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Abstract

We show that for industrialization and international wage convergence through multi-plant foreign direct investment (FDI) to occur, the measure of the quality of the social infrastructure in the South relative to that in the North must be at least as large as the South-North

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wage ratio. We also show that if profitable FDI flows already take place from the North to the most productive economy in the South, then less productive Southern economies can also become recipients of FDI, provided that they are integrated into the world trading system, and there are no impediments to the decline of their wage levels. An increase in the size of public debt in the North decreases the amount of FDI outflow. Incorporating human capital accumulation decisions, we show that FDI flows to the South result in increased skill premiums in the North but they also lead to a period of higher global growth rate as well as a narrower North-South unskilled wage gap.

JEL classification: F21, F23, O14

Keywords: multi-plant FDI, convergence, social infrastructure

1. Introduction

In the 1960s, when it was fashionable for developing countries to shut their doors to inflows of foreign direct investment (FDI) and to industrialize through import substitution, Singapore chose an alternative path of economic development. Going against the tide, Singapore sought to industrialize through attracting multinational corporations (MNCs) to base affiliates within its shores to produce parts and components, which were then exported back to the home country for final assembly. Figures 1 and 2 tell the story of one dimension of the economic miracle that followed. With steady increases in the stock of FDI—principally from the United States, the United Kingdom and Japan—Singapore's wage level caught up substantially to the levels of its principal source countries. From a mere 10 percent of the US and UK wage levels in 1970, Singapore's wage level reached over 60 percent of the US level and nearly 70 percent of the UK level by the end of the 90s.

In this paper, we are motivated by the Singapore experience to ask what economic principles, operating within a well-specified general-equilibrium model of the world economy, are likely to be at work to produce such international wage convergence via FDI. Can another emerging economy with little natural resources and a small domestic market like Singapore or a coun-

try with a large but poor population like many former socialist economies in Asia (e.g. Cambodia and Vietnam) and Eastern Europe, adopt a similar economic strategy to achieve a take-off into industrialization? What would it have to do? A central thesis of this paper is that the quality of social infrastructure, to use the term coined by Hall and Jones (1999) to describe the quality of institutions and government policies, in the South compared to that in the North is a prime factor influencing the size of international investment flows from the North to the South. The inflow of FDI to the South, in turn, acts to pull up Southern wages.[1] In Figure 3, we show scatter plots relating the size of the stock of inward FDI to the index of social infrastructure developed by Hall and Jones (1999), with 1.0 denoting the highest quality and zero the lowest quality. (The countries with the highest measured levels of social infrastructure using the Hall-Jones index are Switzerland, the United States, and Canada; three countries that are close to the lowest in social infrastructure are Zaire, Haiti, and Bangladesh.) Although Hall and Jones constructed their index without regard to the inflows of FDI, our scatter plots, for a grouping of all 120 countries and for a grouping of developing countries alone, show a positive relationship between the quality of social infrastructure and the size of inward stock of FDI in 1995. This paper's hypothesis is that the relationship shows causality, not merely correlation, so that raising the quality of social infrastructure *leads* to the inward flow of FDI. To support our thesis, we first develop a theory where the measure of the quality of social infrastructure in the South relative to that in the North is a key determinant of North-South FDI flows. Then we conduct a case study of Singapore, a country that relied almost entirely on this strategy to industrialize and by all accounts succeeded via this strategy to dramatically raise its standard of living within the span of less than forty years, to draw out the main features of social infrastructure that seem to be important for attracting FDI.

We think that the exercise we perform in this paper is useful for several reasons. First, an influential view in the theory of economic development makes the reliance on a huge domestic market a *necessary* component of a strategy for economic take-off (Murphy, Shleifer and Vishny, 1989a, 1989b). Murphy et al. cite the fact that although reliance on international trade is an

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[1] Our theory will consider throughout an integrated North where horizontal investment flows occur naturally among the developed Northern economies.

important part of the success story of some developing countries, these same countries nevertheless satisfied a precondition that their domestic market was large. This argument, however, does not apply to the city-state of Singapore. It is true that Singapore's first development plan was initially premised upon the prospect of a Common Malayan Market with a combined population of ten million. But that strategy was abandoned in 1965 when Singapore left the Malaysian Federation. It then became clear that industrialization could not be based upon producing and selling to a domestic market of only two million people, many of whom were unemployed. Instead, Singapore made a conscious effort to attract MNCs to its shore, mainly to produce intermediaries which were then exported back to the home country for final assembly, the central pillar of its economic strategy. This example, as well as the later examples of Indonesia, Malaysia and Thailand, which adopted a similar strategy, serve as a motivation for us to develop, at a theoretical level, the general principles that operate to enable an economy *lacking* a sizeable domestic market to achieve the catch-up to Northern wages.[2]

Second, it is necessary to draw insights from two separate strands of the economic literature over the past two decades—one documenting the empirical importance of, and modeling of, multi-plant multinational enterprises or horizontal investment, and another the dynamic models of trade and innovation—to provide an empirically satisfying account of economic development through international investment. Such an Industrial Organization-based theory of economic development through international investment is needed because the standard neoclassical theory of international capital flows fails empirically (Lucas, 1990). In that model, with two countries producing

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[2]Perhaps as a reflection of the lessons learned from the Singapore experience, Singapore's Deputy Prime Minister Lee Hsien Loong said in a speech given at The Forbes Global CEO Conference held in Singapore on September 19, 2001: "ASEAN countries must also continue efforts to attract foreign investment. To a greater or lesser extent, all need investments by MNCs to create jobs, upgrade skills and technology, and generate exports. Some economists have advocated building up the domestic economy as an alternative strategy, to lessen a country's vulnerability to external problems. But while promoting indigenous cottage industries can be useful, this by itself will not enable countries to move up the economic ladder."

the same good with the same constant-returns-to-scale production function relating output to homogeneous capital and labor inputs, the marginal product of capital is higher in the South where capital is scarce (relative to the size of the labor force). Consequently, if there are no barriers to the international flows of capital, FDI will flow from the North to the South until capital-labor ratios are equalized, and hence Southern wages will converge to Northern levels. Lucas (1990) establishes that the assumptions on technology and trade conditions underlying the standard neoclassical model "must be drastically wrong," and he asks, "[B]ut exactly what is wrong with them, and what assumptions should replace them? This is a central question for economic development." (p. 92)

In this paper, we propose to depart from the standard neoclassical model by introducing multi-plant cost advantages in an international context. Markusen (1984) was the first to develop a general-equilibrium model of multi-plant economies achieved through horizontal FDI. (See Markusen and Maskus (2001) for a recent update of the empirical importance of such investment flows.) That paper's model, however, is entirely static, hence not a growth model. The other strand of the literature is best summarized in the work of Grossman and Helpman (1991). Although multinational enterprises are incorporated into their growth model, the authors essentially seek to identify how *vertical* investment arises when conditions for international factor price equalization fail. The problem is that empirical evidence so far suggests strong support for the horizontal approach to investment flows, but little support for the vertical approach (Markusen and Maskus, 2001). Our paper is an attempt to correct this defect; it studies the conditions under which horizontal FDI takes place in a dynamic setting, and how multi-plant FDI flows in turn affect the global growth rate as well as the evolution of the North-South wage gap. In our theory, Northern firms, who are the only ones engaging in product innovation, generate bigger streams of profit if they can find cost-effective locations overseas to base multiple plants to manufacture using the design blueprints developed in the home country. We find that the quality of the social infrastructure in the South compared to that in the North is a prime factor influencing the size of such investment flows.

Third, the question of how conventional macroeconomic factors in the North can affect the outflow of FDI, and the consequent evolution of the wage gap, is one that has not been formally addressed in the literature. Yet, over the medium term, macroeconomic factors seem to have a large

influence on the amount of FDI outflows from the OECD countries. For example, from the early 70s, many OECD countries engaged in a build-up of public debt. Then, in the 90s, the level of public debt began to decline, most notably in the United States. In contrast to the trend in the other OECD countries, however, Japan had a massive build-up of public debt in the 90s—its government debt to GDP ratio doubled over the decade to reach over 125 percent by 2001. Figure 4 shows that, in the 90s, there was a surge of FDI outflows from the US and the UK but a marked decline in the outward flows of FDI from Japan. Does a massive build-up of public debt as occurred in Japan in the 90s discourage FDI outflows, and does increased fiscal responsibility as occurred under the Rubin-Summers compact at the US Treasury during most of the 90s tend to stimulate outflows of FDI? We show that, in our stylized model, an increase in the level of public debt in the North causes a slowdown in the pace of product innovation, and decreases the size of the outflow of FDI. Therefore, long-term fiscal frugality in the North is good for economic development of the South in our theory.

