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Industrial structure and financial capital flows

Working paper

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Abstract

Commodity trade and financial asset trade are both integral parts of globalization, yet little has been studied on their *interplay.* In a framework that integrates these two paradigms of trade, a new force driving international capital flows emerges: capital tends to flow towards countries that become more specialized in capital-intensive industries (a composition effect). This force competes with the standard, "convergence force" which channels capital towards the location where it is more scarce, in response shocks such as globalization, country-specific labor force or labor-technology shock shocks. If the composition effect dominates, capital flows away from the country hit by a positive shock—"a flow reversal"—and asset prices rise *globally* rather than locally. Two implications arise: rich countries' current account deficits may be a consequence of their shifting towards capital-intensive industries; young and fast growing developing countries may help sustain asset prices in an aging industrialized world. Predictions of the current account and specialization patterns are shown to be consistent with the data.

JEL Classification: **F21, F32, F41**

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1 Introduction

Commodity trade and financial capital flows have both played primary roles in the process of globalization. They are often termed as "the two engines of integration". Until now, little has been studied on how they interact. The conventional separation of models of international macroeconomics and trade theory ignores the impact of macroeconomic dynamics on the structure of trade and the aggregate feedback effects of trade patterns. This paper demonstrates that this interaction can become crucial in determining the global allocation of financial capital and the behavior of asset prices, shedding new light on widely-debated issues of global imbalances.

The main purpose of this paper is to develop a framework that integrates trade and financial capital flows, allowing for their interplay. With only basic ingredients, it derives new and often surprising results on how the global equilibrium responds to a variety of shocks and structural changes. In contrast to standard frameworks, a permanent labor-force or labor productivity boom in a country can induce a capital *outflow* from that country. Trade and financial liberalization can cause capital to flow from developing countries to advanced economies. The underlying mechanism hinges on a new force driving international capital flows: financial capital tends to flow towards economies that become more specialized in capital-intensive sectors (a composition effect). Simultaneously present is the standard, "convergence effect" which channels capital towards the location where the effective capital-labor ratio is lower. These two forces can become competing, and the direction of capital flows depends on which of the two effects dominates.

Two salient international developments of the past few decades have been globalization and the rapid labor force and labor productivity growth in emerging markets.[1] The implication of these changes, as predicted by the standard international-macroeconomic framework, is that South should be net importers of capital because of the higher investment opportunities it offers. Yet patterns in the data show exactly the opposite.

The implicit assumption, however, is that countries cannot engage in intra-temporal, commodity trade but only in intertemporal trade. This assumption becomes untenable when global forces such as those of the recent decades fundamentally alter a country's comparative advantage, and consequently, its structure of trade.[2] How does the change in specialization patterns in turn affect capital flows? An integrated framework which permits this very interaction can make markedly different predictions on capital flows from the standard model. A country which becomes relatively

[1] Freeman (2004) estimates that higher population growth in developing countries, and the integration of China, India, and ex-Soviet bloc increased the labor force in developing countries from 680 million workers in 1990 (before the integration of these countries) to 2.23 billion workers in 2000, of which these countries contributed 1.38 billion. This is referred to as the "Great Doubling" of the world labor force. Herd and Dougherty (2007) estimates that India's labor productivity grew by 4.36% over the period 1990-99, and 3.76% over 2000-05. In China, labor productivity grew by 8.66% over 1990-99, and 7.67% over 1999-2005.

[2] Further evidence is provided by Romalis (2004), which finds that countries tend to capture larger shares of world production and trade of commodities that require more intensive use of their abundant factors, and that countries that rapidly accumulate a factor see their production and export structures systematically shift towards industries that intensively use that factor. Discussions on why earlier works failed to find factor content of trade can be found in the works of Donald R. Davis et al.(1997), Davis and David E. Weinstein (2001a), and Alexander Wolfson (1999).

capital abundant,[3] and subsequently shifts resources from labor-intensive industries to capital-intensive industries, sees a rise in the *share* of capital-intensive goods in total domestic output and hence a rise in its investment share of output. The other country, which has become more labor-intensive, sees the opposite. So, while on the one hand, the standard, "convergence" force exerts its impact by drawing capital away from industrialized 'North' to emerging 'South' (where the capital-labor ratio is lower), this force is offset by the "composition" effect, which raises North's demand for capital and tends to draw capital towards North. If sectors are sufficiently different so that specialization patterns are pronounced enough, the composition effect dominates, causing a "reverse capital flow"(from South to North); investment comoves across countries, and asset prices rise globally rather than just locally in South. The prediction, thus, of the emerging periphery running a current account surplus and the industrialized core running a deficit is more consistent with the data than that of the standard model in which the "convergence" effect is the only impetus to capital flows and predicts just the opposite.

The framework developed in this paper is a stochastic, two country, overlapping generations model with production and capital accumulation, based on the closed-economy, one-good framework in Abel (2003).[4] I incorporate multiple sectors that differ in factor intensity to capture factor-endowment trade and allow for financial capital to flow across borders. The key difference between this model and a dynamic Heckshers-Ohlin model is the existence of capital adjustment costs, which endogenously determine the price of capital, and also serve to pin down the capital stock in a world of factor price equalization.[5] The framework is analytically tractable despite the numerous features that are embedded in this model. Semi-closed form or full closed-form solutions obtained in different cases make transparent the underlying mechanisms that are key to understanding the new results.

In this integrated framework, the standard neoclassical case becomes only one of two special cases. When there is a single sector, or when there are multiple sectors but feature no differences in factor intensities, only the convergence effect is present. A second special case, in which the most labor-intensive sector uses only labor as an input to production, isolates the composition effect and illustrates a scenario in which factor price equalization leads investment and asset prices to always comove across countries. The more general case is the one in which the convergence effect and the composition effect coexist and primitive parameters determine the relative strength of the two. The last two cases are analyzed separately and brought into sharp contrast with the first.

[3] The notion of 'capital abundance' still exists despite the fact that capital is internationally mobile. Here, since capital stock is fixed for one period, a labor force increase in one country causes its aggregate capital-labor ratio to fall.

[4] Abel (2003) develops a closed-economy, one-sector overlapping-generations model with capital adjustment costs to analyze the effect of a baby boom on stock prices and capital accumulation.

[5] In a Hecksher-Ohlin world with factor price equalization, capital earns the same returns everywhere and can be located anywhere. One conventional way to pin down the capital stock at the country level is to impose balanced trade (that capital needs to stay within borders). In this case, North's increase in the demand for capital must be met entirely domestically, through sectoral reallocation and savings. But rather than imposing the unrealistic assumption of financial autarky, another way to pin down the path of capital while allowing for both trade and financial openness is to introduce adjustment costs to capital, which temporarily breaks FPE. Further discussions on adjustment costs can be found in Section 4.3.

The framework can be easily extended and provides a rich setting for analyzing a host of issues. One important prediction is that even if two countries have the *same* returns to capital prior to opening up their economies, net capital flows are not necessarily precluded once they integrate. A rich country which features a higher total factor productivity, and therefore a higher capital-labor ratio, exports capital-intensive goods when opening up to trade. Insofar as countries' industrial structures change, the composition effect causes rich countries to experience a net capital *inflow*. Further, the sequencing of trade and financial liberalization have different implications for developing countries. While simultaneous liberalization may lead to a capital outflow in South, and an asset price drop, trade liberalization without financial liberalization will prevent such an outflow and lead to an asset price boom.

Beyond its predictions for global imbalances, the framework can also shed light on the widely-debated "asset meltdown hypothesis". While some believe that the "age wave" hitting industrialized countries will precipitate a large drop in asset prices as post-war baby boomers start selling assets for retirement consumption to a smaller young cohort, the predictions of the framework suggest that the fast-growing and young developing countries can potentially emerge as a remedy. Higher demand for industrialized countries' assets from developing countries, as industrial countries become more specialized in capital-intensive sectors, will help sustain their asset prices despite the imminent reduction of their labor force. Yet, allowing for the trade channel of adjustment is key.

The closest framework to ours is the one-good or two-good stochastic growth models of large open economies (Backus, Kehoe and Kydland (1992), (1994)), from which the key point of departure is the assumption of factor-intensity differences across sectors, intended to capture factor-endowment trade. The overlapping generations structure featured in the model is analytically convenient although not essential.[6]

In spirit, this paper is closer to a few recent papers that also highlight the interaction between trade and capital flows, such as Antrás and Caballero (2007), Ghironi and Melitz (2005), Cuñat and Maffezzoli (2004), and Ju and Wei (2006).[7] The main point of this paper, in contrast to the others, is that specialization patterns alone can alter the nature of financial flows.[8]

Finally, on explaining global imbalances, in particular the net flow of capital from South to North, this paper proposes an alternative view highlighting the importance of trade and specializa-

[6]A technical appendix showing similar results in a representative-agent model is available upon request.

