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Transition to FDI Openness*

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ABSTRACT

Empirical studies quantifying the benefits of increased foreign direct investment (FDI) have been unable to provide conclusive evidence of a positive impact on the host country's economic performance. I show that the lack of robust evidence is not inconsistent with theory, even if the gains to FDI openness are large. Anticipated welfare gains to increased inward FDI should lead to immediate declines in domestic investment and employment and eventual increases. Furthermore, since part of FDI is intangible investment that is expensed from company profits, gross domestic product (GDP) and gross national product (GNP) should decline during periods of abnormally high FDI investment. Using the model of McGrattan and Prescott (2009) and data from the IMF *Balance of Payments* to parameterize the time paths of FDI openness for each country in the sample, I do not find an economically significant relationship between the amount of inward FDI a country did over the period 1980–2005 and the growth in real GDP predicted by the model. This finding rests crucially on the fact that most of these countries are still in transition to FDI openness.

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1. Introduction

Empirical studies quantifying the benefits of increased foreign direct investment (FDI) have been unable to provide conclusive evidence of a positive impact on host country's economic performance. Kose, Prasad, Rogoff, and Wei (2009) provide a survey of empirical cross-country studies and report that only one finds a positive link between FDI and growth in per capita GDP. Critics of capital account liberalizations have used the empirical results to argue that lower restrictions on capital movements provide little benefits but could generate significant volatility in developing economies.

This paper reconsiders the empirical findings in light of the theory of McGrattan and Prescott (2008, 2009) which predicts large gains to FDI openness, especially for small countries integrating with larger countries or with a union of other countries. Specifically, I derive the properties of equilibrium paths for a multicountry general equilibrium model following the announcement of lower restrictions on FDI at a specified future date. Countries in this analysis are assumed to differ only in size, where size depends not only on a country's population but also on its level of technology. A country is small if it has few people or a low level of technology or both.

Of particular interest is the path of a small country that commits to a policy of lowering restrictions on FDI. In the model I analyze, if there is a gradual lowering of capital restrictions, the paths of per capita GDP and employment fall below historical trends and do not recover until barriers have fallen sufficiently. The declines occur as soon as the government announces its intent to lower FDI restrictions because households immediately raise consumption and leisure in response to higher permanent income. The lower restrictions on FDI in the future imply a higher effective level of total factor productivity (TFP).

A second factor affecting the path of GDP is intangible investment that is expensed and therefore not counted in gross product. When multinationals make intangible investments in subsidiaries abroad, the host country's profits are lower and their GDP is lower. Theory predicts that these investments are abnormally high as barriers to FDI are lifted, implying a negative correlation between FDI investment and host country GDP.

If there are restrictions on portfolio investments that are relaxed after countries open to foreign FDI investment, the transitional patterns change but the main conclusions to be drawn do not.[1] Consumption in the small country rises gradually prior to the lifting of capital controls and then jumps once the policy change takes place. As in the case with no portfolio restrictions, FDI investment is negatively correlated with GDP because the small country is making large intangible investments. Thus, care must be taken when studying world-wide capital flows that appear to be flowing in the wrong direction.[2]

To determine the quantitative significance of my results, I parameterize a 50-country version of the model using data from the IMF's *Balance of Payments* and the World Bank's *World Development Indicators*. Countries chosen for the exercise have complete data on inward FDI, GDP, and populations over the period 1980-2005. Observations on direct investments are used to parameterize time paths of country *openness parameters*, which are policy parameters determining the inflow of foreign investment. The model is simulated and growth in GDP per capita computed.

In the 50-country version of the model, parametrized to generate FDI flows comparable

[1] Most of the theoretical literature on capital account liberalization focuses on portfolio investment and the integration of countries with different financial systems at different stages of financial development. Recent examples include Caballero et al. (2008), Mendoza et al. (2009), and Aoki et al. (2006).

[2] Using international accounts for the period 1980–2000, Gourinchas and Jeanne (2008) show that countries with lower GDP and TFP growth receive most of the capital inflows, which is inconsistent with the neoclassical growth model. Here, I show that this finding is not inconsistent with the neoclassical growth model extended to include intangible capital.

to those reported by the IMF, I find no evidence of strong positive benefits to FDI when I conduct an empirical analysis typical of the literature. In contrast to Gourinchas and Jeanne (2006), however, the failure to find benefits here is not due to the fact that the theoretical gains to openness are small. The potential gains to openness are large in the model I analyze, but the main theoretical prediction of the model implies that the gains are only evident once countries have passed a particular threshold when lowering their capital restrictions.[3]

Section 2 lays out a model which has a central role for FDI. Section 3 is a set of propositions about the pattern of transition of a small country joining a larger financially integrated union. In Section 3, I also demonstrate that the shifts in aggregate activity are large for plausible parameterizations of the model. Section 4 is an application of the model based on data from the IMF. Section 5 concludes.

2. Model

In this section, I describe a version of the multicountry general equilibrium model of McGrattan and Prescott (2009).[4] I first describe the technologies available to multinationals and then the problems faced by households in the different countries.

2.1. Multinationals

Multinationals from country j operating in country i produce output Y_{it}^j at time t,

$$Y_{it}^j = A_{it}\sigma_{it}\left(N_{it}M_t^j\right)^{\phi}\left(Z_{it}^j\right)^{1-\phi},$$

[3] A recent literature has begun to explore such thresholds. See for example Kose, Prasad, and Taylor (2009).

[4] I do not distinguish between equity and debt portfolio income of households, I use constant tax rates, and I abstract from nonbusiness activity.

with *technology capital* M_t^j and a composite of country-specific inputs denoted by Z_{it}^j.[5] Technology capital is accumulated know-how from investments in R&D, brands, and organizational capital that can be used in as many locations as firms choose, both at home and abroad. The total number of locations available in country i at time t is N_{it} and firms take this as given in solving their optimization problem. Since technology capital can be used simultaneously in multiple locations, it is not indexed by i. The span of control of this organizational capital is limited due to the fact that countries are assumed to have a fixed number of production locations.

Country i's technology level in t is denoted by A_{it}. For countries incorporated outside i, the effective technology level if they operate in i is $A_i\sigma_i$, where σ_i is the degree of openness of country i to foreign direct investment. A value for σ_i of 1 implies that the country is totally open—so domestic and foreign firms have the same opportunities. A value of less than 1 implies that domestic and foreign firms are not treated equally. In particular, there are costs to foreign firms, and these costs have the same effect as if they had lower TFP than domestic firms.

The composite capital-labor input in country i is modeled as a Cobb-Douglas technology,

$$Z_i^j = \left(K_{T,i}^j\right)^{\alpha_T} \left(K_{I,i}^j\right)^{\alpha_I} \left(L_i^j\right)^{1-\alpha_T-\alpha_I} \tag{2.1}$$

with inputs of tangible capital, $K_{T,i}^j$, plant-specific intangible capital, $K_{I,i}^j$, and labor L_i^j. This specification of technology implies that multinationals use two types of intangible capital, one that is plant-specific and one that is not.

[5] See McGrattan and Prescott (2008) for a micro-foundation of this aggregate production function.

The stand-in multinational from j maximizes the present value of the stream of after-tax dividends:

$$\max (1-\tau_d) \sum\nolimits_t p_t D_t^j, \tag{2.2}$$

where dividends are the sum of dividends across all operations in all countries indexed by i and are given by $D_t^j = \sum_i D_{it}^j$ with

$$D_{it}^j = (1-\tau_{pi}) \left(Y_{it}^j - W_{it} L_{it}^j - \delta_{\scriptscriptstyle T} K_{\scriptscriptstyle T,it}^j - X_{\scriptscriptstyle I,it}^j - \chi_i^j X_{\scriptscriptstyle M,t}^j \right) - K_{\scriptscriptstyle T,i,t+1}^j + K_{\scriptscriptstyle T,it}^j, \tag{2.3}$$

$\chi_i^j = 1$ if $i = j$ and 0 otherwise, $X_{\scriptscriptstyle I,i}^j$ is investment in plant-specific capital which is split among locations in country i that j operates, and $X_{\scriptscriptstyle M}^j$ is the technology capital investment of multinational j used in all locations in which j operates.[6] The multinational takes as given sequences of prices p_t and wages W_{it}. The same wage rate is paid by all multinationals operating in i.

Dividends for j are equal to worldwide after-tax profits less net investment of tangible capital, $\sum_i (K_{\scriptscriptstyle T,i,t+1}^j - K_{\scriptscriptstyle T,it}^j)$. Taxable profits are equal to sales less expenses, where the expenses are wage payments, tangible depreciation, and expensed investments on plant-specific intangible capital and technology capital. Taxable profits in country i are taxed at rate τ_{pi}. The capital stocks of the multinational next period are given by

$$K_{\scriptscriptstyle T,i,t+1}^j = (1-\delta_{\scriptscriptstyle T}) K_{\scriptscriptstyle T,it}^j + X_{\scriptscriptstyle T,it}^j \tag{2.4}$$

$$K_{\scriptscriptstyle I,i,t+1}^j = (1-\delta_{\scriptscriptstyle I}) K_{\scriptscriptstyle I,it}^j + X_{\scriptscriptstyle I,it}^j \tag{2.5}$$

$$M_{t+1}^j = (1-\delta_{\scriptscriptstyle M}) M_t^j + X_{\scriptscriptstyle M,t}^j. \tag{2.6}$$

[6] McGrattan and Prescott (2009) assume that all dividends are taxed at the same rate. If not, one has to account for clientele effects.