Finally, there is, in the advanced economies today, an anti-globalization movement which advances the view that increased international capital flows lead to an immiserization of Northern incomes. In fact, our analysis shows that, in the model with homogeneous labor, the discovery of cheaper alternative sources of labor input overseas *raises* Northern firms' projected streams of future profits, hence the value of their assets, and stimulates further product development. This serves to pull up wages. It is true that, with a distinction made between skilled and unskilled workers, our finding is that when conditions are right for profitable FDI to take place, the skill premium in the North is indeed raised. At the same time, however, the pace of human capital accumulation is increased, the global economy experiences a period of faster growth, and the North-South unskilled wage gap is narrowed.

The rest of the paper is organized as follows. In Section 2, we develop a dynamic model exhibiting transitional growth to show the condition under which profitable multi-plant North-South FDI will occur, and the effect this has on the North-South wage gap. In Section 3, we pursue two questions: Firstly, suppose that there are many countries in the South, each with differing qualities of social infrastructure. If industrialization through FDI already takes place in the most productive country in the South, will it necessarily also occur in the remaining less productive Southern countries once the latter join the international trading system? We establish the theoretical condition

under which the whole world will become industrialized through multi-plant FDI. Secondly, we study how public debt policy affects the size of FDI out-flows from the North. In Section 4, we explicitly introduce the human capital accumulation decision, and study how multi-plant FDI affects growth, the skill premium and the North-South wage gap. In Section 5, we conduct a case study of the Singapore economy to draw out what are the main features of social infrastructure that attract FDI inflows. We make some concluding remarks in Section 6.

2. The model

We suppose that there are two regions in the world economy we call North and South. The asymmetry across the two regions lies in their technological capabilities. Only in the North is there the capability to engage in R&D to develop the next state-of-the-art brand of intermediary.[3] It is this constant flow of innovation activity that pushes out the world technology frontier. For now, we let each region be homogeneous. In the absence of FDI inflows, we assume that only cottage industries exist in the South, which produce a competitive good A according to the production function, $Q_A = a_S^{-1} L_{SA}$. Here, we interpret a_S^{-1} as reflecting a measure of the quality of social infras-tructure in the South. Labor force (equal to population) size in the South is equal to L_S. In the absence of FDI inflows, all labor is employed in sector A, so $L_{SA} = L_S$. Under competition, Southern wage is given by $w_S = p_A a_S^{-1}$, where p_A is the world price of good A.

The North produces an industrial final good I that is assembled from a range of differentiated intermediate capital goods according to the production function, $Q_I = [\int_0^n x_i^\alpha di]^{1/\alpha}$, $0 < \alpha < 1$, where x_i is the output of intermedi-ate capital good i, $(1-\alpha)^{-1}$ gives the elasticity of demand for the input, and n (a large number) is a measure of the range of varieties of capital inputs. To keep the algebra tractable, it is convenient to assume that capital inputs depreciate by 100 percent when used in production. Assuming symmetry across intermediate capital goods, we can write $Q_I = n^{(1-\alpha)/\alpha} X$, $X \equiv nx$. Firms in the North engage in private sector R&D to generate the next va-riety of the differentiated intermediate capital good. The resource cost of

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[3]Acemoglu and Zilibotti (2001) estimate that over 90 percent of the R& D expenditure in the world is carried out in the OECD.

developing a new design blueprint is given by $w_N b_N$, $b_N > 0$, where w_N is Northern wage. With free entry and exit in the research activity, for $\dot{n} > 0$, where a dot over a variable denotes its time derivative, we have

$$w_N b_N = v. \tag{1}$$

Here, v is the asset value of a brand of differentiated capital good. Using R&D resource cost as our numeraire, we have $v = 1$, so $w_N = b_N^{-1}$.

Once a blueprint has been designed, it is sent to the manufacturing floor for production. With the North treated as homogeneous, multi-plant FDI occurs extensively among the developed countries in the North.[4] The dividend per firm is given by $\pi \equiv p_x x - w_N a_N x$, where p_x is the price of the typical intermediate capital good, and a_N^{-1} measures the quality of social infrastructure in the North. Maximization of per firm dividend gives the condition:

$$w_N = \frac{\alpha p_x}{a_N}, \tag{2}$$

whence $p_x = a_N(\alpha b_N)^{-1}$. Next, using (2), $\pi = (1 - \alpha)p_x X / n$. With perfect competition in the production of good I, the value of final output is equal to the total value of assembled inputs if $Q_I > 0$, that is, $p_I Q_I = p_x X$. Hence, we can write

$$\pi = \frac{(1 - \alpha)p_I Q_I}{n}. \tag{3}$$

We let labor force (equal to population) size in the North be given by L_N. Households in the North and South are assumed to be identical, and growing at the identical growth rate of γ. Each agent has a constant probability of death, θ, as in Blanchard (1985), with each worker turning over his wealth to an actuarially fair annuity company, and receiving a return of $r + \theta$ on his annuity. There is a perfect international bond market. Each household born at time s solves an intertemporal problem determining its current and expected stream of consumption:

$$\text{Max} \int_t^\infty \log[u(\tau, s)] \exp^{-(\theta+\rho)(\tau-t)} d\tau$$

$$\text{s.t.} \int_t^\infty E(\tau, s) \exp^{-\int_t^\tau (r_\nu+\theta)d\nu} d\tau \leq \int_t^\infty Y(\tau) \exp^{-\int_t^\tau (r_\nu+\theta)d\nu} d\tau + W(t, s),$$

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[4]Markusen (2002) documents that two-way horizontal FDI flows are common between pairs of developed countries.

where $W(s, s) = 0$. Here, Y is non-interest income, W is non-human wealth, E is consumer expenditure, r is the short-term real rate of interest, and ρ is the subjective rate of time preference. Solving this problem, and aggregating across all cohorts alive at time t, we obtain

$$\frac{\dot{E}}{E} = r - \rho - \frac{(\gamma + \theta)(\theta + \rho)W}{E}, \tag{4}$$

where, in the absence of public debt, $W = nv/L$, $L \equiv L_S + L_N$ being the size of the global labor force. Note that E is per capita world aggregate consumption expenditure and W is per capita world aggregate non-human wealth. Letting the period utility function be Cobb-Douglas with σ being the share of total expenditure going to good I, we have $p_I C_I = \sigma E$. In market-equilibrium, $LC_I = Q_I$, so $p_I Q_I = \sigma L E$. Using this in (3), we have

$$r = \pi = \frac{(1 - \alpha)\sigma E}{n/L}, \tag{5}$$

since by our normalization, $v = 1$. Substituting (5) into (4), we get

$$\frac{\dot{E}}{E} = \frac{(1 - \alpha)\sigma E}{\tilde{n}} - \rho - \frac{(\gamma + \theta)(\theta + \rho)\tilde{n}}{E}, \tag{6}$$

where we define $\tilde{n} \equiv n/L$.

Workers in the North are allocated to two activities: R&D and manufacturing. Hence, $b_N \dot{n} + a_N X = L_N$, which we can rewrite as

$$\dot{\tilde{n}} = b_N^{-1}[\tilde{L}_N - \frac{a_N X}{L}] - \gamma \tilde{n}, \tag{7}$$

where $\tilde{L}_N \equiv L_N/L$. We now want to express X in terms of E. Noting that $p_x X = p_I Q_I = \sigma L E$, and $p_x = a_N(\alpha b_N)^{-1}$, we obtain $a_N X/L = \sigma \alpha b_N E$. Using this result in (7), we get

$$\dot{\tilde{n}} = b_N^{-1}[\tilde{L}_N - \sigma \alpha b_N E] - \gamma \tilde{n}. \tag{8}$$

Eqs. (6) and (8) give us two dynamic equations in E and $\tilde{n}$ to characterize the equilibrium path of the world economy, given an initial value of $\tilde{n}$. We see in Figure 5 that a unique saddle-path is obtained. Suppose the world

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economy is initially in a steady state. It is straightforward to show that the steady-state wage gap in the absence of North-South FDI flow is given by[5]

$$\frac{w_N}{w_S} = \frac{\sigma \alpha \tilde{L}_S}{(1-\sigma)\tilde{L}_N}\left[1 + \frac{\gamma}{\sigma\alpha(\frac{E}{\tilde{n}})^*}\right], \tag{9}$$

where

$$(\frac{E}{\tilde{n}})^* = \frac{\rho + \sqrt{\rho^2 + 4(1-\alpha)\sigma(\theta+\gamma)(\theta+\rho)}}{2(1-\alpha)\sigma}.$$

