

Can the Knowledge Capital Model Explain Foreign Investment in Services?

The Case of Singapore

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Abstract

Singapore has been a powerful magnet for foreign direct investment and in recent years has also made significant investments abroad, especially in developing countries and increasingly in services. This paper analyzes the determinants of Singapore's investment using the Knowledge-Capital Model and compares the impact of skill endowments on manufacturing and service sector investments. The results suggest that inward and outward investment with respect to industrialized countries in manufacturing and services was skill-seeking. A 10 percent decline in skill differences with industrialized countries resulted in a 19 percent rise in inbound manufacturing investment stocks, but only a 7 percent rise in inbound services stocks. Inward investment from developing countries in services was also skill-seeking,

but outward investment to developing countries in both sectors was labor-seeking. A 10 percent increase in skill differences with developing countries resulted in a 23 percent rise in outbound manufacturing investment stocks and a 13 percent rise in outbound services stocks. Furthermore, when the analysis distinguishes between services on the basis of skill intensity, there is a significant difference between the determinants of foreign direct investment in skill-intensive services and foreign direct investment in other services and goods. However, when services are disaggregated on the basis of "proximity" needs, there is no significant difference in the determinants of foreign direct investment in proximity services compared with foreign direct investment in non-proximity services.

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1. Introduction

Singapore, in its fiftieth year of existence as a nation-state, has been remarkably successful in attracting foreign direct investment (FDI) and in recent years has also become a significant foreign investor, especially in developing countries (Chellaraj et al. 2013; Shin 2006). This two-way investment has increasingly been in services. In 2012, the share of services was four times larger than manufacturing in Singapore's inbound investment stock, and three times greater in its outbound investment stock (Table 1). In this paper we apply the Knowledge-Capital (KK) model of multinational enterprises (MNEs) to compare the determinants of manufacturing and services foreign investment to and from Singapore. The KK model has been previously applied to aggregate and manufacturing investment (Carr et al., 2001 (hereafter CMM); Chellaraj et al., 2013), but it has not to our knowledge been tested for bilateral services investment even though the latter has grown in importance globally.

Singapore has rapidly closed its skills gap with most industrialized countries over the past three decades through the expansion of higher education and by facilitating the inflow of foreign talent (Sim, forthcoming; Hanushek and Woessmann, 2015; Yusuf and Nabeshima, 2012; Anwar, 2008). As a result, the nature of Singapore's aggregate inward foreign investment from industrialized countries has shifted from a labor-seeking orientation to a skill-seeking orientation, while its outward investments in developing countries, particularly in the ASEAN region, is more focused on labor-seeking activities (Chellaraj et al., 2013). While there is evidence on the determinants of aggregate FDI (Chellaraj et al., 2013), studies on FDI in specific sectors such as services are rare. The application of the KK model separately to Singapore's manufacturing and

service sectors is both novel and appropriate, because it incorporates market-seeking, skill-seeking and labor-seeking motivations into a single model.

It is plausible that Singapore's increasing relative skill endowments also underlay the increase in inbound service sector investment from both industrialized and developing countries. Outbound services investment in developing countries is expected to be labor-seeking and in industrialized countries skill-seeking. We explore further the significance of two key distinctions between services and manufacturing. First, services, especially financial, education and health, communications and business services, are on average much more skill intensive than manufacturing (Table 2).¹ Therefore, we would expect a stronger skill-seeking motivation for FDI in skill intensive services compared to manufacturing and less skill intensive services. Second, services, particularly construction and commerce, but also to some extent business and finance, need greater face-to-face contact between suppliers and customers than goods. Apart from the technological imperative for proximity, there may also be a regulatory imperative: preference in bidding for publicly-funded service sector projects (e.g. light rail projects) in countries such as Thailand is given to firms located in the ASEAN region including Singapore.² Therefore there is likely to be a stronger market-seeking or horizontal orientation to FDI in face-to-face services.

Our results indicate that the direct coefficient on relative skill differences, specified as the percentage of the labor force with a tertiary education in the parent country, less the corresponding ratio in the host country, is negative and significant for the services inbound sample, but insignificant for the manufacturing inbound sample. These findings suggest that services inbound

¹ As Table 2 shows, there is significant heterogeneity within services and within manufacturing in skill intensity. But even the most skill intensive sectors in manufacturing, such as transport equipment and electronics equipment, have skill intensities comparable with the relatively less skill intensive services sectors such as transport and commerce and much lower skill intensities than sectors such as finance, education and health.

² http://www.eria.org/projects/PPP_ComparativeTable_February_2013.pdf

investment stocks rose with a relative increase in Singapore skills compared to parent nations, which were predominantly industrialized economies. Disaggregated results suggest that both inward and outward investment with respect to industrialized countries in both manufacturing and services was skill-seeking. Inward investment from developing countries in services was also skill-seeking, but outward investment to developing countries in both sectors was labor-seeking. Furthermore, when we distinguish between services on the basis of skill-intensity, we find a significant difference between the determinants of FDI in skill-intensive services and FDI in other services and goods. However, when services are disaggregated on the basis of “proximity” needs, we do not find any significant difference in the determinants of FDI in proximity services compared to FDI in non-proximity services.

This paper proceeds as follows. In the next section we briefly review the KK model to motivate the analysis. In Section 3 we specify the 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 MNEs has focused on two motivations for FDI: to access markets to circumvent trade frictions (horizontal FDI) and to employ low-wage labor for labor-intensive portions of the production process (vertical FDI)³. In the former case, multiple plants producing similar goods and services are located in different markets and produce either for local or regional markets. In the latter, headquarters are split from at least some production, and goods are traded in different stages of fabrication.

³ Baltagi et al. (2007), Bergstrand and Egger (2007) and Bergstrand and Pfaffermayr (2005) included a three factor model, labor, skills and physical capital.

The general-equilibrium KK model of FDI (Markusen and Maskus, 2002; Markusen, 2002) makes three principal assumptions. First, services of knowledge-based activities can be geographically separated from production of goods and services, and supplied to production facilities at low cost. Second, these knowledge-intensive activities are skilled-labor-intensive relative to production of goods and services. These assumptions generate incentives for firms to fragment production into vertical phases, locating R&D activities where skilled labor is relatively abundant and production of goods and services where unskilled labor is well endowed. Thus a retail service sector firm will locate its marketing research where there is plenty of skilled labor, while stores for selling products are located close to customers. Similarly in the financial sector firms may perform complicated research in the skill abundant country while locating subsidiaries or branches to sell financial products in proximity to its clients. The third assumption is that knowledge-based assets are inherently joint inputs and may be deployed simultaneously at multiple production facilities. This characteristic generates firm-level scale economies and supports horizontal investments in facilities that produce the same goods and services in different locations.

