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The Role of Foreign Direct Investment in Korea's Economic Development

Productivity Effects and Implications for the Currency Crisis

June-Dong Kim and Sang-In Hwang

9.1 Introduction

Since the 1960s, Korea has accomplished remarkable economic growth, allowing it to overcome the devastation caused by the Korean War. However, the currency crisis of 1997 brought Korea into the most severe hardship since the Korean War. One factor that could contribute to Korean recovery from the financial crisis is a stable flow of foreign direct investment (FDI) because FDI appears less prone to sudden swings than other forms of capital inflow. However, negative sentiment about foreign investment still exist, reflecting fears of foreign control over the domestic economy. In fact, the Korean government as well as the general public was in favor of indigenous industrialization rather than FDI-based development.

Now we need to investigate the role of FDI in economic development, as the Korean economy suffers a currency crisis. Specifically, with public sentiment running against the harsh conditions of the IMF financial arrangements, it is interesting to see whether FDI can in fact help Korea to avoid the IMF bailout loans. Multinational firms may help the crisis-ridden country to circumvent the IMF financial arrangements by providing local subsidiaries and business partners normal access to raw materials or trade financing.

As a longer term issue, we need to examine whether FDI enhances efficiency and thus contributes to sustainable growth. Despite the low realization of FDI, case study evidence shows that foreign firms helped to develop such strategic industries as semiconductors and to raise productivity through the transfer of technology and managerial know-how.

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This paper investigates these two issues regarding the role of FDI in Korea's economic development. First, we examine whether the quantitative data supports anecdotal evidence of the productivity spillover effects of FDI in Korean manufacturing. Further, we investigate the role of FDI in a currency crisis by looking at the relation between the relative importance of FDI and the incidence of IMF bailout loans in developing countries.

The paper is organized as follows: Section 9.2 reviews the evolution of the Korean government's FDI policy. Section 9.3 presents the trends and patterns of FDI inflow into Korea. Section 9.4 estimates the effects of FDI on the productivity of Korean manufacturing industries. Section 9.5 investigates whether FDI can play a role in preventing IMF rescue loans using data for ninety developing countries. Concluding remarks are made in section 9.6.

9.2 Historical Overview of Foreign Direct Investment Policy in Korea

In order to investigate the role of FDI in Korea's economic development, it is helpful to review the government's policy on FDI. Korea is well known around the world as an "outward-oriented" country. Yet, as demonstrated below, the main orientation of Korea's investment policies has failed to embrace an open market strategy throughout its development stages.

9.2.1 Institutionalization, 1960–83

Following the import substitution drive of the 1950s, Korea shifted its development strategy toward a more outward-oriented system that emphasized export promotion. The new export-led growth strategy went hand in hand with policies aimed at introducing FDI. In 1960, the Korean government enacted the Foreign Capital Inducement Act (FCIA) and related decrees.

The government wanted to use FDI to ease balance-of-payments difficulties and as a supply of needed technology and expertise. FDI was welcomed into the light manufacturing export sector, especially in the two Free Export Zones at Masan and Iri. However, foreign investment continued to be discouraged in those sectors still protected by import substitution measures because the Korean government feared that otherwise the economy would become dominated by foreign firms. Moreover, the Korean government wanted to channel the limited amount of capital resources to industries vital to long-term economic growth. With this strategy in mind, the Korean government preferred foreign borrowing, which brought foreign resources under its control.

9.2.2 Liberalization of Foreign Direct Investment, 1984–97

A major change occurred in the early 1980s as the Korean economy began to experience serious difficulties due to the negative effects of the

Heavy and Chemical Industry Promotion Plan of the 1970s. A new industrial strategy was thus adopted in the early 1980s in an attempt to upgrade Korea's industrial structure into one embracing more technology- and skill-intensive sectors. A key component of this technological upgrade was the liberalization of FDI.

In 1984, the Korean government replaced the positive list system with a negative list system in which all industries not listed were open for FDI approval.

In December 1989, various performance requirements imposed on foreign-invested enterprises, such as export, local content, and technology transfer requirements, were abolished.

Starting in 1994, the Korean government liberalized restricted business categories according to the Five-Year Foreign Investment Liberalization Plan, which has been updated every year thereafter. Multilateral trade negotiations such as GATT and the government's aim to induce more competition in the domestic market fostered a gradual opening of the service sector.

In December 1996, when Korea joined the OECD, the Korean government furthered liberalization by amending the FCIA to create the Act on Foreign Direct Investment and Foreign Capital Inducement. Its main purpose was to bring Korea's FDI system in line with international norms and standards. For example, the concept of FDI was expanded to encompass long-term (five year or more) loans. Also, starting in February 1997, foreign investors were allowed to acquire outstanding shares of Korean companies through friendly mergers and acquisitions (M&As). Such friendly M&As required the consent of the board of directors of the targeted company.

Even though the Korean government made some real efforts to liberalize FDI, its overall stance toward FDI was passive. The government allowed FDI into liberalized business categories and activities but refused to remove various impediments and to promote FDI to the extent carried out in the Southeast Asian countries.

9.2.3 Promotion after Currency Crisis, 1998 and Afterward

At the end of 1997, Korea was throttled by a currency crisis when the won depreciated over 100 percent against the U.S. dollar. Loss of foreign reserves and the reluctance of foreign lenders to roll over loans brought Korea to the brink of default in late December 1997. To overcome the crisis in the most rapid and painless way possible, the Korean government is targeting more active promotion of FDI.

In November 1998, the Korean government enacted the Foreign Investment Promotion Act. This new legislation focuses on creating an investor-oriented policy environment by streamlining foreign investment procedures, expanding investment incentives, and establishing an institutional framework for investor relations, including one-stop service. The Korean

government also undertook full-fledged liberalization in the area of hostile cross-border M&As and foreign land ownership.

9.3 Trends of Foreign Direct Investment in Korea

FDI in Korea was minimal during the initial liberalization that lasted from the 1960s until the mid-1980s (table 9.1). In the 1980s, however, annual average FDI in Korea increased from US$100 million to over $800 million. Following a contraction that lasted until 1993, FDI resumed an upward trend, reaching $3 billion in 1997 and a record $5.1 billion in 1998. This growth is in part explained by the fall in stock market and real estate prices and the depreciation of the won. It also reflects the Korean government's new policy measures to promote FDI and progress in restructuring the financial and corporate sectors.

For the sectoral distribution of FDI inflow into Korea, the manufacturing sector was the largest recipient during the early liberalization period, absorbing 67.4 percent of total inward FDI during 1962–86 (table 9.2). This trend continued until 1993, when the share of the manufacturing sector exceeded 65 percent of total FDI inflow. The share of manufacturing as a percentage of total FDI has remained at approximately 55 percent since 1996.

