivity growth utilizing rich information.

The paper is organized as follows. In Section II, using cross-country regressions, we explain the critical factors for East Asia's growth performance, and analyze the role of international trade and direct investment on long-term income growth at the aggregate-economy level. In Section III, we investigate the links between global integration and productivity growth with plant- and industry-level micro data from the Korean manufacturing sector. Finally, Section IV concludes.

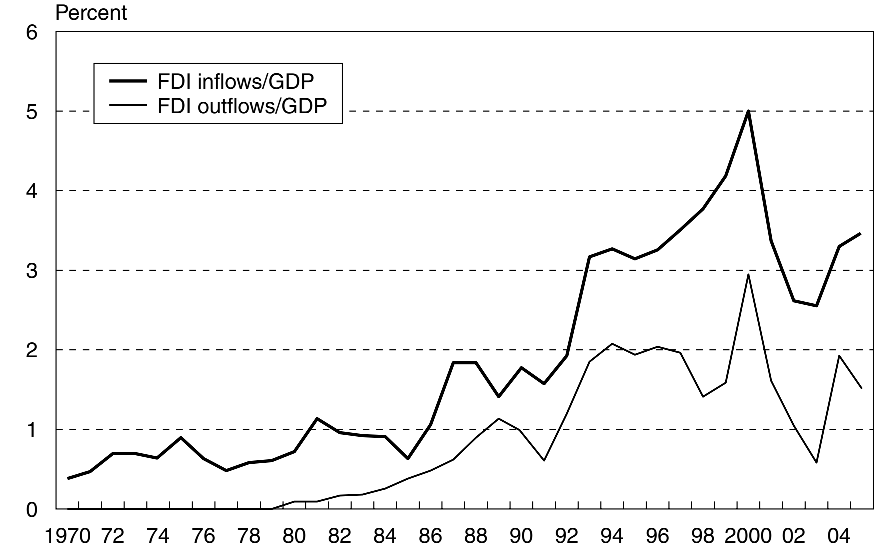
2. This paper focuses on the growth effect of FDI flows. The literature on the effects of financial integration shows that FDI produces more benefits than other types of financial flows, since it has a positive effect on productivity growth through technology spillover. Kose *et al.* (2006) provide an extensive discussion of the benefits and costs of financial openness on developing economies.

Figure 1 Trade and FDI Flows of East Asia

[1] Trade Volume, Exports, and Imports (Share of GDP)



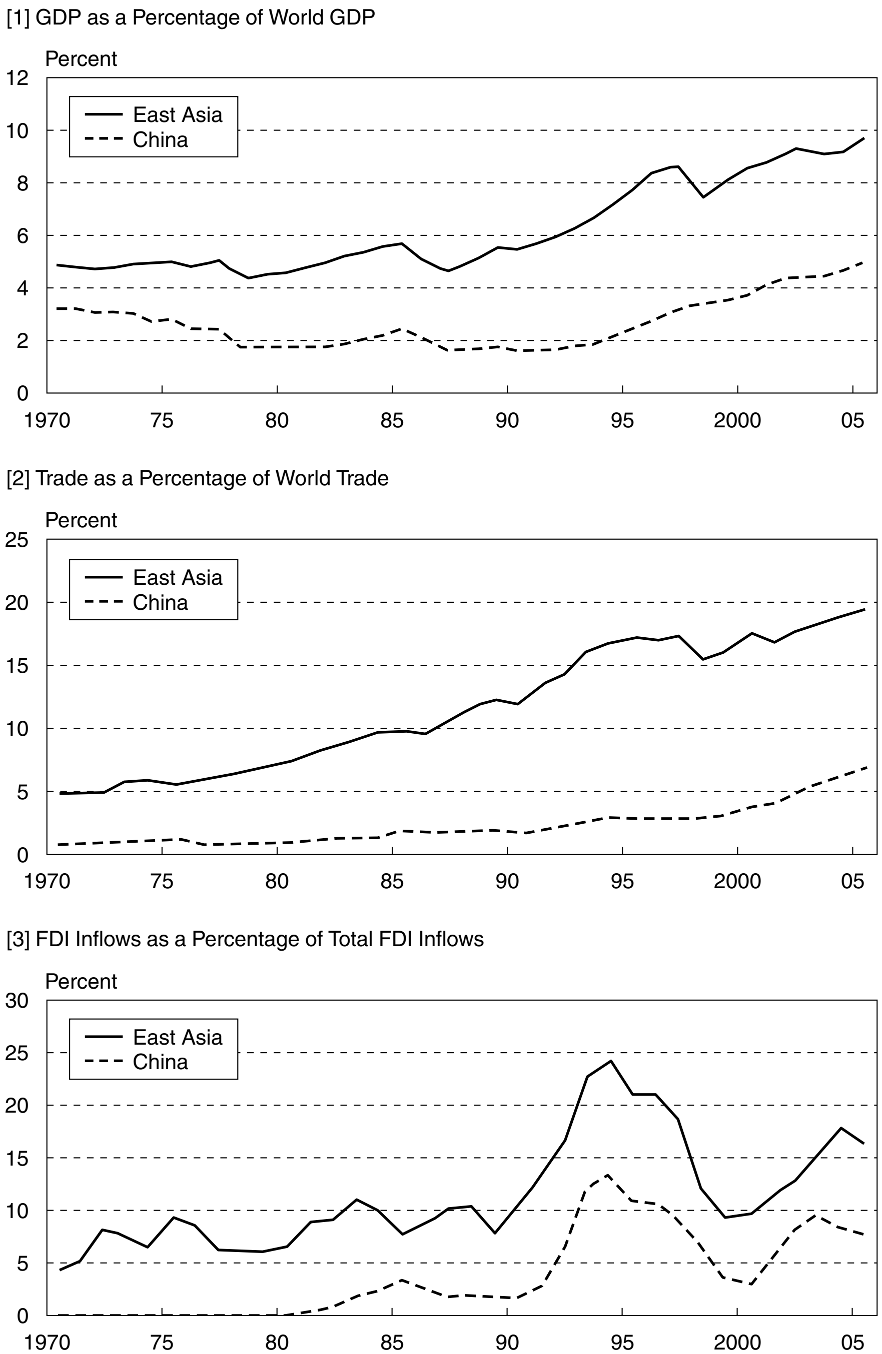
[2] FDI Flows (Share of GDP)



Note: East Asia comprises China, Hong Kong, Taipei,China, Korea, Indonesia, Malaysia, the Philippines, Singapore, and Thailand.

Sources: World Bank, *World Development Indicators,* 2006; UNCTAD, *World Investment Report,* 2006; data for Taipei,China from Asian Development Bank Statistical Database System.

Figure 2 The Emergence of East Asia



Sources: World Bank, *World Development Indicators*, 2006; UNCTAD, *World Investment Report*, 2006; data for Taipei,China from Asian Development Bank Statistical Database System.

II. Cross-Country Analyses of Economic Growth

The general approach in this section is to extend existing work on cross-country analyses of economic growth to assess the effects of international trade and investment integration in detail. We employ an empirical framework that has been widely used in previous studies such as Barro and Lee (1994), Sachs and Warner (1995), and Barro and Sala-i-Martin (2003, chapter 12).

This model is based on an extended version of the neoclassical growth model. The model predicts "conditional convergence" of income, implying that an economy with lower initial income relative to its own long-run (or steady-state) potential level of income grows faster than a higher-income economy over time. In a cross-country context, convergence implies that poorer countries would grow faster than richer countries, when controlling for the variables influencing the steady-state level of per capita income.

The framework for determining the growth rate of real per capita GDP is indicated by the baseline regression, shown in column 1 of Table 2. As the general approach has been described elsewhere, we include here only a brief discussion.[3] Our regression applies to a panel dataset of 85 countries over seven five-year periods from 1970 to 2005. The panel is unbalanced with a total of 539 observations. Estimation is by three-stage least squares, using mostly lagged values of the independent variables as instruments (see Note to Table 3).[4]

The dependent variables are the five-year growth rates of real per capita GDP. We include in this analysis a representative set of the explanatory variables that have been used in previous work. We categorize these explanatory variables into seven broad dimensions: (1) initial per capita GDP; (2) investment; (3) initial human capital stock (schooling and initial life expectancy at birth); (4) fertility rate; (5) external environment (terms of trade, and balance-of-payments crises);[5] (6) institutions and policy variables (government consumption, quality of institutions, inflation, and democracy); and (7) openness (trade and direct investment). The definitions and sources of the variables are described in Note to Table 2.

A summary of the variables for 1970–75 and 2000–05 is presented in Table 2, grouped by four developing regions including East Asia, Latin America, Sub-Saharan Africa, and South Asia. The data indicate by and large that East Asian economies had more favorable conditions for rapid growth than the other regions, based on relatively

3. Our framework adopts empirical methodology and a representative set of the explanatory variables that have been widely used in previous works. See Barro and Sala-i-Martin (2003, chapter 12) and De Gregorio and Lee (2004).
4. The framework does not include country fixed effects, because this procedure tends to eliminate the bulk of the information in the data, that is, the cross-sectional variations of the panel. De Gregorio and Lee (2004) show that many explanatory variables including initial income, fertility, inflation, and openness turn out to have much stronger effects on growth in the first-difference specification of this panel framework.
5. A balance-of-payments crisis episode is defined from monthly data by combining two criteria: a nominal currency depreciation of at least 25 percent in any quarter of a specific year with the depreciation rate exceeding that of the previous quarter by a margin of at least 10 percent; and when an indicator of currency pressure—a weighted average of monthly nominal exchange depreciation and monthly foreign reserve loss—exceeds three standard deviations above the mean of the indicator over the sample period for each economy, provided that either the monthly nominal depreciation rate or percentage change of reserve loss is larger than 10 percent. A crisis that does not occur at least three years after the latest crisis is counted as a continuation of the initial crisis rather than an independent crisis.

Table 2 Summary of Key Variables by Region, 1970–75 and 2000–05 Periods (Unweighted Average)

	East Asia (*N* = 9)	Latin America (*N* = 21)	Sub-Saharan Africa (*N* = 18)	South Asia (*N* = 4)
1970–75				
Per capita GDP growth	0.052	0.025	0.017	0.008
Per capita GDP in 1970	3,074	4,664	1,554	1,290
Investment/GDP	0.228	0.150	0.151	0.106
Fertility rate in 1970	4.8	5.5	6.7	6.0
Schooling in 1970	3.96	3.36	1.31	2.14
Life expectancy in 1970	64.8	65.1	51.3	58.6
Government consumption	0.050	0.102	0.139	0.085
Rule-of-law index	0.611	0.381	0.357	0.292
Inflation	0.105	0.202	0.105	0.151
Democracy index	0.346	0.479	0.222	0.736
Terms of trade	0.003	–0.009	–0.047	–0.085
Balance-of-payments crisis	0.22	0.29	0.06	0.25
Trade openness	0.324	–0.147	–0.011	–0.106
FDI inflows/GDP	0.0179	0.0212	0.0125	0.0003
FDI outflows/GDP	0.0011	0.0009	0.0005	–0.0003
2000–05				
Per capita GDP growth	0.031	0.013	0.015	0.038
Per capita GDP in 2000	13,448	6,524	1,959	2,755
Investment/GDP	0.218	0.128	0.085	0.111
Fertility rate in 2000	2.0	3.0	5.5	3.2
Schooling in 2000	7.62	5.78	3.32	3.94
Life expectancy in 2000	4.3	4.2	3.8	4.2
Government consumption	0.095	0.139	0.156	0.187
Rule-of-law index	0.643	0.450	0.453	0.483
Inflation	0.025	0.083	0.127	0.054
Democracy index	0.570	0.741	0.493	0.560
Terms of trade	–0.018	0.002	–0.011	–0.039
Balance-of-payments crisis	0.00	0.33	0.33	0.00
Trade openness	1.049	–0.155	–0.115	0.016
FDI inflows/GDP	0.0462	0.0361	0.0261	0.0094
FDI outflows/GDP	0.0340	0.0087	0.0021	0.0008

Note: The sample consists of the 85 economies that are used in the regressions in Table 3. Per capita GDP levels and growth rates are based on 2000 international (purchasing power parity adjusted) prices, based on the Penn World Tables 6.2, as described in Heston, Summers, and Aten (2006).