Let the production function for an intermediate input in the South be given by $x_S = L_{Sx}/(\mu a_S)$, $\mu > 0$. By suitable choice of units, we set μ equal to 1. Hence, $x_S = L_{Sx}/a_S$. The condition for a Northern firm with patent rights to a particular design blueprint to find it profitable to base another manufacturing plant in the South is: $w_N a_N \geq w_S a_S$. Using (9), we can express the condition for profitable FDI outflow from the North as:

$$\frac{\sigma\alpha\tilde{L}_S}{(1-\sigma)\tilde{L}_N}\left[1 + \frac{\gamma}{\alpha\left(\frac{\rho+\sqrt{\rho^2+4(1-\alpha)\sigma(\theta+\gamma)(\theta+\rho)}}{2(1-\alpha)}\right)}\right] \geq \frac{a_S}{a_N}. \tag{10}$$

We obtain the following proposition:

Proposition 1. *For positive FDI flow to take place from the North to the South, the degree of relative backwardness of South's social infrastructure compared to the North (measured by a_S/a_N) must not be greater than the North-South wage gap (w_N/w_S). The North-South wage gap, in turn, is larger, the greater is the relative size of the Southern labor force (L_S/L_N), the larger is the share of world expenditure on the industrial final good I (σ), the faster is the steady-state growth rate of new products (determined*

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[5]The steps are as follows: Since by our normalization, $w_N = b_N^{-1}$, and $w_S = p_A a_S^{-1}$, $w_N/w_S = a_S/(p_A b_N)$. However, by the global market-clearing condition for good A, $p_A = (1-\sigma)a_S E/\tilde{L}_S$. Consequently, $w_N/w_S = \tilde{L}_S/[(1-\sigma)b_N E]$. Next, setting $\dot{E} = 0$ in (6), and $\dot{\tilde{n}} = 0$ in (8), we have a pair of equations to determine the steady-state values of E and $\tilde{n}$. Substituting the steady-state value of E into the expression of w_N/w_S, we obtain (9).

in this model by labor force growth, γ), the smaller is the subjective rate of time preference (ρ), and the longer is the expected length of life (θ^{-1}).

Since the quality of the social infrastructure in the South relative to that in the North is itself independent of the factors determining the North-South wage gap, there is no reason why profitable FDI flows will take place from the North to the South. When the inequality in (10) is not satisfied, no North-South FDI flows take place even though the North and South are engaged in international exchange of goods.[6] Given a_S/a_N, it is interesting that a slowdown of population growth (γ) inhibits the outflow of FDI from the North. This is because a decline in population growth slows down the growth of ideas, which is what keeps the world economy growing in this model, and reduces the North-South wage gap. The relative advantage of building a new plant in the South is accordingly diminished with slower growth, given a_S/a_N. We are now interested in answering the following question: If starting initially at the steady state, the condition is satisfied for profitable North-South FDI flow to occur, how is the path of the North-South wage gap affected? We have the next proposition:

Proposition 2. *When the condition for profitable North-South FDI flow to occur is satisfied, the North-South wage gap immediately drops and then gradually narrows even further.*

To prove the second proposition, we note that in the steady state in the absence of North-South FDI flow, we can replace the term E in $w_N/w_S = \tilde{L}_S/[(1-\sigma)b_N E]$ by the value of E that makes $\dot{\tilde{n}} = 0$, namely, $E = (\sigma\alpha b_N)^{-1}\tilde{L}_N - (\sigma\alpha)^{-1}\gamma\tilde{n}$, to give

$$\frac{w_N}{w_S} = \frac{\tilde{L}_S}{b_N(1-\sigma)\left[\frac{\tilde{L}_N}{\sigma\alpha b_N} - \frac{\gamma\tilde{n}}{\sigma\alpha}\right]}.$$

Using this, we can re-write the condition for profitable North-South FDI flow, namely, $w_N a_N \geq w_S a_S$, as:

$$\sigma\alpha a_N \tilde{L}_S - a_S(1-\sigma)\tilde{L}_N + a_S(1-\sigma)b_N\gamma\tilde{n} \geq 0. \qquad (11)$$

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[6]Such an equilibrium consists only of intra-North multi-plant FDI flows but zero North-South FDI flow.

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We now want to use the condition in (11) to show that when profitable North-South FDI flow occurs, it shifts the stationary locus for $\dot{\tilde{n}} = 0$ in Figure 5 rightwards, hence upwards. When multi-plant North-South FDI occurs, the design blueprint developed in the North is communicated to both the Northern as well as Southern manufacturing facilities for production. Consequently, with North-South FDI flow, $X = X_N + X_S$, where X_N is the total amount of intermediaries produced in the North, and X_S is the amount produced in the South. In the South then, labor is allocated to two different sectors: the sector with the cottage industries and the industrial sector. Note that if there are no barriers to international investment, North-South FDI flows take place until the unit costs are equalized, that is, $w_N a_N = w_S a_S$. The condition that total labor demand equals labor supply in the South is given by $L_{SA} + a_S X_S = L_S$, where $X_S \equiv n x_S$. To solve for L_{SA}, we note that $w_S L_{SA} = (1 - \sigma) LE$. Using the arbitrage condition under unhindered international investment, $w_N a_N = w_S a_S$, and our normalization $w_N b_N = 1$, we can write $L_{SA} = (1 - \sigma) a_S b_N LE / a_N$. Therefore,

$$X_S = \frac{1}{a_S} \left[L_S - \frac{(1 - \sigma) a_S b_N LE}{a_N} \right],$$

which, upon using in $b_N \dot{n} + a_N X_N = L_N$ with $X_N = X - X_S$ and $a_N X = \sigma \alpha b_N LE$, yields

$$\dot{\tilde{n}} = \frac{\tilde{L}_N}{b_N} + \frac{a_N \tilde{L}_S}{b_N a_S} - [\alpha \sigma + 1 - \sigma]E - \gamma \tilde{n}. \tag{12}$$

The equation for the stationary locus $\dot{\tilde{n}} = 0$ with positive North-South FDI flow is given by

$$E = \frac{1}{\alpha \sigma + 1 - \sigma} \left[\frac{\tilde{L}_N}{b_N} + \frac{a_N \tilde{L}_S}{b_N a_S} - \gamma \tilde{n} \right].$$

At any given $\tilde{n}$, we can check that the stationary locus for $\dot{\tilde{n}} = 0$ is now higher than the original stationary locus given by $E = (\sigma \alpha)^{-1}[b_N^{-1} \tilde{L}_N - \gamma \tilde{n}]$. To prove this, we show that

$$\frac{1}{\alpha \sigma + 1 - \sigma} \left[\frac{\tilde{L}_N}{b_N} + \frac{a_N \tilde{L}_S}{b_N a_S} - \gamma \tilde{n} \right] - \frac{1}{\alpha \sigma} \left[\frac{\tilde{L}_N}{b_N} + -\gamma \tilde{n} \right] > 0,$$

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which is the case if and only if the condition in (11) is satisfied. Hence, if the condition for profitable North-South FDI flow is satisfied, we obtain the trajectory given in Figure 6. We see from there that E immediately jumps up, and then continues to rise until it reaches a new steady state where E and $\tilde{n}$ are both higher. The implied closing of the North-South wage gap can be read off from the relation, $w_N/w_S = \tilde{L}_S/[(1 - \sigma)b_N E]$, so when the opportunity to build cost-effective multiple plants overseas opens up, we find E jumping up, which raises the rate of return to the R& D activity (see equation (5)), increases the pace of product innovation, and pulls up the Southern wage relative to Northern wage.

How is the narrowing of the North-South wage gap effected? We show expressions for the real wages of a typical worker in the North and South below:

$$\frac{w_N}{p_I} = \frac{\alpha n^{\frac{(1-\alpha)}{\alpha}}}{a_N},$$

$$\frac{w_N}{p_A} = \frac{\tilde{L}_S}{(1 - \sigma)a_S b_N E},$$

$$\frac{w_S}{p_I} = \frac{(1 - \sigma)\alpha b_N n^{\frac{(1-\alpha)}{\alpha}} E}{a_N \tilde{L}_S},$$

$$\frac{w_S}{p_A} = \frac{1}{a_S}.$$

Upon opening up to inflows of FDI from the North, the Southern worker's real consumption wage clearly jumps up, and continues a steady rise until it reaches a higher level in the new steady state so he is unambiguously better off. As for the Northern worker, his wage in terms of the industrial good is unchanged on impact (since n is a slow-moving state variable) but his wage in terms of good A drops, and continues to decline to reach a permanently lower level in the new steady state. The decline of the Northern worker's real wage in terms of good A is, however, compensated by a higher than normal increase of the real wage in terms of the industrial good as the number of new products grows at a rate faster than γ for a period. Hence the Northern worker's real consumption wage, which falls initially, can finally rise above its original level, especially if the share of expenditure going to the industrial good I is high.