In the manufacturing sector, the composition of inward FDI changed toward more investment in the heavy and chemical industries. Since the mid-1980s, FDI in labor-intensive and low-technology industries, such as textiles and clothing, has fallen significantly because of the rise in labor costs. Instead, the electrical and electronics sector and transport equip-

Table 9.1 **Trends of FDI in Korea, 1962–98 (million U.S. dollars)**

Year	Notified	Actual
1962–81	1,886.1	1,477.8
1982–86	1,767.7	1,157.8
1987–88	2,347.1	1,519.7
1989	1,090.3	812.3
1990	802.6	895.4
1991	1,396.0	1,177.2
1992	894.5	803.3
1993	1,044.3	728.1
1994	1,316.5	991.5
1995	1,941.4	1,357.1
1996	3,202.6	2,308.3
1997	6,970.9	3,085.9
1998	8.852.4	5,155.6

Source: Ministry of Finance and Economy, *Trends in International Investment and Technology Inducement* (Seoul, 1999).

Table 9.2 **Share of Selected Manufacturing Industries in Total FDI, 1962–98 (percent)**

Industry	1962–86	1987–90	1991	1992	1993	1994	1995	1996	1997	1998	Cumulated
Manufacturing	67.4	63.3	80.0	75.3	67.6	35.4	43.2	56.2	59.4	54.9	59.4
Food	3.4	4.5	1.3	13.5	2.0	0.5	1.1	1.8	15.0	12.2	7.1
Chemicals	14.2	12.4	15.5	28.5	33.7	11.0	10.0	10.1	8.3	8.3	12.1
Medicine	2.8	3.6	4.8	3.8	1.8	3.2	2.9	1.1	1.3	2.3	2.5
Petroleum	3.3	1.5	33.5	0.2	2.8	0.5	3.3	9.3	0.1	0.0	3.8
Machinery	4.2	7.7	9.5	5.9	3.3	7.0	6.5	5.9	3.1	10.4	6.8
Electrical and electronics	14.7	17.9	9.1	7.1	3.6	3.7	10.2	12.2	7.1	4.5	9.6
Transport equipment	11.2	10.1	2.0	4.2	11.5	3.1	3.4	10.8	11.6	3.0	7.5
Other manufacturing	9.9	4.5	4.2	9.2	8.6	5.5	5.2	4.4	12.6	0.6	0.8

Source: Ministry of Finance and Economy, *Trends in International Investment and Technology Inducement* (Seoul, 1999).
Note: Based on actual investments. For 1962–86 and 1987–90, figures are annual averages.

ment and chemicals are receiving increased amounts of foreign investment. Since 1997, foreign food companies increased their investment in Korea by acquiring domestic food companies and their distribution networks.

The composition of FDI in the service sector has also changed. The hotel business used to be the largest subsector in terms of cumulated FDI up to the early 1990s. Since the mid-1990s, FDI in wholesale and retail trade as well as financing and insurance increased remarkably (table 9.3).

Since 1998, after the outbreak of the currency crisis, a number of domestic firms have been sold in order to alleviate debt burdens, as shown in table 9.4. Since the M&A market is not well developed in Korea, there are still wide gaps between the prices at which domestic firms are offered and the prices foreigners are willing to pay. Delay in the sale of such assets can also be attributed to the high debt ratios and lack of transparency of domestic firms, as well as the lack of improvement in labor market conditions.

9.4 Effect of Foreign Direct Investment in Korea on Productivity

Despite the small amount of FDI in Korea relative to the size of its economy, it was foreign firms that brought the key technology and constructed the basis for such industries as electronics and pharmaceuticals. For example, subsidiaries of foreign semiconductor firms contributed to the growth of domestic firms into major players in the world market by spinning out skilled workers and managers as well as through technical guidance to subcontractors. Also, multinational pharmaceutical firms helped the domestic pharmaceutical industry to develop new drugs by boosting local research capabilities.[1] More specifically, anecdotal evidence shows that foreign-invested firms may raise productivity by spinning out skilled workers, providing technical guidance to subcontractors, bringing in new capital goods and technology, introducing advanced management know-how, conducting in-house R&D, and enhancing competition.[2]

The purpose of this section is to examine whether the quantitative data support the qualitative case study evidence for productivity spillovers in Korea. Previous empirical studies of this issue present mixed evidence on productivity spillovers from foreign investment. Studies using sector-level data tend to show positive evidence for productivity spillovers from foreign presence (ownership) or level of FDI (Caves 1974; Globerman 1979; Blomström and Persson 1983; Choi and Hyun 1991; Hong 1997; Chan,

1. A more detailed description of the impact of foreign-invested firms on the development of the Korean semiconductor and pharmaceutical industries is given in Kim (1997).

2. Blomström and Kokko (1996) presented an overview of empirical studies on productivity spillovers by classifying them into backward and forward linkages, training of local employees, and demonstration and competition effects.

Table 9.3 **Share of Selected Service Industries in Total FDI, 1962–98 (percent)**

Industry	1962–86	1987–90	1991	1992	1993	1994	1995	1996	1997	1998	Cumulated
Service	31.9	36.3	20.0	24.4	32.4	64.6	56.8	43.8	39.0	41.5	39.3
Wholesale and retail	0.6	0.1	0.4	1.4	0.7	2.5	4.3	14.3	8.3	10.1	5.7
Trading	0.0	1.7	4.5	6.8	11.6	9.5	8.0	4.8	6.3	4.7	4.7
Hotel	18.7	20.7	3.1	1.1	7.1	20.8	4.3	5.0	3.1	0.0	8.1
Transport and storage	1.2	0.2	0.1	0.2	0.2	0.2	0.3	5.2	1.0	0.1	0.9
Financing	7.1	9.5	6.2	5.7	4.5	20.5	26.3	7.7	9.8	9.1	10.0
Insurance	0.1	2.4	3.7	5.4	1.2	0.8	4.0	0.7	0.2	1.4	1.6
Construction	1.6	0.3	0.2	0.0	0.1	0.7	0.9	1.4	1.6	0.1	0.7
Restaurant	0.0	0.1	0.3	1.3	4.7	0.6	0.5	0.1	0.1	0.1	0.4
Other service	2.5	1.2	1.6	2.5	2.4	9.0	8.3	4.5	8.5	15.8	7.1

Source: Ministry of Finance and Economy, *Trends in International Investment and Technology Inducement* (Seoul, 1999).

Note: Based on actual investment. For 1962–86 and 1987–90, figures are annual averages.

