Import Substitution and Economic Growth

Mauro Rodrigues*

UCLA

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Abstract

In spite of Latin America's dismal economic performance between the 1950s and 1980s, the region experienced strong capital deepening. Furthermore, productivity (measured as TFP) grew at low rates in comparison with the U.S. In this paper, we suggest that all these facts can be explained as a consequence of the restrictive trade regime adopted at that time. Our analytical framework is based on a dynamic Heckscher-Ohlin model, with scale economies in the capital-intensive sector. We assume an economy that is initially open and specialized in the production of labor-intensive goods. The trade regime is modeled as a move to a closed economy. The model produces results consistent with the Latin American experience. Specifically, for a sufficiently small country, there will be no long-run growth in income per capita, but capital per capita will increase. As a result, measured TFP will fall.

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1 Introduction

Between the 1950s and 1980s, Latin American countries pursued import substitution (IS) as a development strategy. A set of policies was implemented with the objective of developing an internal manufacturing sector. A crucial element of the IS strategy was to grant high levels of protection to domestic producers, largely closing these economies to international trade. Despite these efforts, most countries in the region were unable to gain any significant ground relative to the industrial leaders. In 1950, Latin America's GDP per capita was 27 percent of that of the U.S.; in 1980, this number was 29 percent. Figure 1 displays this pattern: relative income remained roughly stable throughout the 1950s, 1960s and 1970s, before collapsing in the 1980s.[1]

While other countries or regions also failed to develop during this period, a key distinctive feature of the Latin American case is that low growth went along with strong capital deepening. Table 1, based on Hopenhayn and Neumeyer (2004), illustrates this point. Although Latin America's growth rate in output per capita was similar to that of the U.S. between 1960 and 1985, capital-output ratio increased at a rate comparable to the fast-growing countries of East Asia. Furthermore, productivity – measured as total factor productivity (TFP) – grew at a slow rate especially relative to the U.S. In other words, Latin America fell behind the world technological frontier – represented here by the U.S. – during this period.[2]

In this paper, we suggest that a single explanation, namely the adoption of import substitution policies, can account for the unique combination of low productivity with strong capital deepening that characterized Latin America during this period. We argue that the sectors targeted by these policies were subject to economies of scale. Given the small size of the average Latin American country, these industries were unable to develop once restrictions to international trade were imposed. As result, the region stagnated.

The analytical framework presented here is based on a dynamic Heckscher-Ohlin model with two factors, capital and labor, and two sectors, a labor-intensive sector and a capital-

[1] Figure 1 is based on data from Maddison (2003). GDP per capita is PPP adjusted. Latin American GDP per capita is a population-weighted average of data from Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela.

[2] This pattern was also identified by Syrquin (1986). Moreover, Cole et al (2005) show that Latin America's capital-output ratio has approached the U.S. since the post-war, even though there has been no catch up in terms of income per capita.

intensive sector. We allow for economies of scale in the production of the capital-intensive good. We assume a country that is initially at an open-economy steady state in which it is fully specialized in the production of labor-intensive goods. IS is modeled as an unanticipated move to a situation where there is no trade in goods.

We show that the model is qualitatively consistent with important features of the Latin American experience. Specifically, the model predicts that, for a sufficiently small country, IS will lead to no long-run growth in output per capita. Capital per capita will however increase and, as a result, measured TFP will fall.

This result follows because Factor Price Equalization holds in our model. That is, capital return depends on the world capital stock, but not on the distribution of capital across countries. This implies that an open economy may display a relatively low capital stock in steady state. Closing the economy raises temporarily the return on capital, which leads to capital deepening in the long run. Nevertheless, if the economy is sufficiently small, output per capita will not take off due to the lack of scale.

Quantitatively, the model is able to approximate some key facts of the Latin American development experience. Specifically, the model implies that the average Latin American country exhibits high rates of capital deepening, but growth rates in output per capita that are similar to those of the U.S. Consequently, the model can produce low TFP growth rates as in the data.

An important implication of our theory, which emphasizes scale effects, is that larger countries should do relatively better than smaller countries after adopting IS policies. This prediction is in line with the experience of Brazil and Mexico, the largest economies in the region. Between 1950 and 1980, Brazil increased from 17 to 28 percent of the U.S. GDP per capita, while Mexico increased from 25 to 34 percent. Figure 2 shows that these countries significantly outperformed the average Latin American country during the IS years.[3]

Several scholars have considered Latin America's trade regime as a possible source for its lack of development (see for instance Balassa (1989), Lin (1989), Edwards (1995), Taylor (1998), Hopenhayn and Neumeyer (2004) and Cole et al (2005)). Specifically, they argue that these economies have been largely closed to international trade, especially when compared with countries that successfully reduced their gap relative to the industrial leaders in a similar period. In this paper, we provide a dynamic general equilibrium model to explore

[3]Data from Maddison (2003). Our argument is also compatible with recent empirical evidence from Ades and Glaeser (1999) and Alesina, Spolaore and Wacziarg (2000, 2005). These authors have shown that, among countries that are relatively closed to trade, larger economies tend to perform better. Nonetheless, this size effect diminishes as more open economies are considered.

this relationship. In addition, our work analyzes the implications of Latin America's trade regime on capital accumulation and aggregate productivity.

Our emphasis on scale is motivated by the work of economists during the IS years, which identified problems such as small-scale and inefficient production plants, especially in consumer durables and capital goods sectors. For instance, in the 1960s Scitovsky (1969) pointed out that the automobile industry required plants with an annual output of 250,000 units in order to minimize costs. Nonetheless, there were eight Latin American countries with established automobile industries, whose combined production of around 600,000 cars and trucks was generated by 90 firms.[4]

This paper is related to the classical work of Johnson (1967), which was also motivated by the unsatisfactory results of IS policies. In the context of the static Heckscher-Ohlin model, this author has shown that, if the capital-intensive sector is protected by a tariff, an exogenous increase in the capital stock may not lead to growth in national income. This follows because capital accumulation shifts resources towards the protected sector, amplifying the inefficiency imposed by the tariff. The argument was later formalized by Bertrand and Flatters (1971) and Martin (1977). Although our paper generates similar results, we consider an alternative mechanism in which scale plays a crucial role. In addition, capital accumulation occurs endogenously in our model.

Our modelling strategy is closely related to dynamic Heckscher-Ohlin models, as in Baxter (1992), Ventura (1997), Atkeson and Kehoe (2000) and Cunat and Maffezzoli (2004). These papers typically study economies composed of two standard competitive sectors (with different factor intensities) and two factors, capital and labor, where capital is reproducible. We add to them by considering a capital-intensive sector characterized by economies of scale and imperfect competition.

Specifically, the production structure assumed here is similar to Ethier (1982) and Helpman and Krugman (1985). While the labor-intensive good is produced by competitive firms using a standard constant returns to scale technology, the capital-intensive sector is composed of differentiated variety producers, which behave as monopolistic competitors and operate a production function subject to a fixed cost. Economies of scale arise from the expansion of the set of varieties available. This structure is particularly useful here, since it allows for Factor Price Equalization even in the absence of perfect competition.

Our paper also borrows ideas from the literature on international trade and economic growth, especially Grossman and Helpman (1989, 1990), Rivera-Batiz and Romer (1991) and

[4] Other references include Balassa (1971), Baer (1972) and Carnoy (1972).

Young (1991). As in these papers, we consider an environment in which growth is associated with the introduction of new goods.

The paper is organized as follows. Section 2 describes the model and analyzes the steady state of a closed economy. Section 3 introduces international trade and describes the steady state of an open economy. Section 4 assesses qualitatively the long-run effects of the policy change on capital and income per capita, along with the effect of country size on this relationship. Section 5 extends the model to allow for long-run growth. Section 6 presents our quantitative results. Section 7 concludes.

2 The Model

Time is discrete and indexed by the subscript t, $t = 0, 1, 2, ...$ There is no uncertainty. There are two basic factors: capital and labor; and two sectors: a labor-intensive sector (sector 1) and a capital-intensive sector (sector 2). The labor-intensive sector is competitive and subject to constant returns to scale. The capital-intensive sector generates output by combining a set differentiated varieties in a Dixit-Stliglitz fashion. Each variety is produced using capital and labor but there is a fixed cost, which gives rise to scale economies. Variety producers behave as monopolistic competitors.

Goods 1 and 2 (produced respectively by sectors 1 and 2) are combined to produce the final good, which can be either consumed or invested. There is a measure N of identical infinitely-lived households. We interpret N as the scale of the economy. Factors are fully mobile across sectors, but immobile across countries. There is no international borrowing or lending. For the moment, we assume that there is no international trade in goods, since we initially focus on the closed economy.

2.1 Final stage of production

The final good Y is produced by a competitive firm which combines the labor-intensive good (Y_1) and the capital-intensive good (Y_2) through a Cobb-Douglas production function:

$$Y_t = Y_{1t}^{\varpi} Y_{2t}^{1-\varpi}$$

where $0 < \varpi < 1$ is the share of the labor-intensive good in the final output. We set the final good as the numeraire and denote the prices of the labor- and the capital-intensive good as

p_1 and p_2 respectively. Optimality conditions imply:

$$\frac{p_{1t}^{\varpi}p_{2t}^{1-\varpi}}{\varpi^{\varpi}(1-\varpi)^{1-\varpi}} = 1 \tag{1}$$

$$\frac{p_{1t}}{p_{2t}} = \frac{\varpi}{1-\varpi}\frac{Y_{2t}}{Y_{1t}} \tag{2}$$

2.2 Labor-intensive sector

The production structure of sector 1 is standard. Competitive firms operate a constant returns to scale technology, with capital and labor as inputs. In particular, we assume a Cobb-Douglas functional form with capital share θ_1:

$$Y_{1t} = K_{1t}^{\theta_1} L_{1t}^{1-\theta_1}$$

First-order conditions yield:

$$r_t = p_{1t}\theta_1 k_{1t}^{\theta_1 - 1} \tag{3}$$

$$w_t = p_{1t}(1-\theta_1)k_{1t}^{\theta_1} \tag{4}$$

where r is the rental-rate of capital, w is the wage rate and k_1 is the capital-labor ratio of sector 1.

