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EAST-WEST CENTER WORKING PAPERS

Economics Series

No. 100, February 2009

Labor Skills and Foreign Direct Investment in a Dynamic Economy: Estimating the Knowledge-Capital Model for Singapore

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LABOR SKILLS AND FOREIGN DIRECT INVESTMENT IN A DYNAMIC ECONOMY: ESTIMATING THE KNOWLEDGE-CAPITAL MODEL FOR SINGAPORE

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Acknowledgments

Most of the research for this paper was undertaken at the World Bank Headquarters in Washington DC and the World Bank Country Office in Singapore. Research for this paper was partially undertaken while Gnanaraj Chellaraj was a Visiting Scholar, and Keith Maskus a Visiting Professor at the University of Adelaide, Australia. The authors are grateful to the School of Economics, University of Adelaide, Department of Economics, University of Colorado, Boulder, the East-West Center and the World Bank Country Office in Singapore for their technical support. This paper was presented at the East-West Center on February 18, 2009. Partial funding for this paper from British DIFID is gratefully acknowledged. Finally, the authors are grateful to Marcus Noland, Nancy Lewis, Sumner LaCroix, Rana Hasan, Jian Zhang and the anonymous reviewers for helpful comments and suggestions.

Abstract

In this paper we analyze changes in the inbound and outbound investment between Singapore and a sample of industrialized and developing countries. The nature of Singapore's two-way investment with the industrialized nations has shifted into skill-seeking activities over the period, while Singapore's investments in developing countries have increased sharply and become concentrated in labor-seeking activities. Over the 1984-2003 period, as host Singapore became skill abundant relative to parent industrialized countries, average inbound investment stocks from these countries increased by US$ 24.8 billion annually, while the corresponding figure for outbound stocks to host developing countries was US$ 9.5 billion.

1. Introduction

In this paper, we explore the influence of skills on foreign investment in a small newly industrialized country (NIC), Singapore. Singapore has been successful in attracting FDI during its period of rapid economic development (Shin, 2005). The country has also experienced significant deepening of its human capital stock during this period. It is possible that the rapid growth of its skill endowments has been a significant factor in attracting FDI, with causation running in both directions.

One framework within which to analyze the role of skill endowments on FDI location is the Knowledge Capital (KK) model. This model has been applied to a number of industrialized countries, including the United States (Carr, Markusen and Maskus 2001; hereafter CMM). The KK model has, however, not been tested for any of the NICs and has been applied to investment data for only one developing country, China (Gao, 2003).

At the time of independence in 1965, Singapore was a relatively unskilled-labor-abundant and natural-resource-poor developing country with high levels of poverty and low economic growth. Shortly thereafter the Government of Singapore (GOS) adopted an industrialization strategy, including opening the country to foreign investment in most sectors. The GOS actively promotes cross-border investment and has removed almost all barriers to trade (Ramkishnen and Thangavelu, 2008). In addition it facilitated trade by promoting efficiency in cross-border flow of goods, services and selected labor flows, in particular skilled labor. Singapore is a member of several regional and international trade and investment forums (including ASEAN, APEC, WTO, etc) and has negotiated bilateral trade and investment pacts with many countries around the world.

Until the late 1970s, multinational enterprises (MNEs) were attracted by the country's large low-skilled population and low wages (Low, 1999). By the early 1980s, Singapore's

economy was growing rapidly and wages were escalating, leading MNEs producing labor-intensive goods to look elsewhere. In response, the GOS developed strategies to attract FDI in higher-technology goods by focusing on developing the skills of its population (Low, 1999) Between 1984 and 2003 Singapore rapidly closed its skills gap with most industrialized countries through training and expanding education (Anwar, 2008). The existence of skill-deepening may be seen from the fact that skilled employment increased from 16 percent of the labor force in 1982 to 33 percent of the labor force in 2003 (International Labor Organization).

Compared to other industrialized countries, Singapore has few domestically owned and headquartered MNEs. Rather, its strategy has been to make the country an attractive investment location for foreign MNEs. This policy, generally known as the "complementary strategy" (Shin 2005), mostly emphasized investments in skills development (Chang, 2005; Hu, 2004). In the mid 1980s, the GOS adopted a policy of promoting and developing Singapore as a regional hub (Dobson and Chia, 1997). There were two strategic elements: developing highly specialized niches and upgrading the low productivity domestic sector. The Singapore government adopted the cluster strategy of promoting key industries in electronics, pharmaceutical, telecommunications, etc (Hattari et al., 2008). In the most recent decade Singapore has shifted from low end manufacturing toward research, innovation, banking and financial investments (Sung 2006). Kee and Hoon (2005) argue that the rapid economic development of Singapore may be partly attributed to these policies.

In 2003, inbound direct and portfolio investment stocks exceeded the corresponding outbound investment stocks by a margin of over 4 to 1, as noted in Figure 1. Further, two-way investment between industrialized countries and Singapore exceeded that between

developing countries and Singapore by more than 3 to 1. Most inbound investment comes from industrialized countries while most outbound investment goes to developing countries. Again, it is plausible that increasing relative Singapore skill endowments underlay the increase in outbound investment stocks, especially in developing countries.

Singapore poses an interesting study of the role of skills on FDI because of its unique and dynamic nature. It went from a small, labor-abundant developing nation in the mid-1970s to a larger, though still small (in terms of GDP), skill-abundant NIC today. In consequence, the nature of its inward FDI should have shifted from a labor-seeking orientation to a skill-seeking orientation. Meanwhile, its investment in developing nations should reflect a growing labor-seeking motive as international firms seek low-cost manufacturing locations to service from regional headquarters. We study these changes in this paper, through the prism of the knowledge-capital model.

The paper proceeds as follows. In the next section we review the literature that motivates the analysis. In Section 3 we specify the KK model for estimation and in Section 4 we provide the econometric results. In the final section we discuss the potential economic and policy significance of the findings and offer concluding remarks.

2. The Knowledge-Capital Model and Prior Empirical Literature

Since Markusen (1984) and Helpman (1984), the general-equilibrium theory of the multinational enterprise has focused on two distinct motivations for investment: to access markets in order to circumvent trade frictions (horizontal FDI) and to employ low-wage labor for assembly parts of the production process (vertical FDI, or fragmentation). In the former case, multiple plants making similar goods are located in different markets and produce

either for local markets or regional exports. In the latter, headquarters are split from assembly, and goods are traded in different stages of fabrication.

2a. Theoretical Overview

These motivations may be understood consistently within the general-equilibrium knowledge-capital model of FDI, explicated in Markusen (2002). The KK approach includes three principal assumptions. First, services of knowledge-based activities, such as R&D, can be geographically separated from production and supplied to production facilities at low cost. Second, these knowledge-intensive activities are skilled-labor intensive relative to production. These assumptions create a motive for the vertical fragmentation of production, locating R&D activities where skilled labor is abundant and production where unskilled labor is plentiful. There will also be a motive for locating production in large markets if there are plant-level scale economies.

Third, knowledge-based services have a (partial) joint-input characteristic, in that they can be utilized simultaneously by multiple production facilities. The third assumption creates firm-level scale economies and motivates horizontal investments that replicate the same products or services in different locations.

The model assumes two homogeneous goods (X and Y), two countries (h and f), and two homogeneous factors, unskilled labor (L) and skilled labor (S), which are internationally immobile. Good Y is labor-intensive and produced under constant returns to scale in a competitive industry. Good X is skilled-labor-intensive overall, has increasing returns to scale at the plant level, and is subject to Cournot competition with free entry and exit. Within a firm, headquarters services and plant facilities may be geographically separated and a firm may have plants in one or both countries. Because R&D services can be shared across plants, sector X

exhibits firm-level economies of scale as well. Transport costs in trade use unskilled labor and there are fixed costs of investing in a new plant.

With this structure, there are several firm types that can arise in equilibrium. First, there may be national firms that maintain a single plant and headquarters in one country and may or may not export to the other. Second, there may be horizontal MNEs that maintain plants in both countries with headquarters located in one country. Finally, there may be vertical MNEs that maintain a single plant in one country and headquarters in the other.

Different country characteristics favor various firm types producing or maintaining headquarters in either country. For example, national firms will be more likely in country h if it is relatively large, which encourages local production while firms would avoid investment costs in the smaller nation. National firms also dominate if the two nations are similar in size and relative endowments, tending to discourage vertical FDI, and transport costs are low or foreign investment barriers are high, reducing horizontal investment.