2.2. Households

In each period t, households in i choose how much to consume C_{it}, how much total labor to supply L_{it}, and how much to borrow from abroad, $B_{i,t+1} - B_{i,t}$. Without loss of generality, I assume that households in i own all of the equity shares of multinational firms incorporated in i and thus foreign borrowing and lending residually determines their net portfolio income. The maximization problem for the stand-in household is

$$\max_{\{C_{it}, L_{it}, B_{i,t+1}\}} \quad \sum_t \beta^t N_{it} \left[\log\left(C_{it}/N_{it}\right) + \psi \log\left(1 - L_{it}/N_{it}\right)\right]$$

subject to

$$\sum_t p_t \left[C_{it} + B_{i,t+1} - B_{it}\right] \leq \sum_t p_t \left[\left(1 - \tau_{li}\right) W_{it} L_{it} + \left(1 - \tau_d\right) D_t^i + r_{bt} B_{it} + \kappa_{it}\right],$$

where the total population in i is assumed to be proportional to the total number of locations N_{it}. Without loss of generality I assume a constant of proportionality of 1 between the number of people and the number of production locations within a country. Households take the sequence of returns on portfolio income, r_{bt}, wage rates W_{it}, prices, p_t, and government transfers, κ_{it}, as given. Labor is not mobile across countries, but can be supplied to domestic or foreign companies. Taxes are levied on labor at rate τ_{li} and dividends at rate τ_d.[7]

2.3. Competitive Equilibrium

The competitive equilibrium is defined as a set or prices $\{p_t, r_{bt}, W_{it}\}$ and quantities $\{D_{it}^j, Y_{it}^j, K_{T,it}^j, K_{I,it}^j, M_t^j, L_{it}^j, L_{it}, C_{it}, B_{it}, X_{T,it}^j, X_{I,it}^j, X_{Mt}^j\}$, that are consistent with the maximization problems of multinationals and households. In addition, markets must clear.

[7] Given taxes are constant, I combine taxes on consumption and labor into the labor wedge τ_{li}.

The market clearing condition for the labor market in each country i is

$$\sum_j L_{it}^j = L_{it}.$$

The market clearing condition for financial assets is

$$\sum_i B_{it} = 0.$$

The market clearing condition for goods is

$$\sum_i \left\{ C_{it} + \sum_j \left(X_{T,it}^j + X_{I,it}^j \right) + X_{M,t}^i \right\} = \sum_{i,j} Y_{it}^j$$

These conditions along with household budget constraints above imply that government transfers in country i satisfy

$$\kappa_{it} = \tau_{li} W_{it} L_{it} + \tau_d D_t^i + \tau_{pi} \left\{ \sum_j \left(Y_{it}^j - \delta_T K_{T,it}^j - X_{I,it}^j \right) - W_{it} L_{it} - X_{M,t}^i \right\}.$$

Before deriving properties of the competitive equilibrium, I need to describe how to construct national accounting statistics for the model which are the inputs in the empirical studies surveyed by Kose, Prasad, Rogoff, and Wei (2009).

2.4. Accounting Measures

In this section, I describe how to construct the relevant accounting measures for the model.

Gross domestic product (GDP) for country i at date t is given by

$$\text{GDP}_{it} = C_{it} + \sum\nolimits_j X_{T,it}^j + NX_{it}, \tag{2.7}$$

where NX_i is net exports of goods and services by country i. Consumption and investment include both private and public expenditures. Intangible investments are expensed and

therefore are not included in the measure of GDP. In other words, GDP is not a measure of total output.

To see this, consider a second way of calculating GDP, namely to add up all domestic incomes. Specifically, if we sum up compensation of households ($W_i L_i$), total before-tax profits of businesses operating in i, ($Y_i - W_i L_i - \sum_j (\delta_{\tau} K^j_{\tau,i} + X^j_{I,i}) - X^i_M$), and tangible depreciation ($\sum_j \delta_{\tau} K^j_{\tau,i}$), we have GDP from the income side:

$$\text{GDP}_{it} = Y_{it} - X^i_{M,t} - \sum\nolimits_j X^j_{I,it}. \tag{2.8}$$

This has to be equal to product in (2.7). From (2.7) and (2.8), it is easy to calculate net exports as total output produced in country i less the sum of consumption and all investments.

Given that we are interested in measurement, it is worth noting that GDP for country i, as defined in (2.8), is *not* a measure of production of country i in the model economy. In the model economy, total production in country i is Y_i. GDP is lower because some investments are expensed.

Next, consider adding flows to and from other countries. The BEA's measure of gross national product (GNP) is the sum of GDP plus net factor income from abroad. Net factor receipts (NFR) are the sum of FDI income of multinationals and portfolio income of households:[8]

$$\text{NFR}_{it} = \sum_{l \neq i} \{D^i_{lt} + K^i_{\tau,l,t+1} - K^i_{\tau,lt}\} + \max\left(r_{bt} B_{it}, 0\right). \tag{2.9}$$

Analogously, net factor payments (NFP) from i to the rest of the world are the sum of FDI income of foreign affiliates in i sent back to foreign parents, and portfolio incomes of

[8] Equity holdings are categorized by the BEA as direct investment when the ownership exceeds 10 percent. Otherwise they are categorized as portfolio income.

country i that are sent to investors outside of i:

$$\text{NFP}_{it} = \sum_{l \neq i} \{D^l_{it} + K^l_{T,i,t+1} - K^l_{T,it}\} + \max\left(-r_{bt} B_{it}, 0\right). \tag{2.10}$$

Adding net factor income to net exports and to GDP, we have the current account (CA) and GNP, respectively:

$$\text{CA}_{it} = NX_{it} + \text{NFR}_{it} - \text{NFP}_{it} \tag{2.11}$$

$$\text{GNP}_{it} = \text{GDP}_{it} + \text{NFR}_{it} - \text{NFP}_{it}. \tag{2.12}$$

In the balance of payments, the current account must be equal to the financial account which sums up new acquisitions abroad. For the model, the financial account for country i is

$$\text{FA}_{it} = \sum_{l \neq i} \left(K^i_{T,l,t+1} - K^i_{T,lt}\right) - \sum_{l \neq i} \left(K^l_{T,i,t+1} - K^l_{T,it}\right) + B_{it+1} - B_{it}, \tag{2.13}$$

where the first term is net FDI investment by multinationals from i abroad, the second term is the (negative) of net new investment by foreigners operating in i, and the third term is new portfolio acquisitions by households from i. Empirical studies report regressions of per capita growth of GDP on FDI investment (or FDI investment relative to some measure of aggregate output), controlling for changes in other variables. The right hand side variable is the second term of (2.13).

3. Equilibrium Paths in Theory

In this section, I examine the properties of the equilibrium paths as the degree of openness (σ) changes for a world with two countries. The two countries differ only in their *size*, where size is defined to be $N_{it} A_{it}^{1-(1-\phi)(\alpha_T+\alpha_I)}$ for country i. One interpretation of the exercise is a small country joining a union of countries that are already financially integrated. The

joiner is called "small" if it has few people or a low technology level relative to the union it is joining.

3.1. Qualifying the effects

In this section, I qualify the effects of increased FDI by proving several propositions about the equilibrium paths. Propositions 1–3 assume no restrictions on borrowing and lending and Proposition 4 assumes that $B_{t+1} = 0$ for $t = 1, \ldots, t^*$.

In Figure 1, I display the path of the degree of openness that I'll use for the propositions that follow. I assume it is the same for both countries. The policy σ^*_{it} is announced in $t = 1$, and the restrictions are lifted in $t = t^* + 1$. I'll assume that $N_{it} = N_i(1 + \gamma_N)^t$ and $A_{it} = A_i(1 + \gamma_A)^t$ for some fixed N_i and A_i. All results will be described in terms of historical trends where γ_N is the common trend growth rate in populations and γ_A is the common trend growth trend rate in technologies. The historical trend is assumed to be consistent with no borrowing or lending and therefore $B_{i0} = 0$ for the equilibrium described below.

In order to make precise statements about the equilibrium paths, I make two additional assumptions. The first concerns σ_{it}: at $t = 0$, the countries are completely closed to each other's FDI ($\sigma_{i0} = 0$), and at $t = t^* + 1$, σ^*_{it} is high enough so that the small country does not find it optimal to make any further expenditures in technology capital ($X^i_{M,t} = 0$ for $t > t^*$ with i indexing the small country).[9] The second assumption is that foreign households receive a very small amount of income denoted by ϵ_t between periods $t = 1$ and $t = t^*$. The income stream is such that $r_{b,t+1}$ is constant in equilibrium prior to

[9] The patterns do not change for $\sigma_{i0} > 0$ as long as it is below a particular threshold.

t^*.[10] I show below that this "trick" allows me to make very precise statements about a complicated dynamic path in an economy that is so close to the economy of interest (with $\epsilon_t = 0$) that the paths cannot be distinguished when graphed. I refer to this related economy as the *ϵ-economy*.

Proposition 1. The small country's output and labor in the ϵ-economy are below their historical trend between $t = 1$ and $t = t^*$.