2.3 Capital-intensive sector

Sector 2 is subject to economies of scale. We model the production structure as a two-stage process. In the first stage, a continuum of measure n monopolistic competitors use capital and labor to produce differentiated varieties. In the second stage, a competitive firm combines those varieties to assemble good 2. For this last stage, we assume a CES production function with elasticity of substitution $1/(1-\gamma)$, in which each variety enters symmetrically:

$$Y_{2t} = \left(\int_0^{n_t} x_{it}^{\gamma} di\right)^{1/\gamma}, \quad 0 < \gamma < 1$$

where x_i is the quantity of variety i used in the production of Y_2. The problem for the second-stage firm is then given by:

$$\max_{x_{it}} \left\{ p_{2t} \left(\int_0^{n_t} x_{it}^{\gamma} di \right)^{1/\gamma} - \int_0^{n_t} p_{it} x_{it} di \right\}$$

The solution of this problem yields the demand for a given variety i:

$$x_{it} = \left(\frac{p_{it}}{p_{2t}} \right)^{\frac{1}{\gamma-1}} Y_{2t} \tag{5}$$

where p_i is the price of variety i. Moreover, given that there are no profits in the second stage:

$$p_{2t} = \left(\int_0^{n_t} p_{it}^{\gamma/(\gamma-1)} di \right)^{(\gamma-1)/\gamma} \tag{6}$$

In the first stage, each variety i is produced using capital (K_i) and labor (L_i), which are combined through a Cobb-Douglas production function. In addition, each producer has to pay a fixed cost f in units of its own output:

$$x_{it} = K_{it}^{\theta_2} L_{it}^{1-\theta_2} - f \tag{7}$$

where $\theta_2 > \theta_1$, i.e. sector 2 is more capital intensive than sector 1. Variety producers behave as monopolistic competitors, i.e. variety i's producer maximizes profits:

$$\max_{p_{it}, x_{it}} \{ p_{it} x_{it} - \psi_t (x_{it} + f) \}, \quad \psi_t = \frac{r_t^{\theta_2} w_t^{1-\theta_2}}{\theta_2^{\theta_2} (1-\theta_2)^{1-\theta_2}}$$

subject to its own demand function (5), where ψ is the marginal cost of the variety producer. The solution of this problem delivers the usual constant mark-up rule:

$$p_{it} = p_t = \frac{1}{\gamma} \psi_t \tag{8}$$

Furthermore, free entry implies that profits are always equal to zero:

$$p_t x_{it} = \psi_t (x_{it} + f) \tag{9}$$

Equations (8) and (9) imply that production is constant across time and varieties:

$$x_{it} = x = \frac{1-\gamma}{\gamma} f \tag{10}$$

This means that expansion and contraction of sector 2 take place through changes in the number of varieties, but not through changes in output per variety. Moreover, each variety uses the same quantity of inputs, i.e., $K_i = K_2$ and $L_i = L_2$ for all i. This follows from the fact that all varieties enter the production of good 2 symmetrically and face the same technology and prices.

Finally, from the optimal choice of capital and labor:

$$\frac{w_t}{r_t} = \frac{1-\theta_2}{\theta_2} k_{2t} \tag{11}$$

where k_2 is the capital-labor ratio of each variety.

2.4 Households

There is a continuum of measure N identical infinitely-lived households. At any given point in time t, each household is endowed with k_t units of capital and one unit of time, which is supplied inelastically. Income can be used either for consumption or investment. For a given initial level of capital k_0, each household chooses sequences of consumption $\{c_t\}_{t=0}^{\infty}$ and capital stock $\{k_{t+1}\}_{t=0}^{\infty}$ to solve:

$$\max \left\{ \sum_{t=0}^{\infty} \beta^t u(c_t) : c_t + k_{t+1} - (1-\delta)k_t \leq w_t + r_t k_t \right\}$$

where $0 < \beta < 1$ is the discount factor, $0 < \delta < 1$ is the depreciation rate and $u(.)$ is twice differentiable, strictly increasing and strictly concave. First-order conditions yield the usual Euler equation:

$$u'(c_t) = \beta u'(c_{t+1})(r_{t+1} + 1 - \delta) \tag{12}$$

2.5 Closed-economy equilibrium

Given that there is no international trade in goods, all domestic markets have to clear:

$$
\begin{aligned}
N[c_t + k_{t+1} - (1-\delta)k_t] &= Y_t = Y_{1t}^{\varpi} Y_{2t}^{1-\varpi} && (13)\\
Y_{1t} &= K_{1t}^{\theta_1} L_{1t}^{1-\theta_1} && (14)\\
Y_{2t} &= \left(\int_0^{n_t} x_{it}^{\gamma} di\right)^{1/\gamma} = n_t^{1/\gamma} x && (15)\\
N k_t &= K_{1t} + n_t K_{2t} && (16)\\
N &= L_{1t} + n_t L_{2t} && (17)
\end{aligned}
$$

where equations (13)-(17) denote respectively the market clearing conditions for the final good, good 1, good 2, capital and labor markets. The closed-economy equilibrium is a sequence of prices and allocations $\{p_t,\ p_{1t},\ p_{2t},\ w_t,\ r_t,\ K_{1t},\ K_{2t},\ L_{1t},\ L_{2t},\ n_t,\ x,\ c_t,\ k_{t+1}\}_{t=0}^{\infty}$ that satisfies equations (1)-(17), for a given initial level of capital per capita k_0.

2.6 Closed-economy steady state

In what follows, variables with no time subscript denote their respective steady-state values. Appendix 1 lists the equations that characterize the closed-economy steady state for an economy of size N.

The choice of functional forms allows us to reach closed-form solutions for the main variables in steady state. In particular, expressions for number of varieties, capital per capita, output per capita and consumption per capita are given by:

$$
\begin{aligned}
n &= T_n N^{\frac{\gamma[\varpi(1-\theta_1)+(1-\varpi)(1-\theta_2)]}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2}} && (18)\\
k &= T_k N^{\frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2}} && (19)\\
y &= T_y N^{\frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2}} && (20)\\
c &= T_c N^{\frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2}} && (21)
\end{aligned}
$$

where T_n, T_k, T_y and T_c are constants that do not depend on N. Appendix 2 describes how these equations are obtained.

The impact of country size on n, k, y and c depends on the sign of the exponents in the expressions above. Assumption 1 guarantees that those exponents are positive.

Assumption 1 $\gamma > \frac{(1-\varpi)\theta_2}{1-\varpi\theta_1}$

Intuitively, Assumption 1 ensures that entry (in the form of higher n) will restore zero profits. In particular, a higher N corresponds to a higher demand for each existing variety and, everything else constant, to positive profits.

An increase in n then has two opposite effects on profits per variety. On one hand, it is associated with an increase in k, as the capital-intensive sector expands. This in turn leads to higher wages and therefore higher costs for each variety. On the other hand, equation (6) can be written as:

$$p_2 = \left(\int_0^n p^{\gamma/(\gamma-1)} di \right)^{(\gamma-1)/\gamma} = n^{(\gamma-1)/\gamma} p$$

which indicates that the increase in n also leads to higher variety prices (relative to the price of good 2) and, as a result, higher revenues per variety. Assumption 1 guarantees that the demand for each variety is sufficiently elastic, such that costs increase faster than revenues as entry takes place. Consequently, an increase in the number of varieties will eventually drive profits back to zero.[5]

Given this assumption, our first proposition follows directly:

Proposition 1 *Given assumption 1, steady-state per capita output, capital and consumption are increasing functions of N in a closed economy.*

In other words, the presence of scale economies enables larger internal markets to support a higher number of varieties in steady state. As a result, they will display higher per capita income, capital and consumption when closed.[6] All remaining variables can also be expressed in terms of N. For the remaining of the paper, $z(N)$ will denote the closed-economy steady state value of a variable z.

3 Open-economy Equilibrium

We introduce trade in this model through a simple extension of the framework in section 2. In particular, we assume now that there are two countries, home and foreign, with sizes N

[5] As we show in Section 5, Assumption 1 also guarantees the existence of a balanced growth path when country size grows at a constant rate.

[6] It is interesting to note that when $\gamma = 1$ (varieties are treated as perfect substitutes) or $\varpi = 1$ (good 2 is irrelevant), economies of scale do not matter and therefore k, y and c do not depend on N.

and N^* respectively, where $N+N^*=1$. These economies share all the remaining parameters. Variables with an asterisk refer to the foreign country.

Economies are allowed to trade good 1 and varieties costlessly. Good 2 and the final good are then assembled internally by each country. The world market clearing condition for good 1 is as follows:

$$Y_{1t}+Y_{1t}^*=K_{1t}^{\theta_1}L_{1t}^{1-\theta_1}+K_{1t}^{*\theta_1}L_{1t}^{*1-\theta_1}$$

Y_1 and Y_1^* now stand for the amount of good 1 used by the home and the foreign country respectively, while their total production is denoted by their respective production functions.

A measure of n (n^*) varieties is produced by the home (foreign) country, such that there are now $n+n^*$ varieties available to generate good 2 in each country. Production of good 2 is then given by:

$$Y_{2t}=(n_t+n_t^*)^{1/\gamma}x_t^d, \quad Y_{2t}^*=(n_t+n_t^*)^{1/\gamma}x_t^{d*}$$

where the home (foreign) country utilizes x^d (x^{d*}) units of each of the $n+n^*$ varieties now available. Market clearing implies that $x=x_t^d+x_t^{d*}$.

Since there is no international borrowing or lending, trade must be balanced:

$$\begin{aligned}
p_{1t}Y_{1t}+p_t(n_t+n_t^*)x_t^d &= p_{1t}K_{1t}^{\theta_1}L_{1t}^{1-\theta_1}+p_tn_tx \\
p_{1t}Y_{1t}^*+p_t(n_t+n_t^*)x_t^{d*} &= p_{1t}K_{1t}^{*\theta_1}L_{1t}^{*1-\theta_1}+p_tn_t^*x
\end{aligned}$$

The description of the open economy equilibrium is completed by the optimality conditions for each of the agents, along with market clearing conditions for factors and goods that are not traded internationally. Such equations are analogous to those of the closed-economy case, except that there are now two of each (one for each country).

Nevertheless, the optimality conditions for sector 1 firms and variety producers must be slightly modified. The presence of international trade allows for the possibility of complete specialization of these economies either in the production of good 1 or in the production of varieties. For this reason, the first order conditions for a sector 1 firm in the home country are given by:

$$r_t \geq p_{1t}\theta_1k_{1t}^{\theta_1-1}, \quad \text{with equality if } K_{1t}>0 \tag{22}$$

$$w_t \geq p_{1t}(1-\theta_1)k_{1t}^{\theta_1}, \quad \text{with equality if } L_{1t}>0 \tag{23}$$

Similarly for a variety producer:

$$p_t \leq \frac{1}{\gamma}\psi_t, \quad \text{with equality if } n_t > 0 \tag{24}$$

Analogous conditions hold for the foreign country.