Horizontal MNEs become important if the nations are similar in size and relative endowments, transport costs are high and investment costs are low. In this environment firms find it advantageous to locate production capacity in both locations, taking advantage of firm-level scale economies, while selling primarily in local markets to avoid transport costs. However, if the countries vary in endowments but have similar size firms, MNEs would concentrate headquarters in the skilled-labor-abundant country and production in the skilled-labor-scarce country. Thus vertical firms headquartered in the skilled-labor-abundant countries are favored unless trade costs are high. Vertical MNEs become especially significant if one country is small and skilled-labor abundant, in which case headquarters

locate there and produce in the other location. This incentive is increased if trade costs from the host country back to the parent country are low.

2b. Application to Singapore

We apply this model informally to Singapore in order to motivate our regression analysis. Throughout the period of analysis, Singapore, despite experiencing rapid economic growth, remained small in terms of its own market size (domestic consumption) in comparison with the other countries in our sample. However, the economy dramatically increased its relative skill endowments. For example, Figure 2 depicts trends over time in relative skill differences between Singapore and selected industrialized countries (the United States, the United Kingdom, Japan, Australia, Germany and the Netherlands).[1] The downward trend in each case reflects increases in Singapore's endowment of occupational skills relative to the partner nation. Specifically, the skills gap between Singapore and its industrialized investment partners began to fall in the late 1980s, with more dramatic falls occurring in the early 1990s. Indeed, by this measure Germany, the Netherlands and Australia became scarce in such skills compared to Singapore over the period, while the gap between U.S. and UK skills, on the one hand, and Singapore, on the other, fell sharply. Singapore also built an increasing skill gap relative to the developing economies in our sample.

Thus, throughout our period Singapore was small in size but shifted its endowment ratio from being labor-abundant to skill-abundant, even with respect to many of the industrialized countries. This development path should then be reflected in the data from a positive impact of skill differences on inward investment early in our period, reflecting the

[1] We define this measure of skill differences in the next section.

tendency of FDI to seek low-cost labor in Singapore. Put differently, a rise in Singapore's skill ratio would diminish incentives for vertical investment, which would not be offset by a gain in horizontal investment incentives. However, late in the period inward FDI from industrialized partners should expand with a rise in Singapore's skill endowment because that investment would be skill-seeking in nature.

As an initial study, Figure 3 shows the growth of inward FEI stocks from the same set of industrialized countries over the period. In all cases, as skill differences decreased investment in Singapore expanded, but this increase accelerated late in the period.

2c. Prior Estimation

In CMM (2001) the initial empirical estimation of the KK model was performed, using a 1986-1994 panel dataset of bilateral country-level affiliate sales in manufacturing, involving both U.S. affiliates abroad and foreign affiliates in the United States. In their econometric work, the authors found that a convergence in income (GDP) between the United States and any investment partner (holding the sum of their incomes constant) increased affiliate sales in both directions. There was substantially greater evidence of horizontal FDI, with affiliate sales rising in host countries with skill endowments closer to those of the United States, than of vertical FDI. This result may have been due to the selection of countries, which did not include many lower-income developing nations.

This empirical evidence has been substantiated by other studies. Gao (2003) included an additional variable to account for ethnic networks and found that there is a significantly positive role in inward FDI of ethnic Chinese networks. Waldkirch (2008) studied German MNEs and found that FDI happens largely between similarly endowed countries, with little

evidence of any vertical motivation. Braconier, Norback and Urban (2005) included other industrialized countries, such as Sweden, and found evidence to support the KK model.

An important criticism of the CMM approach was that pooling bilateral data could disguise the actual relationships between endowment differences and MNE activity. The reason is that the United States was the host in half the observations and the parent in the rest, implying that the sign of their skill-endowments variable (the difference between parent and host in the ratio of skilled to total labor) depended on the direction of the investment. Thus, where the United States was a skill-abundant host (parent), an increase in skill differences implied a convergence (divergence) in endowments. This difference makes interpretation of coefficients difficult and calls for splitting the sample into inward and outward investment (Blonigen, Davies and Head, 2003; Blonigen, 2005).

A second criticism of such studies is the potentially inappropriate pooling of data from developing and industrialized countries. Blonigen and Wang (2004) found that the underlying factors affecting the location of FDI activity varied systematically across these country groups in a way that was not captured by prior empirical models. Thus, U.S. outward FDI to large industrialized countries is strongly attracted to countries with higher skill abundance, suggesting a horizontal motivation. However, the effect was reversed for FDI in developing countries, although the relationship was not statistically significant.[2]

As Blonigen and Wang's (2004) criticism would suggest, a drawback of the earlier studies is that, except for Gao (2003), they did not consider data for specific developing countries or NICs, such as Singapore. Furthermore, many multinationals base themselves in Singapore and invest in neighboring developing countries, and hence there is a need to take

[2] See also Yeaple (2003).

into account the market size of the entire ASEAN region. In principle, application of the KK model to Singapore is both novel and appropriate, because during the period of analysis the country made a transition from attracting labor-intensive foreign investment to acquiring skill-intensive foreign investment. Furthermore, as MNEs use Singapore as regional headquarters to invest in neighboring countries, the use of ASEAN GDP to account for host market size is appropriate for inbound foreign investment. As this research incorporates both these investment objectives, a panel study of two-way FDI into and out of Singapore taking into consideration the impact of the regional market size should be of considerable interest. In addition, we also incorporate the role of the GOS in maintaining political stability, strict anti-corruption laws as well as the development of infrastructure such as roads, rails, energy, telecommunications and ports.

3. Empirical Framework and Data

Here we specify the econometric approach that represents the KK model and address a number of questions. We then describe our dataset, which was developed specifically for this analysis and seems unique in its comprehensive coverage of a panel of two-way FDI stocks for a country in transition from labor abundance and low incomes to skill abundance and high incomes.

3a. Basic Specification

The KK model provides an econometric specification, grounded in theory, for explaining the general determinants of FDI activities. It is sufficiently flexible to permit the data to reveal, indirectly, whether FDI into and out of Singapore is driven by factor-cost (vertical) motivations, market-seeking (horizontal) motivations, or both. Following CMM, our initial specification is as follows:

$$FEI_{ijt} = \beta_0 + \beta_1 (GDP_{it} + GDP_{jt}) + \beta_2 (GDP_{it} - GDP_{jt})^2 + \beta_3 (SK_{it} - SK_{jt})$$
$$+\beta_4 (GDP_{it} - GDP_{jt}) * (SK_{it} - SK_{jt}) + \beta_5 IC_{jt} + \beta_6 INST_{jt} + \beta_7 INFRA_{jt} + \beta_8 TC_{jt} + \beta_9 TC_{jt} *$$
$$(SK_{it} - SK_{jt})^2 + \beta_{10} TC_{it} + \beta_{11} DIST_{ij} + e_{ijt} \quad (1)$$

In this specification the dependent variable is the stock of foreign equity investment (FEI) invested by country i (the parent) in country j (the host).[3] For inward investment, Singapore is always the host country and for outward investment Singapore is always the parent country. CMM (2001) employed majority-owned affiliate sales in manufacturing as their measure of FDI activity. This measure is not available for Singapore for the period 1984-2003, and hence we choose to analyze investment stocks instead. Note that focusing on stocks instead of activity flows may actually be an advantage, for the former measures reflect long-term decisions to invest and are less volatile, and less dependent on omitted variables, than are annual activity measures (Braconier, Norback and Urban, 2005).

The first right-hand side variable is the sum of parent-country and host-country real gross domestic product, which we label GDP Sum. It captures joint market size and the coefficient is expected to be positive. The next variable is the squared difference in GDP between parent and host nations. These differences capture changes in relative size, holding relative factor endowments fixed, and the theory implies that incentives for market-seeking investment should increase as countries become more similar in size. Thus, in principle there should be an inverted U-shaped relationship between FEI stock and country size differences, suggesting that the coefficient should have a negative sign.

As noted above, one difficulty with this interpretation is that Singapore is small relative to the other countries in the data. When one partner is small, the underlying

[3] Definitions of variables and data sources are provided in the following subsection.

theoretical discrimination between horizontal and vertical motivations is less sharp and it is possible to observe a positive coefficient on size differences. This might be particularly true early in the period of Singapore's growth when it was relatively more labor-abundant.