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It is worth pointing out that our model predicts conditional convergence rather than absolute convergence. In the new steady state associated with unhindered international investment flows, unit costs in the Northern and Southern plants are equated so $w_S/w_N = a_S^{-1}/a_N^{-1}$. Absolute convergence is obtained only if $a_S^{-1} = a_N^{-1}$. If the index of the quality of social infrastructure in the South is, say, only 70 percent of the level in the North, then international investment flows, when they occur, can bring the Southern wage only up to 70 percent of the Northern wage level in the new steady state.

3. Extension to many countries and public debt shock

3.1 Extension to multiple Southern countries

Suppose that there are J number of countries in the South with different levels of quality of social infrastructure, $a_S^1 < a_S^2 < \cdots < a_S^J$, with country 1 having the best social infrastructure, and country J having the worst social infrastructure.[7] Let the North currently be engaged in international trade only with the most productive Southern economy, and let the condition for profitable foreign direct investment in country 1 also be satisfied so Northern firms have multiple plants in country 1. The question to be answered is the following: Will the decision by all the other less productive Southern economies to integrate into the world trading system be sufficient to generate FDI inflows? We want to prove the following proposition:

Proposition 3. *Suppose that the North trades with all the countries in the South, each with differing qualities of social infrastructure. Then, if the North finds it profitable to place multiple plants in the most productive Southern economy, it must find it profitable also to place multiple plants in the less productive economies, provided that there are no impediments to wage adjustments in the less productive Southern economies.*

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[7]It would be straightforward to introduce some diversity in the index of social infrastructure in the countries in the North as well although there is much less diversity among countries in the North. (The correlation coefficient between the output per worker and the index of social infrastructure in the Hall and Jones sample is 0.89.) International trade in goods alone will equalize the unit wage cost across Northern countries.

With trade among all the countries, market-clearing of good A requires that $\sum_{j=1}^{J} w_S^j L_S^j = (1-\sigma)E$. Using $w_S^j = p_A/a_S^j$, and $w_N = b_N^{-1}$ under our normalization, we obtain

$$\frac{w_N}{w_S^1} = \frac{a_S^1 \sum_{j=1}^{J}(L_S^j/a_S^j)}{b_N(1-\sigma)E}. \tag{13}$$

Using the value of E that makes $\dot{\tilde{n}} = 0$ in the absence of North-South FDI flow, namely, $E = (\sigma\alpha b_N)^{-1}\tilde{L}_N - (\sigma\alpha)^{-1}\gamma\tilde{n}$, and substituting the steady-state value of $\tilde{n}$, the condition that is satisfied for FDI to flow to country 1 is

$$\frac{\sigma\alpha a_S^1 \sum_{j=1}^{J}(L_S^j/a_S^j)}{(1-\sigma)L_N}\left[1 + \frac{\gamma}{\alpha\left(\frac{\rho+\sqrt{\rho^2+4(1-\alpha)\sigma(\theta+\gamma)(\theta+\rho)}}{2(1-\alpha)}\right)}\right] \geq \frac{a_S^1}{a_N}. \tag{14}$$

For FDI flow to occur from the North to country j; $j = 2, 3, \cdots, J$, we must have $w_N a_N \geq w_S^j a_S^j$; $j = 2, 3, \cdots, J$. However, we see from (13) that we can write

$$w_N = \frac{w_S^1 a_S^1 \sum_{j=1}^{J}(L_S^j/a_S^j)}{b_N(1-\sigma)E}.$$

The condition that FDI flows from the North to country 1 is that $[w_N a_N]/[w_S^1 a_S^1] \geq 1$, which we can now write as

$$\frac{w_N a_N}{w_S^1 a_S^1} = \frac{a_N \sum_{j=1}^{J}(L_S^j/a_S^j)}{b_N(1-\sigma)E} \geq 1,$$

or, replacing E,

$$\frac{\sigma\alpha a_N \sum_{j=1}^{J}(L_S^j/a_S^j)}{(1-\sigma)L_N}\left[1 + \frac{\gamma}{\alpha\left(\frac{\rho+\sqrt{\rho^2+4(1-\alpha)\sigma(\theta+\gamma)(\theta+\rho)}}{2(1-\alpha)}\right)}\right] \geq 1. \tag{15}$$

Since, with free international trade, $p_A = w_S^1 a_S^1 = w_S^2 a_S^2 = \cdots = w_S^J a_S^J$, it follows that if (15) is satisfied for country 1, then

$$\frac{w_N a_N}{w_S^j a_S^j} \geq 1; \text{ for } j = 2, 3, \cdots, J,$$

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so we find that if the condition for profitable FDI flow into the most productive Southern economy is satisfied, the integration of the less productive Southern economies into the world trading system ensures that these latter economies also satisfy the condition for profitable FDI flows.

To understand this result, let us compare country 2 with country 1 in the South. Suppose that the index of the quality of social infrastructure in country 2 is only half as good as the index in country 1 so $a_S^2 = 2a_S^1$. If $w_S^1 a_S^1 < w_N a_N$, then our result says that if country 2 chooses to join the international trading system, it necessarily follows that $w_S^2 a_S^2 < w_N a_N$. The reason is that international competition brings $w_S^2 a_S^2$ into equality with $w_S^1 a_S^1$ so $w_S^2 = 0.5 w_S^1$, that is, international trade competition drives the wage level in Southern country 2 down to half the level of Southern country 1. As Kravis (1970) emphasized, international trade plays a handmaiden role in economic development in that it brings a country's cost structures in line with external prices.

An important qualification to the result that free trade facilitates the inflow of FDI is that there should be no impediment to the decline of wage levels in the less productive Southern economies when they join the international trading system. It may be possible, however, that for efficiency wage reasons, wages cannot decline without greatly hurting worker productivity. Then cost minimization requires the payment of an incentive-compatible minimum wage. To take a particular formulation of the efficiency wage hypothesis, it could be that the wage levels in Zaire or Haiti may already be so low in the absence of international trade that they cannot go down further without substantially reducing the amount of nutritional intake below the minimum level required for productive work. In such a situation, opening up to international trade will cause a fall of the demand wage below the minimum supply wage, with the consequence that massive unemployment must inevitably result. In such a case, there does not exist an equilibrium in the very low productivity economy under free trade where there is a positive level of equilibrium employment.[8]

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[8]Continuing with our example of Southern economies 1 and 2, under free trade, $w_S^2/w_S^1 = a_S^1/a_S^2 = 1/2$. Let p^C denote the consumer price index, which is the same in both countries under the assumption of that all goods are tradable and preferences are identical. Then $w_S^2/p^C = 0.5(w_S^1/p^C)$. If the real consumption wage, w_S^2/p^C, is below the

3.2 A helicopter drop of public debt

Suppose that in the North, there is a helicopter drop of public debt, which we suppose is equal to the amount βL. There are two ways of thinking about how this affects the outward flow of FDI from the North. The first is to see how, starting at an initial steady state with no North-South FDI flow, a helicopter drop of public debt decreases the North-South wage gap so that a smaller relative inefficiency of Southern social infrastructure compared to the North is now required for profitable North-South FDI flow to occur. With positive levels of public debt, the North-South wage gap originally given in (9) is replaced by

$$\frac{w_N}{w_S} = \frac{\sigma\alpha\tilde{L}_S}{(1-\sigma)\tilde{L}_N}\left[1 + \frac{\gamma}{\sigma\alpha(\frac{E}{\tilde{n}})^{**}}\right], \qquad (16)$$

where

$$(\frac{E}{\tilde{n}})^{**} = \frac{\rho + \sqrt{\rho^2 + 4(1-\alpha)\sigma(\theta+\gamma)(\theta+\rho)(1+\beta\tilde{n}^{-1})}}{2(1-\alpha)\sigma}.$$

Differentiating, we obtain

$$\left.\frac{d(E/\tilde{n})^{**}}{d\beta}\right|_{\beta=0} = \frac{(\theta+\gamma)(\theta+\rho)}{\tilde{n}^{**}\sqrt{\rho^2+4(1-\alpha)\sigma(\theta+\gamma)(\theta+\rho)}} > 0,$$

where

$$\tilde{n}^{**} = \frac{\tilde{L}_N}{\sigma\alpha b_N[(E/\tilde{n})^{**} + \gamma(\sigma\alpha)^{-1}]}.$$

Hence, for given a_S/a_N, a greater level of public debt makes the condition for profitable North-South FDI flows, $w_N/w_S \geq a_S/a_N$, more difficult to satisfy.