Table 9.4 **Major Cross-Border Mergers and Acquisitions since the Currency Crisis in Korea (1998)**

Korean Firm	Foreign Buyer	Contents
Hanwha	FAG OEM and Handel (Germany)	Sold bearing unit for 320 billion won (US$213 million)[a]
Hanwha	BASF (Germany)	Sold 50% stake in Hanwha BASF Urethane for 120 billion won ($80 million)[a]
Hyosung	BASF (Germany)	Sold 50% stake in Hyosung BASF for 64 billion won ($43 million)[a]
Daesang	BASF (Germany)	Sold Lysine unit for $600 million
Halla	Bowater (USA)	Sold Halla Pulp and Paper for $210 million
Shinho Paper Co.	Norske Skog (Norway)	Sold for $175 million
Sambo Computer	Seiko Epson (Japan)	Sold printer unit for $20 million
Korea Exchange Bank	Commerz Bank (Germany)	Sold 29.8% stake for $276 million
Korea Makro	Wal-Mart (USA)	Sold Makro's subsidiary for $181 million
Samsung Heavy Industries	Volvo (Sweden)	Sold construction equipment division for $750 million
Anam Semiconductor	ATI (USA)	Sold semiconductor manufacturing factory for $600 million
Samsung Electronics	Fairchild (USA)	Sold semiconductor manufacturing factory for $455 million

[a]Exchange rate of 1,500 won per dollar is applied.

chap. 12 in this volume).[3] However, studies using firm-level data find that FDI has a statistically insignificant impact on total factor productivity (TFP) growth (Haddad and Harrison 1993; Aitken and Harrison 1994; Djankov and Hoekman 1998).[4]

One reason for these differing results is that most studies using sector-level data did not cure the identification problem: if foreign investment tends to locate in more productive sectors, estimates of the impact of FDI on the productivity of domestic industries are biased upward (Aitken and Harrison 1994; Harrison 1996).

3. Using a cross-country data set for sixty-nine developing countries, Borensztein, de Gregorio, and Lee (1998) also found that FDI contributes more to growth than does domestic investment when sufficient capability to absorb advanced technologies, measured by human capital, is available in the host economy.

4. One exception is Chung, Mitchell, and Yeung (1994), which found, using firm-level panel data on U.S. automobile component manufacturers, that productivity gains among host country suppliers largely stem from the increase in competition created by FDI rather than from direct technology transfer.

Given the absence of appropriate firm-level data in Korea, we resort to industry aggregate data in six manufacturing subsectors; food, textiles and clothing, chemicals and petroleum, metals, machinery, and electrical and electronics.[5] This paper differs from previous studies using sector-level data by taking the endogeneity problem into consideration, estimating a random-effects model with instruments.

9.4.1 Empirical Framework

Constrained by the insufficient number of observations, we take the growth accounting approach for calculating TFP in each subsector. Although the growth accounting approach is subject to criticism, it can avoid such econometric problems as limited degrees of freedom that are expected to occur if the production function approach is used (Collins and Bosworth 1996, 139).[6]

The conventional growth accounting framework shows that the growth rate of value added in sector i can be decomposed into the contribution of increases in factor inputs plus a residual. That is, it assumes the underlying relation between output (Q) and the inputs capital (K), labor (L), and technology or TFP (A) as follows:

$$(1) \qquad Q_i = F(K_i, L_i, A_i), \qquad i = 1, \ldots, n.$$

Equation (1) yields an index of growth in TFP, denoted by a_i, which can be defined as the growth rate of output, q_i, less the share-weighted growth of the factor inputs, k_i and l_i:[7]

$$(2) \qquad a_i = q_i - \alpha_K k_i - \alpha_L l_i.$$

We use the Törnqvist approximation of the Divisia index for factor shares, which is the arithmetic average of the current and previous period's factor shares.[8]

For the impact of FDI on productivity, we use the following specification:

$$(3) \qquad a_{it} = \beta_0 + \beta_1 \mathrm{fdi}_{i,t-1} + \beta_2 \mathrm{roy}_{i,t-1} + \varepsilon_{it},$$

where fdi represents the growth rate of the FDI stock and roy stands for the growth rate of the royalty stock, which is used as a proxy for imported technology from foreign countries. Unlike the FDI stock, royalties paid

5. These are at the two-digit level.

6. Hong and Kim (1996) showed that estimates of TFP growth obtained by the growth accounting approach are similar to estimates obtained by the translog production function approach in Korean manufacturing industries during 1967–93.

7. Any deviations from constant returns to scale and unmeasured human capital are allocated to this residual of TFP (Lee 1995; Collins and Bosworth 1996).

8. Lee and Zang (1998) also used the Divisia-Törnqvist index for calculating regional productivity in Korea.

for imported technology may have offsetting effects on productivity. In other words, it may raise productivity through technology transfer or lower productivity by reducing the incentive to conduct R&D. We assume that it takes one year for foreign-invested firms to start operating after investment and also that technology imports affect productivity with a one-year lag. Hence, the explanatory variables fdi and roy are lagged one year to adjust for a time delay.[9]

9.4.2 Data

Annual data on real output (value added) and employment in the manufacturing industries were taken from the *Report on Mining and Manufacturing Survey,* published by the National Statistical Office, which contains very detailed microlevel industry data. The number of employees was multiplied by average man-hours to yield data on labor input. For real net capital input, we used industry-specific real net capital stock data calculated by Pyo (1997), who employed the polynomial benchmark estimation method.[10] We adjusted this net capital stock by operation ratio indexes from the *Korea Statistical Yearbook,* published by the National Statistical Office.[11]

For the real value of the FDI and royalty stocks, we used the data of Choi and Hyun (1991) for 1974–89, with the exception that we adjusted for 1990 constant gross fixed capital formation prices. For 1990–96, we updated these FDI and royalty stocks, by adding the new inflow of FDI and royalties to the depreciation-adjusted stocks.[12]

9.4.3 Estimation Results

Because of the possible endogeneity between productivity effects and the independent variables, estimating equation (3) by ordinary least squares (OLS) may give biased and inconsistent estimates. To deal with the possible endogeneity that FDI flows into the manufacturing subsectors with high productivity, we estimate a random-effects model. The random-effects model has an advantage over the fixed-effects estimation in that it avoids the imposition of constant productivity growth over time. To correct for the remaining endogeneity problem, we also estimate the random-effects model using instruments.[13]

9. Taking lags for the independent variables may also reduce the possible endogeneity.

10. Using net capital stock data (Nk) from the National Wealth Surveys for 1968, 1977, and 1987 and fixed capital formation data (I) in the polynomial benchmark-year equation, he estimated economic depreciation rates to calculate the real net capital stock for each year.

11. Basu (1995) found that cyclical factor utilization is very important for explaining procyclical productivity.

12. The assumed depreciation rates taken from Choi and Hyun (1991) are 12 percent for FDI and 15 percent for royalties.

13. Specifically, fitted values of the independent variables using instruments are inserted in the estimation of a random-effects model.