The next variable is the difference in relative skill endowments between the parent and host countries. This is a central variable in the KK model for its potential to identify differences in investment motivations. Thus, if the parent country is skill-abundant and the recipient country is abundant in lower-skilled labor, an increase in skill differences should raise incentives for vertical FEI, or fragmentation, implying a positive coefficient. However, if countries are relatively similar in their endowments, supporting horizontal incentives for FEI, an increase in this difference would tend to diminish investment, generating a negative coefficient. Finally, if the recipient nation is skill-abundant, implying that the skill differences variable is negative, a rise in its endowment would attract skill-seeking FEI. In that case the coefficient would be negative. The interaction between country-size differences and skilled labor differences is expected to have a negative impact since FEI stocks should be smaller where market size differences are large, for a given difference in skills. This variable is designed to capture some of the non-linearities implicit in the KK model.

The variable IC_{jt} captures the costs of investing in the host country, whether that is Singapore for inbound FEI stocks or partner nations for outbound FEI stocks. Higher host-country investment costs should reduce investment. The variable $INST_{jt}$ captures the institutional barriers in Singapore for inward FEI and partner nations for outbound FEI. Higher host country institutional barriers should reduce investment. Similarly $INFRA_{jt}$ captures the infrastructure barriers in the host country and should have a negative impact on FEI. The next variable, TC_{jt} is a measure of trade costs (import restrictions) in the host

country. To the extent that investment is driven by market-seeking incentives, higher host-country trade costs should increase it due to tariff-jumping. However, where investment is undertaken to fragment production networks, higher trade costs can deter FEI. Finally, parent-nation trade costs (TC_{it}) should have a negative impact on FEI stocks since they make exporting output back home more costly. The interaction term between host-country trade costs and squared skill differences is designed to capture the fact that such costs should encourage horizontal, but not vertical, investment, in which case they should matter less when skill differences are large. But, as CMM (2001) point out, this is not a theoretically sharp hypothesis. Finally, $DIST_{ij}$ is the distance in kilometers between Singapore and the capital cities of partner countries. Generally, one would anticipate a negative coefficient on this variable.

While coefficient β_3 captures the direct marginal impact of skill differences on investment stocks, the total marginal effect depends on other economic determinants, as suggested by the non-linearities captured in interaction terms. For example, if β_4 is negative and the parent country is larger than the host, a reduction in the difference in country size (that is, an increase in the size of the host) should reduce the sensitivity of investment stocks to skill differences. In terms of our application, if over time Singapore (as host) grows in size relative to parent investors, the relationship between Singapore skill differences and investment stocks should get smaller or become negative, reflecting a shift in incentives away from vertical to horizontal FEI.

This basic framework is applied to data samples involving both inbound and outbound FEI stocks in Singapore. This estimation should capture the basic influences of the KK model. However, we also split the sample into inbound and outbound separately for

industrialized-country and developing-country partners and investigate foreign investment behavior for these groups separately. For inbound investment from industrialized countries, the motivation is expected to shift over time from labor-seeking to skill-seeking. Investment by developing countries in Singapore is small, coming mostly from neighboring ASEAN countries and India and China, compared to Singapore's corresponding outbound investment. Hence, outbound investment from Singapore to developing countries is expected to be predominantly vertical, while we have no particular expectation about inbound investment.

As noted in Figure 2, Singapore rapidly increased its share of skilled occupations in its labor force in the 1980s and 1990s, to the point where it became skill-abundant relative to many of its developed-country partners even as foreign investment continued to increase (Figure 3). This implies that the skill-difference variable shifted from being positive to negative for a number of parent countries investing in Singapore over the period. In itself, this fact is consistent with the rapid development of the country shifting incentives away from low-wage investment to skill-seeking investment. To capture this possibility we also split the sample into two groups, first the observations from 1984 to 1987 and second those from 1988 to 2003. This sample split is based on an inspection of the skills data contained in the next subsection.

3b. Data Sources and Description

The dependent variable in the KK model should be a measure of bilateral stocks of foreign direct investment. Unfortunately, Singapore only sporadically compiled outbound and inbound FDI data for some countries in the sample before 1994. Information from 1984-2003 is available on bilateral stocks of foreign equity investment, defined as the sum of direct equity investment and portfolio equity investment. Direct equity investment incorporates all

investments made in ownership entailing a measure of management control, with a minimum ownership threshold of ten percent, while portfolio investment involves financial stakes unrelated to management control. Thus, the measure we analyze, FEI stocks, is somewhat broader than FDI. However, in Singapore portfolio investment is relatively small. Stocks of such investment amounted to no more than 9.5 percent of total FEI stocks from 1994 to 2003 and averaged less than 4.0 percent. Moreover, the correlation between FEI stocks and FDI stocks from 1994 through 2003 is 0.929. We employ data on investment stocks in all sectors, which include manufacturing and services, and in total manufacturing. The sources of the FEI data are the *Statistical Yearbook of Singapore, Foreign Equity Investment in Singapore* and *Singapore's Investment Abroad,* both published by the Singapore Department of Statistics. They are converted into millions of 1990 US dollars using contemporaneous exchange rates and the US GDP deflator.

Data on the right-hand side variables come from sources detailed in CMM (2001), updated through 2003. Real GDP is measured in billions of 1990 US dollars for each country. Annual real GDP figures in local currency were converted into dollars using the market exchange rate. Both GDP and exchange rate data are from the *International Financial Statistics* of the IMF. Skilled labor abundance is defined as the sum of occupational categories 0/1 (professional, technical, and kindred workers) and 2 (administrative workers) in employment in each country, divided by total employment. These figures are compiled from annual surveys reported in the *Yearbook of Labor Statistics* published by the International Labor Organization. In cases where some annual figures were missing, the skilled-labor ratios were taken to equal the period averages for each country. Our skill-difference variable is the relative skill endowment of the parent country less that of the host country.

The cost of investing in the affiliate country is a simple average of several indices of perceived impediments to investment, reported in the *World Competitiveness Report* (1986-1994) and *Global Competitiveness Report* (1995-2003) of the World Economic Forum. The investment barriers include restrictions on the ability to acquire control in a domestic company, limitations on the ability to employ foreign skilled labor, restraints on negotiating joint ventures, strict controls on hiring and firing practices, market dominance by a small number of enterprises, an absence of fair administration of justice, difficulties in acquiring local bank credit, restrictions on access to local and foreign capital markets, and inadequate protection of intellectual property. The resulting indices are computed on a scale from zero to 100, with a higher number indicating higher investment costs. The institutional barriers are defined as the frequency of bribery and corruption in the host country and are computed on a scale from zero to 100 with zero being the least corrupt and 100 being the most corrupt. Meanwhile, the infrastructure barriers refers to the quality of infrastructure in the host country and includes the quality of railroad, ports, air transport, waterways, roads, electric supply as well as telecoms and telephones. They are also computed on a scale of zero to 100 with zero being the most efficient and 100 being the least efficient. Finally, the trade-cost index is taken from the same source and is defined as a measure of national protectionism, or efforts to prevent importation of competitive products. It also runs from zero to 100, with 100 being the highest trade costs. All of these indices are based on extensive surveys of MNE managers. Finally, distance is the number of kilometers of each country's capital city from Singapore.

The number of countries and years included for manufacturing (1994-2003) is lower than that of the full sample (1984-2003).[4] The full sample was also estimated for the period 1994-2003 using the same countries as in the manufacturing sample for comparison purposes. As discussed earlier, the substantial improvement in Singapore's skill base and investment climate should have raised the incentives of MNEs to locate regional headquarters there, from which to increase outward vertical FDI.

Summary statistics on all variables are available on request. To overview them, industrialized countries make up about 2/3 of the sample. Overall total outbound FEI stocks to developing countries were far higher than the reverse activity. In contrast, total inbound FEI stocks from industrialized countries were much higher than Singapore's outbound FEI to those nations. Average FEI stocks were considerably larger after 1988 than before in both directions. It is important to note that there are a number of years early in the period where either inward or outward investment stocks were reported to be zero, almost always with developing countries. Thus, our estimation procedure is Tobit.

3c. Endogeneity and Instrumental Variables

It is evident that causation may run both ways between skill differences, which is our primary determinant of interest, and foreign investment. For example, an increase in inbound FEI may raise the level of skills in Singapore due to professional training within MNEs. Moreover, flows of investment may be accompanied by skilled engineers and managers within the firm. Thus, the skill-differences variable is likely to be endogenous to investment

[4] The countries included in the full sample (1984-2003) are Australia, Canada, France, Germany, the Netherlands, Japan, Switzerland, Taiwan, UK, USA, Hong Kong, China, India, Indonesia, Malaysia, the Philippines, South Africa and Thailand. There were no manufacturing FEI data for South Africa. For India, data were available only after 1998. Hence both countries are excluded from the 1994-2003 analysis.

to some degree. To address this issue we develop instruments that plausibly are correlated with skill differences but not correlated with the regression error term.