[7]Cuñat and Maffezzoli (2004) examine the business cycle properties generated by a multi-sector stochastic two country growth model and show that its predictions of the trade balance and terms of trade are more consistent with empirical facts than in the one-sector model. This paper differs from theirs both in terms of the formalization of the model and in terms of purpose. In this model, closed-form and semi-closed form solutions are obtainable, explicitly demonstrating the countervailing forces of the convergence effect and the composition effect in shaping international capital flows and asset prices. This paper also focuses on shocks that change countries' comparative advantage, and links it to current debates on global imbalances. Ju and Wei (2006) highlights the interaction between labor market rigidities and trade as an impetus to capital flows, while Antrás and Caballero (2007) highlight the interaction between financial heterogeneity and trade. In terms of its formalization, this framework differs from both papers in that the present setting is a stochastic general-equilibrium global model that jointly determines and quantifies the full path of capital, asset prices, and global imbalances.

[8]There are many other two-sector, two-country models which feature factor-proportions type trade, but assume that capital cannot flow across countries. Examples include Beaudry and Collard (2004), Ventura (1997), Atkeson and Kehoe (2000), Mundell (1957), Mussa (1978), and Neary (1978), among others.

tion, in contrast to others works, such as Caballero, Farhi, and Gourinchas (2008) and Mendoza, Quadrini, and Rios-Rull (2007), that put financial-market heterogeneity between the two regions at center stage.

The rest of the paper is organized as follows. The multiple-sector framework is described in Section 2. A special case that isolates the composition effect and gives rise to a closed-form solution characterizing the evolution of capital and the price of capital is presented in Section 3. Section 4 presents numerical results of the general case in which the composition effect and the convergence effect coexist, and discusses the conditions under which the composition effect dominates. Additional implications of the framework are taken up in Section 5. Section 6 provides some supportive empirical evidence on the relationship between specialization and the current account deficit, and Section 7 concludes.

2 The Model Description

Consider a world with two countries, Home (h) and Foreign (f), each characterized by an overlapping generations economy in which consumers live for two periods. The countries produce the same types of intermediate goods $i = 1.., m$, which are traded freely and costlessly, and are conveniently indexed by their capital intensity, $\alpha_1 < \alpha_2 ... < \alpha_i ... < \alpha_m$. Intermediate goods are combined to produce a final good, which is used for consumption and investment. Preferences and production technologies are assumed to have the same structure and parameter values across countries. However, the technologies differ in two aspects: in each country, the labor input consists only of domestic labor, and intermediate-goods-producing firms are subject to country-specific productivity and labor force shocks. Henceforward, j denotes countries and i denotes sectors.

2.1 Demographics, preferences and technologies

In the beginning of period t, N_t^j young workers arrive in country $j = h, f$. They inelastically supply one unit of labor in youth, and none when old in the next period. The measure of young consumers, N_t^j, is assumed to follow a geometric random walk:

$$lnN_t^j = lnN_{t-1}^j + \epsilon_{Nt}^j$$

where ϵ_{Nt} represents a random labor force growth rate which is *iid.* A high ϵ_{Nt}^j represents a labor force boom.

Each consumer in country j admits preferences of the form

$$u(c_t^j) = \frac{c_t^{j\,1-\rho}}{1-\rho}$$

where c_t^j denotes the consumption by a consumer in j. Intermediate goods are aggregated by a constant elasticity of substitution, θ, to form a unit of consumption good or a unit of investment good. For any consumer in j,

$$c_t^j = \left[\sum_{i=1}^{m} \gamma_i^{\frac{1}{\theta}} {c_{it}^j}^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}$$

where $\sum_i \gamma_i = 1$. c_{it}^j denotes the consumption demand of a j consumer for good i.

Perfectly-competitive firms use domestic labor, supplied by the young consumers, and capital to produce an intermediate good i in country j:

$$Y_{it}^j = \left(K_{i,t}^j \right)^{\alpha_i} \left(A_t^j N_{it}^j \right)^{1-\alpha_i} \tag{1}$$

where $0 < \alpha_i < 1$ for any i. K_{it}^j is j's aggregate capital stock in sector i, and N_{it}^j is its aggregate input of labor employed in sector i, at t. A_t^j represents the country-specific labor productivity, and follows

$$\ln A_t^j = \ln A_{t-1}^j + \epsilon_{At}^j$$

where the growth rate of labor productivity, ϵ_{At}^j, is *iid* and is independent of ϵ_{Nt}^j, a random labor force growth rate.

The capital used in producing good i is augmented by investment goods, I_{it}. The law of motion for capital stock in i is given by $K_{i,t+1}^j = G(K_{it}^j, I_{it}^j)$ where I_{it}^j is the aggregate investment in sector i in country j at t. $G(K_{it}^j, I_{it}^j)$ is linearly homogeneous in K_{it}^j and I_{it}^j, and there are convex adjustment costs, which satisfy $\frac{\partial^2 G^j}{\partial^2 I_{it}^j} < 0$. Following Abel (2003), I take a log-linear specification of $G(K_{it}^j, I_{it}^j)$:

$$K_{i,t+1}^j = a \left(I_{it}^j \right)^{\phi} \left(K_{it}^j \right)^{1-\phi}, \tag{2}$$

where $0 \leqslant \phi \leqslant 1$.[9] The purpose of this assumption is to derive analytical solutions for the equilibrium price and quantity of capital. [10]

[9] As shown in Abel (2003), if $\phi = 1$ and $a = 1$, the capital accumulation equation becomes the one in the neoclassical growth model with complete depreciation in each period. If $\phi = 0$ and $a = 1$, this becomes the case of the Lucas-tree asset pricing model in which the capital stock is constant.

[10] In comparing the log-linear model with a standard capital adjustment technology:

$$K_{i,t+1} = (1-\delta)K_{it} + I_{it} - \frac{b}{2}\left(\frac{I_{it}}{K_{it}} - \delta\right)^2 K_{it},$$

it can be shown that the two models are equivalent up to the second order if and only if $a = \phi^{-\phi}$, $\delta = \phi$, $b = \frac{1-\phi}{\phi}$.

2.2 Consumers

In the first period, a young consumer in the Home country inelastically supplies one unit of labor and earns the competitive wage w_t^h, which is used for consumption $c_t^{y,h}$, for purchasing state-contingent securities, $b_{t+1}^h(s)$, at the corresponding state-contingent price $Q_t(s)$, and for purchasing capital. Let $k_{i,t+1}^{h,j}$ be the amount of capital that a young consumer in Home buys in sector i from country j, at a price q_{it}^j per unit, at the end of period t to be carried into period $t+1$. A Home young consumer's budget constraint is therefore:

$$c_t^{y,h} = w_t^h - \sum_{j=h,f} \sum_{i=1}^{m} q_{it}^j k_{i,t+1}^{h,j} - \sum_s Q_t(s) b_{t+1}^h(s). \tag{3}$$

Assume that consumers do not have bequest motives, and therefore consume all available resources when they are old. The budget constraint for a Home, old consumer is

$$c_{t+1}^{o,h}(s) = \sum_{j=h,f} \sum_{i=1}^{m} R_{i,t+1}^j(s) q_{it}^j k_{i,t+1}^{h,j} + b_{t+1}^h(s) \tag{4}$$

where $R_{i,t+1}^j$ is the rate of return on capital earned in sector i in country j.

A consumer in Home maximizes its lifetime utility of consumption

$$u(c_t^{y,h}) + \beta \sum_s \pi(s) u\left(c_{t+1}^{o,h}(s)\right)$$

where β denotes the discount factor, $\pi(s)$ is the probability of state s occurring in the following period, $c_t^{y,j}$ denotes the consumption of a young consumer in j in period t, and $c_{t+1}^{o,j}$ denotes the consumption by an old consumer in j in period $t+1$.[11] A similar set of equations hold for consumers in Foreign.

2.3 Firms

Representative firms in sector i and country j are perfectly competitive, and choose inputs K_{it}^j, N_{it}^j, and investment I_{it}^j to solve

$$\max \sum_{t=0}^{\infty} \sum_{s^t} Q(s^t) \left(p_{it} Y_{it}^j - w_{it}^j N_{it}^j - I_{it}^j\right)$$

subject to Eq. 1 and Eq. 2, where p_{it} is the international price of good i, following the law of one price in the freely-traded intermediate goods. w_{it}^j is the real wage paid in sector i in country j at t.

[11] The first order condition of the consumer's problem is $Q_t(s) = \beta\pi(s)u_c(c_{t+1}^{o,j}(s))/u_c(c_t^{y,j})$. The Euler equation associated with any asset i in any country j is $u_c(c_t^{y,j}) = \beta E_t[u_c(c_{t+1}^{o,j})R_{i,t+1}^j]$ where u_{ct} denotes the derivative of the utility function with respect to consumption.

The price of capital, q_{it}^j, is given by the first order condition for I_{it}^j. It is the price, in terms of the consumption good, of acquiring one unit of capital in sector i and country j at the end of period t to be carried into the the next period. This price is the amount that I_{it}^j needs to be increased to augment $K_{i,t+1}^j$ by one unit, that is, $\left(\partial K_{i,t+1}^j / \partial I_{it}^j\right)^{-1}$. This implies that

$$q_{it}^j = \frac{1}{a\phi}\left(\frac{I_{it}^j}{K_{it}^j}\right)^{1-\phi}. \tag{5}$$

If $0 < \phi < 1$, then q_{it}^j is increasing in sector i's investment-capital ratio, I_{it}^j/K_{it}^j.