Table 9.5 **Regression Estimates of Productivity Effects of FDI in Korean Manufacturing, 1974–96**

Variable	OLS	Random Effects	Random Effects with Instruments[a]
Constant	0.049	0.050	0.066
	(3.413)	(3.123)	(3.106)
$fdi_{i,t-1}$	0.037	0.037	0.026
	(1.145)	(1.123)	(0.172)
$roy_{i,t-1}$	−0.054	−0.058	−0.138
	(−0.948)	(−0.980)	(−1.142)
N	138	138	138
LM test[b]		1.32	1.20
		[0.25]	[0.27]
Hausman test[c]		0.29	0.71
		[0.86]	[0.70]
R^2	0.014	0.014	0.014

Note: Equation is $a_{it} = \beta_0 + \beta_1 fdi_{i,t-1} + \beta_2 roy_{i,t-1} + \varepsilon_{it}$. Numbers in parentheses are t-statistics. Numbers in brackets are probability values of χ^2 tests.

[a] $fdi_{i,t-2}$, $fdi_{i,t-3}$, $roy_{i,t-2}$, and $roy_{i,t-3}$ are used as instruments.

[b] High values of the LM test favor a one-factor model over a classical regression model with no group specific effects.

[c] Low values of the Hausman test favor a random-effects model.

Table 9.5 reports the results of OLS and random-effects estimations with and without instruments.[14] For both the OLS and the random-effects models, the coefficient on the growth rate of FDI stock is positive but statistically insignificant.[15] Unlike the case study evidence, the industry aggregate data do not show that FDI has a positive effect on productivity. This might be due to aggregation of data at the sector level in that the experiences of individual firms are not sufficient to have an impact at the aggregate level. We expect a different result from a firm-level analysis, which we leave for future research.

The growth rate of the royalty stock has a negative but statistically insignificant effect for both the OLS model and the random-effects model with and without instruments. One possible explanation for the insignificant effect of royalties on productivity is that the negative effect of the importation of technology by reducing incentives to conduct in-house R&D may offset its positive effect on productivity through technology transfer.

14. We could not gain much using the random-effects model, as shown by the LM test results. This may be because growth rates of productivity across sectors do not differ much. The mean and variance of growth rates of productivity for each sector fall in the ranges −0.005 to 0.004 and 0.013 to 0.044, respectively.

15. The coefficient and t-ratio are smaller when the random-effects model is estimated using instruments.

9.5 The Role of Foreign Direct Investment in a Currency Crisis: Is It a Safety Net?

In 1997, Thailand, Indonesia, Malaysia, and Korea were hit by currency crises. There is a wide range of literature on the nature of the Asian crisis (Krugman 1998; Sachs 1997a; Fischer 1998; Frankel 1998).[16] According to this literature, the causes of the Asian crisis can be broadly summarized as two general factors: one is the moral hazard of domestic financial intermediaries, and the other is the bank run by foreign investors. From the midst of the crisis, we explain the causes as a combination of these two explanations—underlying structural problems and an abrupt loss of investor confidence.

In fact, the moral hazard of financial intermediaries whose liabilities were perceived as having an implicit government guarantee created bubbles in asset prices.[17] Asian-style corporate governance, which emphasizes growth rather than profitability, as well as the closed and underdeveloped domestic banking system, which lacks appropriate risk management, also contributed to these bubbles by allowing overinvestment.

The bursting of the bubbles touched off a downward spiral in which falling asset prices exposed the insolvency of intermediaries, forcing them to cease operations, leading to further asset deflation (Krugman 1998). The bank run or financial panic aggravated this vicious circle as foreign investors liquidated their investments early, thus making the crisis even more severe.

Frankel and Rose (1996) and Park and Lee (1998) showed that a low level of net FDI—that is, FDI inflow subtracted from FDI outflow—correlates closely with the incidence of currency crisis.

One argument in favor of FDI is that of stability. In the event of a crash, investors can suddenly dump securities and banks can refuse to roll over loans, but multinational corporations cannot quickly pack up their factories and go home (Frankel and Rose 1996, 355). In addition, the mere potential of FDI may act as a stabilizer against the risk of financial panic because the presence of potential foreign buyers would provide sufficient liquidity to make a liquidity crisis impossible (Krugman 2000).

Related to this argument, one can argue that even in a currency crisis, countries (such as Malaysia) where multinational firms have a dominant presence in the domestic economy may endure or overcome the crisis with-

16. The Asian currency crises were born in an environment marked by the globalization of financial and capital markets and the movement of massive capital flows across national borders. Thus they have distinct characteristics from the other currency crises in the past. See NBER (1998) for details.

17. The implicit government guarantee can be attributed to directed lending or connected lending, characteristic of "crony capitalism."

out being forced to resort to IMF bailout loans.[18] Thanks to their parent firms, subsidiaries of multinational firms in crisis-ridden countries do not suffer lowered credit ratings or such difficulties in importing raw materials or in trade financing as do other domestic firms.

The following subsections examine this last hypothesis, that FDI is associated with IMF rescue loans, by using cross-sectional data from 1994 to 1997 and pooled data from 1973 to 1994 for developing countries. Santaella (1995) provided a complementary work that analyzes the macroeconomic conditions surrounding IMF financial arrangements in developing countries but did not study the relation between IMF arrangements and FDI. For an empirical analysis, we adopt the probit estimation of Frankel and Rose (1996), which is a nonstructural exploration of the data.

9.5.1 Cross-Sectional Analysis of Currency Crashes and IMF Rescue Loans, 1994–97

We first use cross-sectional data on ninety developing countries to investigate whether countries experiencing currency crashes or IMF rescue loans during the period 1994–97 have lower levels of FDI than other countries.[19]

Variables and Data

As the dependent variable, we construct a binary variable, b9497, which takes a dichotomous value of one if the country received a bailout loan from the IMF during 1994–97 and zero otherwise. IMF Stand-By and Extended Fund Facility (EFF) Arrangements were used to proxy rescue loans. Stand-By Arrangements can be considered emergency loans for balance-of-payments support, and the EFF is intended to allow member countries

18. IMF bailout loans usually accompany painful macroeconomic adjustment. Sachs (1997b) criticized the IMF programs addressing the Asian crisis, pointing out that demanding too much austerity in the form of budget cuts and tight credit to countries with high savings and budget surpluses may transform a currency crisis into a rip-roaring economic downturn. Feldstein (1998) also argued that the IMF should have focused on providing technical advice and limited financial assistance as a supportive organization rather than as the agent of painful contractions in its dealing with the Asian crisis.

19. The ninety developing countries are Algeria, Argentina, Bangladesh, Barbados, Belize, Benin, Bolivia, Botswana, Brazil, Burkina Faso, Cameroon, Cape Verde, Central African Republic, Chad, Chile, China, Colombia, Comoros, Congo, Costa Rica, Côte D'Ivoire, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Ethiopia, Fiji, Gabon, Gambia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Jamaica, Jordan, Kenya, Republic of Korea, Lesotho, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Mauritania, Mauritius, Mexico, Morocco, Nepal, Nicaragua, Niger, Nigeria, Oman, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Portugal, Romania, Rwanda, Saint Vincent, Senegal, Seychelles, Sierra Leone, Solomon Islands, Sri Lanka, Sudan, Swaziland, Syrian Arab Republic, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Uganda, Uruguay, Vanuatu, Venezuela, and Zimbabwe.

to adopt measures with a medium-term horizon for solving their balance-of-payments adjustment problems.