For countries with sufficiently low capital per capita, condition (24) does not bind and the economy fully specializes in the production of good 1. Likewise, conditions (22) and (23) do not bind when capital per capita is sufficiently high, so that the country only produces varieties. For intermediate values of capital per capita, the economy will produce some of good 1 and some varieties. This set of intermediate values is often referred to as the cone of diversification by the international trade literature.

If both home and foreign country capital stocks lie within the cone of diversification, conditions (22)-(24) bind for the two economies. As a result, they will face the same factor prices r and w.[7] This result is commonly known as the Factor Price Equalization theorem.

3.1 Open-economy steady state

In steady state, the rental rate of capital is determined uniquely by the discount factor and the depreciation rate. Since the countries share these parameters, they will display the same rental rate $r = r^* = 1/\beta - (1-\delta)$. This means that capital-labor ratios k_1 and k_2 will be shared by both countries, so that the wage rate is also equalized. In other words, Factor Price Equalization holds in steady state. Proposition 2 establishes this result:

Proposition 2 *In an open-economy steady state, r, w, p_2, k_1, k_2, K_2 and L_2 are equalized across countries.*

Proof. See Appendix 4. ■

Proposition 2 also implies that conditions (22)-(24) hold as equalities in steady state for both countries. In other words, their steady state capital stocks lie within the cone of diversification.

Proposition 3 states that open-economy prices and factor intensities are the same as in a closed economy of size $N + N^* = 1$:

[7] Since sector 1 is competitive, price is equal to the marginal cost, i.e., $p_{1t} = r_t^{\theta_1} w_t^{1-\theta_1} / [\theta_1^{\theta_1}(1-\theta_1)^{1-\theta_1}] = r_t^{*\theta_1} w_t^{*1-\theta_1} / [\theta_1^{\theta_1}(1-\theta_1)^{1-\theta_1}]$. Moreover, assuming that equation (24) binds for both countries, $p_{1t} = (1/\gamma) r_t^{\theta_2} w_t^{1-\theta_2} / [\theta_2^{\theta_2}(1-\theta_2)^{1-\theta_2}] = (1/\gamma) r_t^{*\theta_2} w_t^{*1-\theta_2} / [\theta_2^{\theta_2}(1-\theta_2)^{1-\theta_2}]$. These two equations imply that $r_t = r_t^*$ and $w_t = w_t^*$.

Proposition 3 *Open-economy steady state values for $r, w, p, p_1, p_2, k_1, k_2, K_2$ and L_2 coincide with their respective steady state values in a closed economy of size 1.*

Proof. See Appendix 4. ■

The idea of this last proof is to show that the open-economy steady state satisfies the equations that characterize the closed-economy steady state for $N = 1$. Marginal conditions are satisfied since prices are equalized across countries. Market clearing conditions for good 1 and varieties hold by assumption, since these goods are traded internationally. Market clearing conditions for the remaining nontraded goods and factors are satisfied by adding those conditions across countries.

This result also allows us to pin down world quantities in steady state. For instance, the world capital stock is equivalent to the capital stock of a closed economy of size 1. For this reason, we denote by $z(1)$ the world value of a given variable z in steady state.

Nonetheless, country-level quantities cannot be determined by such a strategy, since it does not guarantee that domestic markets clear. In particular, although the world capital stock is uniquely determined, there are several ways to allocate this capital across countries. To see this, let k and k^* be respectively the home and foreign capital per capita, such that $Nk + N^*k^* = k(1)$. Moreover, assume that these capital stocks lie within the cone of diversification, i.e. $k, k^* \in [k_1(1), k_2(1)]$.[8]

Then market clearing in home capital and labor markets can be written as:

$$\begin{aligned} k_1(1)L_1 + nK_2(1) &= Nk \\ L_1 + nL_2(1) &= N \end{aligned}$$

These two equations allow us to solve for n and L_1 and therefore for the allocation of factors across sectors. In particular, the number of varieties produced by the home country is given by:

$$n = \frac{N}{L_2(1)} \frac{k - k_1(1)}{k_2(1) - k_1(1)} \tag{25}$$

In addition, $n^* = n(1) - n$ is the number of varieties produced by the foreign country. We can then calculate all the remaining variables as follows. Per capita income and consumption

[8] In the lower limit of the cone of diversification, all factors are allocated to the production of good 1, $K_1 = Nk$ and $L_1 = N$, so that $k = K_1/L_1 = k_1(1)$. In the upper limit of the cone of diversification, all factors are allocated to the production of varieties, i.e., $nK_2 = Nk$ and $nL_2 = N$, so that $k = K_2/L_2 = k_2(1)$. Values in between these limits correspond to production structures that mix good 1 and varieties.

are given by $y = w(1) + rk$ and $c = y - \delta k$. From the Cobb-Douglas assumption in the production of the final good, $Y_1 = \varpi Ny/p_1(1)$ and $Y_2 = (1-\varpi)Ny/p_2(1)$. Finally, $K_1 = Nk - nK_2(1)$, $L_1 = N - nL_2(1)$ and $x^d = Y_2/[n(1)^{1/\gamma}]$. Values for the foreign country can be obtained similarly.

From equation (25), we can also see how the patterns of production and trade are affected by changes in the distribution of capital across countries. If $k = k_1(1)$ – the lower limit of the cone of diversification – equation (25) implies that $n = 0$, so that the home country specializes in the production of good 1 and all varieties are generated by the foreign country. Since varieties are subject to a capital-intensive production process, higher values of k are then associated with a larger share of varieties being produced in the home country. When k reaches the upper limit of the cone of diversification $k_2(1)$, it follows that $nL_2(1) = N$, i.e. all factors are allocated to the production of varieties.

Furthermore, the distribution of capital across countries also determines the distribution of income and consumption in steady state. Countries with higher capital per capita will display higher consumption and income per capita. This follows from the fact that per capita income and consumption are linear functions of k in steady state, i.e. $y = w(1) + rk$ and $c = w(1) + (r - \delta)k$.

4 Import Substitution

We now use the framework developed in the previous sections to analyze the impact of trade restrictions. Our main analytical results emphasize steady-state comparisons between the closed- and the open-economy equilibrium, especially regarding capital, income and consumption per capita.

More precisely, we assume that the home country is initially open and fully specialized in the production of the labor-intensive good. In other words, initial capital per capita is given by $k_{open} = k_1(1)$ – the lower limit of the cone of diversification – and initial income per capita is given by $y_{open} = w(1) + rk_1(1)$. This is the lowest per capita income that can be supported by an open-economy steady state. Moreover, consumption per capita is $c_{open} = y_{open} - \delta k_{open}$.

We model import substitution as an unanticipated move to a closed-economy situation. We also assume that the economy remains closed for a sufficiently long period of time, so that it can reach its closed-economy steady state. In the new steady state, capital, income and consumption per capita are given respectively by $k_{closed} = k(N)$, $y_{closed} = y(N)$ and

$c_{closed} = c(N)$.

It is important to note that, in an open-economy situation, per capita income, consumption and capital depend on the size of the world economy ($N + N^* = 1$), but not on the size of the home market N. This stands in contrast with the closed-economy steady state, in which those objects are increasing functions of N.

Proposition 4 analyzes the relationship between country size and the impact of import substitution on capital, income and consumption per capita:

Proposition 4

1. *There exists a unique* $\overline{N}_k \in (0, 1)$ *such that* $k_{closed} \geq k_{open}$ *if* $N \geq \overline{N}_k$ *and* $k_{closed} < k_{open}$ *if* $N < \overline{N}_k$

2. *There exists a unique* $\overline{N}_y \in (0, 1)$ *such that* $y_{closed} \geq y_{open}$ *if* $N \geq \overline{N}_y$ *and* $y_{closed} < y_{open}$ *if* $N < \overline{N}_y$

3. *There exists a unique* $\overline{N}_c \in (0, 1)$ *such that* $c_{closed} \geq c_{open}$ *if* $N \geq \overline{N}_c$ *and* $c_{closed} < c_{open}$ *if* $N < \overline{N}_c$

4. $\overline{N}_k < \overline{N}_y < \overline{N}_c$

Proof. See Appendix 4. ■

There are two effects of IS on capital per capita. On one hand, since the country now needs to produce varieties (which are capital intensive), capital has a tendency to increase in a closed economy. On the other hand, the smaller scale (relative to the open economy) forces capital to shrink. If N is sufficiently low, the latter effect dominates so that k falls.

Similar effects apply to income per capita. However, the prohibition of international trade leads to a misallocation of resources across sectors. This brings an extra effect into play, which contributes to reducing y. For this reason, when N is such that $k_{open} = k_{closed}$, closing the economy leads to a fall in the long-run income per capita (part 4 of Proposition 4). Put differently, if $N = \overline{N}_y$, the economy experiences capital deepening, but output per capita does not show any long-run growth.

These results show how the model can qualitatively account for key features of the Latin American experience during the IS period. In particular, sufficiently small countries (with size around $\overline{N}_y$) display low growth in output per capita, but high growth in capital per capita. As a result, measured TFP falls.[9] Furthermore, larger countries can be more successful in reducing their gap relative to industrial leaders, which is consistent with the cases of Brazil and Mexico.

Proposition 4 also allows us to analyze the effects of IS on consumption per capita and therefore the long-run welfare implications of the model. Specifically, $\overline{N}_c > \overline{N}_y$ means that the size requirement to generate long-run growth in consumption is even more strict. This follows because at $N = \overline{N}_y$ the economy reaches the same per capita income as initially, but needs a higher level of investment in steady state. In other words, growth in income per capita is not necessarily associated with long-run welfare gains.[10]

Proposition 5 establishes the same results as Proposition 4, but for capital, income and consumption per capita relative to the foreign country:

Proposition 5

1. *There exists a unique* $\overline{N}_k \in (0, 1/2)$ *such that* $\frac{k_{closed}}{k^*_{closed}} \geq \frac{k_{open}}{k^*_{open}}$ *if* $N \geq \overline{N}_k$ *and* $\frac{k_{closed}}{k^*_{closed}} < \frac{k_{open}}{k^*_{open}}$ *if* $N < \overline{N}_k$
2. *There exists a unique* $\overline{N}_y \in (0, 1/2)$ *such that* $\frac{y_{closed}}{y^*_{closed}} \geq \frac{y_{open}}{y^*_{open}}$ *if* $N \geq \overline{N}_y$ *and* $\frac{y_{closed}}{y^*_{closed}} < \frac{y_{open}}{y^*_{open}}$ *if* $N < \overline{N}_y$
3. *There exists a unique* $\overline{N}_c \in (0, 1/2)$ *such that* $\frac{c_{closed}}{c^*_{closed}} \geq \frac{c_{open}}{c^*_{open}}$ *if* $N \geq \overline{N}_c$ *and* $\frac{c_{closed}}{c^*_{closed}} < \frac{c_{open}}{c^*_{open}}$ *if* $N < \overline{N}_c$
4. $\overline{N}_k < \overline{N}_y < \overline{N}_c$

Proof. See Appendix 4. ■

Corollary 1 analyzes the impact of the policy change on capital-output ratios:

[9] Although Table 1 reports some TFP growth, the fall in TFP produced by the model is consistent with the data. The reason is that our economy has no intrinsic source of long-run growth. In a growing economy, this corresponds to an increase in TFP at rate lower than trend. In Section 6, we show that our model can be easily extended to allow for long-run growth.