Specifically, the KK model combines factor endowments with complex economies of scale to explain FDI location decisions. It presumes two countries and two homogeneous factors, unskilled labor and skilled labor, which cannot move across borders. The model also assumes two homogeneous goods or services, one of which is labor-intensive and subject to constant returns to scale. The other is skilled-labor-intensive and demonstrates increasing returns to scale (IRS). Firms in this sector can separate headquarters services from production, which may be located in either the home or foreign countries, or both. These services can be shared across plants, which support firm-level economies of scale in this sector. Finally, there are transport costs in trading goods or services and fixed costs of investing in a new plant.

The model predicts the potential existence of several firm types in the IRS good or service in equilibrium. First, there may be national firms that operate a single plant and headquarters in one country and may export to the other. Second, horizontal MNEs maintain plants in both countries but have headquarters in a single location. Finally, vertical MNEs operate headquarters in one nation and a single plant in the other country

In this context, the determination of which firms produce in which location and the decision to split headquarters from plants depends on various sector, country and market characteristics. For example, in certain service sectors, the investment may be country and time specific where the investment ends when the project is complete. Thus, a port development project may be specific to a country and the contract may specify that the project be completed during a specific time. Second, national firms will be more prevalent in a relatively large country because size supports local production while permitting firms to avoid the fixed costs of investing in the smaller nation. National firms are also prominent where the two countries have similar factor endowments, which diminishes incentives for labor-seeking vertical FDI. They also predominate where transport costs are low or foreign investment barriers are high, characteristics that reduce returns to market-seeking horizontal FDI.

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 prefer to place production capacity of goods and services in both locations, taking advantage of firm-level scale economies, while selling primarily in local or regional markets to avoid transport costs. Thus research activities in finance and marketing related to two different regions may be carried out in two skill abundant countries located in those two regions in order to sell primarily in the local or regional market to reduce transport costs. However, if the countries vary in factor

supplies, MNEs would concentrate headquarters in the skilled-labor-abundant country and production in the skilled-labor-scarce country. This incentive is strongest where trade costs are low, for then it is economic to supply both markets from the single foreign plant. Vertical FDI is particularly likely if one country is small and skilled-labor abundant, in which case headquarters locate there and produce both goods and services in the other location. Thus a retail firm in a small skill abundant country will locate its headquarters in that country to undertake activities such as complex market research, while only locating stores for selling the product in the labor abundant location.

2a. Application to Singapore

Between 1984 and 2011 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 by sharply increasing the number of college graduates in its population and through the importation of foreign talent to offset brain drain (Ahsan et al., 2014). Singapore also built an increasing skills gap relative to the developing economies in our sample. A positive impact of skill differences on inward investment observed between 1984 and 1996 reflected the tendency of foreign investment to seek low-cost labor in Singapore. However, after 1996 inward foreign investment from industrialized partners expanded with a rise in Singapore's skill endowment because such investment is skill-seeking in nature (Chellaraj et al. 2013).

Table 1 shows the breakdown of Singapore's real manufacturing and services foreign equity investment (FEI) stocks to and from industrialized and developing countries in 2012. Around 90 percent of the manufacturing and services inbound FEI stocks came from industrialized countries. However, developing countries are much more important for outbound investment. As

much as 81.5 percent of all manufacturing outbound investment went to developing countries in our sample, and close to 56 percent of the services investment went to these countries. Overall, services dominate both inward and outward investment, with both industrial and developing countries.

2b. Prior Estimation

Carr et al. (2001), using a 1986–1994 panel data set involving both US manufacturing affiliates abroad and foreign manufacturing affiliates in the USA, found that a convergence in income (GDP) between the USA 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 than of vertical FDI, with affiliate sales rising in host countries with skill endowments closer to those of the USA. Similar results were found by Markusen and Maskus (2002). These results may have been due partly to the selection of countries, which did not include many lower income developing nations. For other countries, Gao (2003) found that ethnic Chinese networks played a significantly positive role in inward FDI into China. Braconier et al. (2005) also found evidence to support the KK model using European and Japanese data. Tanaka (2009) found that Japanese MNEs exhibit a vertical motivation while the US MNEs exhibit a horizontal motivation. However, a more recent study indicates that the vertical component of the KK model is relevant even for countries with similar endowments (Mariel et al., 2009). Another study (Awokuse et al., 2012) found that US FDI abroad at the industry level exhibits a complex mixture of motivations. Finally, Lankhuizen (2014) suggests that skill differences per se do not accurately explain FDI, and the actual skill levels of the host country are also important.

Carr et al. (2001) pooled bilateral data which could disguise the actual relationships between endowment differences and MNE activity. The reason is that the USA 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 USA 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 et al., 2003).

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 US outward FDI to large industrialized countries is strongly attracted to countries with higher skill abundance, suggesting a horizontal motivation but the effect was reversed for FDI in developing countries. The above criticisms were addressed in a study by Chellaraj et al. (2013) using aggregate bilateral foreign investment stocks data for Singapore. It found strong evidence that the nature of Singapore's two-way investment with the industrialized nations has shifted into skill-seeking activities over the 1984-2007 period. Meanwhile, Singapore's investments in developing countries have increased sharply and become concentrated in labor-seeking activities.

Although Chellaraj et al. (2013) applied the KK model to aggregate Singapore FDI, they did not apply it to the service sector. This research is the first attempt to estimate the KK model for the service sector for any country and also the first attempt to separately compare the impact of skills on manufacturing and service sector investments and within differing classes of services such as transport and business services based on skill intensity. As this research incorporates investment objectives for both sectors separately and service sectors grouped by skill intensity, it is an extension of the studies applying the KK model, discussed earlier.

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 data set, which was developed specifically for this analysis and seems unique in its comprehensive coverage of a panel of two-way manufacturing and services FEI stocks for Singapore.