In the presence of North-South FDI flow, the dynamic system with positive levels of public debt is given by

$$\frac{\dot{E}}{E} = \frac{(1-\alpha)\sigma E}{\tilde{n}} - \rho - \frac{(\gamma+\theta)(\theta+\rho)(\tilde{n}+\beta)}{E}, \qquad (17)$$

$$\dot{\tilde{n}} = \frac{\tilde{L}_N}{b_N} + \frac{a_N\tilde{L}_S}{b_Na_S} - [\alpha\sigma + 1 - \sigma]E - \gamma\tilde{n}. \qquad (18)$$

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minimum level required to satisfy nutritional needs for productive work, no equilibrium with positive employment exists.

In Figure 7, we show that the stationary locus for $\dot{E} = 0$ is shifted upwards as a result of the helicopter drop of public debt. Consequently, the result of increased public-sector indebtedness is a period of slowdown in the pace of product development and the rate of outflow of FDI from the North, so that $\tilde{n}$ gradually declines.

4. Introducing human capital accumulation in the North

We now differentiate between two kinds of workers: skilled and unskilled. The South only has unskilled workers who can either work in cottage industries or, if FDI inflows occur, work in the industrial sector to produce capital intermediate goods. In the North, unskilled workers work on the production line to produce capital intermediate goods but skilled workers engage in R&D activity. Workers, at the start of their life, have to decide whether to invest in education or remain unskilled. We assume that workers in the North differ in their abilities to learn, ζ, and these abilities are distributed uniformly, ζ lying between 0 and 1. The effective cost of education is given by $\kappa w_N^u / \zeta$; $\kappa > 0$, so more able workers incur a smaller cost in terms of foregone income. Here, w_N^u is the unskilled worker's wage in the North. It is assumed that education instantaneously converts an unskilled to a skilled worker.[9] Workers choose to obtain education if

$$w_N^{sk} - \frac{\kappa w_N^u}{\zeta} > w_N^u,$$

where w_N^{sk} is the skilled worker's wage in the North. The ability of the worker that makes the LHS equal to the RHS of the preceding expression is given by $\zeta^* = \kappa(\omega_N - 1)^{-1}$, where $\omega_N \equiv w_N^{sk}/w_N^u$ is the skill premium. Given the uniform distribution of ability among Northern workers, we have $L_N^{sk}/L_N = 1 - \zeta^*$, that is,

$$\tilde{L}_N^{sk} = [1 - \frac{\kappa}{\omega_N - 1}]\tilde{L}_N, \tag{19}$$

where $\tilde{L}_N^{sk} \equiv L_N^{sk}/L$, and L^{sk} is the number of skilled workers.

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[9]Eicher and García-Peñalosa (2001) assume that there are fixed costs in education.

Assuming identical preferences, (6) continues to hold but (7) is now replaced by

$$\dot{\tilde{n}} = \frac{\tilde{L}_N^{sk}}{b_N} - \gamma\tilde{n}. \tag{20}$$

Noting that $b_N w_N^{sk} = v = 1$ by our normalization, and using $w_N^u = \alpha p_x/a_N$, and $p_x X = \sigma LE$, we have

$$\omega_N = \frac{a_N X}{\alpha b_N \sigma LE}.$$

But $a_N X/L = \tilde{L}_N^u = \tilde{L}_N - \tilde{L}_N^{sk}$ so

$$\omega_N = \frac{\tilde{L}_N - \tilde{L}_N^{sk}}{\alpha b_N \sigma E}. \tag{21}$$

Using this in (19), we can show that $\tilde{L}_N^{sk} = \Psi(E); \ \Psi' < 0$. We can, therefore, replace (20) with

$$\dot{\tilde{n}} = \frac{\Psi(E)}{b_N} - \gamma\tilde{n}. \tag{22}$$

Let us examine the condition under which North-South FDI flow occurs, which is that $w_N^u a_N \geq w_S a_S$. Now, we have, before North-South FDI flows, $w_S a_S = (1-\sigma)a_S E/\tilde{L}_S$ and $w_N^u a_N = \alpha\sigma a_N E/(\tilde{L}_N - \tilde{L}_N^{sk})$. Hence, the condition for North-South FDI flow to occur is

$$\frac{\alpha\sigma a_N \tilde{L}_S}{(1-\sigma)a_S(\tilde{L}_N - \tilde{L}_N^{sk})} \geq 1. \tag{23}$$

If the condition is satisfied for North-South FDI flow to occur, international investment in our model economy takes place until $w_N^u a_N = w_S a_S$. Equation (6) continues to hold but the dynamic equation for $\tilde{n}$ is now modified. With multiple plants in the South, $X = X_N + X_S$, where $X_N = (\tilde{L}_N - \tilde{L}_N^{sk})/a_N$, and $a_S X_S + L_{SA} = L_S$. Using $L_{SA} = (1-\sigma)LE/w_S$, $w_N^u a_N = w_S a_S$, and $w_N^u a_N = \alpha\sigma a_N E/X$, we obtain

$$X_S = \left[\frac{\alpha\sigma}{\alpha\sigma + 1 - \sigma}\right]\frac{L_S}{a_S} - \left[\frac{1-\sigma}{\alpha\sigma + 1 - \sigma}\right]\frac{L_N - L_N^{sk}}{a_N},$$

and hence

$$X = \left[\frac{\alpha\sigma}{\alpha\sigma + 1 - \sigma}\right]\left[\frac{L_S}{a_S} + \frac{L_N - L_N^{sk}}{a_N}\right].$$

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We then have

$$w_N^u = \frac{\alpha \sigma LE}{a_N X} = \frac{(\alpha \sigma + 1 - \sigma)E}{(\frac{a_N}{a_S})\tilde{L}_S + \tilde{L}_N - \tilde{L}_N^{sk}},$$

and since $w_N^{sk} = b_N^{-1}$ with our normalization, the skill premium is now given by

$$\omega_N = \frac{(\frac{a_N}{a_S})\tilde{L}_S + \tilde{L}_N - \tilde{L}_N^{sk}}{b_N(\alpha\sigma + 1 - \sigma)E}. \tag{24}$$

Comparing (21) and (24), the crucial question is whether North-South FDI flows raise the skill premium. This is the case, at any given E, if

$$\left[\frac{(\frac{a_N}{a_S})\tilde{L}_S + \tilde{L}_N - \tilde{L}_N^{sk}}{b_N(\alpha\sigma + 1 - \sigma)E}\right] - \left[\frac{\tilde{L}_N - \tilde{L}_N^{sk}}{\alpha b_N \sigma E}\right] > 0,$$

which simplifies to

$$\frac{\alpha\sigma a_N L_S}{(1-\sigma)a_S(L_N - L_N^{sk})} > 1,$$

precisely the condition for profitable North-South FDI flow (see equation (23)). At given E, the opportunity to reduce cost by building multiple plants abroad leads to an increase in the skill premium, which induces more education and hence an increase in the flow rate of new product development. In a diagram analogous to Figure 6, there is a rightward shift of the stationary locus of $\dot{\tilde{n}} = 0$ when the condition for profitable FDI is satisfied.

Intuitively, with the human capital accumulation decision made endogenous, the opportunity to place cost-effective multiple plants overseas raises the rate of return to the R& D activity. The increased demand for skilled workers, who are the ones engaged in the design of new blueprints, raises the skill premium, in turn encouraging more unskilled workers to incur the cost of acquiring human capital. As the pool of skilled workers is enlarged, the pace of innovation is above normal for some time, the rate of outflow of FDI is increased, and the demand for Southern workers to work in multiple plants placed overseas is also increased hence pulling up Southern unskilled wages relative to Northern unskilled wages.

5. The Singapore case study

Our paper's hypothesis is that, given the factors determining the North-South wage gap, raising the quality of social infrastructure in the South

increases the inward flow of FDI. Having set out the theory, we next seek to provide further evidence that raising the quality of social infrastructure *causes* an increase in the inward flow of FDI, and to identify the features of social infrastructure that seem to be important for attracting FDI, by turning to a case study of Singapore.[10]

Singapore's success in industrialization has been largely attributed to foreign investment. As Figure 1 makes clear, the stock of inward FDI began a steady climb from 1970 onwards. By 1995, the share of total manufacturing employment contributed by wholly foreign-owned firms and joint ventures had grown to nearly 70 percent, and the corresponding share of total manufacturing output to more than 90 percent. (Wholly foreign-owned firms alone contributed to about 50 percent of total manufacturing employment and total manufacturing output in 1995. In that year, too, over 70 percent of their total sales went to overseas markets.) This was the result of a conscious government policy to create an investor-friendly environment. In his Budget Statement presented to Parliament on March 9, 1970, Dr. Goh Keng Swee, widely viewed as Singapore's early economic architect, provided the rationale behind the government's liberal policy toward foreign investors: "We have made long and strenuous efforts to attract foreign investment into Singapore, but not because we need the money. The high level of our overseas assets shows that we have more than we can usefully spend in Singapore. We welcome foreign investors for the two things they bring with them—technology and markets."