[10] In this exercise, the size of the home country is bounded above by the amount of labor the world economy allocates to sector 1, i.e. $L_1(1)$. If $N > L_1(1)$, the home country cannot be initially specialized in the production of good 1. In Proposition 4, we are implicitly assuming that the thresholds $\overline{N}_k$, $\overline{N}_y$ and $\overline{N}_c$ are below $L_1(1)$, but there is no guarantee that this is true. Nonetheless, for a large range of parameter values – in particular for those used in our quantitative section – $\overline{N}_k$ and $\overline{N}_y$ fall below $L_1(1)$. The same is not true for $\overline{N}_c$, meaning that most countries are likely to display a fall in long-run consumption per capita.

Corollary 1 For any $N \in (0,1)$, $k_{closed}/y_{closed} = k^*_{closed}/y^*_{closed}$ and $k_{open}/y_{open} < k_{closed}/y_{closed}$.

Proof. From equations (19) and (20), $k_{closed}/y_{closed} = T_k/T_y$ does not depend on N. Moreover, for all N, $k_{open}/y_{open} = k_1(1)/[w(1)+rk_1(1)]$. This implies that the change in the home country capital-output ratio is independent of its size. But the capital-output ratio rises for $N = \overline{N}_y$ (Proposition 4), since k increases, but y does not change. This implies that $k_{open}/y_{open} < k_{closed}/y_{closed}$ for every N. ■

According to Proposition 1, two closed economies will not display convergence in capital and output per capita, unless they are of equal size. Nonetheless, Corollary 1 establishes that convergence will happen in terms of capital-output ratios.

More importantly, the result also implies that the home country will experience an increase in its capital-output ratio independent of its size. This means that the policy change will induce capital deepening, whether or not there are gains in terms of output per capita.

4.1 Implications for TFP

Assume that TFP (denoted by A) is measured using a Cobb-Douglas production function for the aggregate economy:

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha}$$

where $\alpha = \varpi\theta_1 + (1-\varpi)\theta_2$ is a weighted average of the sectoral capital shares. Measured TFP growth is then given by:

$$\widehat{A} = \widehat{y} - \alpha\widehat{k}$$

where $\widehat{y} = (1/T)\ln(y_{closed}/y_{open})$ and $\widehat{k} = (1/T)\ln(k_{closed}/k_{open})$ are respectively annual growth rates of capital and output per capita over a time interval T. Clearly, TFP falls for countries with size around $\overline{N}_y$ in Proposition 4, since they display an increase in k but relatively no change in y. From equations (19) and (20), we can also show that the TFP loss is inversely related to country size:

$$\frac{\partial\widehat{A}}{\partial N} = \frac{1}{T}\frac{\partial\ln[y(N)]}{\partial N} - \alpha\frac{1}{T}\frac{\partial\ln[k(N)]}{\partial N} = \frac{1}{T}\frac{(1-\alpha)(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2} > 0$$

Intuitively, TFP falls as a result of the misallocation of resources entailed by closing the economy. However, this effect is partially counteracted by the expansion of the sector characterized by scale economies. Since the latter effect is less important for smaller countries, they tend to experience sharper TFP falls.

4.2 Transition Paths

In this subsection, we present a numerical example on the transition between the initial open-economy steady state and the closed-economy situation. Although we are mostly interested in the long-run implications of IS policies, examining the transition provides further intuition on the model.

Figure 3 displays our example.[11] The policy is implemented at $t = 0$. Before this instant, the economy is at its open-economy steady state. We show time series for the number of varieties as well as for capital, output and consumption per capita. To emphasize the importance of country size, we consider two cases: $N = 0.05$ and $N = 0.10$. Both these cases are characterized by a long-run increase in capital per capita, but they differ in the effects on long-run output per capita.

Variables behave similarly for both values of N. At $t = 0$, the policy forces the country to produce all varieties consumed internally. As a result, n jumps from zero to a positive number. Nonetheless, given that capital is initially low, shifting resources towards the capital-intensive sector – the activity in which the economy does not have comparative advantage – generates a sharp fall in output and consumption. As time passes and capital accumulates, the number of varieties produced domestically increases further. Output and consumption then follow an increasing path after the initial drop.[12]

This example also illustrates the role of scale on the transition. Specifically, the larger country is able to produce more varieties internally, both at $t = 0$ and as time passes. As a result, output and consumption display not only a smaller initial drop, but stronger subsequent growth. In the case considered here, lack of scale prevents the smaller country from recovering its initial level of income per capita, whereas the larger economy is able to experience some long-run growth in y. The example also shows that the policy can lead to welfare losses, even if it induces long-run growth in income per capita. For both values of N, the whole path of consumption per capita lies below the initial level c_{open}.

[11] Transition paths were calculated numerically using the following parameter values: $\theta_1 = .17$, $\theta_2 = .49$, $\varpi = .5$, $\beta = .96$, $\delta = .1$, $\gamma = .9$ and $f = .1$. Moreover, we assume log utility for this exercise.

[12] For both values of N considered here, capital per capita grows in the long run. However, as shown in Proposition 4 (part 1), k displays negative long-run growth if N is sufficiently low. In this case, the time paths behave similarly at time $t = 0$. However, since k falls displays a falling path, n, y and c will decline during the transition to the closed-economy steady state.

5 Balanced Growth Path

The previous section has shown how our model is qualitatively consistent with key facts of Latin America's development experience. In the remaining of this paper, we assess the model's quantitative performance when compared with data. To do so, we extend our framework to allow for long-run growth.

Specifically, we assume that country size evolves as follows:

$$\begin{aligned} N_t &= N_0[1+g(N)]^t \\ N_t^* &= N_0^*[1+g(N)]^t \end{aligned}$$

where $g(N)$ is assumed constant across time and countries. Initial country sizes are normalized so that $N_0 + N_0^* = 1$. We define a balanced growth path as the situation in which all variables grow at constant rates. Assuming CRRA preferences with risk-aversion coefficient σ, the rental rate is constant over time and given by:

$$r = \frac{[1+g(c)]^\sigma}{\beta} - (1-\delta) \tag{26}$$

where $g(c)$ is the growth rate of per capita consumption. From this expression, we can calculate the growth rates of the remaining variables. Proposition 6 shows that per capita output, capital and consumption exhibit the same growth rate:

Proposition 6 *In a balanced growth path, per capita output, capital and consumption grow at the same rate, which is given by:*

$$g(y) = g(k) = g(c) = \frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1) - (1-\varpi)\theta_2} g(N) \tag{27}$$

Proof. See Appendix 4. ■

Notice that the number of varieties can continuously expand as a result of size growth. This allows per capita quantities to display a long-run trend. In the aggregate, this trend appears as TFP growth:

$$\widehat{A} = g(y) - \alpha g(k) = \frac{(1-\alpha)(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1) - (1-\varpi)\theta_2} g(N) \tag{28}$$

Proposition 6 also shows that Assumption 1 is necessary for the existence of a balanced growth path. This assumption constrains the parameters of the model so that k, y and c display positive long-run growth rates.

We solve for the balanced growth path as usual. First, we detrend all variables by their respective long-run growth rates. We then recast the model in terms of the detrended variables and solve for the steady state. This procedure yields a system of equations that is analogous to the one described in Appendix 3.[13] Consequently, Propositions 1 through 5 hold for the balanced growth path as well. However, these results now refer to the relationship between detrended variables and initial country sizes N_0 and N_0^*.

6 A Quantitative Application to the Latin American Case

In this section, we evaluate the model's quantitative implications for Latin America. We focus mainly on the long-run effects on income per capita, capital-output ratio and TFP. Outcomes are compared with actual growth rates from the period 1960-1985, as displayed in Table 1. In what follows, we describe our choice of parameter values, as well as the numerical results that arise.

6.1 Parameter Values

Capital shares (θ_1 and θ_2) and the share of the labor-intensive good (ϖ) are taken from Cunat and Maffezolli's (2004) work on the dynamic Heckscher-Ohlin model, i.e., $\theta_1 = .17$, $\theta_2 = .49$ and $\varpi = .61$. This implies that the aggregate capital share of this economy $\alpha = \varpi\theta_1 + (1-\varpi)\theta_2$ is approximately 30 percent.

We measure the size of a country by its stock of effective labor, that is $N = EL$, where E is labor productivity and L is population.[14] We denote by $g(E)$ the growth rate of labor productivity and assume no population growth.[15] The aggregate production function can be then written as $Y_t = A_t K_t^{\alpha}(E_t L_t)^{1-\alpha}$. Although A and E play similar roles in this equation,

[13] There are only minor changes in this system of equations. Equation (A.3.1) should be replaced by equation (26). Equations (A.3.11) and (A.3.12) should be rewritten respectively as $N_0[c + (g(k) - \delta)k] = Y_1^{\varpi} Y_2^{1-\varpi}$ and $N_0^*[c^* + (g(k) - \delta)k^*] = Y_1^{*\varpi} Y_2^{*1-\varpi}$.

[14] Trefler (1993) has shown that factor-price equalization cannot be rejected by cross-country wage data when the labor input is adjusted by international productivity differences.

[15] Increasing the population growth rate from zero has no significant impact on our main quantitative results.

they are fundamentally distinct in our model: while E follows an exogenous process, A is an outcome of the model. We explore this distinction to calibrate the parameters $g(E)$ and γ.