To compare the relation between FDI and IMF rescue loans with previous work on currency crisis, we also use a variable for currency crash, e9497, constructed as in Frankel and Rose (1996). The binary variable, e9497, takes the value one if the country experienced a nominal currency depreciation of at least 25 percent and an increase in the rate of depreciation of at least 10 percent during the period 1994–97 and zero otherwise.[20]

As independent variables, we use seven of the variables used in Frankel and Rose (1996), for which we use 1993 data due to availability.[21] As internal domestic macroeconomic variables, we use the growth rate of domestic credit (Domestic credit), which is a measure of monetary policy, and the growth rate of real GDP per capita (Growth rate). As measures of vulnerability to external shocks, we use the ratio of foreign exchange reserves to monthly import values (Reserves/imports), the current account as a percentage of GDP (Current account), and the ratio of total debt to GNP (Debt). For the composition of capital inflows and foreign debt, we use the ratio of short-term debt to total debt (Short-term debt), the ratio of net FDI inflow to total debt (FDI flow/debt), and the ratio of inward FDI stock to total debt (FDI stock/debt).

The variables of interest are FDI flow/debt and FDI stock/debt, denoting FDI inflow and inward FDI stock, respectively. FDI inflow represents the stability of the foreign capital inflow. It also incorporates the foreign investors' view of the policy regime or investment environment of the host country. Thus it is appropriate to test the first claim about the role of FDI in a currency crisis, that is, its role as a stabilizer. Meanwhile, inward FDI stock represents the presence of multinational firms in the host country. Hence, it is more suited for testing the other hypothesis, on the role of FDI in circumventing the need for IMF rescue loans in a crisis-ridden country.

Probit Estimation Results

Table 9.6 presents the probit estimation results of the cross-sectional analysis for the period 1994–97. For the currency crash case, only the coefficient on the growth rate of GDP per capita is significant. Its negative sign shows that countries with higher growth rates tend to have lower incidences of currency crash. Unlike previous studies, neither FDI flow nor FDI stock is associated with currency crash.

For IMF rescue loans, the coefficients on FDI flow and FDI stock, -0.1074 and -0.0209, respectively, are both significantly negative. This

20. In calculating the depreciation of currency, we use end-of-year exchange rates. The estimation results are not seriously affected by using the annual average of exchange rates, although the explanatory power in terms of log likelihood gets marginally smaller.

21. Definitions and data sources for the variables used are presented in appendix table 9A.3.

Table 9.6 **Probit Estimation of Currency Crashes and IMF Rescue Loans, 1994–97: Cross-Sectional Data for 90 Developing Countries**

	Dependent Variables			
Independent Variable	Currency Crash (e9497)		IMF Rescue Loan (b9497)	
Short-term debt	0.0039	0.0060	0.0125	0.0197
	(0.38)	(0.60)	(1.13)	(1.61)
Debt	−0.1214	−0.1085	−0.9743	−0.8793
	(−0.64)	(−0.66)	(−2.31)	(−2.56)
Growth rate	−0.0882	−0.0757	0.0038	−0.0140
	(−2.08)	(−2.23)	(0.09)	(−0.41)
Reserves/imports	0.0122	−0.0090	−0.0081	−0.0410
	(0.21)	(−0.17)	(−0.14)	(−0.59)
Domestic credit	−0.0005	−0.0005	−0.0010	−0.0015
	(−0.55)	(−0.55)	(−0.76)	(−0.30)
Current account	−0.0076	−0.0107	−0.0011	−0.0024
	(−0.47)	(−0.66)	(−0.06)	(−0.13)
FDI flow/debt	0.0186		−0.1074	
	(0.64)		(−2.53)	
FDI stock/debt		−0.0017		−0.0209
		(−0.51)		(−2.69)
N	84	90	84	90
N with dep. = 1	34	40	29	32
N with dep. = 0	50	50	55	58
Log likelihood	−53.57	−57.83	−46.34	−49.03

Note: Numbers in parentheses are *t*-values. For independent variables, 1993 data are used. Coefficients on the constant are not reported.

implies that countries with which the IMF made Stand-By and EFF Arrangements during 1994–97 tend to have lower FDI inflow and stock in 1993 than other countries. The coefficients on the other variables, except for the ratio of total debt to GNP (Debt), are not significant.

9.5.2 Analysis of Currency Crashes and IMF Rescue Loans Using Pooled Data, 1973–94

The cross-sectional analysis in subsection 9.5.1 has one drawback in that the number of total observations is small relative to the number of independent variables. In addition, the data in 1993 may not be able to sufficiently explain the incidence of currency crashes and IMF rescue loans in the four-year period ahead. To overcome this problem, we conduct the same analysis using pooled data for 1973–94 for eighty-four developing countries.[22]

22. Due to lack of data on IMF financial arrangements, seventeen countries are deleted from the list of ninety countries in subsection 9.5.1. They are Belize, Comoros, Djibouti, Equatorial Guinea, Grenada, Guinea-Bissau, Hungary, Maldives, Oman, Papua New Guinea, Portugal, Saint Vincent, São Tomé, Seychelles, Solomon Islands, Vanuatu, and Zim-

Variables and Data

The data descriptions are the same as in the cross-sectional analysis of subsection 9.5.1, except that for the dependent variable, ER, representing the event of currency crash, we adopt the three-year "windowing" of Frankel and Rose (1996).[23] That is, we exclude crashes that occurred within three years of each other to avoid counting the same crash twice. Similarly, for the other dependent variable, IMF, denoting the incidence of IMF Stand-By and EFF Arrangements, we exclude arrangements that were made in consecutive years to avoid double counting.[24] Among the independent variables, the ratio of inward FDI stock to total debt is deleted due to the absence of relevant data in the full sample period.

Probit Estimation Results

Table 9.7 reports the probit estimation results using pooled data for eighty-four countries during the twenty-two years from 1973 to 1994.[25] "Lagged t" means that the independent variables are those in the current year. In the "Lagged $t-1$" column, we tabulate the results in which all regressors are lagged one year to adjust for time lag in the relation between currency crashes or IMF rescue loans and macroeconomic conditions.

The estimated coefficient on our variable of interest, FDI flow/debt, is significantly negative in all cases, implying that FDI inflow relative to total debt is negatively associated with currency crashes and IMF rescue arrangements in both the current and lead periods.