Proof. Let $x_{it} = X_{it}/(1+\gamma_Y)^t$ where

$$\gamma_Y = (1+\gamma_N)^{\frac{1-(1-\phi)(\alpha_T+\alpha_I)}{(1-\phi)(1-\alpha_T-\alpha_I)}} (1+\gamma_A)^{\frac{1}{(1-\phi)(1-\alpha_T-\alpha_I)}} - 1$$

is trend growth rate of all variables that grow with the exception of labor inputs; labor inputs grow at rate γ_N. Unless otherwise noted, i indexes the small country.

At $t = 1$, detrended consumption c_{it} in the small country rises relative to its historical trend, $c_{i1} > c_{i0}$, because the value of the country's endowment is higher given effective TFP is higher in the future, and households want to smooth their consumption over time. Between $t = 2$ and $t = t^*$, $c_{it} = c_{i1}$ because r_{bt} is constant (by choice of $\{\epsilon_t\}$). To be consistent with the intertemporal condition for asset holdings, this rate has to equal $(1+\gamma_y)/\beta - 1$ where γ_y is the rate of growth of per capita consumption, $\gamma_y = (1+\gamma_Y)/(1+\gamma_N) - 1$.

From the intratemporal first-order condition of households (assuming log preferences),

$$\frac{y_{it}}{l_{it}} = \frac{y^i_{it}}{l^i_{it}} \propto \frac{c_{it}}{1-l_{it}}, \quad t = 1 \ldots t^*. \tag{3.1}$$

[10] In the numerical experiments shown later, the income needed to have a constant rate of return is on average about one-tenth of one percent of income. If the additional income is set equal zero, the rate of return is approximately, but not exactly, constant.

The first equality in (3.1) follows from the fact that countries are initially closed and all labor in i is therefore supplied to domestic companies and all output in i is produced by domestic companies. With capital stocks initially fixed and consumption higher in period $t = 1$, it must be the case that $l_{i1} < l_{i0}$ and $y_{i1} < y_{i0}$ if (3.1) holds. With capital fixed, it must also be the case that labor falls by more than output in $t = 1$.

In period $t = 2$, output and labor must fall further because domestic capital stocks fall between the first and second periods. To see this, note that the capital-output ratio is pinned down by the return r_{bt}. If this return in the second period is equal to $(1+\gamma_y)/\beta-1$, then the capital-output ratios have to be equal to their historical levels (at $t = 0$). Using this fact along with the production technologies, it follows that labor productivity in the second period must also be at its historical level. It then follows from (3.1) that $y_{i2} < y_{i1}$ and $l_{i2} < l_{i1}$ since the labor productivity in the second period is below the labor productivity in the first period.

Since the return does not change between $t = 2$ and t^*, the same logic as above can be used to show that $y_{it} = y_{i2}$ and $l_{it} = l_{i2}$, $t \leq t^*$. ■

The proof is constructive in that it implies specific patterns for the key macroeconomic aggregates. Consumption in the small country rises at the announcement of the new policy but stays flat until the change occurs. At that point, it will increase further because worldwide output will be higher. At the announcement of the union, labor and output fall for two periods and then remain flat until the policy change occurs. The economy will appear to be immediately depressed. The beginning-of-period domestic capital stocks fall for one period and then remain flat. After $t = 1$ and prior to the policy change, capital-output ratios and labor productivity remain at their historical trends.

With multinationals investing in intangible capital, the relevant measure of economic performance is not output but rather GDP or GNP.

Proposition 2. The small country's GDP and GNP in the ϵ-economy initially rise above their historical trends and fall below trend between $t = 2$ and $t = t^*$.

Proof. Recall the definitions of GDP and GNP in (2.8) and (2.12), respectively. In the first period, when the policy in announced, net factor incomes for the period are already determined, and therefore GNP must be equal to GDP. To show that both are above their historical trend in $t = 1$, I have to show that intangible investments fall by more than output since GDP is defined as output less the sum of investment in plant-specific intangible capital and technology capital. This is shown as follows:

$$\begin{aligned}
\frac{x^i_{I,i1} - x^i_{I,i0}}{x^i_{I,i0}} &= \frac{1+\gamma_Y}{\delta_I + \gamma_Y}\left(\frac{k^i_{I,i2} - k^i_{I,i0}}{k^i_{I,i0}}\right) \\
&= \frac{1+\gamma_Y}{\delta_I + \gamma_Y}\left(\frac{y^i_{i2} - y^i_{i0}}{y^i_{i0}}\right) \\
&< \frac{1+\gamma_Y}{\delta_I + \gamma_Y}\left(\frac{y^i_{i1} - y^i_{i0}}{y^i_{i0}}\right)
\end{aligned}$$

where the first equality uses the capital accumulation equation after detrending all variables, the second equality follows from the fact that the capital-output in the second period is equal to the historical capital-output ratio, and the third equality follows from Proposition 1. Since $\delta_I \leq 1$, it must be the case that plant-specific intangible investment falls by more than output. The same argument can be made for technology capital. Therefore GDP and GNP are both above trend in $t = 1$.

In the second period, since the capital-output ratios are at their historical trends, it must be the case that GDP in the small country is below its own trend by the same amount

as output. At $t = t^*$, GDP falls further below its historical trend than output has fallen because investment of foreign multinationals in both tangible and plant-specific intangible rises above zero. GDP is lower because of the rise in plant-specific intangible.

The path of GNP depends on the path of borrowing and lending from abroad. The small country's budget constraint and information about the other aggregates can be used to determine that the small country receives portfolio income only for $t = 2$ and pays portfolio income to foreigners after that period. This implies that GNP is below GDP after that period. It further implies that GNP is below trend. ■

Proposition 3. At $t = t^*$, the small country's FDI investment from abroad in the ϵ-economy increases above its historical trend of zero.

Proof. This follows immediately from the fact that tangible capital from abroad earns a positive rate of return in $t = t^*$ and multinationals gain from increased FDI abroad. ■

Next, I consider the case with $B_{t+1} = 0$, $t = 1, \ldots, t^*$. With $\sigma_t = 0$, the two economies are effectively closed and changes in the time series are due to the anticipation of future relaxation of the capital accounts.

Proposition 4. The small country's output and labor in the case of full capital account restrictions are below their historical trend between $t = 1$ and $t = t^*$.

Proof. At $t = 1$, detrended consumption in the small country rises relative to its historical trend, $c_{i1} > c_{i0}$, because the country's endowment is now higher. From the intratemporal first-order condition of households in (3.1), it follows that labor and output fall initially

(between $t = 0$ and $t = 1$) and, with capital fixed, it is the case that labor falls by more than output.

With no borrowing or lending across countries, total investment $y_{i1} - c_{i1}$ falls. With returns equated across assets, it must be the case that investment in all three assets—namely tangible capital, plant-specific intangible capital, and technology capital—all fall.

In period $t = 2$, output and labor must fall further because domestic capital stocks fall between the first and second periods. Since households cannot borrow from abroad, output, investment, and labor continue to fall until $t = t^*$, and net exports remain equal to zero until the restrictions on FDI are lifted. ■

Regardless of whether there are restrictions on portfolio investment, the rise in FDI investment from abroad is coincident with the drop in GDP. The path of openness chosen for the analysis here is very stark, but it is easy to demonstrate numerically that if σ_{it} rises more smoothly than shown in Figure 1, the general pattern that emerges is one of abnormally low GDP during periods when FDI investment is abnormally high.

3.2. Quantifying the effects

To demonstrate that the depression of per capita GDP and labor in the small economy is potentially large, consider parameters of Table 1 taken from McGrattan and Prescott's (2009) model based on U.S. data.[11] In addition, I assume that the relative size of the big country to the small country is 10 and a period is equal to 5 years.

In Figure 2, I plot output and labor for the small country. In this figure and all that follow I display the results for the economy with $\epsilon_t = 0$ for all t in order to demonstrate

[11] Averages are used for any time-varying exogenous parameters.

that the patterns derived above for the ϵ-economy are the same as those shown in the figures for the economy of interest. In particular, notice that in $t = 1$, labor falls further below its historical trend than output. In $t = 2$, they both fall even further and stay low until the policy is actually implemented. For the parameters of Table 1, the decline is large. The economy is just over 80 percent of its historical trend between the time the policy is announced and the time it is implemented.

In Figure 3, I plot consumption relative to its historical trend. Notice that at $t = 1$, consumption jumps up 8 percent and stays there until $t > t^*$. At the time of the policy change, consumption grows steadily to its new level (relative to trend) which is about 10 percent above the historical trend.

In Figure 4, end-of-period capital stocks are shown. Initially, all drop to just over 80 percent of their historical trend level, as with output and labor. When the policy change occurs, investment in the technology capital of the domestic companies ceases. At this point, it becomes optimal to let foreign multinationals invest in technology capital. Total tangible and plant-specific intangible capital stocks rise due to the fact that foreign companies are now investing in the small country.

Output shown in Figure 1 includes investment in intangible. In Figure 5, I show GDP and GNP which are accounting measures and commonly used to assess an economy's economic performance. As the propositions above show, both GDP and GNP are above trend initially. In $t = 2$, GDP is down by the same amount as true output and stays constant relative to its historical trend until intangible investment by foreign multinationals rises significantly. GNP falls throughout the pre-liberalization period because the small country is paying portfolio income to households abroad.