In a perfectly-competitive environment, factors are paid their marginal products. Capital in any sector i in any country j, is productive both in the intermediate goods technology and also in contributing to lowering adjustment costs next period. The total rate of return to capital is therefore the sum of capital's marginal product in the intermediate goods technology, multiplied by the price of the intermediate good, and its marginal contribution to lowering adjustment costs next period—discounted by the price at which a unit of capital was purchased last period, q_{it}^j. The first order condition with respect to $K_{i,t+1}^j$, for any i in j, in conjunction with the optimality conditions of the consumer's problem defines the rate of return to capital:[12]

$$R_{it}^j = \frac{\alpha_i \frac{p_{it} Y_{it}^j}{K_{it}^j} + \frac{1-\phi}{\phi}\frac{I_{it}^j}{K_{it}^j}}{q_{i,t-1}^j}. \tag{6}$$

Labor earns its marginal product. The wage rate per unit of labor is given by the first order condition with respect to N_{it}:

$$w_{it}^j = (1-\alpha_i) p_{it} \frac{Y_{it}^j}{N_{it}^j}. \tag{7}$$

This equation determines patterns of specialization. Since capital is fixed for one period, a labor force/labor technology increase in Foreign would imply a greater expansion of labor-intensive sectors than capital-intensive sectors, in order to equalize wages across sectors.

[12] The first order condition of the firm's problem with respect to $K_{i,t+1}^j$ is

$$1 = \sum_{s^t} Q(s^t)\left(p_{i,t+1}\frac{dY_{i,t+1}^j}{dK_{it}^j} + \frac{dI_{i,t+1}^j}{dK_{i,t+1}^j}\right) / \left(\frac{dI_{it}^j}{dK_{i,t+1}^j}\right),$$

which, combined with the first order conditions from the consumer's problem given in Footnote 11 yields Eq. 6.

2.4 Market Clearing

The intermediate goods markets clear when global demand of any good i equals its global supply:

$$Y_{it}^g = \sum_{j=h,f} c_{it}^j + \sum_{j=h,f} \sum_{k=1}^{m} I_{ki,t}^j, \tag{8}$$

for all $i = 1..,m$, and where $Y_{it}^g \equiv \sum_{j=h,f} Y_{it}^j$. Superscripts g will henceforward represent global variables. c_t^j is j's consumption demand of good i, and $I_{ki,t}^j$ is its investment demand of good i in each sector k.[13]

Domestic labor markets clear when

$$\sum_{i=1}^{m} N_{it}^j = N_t^j$$

for all j.

The law of one price implies that consumers in each country face the same international prices p_i, for all i, which, in conjunction to the assumption of identical preferences across countries, imply that both region's aggregate price index is equalized. The price index that corresponds to CES preferences is

$$P = \left[\sum_{i=1}^{m} \gamma_i p_i^{1-\theta} \right]^{\frac{1}{1-\theta}}. \tag{9}$$

P is normalized to 1. The relative price of any two intermediate goods i and k is determined by the relative world supply of the two goods:[14]

$$\frac{p_{it}}{p_{kt}} = \left(\frac{\gamma_i}{\gamma_k} \frac{Y_{kt}^g}{Y_{it}^g} \right)^{\frac{1}{\theta}}. \tag{10}$$

2.5 Equilibrium

The competitive equilibrium of the world economy consists of a sequence of prices $[p_{it}, R_{it}^j, w_{it}^j]$, and employment and capital allocations $[N_{it}^j, K_{i,t+1}^j]$ such that consumers and firms in j optimize and markets clear. In what follows, a semi-closed form solution of the equilibrium is permissible relying on three simplifying assumptions, summarized below:

Assumption 1 *Preferences are Cobb-Douglas* ($\theta = 1$)

Assumption 2 *Consumers have logarithmic preferences* ($\rho = 1$)

[13]The demands for consumption and investment goods implied by a CES demand function are $c_i^j = \gamma(\frac{p_i}{P})^{-1/\theta} C^j$ and $I_{ki}^j = \gamma(\frac{p_i}{P})^{-1/\theta} I_k^j$, for all t, where P is the domestic price index.

[14]Using consumption and investment demands of any i and k, plugging into Eq. 8 yields the relative price of i and k.

Assumption 3 *The capital-adjustment technology is log-linear (Eq. 2)*

Assumptions 2 simplifies the consumption/saving problem and implies that private saving does not depend on the real rate of return. Severing the link in which the rate of return affects capital accumulation allows for analytical expressions for optimal consumption and optimal investment in each country. When assumptions of 1 and 3 are combined with assumption 2, the global aggregate investment-output ratio and the global industry-level investment-output ratio are both constants. Relying on these results, the evolution of the capital stock in each sector i in any country j, is characterized by one key variable—the present discounted value of the expected future share of good i produced domestically. Without these assumptions, neither the semi-closed form solution in the general case nor the full closed-form solution in the special case, presented in Section 3, is possible. In later sections all of these assumptions are relaxed, and it is shown that none are crucial for the main results of interest.

Assuming that consumers have logarithmic utility, the optimal consumption of a young consumer in period t is a constant fraction of the present value of lifetime resources, which, in this setting, is simply the wage income earned by the young. The aggregate consumption of the young cohort, $C_t^{y,j} \equiv N_t^j c_t^{y,j}$, is [15]

$$C_t^{y,j} = \frac{1}{1+\beta} W_t^j, \tag{11}$$

where $W_t^j \equiv \sum_i w_{it}^j N_{it}^j$ denotes the aggregate wage in j.

At the world level, consumption of the young is a constant fraction of labor income, which, by the assumption of Cobb-Douglas preferences (Assumption 1), occupies a share $s_l = 1 - \sum_i \alpha_i \gamma_i$ of world GDP, denoted as Y_t^g, where $Y_t^g \equiv \sum_i p_i Y_i^g$. It follows that that the global investment-GDP ratio is a constant:[16]

$$\frac{I_t^g}{Y_t^g} = \psi s_l \tag{12}$$

where $\psi = \frac{\phi\beta}{1+\beta}$ and $I_t^g \equiv \sum_j \sum_{i=1}^m I_t^j$.

To determine global investment at the industry level, let $I_{it}^g = \mu_{it} I_t^g$ so that μ_{it} represents the share of industry i's investment in aggregate investment, and $I_{it}^h = \eta_{it} I_{it}^g$ so that η_{it} represents Home's share of global investment in sector i. Investment in any sector i, in any country h, f, can

[15] Substituting Eq. 4 into Eq. 3 and aggregating, and using Eq. 6, and the first order conditions of the consumer's problem yields Eq. 11.

[16] Aggregating Eq. 3 across countries gives $C_t^{y,g} = W_t^g - \sum_{i=1}^m q_{it}^h K_{i,t+1}^h - \sum_{i=1}^m q_{it}^f K_{i,t+1}^f$, where $K_{i,t+1}^j = k_{i,t+1}^{h,j} N_{t+1}^h + k_{i,t+1}^{f,j} N_{t+1}^f$ is the total amount of financial capital claimed by the world on j. Then, setting the expression for optimal aggregate consumption of the young, Eq. 11, to the left hand side of the above equation, while using the fact that $q_{it}^j K_{i,t+1}^j = I_{it}^j/\phi$ from Eq. 5, gives Eq. 12.

thus be written as

$$I_{it}^h = \mu_{it}\eta_{it}\psi s_l Y_t^g \tag{13}$$

$$I_{it}^f = \mu_{it}(1-\eta_{it})\psi s_l Y_t^g. \tag{14}$$

It can be shown that

Lemma 1

$$\mu_{it} = \frac{\alpha_i\gamma_i}{\sum_{k=1}^m \alpha_k\gamma_k} \qquad \forall t \tag{15}$$

The higher the capital share in industry i, α_i, or the greater the preference for good i, γ_i, relative to the weighted average capital share $\sum_k \alpha_k\gamma_k$, the larger the share of global investment occupied by industry i. Here, the reason that industry-specific shocks do not come into play in determining industry-level investment is that the assumption of Cobb-Douglas preferences (Assumption 1) implies that any movements in relative prices are offset by changes in output, so that nominal output remains unchanged. This eliminates the need for resource allocation across industries.

The key variable is η_{it}, the *country-share* of investment in sector i. Deriving the full solution to the economy's equilibrium amounts to solving for η_{it}, for all i. This share can be written explicitly as,[17]

$$\eta_{it} = (1-\lambda)\sum_{k=0}^{\infty}\lambda^k E_t\left(\frac{Y_{i,t+k+1}^h}{Y_{i,t+k+1}^g}\right), \tag{16}$$

where $\lambda = \frac{\frac{\beta(1-\phi)}{1+\beta}}{\frac{1-s_l}{s_l}+\frac{\beta(1-\phi)}{1+\beta}} < 1$. I_{it}^h is thus determined by Home's expected, present-discounted value of the share of its future output in good i, the discount factor λ depending partly on the size of adjustment costs. In the absence of adjustment costs, $\phi = 1$, future output after date $t+1$ does not matter, and investment in sector i is determined by its expected share of output of good i at $t+1$. The higher the adjustment cost (lower ϕ), the higher the discount factor λ ($\lambda'(\phi) < 0$), and the greater the desire to smooth investment over time.