We incorporate two classes of instruments. First is the vector of legal marriage ages for males and females in the partner country, which we take from the UN *Demographic Yearbook* and the relevant statistical yearbooks of individual countries. The idea is that as the prevalence of skills rises, countries are likely to adopt higher minimum marriage ages in response to demographic pressures. For example, France increased its marriage age for women from 15 to 17 in 1999 and India raised it from 17 to 19 in 1996. Thus, for French investment in Singapore these instruments are the marriage ages of males and females in France, whereas for Singapore's investment in India it is the corresponding Indian ages. We note that there is considerable variation across countries in legal marriage ages but not much time variation within any country in our period.

A second class of instruments relates to labor-market conditions abroad. For regressions involving bilateral FEI stocks between Singapore and the industrialized economies we employ the contemporaneous unemployment rates in China and the Philippines. The idea is that changes in aggregate labor demand in those countries should be correlated with labor-market conditions, including occupational mix, in Singapore and the developed economies, but should be exogenous to decisions to change their bilateral FEI stocks. Similarly, for bilateral skill-ratio differences between Singapore and the developing economies our instrument is the average unemployment rate of OECD countries, which is available from an on-line OECD database. The citizens of these countries also have options to go to other countries such as the US, UK or Australia if unemployment rates remain high. But, countries such as the US, UK and Australia have annual quotas on foreign talent while

Singapore does not. Hence, it is appropriate to use unemployment rates in OECD countries, and China and the Philippines as instrumental variables. The Chinese unemployment rate is available from the People's Republic of China *Statistical Yearbook* and the Philippines unemployment rate is available from the Philippines *Yearbook of Statistics*.

3d. Regional FDI Activities

One notable feature that helps explain the structure of foreign investment is that MNEs often establish an affiliate in Singapore and then use it as a base to invest in neighboring developing countries (Low, Ramstetter and Yeung, 1998). Examples of such corporations are presented in the Annex. Outward investment by foreign-controlled firms was around 60 percent of total outward investment during 1995, declining to 40 percent by 1998.[5] It declined further to 35 percent by 2003 due to waves of mergers and consolidations in which Singapore based corporations purchased majority stakes in foreign firms operating in Singapore (Department of Statistics, 2003). To check the robustness of the results using Singapore GDP, and to account for the ASEAN market size, we also use ASEAN GDP to account for regional investment activities for both manufacturing and aggregate investment. Specifically, the variables GDPSUM and the square of GDP differences would change to account for ASEAN GDP. For skill differences interacted with GDP differences, we would use ASEAN GDP interacted with skill differences between Singapore and its investment partners. Meanwhile all other variables remain the same as the basic specification. Here, we focus only on inbound investment from industrialized countries.

[5] Department of Statistics, Government of Singapore

Annual real GDP figures for ASEAN[6] in local currencies were converted into dollars using the market exchange rate. Both ASEAN GDP and exchange rates are from the *International Financial Statistics* of the IMF.

4. Econometric Results

We first apply the basic framework to the inbound and outbound FEI data for all sectors (manufacturing plus services)[7] and countries. We then repeat the analysis for manufacturing separately. The available data series on FEI stocks in manufacturing only begins in 1994, and hence those regressions cover just the latter half of the period.

Our instrumental-variables procedure is to run the first-stage regressions of relative skill differences on the instrumental variables discussed above for each sample and use the predicted values to estimate second-stage tobit regressions. With few exceptions, the Sargan test[8] indicated that the variables are uncorrelated with the residuals and serve as appropriate instruments. The first-stage equations are available upon request.

4a. Basic Specification

The first column of Table 1 presents second-stage Tobit regression results for aggregate inbound FEI stocks in Singapore for the period 1984-2003, while the second column presents the results for aggregate outbound stocks. Table 2 (columns 2 and 4) presents the corresponding results for manufacturing inbound and outbound FEI (1994-2003) while columns 1 and 3 present the results for aggregate inbound and outbound FEI for the

[6] Sum of the GDPs of Singapore, Malaysia, Indonesia, Thailand, the Philippines, Vietnam, Cambodia and Laos. Time series data for Myanmar and Brunei Darrusalam were not available for all years and hence were excluded fromt the ASEAN GDP.

[7] Mining and agriculture are extremely small sectors in Singapore and no FEI data are reported for them.

[8] A Sargan test for over-identifying restrictions is used to test for the validity of instruments. The instruments adopted are valid if the p value is greater than 0.1.

same period. During the 1984-2003 period, the effect of joint market size on inbound investment, measured by the sum of GDP, is positive and significant but the coefficient on squared difference in real GDP is also positive and significant, the latter not the expected outcome under the KK model. For 1994-2003 (Table 2), the squared difference in real GDP is also positive and significant for aggregate inbound stocks. However, the corresponding coefficient for inward manufacturing investment in the second column of Table 2 is negative (though insignificant) as expected under the KK model. These findings suggest that there is a notable difference between manufacturing and non-manufacturing as regards inbound FEI stocks. Inbound manufacturing investments follow the inverted-U shape in size differences, but aggregate inbound investments seem to rise with differences in GDP suggesting that non-manufacturing investments do so as well. It may be that larger parent countries, such as the United States and Japan, are more likely to invest disproportionately in non-manufacturing sectors as their GDP rises. Also in Table 1 and 2, we find that outbound aggregate and manufacturing investment from Singapore rises in market size and falls in GDP size differences, as anticipated.

The investment-cost, trade-cost and infrastructure barrier indexes in the host country are insignificant for aggregate inbound stocks while investment costs are negative and significant at the five percent level for inbound manufacturing FEI. Meanwhile, the institutional barrier index for Singapore is negative and significant at the five percent level for the 1984-2003 aggregate and manufacturing samples suggesting that government policy to promote stability and actions against bribery and corruption over time makes the country attractive for investment. However, the direct impacts of investment costs as well as institutional and infrastructure barriers in outbound aggregate investment and outbound

manufacturing investment achieve the expected signs and are significantly different from zero. Thus, Singapore's aggregate investment abroad as well as in manufacturing avoids higher investment costs as well as higher institutional and infrastructure barriers. Meanwhile for aggregate outbound investment, trade costs of the host countries are insignificant while the trade cost of the parent is negative and significant at the one percent level for both aggregate inbound and outbound stocks. Finally, distance does not have much of an impact on inbound stocks. It however significantly reduces total outbound and manufacturing investment.

Our main interest lies in the impact of relative skill endowments. The direct coefficients on relative skill differences, specified as the parent country's share of skilled occupations in the labor force minus the corresponding figure for the host country, are negative and significant at the one-percent level for the 1984-2003 aggregate inbound samples. But, they are negative and significant only at the five percent level for the aggregate 1994-2003 inbound sample and insignificant for the manufacturing inbound samples. This suggests that although inbound manufacturing investment increases with a relative increase in Singapore skills it is not sensitive to changes in skill differences. However, skill differences are significantly positive at the one percent level in all outbound regressions, suggesting that an increase in Singapore's skills compared to the countries in which it invests tends to increase FEI stocks. Singapore's outbound investment has largely gone to developing countries and in that sample the skill-differences variable is always positive. Thus, an increase in this variable would suggest a rising relative skill endowment in Singapore, which induces a rise in both aggregate and manufacturing outbound FEI stocks.

This finding supports the view that Singapore's investment abroad is concentrated in labor-intensive assembly manufacturing, particularly later in the period.

As noted earlier, the total impact of skill differences depends also on the interaction coefficients. Thus, the average annual impact of changes in FEI stocks as a result of changes in skill differences is derived as follows:

$$\partial FEI/\partial(SK_{it} - SK_{jt}) = \beta_3 + \beta_4 (GDP_{it} - GDP_{jt}) + 2*\beta_9 (TC_{it} * (SK_{it} - SK_{jt})) \quad (2)$$

The interaction between GDP differences and skill differences for 1984-2003 is negative and significant for both aggregate inbound FEI as well as manufacturing FEI. Plugging in the means for the entire aggregate inbound sample in Table 1 into equation (2), we get the following results:

$$\partial FEI/\partial(SK_{it} - SK_{jt}) = -12985 - 0.0054(1080788) + 2*(-0.005)(18.1205*-0.07393) =$$

-US$ 18821.2 million

Over the 1984-2003 period, as host Singapore became skill abundant relative to all parent countries in our sample, average inbound FEI stocks from these countries increased by US$ 18.82 billion annually. Singapore's increasing skill abundance over the time period relative to all parent countries accounted for 41% of average aggregate inbound FEI stocks from these countries in our sample. For most of the period the GDP of all parent countries was always larger than Singapore's, making the GDP difference variable mostly positive. Compared to the industrialized countries Singapore was relatively scarce in skills early in the period. Thus, an increase in skill differences was a divergence in endowments, tending to diminish incentives for market-seeking investment for a given relative size, consistent with the full-period total FEI sample. Later in the period Singapore became skill abundant, even compared to most industrialized parent countries, and a rise in skill differences would imply

a convergence in skills and a tendency to increase skill-seeking FEI, consistent with the manufacturing-sample coefficient on inbound stocks. Note, finally, that the interaction terms between the square of skill differences and trade costs for inbound FEI stocks (Table 1) are negative, though insignificant.[9]

Table 3 offers a different cut of the data by considering aggregate inbound and outbound FEI stocks broken down into investment with industrialized countries and with developing countries. The first and second columns list results for aggregate data with developing countries and the third and fourth columns for industrialized countries. Variations in joint market size positively affect inbound FEI stocks from developing countries, while this variable is not significant for industrialized nations. The coefficients on squared differences in GDP are positive for industrialized countries, consistent with the result for aggregate inbound FEI in Table 1 (column 1) but negative for developing countries, the latter consistent with the KK model.