Another standard accounting measure used to assess an economy's economic performance is TFP, which is typically constructed as follows:

$$\text{TFP}_{it} = \frac{\text{GDP}_{it}}{K_{T,it}^{1/3} L_{it}^{2/3}}$$

where $K_{T,it}$ is the total tangible capital in country i. Like GDP, total factor productivity is low when intangible investments are high. Thus, care must be taken when diagnosing economies with low or slow-growing GDP and TFP.

In Figure 6, I display foreign direct investment by foreign multinationals relative to output in the small country. For the model, the FDI investment by foreign multinationals is summarized by the second term in (2.13), which is the net investment in tangible capital. What is clear is this investment is very high when GDP is very low. The reason is simple: FDI is high because foreign tangible investment is high, GDP is low because foreign plant-specific intangible investment is high, and both investments are high when countries are open to FDI.

In Table 2, I show how the results change as I change the relative size of countries, the maximal degree of openness, the share of income that goes to technology capital, and the economy's tax rates. If either the relative size or maximal degree of openness increases, the swings in GDP, GNP, and labor are even larger than in the baseline parameterization. This is shown in the columns marked "Higher relative size" and "Higher σ^*." If technology capital plays a small role (lower ϕ), a larger threshold for σ^* is needed to get the same results as the baseline case. This is shown in the column marked "Higher σ^*, Lower ϕ." Finally, I show that the level of tax rates is not crucial to the results as long as a ψ is set in a way to get the same fraction of time at work.

Figure 7 shows how the path of GDP changes as I vary t^*. In the case of $t^* = 1$,

foreign investment is made in the same period as the policy change is announced. GDP is low in the first period because of the increase in intangible investments by foreign multinationals. It is high the next period because TFP is now effectively higher. I show two other intermediate cases with $t^* = 3$ and $t^* = 5$. As I showed above, GDP is always higher than trend in the period of the policy announcement and below trend until $t = t^*$. In terms of the quantitative predictions based on parameters of Table 1, the sequence of paths show that GDP per capita falls to a level in the range of 55 to 75 percent of its pre-liberalized level, with the value depending on the delay between policy announcement and policy change. Once barriers are lowered, GDP per capita is higher than the historical level by about 30 percent. The length of delay does affect the long-run trend, but only modestly.

In Figures 8 and 9, I compare the equilibrium paths of GDP and consumption for the case with no restrictions on portfolio investment and the case with restrictions on portfolio investment. As the propositions make clear, the transitions are affected by the households ability to borrow from abroad. If they cannot, adjustments are slow prior to $t = t^*$, but adjust rapidly when restrictions on FDI are lifted.

In the simulation shown, the capital account liberalization assumes that FDI is liberalized first (in 1995) and portfolio investment second (in 2000). If the two types of investment are simultaneously liberalized, the decline in GDP at $t = t^*$ would be larger than shown in Figure 8, and the change in consumption would be smaller than shown in Figure 9.

Thus far, I have considered very stark examples that allow me to be precise about the equilibrium behavior in the model. Next, I consider more realistic choices for the time paths of $\{\sigma_{it}\}$.

4. Equilibrium Paths in Data

In this section, I analyze transition paths of a 50-country version of the model and show that the theoretical findings are supported in a more realistic application of the model. Inputs in the model are chosen so that the model generates certain features of time series taken from the IMF's *Balance of Payments* and the World Bank's *World Development Indicators* over the period 1980–2005. (See Appendix A for details on data sources.) The choice of 50 countries is dictated by data availability for the balance of payments. Countries are assumed to differ in size and in their levels of openness. As before, size depends on both population and TFP. Here, I assume that populations change over time, consistently with observed populations in the sample, and TFP is constant and set so that 1980 per capita GDPs (normalized by the U.S. level) are the same in the model and data.[12] (See McGrattan (2009) for the specific inputs used in the 50-country version of the model.) Remaining parameters are set as before and are reported in Table 1.[13]

In Figure 10, I show the initial and final values of the openness parameters σ_{it} for the 50 countries. To give some idea of the implied ratios of FDI to GDP, I put countries into two groups: one with the share less than 2 percent and one with it greater. The figure shows that these parameters are not the only relevant input for the average ratio of inward FDI to GDP. Another important input is country size. To see this, consider the path of σ_{it} for the United States. The model predicts a relatively low—less than 2 percent—ratio of inward FDI to GDP despite the fact that the U.S. openness parameters are relatively high. For the United States, the initial level of σ_{it} is 0.77 and it eventually rises to 0.89 (which is the point at the upper right corner of the graph). For almost all other countries,

[12] Measured TFPs do vary since they depend on time paths of technology capital.

[13] For numerical reasons, I modify the model slightly, allowing for small quadratic costs of adjusting capital stocks. This avoids numerical difficulties due to binding nonnegativity constraints on investments. See Appendix B and McGrattan (2009) for details.

the openness parameters needed to match their inward FDI flows are below the U.S. level in all periods. But, almost all other countries are smaller than the United States. All else equal, the smaller the country is, the higher is the average inward FDI to GDP since the domestic stock of technology capital is much smaller than the world stock.

Another noteworthy feature of Figure 10 is the magnitude of the parameters that are needed to align FDI flows in the model and data. While most countries did became more open between 1980 and 2005, the levels of σ_{it} needed to match the paths of inward FDI are not that high, but higher values for these parameters would imply FDI flows that are larger than those reported by the IMF. In the examples of Section 3, I assumed eventual values of σ_{it} at or above 0.9. Only one country in our dataset is above that level.

In Figure 11, I document the performance of the model countries that experience variations in population and openness consistent with the 50 countries in my dataset.[14] This figure is the analogue of Lucas's (2009, Figure 2) who compares countries doing a little and a lot of trade. Here, I distinguish countries doing a little or a lot of inward FDI. The x-axis shows the initial real GDP per capita relative to the level of the country parameterized to match U.S. observations. The y-axis is the annual growth rate in per capita GDP over the period 1980–2005. This rate is relative to the growth rate of the country parameterized to match U.S. observations. Thus, an annual growth rate of 0 implies that the country is growing at the same rate as the country matched to the United States. Rates above 0 imply the country is catching up to the U.S. level of per capita GDP and rates below 0 imply that they are falling behind.

As before, I used a cut-off for the average FDI to GDP of 2 percent. Other cut-offs

[14] The findings for Singapore with coordinates (.33, 2.1) are not shown so that the results for the others are more easily seen.

could be used but the message would be the same: there is no obvious relationship between lower capital restrictions and economic performance. This is true despite the fact that FDI *does* ultimately yield benefits to the host countries.

Another way to demonstrate this is through a cross-country regression of growth on initial per capita GDP and the ratio of FDI to GDP.[15] In Table 3, I report results of such a regression for both the data and the model. The first set of results uses all 50 countries in the dataset. In this case, we see that the ratio of FDI to GDP is significant in the regression, but the impact is not economically large. This is consistent with Figure 11. The second set of results drops Ireland and Singapore and, in this case, the impact is small, both economically and statistically.

The main message of these results is a cautionary one. The lack of a robust positive relationship between FDI and growth does not necessarily mean that the benefits to FDI openness are not large. Here, the benefits are large, but one must be careful in drawing the wrong conclusions from the standard empirical analysis.

5. Conclusion

In this paper, I study equilibrium paths of a multicountry dynamic general equilibrium model as countries become more financially integrated. The model is used to reconcile claims that gains to FDI are large with empirical results that show no robust evidence for such benefits. In the model, eventual gains to FDI openness are large, but these gains are not evident until a certain threshold of openness is reached. In fact, researchers would mistakenly conclude that lower restrictions on capital movements provide few benefits if

[15] Many of the studies surveyed by Kose, Prasad, Rogoff, and Wei (2009) include other control variables about which the model is silent. But, researchers have found that adding them reduces the already small coefficients on the ratio of FDI to GDP.

they applied the standard empirical analysis to the data generated from the model. I show this using a 50-country version of the model and data from the IMF's *Balance of Payments* and the World Bank's *World Development Indicators*.

Appendix A. Data Sources

IMF and World Bank data were used to construct time series for the ratio of inward FDI to GDP and real GDP per capita. Fifty countries had complete data available for 1980–2005. Countries with populations below 2 million were not included because the computation for very small countries is difficult due to corner solutions for investments. Below, the series and countries are listed.

Series and Sources:

- Direct investment in reporting country, net, in current US dollars (IMF Balance of Payments, 4555..9);
- GDP in current U.S. dollars (World Development Indicators, NY.GDP.MKTP.CD);
- GDP in constant 2000 U.S. dollars (World Development Indicators, NY.GDP.PCAP.KD);
- Total population (World Development Indicators, SP.POP.TOTL).

Countries by Region:

- *North America*: Canada, United States
- *Latin America*: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Jamaica, Mexico, Peru, Venezuela
- *Western Europe*: Austria, Denmark, Finland, France, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Turkey, United Kingdom
- *Middle East*: Israel, Jordan, Saudi Arabia
- *Africa*: Cote D'Ivoire, Egypt, Ghana, Kenya, Mali, Morocco, Nigeria, Senegal, Tunisia
- *Asia*: Japan, Malaysia, Pakistan, Philippines, Singapore, South Korea, Sri Lanka, Thailand
- *Oceania*: Australia, New Zealand

Appendix B. Computational Methods

In this appendix, I briefly describe the numerical issues that arise in computing equilibria for the 50-country version of the model. The two main issues are the large dimensionality of the state space and binding nonnegativity constraints on investment.