Schooling data are the average years of schooling for the population aged 25 and above from Barro and Lee (2001). The investment ratio is the ratio of real investment (private plus public) to real GDP, based on the Penn World Tables 6.2, averaged over the period. The government consumption measure is the ratio of real government consumption (exclusive of spending on education and defense) to GDP, based on the Penn World Tables 6.2. The life expectancy at age 1 and the fertility rate are from the World Bank, *World Development Indicators*. The rule-of-law index, expressed on a zero-to-one scale, with one being the most favorable, is based on the *International Country Risk Guide*'s maintenance of the rule-of-law index. The inflation rate is the growth rate over each period of a consumer price index. The democracy index, expressed on a zero-to-one scale, with one being the most favorable, is based on the indicator of political rights compiled by Freedom House. The growth rate of the terms of trade is the change of export over import prices over the period. The balance-of-payments-crisis variable is described in Footnote 5. The trade openness variable is the ratio of exports plus imports to GDP, filtered for the estimated effects on this measure from the logs of population and area. The measure of FDI inflows or outflows is the average ratio of FDI inflows or outflows over the contemporaneous five-year period, sourced from UNCTAD, *World Investment Report*. The nine East Asian economies comprise China, Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taipei,China, and Thailand. South Asia comprises Bangladesh, India, Pakistan, and Sri Lanka.

higher levels of investment, human capital, quality of institutions, and openness, with lower levels of fertility, government consumption, and inflation. But average per capita growth for the nine East Asian economies slowed from 5.2 percent in 1970–75 to 3.1 percent in 2000–05. This slowdown can be seen as partly the outcome of success during the earlier period. East Asian economies have continuously narrowed their income gap from their long-run potential levels over time. Thus, according to the prediction of the convergence process, the economies with higher initial income can expect slower growth. In fact, East Asian economies grew more slowly than South Asian economies in 2000–05. The average per capita growth rate for the four South Asian economies jumped from 0.8 percent in 1970–75 to 3.8 percent in 2000–05, coinciding with a large improvement in the quality of institutions, control over inflation, and openness.

A. Basic Regression Results

Column 1 of Table 3 presents the regression results of basic specification. The first explanatory variable, the log of per capita GDP at the start of each period, reveals the

Table 3 Cross-Country Panel Regressions for Per Capita GDP Growth Rate

	(1)	(2)	(3)	(4)	(5)
Log (per capita GDP)	–0.0205** (0.0031)	–0.0226** (0.0033)	–0.0204** (0.0033)	–0.0201** (0.0032)	–0.0178** (0.0031)
Investment/GDP	0.0192 (0.0198)	0.0319 (0.0195)	0.0424** (0.0196)	0.0193 (0.0194)	0.0203 (0.0192)
Log (total fertility rate)	–0.0211** (0.0055)	–0.0257** (0.0058)	–0.0238** (0.0058)	–0.0217** (0.0056)	–0.0199** (0.0056)
Average years of schooling	0.0013 (0.0010)	0.0009 (0.0010)	0.0008 (0.0010)	0.0013 (0.0010)	0.0014 (0.0010)
Log (life expectancy)	0.0221 (0.0143)	0.0274* (0.0150)	0.0353** (0.0160)	0.0220 (0.0142)	0.0265* (0.0151)
Government consumption/ GDP	–0.0440* (0.0236)	–0.0495** (0.0236)	–0.0515** (0.0249)	–0.0442* (0.0234)	–0.0381 (0.0243)
Rule-of-law index	0.0151** (0.0069)	0.0177** (0.0071)	0.0168** (0.0075)	0.0156** (0.0069)	0.0131* (0.0072)
Inflation rate	–0.0195** (0.0091)	–0.0151* (0.0088)	–0.0165* (0.0088)	–0.0206** (0.0089)	–0.0256** (0.0088)
Democracy index	0.0390** (0.0177)	0.0497** (0.0177)	0.0495** (0.0185)	0.0423** (0.0175)	0.0413** (0.0178)
Democracy index squared	–0.0275 (0.0167)	–0.0393** (0.0165)	–0.0410** (0.0172)	–0.0308* (0.0165)	–0.0320* (0.0169)
Growth rate of terms of trade	0.0307 (0.0205)	0.0340 (0.0208)	0.0380* (0.0224)	0.0295 (0.0203)	0.0234 (0.0217)
Balance-of-payments crisis	–0.0119** (0.0048)	–0.0144** (0.0051)	–0.0123** (0.0051)	–0.0111** (0.0047)	–0.0087* (0.0045)
Trade openness	0.0075** (0.0037)	—	—	0.0058 (0.0046)	0.0071 (0.0046)
FDI inflows/GDP	—	0.0940 (0.0656)	—	0.0469 (0.0729)	0.1250 (0.0813)
FDI outflows/GDP	—	—	–0.0848 (0.0709)	—	–0.1993** (0.0717)
Number of economies	85	85	85	85	85
Number of observations	539	541	508	536	503

Table 3 (continued)

	(6)	(7)	(8)	(9)	(10)
Log (per capita GDP)	–0.0201** (0.0032)	–0.0227** (0.0032)	–0.0203** (0.0033)	–0.0206** (0.0031)	–0.0177** (0.0032)
Investment/GDP	0.0104 (0.6063)	0.0277 (0.0192)	0.0411** (0.0200)	0.0110 (0.0196)	0.0110 (0.0200)
Log (total fertility rate)	–0.0205** (0.0055)	–0.02525** (0.0057)	–0.0242** (0.0059)	–0.0212** (0.0056)	–0.0205** (0.0057)
Average years of schooling	0.0015 (0.0010)	0.0011 (0.0010)	0.0009 (0.0010)	0.0015 (0.0010)	0.0017* (0.0010)
Log (life expectancy)	0.0253* (0.0144)	0.0306** (0.0149)	0.0342** (0.0160)	0.0256* (0.0143)	0.0262* (0.0151)
Government consumption/ GDP	–0.0474** (0.0235)	–0.0568** (0.0233)	–0.0489* (0.0252)	–0.0512** (0.0233)	–0.0352 (0.0246)
Rule-of-law index	0.0128* (0.0070)	0.0176** (0.0070)	0.0169** (0.0075)	0.0142** (0.0069)	0.0130* (0.0072)
Inflation rate	–0.0146 (0.0090)	–0.0121 (0.0088)	–0.0172* (0.0090)	–0.0156* (0.0090)	–0.0240** (0.0090)
Democracy index	0.0349** (0.0177)	0.0493** (0.0175)	0.0505** (0.0187)	0.0405** (0.0174)	0.0422** (0.0180)
Democracy index squared	–0.0245 (0.0167)	–0.0397** (0.0163)	–0.0423** (0.0175)	–0.0303* (0.0164)	–0.0337** (0.0171)
Growth rate of terms of trade	0.0283 (0.0205)	0.0293 (0.0210)	0.0386* (0.0224)	0.0252 (0.0204)	0.0209 (0.0218)
Balance-of-payments crisis	–0.0111** (0.0049)	–0.0145** (0.0051)	–0.0128** (0.0051)	–0.0106** (0.0047)	–0.0088* (0.0046)
Trade openness *1970–89	0.0165** (0.0054)	—	—	0.0106 (0.0065)	0.0115 (0.0072)
Trade openness *1990–2005	0.0055 (0.0038)	—	—	0.0040 (0.0050)	0.0060 (0.0050)
FDI inflows/GDP *1970–89	—	0.2805** (0.1072)	—	0.1805 (0.1254)	0.1731 (0.1351)
FDI inflows/GDP *1990–2005	—	0.0251 (0.0739)	—	0.0292 (0.0865)	0.0837 (0.0981)
FDI outflows/GDP *1970–89	—	—	–0.1897 (0.2222)	—	–0.3484 (0.2183)
FDI outflows/GDP *1990–2005	—	—	–0.0868 (0.0709)	—	–0.1607** (0.0764)
Number of countries	85	85	85	85	85
Number of observations	539	541	508	536	503

Note: The system has seven equations, corresponding to the periods 1970–75, 1975–80, 1980–85, 1985–90, 1990–95, 1995–2000, and 2000–05. The dependent variables are the growth rates of per capita GDP. Data on GDP are from Penn World Tables 6.2.

The log of per capita GDP, the average years of male secondary and higher schooling, and the log of life expectancy at age 1 are measured at the beginning of each period. The ratios of government consumption and investment to GDP, the inflation rate, the total fertility rate, the growth rate of the terms of trade, the democracy index, the trade openness, FDI inflows, and FDI outflows are period averages. The rule-of-law index is the earliest value available (for 1982 or 1985) in the first equation and the period average for the other equations.

Estimation is by three-stage least squares. Instruments are the actual values of the variables for schooling, life expectancy, openness, and the terms of trade; dummy variables for Spanish or Portuguese colonies and other colonies (which have substantial explanatory power for inflation); lagged values of the log of per capita GDP, the government consumption ratio, and the investment ratio; and the initial values for each period of the rule-of-law index, democracy index, FDI inflows, and FDI outflows. In the first two equations, the rule-of-law indicator is for 1982 or 1985. The initial values of foreign reserve-import ratio are used as an instrument for balance-of-payments crisis. Individual constants (not shown) are included for each period. Standard errors of the coefficient estimates are shown in parentheses. ** and * indicate significant at the 5 percent and 10 percent level, respectively.

"conditional convergence" effect. The log of the total fertility rate is also significantly negative. The measures of initial human capital stock—average years of schooling and life expectancy—turn out to have positive effects on growth. However, the estimated coefficients are statistically insignificant. Also, the ratio of real investment to real GDP has a positive but statistically insignificant effect on growth, as indicated by the coefficient 0.0192 (s.e. = 0.0198). This reflects the fact that many of the explanatory variables included affect an economy's investment rate as well.

The regression results show that government policies and institutions play a significant role in determining economic growth. A subjective measure of the extent of maintenance of the rule of law is significantly positive. Higher inflation, an indicator of macroeconomic instability, is significantly negative for growth. The estimated coefficient implies that a rise in average inflation rate by 1 percentage point reduces growth by 0.02 percentage point a year. The ratio of government consumption (measured exclusively by outlays on education and defense) to GDP enters negatively, but the estimated coefficient is only marginally significant.

The regression results confirm the nonlinear relationship between democracy and growth, as found by Barro (1997). The coefficients on the indicator of democracy and its square terms are positive and negative, respectively, and both coefficients are jointly statistically significant. The pattern of coefficients indicates that the growth rate increases with political freedom at low levels of democracy, but decreases with democracy once the society has attained a certain level of political freedom.

A higher growth rate of the terms of trade (export prices relative to import prices) has a positive effect on growth, but the estimated coefficient is not statistically significant. A balance-of-payments crisis has a strong, negative effect on economic growth. The estimated coefficient on the balance-of-payments crisis variable, –0.0123 (0.0051), indicates that a balance-of-payments crisis shock lowers the growth rate by 1.2 percentage points per year.

In sum, the regression results in column 1 of Table 3 show that per capita GDP growth has strong relationships with initial per capita GDP level, investment, fertility, the quality of human resources, and economic policy and institutional factors, such as rule of law, government consumption, and macroeconomic stability.