This investment-friendly environment was created and maintained through investment incentives and facilities that were complemented by policies aimed at achieving political stability, peaceful industrial relations, orderly wage increases, and manpower development. In a survey conducted by Hughes in the 1960s of 127 firms with direct capital investment from six principal countries investing in Singapore, it is reported that, "The main factors which foreign investors claimed attracted them to Singapore were the government's welcoming attitude expressed in positive assistance mainly through the Economic Development Board and other government departments and instrumentalities, and the efficiency of the public services and utilities. Industrial estates were an added bonus." (See Hughes and You, 1969.) Hence, the government

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[10]The case study draws from the following sources: Hughes and You (1969), Lee (1973), Rodan (1989) and Soon (1993).

has played a central role in improving the quality of the social infrastructure, which propelled Singapore's foreign-investment-driven growth process. We outline below the historical developments in the monumental task of developing a social infrastructure that would convince foreign investors that it was cost effective to base multiple plants in Singapore.

Toward the end of colonial rule in the 1950s, Singapore's heavy reliance on entrepôt trade was deemed inadequate to provide jobs for the increasingly large pool of unemployed. There was also great social and political unrest because of communist and leftist influence over increasingly discontent workers, and uncertainty over the island state's political future. Therefore, when Singapore gained self-government from the UK in 1961, it announced the State Development Plan, 1961-64, whose main aim was to tackle unemployment through industrialization. The Plan closely mirrored the Winsemius Report prepared in late 1960 by a United Nations Industrial Survey Mission headed by Albert Winsemius, which proposed that "owing to the dearth of local industrial know-how and the structural immobility of domestically-based capital, foreign capital would have to be seduced." (cited in Rodan, 1989, p. 75)

Acting in Singapore's favor in attracting FDI were the locational advantage of a deep sea port at major trade routes and a generally corrupt-free bureaucracy, which were inherited from British colonial rule.[11] However, Singapore's existing economy of limited manufacturing in basic industries with low productivity e.g. rubber, tin and oil, would need to overcome the challenges of political and social instability, and the lack of physical and financial infrastructure conducive to foreign investment. The Plan and subsequent policies would build on the above advantages and act decisively to

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[11]There is some evidence that international trade itself directly affects the quality of social infrastructure. In Wei (2000), it is reported that "naturally more open economies"— as determined by their size and geography—exhibit less corruption even after taking into account their levels of development. Wei (1997) found from his sample covering bilateral investment from fourteen source countries to forty-five host countries during 1990-91 that an increase in the level of corruption in the host country significantly reduces inward FDI. Consequently, international trade raises institutional quality, particularly by lowering the extent of corruption, and so facilitates the inflow of FDI.

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tackle the stated challenges.

One of the first tasks of the new government was to control the explosive labor unrest situation. The communists' influence over the labor unions is evident from the many strikes and riots in the 1950s, the height of which was in 1955, a year which witnessed 277 strikes, and a loss of a million man-hours. Such labor union powers had also resulted in high wage costs in Singapore. In the late 1950s, the British authorities had already begun the clamp down on the communists. It banned the Singapore Chinese Middle Schools Union, closed two Chinese schools, expelled 142 students and arrested the entire leadership of the communist left. The new local government carried on by deregistering 106 unions and absorbing the rest into the newly formed National Trade Union Congress (NTUC). Two labor laws were passed in 1968. The Employment Act standardized the terms and conditions of employment and set limits on negotiable fringe benefits, including holidays, sick leave, overtime, retrenchment and severance terms, and a forty-four-hour work week. The Industrial Relations (Amendment) Act excluded from collective bargaining such issues as recruitment, retrenchment, promotion, retirement, transfer, dismissal, and work assignments, placing these matters within management's prerogative. In addition, it spelled out new procedures for labor negotiation and conflict resolution, including compulsory arbitration. Foreign investors must have found the improved industrial relations climate attractive; the steady inflows of FDI that followed helped to reduce unemployment and raise real wages, which helped further to maintain industrial peace. The number of industrial stoppages and man-days lost from strikes dropped drastically. There has been no incidence of industrial stoppages since 1978 except for the year 1986 when Singapore suffered a major recession. In fact, the Department of Statistics has stopped publishing such data since 1992.

Apart from the well-known fact of Singapore's fiscal prudence, the establishment of key institutions is another factor behind Singapore's success in attracting FDI. The key institution charged with the duty of promoting the growth of industries in Singapore is the Economic Development Board (EDB), which was set up in August 1961. Under the 1961 Ordinance, the EDB was given the following tasks: Underwriting the issue of stocks, shares, bonds or debentures and guaranteeing loans; financing and management of industrial enterprises; development of industrial sites and estates; technical assistance to industries; and other general functions. Given the wide scope

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of the functions of the EDB, it had a part to play in each of the investment promotion measures and social infrastructure development projects undertaken.

Through the EDB, the Singapore government wooed foreign investors with extremely attractive financial schemes and negligible restrictions on the flow of capital and goods. MNCs in preferred areas of production were offered below-market or even interest-free finance; generous tax exemptions; and duty-free importation of machinery, equipment, and intermediate inputs. There were also no restrictions and regulations governing the repatriation of capital; the remittance of profits, dividends, interest and royalty payments; or the import of goods and services for consumption, investment and production purposes. In addition, foreign participation of up to 100 percent of foreign equity ownership was allowed in most sectors of the economy.

Another ambitious project undertaken initially by the EDB was the building of industrial estates with full amenities. The bulk of the expenditure was spent on developing the Jurong Industrial Town, for this proved to be the area with the greatest scope for expansion. It was therefore appropriate that in 1968, a new Statutory Board, the Jurong Town Corporation, was formed to take over the management of the industrial estates from the Industrial Facilities Division of EDB. Besides industrial estates, the government also invested heavily in the development of public utilities, transport and communications.

Social development was considered important for national and community cohesion, but it was also vital as a form of social capital investment necessary for industrialization. Projects for housing and education assumed greatest significance as a well-educated populace with a secure home would contribute to a productive workforce. With the decision to industrialize taken, it was recognized that the education system should be adapted to turn out a better educated and more suitably equipped workforce to meet the needs of an industrializing and modernizing economy. To this end, a Five-year Plan in education was introduced. The main features of this Plan were: Equal treatment for the four streams of education—Malay, Chinese, Tamil and English; and an emphasis on the study of Mathematics, Science and Technical subjects. As a first step toward the realization of these aims, the government embarked on an accelerated school building program. During 1961-3 a new school was completed every month, and in 1964 the pace of school building was accelerated so that a new school was built every three weeks. By the

1963 election, there were sufficient schools to provide a place at primary level for every child in Singapore. Later, to provide a manpower base for industrialization, the emphasis of education was shifted to a more technical orientation through the establishment in 1968 of the Technical Education Department within the Ministry of Education to oversee the development of technical education. Apart from academic schools, four other types of schools were created at the secondary level: secondary vocational schools, secondary technical schools, secondary commercial schools and vocational institutions. Along with this new technical bias, the Singapore Polytechnic and the Ngee Ann Technical College were greatly expanded and restructured to accommodate new courses to meet the new needs of the changing economy.

Complementing the technical bias in the education system, the government, through EDB, also involved itself in the training of existing workers to meet skill shortages at crucial times to develop new industries. Within one year of its establishment in 1961, the EDB had formed a Technical Consultancy Division with a Manpower Development Unit, which collaborated with local agencies, foreign governments and MNCs to set up training centers and organize courses. The first continual upgrading and re-training program can be traced to 1968 when the British announced the planned withdrawal of its naval base from Singapore, and a crash program was introduced to re-train clerical and other workers expected to become redundant. Joint industrial training centers were also set up with MNCs, which included Tata Engineering & Locomotive Co., Rollei-Werke, and Philips (Singapore) Pte Ltd. Although the number of workers trained under these specific schemes were small relative to those in the vocational institutes, these training programs by EDB were crucial to meet specific manpower needs during crucial times of shortages. Because of its investment promotional activities, the EDB has a close relationship with industry and is able to identify manpower needs even before they arise. As a smaller operation, it is also more flexible and responsive, and able to convey a signal to other educational institutions of the future manpower needs of industry.

In sum, the government of Singapore, and EDB, in particular, have been able to develop the social infrastructure conducive to inflows of FDI. The country has remained committed to an open liberal policy toward international commerce and capital over many years, and it has built up a reputation as a *reliable* host country to foreign investors. The generally harmonious industrial labor relations in Singapore also work to strengthen that reputation.