3a. Basic Specification

The KK model provides an econometric specification, grounded in theory, for explaining the general determinants of foreign investment activities. It is sufficiently flexible to permit the data to reveal, indirectly, whether investment into and out of Singapore is driven by factor-cost (vertical) motivations, market-seeking (horizontal) motivations, or both. Following Carr et al. (2001) our initial specification is as follows:

$$\begin{aligned} FEI_{ijt} = & \beta_0 + \beta_1 (GDP_{it} + GDP_{jt}) + \beta_2 (GDP_{it} - GDP_{jt})^2 + \beta_3 (SK_{it} - SK_{jt}) \\ & + \beta_4 (GDP_{it} - GDP_{jt}) * (SK_{it} - SK_{jt}) + \beta_5 IC_{jt} + \beta_6 INST_{jt} + \beta_7 INFRA_{jt} + \beta_8 TC_{jt} + \beta_9 TC_{jt} * (SK_{it} - \\ & SK_{jt})^2 + \beta_{10} TC_{it} + \beta_{11} DIST_{ij} + \beta_{12} COMLANG_{ij} + e_{ijt} \end{aligned} \quad (1)$$

In this specification the dependent variable is the stock of manufacturing and services foreign equity investment (FEI) invested by country *i* (the parent) in country *j* (the host).⁴ For inward investment, Singapore is always the host country and for outward investment Singapore is always the parent country. Carr et al. (2001) employed majority-owned affiliate sales in manufacturing as their measure of FDI activity. This measure is not available for Singapore for all years in the sample, 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

⁴ Definitions of variables and data sources are provided in the following subsection.

long-term decisions to invest and are less volatile, and less dependent on omitted variables, than are annual activity measures (Braconier et al., 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. In both cases, 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. This variable captures changes in relative size, holding relative factor endowments fixed, and the theory implies that incentives for market-seeking investment should increase as two countries become more similar in size. Thus, in principle there should be an inverted U-shaped relationship between FEI stock and size differences between two partner countries, suggesting that the coefficient should have a negative sign.

The next variable is the difference in relative skill endowments between the parent and host countries. 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 market 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 between Singapore and its partner industrialized country. 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 $INST_{jt}$ accounts for institutional costs or constraints which are roadblocks to investment in the host country. Higher host-country institutional constraints should also reduce investment. Similarly, $INFRA_{jt}$ captures the infrastructure barriers in the host country and should have a negative impact on FEI. Numerous studies (e.g., Dollar et al., 2004) have indicated that development of infrastructure is vital to attracting foreign investment, particularly in developing countries and NICs. 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 in order to avoid them. 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 Carr et al. (2001) point out, this is not a theoretically sharp hypothesis. $DIST_{ij}$ is the distance in kilometers between Singapore and the capital cities of partner countries. Generally, one would anticipate a negative coefficient on this variable. However, it is also possible that MNEs from remote countries such as the US could set up regional headquarters in Singapore and reinvest in neighboring countries while nearby countries such as Australia and Taiwan, China have easy access to regional markets without having to relocate to a country such as Singapore. Under those circumstances, the coefficient is likely to be positive. Finally, $COMLANG_{ij}$ is the common language that is spoken in both

Singapore and the partner countries and is a dummy variable. It takes on a value of 1 if Singapore and the partner country have a common language; otherwise it takes on the value of zero⁵. This variable is expected to have a positive impact on both inbound and outbound FDI.

While coefficient β_3 captures the direct marginal impact of skill differences between the parent country and host 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 country or region, a reduction in the difference in country or region size (i.e., an increase in the size of the host country) should reduce the sensitivity of investment stocks to host country skill differences. In terms of our application, if over time Singapore (as host) grows in size relative to parent investors, the relationship between skill differences with parent country, 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 manufacturing and services 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 stocks separately for industrialized-country and developing-country partners and investigate foreign investment behavior for these groups separately. In addition we also aggregate (1) different categories of services based on need for face to face contact with customers i.e., those that cannot be delivered across borders— construction, commerce and real estate - and by those that do not need as much face to face contact-business services, finance and transport; (2) the service sector categories with high skill intensity-business services, finance and real estate- and those with lower

⁵ Economies that have a common language with Singapore are China; Taiwan, China; Hong Kong SAR, China (Chinese); and the United Kingdom, Canada, Australia, the United States, and the Philippines (English) and these take on the value of 1 while other countries such as Germany, France and Switzerland take on the value of zero.

skill intensity-commerce, construction and transport-are aggregated and re-estimated separately. For inbound investment from industrialized countries, the motivation is expected to be skill-seeking. Outbound investment to industrialized countries is also expected to be skill-seeking. Investment by developing countries in Singapore is small, coming mostly from neighboring ASEAN countries and China, compared to Singapore's corresponding outbound investment. Hence, outbound investment from Singapore to developing countries is expected to be predominantly vertical and we have no particular expectation about inbound investment for manufacturing and services from developing countries. Finally, we also do not have any expectations regarding inbound and outbound investment when FDI is aggregated using different categories of sectors.

3b. Data Sources and Description

The dependent variable in the KK model should be a measure of bilateral stocks of FDI. Unfortunately, Singapore only sporadically compiled outbound and inbound FDI data for some countries in the sample before 1999. Information from 1993-2012 available on bilateral stocks of foreign equity investment (FEI) between Singapore and partner countries is 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 10 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 was relatively small in this period. Stocks of such investment amounted to no more than 9 percent of total FEI stocks from 1997 to 2012 and averaged less than 4.7 percent. Moreover, the correlation between FEI stocks and FDI stocks from 1997 through 2012 is 0.95. We employ data on investment stocks separately for manufacturing

and services. The sources of the FEI data are the *Statistical Yearbook of Singapore*, *Foreign Equity Investment in Singapore* and *Singapore's Investment Abroad*, published by the Department of Statistics, GOS⁶. 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 Carr et al. (2001), updated through 2012. Real GDP is measured in millions 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 proportion of the labor force with tertiary (college or university) education. These figures are compiled from the various statistical and labor force yearbooks for individual developing countries and from the Department of Statistics, GOS for Singapore. They are taken from the OECD *Education at a Glance* for various years for the OECD countries. 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 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* (1993-1994) and *Global Competitiveness Report* (1995-2012) 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 of hiring and firing practices, market dominance by a small number of enterprises, an absence of fair

⁶ The partner economies included in this study are Australia; Canada; USA; Taiwan, China; Germany; France; Japan; Hong Kong SAR, China; United Kingdom; the Netherlands; Switzerland; Thailand; Malaysia; Indonesia; China; and the Philippines. Some data points were not publicly available and these were obtained from the Ministry of Statistics, Government of Singapore.