The primary difference between bilateral investment with industrialized and developing countries arises in the coefficients on skill differences. The direct impact on inbound and outbound FEI is negative in the case of industrialized partners, a result that we explore further below. In contrast, this coefficient is significantly positive for both inbound and outbound investment with developing countries, indicating that this investment has a vertical orientation. As Singapore's skill endowments rose compared to those in neighboring developing economies, outbound FEI stocks grew larger. The results are similar for inbound stocks from developing countries, where all skill-differences data observations are negative. Here, an increase in skill endowment in a developing-country host would reduce this

[9] All the equations in Tables 3 and 4 were re-estimated using absolute skill values but the result did not change.

negative skill difference. The positive coefficient implies that inward FEI in Singapore from such countries would increase, meaning that as they become more skill abundant relative to Singapore they invest more in the latter. However, it should be remembered that inbound investment stocks from developing countries to Singapore are small and confined mostly to ASEAN member countries and more recently India and China.

At the aggregate means using equation (2), over the 1984-2003 period, as host Singapore became skill abundant relative to all parent industrialized countries such as the Japan, Germany and the US, average inbound investment stocks from these countries increased by US$ 24.8 billion annually. However, more insight may be gained by computing total derivatives of inbound FEI stocks, valued at the sample means of all variables in 1994 (the mid-year of the sample), and taking account of the sign of skill differences for each industrialized country investment partners in Table 3. Plugging in these values in equation (2) we find the following results. First, over the sample period an increase in Singapore's skilled labor abundance relative to the parent country increased total inbound FEI stocks from all industrialized countries and vice versa. Regarding investment from industrialized countries, it is notable that parent firms in these countries have invested significantly in skill-intensive activities in Singapore and also have located regional headquarters facilities there. In addition, regarding investment from developing countries, a rise in Singapore's skill abundance relative to China marginally increases inbound FEI stocks from China. The latter result reflects the importance of size as well as relative skill endowments, for enterprises in large developing countries find it advantageous to locate their skill-intensive operations in Singapore. Our result suggests that as Singapore becomes even more skill-abundant, for given GDP levels, Chinese enterprises invest even more there. Second, at the aggregate

mean, parent Singapore's skilled labor abundance relative to all host developing countries increased total outbound FEI stocks by US$ 9.5 billion. For specific countries, over the sample period an increase in parent-country Singapore's skilled-labor abundance relative to that of host countries increased outbound FEI stocks to all developing countries in the sample.

Table 4 offers a similar cut of the data by considering manufacturing inbound and outbound FEI stocks broken down into investment with industrialized and developing countries. The first and second columns list results for manufacturing data with developing countries and the third and fourth columns for industrialized countries. Unlike the aggregate sample, variations in joint market size are insignificant for FEI stocks to and from industrialized and developing countries. The coefficients on squared differences in GDP are positive and significant for inbound stocks from developing countries, not consistent with the result for aggregate inbound FEI from developing countries in Table 3. They are also insignificant for inbound FEI stocks to and from industrialized countries.

The primary difference between bilateral investment with industrialized and developing countries arises in the coefficients on skill differences. The direct impact on inbound and outbound FEI is negative in the case of industrialized partners, although in the case of inbound stocks insignificant. In contrast, this coefficient is significantly positive for both inbound and outbound manufacturing investment with developing countries, indicating that this investment has a vertical orientation. As Singapore's skill endowments rose compared to those in neighboring developing economies, outbound manufacturing FEI stocks grew larger. The results are similar for inbound stocks, where the skill-difference variable is also positive and significant at the one percent level. The positive coefficient

implies that inward FEI in Singapore from such countries would increase indicating that as they become more skill abundant relative to Singapore they invest more in the latter. Finally, the results presented in Table 4 should be interpreted with caution as the manufacturing samples for bilateral investment with both industrialized and developing countries are small.

Section 4(b). Re-specifying the GDP variable to account for ASEAN Market Size

As discussed earlier, MNEs also invest in Singapore to re-invest in neighboring developing countries. For instance, MNEs establish regional headquarters in Singapore and re-invest in neighboring countries such as Indonesia. Thus, MNEs investing in Singapore are also likely to take into consideration the entire market size of the ASEAN region. To account for the ASEAN market size, and to establish the robustness of the results using the Singapore market size discussed earlier, we recast the market size variable to include the regional FDI activities. We re-estimate the industrialized country inbound equations separately by using the ASEAN GDP measures to account for regional FDI activities.

Second-stage tobit regression results for aggregate inbound FEI stocks in Singapore from industrialized countries using ASEAN GDP for the period 1984-2003 are presented in the first column of Table 5, while the corresponding results for 1994-2003 and manufacturing FEI from industrialized countries for the same period are presented in columns 2 and 3 respectively. Regarding aggregate inbound FEI from industrialized countries for the period 1984-2003, GDP Sum is insignificant while the coefficient on real GDP difference squared is positive and significant, not the expected outcome under the KK model. Meanwhile, for the aggregate 1994-2003 sample, the GDP Sum is positive and significant while the squared difference in real GDP is positive but insignificant. For

inbound manufacturing investment, however, the corresponding coefficients presented in the third column are negative and insignificant.

The host country investment cost is insignificant in all equations. However, the improvements in institutions significantly increase aggregate and manufacturing FEI into Singapore. Meanwhile improvements in infrastructure and increases in host country trade costs also significantly increase manufacturing FEI into Singapore from industrialized countries. Finally, there is one major difference between the results for the aggregate sample with Singapore GDP presented in Tables 1 and 2 and the aggregate inbound industrialized country sample with ASEAN GDP presented in Table 5. Distance has a positive and significant impact on inbound aggregate and manufacturing stocks when ASEAN GDP is used suggesting that countries further away invest more heavily in Singapore than those that are nearer. This may indicate that MNEs from distant countries such as the US and the UK are more likely to invest heavily in Singapore to have an easier access to markets in the ASEAN region by avoiding higher transport costs.

Regarding skill endowments, the direct coefficients on Singapore's relative skill differences are negative and significant at the one-percent level for both the 1984-2003 and 1994-2003 samples. They are positive but insignificant for the manufacturing inbound samples. This may be because Singapore is attracting both high end and low end manufacturing investment. While high end manufacturing investment stays on in Singapore, the low end investment passes through Singapore on its way to neighboring countries. During 2003 manufacturing accounted for about forty percent of all outbound investment (manufacturing plus non-manufacturing investment) by foreign MNEs with regional

headquarters in Singapore, mostly to neighboring countries[10]. However, although non-manufacturing investment to neighboring countries by foreign MNEs accounted for sixty percent of all investment, inbound non-manufacturing investment stocks from industrialized countries were nearly three times the manufacturing investment. This clearly indicates that a majority of the inbound non-manufacturing investment stays on in Singapore while majority of the manufacturing investment coming into Singapore is re-invested in neighboring countries.

For aggregate inbound FEI, the interaction between GDP differences and skill differences is negative and significant for 1984-2003, but insignificant for manufacturing FEI. For the 1994-2003 period aggregate sample it is also insignificant, suggesting that this finding may be related to the time periods of the samples. A reduction in the difference in size between the parent countries and ASEAN (ie., an increase in the size of ASEAN) reduces the sensitivity of investment stocks in Singapore to Singapore's skill differences. During the 1980s and again during the Asian financial crisis of 1997-1998, ASEAN was smaller in size relative to most parent industrialized countries. Over time as the ASEAN hosts, (with the exception of the 1997-98 period), grew in size relative to parent investors, the relationship between Singapore skill differences and inward investment stocks should get smaller or becomes negative (depending upon the partner country), ie., Singapore attracts more horizontal FEI. Finally, the interaction terms between the square of skill differences and host country trade costs are insignificant[11].