The issue of dimensionality arises because the investment decisions of firms in one country affect decisions in all other countries. To handle this, I used a parallel computer and a code that uses the message passing interface (MPI). An initial guess is made for the vector of interest rates, wages in all countries, and transfers in all countries. If there are I countries and T time periods, a fixed point must be found for $(2I + 1)T - 1$ prices and transfers. The guess is distributed by the master processor (0) to all "slave" processors. Given prices and transfers, equilibrium quantities are computed on the slave processors, passed back to processor 0, and the guess for the prices and transfers is updated. A fixed point in quantities must also be solved at each iteration. This is done with a standard Newton method, although I have found that analytical derivatives of the Jacobians are necessary to avoid very slow computations given the large number of unknowns being computed. A fixed point must be found for $(2I+4)T$ quantities that include consumptions, labor supplies, bond holdings, investments in technology capital, I investments in tangible capital, and I investments in plant-specific intangible capital for each period. In all, $(4I + 5)T - 1$ prices and quantities are computed.

The second issue is nonnegativity of investment decisions. As small countries relax capital restrictions and let technology capital flow in from abroad, the returns to investing in their own technology capital fall—possibly nonmonotonically, but ultimately to zero. With a large number of countries in the model it is difficult to apply standard penalty function methods to avoid negative investments. Instead, I allow for (small) quadratic adjustment costs in the accumulation equations (2.4)–(2.6) to aid the solution of the fixed points in prices and quantities. For countries that are close to the corner at the start of the simulation (which is matched up to 1980 observations), I assume that they are at the corner and set the appropriate investments to zero.

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Table 1. Model Constants at Annual Rates[a]

Parameter	Expression	Value
Growth Rates (%)		
Population	γ_N	1.0
Technology	γ_A	1.2
Preferences		
Discount factor	β	.98
Leisure weight	ψ	1.32
Tax Rates (%), all i		
Labor wedge	$\tau_{l,i}$	34
Profits	$\tau_{p,i}$	37
Dividends	τ_d	28
Income Shares (%)		
Technology capital	ϕ	7.0
Tangible capital	$(1-\phi)\alpha_{_T}$	21.4
Plant-specific intangible capital	$(1-\phi)\alpha_{_I}$	6.5
Labor	$(1-\phi)(1-\alpha_{_T}-\alpha_{_I})$	65.1
Depreciation Rates (%)		
Technology capital	$\delta_{_M}$	8.0
Tangible capital	$\delta_{_T}$	6.0
Plant-specific intangible capital	$\delta_{_I}$	0
Section 3 Results		
Size		
Small country, $i = s$	$N_s A_s^{1-(1-\phi)(\alpha_T+\alpha_I)}$	1
Big country, $i = b$	$N_b A_b^{1-(1-\phi)(\alpha_T+\alpha_I)}$	10
Maximal Degree of Openness		
Both countries $i = s, b$	σ_{it}^*	0.9
Section 4 Results: $\{N_{it}, A_{it}, \sigma_{it}\}$ reported in McGrattan (2009)		

[a] See McGrattan and Prescott (2009) for the motivation behind these parameter choices.

TABLE 2. SENSITIVITY OF RESULTS

	Percentage Values Relative to Trend in:[a]				
	Baseline (Table 1)	Higher Rel. Size	Higher σ^*	Higher σ^*, Lower ϕ	Lower Taxes
Output					
$t = 1$	93.7	89.2	86.3	92.5	94.6
$t = 2$	82.1	68.3	59.5	79.8	84.7
$t = t^*$	82.1	68.3	59.4	79.9	84.7
$t = t^*+1$	125.6	135.2	142.8	125.5	127.9
$t = \infty$	115.0	127.6	138.5	119.5	117.0
GDP					
$t = 1$	102.7	105.1	106.8	101.4	102.3
$t = 2$	82.1	68.3	59.5	79.8	84.7
$t = t^*$	61.2	37.6	23.5	55.4	64.0
$t = t^*+1$	132.6	143.2	151.1	128.1	134.9
$t = \infty$	123.1	136.6	148.2	124.2	125.2
GNP					
$t = 1$	102.7	105.1	106.8	101.4	102.3
$t = 2$	82.9	69.8	61.4	80.4	85.8
$t = t^*$	64.1	32.8	13.0	56.3	82.3
$t = t^*+1$	102.8	91.8	84.3	96.2	109.6
$t = \infty$	96.6	87.5	83.6	93.3	101.7
Labor					
$t = 1$	90.5	83.8	79.8	89.0	91.8
$t = 2$	82.1	68.3	59.4	79.8	84.7
$t = t^*$	82.1	68.3	59.4	79.9	84.8
$t = t^*+1$	110.5	112.0	113.2	109.7	112.5
$t = \infty$	103.3	107.3	109.5	105.4	105.3
Consumption					
$t = 1$	107.9	113.9	117.8	108.9	106.7
$t = 2$	107.9	113.9	117.8	108.9	106.7
$t = t^*$	107.9	113.9	117.8	108.9	106.7
$t = t^*+1$	108.5	114.3	118.9	109.5	107.3
$t = \infty$	109.7	115.2	121.2	110.7	108.5
%FDI/Output[b]					
$t = 1$	0.0	0.0	0.0	0.0	0.0
$t = 2$	0.0	0.0	0.0	0.0	0.0
$t = t^*$	40.1	60.4	77.7	43.5	49.7
$t = t^*+1$	7.0	6.7	6.7	7.6	8.9
$t = \infty$	5.5	5.5	5.5	5.7	7.0

[a] Alternatives to baseline are (*i*) relative size of 20, (*ii*) $\sigma^* = .99$, (*iii*) $\sigma^* = .99$, $\phi = .04$, (*iv*) all tax rates set to 0 and $\psi = 2.1$.

[b] These values are not relative to the historical trend which is 0.

TABLE 3. IMPACT OF FDI ON PER CAPITA GDP GROWTH[a]

Regression: g=a_0+a_1 $\text{gdp}_0 + a_2$ fdi/gdp

g = annual growth in real per capita GDP relative to US, 1980–2005

gdp_0 = real per capita GDP relative to US in 1980

fdi/gdp = average ratio of FDI to GDP, 1980–2005

Coefficient	Data $I = 50$	Model $I = 50$	Data $I = 48$[b]	Model $I = 48$[b]
a_0	−1.15	−.20	−1.00	−.02
	(.37)	(.07)	(.48)	(.07)
a_1	.50	−.07	.44	−.08
	(.62)	(.12)	(.62)	(.09)
a_2	.30	.10	.20	.03
	(.12)	(.02)	(.21)	(.02)

[a] Standard errors are in parentheses.

[b] Ireland and Singapore are excluded from the sample.