Note that this "growth-regression" approach does not distinguish the role of factor accumulation from that of technological progress or total factor productivity (TFP) growth. Economic policy and institutional factors can affect both capital accumulation and technological progress. While East Asia's growth is largely attributed to factor accumulation rather than productivity growth (Young [1995] and Bosworth and Collins [2003]), the estimate of TFP, which is often called "index of our ignorance," is subject to many measurement errors. The distinction between capital and technology (productivity) in a "growth accounting" approach is often ambiguous.

B. Integration and Economic Growth

Now, we turn to the role of trade openness, which is our main focus. Column 1 of Table 3 includes a measure of trade integration, which is the ratio of exports plus imports to GDP, filtered for the estimated effects on this measure from the logs of population and area, as described in Barro and Sala-i-Martin (2003, chapter 12).

We recognize there are a large number of alternative measures of trade openness. For instance, Sachs and Warner (1995) construct a composite index on the basis of four policy dimensions: (1) average tariff rates; (2) extent of imports governed by quotas and licensing; (3) average export taxes; and (4) the size of the black market premium on the exchange rate. While the measures have some validity, they are also subject to many criticisms. Rodriguez and Rodrik (2000) claim that the indicators of openness frequently used in the literature are poor measures of trade policy and are highly correlated with other sources of growth, such as macroeconomic policies. Frankel and Romer (1999) suggest trade volume as instrumented by an economy's geographical attributes. However, geographical features can also affect economic growth through different channels such as institutional development and population growth (Acemoglu, Johnson, and Robinson [2002]).

In this paper, we do not delve into this controversy in detail, and will leave it to other recent papers—such as Wacziarg and Welch (2003) and Dollar and Kray (2004)—which provide comprehensive reviews of the facts and additional evidence on the effects of trade liberalization. In general, literature supports the positive effect of trade openness on growth through various channels such as larger markets, imports of capital and intermediate goods, and technological spillover. Trade openness is also considered to provide competitive pressures necessary to increase efficiency and productivity.

Column 1 of Table 3 shows that increased openness to international trade has a significantly positive effect on growth. The estimated coefficient, 0.0075 (0.0037), indicates that an economy with a higher level of trade openness by 10 percentage points of GDP during the entire 1970–2005 period grew 0.08 percentage point faster annually.

Table 2 shows that the East Asian economies were among the most open of all developing economies between 1970 and 2005. Following an initial stage of modest import substitution, most of the fast-growing Asian economies reduced import tariffs and export taxes, and lowered quantity restrictions on trade. This export-orientation strategy contributed significantly to the success of East Asian economies. For example, it accounted for faster growth of 0.6 percentage point per year, compared with Latin America's inward-oriented trade strategy over 1970–2005.[6]

Now we turn to the role of FDI in economic growth. It is often argued that FDI inflows contribute to an economy's external financing and technology spillover and thereby to economic growth. At the economy-wide level, recent empirical work generally finds a positive role of FDI in generating economic growth. De Gregorio (1992) shows that FDI has higher productivity than domestic investment in a cross-section of Latin American countries. For a boarder sample of economies, Blomstrom, Lipsey, and Zejan (1994) find FDI has a significant positive effect on growth. On the contrary, a recent study by Carkovic and Levine (2005) casts skepticism on the cross-country evidence for the positive effect of FDI on growth. Aggregate-level

6. This figure is derived by combining the gap between Latin America and East Asia in terms of openness (0.78) over the sample period and the estimated coefficient on trade openness (0.0075).

evidence on the relationship between FDI inflows and economic growth seems less conclusive.[7]

Column 2 of Table 3 shows the regression results from the cross-country regression with a measure of FDI inflows as an explanatory variable, a proxy for trade openness. The measure is the average ratio of FDI flows over the contemporaneous five-year period. FDI inflows have a positive effect on per capita GDP growth, but the coefficient, 0.0940 (s.e. = 0.0656), is not statistically significant at the 10 percent level. Note that in this specification the FDI inflow variable is instrumented by the lagged value of FDI, considering that FDI inflows are also influenced by output growth over the contemporaneous five-year period. In fact, if the own variable is used for the instrument, the FDI variable is statistically significant at 5 percent; the estimated coefficient is 0.131 (0.054).

In column 3, a measure of FDI outflows enters as an explanatory variable, replacing the FDI inflow variable. On one hand, FDI outflows are expected to lower domestic capital accumulation and thereby economic growth. Production links with low-productivity firms in less developed economies can retard technology progress. On the other hand, FDI outflows can contribute to economic growth by enhancing both the static and dynamic efficiency of an economy, which comes mainly from competition, specialization, and economies of scale accompanying the progress of international fragmentation of production.

The regression shows that FDI outflows have a negative effect on per capita GDP growth, but the estimated coefficient, –0.0848 (0.0709), is not statistically significant at the 10 percent level. In this regression, considering that FDI outflows and GDP growth over the contemporaneous five-year period are simultaneously correlated, the FDI outflow variable is instrumented by the own lagged value.[8]

Column 4 includes both trade openness and FDI inflows as explanatory variables. While trade and FDI inflow variables are all positive, they are statistically insignificant at the 5 percent level. The statistical insignificance of the trade openness variable in this specification may reflect a high correlation between trade and direct investment inflows. While neither trade nor FDI inflows are individually statistically significant, they are jointly marginally significant at the 10 percent level ($p = 0.103$).

Column 5 adds FDI outflows as an explanatory variable, together with trade openness and FDI inflows. While both trade openness and FDI inflow variables remain statistically insignificant, FDI outflows have a significantly negative effect on per capita GDP growth, –0.1993 (0.0717). The estimated coefficient indicates that, given trade volume and FDI inflows, an increase in FDI outflows by 1 percentage point of GDP is associated with a lower growth rate of 0.2 percentage point.

7. Another strand of literature shows that FDI inflows contribute to productivity growth in host economies that have an absorptive capacity for new technologies manifested in FDI. Borensztein, De Gregorio, and Lee (1998) and Xu (2000) find the importance of a minimum level of human capital stock as a means of domestic absorptive capacities for technology spillovers from FDI inflows. Durham (2004) and Alfaro *et al.* (2004) find that for a broader cross-section of economies, financial or institutional development in host economies also plays an important role as an absorptive capacity for FDI technology spillovers. This paper does not investigate this interactive effect, as we lack adequate measures of productivity growth or technology spillovers at the country-specific level.
8. When the own variable is used for the instrument, the FDI outflow variable is still statistically insignificant, –0.051 (0.065).

Columns 6 to 10 of Table 3 consider different slope coefficients for the integration variables for two subperiods, 1970–89 and 1990–2005.[9] Figure 2 shows that FDI flows surged to a larger volume in the early 1990s. In the 1970s and 1980s, capital flows into emerging markets primarily took the form of debt financing. Considering this pattern of capital flows, we attempt to find any discerning effect of FDI flows as well as trade openness on economic growth for the different periods.

The results in column 6 of Table 3 show that the strong positive effect of trade openness on GDP growth occurred mostly in the 1970s and 1980s, rather than later periods. The estimated coefficients are 0.0165 (0.0054) for the 1970–89 period and 0.0055 (0.0038) for 1990–2005. Similarly, in column 7, FDI inflows have a significantly positive effect on GDP growth in the 1970s and 1980s, but not afterward. The estimated coefficient on FDI inflows in 1970–89, 0.2805 (0.1072), implies, if viewed causally, that an increase of 1 percentage point in the FDI-to-GDP ratio per year led to an increase in the per capita GDP growth rate of about 0.28 percentage point per year. Hence, the gap between South Asia and East Asia in terms of FDI inflows, amounting to 1.8 percent of GDP per year in the 1970s and 1980s, implies that a smaller volume of FDI inflows reduced South Asia's growth rate by 0.5 percentage point relative to its East Asian neighbors.

In column 9, where different slope coefficients for both trade and FDI inflows are allowed, all the coefficients are positive and individually statistically insignificant at the 5 percent level.[10] But trade and FDI inflows for the 1970–89 period are jointly significant at the 1 percent level ($p = 0.004$), whereas trade and FDI inflow variables for the 1990–2005 period are jointly insignificant ($p = 0.379$).

The joint significance of trade and FDI inflows in the 1970s and 1980s is also proved in column 10, where the FDI outflow variable is added. While trade and FDI inflow variables for the 1970s and 1980s are individually statistically insignificant, they are still jointly significant at the 1 percent level ($p = 0.004$). In this framework, trade and FDI inflow variables for the 1990–2005 period are jointly marginally significant at the 10 percent level ($p = 0.091$).

These findings indicate that the positive effects of trade and investment integration on GDP were more significant during the 1970s and 1980s, but economies also benefited from deeper international integration during the 1990s and afterward.

Column 9 shows that FDI outflows have negative effects on GDP growth, both in the 1970–89 and 1990–2005 periods, but the estimated coefficients are individually and jointly statistically insignificant. But the strong negative effect of FDI outflows in the 1990–2005 period appears in column 10, where trade and FDI inflow variables are included together. The estimated coefficient, −0.3484 (0.2183), implies that, given trade volume and FDI inflows, an increase in FDI outflows by 1 percentage point of GDP is associated with a lower growth rate of 0.16 percentage point.

9. We have also adopted specifications by assuming different slope coefficients for the integration variables for each decade: the 1970s, 1980s, 1990s, and 2000–05. The regression results, which are qualitatively similar to those presented below, are available from the authors upon request. See also Footnote 10.

10. When slope coefficients are allowed to differ by decade, the estimated coefficients for trade openness in the 1980s and FDI inflows in the 1970s are both positive and individually statistically significant, while the others are statistically insignificant.

III. Micro-Data Analyses of Economic Growth

The findings from cross-country analyses in the previous section have confirmed the significantly positive contribution of trade and investment integration on economic growth in East Asia, particularly during the 1970s and the 1980s. With a focused use of plant-, firm-, and industry-level micro data from Korea, this section aims to shed more light on links between integration and growth in the 1990s and afterward.

A. Impact of Trade and FDI on Growth: Evidence from Micro-Level Data

A growing number of empirical studies using longitudinal micro data confirm that firm dynamics (entry and exit, growth, and decline of individual firms) is an important component of innovation and of aggregate productivity growth. However, empirical studies based on longitudinal micro data in East Asia are still rare, mainly due to the lack of readily available data.

Aw, Chung, and Roberts (2000) examine and compare links between productivity and turnover in the export market using the longitudinal firm-level data from Taipei,China and Korean manufacturing censuses. They find that exporting producers tend to have higher productivity. Their analysis reveals that evidence from Korean firm data is consistent with the "learning-by-exporting" hypothesis, whereas data from Taipei,China show that firms with high productivity self-select to enter export markets.

While Aw, Chung, and Roberts (2000) focused on the "five-yearly" census data, the Korea National Statistical Office compiles plant-level data "annually" covering all plants with five or more employees. Taking advantage of this higher-frequency data, and using the methods of Bernard and Jensen (1999a, b), Hahn (2005) detects evidence of self-selection and (short-lived) "learning-by-exporting" effects in the relation between exporting and plant-level productivity in Korea.

The findings in Hahn (2005) from the Korean data are in fact qualitatively similar to those of Bernard and Jensen (1999a, b) from U.S. data in the following respects: (1) significant and positive contemporaneous correlations are observed between levels of exports and productivity; (2) while exporting plants have substantially higher productivity levels and bigger size than non-exporting plants, evidence is weak that exporting increases plant productivity growth rates; and (3) new exporters grow faster around the time when they enter the export market.

A number of studies also investigate the impact of trade liberalization on productivity growth. The best-known links between import and productivity are based on increased competition, allocative efficiency, and technology spillovers. By and large, the literature supports the positive link between import and productivity growth in firm- or industry-level data, but the existing empirical evidence from micro data is still limited for East Asian economies.