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 constraints include lack of transparency, lack of exchange rate stability, high levels of bribery and corruption in the political system, poor legal and regulatory framework (extent of corruption in the legal system, civil or criminal), politicized and elected law enforcement and judiciary (Chellaraj, 2000), widespread gender and ethnic discrimination and high prevalence of unethical practices. The infrastructure barriers refer to the quality of infrastructure in the host country and include the quality of railroad, ports, air transport, waterways, roads, and electric supply as well as telecommunications 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. Finally, distance is the number of kilometers of each country's capital city from Singapore and is available online from CEPII (the French Center for Research and Studies on the World Economy).⁷

Overall both manufacturing and services outbound FEI stocks to developing countries were far higher than the reverse activity. In contrast, manufacturing and services inbound FEI stocks from industrialized countries were much higher than Singapore's outbound FEI to those nations. It is important to note that there are some years where outward investment stocks to industrialized countries were reported to be zero. Thus, our estimation procedure is Tobit with time and country

⁷ <http://www.cepii.fr/anglaisgraph/bdd/distances.htm>, Paris, France.

fixed effects. The fixed effects control for unobserved influences on FEI stocks that are constant over time or country.

The skill intensity for different sectors was calculated by GTAP (Global Trade Assistance and Production) of Purdue University. It is the global average for all sectors broadly classified as agriculture, services, government and private. Primary agriculture and service sectors such as construction were intensive in unskilled labor, whereas government and private sectors were highly skill intensive. Private sectors include finance and business services while services include transport and construction⁸.

As there are a number of years early in the period where either inward or outward investment stocks were reported to be zero, we use a Tobit estimation procedure. We include year and country fixed effects to control for unobserved influences on FEI stocks that vary over time or are characteristic of a particular investment partner country.

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 the transfer of skilled engineers and managers within the firm between countries. Thus, the skill-differences variable is likely to be endogenous to investment to some degree. To address this issue we develop instruments that are correlated with skill differences but plausibly not correlated with the regression error term.

⁸ “In Singapore, construction and real estate are classified separately. Some of the tasks in the real estate sector include managing and overseeing construction of property as well as facilities management once the construction is complete, while the actual construction of buildings involves tasks which do not require much beyond a high school education (Chin, 2007). Hence, for the purposes of this research real estate is classified as skill intensive and construction is classified as less skill intensive.”

The instrument used in this analysis is the female fertility rate in the parent and host countries, which we lag 20 years to approximate the period between birth and university graduation. Long-lagged fertility rates are likely correlated with later educational attainment, as noted by Becker et al. (2009). For example, studies from poor countries indicate that higher fertility rates increase the likelihood of a family remaining in poverty, making it difficult to procure education for children (Black et al., 2005; Rosenzweig and Schultz, 1987). However, lagged fertility presumably is exogenous with respect to current FEI-location decisions.

Initial experimentation suggests that the fertility rate is an appropriate instrument. For example, in a regression of skill differences on lagged fertility rates the coefficients was highly significant. However, in a related regression of inbound FEI on lagged fertility rates the coefficient was insignificantly different from zero.⁹ We offer further instrument validation in the results tables below.

4. Results

We apply the basic framework to the inbound and outbound manufacturing and services FEI. We then repeat the analysis separately for developing and industrialized country partners for the period, 1993-2012.

4a. Regression Estimates

Our instrumental-variables procedure is to run the first-stage regressions of relative skill differences on the instrumental variable discussed above, along with other exogenous variables, for each sample and use the predicted values to estimate second-stage Tobit regressions. General specification tests are listed at the bottom of each second-stage regression in the tables below. As may be noted, the Sargan tests indicate that with few exceptions, the variables are uncorrelated

⁹ These results are available on request.

with the residuals and serve as appropriate instruments. The F tests for weak instruments suggest that, except for a few cases confined to investment to and from developing countries, the instruments perform well. The first-stage equations are available upon request.

The first and second columns of Table 3 present second-stage Tobit regression results for manufacturing inbound and outbound FEI stocks respectively in Singapore for the period 1993-2012, while the third and the fourth columns present the corresponding results for services. The effect of joint market size, measured by the sum of GDP, on inbound manufacturing and services investment and the coefficient on squared difference in real GDP are insignificant in both cases (columns 1 and 3). Also we find that outbound manufacturing and services investment (columns 2 and 4) from Singapore rises in market size and falls in GDP size differences, as expected by the KK model.

The investment-cost index in the host country is insignificant in all cases. The parent and host country trade costs are also insignificant in all cases. The variable capturing infrastructure quality is negative and significant in both the manufacturing and services inbound sample, suggesting that reductions in such costs encouraged inward investments. There were also strongly negative impacts of infrastructure barriers in host countries on outbound manufacturing and services investment from Singapore. Thus, both Singapore's manufacturing and services investment abroad and foreign investment in Singapore seeks to avoid infrastructure bottlenecks. The institutional constraints were negative and significant for inbound and outbound investments only in the case of the manufacturing sector. Distance had a negative but insignificant impact on inbound manufacturing investment stocks but had a positive and significant impact for inbound services stocks. This may indicate that more remote parent countries, such as the United States and the UK, invested significantly more in Singapore in the service sector relative to nearby

industrialized countries such as Japan to establish regional headquarters from which to re- invest in neighboring countries. However, distance significantly reduced both aggregate services investment from Singapore while it had an insignificant impact on outbound manufacturing investment. Finally, common language English and Chinese had a positive and significant impact in all cases suggesting that it facilitates investment between Singapore and the countries with which it has a common language.

Our main interest lies in the impact of relative skill endowments. The direct coefficient on relative skill differences, specified as the percentage of the labor force with a tertiary education in the parent country less the corresponding ratio in the host country, is negative and significant at the one percent level for the services inbound sample, but insignificant for the manufacturing inbound sample. These findings suggest that services inbound investment stocks rose with a relative increase in Singapore skills compared to parent nations, which were predominantly industrialized economies as shown in Table 1. In contrast, the coefficients on skill differences are significantly positive at the one percent level for both manufacturing and services outbound regressions, implying that an increase in Singapore's skills compared to the countries in which it invests tended to increase FEI stocks. As we saw in Table 1, Singapore's outbound investment in both manufacturing and services has largely gone to developing countries and in that sample the skill-differences variable is positive for all observations. Thus, an increase in this variable would suggest a rising relative skill endowment in Singapore, which induces a rise in both services and manufacturing outbound FEI stocks. This finding supports the view that Singapore's investment abroad is concentrated in labor-intensive manufacturing and services.