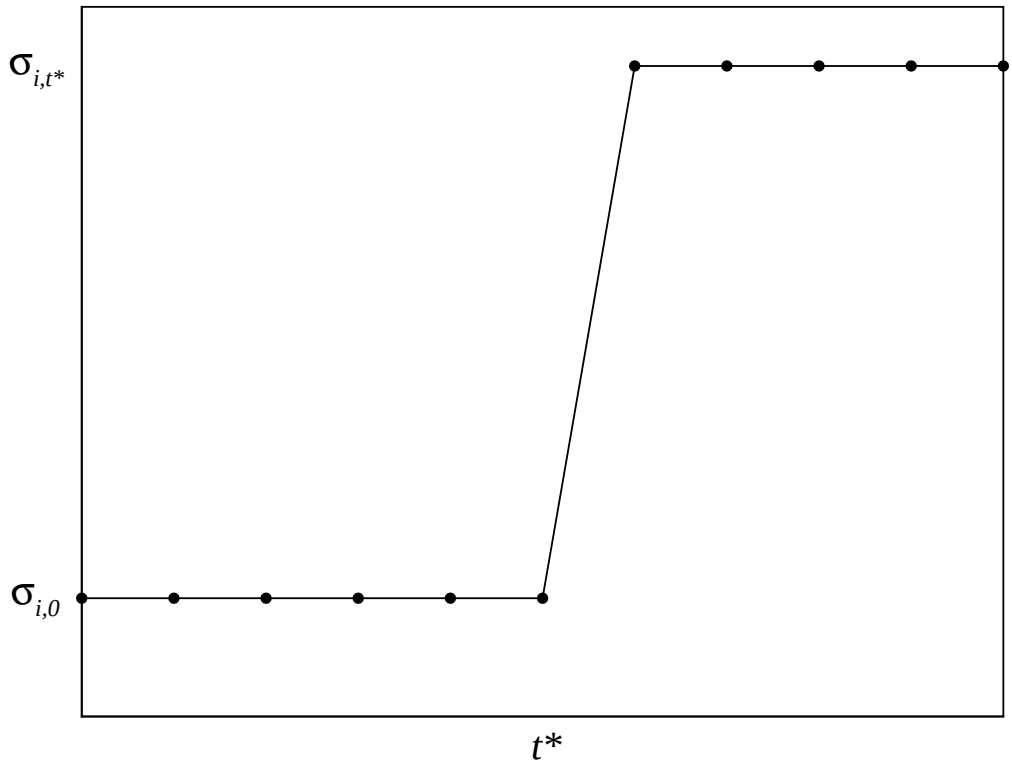

FIGURE 1. PATH OF OPENNESS

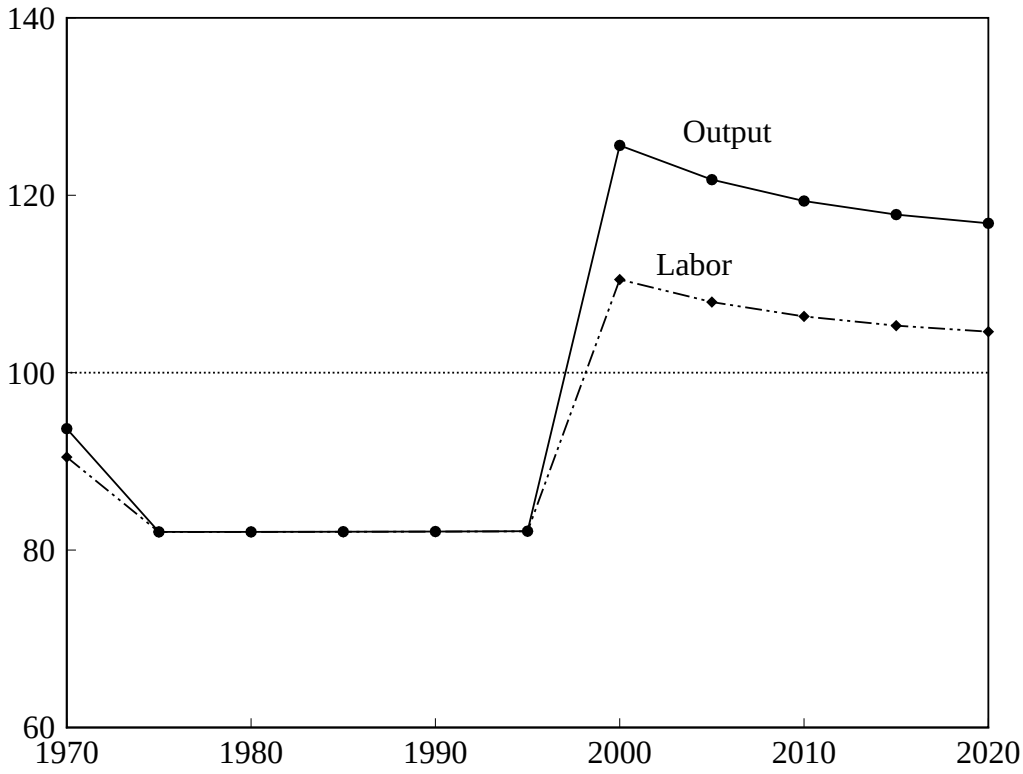

FIGURE 2. OUTPUT AND LABOR RELATIVE TO TREND IN THE SMALL COUNTRY

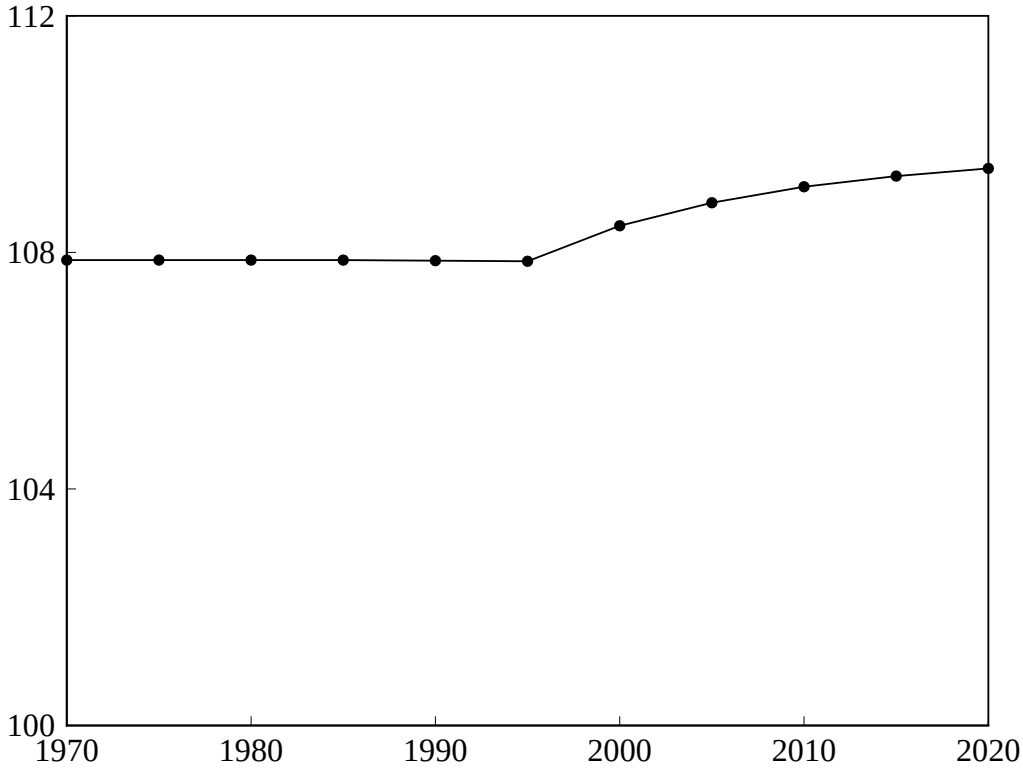

FIGURE 3. CONSUMPTION RELATIVE TO TREND IN THE SMALL COUNTRY

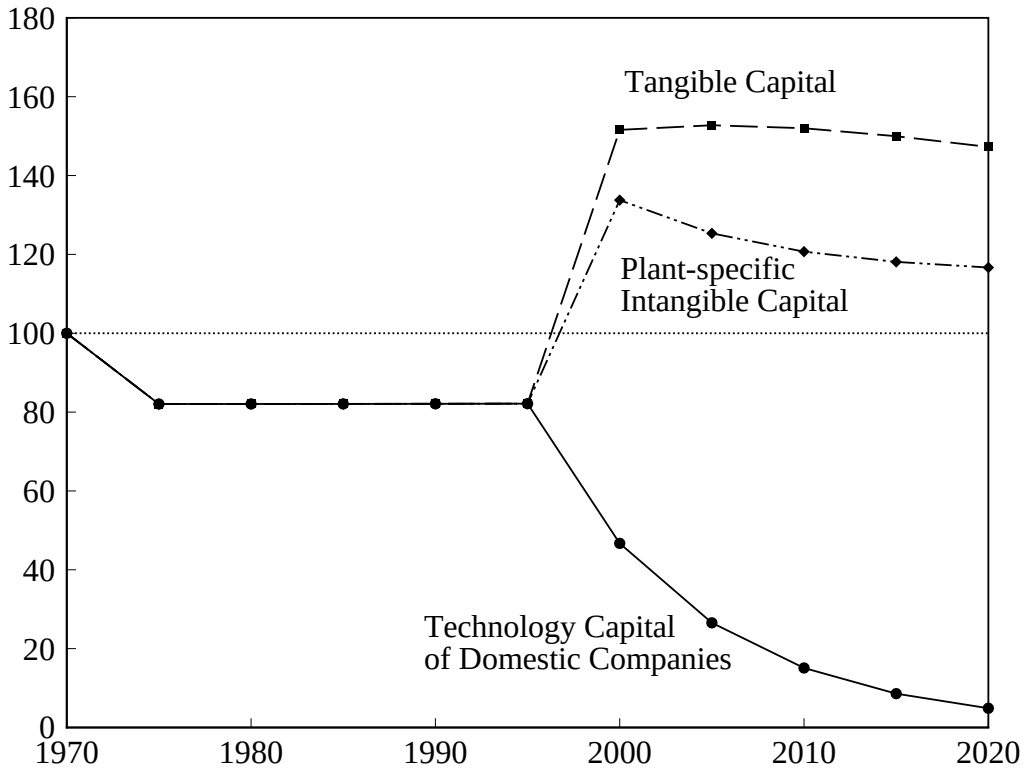

FIGURE 4. CAPITAL STOCKS RELATIVE TO TREND IN THE SMALL COUNTRY

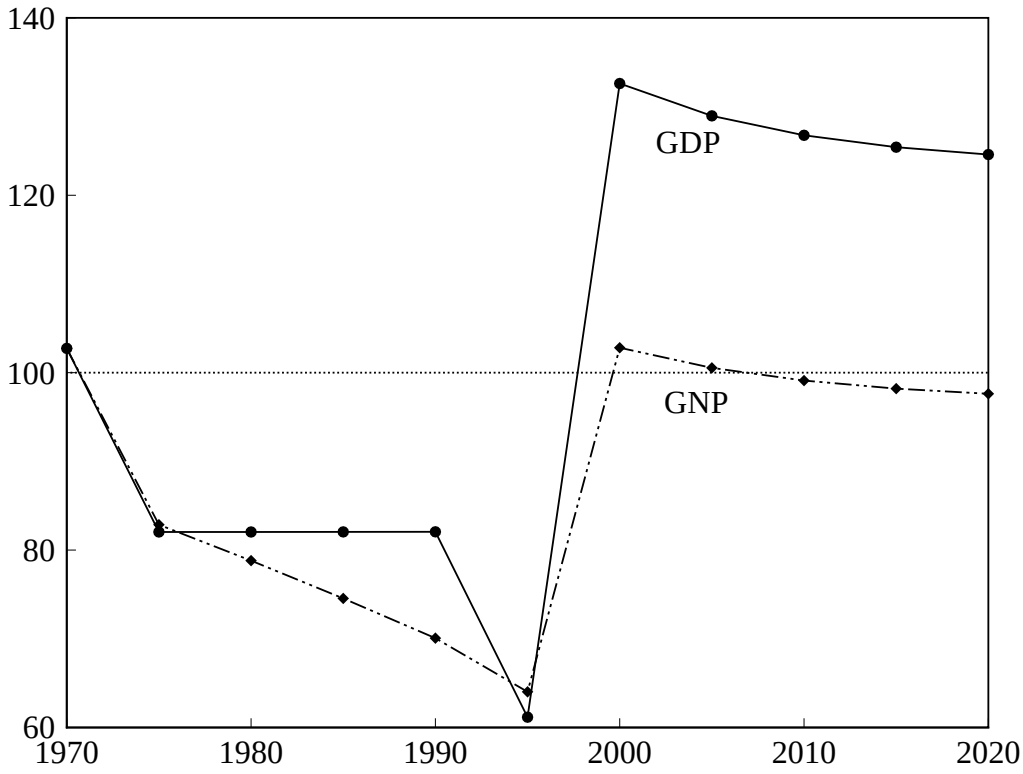