Finally, Equations 13, 14, 15, and 16, combined with the evolution of the capital stock, in $j = h, f$:

$$K_{i,t+1}^j = a\left(I_{it}^j\right)^{\phi}\left(K_{it}^j\right)^{1-\phi}$$

together pin down a unique path of capital, and yield the full solution to the equilibrium of this economy.

[17]Using the Euler equation, $u'(c_t) = E_t[\beta u'(c_{t+1})R_{it+1}]$, and the risk sharing condition, $\frac{c_t^y}{c_{t+1}^o} = \frac{c_t^{y,g}}{c_{t+1}^{o,g}}$, while plugging in optimal consumption of the young, from Eq. 11, and the old, given in the Appendix C.2, yields $\eta_{it} = (1-\lambda) + \lambda E_t[\frac{Y_{i,t+1}^h}{Y_{i,t+1}^g}]$ where $\lambda = \frac{\frac{\beta(1-\phi)}{1+\beta}}{\frac{1-s_l}{s_l}+\frac{\beta(1-\phi)}{1+\beta}}$. Iterating forward yields Eq. 16.

2.6 An Illustration of the Composition Effect

To see the effect of composition (of production) on a country's investment demand, one can write aggregate investment at Home as $I_t^h = \eta_t \psi s_l Y_t^g$, from Eq. 13, where

$$\eta_t \equiv \sum_{i=1}^{m} \mu_i \eta_{it} \tag{17}$$

represents its weighted average share of global production, with the weights $\mu_i = \frac{\alpha_i \gamma_i}{\sum_k \alpha_k \gamma_k}$ increasing in α_i and γ_i, and η_i is Home's expected, present-discounted value of its share of global production of each individual good i, from Eq. 16. This equations tells us that *investment depends on the composition of production*. In determining the share of a country's investment in global output, more weight is put on the capital-intensive sectors (which expand in Home), and less weight is put on the labor-intensive sectors (which contract in Home).[18] By contrast, in the one-sector-adjustment cost model, η_t is Home's expected, present-discounted value of its share of the only good produced globally (Eq. 16 without subscripts i). It says that a positive, permanent, technology or labor force shock in Foreign, which effectively increases Foreign's share of global production, causes a large drop in η_t, and consequently Home's share of investment.

Whereas investment falls at Home in a one-sector model, in response to a positive shock in Foreign, it can rise in a multiple-sector model. A numerical example of the one sector versus the two-sector case illustrates this point more concretely. Suppose that consumers place equal weight on both goods in the two-sector case, that is, $\gamma_i = 0.5$, and suppose that the capital shares in the labor-intensive and capital-intensive sectors are $\alpha^l = 0.1$ and $\alpha^c = 0.5$. Consider a positive 20% labor force shock in Foreign at t. In a one-sector case, the share of Home's expected global production falls by -11.13%, and investment by -1.13% (Table 1), on impact. In the two-sector case, Home's share of expected production of any of the two goods falls uniformly (η_i is negative for all i), for the reason that Foreign's relative size in the world has increased. But this share falls by much more for the labor-intensive sector than for the capital-intensive sector (-12.46% vs -1.4%). Thus, the weighted-average, expected share of future output falls significantly less in the two-sector case compared to the one-sector case (-3.24% vs. -11.13%), making the overall change in investment at Home positive rather than negative (3.62% vs -1.13%). In a multiple-sector world, the composition of production in a country matters for its investment demand.[19]

[18] Note that α_i and γ_i are not observationally equivalent here, although they appear in the same way in the weights μ_i. The reason is that η_{it}, the share of expected future production in sector i depends on α_i, the capital intensity of an industry. In response to a labor force shock in Foreign, more capital-intensive sectors (sectors with high α_i) expand, and more labor-intensive sectors contract.

[19] Notice that it is the compositional shifts in production, and not adjustment costs, that cause investment to rise at Home. The story is not one of investment smoothing, as is clear from the one sector case, which features adjustment costs, since Foreign still needs to import capital in the short run to finance its investment needs.

Table 1: Impact Effect of Unexpected Labor Force Boom on Investment

Investment in Home		
	One Sector	**Two Sectors**
	$\alpha = 0.3$	$\alpha^l = 0.1$, $\alpha^c = 0.5$
$\hat{\eta}_i$		-12.46%, -1.4%
$\hat{\eta}$	-11.13%	-3.24%
$\hat{Y}^g$	$+10\%$	$+6.86\%$
$\hat{I}^h$	-1.13%	$+3.62\%$

Response of Home investment to an unexpected 20% labor force boom in Foreign; $\gamma_i = 0.5$; $\hat{I}^h_t = \hat{\eta}_t + \hat{Y}^g_t$.

2.7 The Initial Steady State

Assuming that initial capital-labor ratios across countries are not too different so that economies are within the cone of diversification, countries diversify in production, and conditional FPE (on technology) holds in the deterministic steady state. The trading equilibrium yields the same resource allocations and prices as the world's integrated equilibrium, in which both goods and factors are perfectly mobile internationally. In equilibrium, a constant fraction of *world* resources is spent in each sector:[20]

$$\tilde{N}^g_i = \frac{(1-\alpha_i)\gamma_i}{s_l} \tilde{N}^g$$

and

$$K^g_i = \frac{\alpha_i \gamma_i}{s_k} K^g$$

where $\tilde{N}^g_i = \sum_j \tilde{N}^j_i$ represents effective world labor supply in sector i. In this equilibrium, there is a multiplicity of steady states, arising from the fact that an infinite number of allocations of capital across countries is consistent with conditional factor price equalization. However, the existence of adjustment costs pins down a unique path of capital, so that given initial conditions K^j_0/N^j_0, the transitional dynamics leads the system to a unique steady state.[21] In this economy, conditional FPE does not hold in the transition to the steady state, but is attained only in the long run.

3 The Composition Effect

This section presents a special case in which the standard "convergence effect" is shut off and the "composition effect" operates in isolation. In general, analytical solutions are not obtainable in two-country stochastic growth models, and analyses are generally restricted to numerical simulations. In this case, a closed-form solution for the price and quantity of capital arises, relying on the

[20]This result depends on Cobb-Douglas preferences (Assumption 1).

[21]A more detailed discussion can be found in Cuñat and Maffezzoli (2004), which also introduce adjustment costs to pin down the capital stock in a world of FPE. An alternative is to assume that the initial equilibrium is one of autarky (described in Appendix B), where capital stock at the country-level is pinned down and is unique.

additional assumption

Assumption 4 $\alpha_1 = 0$.

With this assumption, the wage in any region j (normalized by its TFP) is pinned down by the price of the most labor-intensive good, $w_t^j/A_t^j = p_{1t}$. Since intermediate goods' prices are equalized through trade, conditional wage equalization, $w_t^h/w_t^f = A_t^h/A_t^f$, holds in any period t and state s_t, despite stochastic shocks. It follows that

$$\tilde{k}_{it}^h = \tilde{k}_{it}^f \tag{18}$$

for all $i > 1$. $\tilde{k}_{it}^j = \frac{K_{it}^j}{A_t^j N_{it}^j}$ is the effective capital-labor ratio in sector i. Labor reallocation across sectors alone is sufficient to equalize effective-capital labor ratios in each sector, across countries.

Consider a high $\epsilon_{N,t}^f$ (labor force boom) or $\epsilon_{A,t}^f$ (productivity boom) in Foreign. In order to equalize wages across sectors, Foreign expands relatively more the labor-intensive sectors. The rise in the world supply of labor-intensive goods relative to that of capital-intensive goods puts downward pressure on the relative price of labor intensive goods. For what range of goods do prices fall or rise? It can be shown that

$$\hat{p_k} \leq 0 \quad \Leftrightarrow \quad \alpha_k \leq \sum_i \alpha_i \gamma_i$$

where $\hat{p_k}$ denotes the percentage change of the price of good k (proof in Appendix B). Prices rises for sectors with capital shares greater than the weighted-average capital share, the weights γ_i being the effective size of the sector.

In response to greater profitability of capital-intensive sectors, Home responds by drawing labor out of the first sector and reallocating it towards capital-intensive sectors. Domestic labor reallocation ensures that $\tilde{k}_i$, for all $i \neq 1$, is equalized across countries in every period.[22]

Proposition 1 *With Assumptions* $1-4$, $\eta_{it} = \frac{K_{i0}^h}{K_{i0}^g}$ *for all* t.

The share of Home's investment in any industry i, η_{it}, is a constant and is equal to its initial share of world capital in that sector.