Table 4 offers a different cut of the data by considering manufacturing and services inbound and outbound FEI stocks with developing countries. The first and second columns list

results for manufacturing data with developing countries and the third and fourth the corresponding services data. The joint market size is significant at the one percent level for only the services outbound investment. In all other cases it was insignificant. The squared GDP difference was insignificant in all cases.

Once again the impact of skill differences on FEI to and from developing countries is of interest here. The direct impact on outbound manufacturing and services FEI to developing countries is positive and significant at the one percent level. Meanwhile, the impact on inbound services investment from developing countries is also negative and significant at the one percent level suggesting a horizontal motivation while the impact on inbound manufacturing investment is insignificant similar to the results for aggregate inbound manufacturing investment in Table 3. As Singapore's skill endowments rose compared to those in neighboring developing economies, outbound manufacturing FEI stocks grew larger. The negative coefficient in the case of inbound services FEI from developing countries implies that as Singapore becomes more skill abundant relative to partner developing countries they invested more in Singapore, suggesting that skill shortages in developing countries in the region and China are resulting in outward investment from these countries into Singapore. The results presented in Table 4 should be interpreted with caution as the developing country sample size is small.

Table 5 presents similar regressions for data covering manufacturing and services inbound and outbound FEI stocks with industrialized countries. The first and second columns list results for manufacturing FEI data with industrialized countries and the third and fourth columns the corresponding results using services data. The joint market size is insignificant for all equations except inbound services investment, while the squared GDP difference is negative and significant

at the five percent level, as expected by the KK model, for both services and manufacturing inbound investment.

Once again the impact of skill differences is of interest here. The direct impact on inbound and outbound manufacturing FEI is negative and significant at the one percent level with regards to industrialized countries. Overall inbound investment in skill-intensive manufacturing, such as pharmaceuticals and electronics, also increased during the 1993-2012 period, when Singapore sharply increased its skill abundance (Chellaraj et al., 2013). This trend more than offset investment declines in primary manufacturing industries.¹⁰ The situation was similar for services. Finally, while distance had a negative and insignificant impact on inbound FEI in the case of manufacturing sectors, it had a negative and significant impact on both outbound manufacturing and services FEI to industrialized countries. However, as in the case of aggregate inbound services investment presented in Table 3, distance had a positive and significant impact (at the one percent level) for inbound services FEI from the industrialized countries in our sample indicating that multinationals from remote places such as the US and the UK likely have a regional emphasis. They are likely to invest in Singapore to reinvest in neighboring countries particularly in the ASEAN region relative to nearby industrialized countries such as Australia and Taiwan, China.

The basic results are reinforced by the regressions in Tables 6, which break the aggregate inbound and outbound service sector samples into two groups based on skill intensity shown in Table 2. Construction, transport and commerce sectors are classified as less skill intensive and are aggregated into one group while business, finance and real estate are classified as highly skill intensive and aggregated into another group. The results for the aggregate inbound and outbound

¹⁰ The regression results arise from the sample of total manufacturing. Unfortunately, separate data for investment by industrialized countries in Singapore by various categories of manufacturing are not available.

FEI for the aggregate construction, transport and commerce sectors are presented in Table 6 columns 1 and 2 while the corresponding results for the aggregate business services, finance and real estate are presented in columns 3 and 4. The joint market size is positive and significant at the one percent level only for inbound and outbound skill intensive service sector FEI, while the squared GDP difference is negative and significant for the same set of equations. For the less skill intensive construction, transport and commerce sectors both variables are insignificant.

Once again the impacts of skill differences and distance are of interest here. While aggregate services inbound FEI exhibited a horizontal skill-seeking motivation in Table 3, the results from the disaggregated data indicate that the motivations depended on the categories of services. The inbound FEI for the less skill intensive sectors-transport, construction and commerce display a vertical motivation, i.e., as Singapore becomes relatively less skill abundant compared to its partner countries, it receives more FEI in those sectors. Meanwhile, as Singapore becomes relatively more skill abundant in the aggregate skill intensive sectors – business services, finance and real estate, partner industrialized countries invest relatively more in the country, suggesting a horizontal motivation. Meanwhile, outbound investment in both categories of services displays a vertical motivation. As discussed earlier, Singapore's investment abroad has gone mostly to developing countries and hence this result is not surprising.

Distance had a negative and significant impact on outbound investment for both the less and more skill intensive service sector categories. However, while distance had an insignificant impact on inbound FEI in the less skill intensive sectors, it had a positive and significant impact on inbound FEI in the more skill intensive aggregate business services, finance and real estate service sectors. This further confirms the earlier results for aggregate inbound services investments strongly suggesting that MNEs from remote industrialized countries such as the US and UK are

more likely to invest in Singapore to reinvest in other countries in the region by setting up regional headquarters. Thus, investment from far off countries likely has a regional orientation¹¹.

Finally, when we aggregated the different categories of services by proximity services – construction, commerce and real estate - based on need for face to face contact with customers, and non-proximity services-business, finance and transport- there were no significant differences between the two groups on inbound FEI. The results are presented in Table 7. In both cases, the impact of skill differences was insignificant.

4b. Economic Significance

As noted earlier, the total impact of skill differences depends on both the direct coefficient and the interaction coefficients. Thus, the average annual impact of changes in manufacturing and services FEI stocks as a result of changes in skill differences may be derived as follows:

$$\partial \text{FEI} / \partial (\text{SK}_{it} - \text{SK}_{jt}) = \beta_3 + \beta_4 (\text{GDP}_{it} - \text{GDP}_{jt}) + 2 * \beta_8 (\text{TC}_{it} * (\text{SK}_{it} - \text{SK}_{jt})) \quad (2)$$

We are interested in assessing the economic importance of the effects of changes in skill differences for inbound FEI from industrialized countries. In the case of equation (2), a unit change in $(\text{SK}_{it} - \text{SK}_{jt})$ is an extremely large variation relative to the underlying sizes of skill ratios and the direct derivative is not meaningful. Accordingly, we calculate the implied total elasticity at the sample means of all variables in equation (2). Since our primary regression results are, first, that both Singapore’s manufacturing and services outward FEI to developing countries is strongly labor-seeking and, second, that both inward manufacturing and services FEI from the industrialized nations has a skill-seeking focus, we compute the relevant elasticities. In particular,

¹¹ The samples were split into developing and industrialized countries separately and the results did not change much and hence they are not reported here. While the less skill intensive sectors displayed a vertical motivation for both inbound and outbound investment regarding both industrialized and developing countries, they displayed a horizontal motivation for both inbound and outbound investment from industrialized countries and inbound investment from developing countries in the more skill intensive sectors.

we report computations for the cases of outbound services and manufacturing FEI to developing nations, using the results from columns 2 and 4 in Table 4. For inbound manufacturing and services FEI from industrialized countries we compute elasticities using coefficients shown in Table 5, columns 1 and 3.