[10] Singapore Department of Statistics, 2003

[11] These equations were re-estimated using absolute skill values but did not change the basic results.

More insight may be gained by computing total derivatives of FEI stocks using ASEAN GDP for inbound investment from industrialized countries, valued at the sample means of all variables in 1994 (the mid-year of the sample), and taking account of the sign of skill differences for particular industrial country investment partners in Table 5. Plugging in these values into equation (2) we find the following result: over the sample period an increase in Singapore's skilled labor abundance relative to the parent country increased total inbound FEI stocks from all industrialized countries.

The basic results are reinforced by the regressions in Table 6, which break the aggregate inbound and industrialized country inbound samples into periods before and after 1988 (1984-1987 and 1988-2003).[12] As noted earlier, Singapore's relative endowment of occupational skills rose rapidly in the mid- to late-1980s compared to the industrialized countries, with the relative difference tending to become negative (for Singapore as host) around 1988. The implication of Table 6 seems clear: Singapore's inbound investment shifted from a vertical, labor-seeking orientation (positive coefficient on skill differences) to a more skill-seeking orientation (negative on skill difference and the interaction with GDP differences). This finding is supported again by the breakdown of bilateral investment stocks with the industrialized countries (columns 3 and 4). Here, once again the direct coefficient on skill differences switches from significantly positive to significantly negative. In the latter case, a reduction in relative skill differences, which would imply an increase in Singapore's skill endowment compared to the parent, would suggest a positive impact on inward FEI.

Regression results for the outbound sample did not show any significant differences regarding the skill-differences variable between 1984-1987 and 1988-2003 periods and are

[12] Because the manufacturing data only begin in 1994 it is not feasible to repeat this exercise on those stocks.

not reported here. As suggested by the regressions in Tables 1, 2 and 3, however, these coefficients were positive and significant in the full sample, suggesting that outbound investment in developing countries have been motivated by vertical incentives throughout the period. Regression results controlling for the Asian financial crisis did not show any major impact. Due to lack of many data points after SARS and 9/11 we did not empirically estimate their impacts.

Overall, the strikingly different results with respect to inward and outward multinational activity underscore that pooling these observations may mask the underlying relationships that vary between samples. Singapore's history with foreign investment suggests that its directional flows are induced by different factors, while there was a transition over the period of its inward investment from a labor-seeking to a skill-seeking motivation.

5. Implications and Concluding Remarks

In this paper we analyzed the role of skill development on the activity of MNEs in terms of investment both into and out of Singapore. The estimation is based on the knowledge-capital model, the foundation for a number of recent studies. Most of those studies have focused on industrialized countries and ours is the first attempt to apply the model to a newly industrializing economy.

The analysis presented here indicates that Singapore occupies an interesting position within the context of the knowledge-capital model. Singapore is small (though it grew rapidly) and increased its supply of skilled labor in relation to nearly all countries in the sample over the 1984-2003 period. These dynamics supported an evolution of direct investment into and out of Singapore that may be characterized as follows. First, over time

the nature of inward investment from the industrialized countries shifted sharply from a modestly vertical orientation toward a skill-seeking orientation. Further, Singapore's rapid growth in skill endowments supported a significant rise in horizontal outward FEI in the industrialized world. Second, over the period Singapore's skill share rose considerably in relation to those in neighboring developing countries. This tendency supported a clear vertical orientation in outward investment from Singapore to Asian developing economies, particularly in ASEAN, as headquarters operations in the former sought lower-wage labor for production in the latter. Based on the results using ASEAN market size, some of this trend could be ascribed to incoming investments from industrialized countries in skill-intensive regional headquarters services in Singapore, which in turn re-invest in ASEAN. Finally, analysis of the earlier and later sub-periods suggests that in the 1988-2003 period inward FEI, especially from industrialized countries, was strongly attracted by the growing relative skilled-labor abundance in Singapore.

These findings have important resonance for policy issues. As part of its economic development policy, the GOS followed the "complementary strategy" of rapidly building its skills base while remaining open to investment from abroad. Our results indicate that the policy has been highly successful as MNEs, particularly from the industrialized economies, increasingly invest in skill-intensive sectors in Singapore. Many international firms also use skill-abundant Singapore as a base from which to invest in neighboring ASEAN developing countries.

More fundamentally, to the extent that foreign direct investment contributes to such transformations, Singapore's success in building its labor skills improved both its own growth prospects and the economic development of its developing-country investment

partners, such as Malaysia, Thailand and Indonesia. This has been particularly the case since the late 1980s. Thus, from the point of view of both developing countries, particularly in ASEAN, and Singapore itself, the need for continued skills development in Singapore should be emphasized.

Furthermore, Singapore's transition from attracting labor-intensive foreign investment in assembly early in the period to skill-intensive services and headquarters locations more recently may have important lessons for developing countries. Singapore's strategy emphasized development of its skill base through the expansion of education and the adoption of other relevant human resource policies to attract foreign MNEs, rather than developing its own global enterprises. This alternate strategy could be considered, particularly by smaller developing countries that may not be able to develop their own MNEs due to a small population and general lack of domestic capital. Note, finally, that our results suggest that Singapore's rapid accumulation of skills tended to increase the stock of FDI in Asian developing countries, an element that may have played a role in the ongoing economic development of the latter.

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EXAMPLES OF MNES SETTING UP REGIONAL HEADQUARTERS IN SINGAPORE

Several MNEs have set up Regional Headquarters Operations in Singapore particularly in manufacturing. Among the MNEs setting up Regional Headquarters in Singapore recently are:

3M: The plant which will produce coatings for film based products used in commercial, electronic and automotive applications was completed recently. According to 3M VP for operations, the investment brings the MNE closer to customers and creates a regional source of supply thus simplifying the supply chain.

Alcon: Alcon is building a pharmaceutical manufacturing facility in Singapore (to be completed in mid 2009) to meet the increasing demand for its product in South East Asia. Sales in Asia are rising at a compound annual growth rate of more than 20 percent. The new plant will facilitate an efficient and cost effective distribution of pharmaceuticals throughout Asia, helping it to better meet regional market demand particularly in the ASEAN region.

Berg Propulsion: A new factory has been established in Tuas. The Swedish corporation plans to manufacture controllable pitch propellers for the marine industry to meet increasing regional demand in Asia. Its plan include investments upto US$ 47.5 million over the next five years and includes state of the art precision manufacturing equipment.

Edwards Lifesciences: This MNE opened a heart valve manufacturing facility in Singapore in 2008. The goal of the facility is also to manage sales, marketing and other customer related operations not only in South East Asia, but also Australia and New Zealand, and the Middle East. Singapore was chosen for its skilled manpower, its infrastructure as well as proximity to regional markets.

Table 1. Second-Stage Tobit Results for Singapore's Aggregate Bilateral Inbound and Outbound Investment with Year Fixed Effects, 1984-2003

Regressors	**Aggregate Inbound 1984-2003**	**Aggregate Outbound 1984-2003**
GDP Sum	0.0004** (2.42)	0.0003*** (4.68)
GDP Diff. Squared	1.46e-10*** (7.81)	-5.61e-12 (-0.54)
Skill Diff.	-12985*** (-3.35)	11588*** (13.80)
GDP Diff.*Skill Diff.	-0.0054*** (-10.55)	0.0004 (1.79)
IC Host	-62.82 (-0.54)	-11.42** (-2.20)
INST HOST	-3353.19** (-2.39)	-79.10*** (-12.43)
INFRA HOST	2201.40 (1.90)	-24.52** (-2.29)
TC Host	-0.35 (-0.01)	-60.15 (-0.27)
TC Host*Squared Skill Diff.	-0.005 (-1.89)	49.47 (0.61)
TC Parent	-28.08*** (-2.56)	-43.83*** (-9.47)
Distance	0.089 (0.91)	-0.30*** (-2.78)
Intercept	11036.74 (0.68)	5242.60 (1.28)
Observations	360	360
Sargan P Value	0.12	0.10
Log Likelihood	-2969	-2502

Table 2. Second-Stage Tobit Results for Singapore's Aggregate and Manufacturing Inbound and Outbound Investment with Year Fixed Effects, 1994-2003