The extent and the channels that international trade can contribute to technology spillovers and to productivity growth vary from industry to industry, and also from economy to economy, depending on the economic and technological environment. For example, gain from trade of the United States with China must have little productivity spillover, while exporting cars from Korea to the United States seems far more likely to generate technological learning.

FDI is of growing importance in the internationalization of East Asian firms. Intra-regional trade in East Asia has been increasing with the main engine of this trend being outsourcing and the international fragmentation of production (Ahn, Fukao, and Ito [2007]). The expansion of parts and components trade and processed intermediate goods trade accounts for 65 percent of the total increase of intra-regional trade from 1990 to 2003.

More than half of the expansion of intra-regional trade owes to the growth in trade in electrical and general machinery. The share of the electrical and general machinery industry in total intra-regional trade increased from 28 percent in 1990 to 46 percent in 2003. Intra-regional trade in parts and components increased about sixfold between 1990 and 2003. The growth of intra-regional trade in parts and components is closely related with the expansion of intra-regional trade in electrical and general machinery. In 2003, 90 percent of total intra-regional trade in parts and components consisted of electrical and general machinery (Ahn, Fukao, and Ito [2007]).

Many Japanese and Korean firms—especially those in leading export industries such as electronics and transportation equipment—are rapidly relocating some segments of their production lines and establishing new export bases in the Chinese and other East Asian economies. Compared with Japan, Korea experienced even more rapid progress in outsourcing to East Asian economies, especially China. According to Table 4—based on Chinese statistics on investment flows and cumulative inward investment amounts in all industries—Korea and Japan have been the top two investors in China in recent years in terms of investment amounts—if Hong Kong and the British Virgin Islands are excluded.

While it is often argued that FDI inflows are closely related to technology spillovers from foreign advanced firms to domestic producers, existing theoretical models and empirical evidence of outbound FDI do not offer a clear answer on the impact of outbound FDI in terms of productivity growth of domestic producers. Helpman, Melitz, and Yeaple (2004) build a multi-economy, multi-sector general equilibrium model to explain the decision of heterogeneous firms on whether to serve overseas markets through exports or through "horizontal FDI." A basic idea of the model is that FDI involves higher sunk costs but lower per unit costs than exporting does in serving the overseas market. The model predicts that only the more productive firms will choose to serve foreign markets and that the most productive firms among them will further choose FDI to serve the overseas market.[11]

According to the model of "horizontal FDI," it is expected that high-productivity producers would self-select themselves, overcoming the first hurdle of exporting and the second (more challenging) hurdle of "horizontal FDI." In this case, however, the direction of causation is not from FDI to productivity, but from productivity to FDI. Productivity implications of the "vertical FDI" are even more complicated. Taking advantage of international differences in factor prices by international fragmentation of production would probably help improve multinational firms' profitability. But it is

11. The model predicts that the greater the heterogeneity of firms' productivity, the greater FDI sales will be relative to export sales. These predictions are strongly supported by data on U.S. exports and sales of overseas U.S. affiliates. Head and Ries (2003) also find from Japanese firm data that firms using both FDI and exports to serve foreign markets are more productive than firms that only export.

Table 4 Inward FDI into China, by Source Economy

[1] Number of Inward FDI Projects and Amount of Investment

US$10,000

	Number of projects		Amount of investments fulfilled	
	2003	2004	2003	2004
World total	41,081 (100.0)	43,664 (100.0)	5,350,467 (100.0)	6,062,998 (100.0)
Hong Kong	13,633 (33.2)	14,719 (33.7)	1,770,010 (33.1)	1,899,830 (31.3)
Japan	3,254 (7.9)	3,454 (7.9)	505,419 (9.4)	545,157 (9.0)
Taipei,China	4,495 (10.9)	4,002 (9.2)	337,724 (6.3)	311,749 (5.1)
Macao	580 (1.4)	715 (1.6)	41,660 (0.8)	54,639 (0.9)
Korea	4,920 (12.0)	5,625 (12.9)	448,854 (8.4)	624,786 (10.3)
United States	4,060 (9.9)	3,925 (9.0)	419,851 (7.8)	394,095 (6.5)
Canada	901 (2.2)	995 (2.3)	56,351 (1.1)	61,387 (1.0)
Europe	2,074 (5.0)	2,423 (5.5)	393,031 (7.3)	423,904 (7.0)
Germany	451 (1.1)	608 (1.4)	85,697 (1.6)	105,848 (1.7)
France	269 (0.7)	289 (0.7)	60,431 (1.1)	65,674 (1.1)
Italy	297 (0.7)	358 (0.8)	31,670 (0.6)	28,082 (0.5)
Netherlands	189 (0.5)	199 (0.5)	72,549 (1.4)	81,056 (1.3)
United Kingdom	438 (1.1)	488 (1.1)	74,247 (1.4)	79,282 (1.3)
ASEAN-5	2,128 (5.2)	2,156 (4.9)	285,309 (5.3)	290,962 (4.8)
Singapore	1,144 (2.8)	1,279 (2.9)	205,840 (3.8)	200,814 (3.3)
Indonesia	143 (0.3)	122 (0.3)	15,013 (0.3)	10,452 (0.2)
Malaysia	350 (0.9)	352 (0.8)	25,103 (0.5)	38,504 (0.6)
Philippines	297 (0.7)	241 (0.6)	22,001 (0.4)	23,324 (0.4)
Thailand	194 (0.5)	162 (0.4)	17,352 (0.3)	17,868 (0.3)
Others	5,036 (12.3)	5,650 (12.9)	1,092,258 (20.4)	1,456,489 (24.0)
British Virgin Islands	2,218 (5.4)	2,641 (6.0)	577,696 (10.8)	673,030 (11.1)

[2] Cumulative Number and Amount of Investment of Inward FDI Projects

US$10,000

	Number of projects		Amount of investments fulfilled	
	Up to 2003	Up to 2004	Up to 2003	Up to 2004
World total	465,277 (100.0)	508,941 (100.0)	5,015 (100.0)	5,612 (100.0)
Hong Kong	224,509 (48.3)	239,228 (47.0)	2,226 (44.4)	2,416 (43.0)
Japan	28,401 (6.1)	31,855 (6.3)	414 (8.3)	468 (8.3)
Taipei,China	60,186 (12.9)	64,188 (12.6)	365 (7.3)	396 (7.1)
Macao	8,407 (1.8)	9,122 (1.8)	52 (1.0)	57 (1.0)
Korea	27,128 (5.8)	32,753 (6.4)	197 (3.9)	259 (4.6)
United States	41,340 (8.9)	45,265 (8.9)	441 (8.8)	480 (8.6)
Canada	6,941 (1.5)	7,936 (1.6)	39 (0.8)	45 (0.8)
Europe	16,158 (3.5)	18,581 (3.7)	379 (7.6)	421 (7.5)
Germany	3,504 (0.8)	4,112 (0.8)	89 (1.8)	99 (1.8)
France	2,302 (0.5)	2,591 (0.5)	61 (1.2)	68 (1.2)
Italy	2,137 (0.5)	2,495 (0.5)	25 (0.5)	28 (0.5)
Netherlands	1,254 (0.3)	1,453 (0.3)	51 (1.0)	59 (1.0)
United Kingdom	3,856 (0.8)	4,344 (0.9)	114 (2.3)	122 (2.2)
ASEAN-5	21,158 (4.5)	23,314 (4.6)	321 (6.4)	350 (6.2)
Singapore	11,871 (2.6)	13,150 (2.6)	235 (4.7)	255 (4.6)
Indonesia	1,079 (0.2)	1,201 (0.2)	13 (0.3)	14 (0.2)
Malaysia	2,888 (0.6)	3,240 (0.6)	31 (0.6)	35 (0.6)
Philippines	1,945 (0.4)	2,186 (0.4)	16 (0.3)	19 (0.3)
Thailand	3,375 (0.7)	3,537 (0.7)	25 (0.5)	27 (0.5)
Others	31,049 (6.7)	36,699 (7.2)	582 (11.6)	718 (12.8)
British Virgin Islands	8,877 (1.9)	11,518 (2.3)	302 (6.0)	369 (6.6)

Note: Figures in parentheses indicate shares in world total in percent.

Source: Chinese Ministry of Commerce (2004, 2005).

unclear whether such gains in profitability for multinational firms would necessarily mean productivity gains in the home economy. All in all, links between outbound FDI and domestic productivity growth remain a subject for empirical investigation.

B. Empirical Specification and Data

We investigate the impact of integration (trade and/or FDI) on productivity growth using regression equations for the growth in labor productivity (value added per worker) and for TFP growth:

$$\ln Y_{i,t+3} - \ln Y_{i,t} = \beta_0 + \beta_{Plant} X_{i,t} + \beta_{Industry} Z_{j,t} + \beta_{Dt} D_t + u_i + \epsilon_{i,t},$$

where the left-hand-side variable is the subsequent three-year growth rate of value added per worker (or TFP) at plant (firm) i from year t to year $(t + 3)$ and the following right-hand-side variables:

- $X_{i,t}$: A vector of plant-specific variables for plant (firm) i in year t, which includes the initial levels of the dependent variable (either value added per worker or TFP), the capital-labor ratio, research and development intensity measured as R&D expenditure divided by sales, the export-sales ratio, and the number of workers.
- $Z_{j,t}$: A vector of industry-specific variables for industry j to which plant i belongs in year t, including the industry-level capital-labor ratio, R&D intensity, export intensity, and the growth rates of inbound/outbound FDI and trade (exports plus imports). Moreover, to examine the impact of FDI to—or trade with—major partners, we include the industry-level share of each destination or partner: the shares of FDI to China, the United States, Japan, and Korea, and the shares of trade with China, the United States, Japan, and Korea.
- D_t: A vector of year dummy variables.
- u_i: Plant-specific fixed effects.

Plant-level TFP is estimated by the chained-multilateral index number approach. This uses a separate reference point for each cross-section of observations and then chain-links the reference points together over time, as in the Törnqvist-Theil index. The output, input, and productivity level of each plant in each year is measured relative to the hypothetical plant at the base-time period. This approach allows us to make transitive comparisons of productivity levels among observations in a panel dataset. The productivity index for plant i at time t is measured as follows:

$$\ln TFP_{it} = (\ln Y_{it} - \overline{\ln Y_t}) + \sum_{\tau=2}^{t} (\overline{\ln Y_\tau} - \overline{\ln Y_{\tau-1}}) - \left\{ \sum_{n=1}^{N} \frac{1}{2}(S_{nit} + \overline{S_{nt}})(\ln X_{nit} - \overline{\ln X_{nt}}) \right.$$

$$\left. + \sum_{\tau=2}^{t} \sum_{n=1}^{N} \frac{1}{2}(\overline{S_{n\tau}} + \overline{S_{n\tau-1}})(\overline{\ln X_{n\tau}} - \overline{\ln X_{n\tau-1}}) \right\},$$

where Y, X, S, and TFP denote output, input, the input share, and the TFP level, respectively, and symbols with an upper bar are the corresponding measures for the hypothetical firms. The subscripts t and n are indexes for time and inputs, respectively.

For the regression analyses, we constructed a plant- and industry-level dataset for the Korean manufacturing sector covering the period from 1990 to 2003. This dataset is based on four major sources of information: *Annual Report on Mining and Manufacturing Survey* (Korean National Statistical Office); *UN Commodity Trade Statistics Database* (United Nations Statistics Division); *Overseas Direct Investment Statistics Yearbook* (Export-Import Bank of Korea); and *Foreign Direct Investment Survey* (Ministry of Commerce, Industry, and Energy).

Annual Report on Mining and Manufacturing Survey is conducted annually by the Korean National Statistical Office. The survey covers all plants with five or more employees in the mining and manufacturing industries and contains plant-level information on output, input, and a variety of additional items, including the five-digit Korean Standard Industry Classification (KSIC) code assigned to each plant based on its major product. Variables such as plant-level employment growth, the capital-labor ratio, the ratio of nonproduction to production workers, labor productivity, and TFP were calculated at the plant level based on the information from this survey.