The elasticity calculated from Table 4 indicates that a ten-percent increase in skill differences with developing countries, which occurred as Singapore became more skill abundant relative to that group, resulted in a 23.2 percent rise in outbound manufacturing FEI stocks, or \$ 461.19 million, to the average recipient over the period 1993-2012. Similarly, from Table 4, a ten-percent increase in skill differences with developing countries resulted in a 12.8 percent rise in outbound services FEI stocks, or \$ 414.37 million, to the average recipient. Thus, we find an elastic and economically large response of outward Singaporean manufacturing and services investment in the neighboring developing economies, suggesting a clear vertical orientation to that activity. Turning to inward FEI from the industrialized nations for manufacturing, in Table 5, column 1, a ten-percent decline in skill differences with industrialized countries resulted in a 19.4 percent rise in inbound manufacturing FEI stocks, or \$569.61 million from the average parent. Similarly, a ten-percent decline in skill differences with industrialized countries resulted in a 7.1 percent rise in inbound services FEI stocks, or \$ 325.84 million from the average parent (Table 5, column 3).

5. Implications and Concluding Remarks

Singapore's inbound investment with all countries in the sample is skill-seeking in both manufacturing and services sectors while for outbound investment it is labor seeking. With industrialized countries, both inbound and outbound investment displayed a skill-seeking motivation. Meanwhile, Singapore's skill share rose considerably relative to the neighboring

developing countries in ASEAN and China supporting outward vertical investment in those countries in both sectors. While skill differences have an insignificant impact on inbound manufacturing investment from developing countries, they have a negative and significant impact on inbound services investment, suggesting that Singapore's abundant skills and shortages of skills in partner developing countries result in horizontal investment from those countries.

The motivation for investment in the service sector is related to skill intensity rather than on the need for proximity. With respect to the less skill intensive categories – aggregate transport, construction and commerce - both inbound and outbound investments are labor seeking. Furthermore, while inbound investment in the skill intensive categories, business, finance and real estate is skill-seeking, outbound investment is labor seeking. Most of Singapore's outbound investment has gone to the ASEAN region as well as China and hence this result is not surprising. Finally, services are distinguished on the basis of skill intensity, there is a significant difference between the determinants of FDI in skill-intensive services and FDI in other services and goods. However, when services are disaggregated on the basis of “proximity” needs, there is no significant difference in the determinants of FDI in proximity services compared to FDI in non-proximity services.

Finally, our results show that MNEs from remote industrialized countries such as the US and the UK may invest more in Singapore to reinvest in neighboring developing countries for services but not for manufacturing. There are indications that there is a regional orientation from MNEs located in remote industrialized countries such as the US and the UK regarding the service sectors. Nearby countries such as Australia have the luxury of directly investing in the ASEAN region from their own countries without having to invest first in Singapore. However, it should be noted that the results vary by the category of service sectors. While MNEs in less skill intensive

service sectors do not exhibit this pattern, i.e., distance reduces investment, MNEs in more skill intensive sectors such as finance do, i.e., distance increases investment. Thus, while MNEs in the service sectors such as banking and finance likely invest in Singapore to reinvest, this is not the case regarding sectors such as transport.

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Table 1. Singapore's Manufacturing and Services FEI Stocks to and from Developing and Industrialized Countries (% of total in parantheses), 2012 (1990 Billion US\$)

Category	Total (1990 Bill US \$)	Developing (1990 Bill US\$)	Industrialized (1990 Bill US\$)
Manufacturing Inbound	51.6 (100.0)	3.8 (7.3)	47.8 (92.7)
Manufacturing Outbound	24.7 (100.0)	20.1 (81.5)	4.6 (18.5)
Services Inbound	199.9 (100.0)	23.3 (11.7)	176.6 (88.4)
<i>Construction + Transport + Commerce Inbound</i>	<i>58.1 (100.0)</i>	<i>5.9 (10.1)</i>	<i>52.2 (89.9)</i>
<i>Business + Finance+ Real Estate Inbound</i>	<i>141.8 (100.0)</i>	<i>17.4 (12.3)</i>	<i>124.4 (87.7)</i>
Services Outbound	77.7 (100.0)	43.3 (55.7)	34.4 (44.3)
<i>Construction + Transport + Commerce Outbound</i>	<i>22.5 (100.0)</i>	<i>12.7 (56.4)</i>	<i>9.8 (43.6)</i>
<i>Business + Finance+ Real Estate Outbound</i>	<i>55.3 (100.0)</i>	<i>30.7 (55.5)</i>	<i>24.6 (44.5)</i>

Source: Foreign Equity Investment in Singapore, 2012

Singapore Investment Abroad, 2012, Department of Statistics, Government of Singapore

Table 2. Global Average Skill Intensity for Selected Categories of Manufacturing and Service Sector Industries (% of Total Factors of Production), 2010

Category of Industry	Skilled Labor (%)	Unskilled Labor (%)	Other Factors (%)
MANUFACTURING			
Petroleum	5.1	10.1	84.8
Textiles	9.6	29.5	60.9
Chemicals	13.1	13.1	63.2
Metal Products	13.9	33.9	52.2
Paper	15.1	30.2	54.7
Electronic Equipment	15.2	24.4	60.4
Transport Equipment	16.0	30.7	53.3
SERVICES			
Water Transport	10.6	22.5	66.9
Air Transport	12.6	29.6	57.8
Other Transport	14.6	33.5	49.9
Commerce	15.2	35.9	48.9
Construction	15.4	36.1	48.5
Business Services	18.3	19.1	62.6
Communication	20.6	21.5	57.9
Financial Services	27.1	24.4	48.5
Education and Health	35.5	35.5	29.0