More precisely, equations (26) and (27) imply that the long-run growth rates of output per capita (Y/L) and A are given respectively by:

$$\begin{aligned} g(Y/L) &= \left(1 + \frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1) - (1-\varpi)\theta_2}\right) g(E) \\ g(A) &= \frac{(1-\alpha)(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1) - (1-\varpi)\theta_2} g(E) \end{aligned}$$

We calibrate $g(E)$ and γ such that they replicate the growth rates of Y/L and A for the U.S. economy between 1960 and 1985. In particular, we use the growth rate of productivity net of physical and human capital to measure $g(A)$. The values $g(E) = 1.27\%$ and $\gamma = .96$ yield $g(Y/L) = 1.30\%$ and $g(A) = 0.02\%$, which are consistent with actual growth rates reported by Klenow and Rodriguez-Clare (1997).[16]

Finally, we set $\beta = .96$, $\delta = .05$ and $\sigma = 1$. Table 2 summarizes our choice of parameter values.

6.2 The impact of IS policies

We now consider the impact of IS policies on an average Latin American country. As in the previous sections, we impose an initial distribution of capital such that the home country is fully specialized in the production of the labor-intensive good. At time zero, barriers to international trade are erected. We assume that the country reaches a new balanced growth path after 25 years (from 1960 to 1985).

In 1948, the U.S. was responsible for 38.2 percent of Latin America's imports and 52 percent of the region's exports.[17] For this reason, we set the U.S. as the rest of the world.

The size of an average Latin American country is estimated as follows. The labor productivity gap (E/E^*) is calibrated such that the initial steady state matches Latin America's GDP per capita relative to the U.S. in 1960 (26%).[18] Moreover, from 1960 population data, $L/L^* \approx 6\%$. This implies that the size of a typical Latin American country, $N/(N+N^*)$, is approximately 2 percent. Including Western Europe and Japan in the rest of the world

[16] These values are consistent with those shown in Table 1. Klenow and Rodriguez-Clare (1997) is also the data source used by Hopenhayn and Neumeyer (2004), work in which Table 1 is based.

[17] Bulmer-Thomas (2003).

[18] Data from Maddison (2003). The model predicts that initial relative income per effective labor, y/y^*, is around 84%. We therefore set $E/E^* = .31$, so that relative income per capita is 26%.

drives this number down to 1 percent. We therefore focus on these two values when assessing the effects of IS on Latin America.

There are two caveats to be considered before we present the results. First, we model IS as a move to fully closed economy. This assumption is useful to establish our main analytical results, but it is too extreme compared with the actual Latin American experience. Although trade barriers were considerably high during the IS years, they were not fully prohibitive. Trade shares did not converge to zero.

For this reason, our quantitative exercise explores cases where the home country partially closes its economy to international trade. Specifically, we still assume an economy initially specialized in the production of the labor-intensive good. However, at time zero, the size of the rest of the world is reduced to a smaller yet still positive number, instead of zero as in the previous sections of this paper. We select the new size of the rest of the world to reproduce the average trade share of Latin America between 1960 and 1985. The Penn World Tables provide two measures for the average trade share: 46.9% (in current prices) and 53.7% (in constant prices).

The second caveat concerns the comparison of our quantitative results with the data on Table 1. In that table, TFP reflects changes in output not accounted by changes in physical capital and raw labor. We employ a similar procedure to calculate TFP from our exercise. This means that in the context of our model, TFP embodies both terms A and E. More precisely, $TFP_t = A_t E_t^{1-\theta}$.

6.3 Results

Table 3 displays the annual growth rates of output per capita, capital-output ratio and TFP that arise from this quantitative exercise. We focus mainly on our preferred measures for country size – 0.01 and 0.02 – and on the two values for trade share mentioned above (46.9% and 53.7%), as well as their average, 50.3%.

The model yields growth rates that approximate well those experienced by the average Latin American country. Specifically, the model can roughly reproduce some quantitative features of the Latin American economy, i.e., a high rate of capital deepening, along with growth rates in output per capita that are similar to those of the U.S. For our preferred values for country size and trade share, the model produces growth rates in output per capita between 1.25 and 1.36%, growth rates in the capital-output ratio between 1.34 and 1.50% and growth rates in TFP between 0.46 and 0.52%. In the data, these numbers are respectively 1.33, 1.39 and 0.51%. In particular, the parametrization with $N = 0.02$ and a trade share of 50.3% produces rates that are quite close to the data.

Table 3 also analyzes the situation where the country becomes totally closed (trade share equal to zero). In this polar case, the model tends to exaggerate the impact of IS policies: growth rates in output per capita and capital-output ratio that are too high compared with the data. This follows because the trade policy forces the home country to produce all the varieties that are consumed internally. Given that varieties are subject to a capital-intensive production process, there will be a strong incentive to accumulate capital. Moreover, driving the trade share to zero entails a higher level of distortion in this economy, which is reflected in lower TFP growth rates.

To illustrate the impact of country size, we also report results for $N = 0.05$ and $N = 0.09$. For a given trade share, an increase in size leads to higher growth in output per capita, roughly the same growth rate in the capital-output ratio and, as result, higher TFP growth. This is consistent with the analytical results established in previous sections.

7 Concluding Remarks

This paper was motivated by a set of peculiar facts that characterized the Latin American economy during the IS years. Specifically, the region experienced relatively fast growth in its capital-output ratio, despite of having no significant gains in terms of income per capita. Furthermore, TFP growth was low, especially in comparison with the U.S.

We developed a simple model that can qualitatively account for these facts. The analytical framework was based on a dynamic Heckscher-Ohlin model, with economies of scale in the production of the capital-intensive good. We assumed a country that is initially open to international trade and fully specialized in the production of labor-intensive goods. IS was modeled as a move to a closed-economy situation.

Propositions 4 and 5 established the main result of the paper. For a sufficiently small country, closing the economy will lead to no long-run growth in per capita income, but capital per capita will increase. As a result, measured TFP falls. Intuitively, capital increases since the economy now needs to produce the capital-intensive good, but income may not grow due to the lack of scale.

The model is also able to quantitatively account for some of these key facts. In particular, the model predicts that the average Latin American country will exhibit a fast rate of capital deepening, but it will show no significant growth income per capita (relative to the

U.S.). In addition, the model produces low productivity growth rates, consistent with those experienced by Latin America.

In this paper, we introduced scale economies as in the intraindustry trade literature, i.e. scale arises as access to a higher number of differentiated varieties of a given good. This simple structure allows us to account for the puzzling weak relationship between capital accumulation and output growth observed in Latin America during the IS period.

Nonetheless, this framework leaves an important aspect of the Latin American experience unexplained. As highlighted in our introduction, the scale problem in Latin America was particularly evident from the presence of small production units, especially in industries with large minimum efficient plant sizes. In our model, however, the production of each firm does not depend on the size of the market. Considering the effects of IS policies on firm size can be an interesting extension of our paper. As pointed out by Holmes and Stevens (2005), this would require us to step out of the traditional intraindustry trade production framework in favor of a richer production structure. But we leave this issue for future research.

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Appendices

Appendix 1: Closed-economy steady state

The following set of equations characterizes the closed-economy steady state:

$$
\begin{aligned}
1 &= \beta(r+1-\delta) && \text{(A1.1)}\\
r &= p_1\theta_1 k_1^{\theta_1-1} && \text{(A1.2)}\\
w &= p_1(1-\theta_1)k_1^{\theta_1} && \text{(A1.3)}\\
p_2 &= n^{(\gamma-1)/\gamma}p && \text{(A1.4)}\\
x &= K_2^{\theta_2}L_2^{1-\theta_2}-f && \text{(A1.5)}\\
p &= \frac{1}{\gamma}\frac{r^{\theta_2}w^{1-\theta_2}}{\theta_2^{\theta_2}(1-\theta_2)^{1-\theta_2}} && \text{(A1.6)}\\
x &= \frac{1-\gamma}{\gamma}f && \text{(A1.7)}\\
\frac{w}{r} &= \frac{1-\theta_2}{\theta_2}k_2 && \text{(A1.8)}\\
p_1^{\varpi}p_2^{1-\varpi} &= \varpi^{\varpi}(1-\varpi)^{1-\varpi} && \text{(A1.9)}\\
\frac{p_1}{p_2} &= \frac{\varpi}{1-\varpi}\frac{Y_2}{Y_1} && \text{(A1.10)}\\
N(c+\delta k) &= Y_1^{\varpi}Y_2^{1-\varpi} && \text{(A1.11)}\\
Y_2 &= n^{1/\gamma}x && \text{(A1.12)}\\
Nk &= K_1+nK_2 && \text{(A1.13)}\\
N &= L_1+nL_2 && \text{(A1.14)}
\end{aligned}
$$

Appendix 2: Derivation of Equations (18)-(21)

From equations (6) and (8), we have that:

$$p_{2t} = n_t^{(\gamma-1)/\gamma}\frac{1}{\gamma}\frac{r_t^{\theta_2}w_t^{1-\theta_2}}{\theta_2^{\theta_2}(1-\theta_2)^{1-\theta_2}}$$

Using (3) and (4):

$$\begin{aligned}
p_{2t} &= n_t^{(\gamma-1)/\gamma}\frac{1}{\gamma}\frac{(p_{1t}\theta_1 k_{1t}^{\theta_1-1})^{\theta_2}(p_{1t}(1-\theta_1)k_{1t}^{\theta_1})^{1-\theta_2}}{\theta_2^{\theta_2}(1-\theta_2)^{1-\theta_2}} \\
\frac{p_{2t}}{p_{1t}} &= n_t^{(\gamma-1)/\gamma}\frac{1}{\gamma}\left(\frac{\theta_1}{\theta_2}\right)^{\theta_2}\left(\frac{1-\theta_1}{1-\theta_2}\right)^{1-\theta_2} k_{1t}^{\theta_1-\theta_2} \qquad \text{(A2.1)}
\end{aligned}$$

Combining equations (2), (7), (14), (15) and (17):

$$\frac{p_{2t}}{p_{1t}} = \frac{1-\varpi}{\varpi}\frac{Y_{1t}}{Y_{2t}} = \frac{1-\varpi}{\varpi}\frac{k_{1t}^{\theta_1}[N-n_t(x+f)k_{2t}^{-\theta_2}]}{n_t^{1/\gamma}x} \qquad \text{(A2.2)}$$