UN Commodity Trade Statistics Database (UN Comtrade) is compiled by the UN Statistics Division and contains annual amounts of imports, exports, and re-exports in U.S. dollars by commodity and by trading partner. Commodities are classified according to the Standard International Trade Classification (SITC) (Revision 1 from 1962, Revision 2 from 1976, and Revision 3 from 1988) and the Harmonized System (HS) (from 1988 with revisions in 1996 and 2002). Imports from and exports to Korea's major trading partners by commodity based on SITC Revision 3 and on the HS system from 1990 to 2003 are downloaded from the UN Comtrade website (http://comtrade.un.org/).

Overseas Direct Investment Statistics Yearbook is published by the Export-Import Bank of Korea, an official export credit agency providing comprehensive credit and guarantees for trade and overseas investment. The yearbook reports the flows and stock of outbound foreign direct investment by industry and by destination. The Export-Import Bank has its own code for industry classification (the EXIM code), which by and large is comparable to the three-digit KSIC code. For example, the manufacturing sector as a whole consists of 71 industries according to the three-digit KSIC code and of 70 industries according to the EXIM code. Information on annual FDI flows and stocks disaggregated by the EXIM code and by destination was downloaded from the Export-Import Bank of Korea's website (http://www.koreaexim.go.kr/en/).

The Ministry of Commerce, Industry, and Energy reports quarterly and annual FDI inflow data by industry, region, investment type, and investment size. In this dataset, which covers the period 1991–2005, the manufacturing sector consists of 11 sub-sectors.

While the manufacturing survey contains plant-level information, the trade and FDI databases do not provide plant-level information. Therefore, to merge these four different sources, we can link the data only at a certain level of industry-wide aggregation. As the basic industry classification for our analysis, we use the 78-sector classification of the National Accounting Standards, where the manufacturing sector consists of 34 sub-sectors. Summary statistics for key variables used in the regression analyses are in Table 5.

C. Regression Results

Applying a fixed-effect panel regression method, we estimate the regression equations for the plant-level labor productivity growth and for the TFP growth. Tables 6 and 7 summarize the fixed-effect panel estimation results for labor productivity growth and for TFP growth, respectively. They strongly suggest that economic integration such as inbound FDI, outbound FDI, and trade contributes to the productivity growth in one way or another. For both Tables 6 and 7, columns 1 and 2 show regression results without including the growth rate of industry-level FDI inflows, while columns 3 and 4 are the results when the growth rate of industry-level FDI inflows is included as an explanatory variable.

We first look at the regression results for growth in labor productivity (value added per worker), which is conceptually similar to the per capita GDP growth in the previous section. The first explanatory variable in Table 6, the log of value added per worker at the start of each three-year period, captures the "conditional convergence" effect. The second explanatory variable (the ratio of nonproduction workers to production workers) can be interpreted as a proxy for the skill intensity or education intensity of each plant, in the sense that nonproduction workers tend to be more skilled or more educated. The next four variables (capital-to-labor ratio, R&D intensity, export intensity, and the log of employment size) are all plant-level variables. Table 6 shows that a plant with (1) a higher share of nonproduction workers,

Table 5 Summary of Key Variables for the Plant-Level Data Analyses

Variable	Mean	Standard deviation	Min	Max
ln*(LP)*$_{i,t}$	3.30390	0.73301	–0.97433	8.78669
ln*(TFP)*$_{i,t}$	0.00618	0.67907	–3.19537	4.10403
(Non-production worker share)$_{i,t}$	0.38733	0.80939	0	193.40000
(Capital-labor ratio)$_{i,t}$	30.46873	85.28126	0.00358	22,995.80000
(R&D intensity)$_{i,t}$	0.00702	0.22608	0	131.22330
(Export-sales ratio)$_{i,t}$	0.06603	0.24527	0	88.23529
ln*(Number of workers)*$_{i,t}$	2.88361	1.02232	0.69315	10.42088
(Non-production worker share)$_{j,t}$	0.38250	0.15375	0.12528	1.04929
(Capital-labor ratio)$_{j,t}$	50.91503	51.65717	4.89101	831.67880
(R&D intensity)$_{j,t}$	0.00966	0.01038	0	0.08460
(Export intensity)$_{j,t}$	0.19718	0.15654	0	0.77480
(Import penetration ratio)$_{j,t}$	0.22329	0.26044	0.00023	6.39863
(Preceding inbound FDI growth)$_{j,t}$	0.94408	0.60230	0.08200	2.68300
(Preceding outbound FDI growth)$_{j,t}$	0.65006	7.48124	–1.60808	227.14290
(FDI to China share)$_{j,t}$	0.27726	0.26148	0	3.22876
(FDI to Japan share)$_{j,t}$	0.00394	0.02706	0	0.46643
(FDI to U.S. share)$_{j,t}$	0.16696	0.22482	0	1.09776
(Preceding trade growth rate)$_{j,t}$	0.09816	0.80948	–0.96803	112.18260
(Trade with China share)$_{j,t}$	0.07030	0.06342	0	0.67365
(Trade with Japan share)$_{j,t}$	0.20699	0.13059	0	0.73918
(Trade with U.S. share)$_{j,t}$	0.19870	0.12160	0	0.82800

Note: *i*: plant-level; *j*: industry-level; *t*: 1994–2003.

(2) a higher capital-labor ratio, (3) a greater export orientation, and (4) a larger size at the start of each three-year period tends to have faster labor productivity growth during the three-year period. On the other hand, the coefficients for the plant-level R&D intensity were positive but insignificant.

Table 6 Plant-Level Fixed Effect Panel Regressions (Labor Productivity Growth)

	(1)	(2)	(3)	(4)
ln$(LP)_{i,t}$	–0.34226*** (0.00068)	–0.34223*** (0.00068)	–0.34611*** (0.00072)	–0.34597*** (0.00073)
(Non-production worker share)$_{i,t}$	0.00123** (0.00054)	0.00124** (0.00054)	0.00094* (0.00053)	0.00095* (0.00054)
(Capital-labor ratio)$_{i,t}$	0.00002** (0.00001)	0.00002** (0.00001)	0.00001** (0.00001)	0.00001** (0.00001)
(R&D intensity)$_{i,t}$	0.00044 (0.00052)	0.00047 (0.00052)	0.00039 (0.00049)	0.00043 (0.00049)
(Export intensity)$_{i,t}$	0.00300** (0.00126)	0.00298** (0.00126)	0.00192* (0.00115)	0.00189 (0.00115)
ln*(Number of workers)*$_{i,t}$	0.02272*** (0.00096)	0.02247*** (0.00096)	0.02135*** (0.00103)	0.02105*** (0.00103)
(Non-production worker share)$_{j,t}$	–0.02888*** (0.00548)	–0.03426*** (0.00561)	–0.05689*** (0.00572)	–0.05819*** (0.00585)
(Capital-labor ratio)$_{j,t}$	0.00014*** (0.00001)	0.00014*** (0.00001)	0.00012*** (0.00001)	0.00012*** (0.00001)
(R&D intensity)$_{j,t}$	0.35607*** (0.04735)	0.23745*** (0.04799)	0.44618*** (0.04973)	0.33289*** (0.05063)
(Export intensity)$_{j,t}$	–0.00175 (0.00417)	0.00503 (0.00435)	–0.02556*** (0.00452)	–0.01598*** (0.00470)
(Import penetration ratio)$_{j,t}$	–0.00006 (0.00203)	0.00046 (0.00203)	0.00075 (0.00213)	0.00115 (0.00213)
(Preceding inbound FDI growth rate)$_{j,t}$			0.01067*** (0.00074)	0.01045*** (0.00075)
(Preceding outbound FDI growth rate)$_{j,t}$	0.00001 (0.00016)	–0.00014 (0.00016)	0.00082*** (0.00018)	0.00086*** (0.00018)
(FDI to China share)$_{j,t}$		–0.01342*** (0.00187)		–0.00537*** (0.00198)
(FDI to Japan share)$_{j,t}$		0.43269*** (0.03965)		0.41530*** (0.04264)
(FDI to U.S. share)$_{j,t}$		0.00691*** (0.00196)		0.01335*** (0.00212)
(Preceding trade growth rate)$_{j,t}$	0.00108** (0.00044)	0.00112** (0.00044)	0.00066 (0.00051)	0.00100* (0.00052)
(Trade with China share)$_{j,t}$		–0.01862** (0.00823)		0.01377 (0.00945)
(Trade with Japan share)$_{j,t}$		0.01721*** (0.00460)		0.02380*** (0.00491)
(Trade with U.S. share)$_{j,t}$		0.01432*** (0.00544)		0.00071 (0.00595)
Intercept	1.06119*** (0.00449)	1.05428*** (0.00512)	1.10687*** (0.00486)	1.09825*** (0.00552)
Number of observations	422,343	422,343	365,264	365,264
F-value	12,460.8	9,821.8	11,080.4	8,734.7
R^2	0.5662	0.5667	0.5747	0.5751

Note: *i*: plant-level; *j*: industry-level. Heteroskedasticity-robust standard errors are in parentheses.
***, **, and * indicate significant at the 1 percent, 5 percent, and 10 percent level, respectively.

Table 7 Plant-Level Fixed Effect Panel Regressions (TFP Growth)

	(1)	(2)	(3)	(4)
ln*(TFP)*$_{i,t}$	–0.35299*** (0.00084)	–0.35291*** (0.00084)	–0.35673*** (0.00090)	–0.35663*** (0.00090)
(Non-production worker share)$_{i,t}$	0.00016 (0.00068)	0.00018 (0.00068)	0.00027 (0.00073)	0.00028 (0.00073)
(Capital-labor ratio)$_{i,t}$	0.00000 (0.00001)	0.00000 (0.00001)	0.00000 (0.00001)	0.00000 (0.00001)
(R&D intensity)$_{i,t}$	–0.00431 (0.00652)	–0.00397 (0.00651)	–0.00589 (0.00673)	–0.00565 (0.00671)
(Export intensity)$_{i,t}$	0.00633*** (0.00164)	0.00618*** (0.00161)	0.00540*** (0.00147)	0.00528*** (0.00145)
ln*(Number of workers)*$_{i,t}$	0.00535*** (0.00121)	0.00508*** (0.00121)	0.00388*** (0.00130)	0.00354*** (0.00130)
(Non-production worker share)$_{j,t}$	–0.04259*** (0.00750)	–0.04267*** (0.00764)	–0.06878*** (0.00786)	–0.06652*** (0.00799)
(Capital-labor ratio)$_{j,t}$	0.00014*** (0.00002)	0.00015*** (0.00002)	0.00013*** (0.00002)	0.00014*** (0.00002)
(R&D intensity)$_{j,t}$	0.16421*** (0.06291)	0.09668 (0.06360)	0.29959*** (0.06637)	0.23200*** (0.06737)
(Export intensity)$_{j,t}$	–0.00280 (0.00568)	0.00432 (0.00594)	–0.02594*** (0.00617)	–0.01644*** (0.00642)
(Import penetration ratio)$_{j,t}$	–0.00030 (0.00270)	0.00030 (0.00270)	–0.00051 (0.00290)	–0.00020 (0.00291)
(Preceding inbound FDI growth rate)$_{j,t}$			0.00999*** (0.00094)	0.00951*** (0.00095)
(Preceding outbound FDI growth rate)$_{j,t}$	0.00003 (0.00019)	–0.00009 (0.00019)	0.00087*** (0.00023)	0.00087*** (0.00023)
(FDI to China share)$_{j,t}$		–0.00665*** (0.00218)		–0.00009 (0.00230)
(FDI to Japan share)$_{j,t}$		0.15543*** (0.05346)		0.14406** (0.05739)
(FDI to U.S. share)$_{j,t}$		0.01282*** (0.00263)		0.01873*** (0.00285)
(Preceding trade growth rate)$_{j,t}$	0.00163*** (0.00054)	0.00172*** (0.00054)	0.00057 (0.00069)	0.00086 (0.00071)
(Trade with China share)$_{j,t}$		–0.00622 (0.01058)		0.01313 (0.01230)
(Trade with Japan share)$_{j,t}$		0.01947*** (0.00623)		0.02198*** (0.00672)
(Trade with U.S. share)$_{j,t}$		0.03667*** (0.00732)		0.02446*** (0.00805)
Intercept	–0.00523 (0.00507)	–0.02127*** (0.00602)	0.07270*** (0.00535)	0.05665*** (0.00650)
Number of observations	331,388	331,388	286,819	286,819
F-value	8,847.8	6,964.1	7,830.2	6,164.5
R^2	0.5244	0.5246	0.5301	0.5303

Note: *i*: plant-level; *j*: industry-level. Heteroskedasticity-robust standard errors are in parentheses.
***, **, and * indicate significant at the 1 percent, 5 percent, and 10 percent level, respectively.