Proof. To prove that $\eta_{it} = \frac{K_{i0}^h}{K_{i0}^g}$, guess that $\frac{K_{it}^h}{K_{it}^g} = \eta_{it}$, and show that $\eta_{it} = \eta_{i0}$ is a solution to a contraction mapping, consisting of Eq. 16 and the production technologies, Eq. 1 and 2. By the contraction mapping theorem, it is the unique solution. Appendix B provides details to the full proof. ■

The intuition of this result is that commodity trade (of goods with different factor intensities) brings about the equalization of sectoral capital-labor ratios across countries at all points in time,

[22] The implicit condition is that both countries produce all goods. Appendix B shows a sufficient condition for which all goods are produced by both countries. Intuitively, the size of sector 1 needs to be large enough and the shock small enough so that both countries are required to produce the good.

through industrial rearrangement. This ensures that the marginal product of capital from the production side, $\alpha_i p_i \tilde{k}_i^{j,\alpha_i - 1}$, which rises in *both* countries, is equalized at all times. Therefore, in investing the marginal unit of savings, Foreign allocates it to both countries, and in such a way that marginal adjustment costs paid in sector i and country j, proportional to $\frac{I_i^j}{K_i^j}$, are equalized. The standard convergence force that tends to equalize sectoral capital-labor ratios is effectively shut down, isolating the composition channel of adjustment. Investment ratio across regions in each sector will depend on their initial capital stock ratio in that sector, making this economy history dependent.

3.1 Aggregate Savings and Investment

Summing investment, given by Eq. 13, across sectors, and using Proposition 1, country j's aggregate investment at t becomes

$$I_t^j = \sum_i \mu_i \eta_{i0}^j \psi s_l Y_t^g, \tag{19}$$

where $\psi = \phi\beta/(1+\beta)$, $s_l = 1 - \sum_i \alpha_i \gamma_i$ and μ_i is given by Lemma 1. A high $\epsilon_{A,t}^j$ or $\epsilon_{N,t}^j$ which raises world GDP, raises investment globally, and in such a way that more investment is allocated to country j that has a higher initial, weighted-average capital-intensity, $\sum_i \mu_i \eta_{i0}^j$. In this special case with international trade linkages, investment comoves.

A graphical exposition offers some basic intuition to these results. Relying on the closed-form solution, one can write j's aggregate investment-to-output ratio at t as function of its relative, aggregate capital-labor ratio, denoted as $\kappa_t^j = \tilde{k}_t^j / \tilde{k}_t^g$, at t:[23]

$$\mathcal{I}(\kappa_t^j) = \frac{\psi s_l}{\frac{s_l}{\kappa_t^j} + 1}. \tag{20}$$

This analytical expression is key to understanding why a country which has become relatively more labor-intensive at t can become a net lender of capital. Greater comparative advantage in labor(lower κ_t) causes a greater specialization in labor-intensive goods. This raises the relative share of output allocated to wage income, and reduces the share of output allocated to investment. As in the top panel of Figure 1, the investment-to-output curve is upward sloping.

[23] $p_{it} Y_{it}^j$ can be expressed as $\gamma_i Y_t^g \frac{Y_{it}^j}{Y_{it}^g}$. Since $Y_{it}^j / Y_{it}^g = K_{it}^j / K_{it}^g = \tilde{N}_{it}^j / \tilde{N}_{it}^g = \eta_{i0}^j$, and domestic GDP $Y_t^j = \sum_i p_i Y_i^j = \sum_{i \neq 1} \gamma_i \eta_{i0}^j + \gamma_1 \frac{\tilde{N}_1^j}{N_1^g}$. Wage equalization across sectors in j, $(1-\alpha_i) p_{it} Y_{it}^j / N_{it}^j = A_t^j N_{1t}^j \; \forall\, i \neq 1$, implies $\tilde{N}_{it}^j = (1-\alpha_i)\gamma_i / \gamma_1 \eta_{i0}^j \tilde{N}_1^g$ where $i \neq 1$. Country j's domestic to world GDP can be expressed as $Y_t^j = \left(\frac{s_l}{\kappa_t^j} + 1 \right) \sum_i \mu_i \eta_{i0}^j Y_t^g$, which, combined with Eq. 19 yields Eq. 20, where $\mathcal{I}(\kappa_t^j) \equiv I_t^j / Y_t^j$.

Analogously, savings-to-output ratio in j can be written as

$$\mathcal{S}(\kappa_t^j) = \psi\left(1 - \frac{1}{\frac{s_l}{\kappa_t^j} + 1}\right). \tag{21}$$

Greater specialization in labor-intensive goods reduces the relative share of output allocated to wage income. Since savings derive from wage income in this model, the saving-to-output curve is downward sloping.

The $\mathcal{I}(\kappa_t^j)$ and $\mathcal{S}(\kappa_t^j)$ schedules intersect at the point where countries' capital-labor ratios are equalized–the point at which domestic savings is just enough to serve its domestic investment needs, and no net capital flows needs to occur between countries. A positive shock that reduces j's relative capital-labor ratio at t, leads to a compositional shift that causes its supply of savings to rise by more than its investment demand, the difference of which shows up as a current account surplus.

Similarly, one can graph the savings and investment curves in the one sector model. In this case, the investment-GDP curve is downward sloping, as drawn in the second panel of Figure 1. The reason is that a permanent labor force boom in Foreign that reduces its capital-labor ratio induces higher investment so that capital can scale up with labor. On the other hand, the savings rate is a constant, a result of assuming logarithmic utility and a Cobb-Douglas production function. In contrast to the multi-sector model, j moves into greater current account *deficit* as its capital-labor ratio falls.

These two figures depict the savings-investment relationship when the composition effect and the convergence effect are each respectively isolated. The striking difference is the slope of the investment demand curve, which is negative in the one-sector case but positive in the multi-sector case. In the general case, where both composition and convergence effects coexist, the investment-output curve lies somewhere in between—and becomes positively sloped when the composition effect is stronger and negatively sloped when the convergence effect is stronger. The main action comes from investment demand and not the supply of savings, the reason for which the OLG structure is non-essential. The condition for which one effect dominates the other is demonstrated in Section 4.3.

3.2 The Price and Quantity of Capital

The evolution of the effective, aggregate capital-labor ratio in region j is characterized by:

$$\tilde{k}_{t+1}^j = \Theta\left(\sum_i \mu_i \eta_{i0}^j\right)^{\phi s_l} e^{-(\epsilon_{N,t+1}^j + \epsilon_{A,t+1}^j)} \left(\frac{\tilde{N}_t^g}{\tilde{N}_t^j}\right)^{\phi s_l} (\tilde{k}_t^j)^{1-\phi s_l}, \tag{22}$$

where Θ is a constant.[24] This implies the following propositions:

Proposition 2 *(Path Dependence) The evolution of the $\tilde{k}_t^j$ depends on j's initial weighted-average*

[24] $\Theta = a(\psi s_l/s_k \prod \gamma_i^{\gamma_i}(\alpha_i\gamma_i)^{\alpha_i\gamma_i}[(1-\alpha_i)\gamma_i]^{1-\alpha_i\gamma_i})^{\phi}$