Regressors	**Aggregate Inbound 1994-2003**	**Manufacturing Inbound 1994-2003**	**Aggregate Outbound 1994-2003**	**Manufacturing Outbound 1994-2003**
GDP Sum	0.0008**	0.0003**	4.01e-06***	0.0003***
	(2.51)	(1.99)	(3.52)	(3.77)
GDP Diff. Squared	1.01e-10***	-6.68e-12	-4.50e-11	-1.28e-11**
	(2.88)	(-0.17)	(-0.03)	(-1.97)
Skill Diff.	-10300**	-7867	16238***	8565***
	(-2.03)	(-1.08)	(8.14)	(3.03)
GDP Diff.*Skill Diff.	-0.0003**	-0.0003***	0.0001	-0.0002
	(-2.25)	(-3.99)	(0.40)	(-1.02)
IC Host	7.14	-88.37**	-46.76***	-12.67**
	(0.04)	(-2.07)	(-5.50)	(-2.10)
INST Host	-1048	-466.26**	-31.17***	-15.46***
	(-0.51)	(-2.02)	(-4.60)	(-3.25)
INFRA Host	232.25	2.96	-54.87***	-60.54***
	(0.16)	(0.14)	(-4.46)	(-6.75)
TC Host	38.10	31.28	12.72	-0.22
	(0.62)	(0.98)	(1.39)	(-0.05)
TC Host*Squared Skill Diff.	-1771	-46.19	-75.74	18.29
	(-0.32)	(-0.17)	(-0.74)	(0.28)
TC Parent	-6.14	12.74	-20.75***	76.06
	(-0.42)	(1.02)	(-2.77)	(1.51)
Distance	0.21	0.25	-0.20***	-0.22***
	(1.83)	(1.88)	(-5.39)	(-7.86)
Intercept	8868.27	6419	3912***	449
	(0.37)	(1.75)	(9.96)	(0.44)
Observations	160	160	160	160
Sargan P Value	0.11	0.10	0.12	0.12
Log Likelihood	-1414	-1376	-1226	-1122

Table 3. Second-Stage Tobit Results for Singapore's Aggregate Inbound and Outbound Investment with Developing and Industrialized Countries with Year Fixed Effects, 1984-2003

Regressors	Developing Countries Inbound	Developing Countries Outbound	Industrialized Countries Inbound	Industrialized Countries Outbound
GDP Sum	0.0058***	0.003	-0.0004	-0.0004
	(7.23)	(1.24)	(-1.66)	(-1.90)
GDP Diff. Squared	-6.15e-09***	-1.00e-08***	1.91e-10***	-5.67e-11
	(-11.10)	(-5.05)	(7.29)	(-1.28)
Skill Diff.	10813***	12117**	-14369***	-10152**
	(9.91)	(2.44)	(-2.55)	(-2.24)
GDP Diff.*Skill Diff.	-0.044	0.011	-0.006***	0.0009
	(-1.52)	(1.53)	(-6.23)	(1.82)
IC Host	31.72	32.96	7.933	6.68
	(1.79)	(1.68)	(0.06)	(0.91)
INST Host	1184	-14.95**	-3289.60**	6.69
	(1.52)	(-2.32)	(-1.96)	(0.91)
INFRA Host	-630.22***	-21.57***	1769.80	19.88
	(-4.37)	(-2.77)	(1.26)	(1.92)
TC Host	56.07	-15.32	-20.02	-235.73
	(1.72)	(-1.68)	(-0.31)	(-1.32)
TC Host*Squared Skill Diff.	-1096	-158.40	-499.33	110.53
	(-1.93)	(-0.75)	(-0.32)	(0.69)
TC Parent	-23.99***	9.05	19.44	-235.73
	(-8.62)	(0.51)	(1.40)	(-1.32)
Distance	-0.34***	0.001	0.048	0.06
	(-13.67)	(0.01)	(0.78)	(1.07)
Intercept	-5996**	-735.30	1246.98	1988.64
	(-2.30)	(-0.78)	(0.65)	(0.59)
Observations	140	140	220	220
Sargan P Value	0.09	0.08	0.10	0.11
Log Likelihood	-848	-1003	-1946	-1396

Table 4. Second-Stage Tobit Results for Singapore's Manufacturing Inbound and Outbound Investment with Developing and Industrialized Countries with Year Fixed Effects, 1994-2003

Regressors	Developing Countries Inbound	Developing Countries Outbound	Industrialized Countries Inbound	Industrialized Countries Outbound
GDP Sum	-0.0005 (-1.73)	-0.002 (-1.77)	-0.0004 (-0.85)	-0.00001 (-0.79)
GDP Diff. Squared	5.66e-10*** (4.44)	5.63e-09 (1.55)	8.24e-11 (1.31)	5.04e-13 (0.26)
Skill Diff.	2236*** (14.68)	5375** (2.11)	-12412 (-1.47)	-13731*** (-2.72)
GDP Diff.*Skill Diff.	-0.0001** (-1.96)	-0.0007 (-1.07)	-0.0002 (-1.09)	-0.0002*** (-2.81)
IC Host	-40.38*** (-15.20)	-8.38 (-0.94)	-108.34 (-0.97)	0.92 (0.52)
INST Host	-318.25*** (-12.45)	-12.41*** (-2.83)	-1014** (-2.02)	-7.59** (-2.22)
INFRA Host	0.00 (0.00)	-5.46 (-0.58)	-78.73 (-1.59)	-21.28*** (-2.75)
TC Host	2.92*** (3.16)	-20.28 (-1.42)	37.50 (1.07)	3.21*** (2.63)
TC Host*Squared Skill Diff.	68.37*** (4.24)	240.70 (1.49)	-2964 (-1.15)	141.43*** (3.57)
TC Parent	-0.07 (0.11)	-7.87 (-0.93)	42.13 (1.67)	-14.40** (-1.96)
Distance	-0.13*** (-13.34)	-0.50*** (-4.06)	-0.70*** (-3.05)	-0.03*** (-3.90)
Intercept	5152*** (14.57)	3836*** (5.04)	10734 (1.49)	1039*** (3.13)
Observations	50	50	110	110
Sargan P Value	0.09	0.07	0.08	0.11
Log Likelihood	-226	-348	-968	-583

Table 5. Second-Stage Tobit Results for Singapore's Aggregate and Manufacturing Inbound Investment from Industrialized Countries Using ASEAN GDP with Year Fixed Effects, 1984-2003 and 1994-2003

Regressors	**Industrialized Countries Aggregate Inbound 1984-2003**	**Industrialized Countries Aggregate Inbound 1994-2003**	**Industrialized Countries Manufacturing Inbound 1994-2003**
GDP Sum OECD	-0.0008 (-1.94)	0.0003*** (3.11)	-0.0008 (-1.09)
GDP Diff. Squared OECD	2.69e-10*** (10.02)	1.42e-10 (0.72)	-5.00e-11 (-1.09)
Skill Diff.	-11430*** (-3.38)	-14044*** (-2.56)	13817 (1.42)
GDP Diff. OECD*Skill Diff.	-0.006*** (-6.41)	-0.003 (-1.80)	-0.0016 (-1.30)
IC Host	-78.04 (-0.58)	-44.46 (-0.37)	12.66 (0.61)
INST Host	-4769*** (-2.80)	-1213 (-0.88)	-1177*** (-4.14)
INFRA Host	2965 (1.92)	-159.33 (-0.11)	-27.85** (-2.05)
TC Host	-53.03 (-0.82)	83.45 (1.62)	43.85** (2.47)
TC Host*Squared Skill Diff.	154.01 (0.01)	-513.95 (-0.17)	-547.42 (-0.76)
TC Parent	39.54 (1.95)	-60.33*** (-2.63)	10.81 (0.32)
Distance	0.76*** (4.36)	0.48*** (2.63)	0.18*** (2.54)
Intercept	14950 (0.79)	15878 (0.68)	13021*** (3.69)
Observations	220	110	110
Sargan P Value	0.12	0.11	0.09
Log Likelihood	-1945	-990	-864

Table 6. Second-Stage Tobit Results for Bilateral Aggregate and Industrialized Country Inbound FEI Stocks, Early (1984-1987) and Late (1988-2003) With Year Fixed Effects