Equations (3), (4) and (11) imply that $k_{1t} = \lambda k_{2t}$, $\lambda = [(1-\theta_2)/\theta_2]/[(1-\theta_1)/\theta_1]$. Using this along with equations (32) and (33):

$$n_t\frac{1}{\gamma}\left(\frac{\theta_1}{\theta_2}\right)^{\theta_2}\left(\frac{1-\theta_1}{1-\theta_2}\right)^{1-\theta_2}\lambda^{-\theta_2}k_{2t}^{-\theta_2} = \frac{1-\varpi}{\varpi x}[N-n_t(x+f)k_{2t}^{-\theta_2}]$$

We can then solve for k_{2t} as a function of n_t:

$$k_{2t} = \left(\frac{V}{N}n_t\right)^{1/\theta_2}, \quad V = \frac{\frac{1}{\gamma}\frac{1-\theta_1}{1-\theta_2} + \frac{1-\varpi}{\varpi x}(x+f)}{\frac{1-\varpi}{\varpi x}} \qquad \text{(A2.3)}$$

Furthermore, from equations (7) and (17), we can write L_1, L_2, K_1 and K_2 in terms of n_t:

$$\begin{aligned}
L_{2t} &= (x+f)k_{2t}^{-\theta_2} = (x+f)\frac{N}{Vn_t} \qquad &\text{(A2.4)} \\
L_{1t} &= N - n_t L_{2t} = N-(x+f)N/V = N\left(1-\frac{x+f}{V}\right) \qquad &\text{(A2.5)} \\
K_{2t} &= k_{2t}L_{2t} = (x+f)V^{1/\theta_2-1}n_t^{1/\theta_2-1}N^{1-1/\theta_2} \qquad &\text{(A2.6)} \\
K_{1t} &= k_{1t}L_{1t} = \lambda V^{1/\theta_2}\left(1-\frac{x+f}{V}\right)n_t^{1/\theta_2}N^{1-1/\theta_2} \qquad &\text{(A2.7)}
\end{aligned}$$

Then use (16), (A2.6) and (A2.7) to find k_t:

$$k_t = \left(\lambda V^{1/\theta_2}\left(1-\frac{x+f}{V}\right)+(x+f)V^{1/\theta_2-1}\right)n_t^{1/\theta_2}N^{-1/\theta_2} \qquad \text{(A2.8)}$$

To find y_t, use the production function of the final good, along with (14), (15), (A2.3) and (A2.4):

$$\begin{aligned} y_t &= Y_{1t}^{\varpi} Y_{2t}^{1-\varpi}/N = (k_{1t}^{\theta_1} L_{1t})^{\varpi} (n_t^{1/\gamma} x)^{1-\varpi}/N \\ y_t &= \left[\lambda^{\theta_1} V^{\theta_1/\theta_2} \left(1 - \frac{x+f}{V}\right)\right]^{\varpi} x^{1-\varpi} n_t^{\varpi\theta_1/\theta_2 + (1-\varpi)/\gamma} N^{\varpi(1-\theta_1/\theta_2)-1} \end{aligned} \tag{A2.9}$$

Combine equations (1) and (A2.1) to write p_{1t} in terms of n_t and k_{1t}:

$$p_{1t} = T_{\varpi} \left(\frac{p_{2t}}{p_{1t}}\right)^{\varpi-1} = T_{\varpi} \left[n_t^{(\gamma-1)/\gamma} \frac{1}{\gamma} \left(\frac{\theta_1}{\theta_2}\right)^{\theta_2} \left(\frac{1-\theta_1}{1-\theta_2}\right)^{1-\theta_2} k_{1t}^{\theta_1-\theta_2} \right]^{\varpi-1}$$

where $T_{\varpi} = \varpi^{\varpi}(1-\varpi)^{1-\varpi}$. Then use this expression and equation (3) to write r_t as a function of n_t and k_{1t}:

$$r_t = \theta_1 p_{1t} k_{1t}^{\theta_1-1} = \theta_1 T_{\varpi} \left[\frac{1}{\gamma} \left(\frac{\theta_1}{\theta_2}\right)^{\theta_2} \left(\frac{1-\theta_1}{1-\theta_2}\right)^{1-\theta_2} \right]^{\varpi-1} n_t^{(1-\gamma)(1-\varpi)/\gamma} k_{1t}^{(1-\varpi)(\theta_2-\theta_1)-(1-\theta_1)}$$

Then using (A2.3):

$$\begin{aligned} r_t = {} & \theta_1 T_{\varpi} \left[\frac{1}{\gamma} \left(\frac{\theta_1}{\theta_2}\right)^{\theta_2} \left(\frac{1-\theta_1}{1-\theta_2}\right)^{1-\theta_2} \right]^{\varpi-1} \\ & \left[\lambda \left(\frac{V}{N}\right)^{1/\theta_2}\right]^{-[\varpi(1-\theta_1)+(1-\varpi)(1-\theta_2)]} n_t^{\frac{\theta_2(1-\varpi)-\gamma(1-\varpi\theta_1)}{\gamma\theta_2}} \end{aligned} \tag{A2.10}$$

In steady state, $r = 1/\beta - (1-\delta)$. By plugging this into (A2.10), we can calculate the steady-state number of varieties:

$$n = T_n N^{\frac{\gamma[\varpi(1-\theta_1)+(1-\varpi)(1-\theta_2)]}{\gamma(1-\varpi\theta_1)-\theta_2(1-\varpi)}} \tag{A2.11}$$

where $T_n = \left\{ \frac{r}{\theta_1 T_{\varpi}} \left[\frac{1}{\gamma} \left(\frac{\theta_1}{\theta_2}\right)^{\theta_2} \left(\frac{1-\theta_1}{1-\theta_2}\right)^{1-\theta_2} \right]^{1-\varpi} \left[\lambda V^{1/\theta_2}\right]^{\varpi(1-\theta_1)+(1-\varpi)(1-\theta_2)} \right\}^{\frac{\gamma\theta_2}{\theta_2(1-\varpi)-\gamma(1-\varpi\theta_1)}}$. Substitute (A2.11) into (A2.8) and (A2.9) to solve for steady-state capital and income per capita:

$$\begin{aligned} k &= T_k N^{\frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2}} & \text{(A2.12)} \\ y &= T_y N^{\frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2}} & \text{(A2.13)} \end{aligned}$$

Where:

$$
\begin{aligned}
T_k &= V^{1/\theta_2}\left[\lambda + \frac{x+f}{V}(1-\lambda)\right]T_n^{1/\theta_2} \\
T_y &= \left[\lambda^{\theta_1}V^{\theta_1/\theta_2}\left(1-\frac{x+f}{V}\right)\right]^{\varpi} x^{1-\varpi}T_n^{\varpi\theta_1/\theta_2+(1-\varpi)/\gamma}
\end{aligned}
$$

Moreover, given that $c = y - \delta k$:

$$
c = T_c N^{\frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2}}, \quad T_c = T_y - \delta T_k \tag{A2.14}
$$

Appendix 3: Open-economy steady state

Given that $r, w, p_2, k_1, k_2, K_2, L_2$ are equalized across countries (Proposition 2) and that conditions (22)-(24) bind for both economies, the open-economy steady state can be characterized by the following set of equations:

$$
\begin{aligned}
1 &= \beta(r+1-\delta) && \text{(A3.1)} \\
r &= p_1\theta_1 k_1^{\theta_1-1} && \text{(A3.2)} \\
w &= p_1(1-\theta_1)k_1^{\theta_1} && \text{(A3.3)} \\
p_2 &= (n+n^*)^{(\gamma-1)/\gamma}p && \text{(A3.4)} \\
x &= K_2^{\theta_2}L_2^{1-\theta_2} - f && \text{(A3.5)} \\
p &= \frac{1}{\gamma}\frac{r^{\theta_2}w^{1-\theta_2}}{\theta_2^{\theta_2}(1-\theta_2)^{1-\theta_2}} && \text{(A3.6)} \\
x &= \frac{1-\gamma}{\gamma}f && \text{(A3.7)} \\
\frac{w}{r} &= \frac{1-\theta_2}{\theta_2}k_2 && \text{(A3.8)} \\
p_1^{\varpi}p_2^{1-\varpi} &= \varpi^{\varpi}(1-\varpi)^{1-\varpi} && \text{(A3.9)} \\
\frac{p_1}{p_2} &= \frac{\varpi}{1-\varpi}\frac{Y_2}{Y_1} = \frac{\varpi}{1-\varpi}\frac{Y_2^*}{Y_1^*} && \text{(A3.10)}
\end{aligned}
$$

$$
\begin{aligned}
N(c+\delta k) &= Y_1^{\varpi} Y_2^{1-\varpi} && \text{(A3.11)}\\
N(c^*+\delta k^*) &= Y_1^{*\varpi} Y_2^{*1-\varpi} && \text{(A3.12)}\\
Y_2 &= (n+n^*)^{1/\gamma} x^d && \text{(A3.13)}\\
Y_2^* &= (n+n^*)^{1/\gamma} x^{d*} && \text{(A3.14)}\\
x^d + x^{d*} &= x && \text{(A3.15)}\\
Nk &= K_1 + nK_2 && \text{(A3.16)}\\
N^*k^* &= K_1^* + n^*K_2 && \text{(A3.17)}\\
N &= L_1 + nL_2 && \text{(A3.18)}\\
N^* &= L_1^* + n^*L_2 && \text{(A3.19)}\\
Y_1 + Y_1^* &= K_1^{\theta_1} L_1^{1-\theta_1} + K_1^{*\theta_1} L_1^{*1-\theta_1} && \text{(A3.20)}\\
p_1 Y_1 + p(n+n^*)x^d &= p_1 K_1^{\theta_1} L_1^{1-\theta_1} + pnx && \text{(A3.21)}
\end{aligned}
$$

Appendix 4: Proofs

Proof of Proposition 2. First notice that, from the Euler equations, $r = r^* = 1/\beta - (1-\delta)$. Given that production of good 1 and varieties have to be positive for the world economy, conditions (22)-(24) will bind for at least one country. Assume, without loss of generality, that conditions (22) and (23) bind for the home country and condition (24) binds for the foreign country. Then $r = p_1\theta_1 k_1^{\theta_1-1} \geq p_1\theta_1 k_1^{*\theta_1-1} \implies k_1 \leq k_1^* \implies w = p_1(1-\theta_1)k_1^{\theta_1} \leq p_1(1-\theta_1)k_1^{*\theta_1} \leq w^*$. However, $p = (1/\gamma)\psi^* \leq (1/\gamma)\psi \implies w^* \leq w$. It then follows that $w = w^*$ and $k_1 = k_1^*$. Given the optimal choice of capital and labor in sector 2, $k_2 = k_2^* = \frac{w}{r}\frac{\theta_2}{1-\theta_2}$. From equation (7), $L_2 = L_2^* = (x+f)k_2^{-\theta_2}$ and $K_2 = K_2^* = k_2 L_2$. Finally, zero-profits for good 2 producers imply that $p_2 = p_2^* = (n+n^*)^{(\gamma-1)/\gamma}p$. ■