For currency crashes, the coefficients on the other variables are similar to the results of Frankel and Rose (1996). Lower growth rates, higher growth of domestic credit, and higher portions of short-term debt all seem to raise the odds of a currency crash in the following year.

We saw roughly similar results for IMF rescue arrangements, except that the growth rate of domestic credit is not significantly associated with IMF arrangements and the coefficient on foreign reserves (Reserves/imports) is now significant. This is because the growth rate of domestic credit raises the inflation rate and hence has a direct effect on exchange rates or currency crashes. Meanwhile, a low level of foreign reserves relative to monthly imports indicates a country's inability to deal with a balance-of-payments problem without asking for rescue loans from the IMF. Otherwise, the results imply that the macroeconomic conditions behind cur-

babwe. Eleven countries are then added: Burundi, Lebanon, Liberia, Myanmar, Somalia, Tanzania, Western Samoa, Yemen, Yugoslavia, Zaire, and Zambia.

23. Here the annual average of the nominal exchange rate is used in calculating the depreciation rate.

24. For the case of arrangements made in more than three consecutive years, we count the first two years to take into account a delay or adjustment period in improving economic conditions.

25. For currency crash (ER), we reproduced the estimation results by Park and Lee (1998).

Table 9.7 **Probit Estimation of Currency Crashes and IMF Rescue Loans, 1973–94: Pooled Data for 84 Developing Countries**

	Dependent Variables			
	Currency Crash (ER)		IMF Rescue Loan (IMF)	
Independent Variable	Lagged t	Lagged $t-1$	Lagged t	Lagged $t-1$
Short-term debt	0.0030	0.0101	−0.0022	0.0069
	(0.61)	(2.22)	(−0.44)	(1.43)
Debt	0.5076	0.0594	0.3363	0.0981
	(3.96)	(0.46)	(3.24)	(0.92)
Growth rate	−0.0525	−0.0363	−0.0196	−0.0327
	(−4.96)	(−3.78)	(−2.00)	(−3.41)
Reserves/imports	−0.0087	−0.0377	−0.0525	−0.0786
	(−0.40)	(−1.73)	(−2.13)	(−3.03)
Government budget	0.0122	−0.0164	−0.0004	−0.0277
	(1.13)	(−1.74)	(−0.04)	(−3.00)
Domestic credit	0.0024	0.0005	0.0001	−0.0003
	(4.99)	(3.09)	(0.17)	(−0.75)
Current account	0.0241	0.0119	0.0179	0.0018
	(3.07)	(1.69)	(2.35)	(0.26)
FDI flow/debt	−0.0345	−0.0329	−0.0378	−0.0268
	(−3.43)	(−3.41)	(−3.51)	(−2.58)
N	1,080	1,111	964	996
N with dep. = 1	116	128	130	138
N with dep. = 0	964	983	834	858
Log likelihood	−306.27	−361.87	−354.56	−364.94

Note: Numbers in parentheses are t-values. Coefficients on the constant are not reported.

Table 9.8 **Probabilities of Currency Crashes and IMF Arrangements in Selected Countries, 1997**

	Korea	Indonesia	Thailand	Malaysia	Philippines	Mexico[a]
Currency crashes (ER)	0.195	0.065	0.093	0.064	0.100	0.119
IMF rescue loan (IMF)	0.168	0.050	0.071	0.065	0.097	0.119

Note: Based on estimated coefficients in "Lagged $t-1$" columns of table 9.7 applied to the values of independent variables in appendix table 9A.8.

[a]For Mexico, probabilities are for the year 1994.

rency crashes and IMF rescue loans are similar. In particular, FDI inflow seems to lower the odds of both currency crashes and IMF rescue loans.

Using the estimated coefficients in the "Lagged $t-1$" columns of table 9.7 and values of independent variables for 1996 (1993 for Mexico), we calculate in table 9.8 the predicted probabilities of currency crises and IMF arrangements in some crisis-ridden countries for 1997 (1994 for Mexico). According to the predictions, the probabilities of currency crisis and

IMF arrangements in Korea are the highest among the five crisis-ridden Asian countries. Furthermore, they are higher than the corresponding probabilities for Mexico for 1994. Appendix table 9A.8, which presents values for precrash macroeconomic variables, reveals that the high predicted probabilities of currency crisis and IMF arrangements for Korea can be attributed to the country's relatively high proportion of short-term debt and low ratio of FDI flow to total debt.

Meanwhile, the predicted probabilities for Indonesia are the lowest among these crisis-ridden countries, including Mexico. Indonesia, however, suffered a crisis no less severe than the other countries, so the above probit model may have failed to capture some political factors.

9.6 Concluding Remarks

Throughout Korea's economic development, FDI has played a negligible role. Even in 1996, FDI accounted for less than 1 percent of total domestic fixed capital formation in Korea, far less than in the Southeast Asian countries. Case study evidence shows, however, that despite its quantitative insignificance FDI has had a significant impact on the quality of Korean economic development by spinning out skilled workers and managers and through technical guidance of subcontractors.

However, industry aggregate data for six Korean manufacturing subsectors during 1974–96 fail to support the case study evidence. Estimation of a random-effects model using instruments shows that the productivity spillover effects of FDI are positive but statistically insignificant. We leave the analysis using firm-level data for future research.

Concerning the role of FDI in a currency crisis, the presence of multinational firms may help a crash-ridden country to overcome its crisis without resorting to bailout loans from the IMF. Probit estimation results using cross-sectional data reveal that inward FDI, in both flow and stock, in 1993 was negatively associated with the incidence of IMF Stand-By and EFF Arrangements during 1994–97. Probit analysis using pooled data for eighty-four developing countries during the twenty-two years from 1973 to 1994 also shows that FDI inflow tends to lower the odds of currency crash and IMF rescue loans.

Appendix

Table 9A.1 **Summary Statistics for Variables in Table 9.5**

Variable	Mean	Standard Deviation
a_{it}	0.042	0.116
$\text{fdi}_{i,t-1}$	0.069	0.310
$\text{roy}_{i,t-1}$	0.188	0.178

Table 9A.2 **Correlation Matrix for Variables in Table 9.5**

Variable	(1)	(2)	(3)
1. a_{it}	1.00		
2. $\text{fdi}_{i,t-1}$	0.09	1.00	
3. $\text{roy}_{i,t-1}$	−0.07	0.16	1.00

Table 9A.3 **Definitions and Data Sources for Variables in Section 9.5**

Variable	Definition	Source
IMF (b9497)	One if a country received IMF Stand-By or EFF Arrangements (in 1994–97), zero otherwise	1,2
ER (e9497)	One if a country suffered a depreciation by more than 25% in a year and an increase in the rate of depreciation of at least 10% (during 1994–97), zero otherwise	3
Short-term debt	Ratio of short-term debt to total debt (%)	4
Debt	Ratio of total debt to GNP	4
Growth rate	Growth rate of GDP per capita (%)	4
Reserves/imports	Ratio of foreign reserves to monthly imports (months)	4
Government budget	Ratio of government budget surplus to GDP (%)	4
Domestic credit	Growth rate of domestic credit (%)	4
Current account	Ratio of current account surplus to GDP (%)	4
FDI flow/debt	Ratio of net FDI inflow to total debt (%)	4
FDI stock/debt	Ratio of FDI stock to total debt (%)	5

Sources: (1) Santaella (1995). (2) International Monetary Fund, *Annual Report* (Washington, D.C., various years). (3) International Monetary Fund, *International Financial Statistics Yearbook* (Washington, D.C., various years). (4) World Bank, *World Data* (Washington, D.C., 1995), CD-ROM. (5) United Nations, *World Investment Report* (New York, 1995).