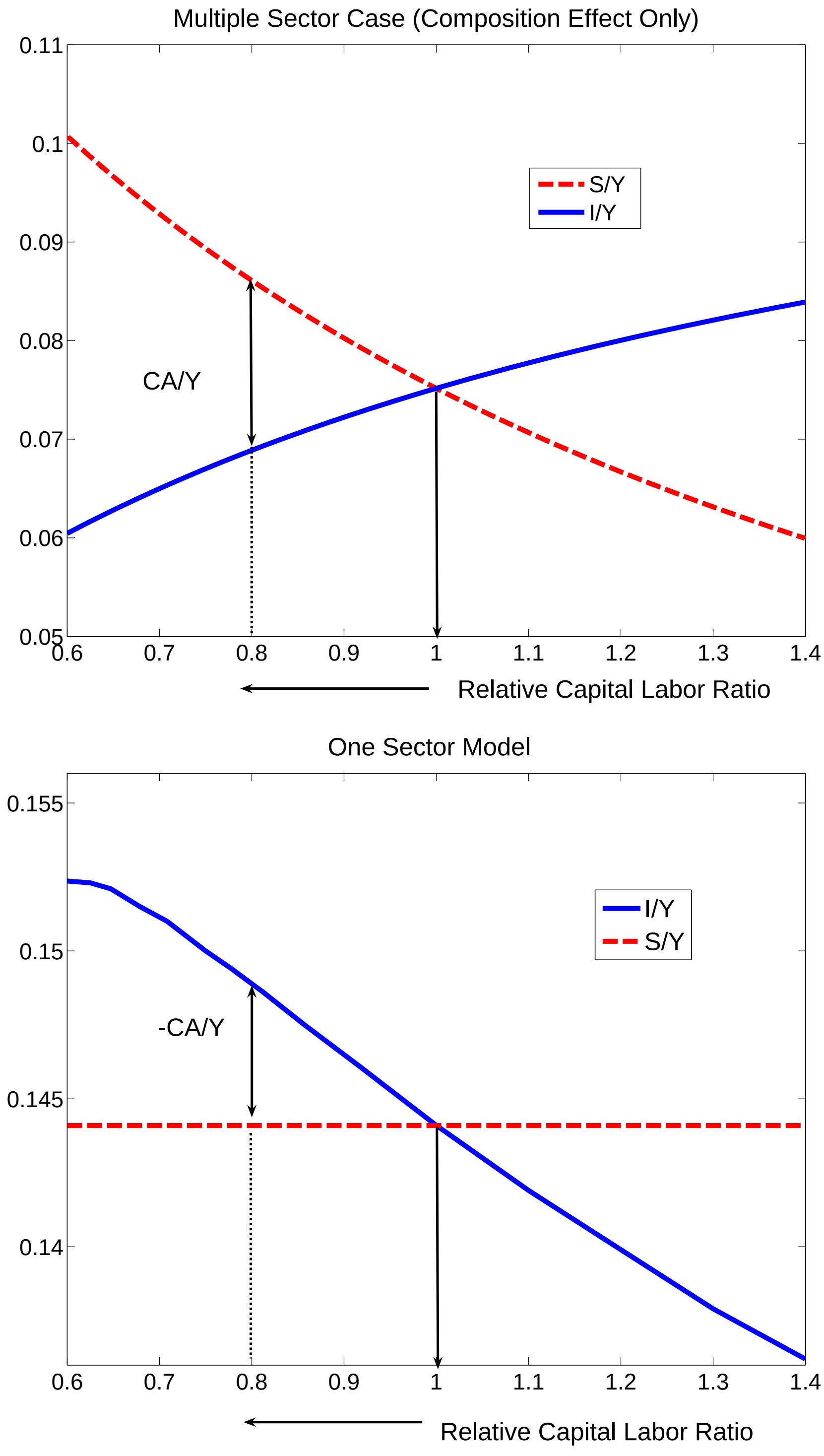

Figure 1: Savings/GDP and Investment/GDP ratio as a function of κ_t^j, $\frac{\tilde{k}^j}{\tilde{k}^g}$. The first panel shows the multiple sector case, based on closed-form solutions. It assumes that $\alpha_1 = 0, \alpha_2 = 0.3, \alpha_3 = 0.5, \alpha_4 = 0.9$, $\gamma_i = 0.25$ for all i. The second panel shows the simulated results of the one sector case, based on Eq. 16 when $i = 1$; $\alpha_1 = 0.3$. In both cases, $\beta = 0.7$ and $\phi = 0.5$.

capital-intensity, $\sum_i \mu_i \eta^j_{i0}$; the higher the initial weighted-average capital intensity in j, the higher the effective capital-labor ratio in j at every point of the transitional path.

The country with the higher initial capital intensity commands lower marginal adjustment cost paid on investment in that country, and thus occupies a higher share of world investment.

The aggregate price of capital q^j_t in j is defined as the weighted average of the price of capital in each sector $i \neq 1$, the weights being the capital share of that industry in total capital stock of region j, $\frac{K^j_i}{K^j}$. The logarithm of the price of capital in sector i in j evolves according to:

$$ln q^j_{it} \;=\; (1-\phi s_l) ln q^j_{i,t-1} + (1-\phi) s_l (ln \tilde{N}^g_t - ln \tilde{N}^g_{t-1}) - ln \Theta_i,$$

where Θ_i is a sector-specific constant. This leads to the following proposition:

Proposition 3 *(Price of capital) q^j_t in any region j is an increasing function of a positive labor force or labor productivity shock if $\phi < 1$, and follows a stationary process if $0 < \phi < 1$.*

Proposition 3 provides conditions under which the price of capital in both countries rises in response to a labor force boom or a positive shock to labor productivity in any region. If $\phi = 1$, the case of complete depreciation, the price of capital is constant and equal to $1/a$. In the more interesting case where $\phi < 1$, the price of capital at Home rises in response to a high $\epsilon^f_{N,t}$ or $\epsilon^f_{A,t}$. If capital can be accumulated ($\phi > 0$), then the price of capital is stationary. However, if capital stock is fixed over time ($\phi = 0$), as in the Lucas-tree model, the price of capital is non-stationary. By contrast, in the one sector case, the price of capital tends to *fall* at Home when $\phi < 1$, as investment flows abroad to take advantage of higher investment opportunities.

Proposition 4 *Country j's stock market-capitalization to domestic GDP ratio at t, $\frac{\sum_{i\neq 1} q^j_{it} K^j_{i,t+1}}{Y^j_t}$ is increasing in j's relative capital-labor ratio, $\tilde{k}^j_t / \tilde{k}^g_t$.*

Using $q^j_{it} K^j_{i,t+1} = (1/\phi) I^j_{it}$, this result immediately follows from Eq. 20.[25]

Corollary 5 *The ratio of sector i's stock market-capitalization to domestic GDP, in any country j, is increasing in $\alpha_i \gamma_i$, and η_{i0}.*

Proposition 4 indicates that the smaller the comparative advantage in labor of Home, the higher its aggregate stock-market value to GDP ratio. This result is consistent with the sharp rise in the value of stocks in the 1990's in the U.S. On the other hand, Corollary 5 says that the stock market value of sector i depends on its effective capital-intensity, $\alpha_i \gamma_i$, and the expected share of global output it produces, η_{i0}.

Aggregate investment is the economic channel through which a labor force boom or a productivity shock affects the price of capital. The high level of aggregate investment relative to the capital

[25] In the one-sector, closed-economy framework of Abel (2003), the stock market-capitalization to domestic GDP ratio is a constant in the long run.

stock in t, which is predetermined, drives up the price of capital along the upward-sloping supply curve of capital, Eq. 5, in both countries.

4 The Competing Forces of the "Convergence" and "Composition" Effects

The previous special case, which isolates the composition effect, leads to factor price equalization after one period, despite the existence of adjustment costs. Investment and asset prices always comove across countries. However, FPE no longer holds in a case where all sectors use both capital and labor as inputs to technology, except in the steady state. The convergence and the composition effect coexist and are competing. Which effect dominates depends on whether factor intensities are sufficiently different so that specialization patterns are pronounced enough to induce a large composition effect. If the composition effect dominates, the previous qualitative results on asset prices and financial flows are preserved. The following quantitative exercise first assumes a two-sector structure before discussing how a many-sector setting differs.

4.1 General Capital Adjustment Function and Parameter Values

The drawback of the log-linear capital adjustment function is that depreciation and adjustment costs, both of which are captured by the parameter ϕ, cannot be separated. Therefore, I henceforward adopt a standard capital-adjustment model in the quantitative exercises (see footnote 7 for equivalence between the two models).

A realistic calibration of a two-period model clearly has its limitations. If one period is interpreted to be 20 years, then adjustment costs are inevitably going to be very small, if paid evenly over time.[26] Capital adjustment costs are widely used in international RBC models but there is no consensus on the calibration strategy to parameterize them.[27] The strategy adopted in this model is to take a standard adjustment cost parameter value, $b = 1$, based on an annual frequency, and compute the amount of capital adjustment that takes place over twenty years. The parameter b is then chosen, in a twenty year period model, so that the same amount of capital adjustment takes place as in the annual frequency model over the same time horizon. Admittedly, no calibration technique of the adjustment cost parameters will be entirely satisfactory, although it can be shown that the qualitative results are insensitive to the size of the adjustment costs, and that the quantitative results are driven to a much larger extent by factor intensity differences than by adjustment costs. Section 4.3 reports a sensitivity analysis. The discount factor β is set to 0.45 to match the

[26]Assuming the existence of some adjustment costs, albeit small in size, is necessary since zero adjustment costs would automatically lead us to the case of indeterminacy of capital stock at the country level.

[27]For example, Baxter and Crucini (1993) calibrates the elasticity of investment relative to Tobin's q to match investment variability in industrial countries. Chari, Kehoe, and McGrattan (2000) calibrates the parameter to match the relative variability of consumption to output. Kehoe and Perri (2002) targets the variability of investment.

initial steady-state annual real interest rate of 4%.

The baseline model takes the benchmark case of Cobb-Douglas preferences, i.e. $\theta = 1$. In this case, γ_i's are equal to the share of sector i in the world's total value added, in an integrated equilibrium. Estimates of factor intensity shares and γ_i's are provided in Cuñat and Maffezoli (2004). Using OECD Annual National Accounts Detailed Table, they aggregate the value of 28 sectors across 24 OECD countries, and calculate the share of each sector in total OECD value added. γ_i's are then calibrated to match these observed shares. Since $1 - \alpha_i$ is just the sector's labor share in value added, one can use data on compensations of employees to compute the sectoral labor share. Assuming that production technologies are identical across countries, the labor share across sectors is taken from U.S. data.[28] I aggregate the 28 sectors into one labor-intensive sector and one capital-intensive sector, of which the capital shares are respectively denoted as α^l and α^c. I rank the sectors by their capital intensity and assume that the first 14 sectors are labor-intensive, and the second half capital intensive. The share of the labor-intensive sector in total value added, γ, is then chosen such that $\gamma = \sum_{i=1}^{14} \gamma_i$. α^l and α^c are calibrated to match the weighted mean of the capital share of the 28 sectors, $\bar{s_k} = \sum_{i=1}^{28} \gamma_i \alpha_i = 0.36$, and the weighted variance, $\sum_i \gamma_i (\alpha_i - \bar{s_k})^2$ (the important of which will become evident), which is 0.04 as measured from the 28-sectors data. The resulting parametrization is $\gamma = 0.61$, $\alpha^l = 0.11$, and $\alpha^c = 0.52$.