By committing itself to act as a one-stop center for foreign investors, EDB has helped to lower the transaction cost of doing business in Singapore. This factor is fortified by a generally corruption-free business environment. Although the government and EDB have been pro-active in the functioning of the economy as a whole, they have also been responsive to market signals. As an example, one benefit the government sees in attracting foreign investors to Singapore is that they provide a market signal to the government about the sort of manpower training that is needed in industry. In this way, it avoids the problem of producing large numbers of graduates who cannot find employment in their chosen field. Apart from the benefits of a good physical infrastructure, a comprehensive and transparent legal framework in Singapore has also contributed to the efficient functioning of the market mechanism and attraction of FDI to Singapore.[12]

6. Concluding remarks

In this paper, we have built upon an empirically and theoretically well-founded notion of multi-plant cost advantage to explore how convergence can take place through international investment. One of our findings is that, given the factors determining the North-South wage gap, the measure of efficiency or quality of the social infrastructure of the South must not fall too far behind that of the North if it is to attract FDI. We also find, however, that medium-term macroeconomic conditions in the North such as fiscal profligacy and increased rate of time preference deter FDI outflows.

Another finding of the paper is that developing countries that choose to integrate themselves into the international trading system are good candi-

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[12]In the same speech noted in footnote 2, Lee noted: "To become attractive investment locations, countries must build up and improve their economic infrastructure, not only in terms of the "hard" components like roads, transportation and telecommunications, but also the systems and institutional framework, be it in financial supervision or enforcement of the rule of law. Equally important, countries must push on with efforts to educate their populations, and equip them with the skills to take on new jobs with higher technology content. These are not quick fix, counter-cyclical activities. But sustained over years and decades, they are the best way to maintain growth and prosperity."

dates for the inflow of multi-plant FDI. This is because integrating into the world trading system achieves the following: For given (total factor) productivity or quality of social infrastructure, international trade drives down a country's wage level to reflect its productivity relative to other more productive developing economies that are already recipients of foreign capital. In this role, trade has served as the "handmaiden of growth," according to Kravis (1970). There is, however, another role that international trade plays, which is potentially as important if we accept the findings of Wei (2000) and Frankel and Romer (1999). These authors argue that economies that are "naturally more open" tend to have better institutions. If that is true, international trade itself leads to improved social infrastructure, which facilitates the inflow of FDI. From the perspective of this paper, the recent surge of FDI inflows into China can be explained by the fact that the membership of China in the WTO signals the country's commitment to improve its social infrastructure and willingness to allow its cost and price structures to be brought in line with external costs and prices.

There are some limitations in the present paper that should now be highlighted as we conclude. While the stock of FDI in Singapore has continued to increase unabated over the past three decades, the character of the foreign investment has changed over the years. It is clear that our model of symmetric horizontal investment is limited in not accounting for the change in the character of foreign investment over time—in terms of their factor intensities and production processes. There is also another dimension to the inflow of FDI that we have not so far taken into account, which is the role played by international service links in coordinating the activity of parent firms and their foreign affiliates. In this conception, Singapore provides headquarter services, facilitated by the ready physical infrastructure—a good harbor, a good airport, an excellent land transport system, a wired up economy, etc.—that enable foreign firms to co-ordinate their activities along the value-added chain such as transmitting the design specifications to the factory floors of manufacturing plants located in the labor-abundant neighboring countries. This aspect of FDI is worthy of future research.

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Figure 1: Real Stock of Foreign Direct Equity Investment in Singapore, 1966-1998
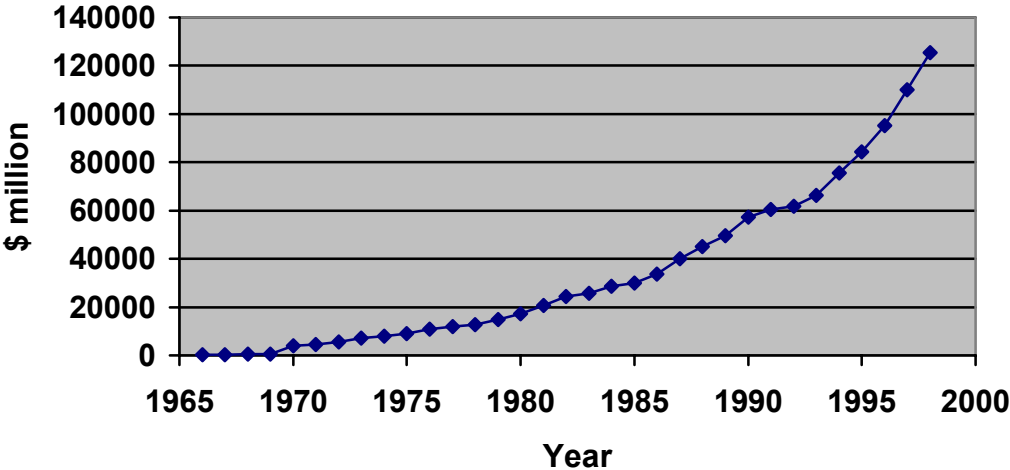
Source: Department of Statistics, Singapore. Foreign Equity Investment in Singapore. various years. International Monetary Fund. International Financial Statistics Yearbook. 2000.

Notes: Data adjusted with GDP deflator, 1995=100.

**Figure 2: Ratio of Singapore Real Manufacturing Wage to Real Manufacturing Wage in USA, Japan & UK, 1970-1999**
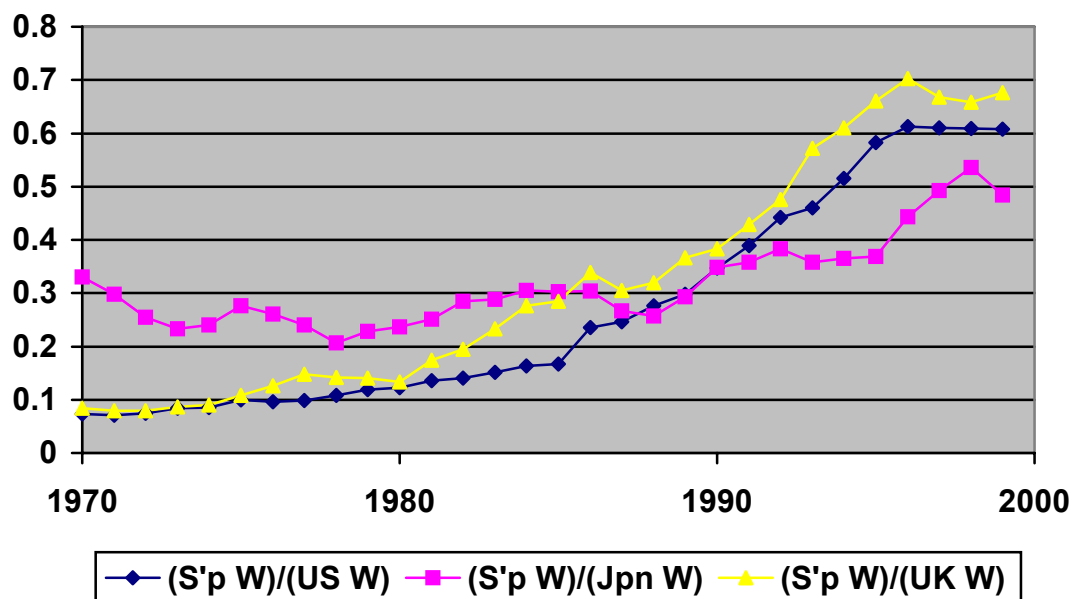
Sources:
- Wage & hours of work: International Labour Office. Yearbook of Labour Statistics, various years. Japan wage in 1994-1999: Japan Statistics Bureau. Japan Statistical Yearbook, various years.
- GDP deflator & exchange rates: International Monetary Fund. International Financial Statistics Yearbook 2000.

Notes:
- Nominal wages adjusted to real with GDP deflator, 1995=100.
- Singapore wages were reported "per hour" in 1970-1985 & "per month" in 1986-1999. The series was made consistent using the formula: Hours of work per month = (hours of work per week*30)/7.
- The Singapore-US & Singapore-UK series are based on hourly wages, and the Singapore-Japan series on monthly wages.
- UK wages (excluding Northern Ireland) were reported only as an index before 1985, and both as an index and in British pounds thereafter. The indices were calculated into British pounds using 1985 & 1988 as the anchor years.
- Since the Yearbook of Labour Statistics had data on Japan wage per month up to only 1993, "wage per month" was calculated from the "wage index" reported in Japan Statistical Yearbook using 1993 as the anchor year.
- All wages are converted to US$ using the period average market exchange rate.

Figure 3: Scatter Plot of Inward Stock of FDI in 1995 against Index of Social Infrastructure for 120 Countries, 24 Developed and 96 Developing.