Regressors	**Inbound 1984-1987**	**Inbound 1988-2003**	**Inbound Industrialized 1984-1987**	**Inbound Industrialized 1988-2003**
GDP Sum	-0.001*** (-17.29)	0.0004** (1.96)	0.00003 (0.37)	-0.001 (-1.34)
GDP Diff. Squared	3.45e-10*** (24.95)	1.69e-10*** (7.31)	8.18e-11*** (3.72)	3.32e-10*** (9.55)
Skill Diff.	18675*** (10.85)	-16624*** (-3.27)	7107*** (6.09)	-19588*** (-4.90)
GDP Diff.*Skill Diff.	-0.006*** (-17.36)	-0.005*** (-7.80)	0.001** (2.11)	-0.004*** (-3.31)
IC Host	0.00 (0.00)	-28.45 (-0.26)	0.00 (0.00)	37.30 (0.28)
INST Host	0.00 (0.00)	-3005** (-2.40)	0.00 (0.00)	-2463 (-1.64)
INFRA Host	0.00 (0.00)	1861.04 (1.69)	0.00 (0.00)	1154 (0.98)
TC Host	3340*** (8.84)	7.35 (0.13)	900.83*** (2.81)	41.47 (0.64)
TC Host*Squared Skill Diff.	2983*** (7.01)	-2005*** (-3.50)	2939*** (5.70)	402 (0.19)
TC Parent	5.22** (2.24)	-35.99*** (-2.54)	-58.84*** (-10.91)	-24.01 (-1.45)
Distance	-0.14*** (-4.39)	0.04 (0.41)	-0.24*** (-6.05)	0.18 (1.55)
Intercept	-60770*** (-8.74)	10901 (0.65)	-13596** (-2.31)	8913 (0.45)
Observations	72	288	44	176
Sargan P Value	0.08	0.12	0.07	0.07
Log Likelihood	-432	-2423	-306	-1556

Figure 1. Singapore Aggregate Foreign Equity Investment Stocks by Sources and Destination, 2003 (Million 1990 US$)

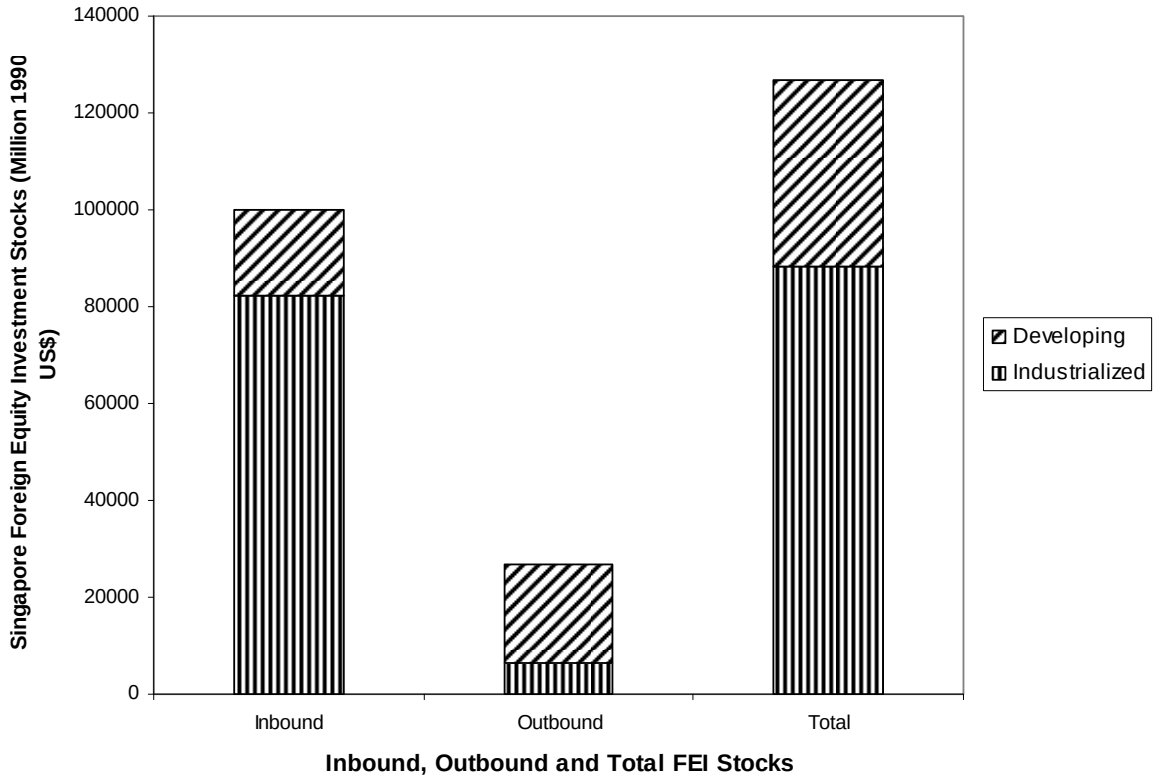

Figure 2. Trends in Skill Differences between Selected OECD Countries and Singapore, 1984-2003

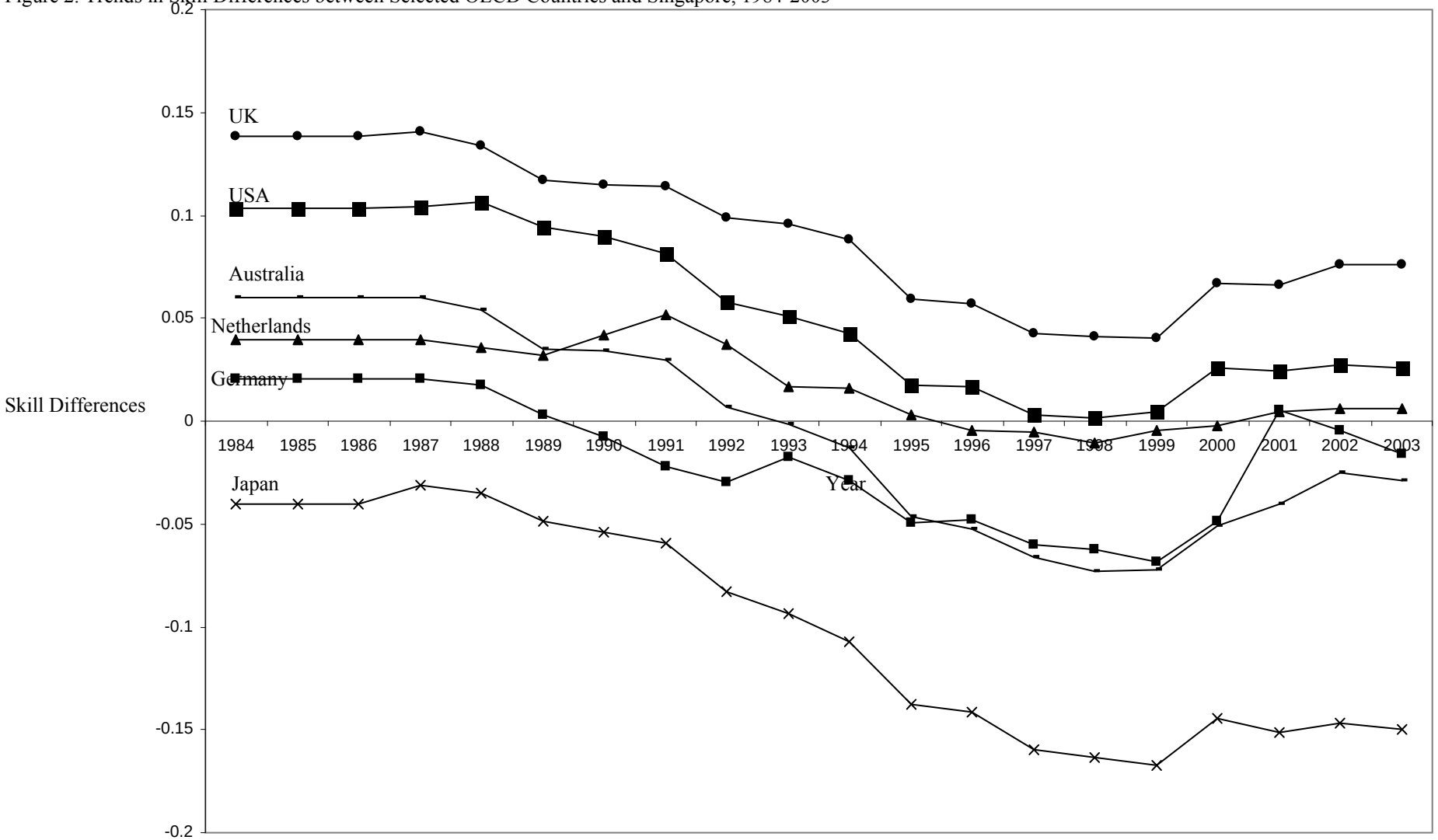

Figure 3. Trends in Inbound FEI Stocks into Singapore from Selected OECD Countries, 1984-2003