Although the key results of interest pertain to symmetric countries as well as asymmetric countries, the exercise is done for countries that are meant to mimic a developing and a developed country. I assume that the only difference between the two countries is their initial capital-labor ratios. These values are taken from Hall and Jones (1999). As a whole, developed countries' capital-labor ratio is about 6 times as large as that of developing countries in 1988.

4.2 Impulse Response

I consider an experiment in which the effective labor force in South doubles permanently and unexpectedly. Since capital is fixed for one period, South allocates a greater fraction of labor to the labor-intensive sector, in order to equalize wages. The higher world supply of the labor-intensive good causes its price p^l to fall, and the price of the capital-intensive good p^c to rise. North shifts resources to the capital-intensive sector, in response to its greater profitability. While returns to capital rise in both sectors in South, the rate of return to capital rises in the capital-intensive sector in North, its export sector, and falls in its import competing sector. The real wage is depressed in South as a result of a greater supply of labor. In North, the real wage rises with respect to purchases of the import good but falls with respect to purchases of the export good, so that the overall effect is ambiguous. For reasonable parameter values, it tends to fall in North.[29]

The first set of panels in Figure 2 displays the response of key variables. The vertical axis

[28] Internationally comparable estimates for all sectors and all countries are available only for 1995 and 1996. They assume that factor intensities have not changed significantly over time.

[29] The impact effect on goods and factor prices are shown analytically in Appendix C.2.

represents the level of each variable normalized by its initial value. The horizontal axis represents generations. Investment comoves as South partly finances North's investment in the capital-intensive sector. The rise in investment in North and the fall in its savings (as a result of declining wages) lead to a current account deficit. Higher investment in both countries bid up the aggregate price of capital globally. However, the price of capital behaves differently across sectors in each country: while the price of capital rises in both sectors in South, the price of capital falls in the labor-intensive industry in North as a result of the downsizing of that sector. North sees an initial trade deficit, due to the increase in investment, and ultimately, a permanent trade surplus as it pays capital gains and interest income abroad.

The second set of panels in Figure 2 juxtaposes the response of North in the one-sector and two-sector case, and brings the two cases into sharp contrast. In the benchmark one-sector case, North's GDP, investment and price of capital fall as capital flows from North to South to take advantage of the latter's higher returns. Intuitively, since only one capital-to-labor ratio is consistent with the steady state in the one-sector case, an increase in labor in South implies an equivalent scaling up of capital in South in the long run. Since capital accumulation takes time, in the presence of adjustment costs, North initially finances some of South's investment, and runs a current account surplus. It runs a trade deficit to finance higher consumption in North, while South runs an initial trade surplus. In the long run, trade is balanced between the two countries.

4.3 When does the composition effect dominate?

When the convergence effect and the composition effect are competing, the result that investment and asset price comove, while capital flows are "reversed" relies on the composition effect outweighing the convergence effect. The composition effect is strong when specialization patterns are pronounced, and the extent of specialization depends on factor intensity differences across sectors. In the limit where factor intensities converge to the same level, the multi-sector model yields qualitatively similar results to a one-sector model, and the convergence effect is isolated. As factor intensities become more disparate, the composition effect becomes stronger. So how different do factor intensities have to be in order for the composition effect to prevail?

In a multiple-sector setting, a measure of the dispersion of factor intensities is the weighted variance of α_i, with weights γ_i capturing the effective size of the sector:

$$\sum_{i=1}^{m}(\alpha_i - \bar{s_k})^2\gamma_i$$

Estimated from the OECD data with 28 sectors, the weighted mean of capital intensity, $\bar{s_k}$, is 0.36, and the weighted variance is 0.04. Figure 3 shows the results of the response of North's investment, at the time of the shock, for various values of the dispersion of factor intensities in a five-sector case. The experiment that holds fixed the weighted mean while increasing the weighted variance shows that North's investment rises with the dispersion of factor intensities.[30] The cutoff weighted-variance, above which North's investment rises and below which North's investment falls, is less than 0.02. This cutoff weighted-variance is naturally also the point at which the price of capital turns from negative to positive, and the current account turns from surplus to deficit. This shows that as factor intensities become more similar, the convergence effect dominates, causing investment to fall in North, and the qualitative results converge to those of the one-sector case. The more different are factor intensities, the more pronounced are specialization patterns, and the stronger is the composition effect.

Other parameters

Adjustment costs change the quantitative response of asset prices and the current account although not their qualitative predictions.[31] Table 3 shows that increasing the size of adjustment costs causes a higher jump in the price of capital at Home, and induces a smaller current account deficit as the amount of desired investment falls. Qualitatively, the price of capital always rises and the current account always falls for Home, so long as factor intensities are sufficiently different. Moreover, the magnitudes of the current account's responses are to a much larger extent governed by factor intensity differences than by the change in the size of the adjustment costs, as can be seen from the various interactions between the values of b and α^c/α^l.[32]

The impact of adjustment costs on the current account is different in the one-sector case. While higher adjustment costs lead to a smaller current account deficit in North in the two-sector case, it leads to a greater current account surplus in North in the one sector case. The reason is that rather than bearing all of the cost of adjusting capital, South imports capital from North, who is paid a higher price of capital in return.

Further, the results are not very sensitive to the coefficient of relative risk aversion and the elasticity of substitution. None of these parameters, except for the factor intensity ratio, matter qualitatively for the main result at hand. The current account pattern of North running a deficit and South a surplus, along with investment comovement and asset price comovement are solely governed by the dispersion of capital intensities, which determines the strength of the composition effect, and the existence of *some* adjustment costs.

[30] Parameters α_i's and γ_i's are chosen so that $\bar{s_k} = 0.36$, $\sum_{i=1}^{m}(\alpha_i - \bar{s_k})^2\gamma_i = 0.04$, and $\sum_i \gamma_{i=1}^{m} = 1$. Note that there is one extra degree of freedom in choosing parameters to satisfy a constant weighted mean and weighted variance, so that there is no unique correspondence between North's investment level and the weighted variance. For this reason, only a linear regression line of the simulated responses is plotted, in order to illustrate the positive relationship between the dispersion of factor intensity and investment in North.

[31] Adjustment costs are crucial to the extent that they pin down the path of capital at the country level, in a world of FPE. They provide a scope for international capital flows to meet the rise in investment demand in the country which shifts resources to capital-intensive sectors. But whether the rise in investment needs is met domestically or from capital inflows depends on the sizes of inter-sectoral versus international adjustment costs. In the extreme case where the former approaches infinity, inter-sectoral reallocation of capital satisfies investment demands. In the other extreme case where the latter approaches infinity, capital inflows from abroad meet investment needs. This model considers the intermediary case where international adjustment costs and inter-sectoral adjustment costs are the same, so that both domestic reallocation and international capital flows play a role.

[32] In the two-sector case, a straightforward way to guage factor intensity differences is simply the ratio of the capital shares in the capital-intensive and labor-intensive sectors, here denoted as α^c/α^l.

5 Applications and Discussions

The integrated framework developed in this paper is able to deliver a number of new predictions for a host of issues. Although a thorough treatment of various applications to the framework is beyond the scope of this paper, this section points to a few important predictions that emerge.

5.1 Globalization and the "Lucas Paradox" Revisited

As originally pointed out by Lucas (1990), large differences in capital-labor ratios may not imply vast differences in the marginal product of capital (MPK), as poor countries also have lower endowments of factors complementary with physical capital, such as human capital and total factor productivity. This has been attributed to be a main reason explaining why very little capital flows from rich to poor countries.

Over the past decade, a more puzzling phenomenon has emerged: not only has there been very little capital flowing from rich to poor countries, but flows have been entirely reversed. If MPK's are indeed similar, this pattern of "reversal" cannot be reconciled in a standard neoclassical model. Extant theories that feature contracting imperfections, or models with incomplete markets limit the flows but do not reverse these flows from poor to rich countries (Ohanian and Wright (2007)). But dispensing with the standard assumption that inherently different trading economies can only produce the same, single good (with rich countries only producing more of it) can go a long way in reconciling with patterns of flows in the data, without the need to appeal to some type of friction. The following numerical experiment illustrates how trade and specialization patterns can cause capital to flow 'upstream' in the event of a globalization shock (from autarky to full trade and financial integration). An important prediction is that we cannot use the similarity in MPK's across countries to infer that there will be little financial capital movements across regions when they integrate.