FIGURE 5. GDP AND GNP RELATIVE TO TREND IN THE SMALL COUNTRY

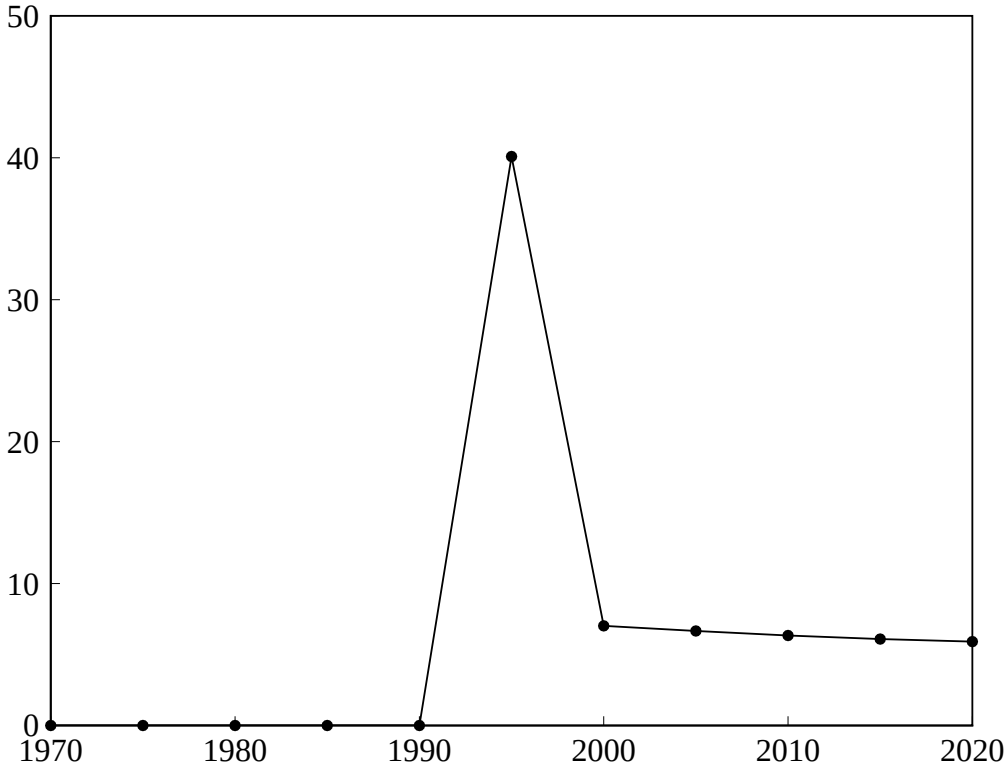

FIGURE 6. FDI INVESTMENT RELATIVE TO OUTPUT IN THE SMALL COUNTRY

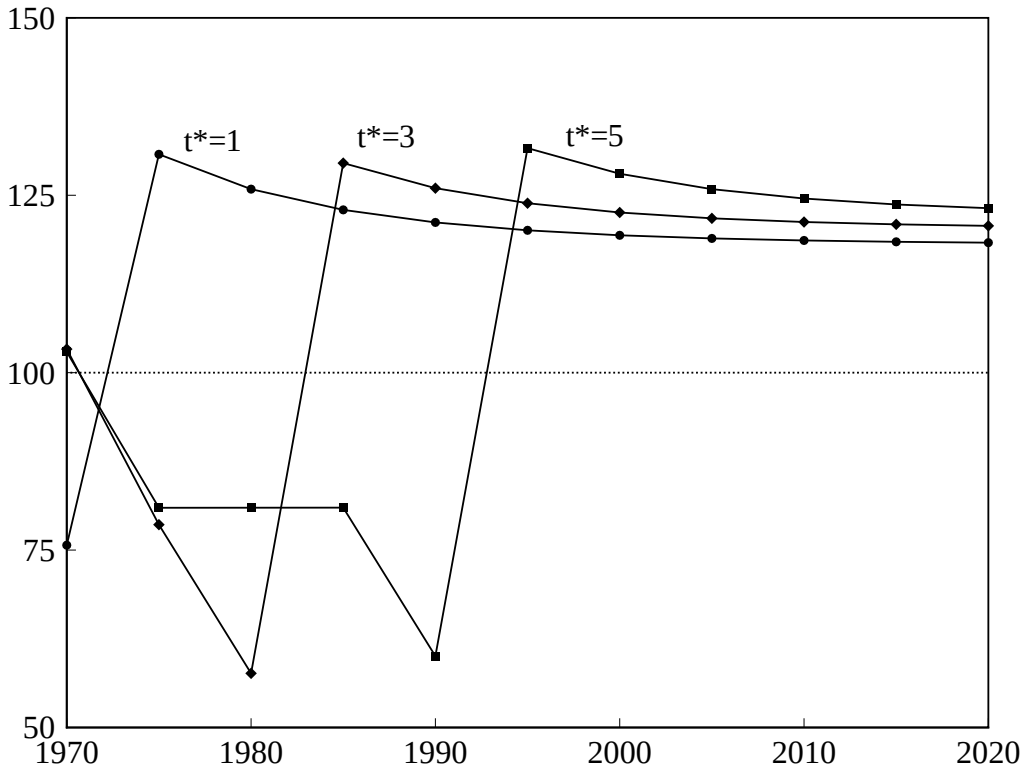

FIGURE 7. GDP RELATIVE TO TREND IN THE SMALL COUNTRY, VARYING t^*

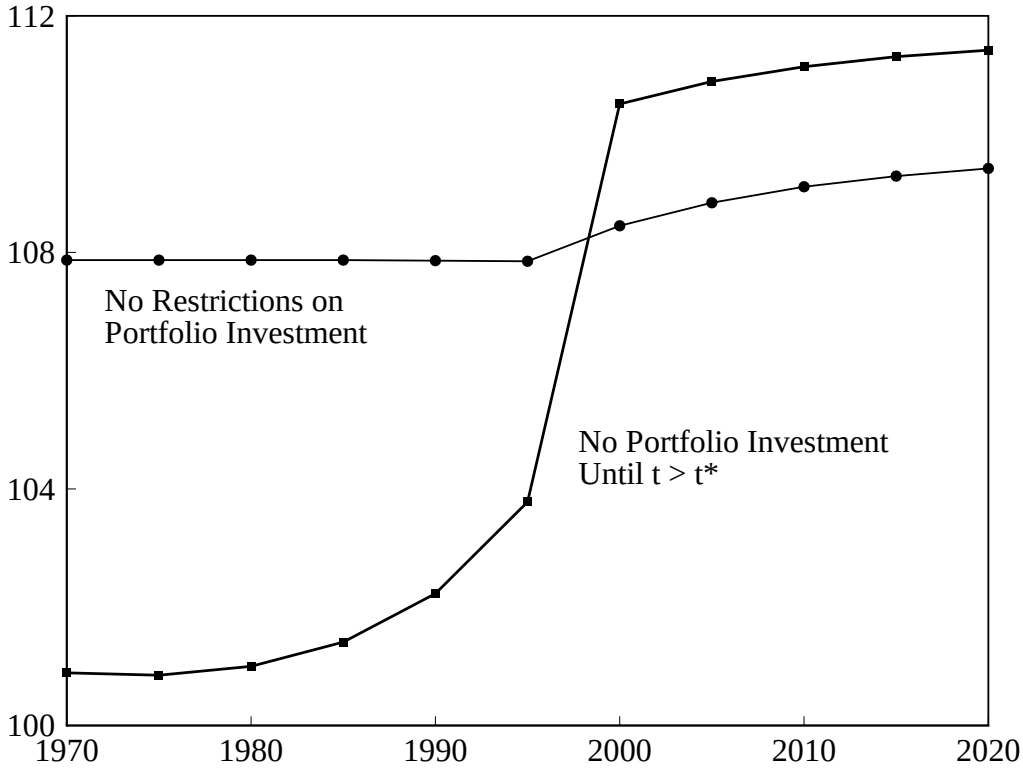

FIGURE 8. CONSUMPTION RELATIVE TO TREND IN THE SMALL COUNTRY, WITH AND WITHOUT RESTRICTIONS ON PORTFOLIO INVESTMENT