Table 9A.4 **Summary Statistics for Variables in Table 9.6**

Variable	Mean	Standard Deviation
b9497	0.35	0.48
e9497	0.41	0.49
Short-term debt	15.07	14.25
Debt	0.80	0.92
Growth rate	1.10	4.14
Reserves/imports	3.57	2.75
Domestic credit	51.15	292.08
Current account	−9.40	10.49
FDI flow/debt	4.05	5.63
FDI stock/debt	17.08	18.82

Table 9A.5 **Correlation Matrix for Variables in Table 9.6**

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. b9497	1.00									
2. e9497	0.26	1.00								
3. Short-term debt	0.06	−0.00	1.00							
4. Debt	−0.17	0.00	−0.02	1.00						
5. Growth rate	−0.09	−0.23	0.15	−0.19	1.00					
6. Reserves/imports	0.05	0.00	−0.01	−0.28	0.04	1.00				
7. Domestic credit	−0.07	−0.08	0.05	−0.08	0.08	0.19	1.00			
8. Current account	0.08	−0.10	0.09	−0.50	0.23	0.32	0.12	1.00		
9. FDI flow/debt	−0.21	−0.02	0.22	0.23	0.43	0.02	−0.06	0.03	1.00	
10. FDI stock/debt	−0.21	−0.06	0.30	−0.05	0.15	−0.11	−0.06	−0.10	0.64	1.00

Table 9A.6 **Summary Statistics for Variables in Table 9.7: Current Values**

Variable	Mean	Standard Deviation
ER	0.12	0.32
IMF	0.13	0.34
Short-term debt	14.60	11.94
Debt	0.54	0.42
Growth rate	1.61	5.75
Reserves/imports	3.41	3.11
Government budget	−4.32	5.83
Domestic credit	47.93	228.25
Current account	−6.79	8.53
FDI flow/debt	4.03	9.44

Table 9A.7 **Correlation Matrix for Variables in Table 9.7: Current Values**

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1. ER	1.00									
2. IMF	0.20	1.00								
3. Short-term debt	0.04	−0.01	1.00							
4. Debt	0.14	0.18	−0.06	1.00						
5. Growth rate	−0.21	−0.12	0.02	−0.21	1.00					
6. Reserves/imports	−0.03	−0.10	0.18	−0.29	0.17	1.00				
7. Government budget	−0.03	−0.05	0.04	−0.26	0.14	0.37	1.00			
8. Domestic credit	0.22	−0.01	0.04	−0.02	−0.08	0.02	−0.02	1.00		
9. Current account	0.06	−0.00	0.19	−0.29	0.09	0.38	0.30	0.03	1.00	
10. FDI flow/debt	−0.11	−0.13	−0.06	−0.26	0.19	0.27	0.21	−0.00	0.08	1.00

Table 9A.8 **Values of Macroeconomic Variables for Calculating Probabilities in Table 9.8**

Variable	Korea	Indonesia	Thailand	Malaysia	Philippines	Mexico[a]
Short-term debt (%)	58.9	24.8	40.8	41	26.6	23.1
Debt/GNP	0.26	0.534	0.504	0.392	0.649	0.332
Growth rate (%)	5.9	6.1	5.2	5.3	5	−2.1
Reserves/imports (months)	2.65	6.73	6.27	4.09	3.52	4.1
Government budget (%)	−1.1	0	1.5	−0.5	−0.1	−1.7
FDI flow/debt[b] (%)	−1.36	3.24	1.26	11.13	1.99	4.15
Domestic credit (%)	19.3	22.7	14.03	12	40.2	11.48
Current account (%)	−4.7	−4	−8.5	−7.4	−4.4	−6.42

Source: Compiled by Park and Lee (1998) from various primary sources.

Note: Values are for 1996 except as noted.

[a]For Mexico, values are for 1993.

[b]For FDI flow/debt, values are for 1995.

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Comment Hong-Tack Chun

Kim and Hwang examine whether FDI in Korea has positive effects on productivity in manufacturing industries. In addition, they investigate whether FDI plays a role in preventing currency crisis.

In their investigation of the productivity effects of FDI in Korea, they use TFP as a measure of productivity in manufacturing industries. TFP is calculated as a residual in the conventional growth accounting framework. Growth in TFP is assumed to be a function of the growth rates of the FDI stock and the royalty stock, which is used as a proxy for imported technology from foreign countries. They use a random-effects model with instruments to avoid possible endogeneity between productivity effects and the independent variables. They found that for both the OLS and the random-effects model, growth in the FDI stock has a positive but insignificant effect on TFP growth in manufacturing industries.

I have two comments on the productivity effects of FDI in Korea. My first comment is on the explanation for their finding that industry aggre-

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gate data do not show a significant effect of FDI on productivity, contrary to case study evidence. As the authors suggest, this might be due to aggregation of data at the industry level in that the experiences of individual firms are not sufficient to have an impact at the aggregate level. Currently, firm-level analysis is almost impossible because data are lacking. However, a subsector-level analysis may show a significant productivity effect because FDI is concentrated in a few subsectors, such as the chemical, electrical and electronics, and transport equipment industries.

My second comment is on the specification of the TFP equation. R&D expenditures by large Korean firms have increased rapidly since the mid-1980s. Human capital has also increased in Korea. Rapid growth in R&D expenditures and human capital might have affected both TFP and FDI. This suggests that a variable for R&D expenditure or human capital, or variables for both, should be included in the TFP equation to avoid the omitted-variables problem.

Let me turn to the role of FDI in a currency crisis. Kim and Hwang apply the probit estimation method of Frankel and Rose (1996) to pooled data from 1973 to 1994 for eighty-four developing countries to see whether FDI has an effect in preventing currency crashes and IMF rescue loans. The estimation results for currency crashes and IMF rescue loans are similar to those of Frankel and Rose.