Now we turn to the industry-level variables as determinants of plant-level productivity growth. Coefficients for the industry-level capital intensity and for the industry-level R&D intensity are almost always significantly positive, while coefficients for the industry-level nonproduction workers' ratio and export intensity tend to be significantly negative. At face value, these results suggest that investment in physical capital and in R&D activities tends to have industry-wide spillover effects. The fact that the industry-level skill intensity or the industry-level export intensity show negative effects on individual plants' productivity growth seems to reflect adversarial effects from intensified competition. The import-penetration ratio had insignificant effects on plant-level productivity growth.

As a comparison of Tables 6 and 7 reveals, the basic conclusion on the industry-level determinants of plant-level productivity growth holds true both for labor productivity growth and for TFP growth. Similarly, the size of a plant or the export intensity of a plant tends to be positively correlated with productivity growth (both for labor productivity and TFP). In contrast, the positive effects of plant-level skill intensity and of R&D intensity seem to be limited only to labor productivity growth.

We have now finally returned to the main issues of this section, that is, links between integration and productivity growth. First, both Tables 6 and 7 confirm that plants in an industry that experienced a higher growth rate of FDI inflows over the previous three years tend to have significantly faster productivity growth over the following three-year period. Both Tables 6 and 7 also reveal that industry-level FDI outflows and industry-level trade also have positive spillover effects on individual plants' productivity growth in one way or another. According to the regression results, a positive contribution of outbound FDI growth is clearly observed when inbound FDI growth is taken into account (columns 3 and 4). In contrast, the positive contribution of trade growth on productivity growth is shown more clearly when FDI inflow growth is not included as an explanatory variable (columns 1 and 2).

Regression results so far indicate that an increased degree of international integration at the industry level tends to be followed by faster productivity growth at the plant level. Columns 2 and 4 of Tables 6 and 7 reveal that not only the degree of international integration but also the composition of the integration matter. Regression results of columns 2 and 4 suggest that increased integration with more advanced economies could have even larger benefits in terms of domestic producers' productivity growth.

IV. Concluding Remarks

The successful performance of East Asian economies over the last four decades is broadly attributed to favorable conditions—such as relatively higher levels of investment, human capital, and quality of institutions, and lower levels of fertility, government consumption, and inflation. In addition, international openness is crucial to East Asia's rapid economic growth. The process of fast income growth achieved in East Asian economies has occurred with rapid growth in trade and direct investment flows.

This paper shows there is a positive relationship between international integration and long-term growth both at aggregate economy and micro-firm levels. The cross-country regression highlights that trade openness and FDI inflows have a significantly positive impact on income growth. Micro-level evidence also confirms the positive role of global integration through trade and direct investment in productivity growth. The estimation based on Korean manufacturing data strongly suggests that global integration through inbound FDI, outbound FDI, and trade contributes to the plant-level labor productivity growth and the TFP growth.

Our empirical findings suggest that the relationship between trade openness and foreign FDI inflows and GDP growth was not strong in the 1990s and afterward, compared with 1970–89. We also find FDI outflows have a negative effect on GDP growth at the aggregate economy level. Micro data analysis reveals further evidence that the impact of outbound FDI depends on the destination of FDI.

While deeper trade and investment integration process continues to be beneficial to Asian economies, it seems that a certain change has occurred in the mechanism by which international integration influences income growth. The impact of global integration on productivity growth depends on the nature of trade and production links between economies. Considering the economic emergence of China and India in the region, it is important for emerging Asian economies to expand linkages to these economies to maximize the benefits accrued from integration.

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Comment

PAUL BLOXHAM[12]
Reserve Bank of Australia

I. Introduction

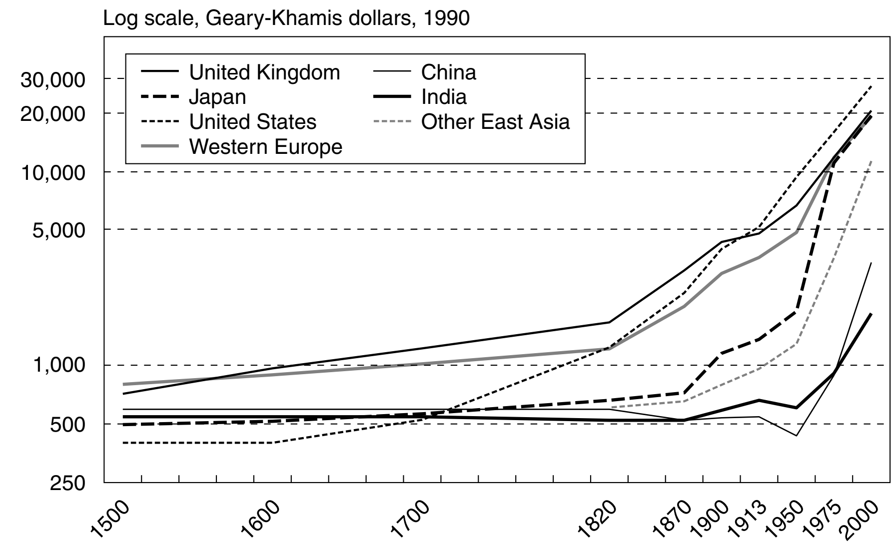
Economic growth is important. It improves the living standards of individuals, lifts people from poverty, and boosts revenue for governments, among many other things.

12. This comment refers to the version of the authors' paper presented at the conference on May 30, 2007, and has not been updated for any subsequent revisions to the paper.

As such, maximizing sustainable growth is a goal of most governments. Despite criticisms, the neoclassical growth model is the most enduring model to explain economic growth. More recent, new growth theories, have also added to the way we think about economic growth. Lucas (2000) showed that a basic model that allows for spillovers between countries can broadly fit the data, with the notion of convergence the result. And one may ask what more fitting example is there to apply these models than to the recent economic growth performance of the East Asian economies? Empirically, catch-up has clearly been a major factor in the exceptional growth performance of the East Asian economies over recent decades. Taking a very long-run view, using Angus Maddison's dataset (Maddison [2007]), it is quite clear that the East Asian economies have been catching up on the technological leaders in the second half of the last century, and as we know, this general trend continues (Figure 1).

While the basic model seems to fit the facts well, the underlying causes of growth are much more difficult to identify. The empirical literature using cross-country regressions continues to advance, but the challenge of identifying unbiased estimators is formidable. A number of problems typically plague these types of models, such as simultaneity (are we properly identifying cause and effect?), measurement issues, multicollinearity, and the degrees of freedom problem (that is, there are fewer data points than plausible hypotheses?). To address these criticisms, more sophisticated econometric techniques are employed and econometricians have been turning to large micro datasets. Unfortunately, the econometric techniques used, such as three stage least squares, still rely on good

Figure 1 GDP per Capita in the Long Run



Notes: 1. Other East Asia comprises Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand.
2. Western Europe and Other East Asia are unweighted averages.

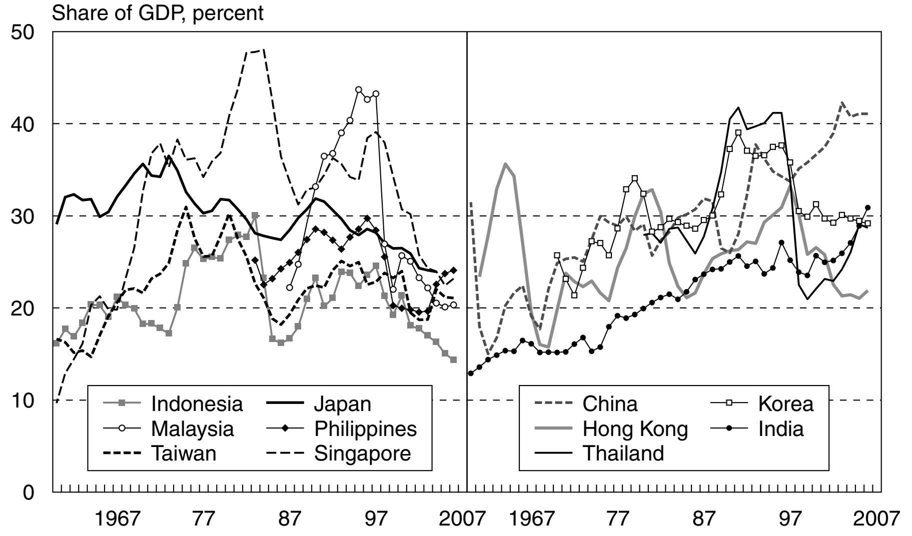
Source: Maddison database.

instruments being found, which is difficult, and/or firm- or industry-level micro datasets, which are scarce. In short, identification of cause and effect is hampered by a lack of good data. I note that in response to the challenge, the economic development literature has recently been making progress in this area, with the use of clever instruments and identification strategies yielding many interesting papers, for example, Acemoglu, Johnson, and Robinson (2001) and Duflo (2001).

II. The Cross-Country Regression Approach

Ahn and Lee (2007) has two distinct parts and employs both of the approaches I have mentioned. In the first part, the authors use a cross-country macro dataset and regress growth in GDP per capita on a whole list of explanatory variables that are typically found in this kind of literature. They get the expected sign on the convergence term, the human capital variable, the institutional variables, and the investment-to-GDP ratio. However, investment-to-GDP is insignificant in most of the regressions, as is the schooling variable. Investment is only significant when foreign direct investment (FDI) outflows are included. As the authors point out in their paper, investment is likely to be collinear with other variables that have been included, although they do go on to add investment to the list of variables that have a strong relationship with GDP per capita. One potential reason for the insignificance of the investment-to-GDP ratio is the difficulty the regression may be having in dealing with the Asian crisis. In a number of countries in the sample, the investment-to-GDP ratio ran up significantly prior to the Asian crisis and then fell sharply (Figure 2). But as we know, in the case

Figure 2 Fixed Asset Investment



Source: CEIC.