Proof of Proposition 3. We show that the system of equations in Appendix 3 satisfies the equations that characterize a closed economy steady state for a country of size 1. Since prices and factor intensities are equalized across countries, marginal conditions (A3.1)-(A3.9) also hold for the world economy. Moreover, equation (A3.10) can be written as:

$$
\frac{p_1}{p_2} = \frac{\varpi}{1-\varpi}\frac{Y_2}{Y_1} = \frac{\varpi}{1-\varpi}\frac{Y_2^*}{Y_1^*} = \frac{\varpi}{1-\varpi}\frac{Y_2+Y_2^*}{Y_1+Y_1^*}
$$

Therefore, all marginal conditions are satisfied. We now show that the market clearing conditions hold for the world economy. Adding equations (A3.11) and (A3.12), taking into account that $Y_2/Y_1 = Y_2^*/Y_1^* = (Y_2 + Y_2^*)/(Y_1 + Y_1^*)$:

$$\begin{aligned}(Nc + N^*c^*) + \delta(Nk + N^*k^*) &= \left(\frac{Y_1}{Y_2}\right)^{\varpi}(Y_2 + Y_2^*) = \left(\frac{Y_1 + Y_1^*}{Y_2 + Y_2^*}\right)^{\varpi}(Y_2 + Y_2^*) \\ &= (Y_1 + Y_1^*)^{\varpi}(Y_2 + Y_2^*)^{1-\varpi}\end{aligned}$$

Adding equations (A3.13) and (A3.14),using (A3.15):

$$Y_2 + Y_2^* = (n + n^*)^{1/\gamma}(x^d + x^{d*}) = (n + n^*)^{1/\gamma}x$$

Following a similar procedure for capital and labor market clearing conditions:

$$\begin{aligned}Nk + N^*k^* &= (K_1 + K_1^*) + (n + n^*)K_2 \\ N + N^* &= (L_1 + L_1^*) + (n + n^*)L_2\end{aligned}$$

Finally, from equation (A3.20):

$$\begin{aligned}Y_1 + Y_1^* &= \left(\frac{K_1}{L_1}\right)^{\theta_1}(L_1 + L_1^*) = \left(\frac{K_1 + K_1^*}{L_1 + L_1^*}\right)^{\theta_1}(L_1 + L_1^*) \\ &= (K_1 + K_1^*)^{\theta_1}(L_1 + L_1^*)^{1-\theta_1}\end{aligned}$$

■

Lemma 1 *$w(N)$ is strictly increasing in N.*

Proof. Combining equations (A2.3) and (A2.11):

$$k_2(N) = (VT_n)^{1/\theta_2} N^{\frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2}}$$

which is strictly increasing in N. Then from equation (11), it follows that $w(N) = \frac{1-\theta_2}{\theta_2} r k_2(N)$ is a strictly increasing function of N. ■

Proof of Proposition 4.

1. $k_{closed} = k(N)$ is strictly increasing in N (Proposition 1), but $k_{open} = k_1(1)$ does not depend on N. Moreover, $k(0) = 0 < k_1(1)$ and $k(1) > k_1(1)$. Therefore, there is only one $\overline{N}_k \in (0, 1)$ such that $k(\overline{N}_k) = k_1(1)$.

2. $y_{closed} = y(N)$ is strictly increasing in N (Proposition 1), but $y_{open} = w(1) + rk_1(1)$ does not depend on N. Moreover, $y(0) = 0 < w(1)+rk_1(1)$ and $y(1) = w(1)+rk(1) > w(1)+rk_1(1)$. Therefore, there is only one $\overline{N}_y \in (0,1)$ such that $y(\overline{N}_k) = w(1)+rk_1(1)$.

3. $c_{closed} = c(N)$ is strictly increasing in N (Proposition 1), but $c_{open} = w(1)+(r-\delta)k_1(1)$ does not depend on N. Moreover, $c(0) = 0 < w(1) + (r-\delta)k_1(1)$ and $c(1) = w(1) + (r-\delta)k(1) > w(1) + (r-\delta)k_1(1)$. Therefore, there is only one $\overline{N}_c \in (0,1)$ such that $c(\overline{N}_c) = w(1) + (r-\delta)k_1(1)$.

4. Let $N = \overline{N}_k$, i.e., $k(\overline{N}_k) = k_{open}$. Then $y(\overline{N}_k) = w(\overline{N}_k) + rk(\overline{N}_k) < w(1) + rk_{open} = y_{open}$, since $w(N)$ is strictly increasing in N (Lemma 1). Therefore $\overline{N}_y > \overline{N}_k$. Now let $N = \overline{N}_y$, i.e., $y(\overline{N}_y) = y_{open}$. Then $c(\overline{N}_y) = y(\overline{N}_y) - \delta k(\overline{N}_y) = y_{open} - \delta k(\overline{N}_y) < y_{open} - \delta k_1(1) = c_{open}$. Therefore, $\overline{N}_c > \overline{N}_y$.

■

Proof of Proposition 5.

1. $\frac{k_{closed}}{k^*_{closed}} = \left(\frac{N}{N^*}\right)^{\frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2}}$ is strictly increasing in N. In addition, $\frac{k_{closed}}{k^*_{closed}} = 0$ for $N = 0$ and $\frac{k_{closed}}{k^*_{closed}} = 1$ for $N = 1/2$. On the other hand, $\frac{k_{open}}{k^*_{open}} = \frac{k_1(1)}{[k(1)-Nk_1(1)]/(1-N)} = \frac{k_1(1)-Nk_1(1)}{k(1)-Nk_1(1)}$ is strictly decreasing in N. Moreover $0 < \frac{k_{open}}{k^*_{open}} < 1$ for every $N \in (0,1/2)$. Therefore, there is only one $\overline{N}_k \in (0,1/2)$ such that $\frac{k_{closed}}{k^*_{closed}} = \frac{k_{open}}{k^*_{open}}$.

2. $\frac{y_{closed}}{y^*_{closed}} = \left(\frac{N}{N^*}\right)^{\frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2}}$ is strictly increasing in N. In addition, $\frac{y_{closed}}{y^*_{closed}} = 0$ for $N = 0$; $\frac{y_{closed}}{y^*_{closed}} = 1$ for $N = 1/2$. On the other hand $\frac{y_{open}}{y^*_{open}} = \frac{w(1)+rk_{open}}{w(1)+rk^*_{open}}$ is strictly decreasing in N. Moreover, $0 < \frac{y_{open}}{y^*_{open}} < 1$ for every $N \in (0,1/2)$. Therefore, there is only one $\overline{N}_k \in (0,1/2)$ such that $\frac{y_{closed}}{y^*_{closed}} = \frac{y_{open}}{y^*_{open}}$.

3. $\frac{c_{closed}}{c^*_{closed}} = \left(\frac{N}{N^*}\right)^{\frac{(1-\gamma)(1-\varpi)}{\gamma(1-\varpi\theta_1)-(1-\varpi)\theta_2}}$ is strictly increasing in N. In addition, $\frac{c_{closed}}{c^*_{closed}} = 0$ for $N = 0$; $\frac{c_{closed}}{c^*_{closed}} = 1$ for $N = 1/2$. On the other hand $\frac{c_{open}}{c^*_{open}} = \frac{w(1)+(r-\delta)k_{open}}{w(1)+(r-\delta)k^*_{open}}$ is strictly decreasing in N. Moreover, $0 < \frac{c_{open}}{c^*_{open}} < 1$ for every $N \in (0,1/2)$. Therefore, there is only one $\overline{N}_c \in (0,1/2)$ such that $\frac{c_{closed}}{c^*_{closed}} = \frac{c_{open}}{c^*_{open}}$.

4. Let $N = \overline{N}_k$, i.e., $\frac{k_{open}}{k^*_{open}} = \frac{k_{closed}}{k^*_{closed}}$. From equations (19) and (20), $\frac{k_{closed}}{k^*_{closed}} = \frac{y_{closed}}{y^*_{closed}}$. Then $\frac{y_{open}}{y^*_{open}} = \frac{w(1)+rk_{open}}{w(1)+rk^*_{open}} > \frac{k_{open}}{k^*_{open}} = \frac{y_{closed}}{y^*_{closed}}$. Therefore $\overline{N}_y > \overline{N}_k$. Now let $\overline{N}_y$, i.e., $\frac{y_{open}}{y^*_{open}} = \frac{y_{closed}}{y^*_{closed}}$. From equations (20) and (21), $\frac{y_{closed}}{y^*_{closed}} = \frac{c_{closed}}{c^*_{closed}}$. Then $\frac{c_{open}}{c^*_{open}} = \frac{y_{open}-\delta k_{open}}{y^*_{open}-\delta k^*_{open}} = \frac{y_{open}}{y^*_{open}} \frac{(1-\delta k_{open}/y_{open})}{(1-\delta k^*_{open}/y^*_{open})} = \frac{c_{closed}}{c^*_{closed}} \frac{(1-\delta k_{open}/y_{open})}{(1-\delta k^*_{open}/y^*_{open})} > \frac{c_{closed}}{c^*_{closed}}$. Therefore $\overline{N}_c > \overline{N}_y$.