The authors also calculate the predicted probabilities of currency crashes and IMF arrangements in six crisis-ridden countries, five Asian countries and Mexico, using the estimated coefficients and values of independent variables for 1996. They find that the probabilities of currency crisis and IMF arrangements in Korea are the highest among these countries. They conclude that the high predicted probabilities of currency crash and IMF arrangements for Korea can be attributed to Korea's relatively high proportion of short-term debt and low ratio of FDI flow to total debt. In addition, they argue that a higher proportion of capital inflow in the form of FDI could help to reduce the likelihood of future crises.

A Frankel and Rose–type model examines the statistical correlation between independent variables and a dependent variable without a structural mechanism that causes currency crisis. Therefore, the estimation results might have been affected by the omission of an important independent variable, and an estimated correlation between a independent and dependent variable may not imply a causal relation. Furthermore, one should not apply estimation results from a Frankel and Rose–type model directly to a particular country without examining the structural mechanism that caused a currency crisis in that country. In the Korean case, it is now well known that a combination of terms-of-trade shock, policy missteps, and low foreign exchange reserves relative to short-term external debt led to the currency crisis. It is doubtful that a higher net inflow of FDI alone would have prevented the crisis, although the crisis might have been less severe with a higher net inflow of FDI.

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Comment Yuri Nagataki Sasaki

In the wake of the Asian currency crisis, many papers have sought a way to prevent such crises. This paper gives us a clue to finding the way.

The paper is composed of two parts. The first part, a historical overview of FDI policy and the trend of FDI in Korea, offers a very convenient survey of the history and background of FDI policy in Korea. The second part examines the productivity effects of FDI in Korea and the role of FDI in a currency crisis.

I have some comments on the second part of the paper, sections 9.4 and 9.5. In section 9.4, the effect of FDI on productivity is examined and contrasted with the effect of royalties on productivity. Section 9.5 examines the role of FDI as a safety net during a currency crisis and explains that FDI plays this role in contrast with other forms of debt.

First, as the authors point out, it is said that foreign firms tend to locate in more productive sectors, and estimates of the impact of FDI on the productivity of domestic industries may often be biased upward. This paper uses industry-level data, not firm-level data, so the coefficients of FDI change are possibly biased upward.

Second, the paper shows that FDI has had a positive effect on the TFP growth of Korea. But if the TFP growth rate of Korea is very low, FDI may play a very limited role in its total growth. For example, Young (1995) reported that average TFP growth of manufacturing in Korea during the period 1966–90 was estimated at 3 percent. Young also showed that TFP growth in East Asia is not as high as in the G-7 countries and concluded that East Asian countries may not enjoy learning-by-doing externalities.

Third, the paper mentions that the predicted sign of royalty change, gamma in equation (3), or β_2 in table 9.5, is negative because royalties reduce R&D. But there is no evidence that royalties reduce R&D and that FDI does not have a similar effect on R&D. It would be better to explain the difference between the effect of FDI and that of royalties. Or if one can get data on R&D in Korea, it might be interesting to test the effects of royalties and FDI on R&D directly.

Fourth, table 9.1 shows that FDI inflows into Korea have increased time

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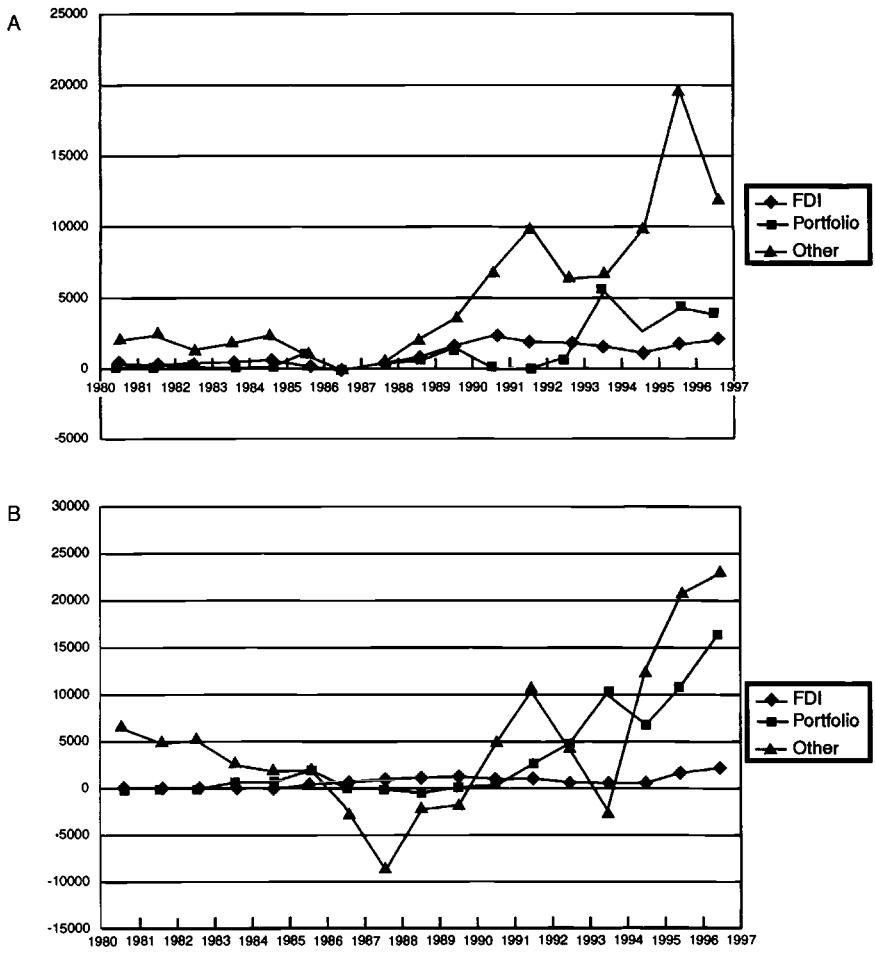

Fig. 9C.1 Capital inflows: *A*, Thailand; *B*, Korea

after time, as the Korean government has liberalized FDI policy. Although the data are annual and the sample size is small, it would be better to add some dummies to the equation to measure the effects of policy change.

My last comment is on section 9.5: This paper proposes that the Korean government promote FDI in order to raise the ratio of FDI to total debt. But another way to raise the FDI ratio is to decrease other debts, especially short-term debt. Large amounts of short-term debt—which can be promoted by countries in various ways, for example, by creating international banking facilities or by pegging exchange rates—have a strong impact on currency crisis. Figure 9C.1 shows FDI inflow, portfolio investment liabilities, and other liabilities in Thailand and Korea during

1980–96. These graphs are not strong evidence, but they show that FDI was stable but other debts grew rapidly just before the Asian currency crisis. Thus rapid growth in other debts, including large amounts of short-term debt, seems to have been one important factor in inducing the crisis.

Reference

Young, A. 1995. The tyranny of numbers: Confronting the statistical realities of the East Asian growth experience. *Quarterly Journal of Economics* 110:641–80.