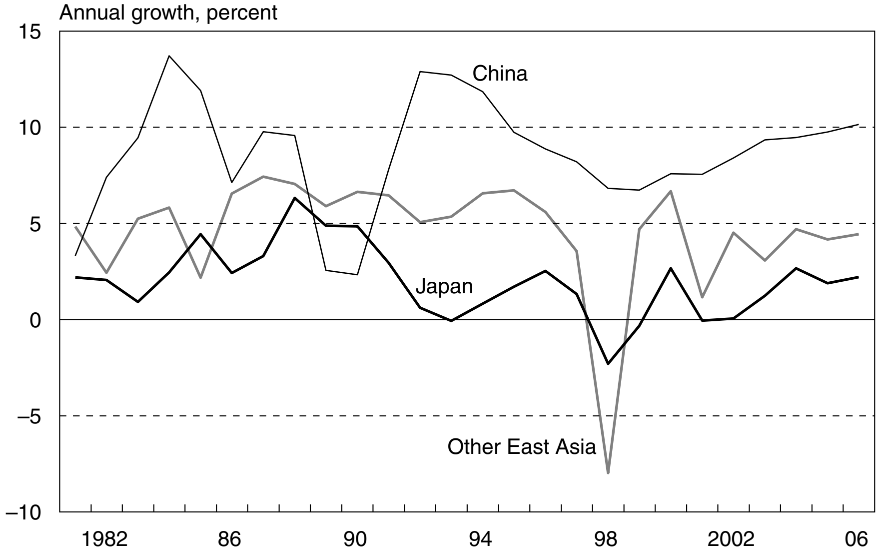
of many of these countries investment was misallocated and there was a subsequent investment overhang. The regression technique used does not recognize this. But from the perspective of policy, it is clear that a distinction needs to be drawn between good and bad investment. In my view, how to deal with the Asian crisis is what needs to be better addressed in this paper.

Now I turn to the main variables of interest: FDI and trade openness. On FDI, the authors make a distinction between FDI outflows and FDI inflows. They find that FDI inflows are positively correlated with growth, while outflows are negatively correlated. For the sample as a whole, however, most of the regressions presented have coefficient estimates that are insignificant. Curiously, including FDI outflows in the regressions makes the coefficient on investment-to-GDP become significant and larger. This may reflect developments during the Asian crisis. The data suggest that the ratio of FDI-outflows-to-GDP continued to rise after the Asian crisis, and at the same time growth in GDP per capita slowed. Theory is not clear about the impact that FDI outflows should have on GDP growth. There is a literature on technology transfer, which could justify these signs, but then so could endogeneity and foresight by investors. It is, however, interesting to note that the negative coefficient is in contrast to the positive coefficient on outflows of FDI estimated in the second part of the paper, which uses a micro dataset from Korea. We could interpret this result as suggesting that Korea differs from the other countries in the sample, which may limit the broader applicability of the results from the micro data.

On trade openness, the authors find that if the ratio of trade-to-GDP is 10 percentage points larger this boosts growth by 0.08 percentage point annually. This is relatively small when you consider that average annual growth in GDP per capita in East Asia was around 4.5 percent over the past 35 years or so; especially given that once FDI outflows are included in the regression the trade openness variable becomes insignificant. One could interpret this result as suggesting that these variables are identifying the same effect. From the perspective of integration, it made me wonder whether there was a distinction between the impact of intra- and extra-regional trade. The extent to which integration is within-region, versus extra-regional, could be of interest in terms of its impact on economic growth and for policy.

In the next part of the paper, the authors break up the sample into different time periods. They find a positive and significant effect of trade openness and FDI in the earlier period, while between 1990 and 2005 the effect is small and insignificant. The question I have is, how robust are these results? Growth in East Asia (excluding China and Japan) is clearly slower in the period after the Asian crisis than in the period before (Figure 3). It is possible that the smaller coefficients on the trade and FDI variables in the second part of the sample are due to identification problems, with the slower trade growth perhaps being a result of slower GDP growth. The extent of endogeneity problems in this case is difficult to assess, given that the authors did not provide details of the standard diagnostic tests for instrumental variable estimation. It would also be interesting to see some kind of sensitivity analysis of these results, perhaps using different time spans to assess how much the Asian crisis is driving the results. Given that the approach the authors use has five-year blocks of data, the results are likely to be hampered by the outlier observations of 1995–2000, as this

Figure 3 GDP per Capita



Note: Other East Asia comprises Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand.

Source: International Monetary Fund.

period is not explained by long-run fundamentals. It would be interesting to see the sensitivity of the results to its exclusion.

If we step back for a moment and assume that the estimated coefficients on the trade and FDI terms are properly identified, then what is the explanation for the results and what are the policy implications? The finding that openness was not as important in the 1990s as in the 1970s and 1980s is a strong result. Taken literally, it might imply that the gains from openness are higher in the earlier periods of development. Perhaps it would suggest that there are diminishing returns to openness? Maybe this is because the main benefit of trade and foreign investment is technology transfer, which may exhibit diminishing returns? But before we get too caught up in discussing its implications, I think we ought to learn a little more about the robustness of the results, given the concerns about whether cause and effect are being properly identified.

III. The Micro-Dataset Approach

Part two of Ahn and Lee (2007) takes plant-, firm- and industry-level micro data for Korea. They use a panel to look at the impact on plant-level labor and total factor productivity (TFP) of industry-level FDI inflows, outflows, and industry-level trade. They apply a fixed effects panel regression technique. In terms of the problems we referred to earlier, the use of this richer panel helps get around the issue of degrees of freedom. The use of lagged explanatory variables helps with the simultaneity problem, although it still assumes that the causality runs from the FDI and trade to productivity. It is, for example, feasible that if a firm expected that it would have higher productivity in the future it may choose to increase its level of international integration in advance (this is more likely to apply to FDI than trade). Again the authors do not provide the results from the standard diagnostic tests, so it is difficult for us to assess how reliable their estimates are. They also have not used instruments in their micro-analysis, which could make their estimates biased, for the reasons I discussed earlier.

The results they find are that FDI, both inbound and outbound, and trade openness are positively correlated with labor productivity and TFP. They suggest that the causality runs from higher FDI to higher productivity. It is an important question as to whether greater openness to trade causes higher productivity or if high productivity firms become exporters. In addition to the results regarding trade openness, the authors find that research and development and investment in physical capital at the industry level are positively correlated with higher levels of productivity, while at the firm level these factors are statistically insignificant. If this effect is properly identified, it has quite interesting policy implications. As the authors point out, this suggests that there are likely to be positive externalities to R&D and investment. While the macro regressions struggled to find a statistically significant role for investment, the micro study suggests there is a role. Though again, it is important to ask to what extent this effect is being properly identified, and then in the broader context how applicable this result is to the region as a whole.

IV. Conclusion

In summing up, I would like to make three points.

While determining directions of causation is difficult, there is still information in establishing correlation. East Asia has had the best economic growth performance in the world over recent decades and is also highly open to trade and capital flows. So it seems that this is another paper suggesting trade and openness are good for growth, which is welcome.

I argue that in the case of Ahn and Lee (2007), more attention should be devoted to dealing with the identification problems. While the authors' estimates suggest that openness was more important in the 1970s and 1980s than in the latter part of the sample, I would be cautious in over-interpreting this result without further confirmation that it is being properly identified, particularly given the abrupt and clear impact of the Asian crisis on the time-series data. If it is properly identified, more investigation is needed to understand why this has occurred. The micro dataset exercise yields some plausible results, although once again it is not clear that the endogeneity problems have been dealt with effectively. The micro study shows that FDI and trade openness seem to have been important for explaining productivity in Korea in recent decades.

From a broader perspective, as the authors show, in the period subsequent to the Asian crisis growth in East Asia (excluding China and Japan) has slowed. The average rate of growth of per capita GDP in East Asia excluding China and Japan in the decade after the Asian crisis was half that recorded in the decade up to 1996. The reasons for this slower growth are of great interest, and further work dealing with the impact of the crisis would be useful. However, dealing with the Asian crisis is empirically difficult in a time-series model, particularly with a macro dataset, as there are few observations to use to properly achieve identification. Continued work that takes the identification problem seriously could provide some fruitful insights to policymakers and academics alike.

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Comment

CHENG HSIAO[13]

University of Southern California
and City University of Hong Kong

I. Introduction

I would like to congratulate the authors for their thorough and insightful analysis of economic and institutional factors that contribute to East Asian economic growth. As they emphasized, in addition to the usual growth fundamentals, trade openness and foreign direct investment have contributed significantly to the high growth and fluctuations of the East Asian economies in the last four decades, as have government policies and institutions. They also show that a balance-of-payments crisis has a strong, negative effect on economic growth and over time East Asian economies have continuously narrowed their income gap from their long-run potential levels. In light of their results, I will focus my discussion on three areas: (1) exchange rates and macroeconomic stability; (2) trade fragmentation and economic convergence; and (3) the question of what drives structural reforms.

13. I would like to thank Eden Yu and Isabel Yan for helpful discussions.

II. Exchange Rate and Macroeconomic Stability

Collectively stable exchange rates can help national central banks more securely anchor their national price levels, smooth business cycle fluctuations [and] encourage greater diversification of private asset holdings across countries.[14]

A. Prominent Features of East Asian Economies

Three prominent features of East Asian economies since the 1997–98 financial crisis are as follows.

(1) Intra-regional trade in East Asia has risen. In 1980, about 32 percent of overall trade of China, Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Taiwan and Thailand was with each other. By 2002, over 50 percent of overall trade was intra-regional.

(2) Debtor countries have become creditors. Most East Asian economies are becoming U.S. dollar creditors. By the end of December 2006, foreign exchange reserves held by China totaled US$1.066 trillion. In Japan, the recent total was US$895 billion, in Taiwan US$266 billion, in Korea US$240 billion, in Singapore US$137 billion, in Hong Kong US$134 billion, in Malaysia US$88 billion, in Thailand US$70 billion, and Indonesia US$33 billion. These countries' latest 12-month current account balances as a percentage of GDP are all positive (Table 1).

(3) The dollar is used as the international currency and East Asian economies have returned to the dollar-pegged exchange rate system. Almost all intra-regional trade is invoiced in dollars except when trade is conducted directly with Japan.

Prior to the 1997–98 financial crisis, the East Asian economies—except for Japan—either formally or informally pegged their currencies to the dollar. Despite the push by the International Monetary Fund for East Asian currencies to float more

Table 1 Foreign Exchange Reserves and Current Account Balance as a Percentage of GDP

	Foreign exchange reserves (US$ billions)	Latest 12-month current account balance as a percentage of GDP
China (Dec. 2006)	1,066	7.6
Japan (Jan. 2007)	895	3.8
Taiwan (Jan. 2007)	266	5.9
Korea (Jan. 2007)	240	0.3
Singapore (Jan. 2007)	137	23.5
Hong Kong (Jan. 2007)	134	9.4
Malaysia (Mar. 2007)	88	12.9
Thailand (Mar. 2007)	70	1.9
Indonesia (Oct. 2005)	33	1.2

Sources: For foreign exchange reserves: International Monetary Fund.
For current account balance: *Economist*, March 31, 2007.

14. McKinnon (2005).

freely, by 2003 practically all the countries had again softly pegged their currencies to the dollar (e.g., McKinnon [2005]). This may be a reasonable policy choice given that forward markets in foreign exchange remain expensive or poorly developed. Pegging currencies to the dollar both facilitates hedging by merchants and banks against exchange rate risk and helps central banks anchor domestic price levels (McKinnon [2005]).

B. Risks for the U.S. Dollar-Denominated Economy

Since neither a debtor country nor a creditor country in the region can borrow or lend in its own currencies, the risks of "original sin" (Eichengreen and Hausmann [1999]) or "conflicted virtue" (McKinnon [2005]) for East Asian economies could increase.

"Original sin" per Eichengreen and Hausmann (1999) is a situation in which the domestic currency cannot be used to borrow abroad or to borrow long term, even domestically. In the presence of this incompleteness, financial fragility is unavoidable because all domestic investments will have either a currency mismatch (e.g., projects that generate Thai baht will be financed with U.S. dollars) or a maturity mismatch (long-term projects will be financed by short-term loans). A currency attack forcing an immediate repayment of short-term dollar debts to foreigners could precipitate devaluation, leading to a shoot-up in value of the banks' liabilities relative to their assets, causing massive domestic bankruptcies, even for firms that are profitable and would be viable otherwise (e.g., Bernanke and Gertler [1989]).