■

Proof of Proposition 6. Log-differentiating equation (A.2.10), taking into account that r is constant over time:

$$
\begin{aligned}
0 &= \frac{\varpi(1-\theta_1)+(1-\varpi)(1-\theta_2)}{\theta_2}g(N)+\frac{\theta_2(1-\varpi)-\gamma(1-\varpi\theta_1)}{\gamma\theta_2}g(n) \\
g(n) &= \frac{\gamma[\varpi(1-\theta_1)+(1-\varpi)(1-\theta_2)]}{\gamma(1-\varpi\theta_1)-\theta_2(1-\varpi)}g(N)
\end{aligned}
$$

where $g(n)$ is the long-run growth rate in the number of varieties. By log-differentiating (A.2.8), we can find the long-run growth rate of k:

$$
g(k)=\frac{1}{\theta_2}[g(n)-g(N)]=\frac{(1-\varpi)(1-\gamma)}{\gamma(1-\varpi\theta_1)-\theta_2(1-\varpi)}g(N)
$$

Similarly for equation (A.2.9):

$$
\begin{aligned}
g(y) &= \left(\frac{\varpi\theta_1}{\theta_2}+\frac{1-\varpi}{\gamma}\right)g(n)-[\varpi(1-\theta_1/\theta_2)-1]g(N)= \\
& \frac{(1-\varpi)(1-\gamma)}{\gamma(1-\varpi\theta_1)-\theta_2(1-\varpi)}g(N)
\end{aligned}
$$

Given that both y and k grow at the rate $g(k)=g(y)$, $c_t=y_t-k_{t+1}+(1-\delta)k_t$ will display the same growth rate in a balanced growth path. ■

Table 1

Average Annual Growth Rates (1960-85)[19]

	Y/L	K/Y	TFP
Latin America	1.33%	1.39%	0.51%
East Asia	4.74%	1.63%	2.83%
Developed	2.40%	0.61%	1.50%
Rest	2.14%	1.05%	1.18%
World	2.24%	1.08%	1.24%
U.S.	1.30%	0.56%	0.74%

Table 2

Parameter Values

Parameter	Value	Interpretation
θ_1	.17	Capital share in labor-intensive sector
θ_2	.49	Capital share in capital-intensive sector
ϖ	.61	Share of labor-intensive good
β	.96	Discount factor
δ	.05	Depreciation rate
σ	1	Curvature parameter in utility function
γ	.96	CES parameter in the production of good 2
$g(E)$	1.27%	Labor productivity growth rate

[19] Table 1 is based on Hopenhayn and Neumeyer (2004). Y/L = capital per capita; K/Y = physical capital-output ratio; TFP = total factor productivity. TFP is calculated using a production function of the type $Y = AK^{\alpha}L^{1-\alpha}$, with $\alpha = .3$.

Table 3
Growth Rates Implied by Model

	Trade Share = 53.7%			**Trade Share = 50.3%**			**Trade Share = 46.9%**			**Trade Share = 0.0%**		
	Y/L	*K/Y*	*TFP*	*Y/L*	*K/Y*	*TFP*	*Y/L*	*K/Y*	*TFP*	*Y/L*	*K/Y*	*TFP*
N=.01	1.25	1.34	0.47	1.27	1.43	0.46	1.29	1.50	0.46	1.52	2.23	0.40
N=.02	1.32	1.35	0.52	1.34	1.43	0.51	1.36	1.50	0.50	1.59	2.23	0.44
N=.05	1.40	1.34	0.58	1.42	1.42	0.57	1.44	1.50	0.56	1.67	2.23	0.50
N=.09	1.45	1.33	0.62	1.47	1.41	0.61	1.49	1.49	0.60	1.73	2.23	0.54
Data	1.33	1.39	0.51									

Figure 1
Latin American GDP per capita relative to U.S.

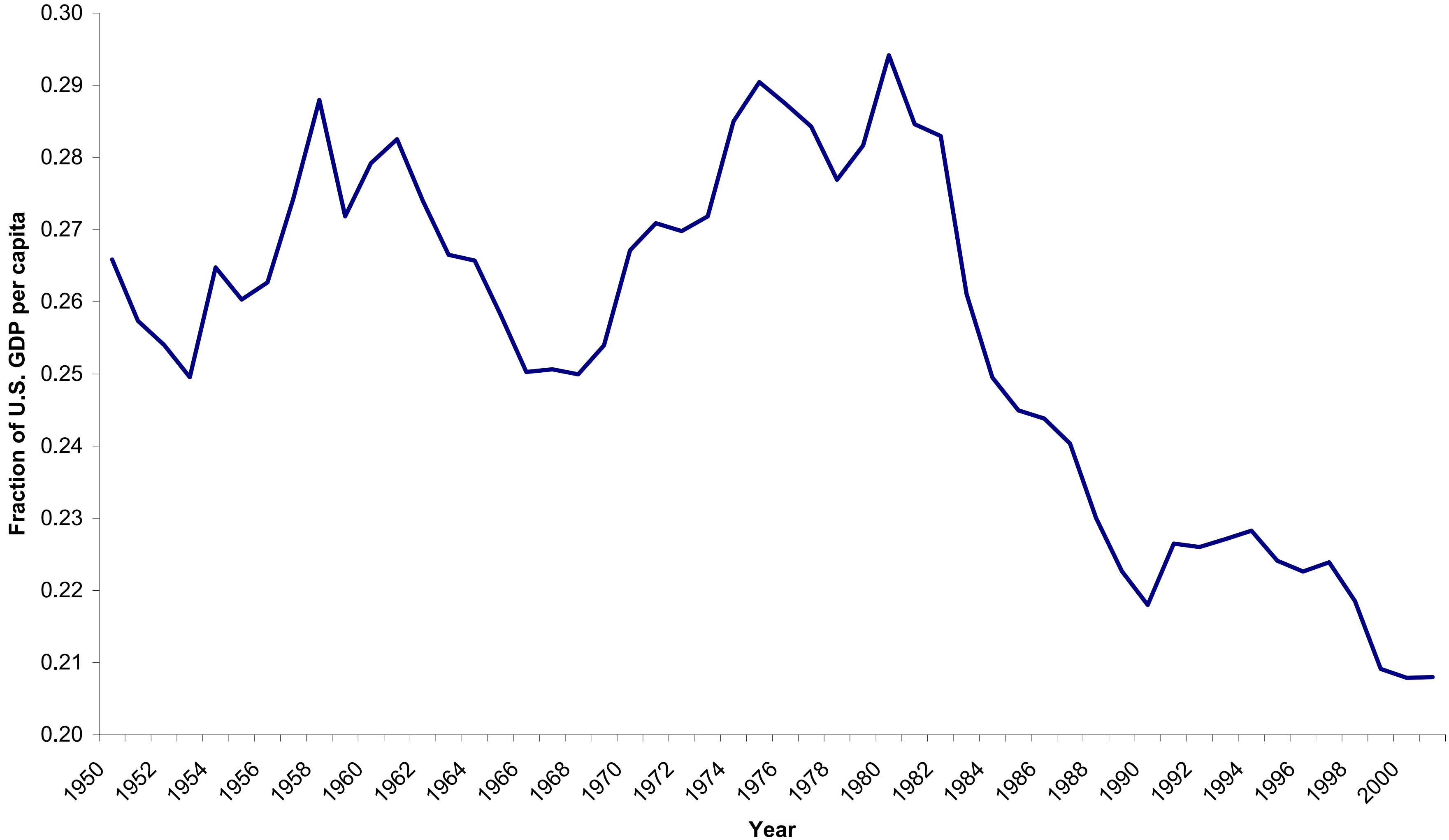

Figure 2
GDP per capita relative to U.S.

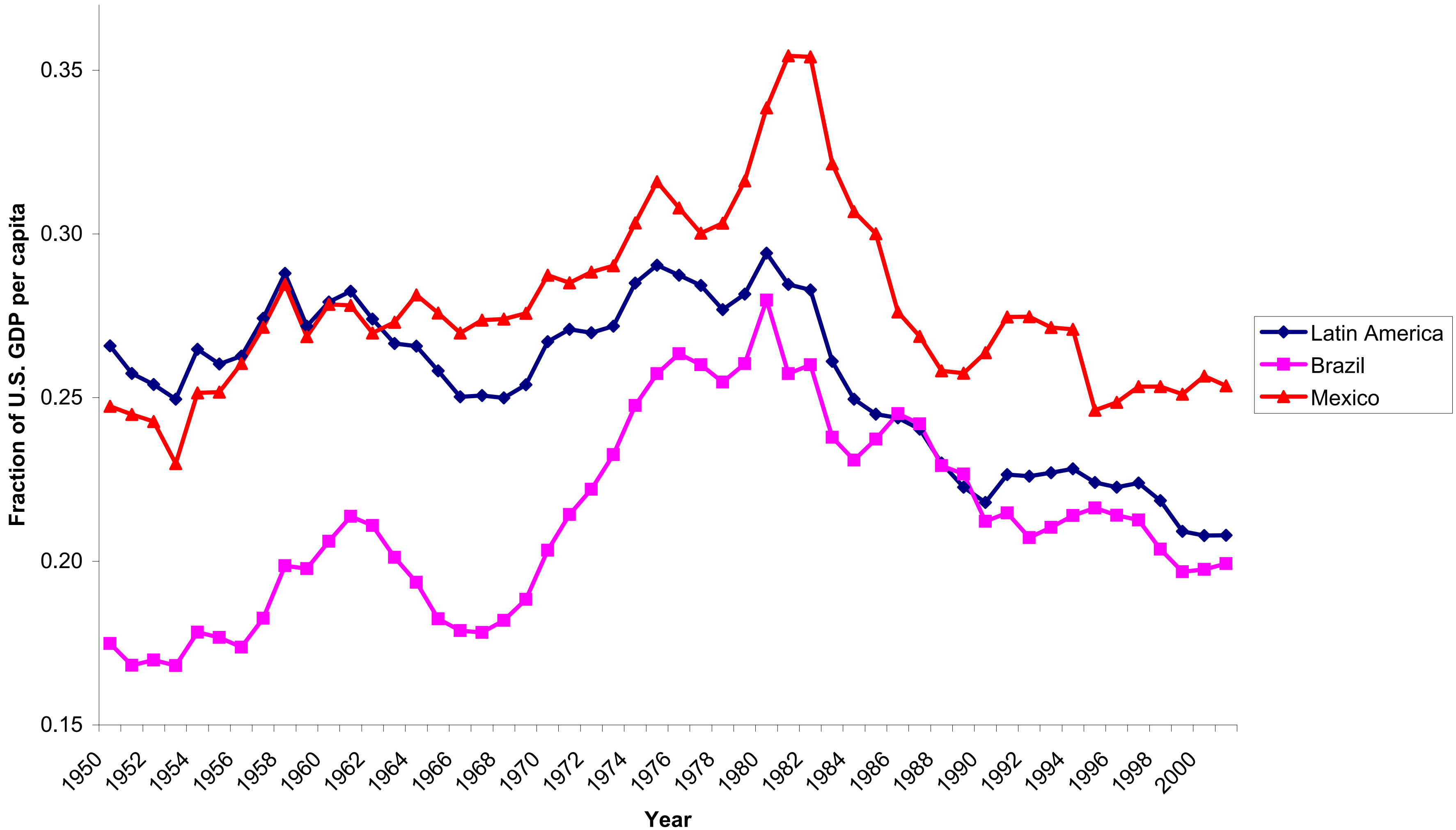

Figure 3: Transition Paths