Source: <https://www.gtap.agecon.purdue.edu/resources/download/704.pdf>

Note; skill intensity in percentage is calculated for the world as a whole. Skilled labor includes professional workers such as managers and administrators, professionals and para professionals. While unskilled labor includes production workers such as farm workers and clerks. “Other Factors” include capital, natural resources, land and indirect tax

Table 3. Second-Stage Tobit Results for Singapore's Manufacturing and Services Inbound and Outbound Investment with Year and Country Fixed Effects, 1993-2012

Regressors	Manufacturing Inbound 1993-2012	Manufacturing Outbound 1993-2012	Services Inbound 1993-2012	Services Outbound 1993-2012
GDP Sum	0.00002 (0.08)	0.0008*** (6.47)	0.0004 (1.64)	0.002*** (8.04)
GDP Diff. Squared	-1.17e-11 (-1.42)	-2.23e-11*** (-6.72)	3.95e-12 (0.56)	-3.65e-11*** (-5.05)
Skill Diff.	-9004 (-1.56)	6387*** (5.50)	-9943*** (-3.18)	26699*** (4.96)
GDP Diff.*Skill Diff.	0.0001 (0.10)	-0.001 (1.75)	-0.004*** (-2.81)	0.0004 (1.53)
IC Host	-87.16 (-1.59)	10.16 (1.05)	-50.30 (-1.06)	28.92 (1.31)
INST Host	-958.06** (-2.08)	-31.59*** (4.67)	-69.75 (-0.17)	-15.74 (-1.06)
INFRA Host	-877.77*** (-2.58)	-58.24*** (-3.17)	-624.38** (-2.29)	-162.42*** (-4.21)
TC Host	87.45 (0.14)	3.37 (0.48)	-31.43 (-0.70)	-4.87 (-0.34)
TC Host*Squared Skill Diff.	-380.21 (-1.10)	365.55*** (3.95)	-920 (-1.36)	331.85*** (3.70)
TC Parent	23.53 (1.40)	-24.62 (-1.02)	9.58 (0.66)	75.72 (0.39)
Distance	-0.09 (-0.89)	0.03 (0.86)	0.44*** (3.86)	-2.47*** (-7.95)
Common Language	3692** (2.57)	3398*** (15.64)	2663*** (4.03)	1029** (2.05)
Intercept	27087 (1.81)	175.10 (0.30)	7792 (1.75)	621.40 (0.15)
Observations	320	320	320	
Sargan P Value	0.093	0.108	0.102	0.16
F test for Weak Instruments	10.63	17.11	12.78	16.46
Log Likelihood	-2841	-2463	-2792	-2737

Note: *** Significant at 1% level

**Significant at 5% level

Table 4. Second-Stage Tobit Results for Singapore's Manufacturing and Services Inbound and Outbound Investment with Developing Countries with Year and Country Fixed Effects, 1993-2012

Regressors	Manufacturing Developing Countries Inbound 1993-2012	Manufacturing Developing Countries Outbound 1993-2012	Services Developing Countries Inbound 1993-2012	Services Developing Countries Outbound 1993-2012
GDP Sum	-0.0001 (-1.58)	-0.002 (-1.80)	-0.001 (-1.89)	0.006*** (7.85)
GDP Diff. Squared	1.60e-10 (1.65)	9.39e-09 (1.87)	6.05e-09 (1.86)	-3.84e-09 (-1.46)
Skill Diff.	-171.40 (-0.77)	25759*** (8.86)	-21040*** (-6.15)	23207*** (2.93)
GDP Diff.*Skill Diff.	0.0003 (1.89)	0.001 (1.51)	-0.17*** (-8.29)	-0.002*** (-3.95)
IC Host	1.58 (1.10)	-1.00 (-0.06)	-40.68 (-0.96)	-45.44** (-2.12)
INST Host	-15.62 (-1.20)	-17.52*** (-2.53)	430.71 (1.12)	18.04 (1.89)
INFRA Host	9.46 (1.04)	13.42 (0.65)	134.34 (0.50)	-53.51** (-1.99)
TC Host	-1.43 (-0.63)	87.45*** (5.74)	71.08 (1.14)	751.23** (2.37)
TC Host*Squared Skill Diff.	23.90** (1.96)	-215.63 (-1.72)	2739*** (3.25)	-1290 (-0.27)
TC Parent	0.27 (0.54)	89.19 (1.69)	0.17 (0.01)	-4.47 (-0.21)
Distance	-0.14*** (-10.29)	-2.01*** (-8.06)	-1.34*** (-2.78)	-1.80*** (-4.43)
Common Language	177.79*** (9.78)	2864*** (4.50)	972.52*** (3.09)	1366*** (3.30)
Intercept	235.86 (1.47)	-3616** (-2.52)	-5629 (-1.14)	-13314** (-2.06)
Observations	100	100	100	100
Sargan P Value	0.088	0.103	0.102	0.103
F test for Weak Instruments	9.21	11.22	10.78	10.01
Log Likelihood	-442	-782	-781	-811

Note: ***Significant at 1% level

**Significant at 5% level

Table 5. Second-Stage Tobit Results for Singapore's Manufacturing and Services Inbound and Outbound Investment with Industrialized Countries with Year and Country Fixed Effects, 1993-2012