"Conflicted virtue" per McKinnon (2005) occurs when an international creditor country cannot lend in its own currency, and with the passage of time, two things happen. First, "as the stock of dollar claims cumulates, domestic holders of dollar assets worry more that a self-sustaining run into the domestic currency will force an appreciation." Second, "foreigners start complaining that the country's ongoing flow of trade surpluses is unfair and results from having an undervalued currency." Unhedged individual or institutional holders of U.S. dollar assets in creditor economies are at risk should the domestic currency appreciate. Furthermore, when the world price level measured in dollars is very stable, exporters could lose mercantile competitiveness when the domestic currency appreciates, leading to a domestic deflationary spiral. McKinnon and Ohno (2001) have shown that repeated yen appreciation from the 1980s to 1995 contributed to Japan's deflationary slump in the 1990s.

On the other hand, policies to sustain undervalued domestic currencies ultimately generate unsterilizable increases in foreign currency reserves. Accumulation of excess foreign currency reserves distorts domestic financial systems by pushing interest rates below the equilibrium level and causes excess monetary growth, domestic asset price bubbles, overheating, inflation, and the loss of competitiveness that most governments try to prevent. It also makes Asian economies depend excessively on demand from outside the region.

C. Costs of a Financial Crisis

Many Asian economies have fragile financial systems. Problems in financial sectors could trigger currency crises (e.g., Kaminsky and Reinhart [1999]). The costs associated with financial crises or balance-of-payments crises are huge. In the year before and the year after the financial crisis began, (1996 versus 1998), GDP growth for Indonesia was 8 percent versus −13.1 percent; for Korea, 6.8 percent versus −6.7 percent; for Malaysia, 10 percent versus −7.4 percent; for the Philippines, 5.8 percent versus −0.6 percent, and for Thailand, 5.9 percent versus −10.9 percent (Table 2). The five worst-hit countries (Indonesia, Malaysia, the Philippines, Korea, and Thailand) are still suffering 10 years after the 1997–98 financial crisis. Comparing the period from 1990–96 with 2000–06, the Asian Development Bank (2007) finds that their "growth has settled on a lower trajectory." It has slipped by an average of 2.5 percentage points a year. The root cause lies in falling rates of investment. It appears that once business confidence and perception are shaken, it is difficult for them to recover. In addition to the direct economic costs, there are political and social costs from the occurrence of financial crisis that are difficult to quantify.

D. Safeguard Mechanism

Stability of exchange rates promotes trade by reducing transaction costs. Orderly adjustment of exchange rates can help national central banks more securely anchor their national price levels and encourage greater diversification of private asset holdings across countries. However, the East Asian exchange rate system is hardly secure. Misalignment of exchange rates often triggers currency attacks. The problem is compounded by "currency mismatch" and "maturity mismatch." Moreover, the markets almost always overreact, as can be seen in the fluctuation of exchange rates prior, during, and after the 1997–98 financial crisis in the bottom half of Table 2. However, the establishment of a "common Asian currency" is not a reachable goal in the near future, given the current disparities in political structure and diverse stages of development among East Asian economies.

The focus probably should be on the establishment of a pool of exchange reserves and forging institutional rules to ensure smooth adjustment in exchange rates and greater regional monetary harmonization to facilitate hedging by merchants and banks against exchange rate risk; and to help central banks anchor their domestic price levels.

Table 2 Macroeconomic Indicators during the Balance-of-Payments Crisis

	Indonesia	Korea	Malaysia	Philippines	Thailand
GDP growth					
1990–95	4.77	6.53	6.13	0.38	6.49
1996	8.0	6.8	10.0	5.8	5.9
1997	4.5	5.0	7.3	5.2	–1.4
1998	–13.1	–6.7	–7.4	–0.6	–10.5
2000–05	2.33	3.89	2.94	1.25	4.08
Real exchange rate (index)					
1996	99.5	99.6	93.4	85.8	101.6
1997	107.1	107.0	96.5	91.3	110.0
1998	212.2	134.0	117.1	114.8	121.5
1999	139.1	119.8	118.2	107.7	117.0

Sources: De Gregorio and Lee (2003, table 10) and Ahn and Lee (2007, table 1).

III. Fragmentation or Convergence

The robust growth of each East Asian economy is accompanied by the even more robust growth of intra-regional trade (Wakasugi [2007]). Intra-East Asian trade increased from 32 percent in 1980 to 60 percent in 2003. China's imports from Hong Kong, Indonesia, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand rose from 6.2 percent of overall imports in 1980 to 40.9 percent in 2001, while China's exports to these economies as a percentage of overall exports remain about the same. On the other hand, Chinese exports to the United States rose from 5.4 percent in 1980 to 20.4 percent in 2001.

De jure integration results in a large trade creation effect (e.g., Hiratsuka [2006] and Wakasugi [2007]). Integration of the production system in East Asian economies is driven by heterogeneity in factor endowments and factor prices. But as income grows, presumably economies will move up the higher-value-added ladder to sustain the growth. Table 3 shows the changes in employment over the last 200 years in the United States. Today, 82 percent of the 140 million U.S. workers are employed in the service sector and fewer than 20 percent are in the manufacturing sector. At the end of 2005, the U.S. auto and auto parts manufacturing industry employed about 1.1 million workers and represented 0.8 percent of the value of U.S. GDP. The legal service sector employed about the same number but contributed 1.5 percent of GDP.

Chinese trade data show a similar pattern. In the early 1980s, Chinese exports were largely agricultural products, raw materials, and basic manufactures. Imports were dominated by sophisticated manufacturing products such as machinery and transportation equipment. Today, the percentage of machines, transport equipment, and miscellaneous manufactured goods (clothing and accessories, precision instruments, photo and optical equipment) has risen to nearly 70 percent of exports and agricultural products and raw materials have fallen to less than 10 percent (Table 4). On the other hand, the commodity composition of imports has changed in the opposite direction. The percentage of raw materials rose from about 8 percent in 1985 to 18 percent in 2000. The percentage of imports of basic manufactures (leather, wood, paper, textile, yarn, iron and steel, and nonferrous metals) declined from about 28 percent to 19 percent. However, East Asia has achieved economic integration only in terms of trade in intermediate goods, not in consumption goods and services (e.g., Hiratsuka [2006]). As people increase their incomes, they shift their spending toward services. For every dollar Americans spend on goods, they spend US$1.70 on services—roughly

Table 3 U.S. Distribution of the Labor Force

Percent

	1800	1900	1950–60	2007
Agriculture	Over 90	37	10	1.5
Industry (manufacturing, construction, and mining)	4	28	38	16
Services	4	26	50	82

Source: Fisher (2007).

Table 4 Chinese Exports and Imports by Commodity

Percent

	Agricultural products	Raw materials including fuels	Basic manufactures	Machines and transport equipment	Miscellaneous manufactured goods
Exports					
1985	14.92	35.61	16.49	2.81	12.81
2000	4.92	4.93	17.38	33.08	34.31
Imports					
1985	4.41	7.99	27.95	38.95	4.52
2000	2.53	17.97	18.88	40.81	5.64

Source: Adapted from McKinnon (2005, tables 5.2 and 5.3).

a 40–60 percent mix. In contrast, China spends 58 percent on goods versus 42 percent on services. India spends 63 percent on goods and 37 percent on services (Fisher [2007]). What do these shifts away from the goods and lower-value-added sectors to the higher-valued services sector mean to the pattern of trade or convergent hypothesis as East Asian economies grow? Will we see trade fragmentation perpetuate disparity in income among East Asian economies, or will we see adjustments in factor prices to achieve more equity (e.g., Krugman [2000] and Leamer [1996])?

IV. What Drives Structural Reform?

Ahn and Lee (2007) have shown that government policies and institutions contributed significantly to the high growth of the East Asian economies. As pointed out by De Gregorio and Lee (2003), East Asian nations were involved "in a continuing process of reform, adapting policy instruments and institutions—willingness to experiment and adapt policies to changing circumstances is a key element in economic success."

What drives structural reform? Is reform a continuing process of gradual improvement, or do crises beget reform? It is sometimes argued that "crises and emergencies may be welfare-enhancing and hence desirable. When ongoing social conflict implies that an economy has settled in a Pareto-inferior equilibrium, radical changes are often needed to break the stalemate and put the economy on a welfare-superior path . . . . The extreme welfare loss that each agent suffers in a crisis dwarfs the loss he may associate with an unfavorable distribution of the burden of a major policy change" (Drazen and Grilli [1993]). Tommasi and Velasco (1996) have argued that "economic crises seem to either facilitate or outright cause economic reform," yet Campos, Hsiao, and Nugent (2007) find that political considerations (political crises as well as political institutions) are more important determinants. What are the main drivers of reform? If crises beget reform, what is the benefit and cost of a reform or a crisis?

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General Discussion

In his response to the discussants, Jong-Wha Lee admitted that cross-country regressions always had problems with identifying causality and dealing with endogeneity. He then explained that to deal with these issues, the paper analyzed not only the cross-country datasets but also firm-level datasets from Korea. Sanghoon Ahn added that the use of firm-level datasets should partially address those problems as industry-level shocks triggered some changes at the individual plant level, but not the other way around. On the impact of the Asian crisis, Lee noted that the cross-country regression controlled for the balance-of-payments crisis as an additional explanatory variable. Regarding the comment on the effect of the trade openness being small, Lee stressed that the effect was large enough to explain more than 0.6 percentage point of the difference in average growth rates between East Asia and South Asia. Responding to the suggestion of Cheng Hsiao (University of Southern California) for a better understanding of what was behind the explanatory variables, Lee stated that the fundamentals may be determined by history, culture, and the endowment of resources, including human capital.

In the general discussion, David Weinstein (Columbia University) questioned the extent of East Asian economies included in the analysis. Takatoshi Ito (University of Tokyo) pointed out that Hong Kong and Singapore could be outliers in terms of exports and imports to GDP, as they possessed entrepôt characteristics. Lee responded that he chose emerging countries with similar conditions at the beginning of the sample, that is, 1970. He then explained that to remove the effect of the outliers, the paper filtered out the effect of country size because small countries were more likely to be open economies.

With respect to the causality issue, Ito argued that the decline of growth rates promoted foreign direct investment (FDI) outflow and hence the causation was just the opposite of that expected. Weinstein further pointed out that there were no real theoretical links between variables such as trade openness, FDI, and the growth variable. Therefore, the cross-country regression had difficulty in interpreting the causality. Lee agreed that causation would run in both directions. He stated that there were already several theoretical arguments, and the issue must be left to the empirical findings. On Ito's point, Ahn remarked that the FDI outflow may have been caused by exogenous factors, such as yen appreciation following the Plaza Accord and the emergence of China, not by the decline in growth rates. Marvin Goodfriend (Carnegie Mellon University) claimed that the role of FDI could be understood within the process of developing countries' familiarization with other countries, yielding the loop between trade and productivity growth.

Ito argued that if the FDI outflow was dominated by Japanese and Korean firms, with others being minor, the economic slowdowns of the two countries may be reflected in the negative coefficients of FDI outflow on output growth. Lee admitted the possibility that FDI outflows from Japan and Korea could have been dominant. However, he stressed that each country was treated equally as one observation, and hence the results did not suffer much from these two observations. Bennett T. McCallum (Carnegie Mellon University) suggested that the balance-of-payments crisis should be excluded from the cross-country regression because of the endogeneity problem. Lee responded that the paper addressed the problem by using the initial values of foreign reserve-import ratio as an instrument. Lawrence Schembri (Bank of Canada) claimed that the role of factor accumulation in East Asian economic growth should be explored, since openness would provide the incentive for factor relocation. Lee responded that a number of studies had shown the dominant role of factor accumulation, though distinguishing between factor accumulation and total factor productivity growth was always difficult.