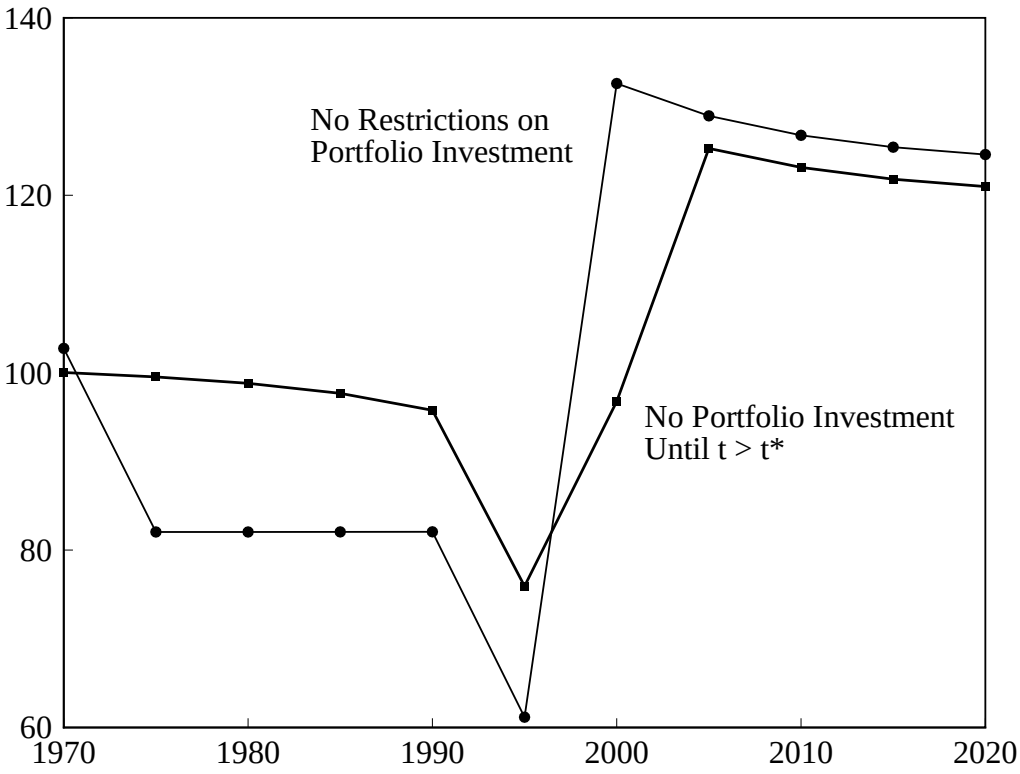

FIGURE 9. GDP RELATIVE TO TREND IN THE SMALL COUNTRY, WITH AND WITHOUT RESTRICTIONS ON PORTFOLIO INVESTMENT

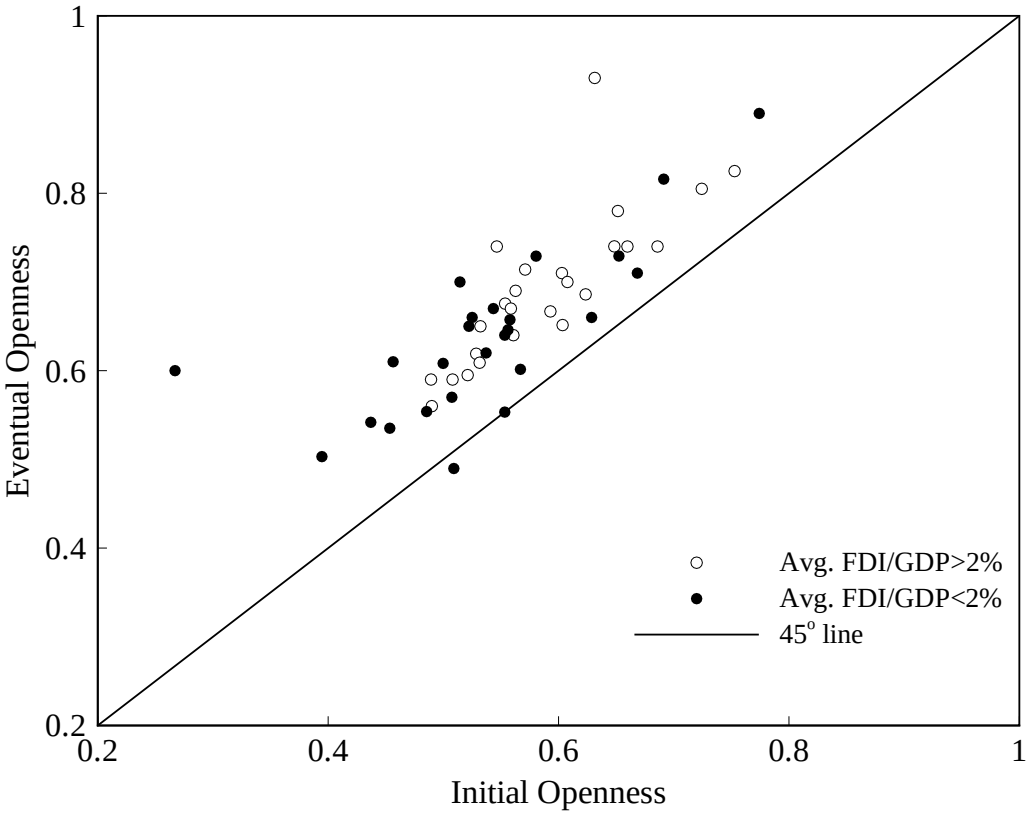

FIGURE 10. OPENNESS PARAMETER (σ_{it}) AT INITIAL AND FINAL t IN THE 50-COUNTRY MODEL

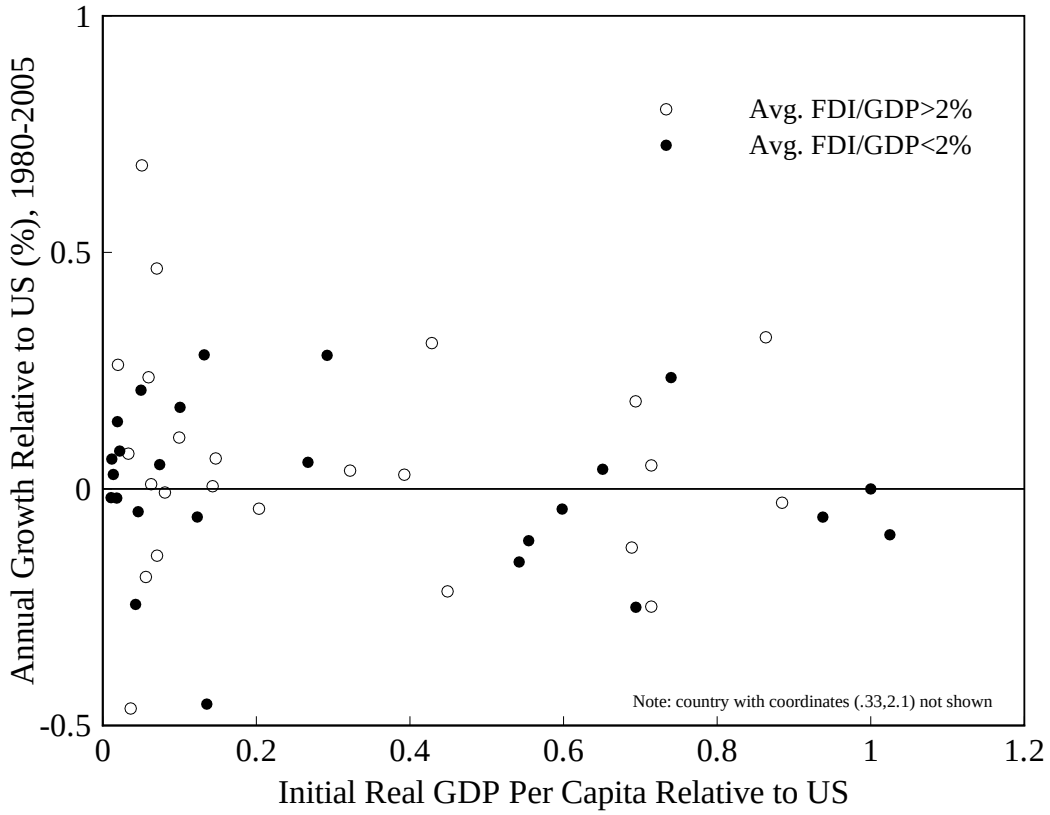

FIGURE 11. PERFORMANCE OF COUNTRIES WITH HIGH AND LOW INWARD FDI SHARES IN THE 50-COUNTRY MODEL