<u>All 120 Countries</u>　　　　　<u>Only Developing Countries</u>

LGFDI vs. INFRA　　　　　　LGFDI_NO_DEV vs. INFRA_NO_DEV
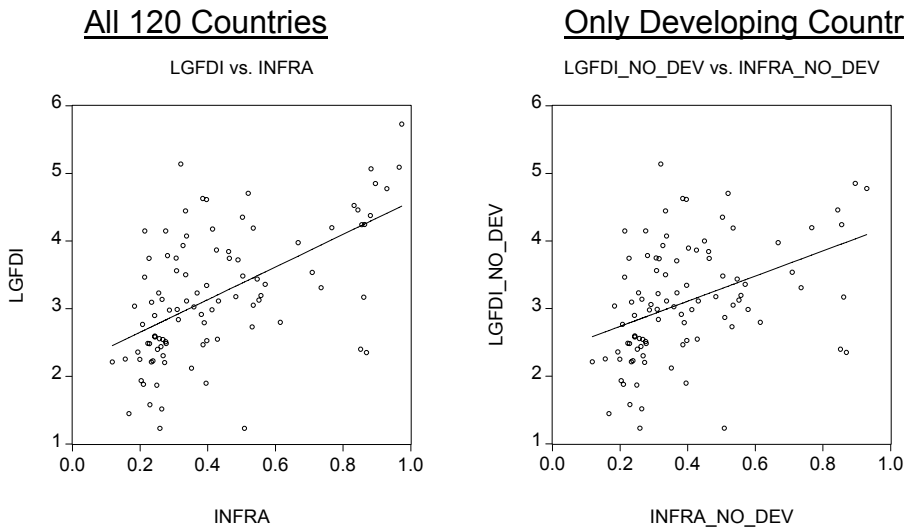
Sources:
Social infrastructure index: Hall, Robert E. & Charles Jones (1999), "Why do some countries produce so much more output per worker than others?", Quarterly Journal of Economics 114:83-116.
FDI: United Nations. World Investment Report 2000.

Notes:
1. Social Infrastructure is made up of two indices: an index of government antidiversion policies (GADP) for 1986-95 & the extent to which country is open to international trade, measured by the fraction of years the economy has been open to trade from 1950-94.
2. To have a corresponding FDI data set, FDI Inward Stock in 1995 is used.
3. The data set includes 120 countries listed by Hall & Jones (1999) for which data is available.
4. The social infrastructure indices for Belgium and Luxembourg are combined into one index by taking the average of the two to correspond with the FDI data because the World Investment Report gives Belgium and Luxembourg FDI as one.
5. The selection of 24 countries as developed follows the classification in the World Investment Report.

Figure 4: Real Outflow of Direct Investment from US, Japan & UK, 1970-1999. (Based on Balance of Payment Data)
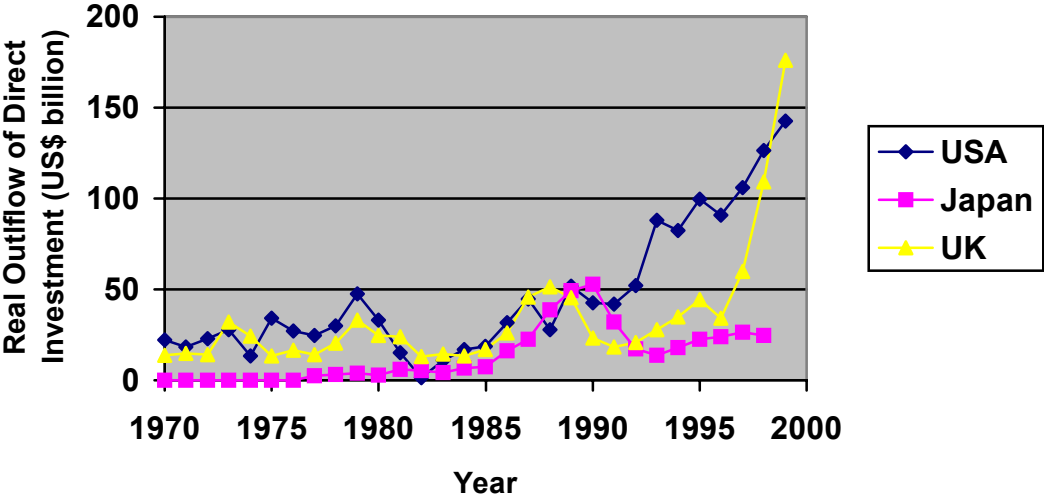
Source: International Monetary Fund. International Financial Statistics Yearbook 2000. (1995=100)

Notes: "Direct Investment Abroad" defined as "the flow of direct investment capital out of the economy", "includes equity capital, reinvestment earnings and other capital associated with various inter-company transactions between affiliated enterprises".
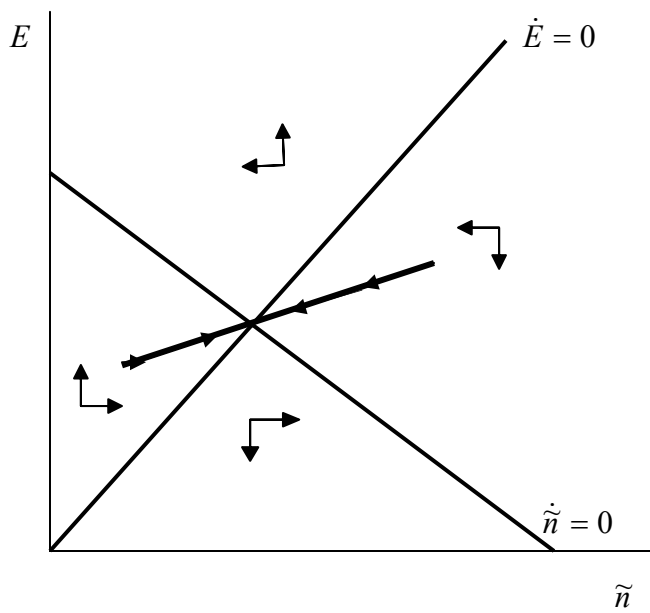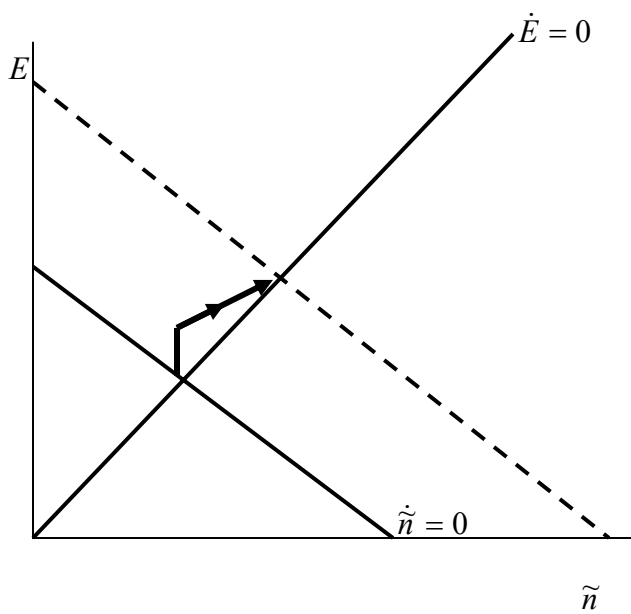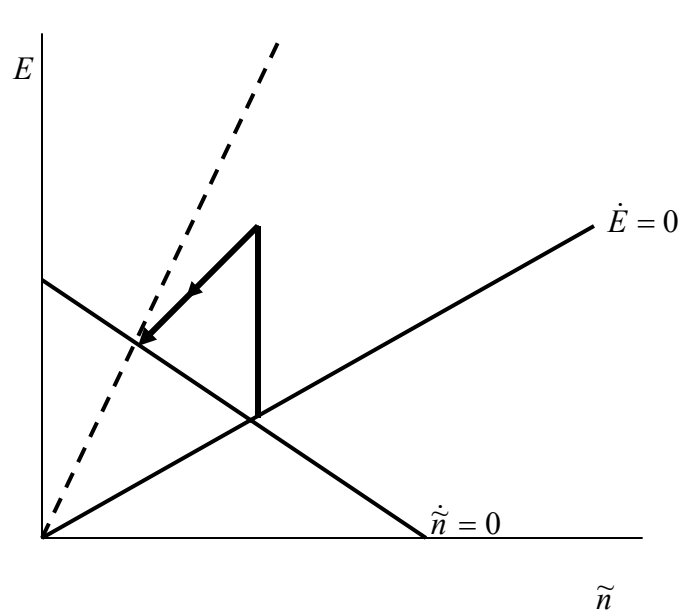
Figure 5: Phase Diagram

Figure 6: Effect of FDI flows

Figure 7: Helicopter Drop of Public Debt