Regressors	Manufacturing Industrialized Countries Inbound 1993-2012	Manufacturing Industrialized Countries Outbound 1993-2012	Services Industrialized Countries Inbound 1993-2012	Services Industrialized Countries Outbound 1993-2012
GDP Sum	0.006 (1.30)	-0.00002 (-0.53)	0.001*** (2.85)	-0.004 (-1.45)
GDP Diff. Squared	-3.05e-11** (-2.51)	8.15e-12 (1.51)	-1.88e-11** (-1.96)	2.08e-11 (1.88)
Skill Diff.	-125190*** (-3.69)	-41005*** (-4.92)	-71457*** (-5.21)	-17514*** (-2.88)
GDP Diff.*Skill Diff.	0.004 (1.82)	0.0003 (1.41)	0.0004 (0.03)	-0.0008 (-1.19)
IC Host	-246.47*** (-3.22)	-20.34 (1.86)	-197.51*** (-3.22)	49.67 (1.92)
INST Host	-1741*** (-2.69)	11.86 (1.00)	-1031.11** (-1.97)	6.58 (0.16)
INFRA Host	-1448*** (-3.02)	-38.18 (-1.62)	-1447*** (-3.78)	-169.37** (-2.48)
TC Host	-35.33 (-1.03)	35.61*** (5.12)	893.77 (0.43)	1170*** (5.26)
TC Host*Squared Skill Diff.	3550*** (3.63)	-63.29 (-1.04)	2177*** (2.79)	729.94** (2.05)
TC Parent	-86.73** (-2.46)	-55.49 (-0.22)	-105.85 (-3.67)	-4.42 (-0.28)
Distance	-0.35 (-1.44)	-1.10*** (-4.52)	1.16*** (5.54)	-0.22*** (-5.11)
Common Language	7754** (2.20)	-558.26 (-0.68)	10765** (2.23)	4033*** (11.65)
Intercept	54536*** (3.30)	12040** (2.02)	-2008 (-0.04)	-19925*** (-4.23)
Observations	220	220	220	220
Sargan P Value	0.106	0.104	0.149	0.107
F test for Weak Instruments	10.37	10.56	15.11	10.85
Log Likelihood	-1977	-1381	-1926	-1820

Note:***Significant at 1% level

**Significant at 5% level

Table 6. Second-Stage Tobit Results for Singapore's Categories of Services Inbound and Outbound Investment with Year and Country Fixed Effects Aggregated by Skill Intensity, 1993-2012

Regressors	Construction + Transport + Commerce Inbound 1993-2012	Construction + Transport + Commerce Outbound 1993-2012	Business + Finance + Real Estate Inbound 1993-2012	Business + Finance + Real Estate Outbound 1993-2012
GDP Sum	-0.0003 (-0.70)	0.0001 (1.32)	0.012*** (4.20)	0.002*** (7.99)
GDP Diff. Squared	-4.98e-12 (-0.31)	-1.46e-12 (-0.84)	2.26e-11*** (3.02)	-3.57e-11*** (-5.52)
Skill Diff.	33656** (2.23)	6744*** (8.58)	-12562*** (-3.77)	17458*** (2.84)
GDP Diff.*Skill Diff.	-0.007*** (-2.82)	0.001 (1.87)	0.002 (1.76)	0.003 (1.22)
IC Host	-35.36 (-0.37)	6.15 (1.06)	-40.02 (-0.79)	17.97 (0.85)
INST Host	-671.61 (-0.82)	-5.22** (-2.50)	-45.20 (-0.10)	-10.16 (-0.79)
INFRA Host	688.70 (1.09)	-37.16*** (-3.87)	-336.36 (-1.14)	-129.40*** (-3.68)
TC Host	11.93 (1.33)	25.41** (2.44)	-17.18 (-0.36)	28.11** (2.02)
TC Host*Squared Skill Diff.	-136.85 (-0.20)	284.07*** (5.59)	-1293 (-1.70)	46.81*** (2.91)
TC Parent	-15.14 (-0.51)	-16.83*** (-4.67)	23.91 (1.55)	-8.82 (-0.19)
Distance	-0.84 (-1.07)	-0.04** (-2.03)	0.49*** (4.00)	-1.54*** (-2.73)
Common Language	1831 (0.90)	1047** (1.96)	1774*** (2.55)	1024 (1.41)
Intercept	-2325 (-1.28)	1307 (1.91)	1994 (0.42)	1246 (0.94)
Observations	320	320	320	320
Sargan P Value	0.107	0.111	0.106	0.117
F test for Weak Instruments	10.83	11.66	11.21	12.44
Log Likelihood	-3011	-2145	-2813	-2657

Note: ***Significant at 1% level

**Significant at 5% level

Construction + Transport + Commerce is labor seeking both inbound and outbound
Business + Finance + Real Estate is skill seeking inbound but labor seeking outbound

Table 7. Second-Stage Tobit Results for Singapore's Categories of Services Inbound and Outbound Investment Aggregated by Proximity with Year and Country Fixed Effects, 1993-2012

Regressors	Construction + Real Estate + Commerce Inbound 1993-2012	Construction + Real Estate + Commerce Outbound 1993-2012	Business + Finance + Transport Inbound 1993-2012	Business + Finance + Transport Outbound 1993-2012
GDP Sum	-0.00001 (-1.19)	0.0007*** (8.03)	0.0004 (1.39)	-0.004 (-0.91)
GDP Diff. Squared	4.30e-13 (1.24)	-2.11e-11*** (-9.53)	4.44e-11*** (4.94)	5.51e-12 (-0.49)
Skill Diff.	630.49 (1.21)	1380*** (2.33)	7725 (1.46)	1992*** (2.60)
GDP Diff.*Skill Diff.	0.0001 (1.12)	0.0002 (0.47)	0.002 (1.60)	-0.01 (-0.44)
IC Host	185.56 (1.45)	15.47 (1.41)	-91.66 (-1.23)	-33.61 (-1.01)
INST Host	-385.88** (-2.15)	-7.82** (-2.03)	-2504*** (-4.20)	-61.99** (-2.84)
INFRA Host	-76.70 (-1.84)	8.06 (0.83)	-6201*** (-4.53)	2.26 (-0.04)
TC Host	2.15 (1.70)	-3.72 (-0.34)	1142 (0.56)	-32.68 (-1.73)
TC Host*Squared Skill Diff.	32.98*** (3.27)	-170.22 (-1.36)	-69.41 (-0.21)	239.97 (0.67)
TC Parent	-27.95*** (-2.70)	-11.77*** (-3.22)	-56.85 (-1.33)	0.44 (0.01)
Distance	0.01 (0.14)	-1.22*** (-4.44)	-0.37 (-1.29)	-2.72** (-1.96)
Common Language	2.48 (0.06)	1354 (4.46)	482.99 (0.74)	1073 (0.70)
Intercept	2400 (1.88)	-527.33 (-1.11)	4148*** (5.04)	4412** (2.30)
Observations	320	320	310	320
Sargan P Value	0.095	0.100	0.087	0.098
F test for Weak Instruments	9.77	10.03	9.22	10.06
Log Likelihood	-1287	-1879	-1484	-2263

Construction + Real Estate + Commerce and Business + Finance + Transport has no impact on skills for inbound but vertical for outbound.

Note: ***Significant at 1% level

**Significant at 5% level