Assume that two countries are initially in autarky. The difference between the industrialized North (country n) and the emerging South (country s) is that North features a higher total factor productivity (TFP). The autarkic equilibrium (described in Appendix A) is one in which goods and factor prices are determined by their respective aggregate capital-labor ratio:

$$p_k^{j,aut} \propto (\frac{K^j}{N^j})^{\sum_i \alpha_i\gamma_i - \alpha_k} \tag{23}$$

$$w^{j,aut} \propto A^j(\frac{K^j}{N^j})^{\sum_i \alpha_i\gamma_i} \tag{24}$$

$$R_k^{j,aut} \propto A^j(\frac{K^j}{N^j})^{\sum_i \alpha_i\gamma_i - 1} \tag{25}$$

In the initial steady state, returns are pinned down by preferences, which are equalized across countries. Thus, a higher TFP in North than in South, $A^n > A^s$, implies a higher capital-labor ratio in North (shown in Appendix A). According to Eq. 23, capital-abundant North features a lower relative price of capital-intensive goods: $(\frac{p_k}{p_i})^{n,aut} < (\frac{p_k}{p_i})^{s,aut}$ for any good $k > i$. Since the international price of good i once countries open up to trade is just the weighted average of the autarky prices in the two regions, North will see an increase in the price of all goods i such that $p_i^{n,aut} < p_i^{s,aut}$, or in other words, all goods $i \geq k$ such that

$$\alpha_k \geq \sum_i \alpha_i \gamma_i,$$

and South will see an increase in the price of goods $i < k$.[33] As a consequence, North becomes more specialized in capital-intensive goods and South in labor-intensive goods.

Trade liberalization causes wages to rise in South and to fall in North, in the two-sector case (analyzed in Appendix C.1). Since wage income accrues to the young consumers, who are the savers in the economy, aggregate savings rises in South. Insofar as countries shift their industrial structure in response of trade liberalization, South sees a reduction in its supply of capital relative to its demand for capital. In this case, the convergence force remains dormant (since initial returns were equalized), and simultaneous trade and financial liberalization therefore leads to a unambiguous net capital inflow in North, by the composition effect.[34]

Trade and specialization patterns can cause the respective marginal product of capital to diverge as a consequence of industrial restructuring. Therefore, the similarity in the rates of return to capital prior to financial liberalization is not enough to draw the conclusion that net capital flows will be precluded. However, an additional implication is that the sequencing of liberalization can also have differential impact on developing countries. Simultaneous liberalization may lead to a capital outflow in South, and an asset price drop, but trade liberalization without financial liberalization will prevent such an outflow and lead to an asset price boom. The reason is that a rise in wage income in South, as a consequence of trade liberalization, raises aggregate savings. Since aggregate savings need to contemporaneously equal aggregate investment with financial autarky, higher aggregate investment drives up the price of capital.

5.2 Demographic Divergence and Asset Prices

This framework can also be applied to address the looming "age wave" of industrialized countries that has garnered much attention from policy makers and academics alike. Just as some believe that the post-war baby boom and its flow of private savings had fueled the stock market and sent stock prices soaring in the past two decades, others fear that the imminent "age wave" that is hitting the industrialized countries will precipitate an "asset meltdown" as baby boomers start selling their large quantities of stocks for retirement consumption to a much smaller group of young cohort. Abel (2003), among others, shows that a baby boom causes an initial increase in the price of capital, followed by a fall.

Yet, the opposite demographic trend is occurring in developing countries. According to U.N.

[33] If $(\frac{K}{N})^n > (\frac{K}{N})^s$, $p_x^n < p_x^s$ iff $\sum \alpha_i \gamma_i - \alpha_k > 0$.

[34] Numerical results in the two-sector case are available upon request.

demographic projections (World Population Prospects: the 2008 Revision), demographic trends have diverged between industrialized countries and emerging markets since the mid-1980s, and is likely to continue for the next few decades. The share of working age population, population aged between 15-59, has increased from 54.3% in 1980 to a projected figure of more than 62% in 2030 for low and middle-income countries, in contrast to the decrease from 62% in 1980 to a projected 55% in 2030 for advanced economies. For Jeremy Siegel, in popular press, the far younger, and rapidly growing developing world can emerge as a solution to the "age wave crisis", as they procure the purchasing power needed to purchase assets from the developed world. Closer scrutiny of this argument under the discipline of a neoclassical framework suggests that this is untenable. If anything, faster labor force or productivity growth in emerging market would only cause their savings to stay mostly locally, where marginal product of capital and investment demand is high. It will likely generate further drops in asset prices in industrialized countries if investment takes place abroad. Yet, in a world where comparative advantage determines the structure of trade, and financial capital moves freely, higher labor force and/or labor productivity growth in emerging markets can potentially help sustain asset prices in an aging North.

One caveat is that labor force booms arising from demographic trends are to some extent anticipated. In reality labor-force booms are neither completely unexpected (demographic trends are predictable up to a certain point) nor completely anticipated (migration, female labor force participation, labor force reforms), but lie somewhere in between. Figure 4 shows results from the extreme case in which a labor force boom is perfectly anticipated, and contrasts the predictions of a one-sector case and a two-sector case scenario. The overall qualitative result on asset prices and capital flows is maintained in the anticipated case, for the periods after the shock, although its quantitative effect is tempered. The contrast remains sharp with the one-sector case, whereby the price of capital and investment falls and mean reverts for North, and the rise in asset prices is entirely accrued to Southern consumers, rather than shared across countries.[35]

5.3 Protectionism

The previous results rely on an environment where goods market and financial markets are both perfectly integrated. However, either trade autarky or financial autarky can lead to vastly different predictions for the current account and asset prices. Consider the following results:

Result 1: If countries can engage in free goods trade but financial capital is not allowed to flow across borders (i.e. if trade has to be balanced), then a positive labor force or productivity shock in South will cause the price of capital to rise in South, and to fall in North.

[35]Initially, before the shock occurs, South starts accumulating capital a few periods ahead in expectation of a labor force boom at $t = 4$, since capital can only be gradually adjusted in the presence of adjustment costs. However, at the time of the shock $t = 4$, South still expands disproportionately more its labor-intensive sector, since capital is fixed for one period, and to equalize wages across sectors involve allocating more labor to labor-intensive ones. The composition effect is still present although tempered.

This result comes from the fact that aggregate savings must equal aggregate domestic investment in the absence of international movement of financial capital. As North shifts to capital-intensive sectors, the reduced demand for domestic labor can cause wages to fall in North (shown in Appendix C.1). Since aggregate savings derive from wage income, aggregate investment falls and puts downward pressure on the price of capital in North. This implies that protectionist policies in North can exacerbate the consequences of its shrinking labor force.

Result 2: If financial capital can flow across borders but countries cannot engage in free trade in goods, South's price of capital will rise while North's price of capital will fall as a consequence of a positive labor force or productivity shock in South.

With the trade channel entirely shut off, a positive labor force or productivity shock in South will cause no changes in the patterns of specialization, and hence no impetus for capital flows induced by changes in industrial structure. Capital will flow from North to South to capture higher investment opportunities, leading to a decline in the price of capital in North.

6 Empirical Implications and Suggestive Evidence

A central prediction of the model is that countries which have become more specialized in capital-intensive industries experience greater demand for financial capital and thus run a greater current account deficit. Since no studies have yet examined the empirical relationship between the current account and the capital-intensity of a country's export, this segment of the paper serves as a starting point.

A requisite variable is a measure of a country's capital intensity of exports. To construct this measure, I borrow a notion of "revealed comparative advantage" (RCA) often adopted in the trade literature. Most recently, Romalis (2004) uses this measure to examine the relationship between factor proportions and the structure of trade. To do so, he estimates a country-specific coefficient α_c from the following regression:

$$x_{cz} = \beta_c + \alpha_c \cdot k_z + \gamma_c \cdot s_z + \epsilon_{cz} \tag{26}$$

x_{cz} is the share that country c commands of U.S. imports in industry z, k and s are the capital intensity and skill intensity of industry z. α_c is thus the percentage point increase in country c's market share of z, for each 1-percentage point increase in capital-intensity. Countries can thus be ranked according to α_c, a "revealed comparative advantage" in capital-intensive sectors.

Factor intensities, k and s, of each industry are calculated using the "NBER Manufacturing Industry Productivity Database", which covers 459 industries, until 1996. I assume that factor intensities of each industry are the same across countries and thus use the U.S. data as a benchmark.

As a result of data availability, I also assume that between the periods of 1996-2006, the factor intensities of industries have not changed. Following Romalis (2004) k is measured as 1 less the share of total compensation in value added. s is measured as the share of nonproduction workers in total employment in each industry. U.S. imports (data described in the appendix) are classified by detailed commodity and country of origin.

To examine the "RCA" for developing and developed countries as a whole, regression 26 is first performed for South, defined to be countries with per capita GDP at PPP of not more than 50 percent of the U.S. level in each period.[36] South's market share is calculated as $x_{sz} = \sum_{c \in South} x_{cz}$ for each industry z. The periods in consideration are 1989, 1993, 1998, 2002, and 2006. Table 4 reports the results for South over time. South's market share falls significantly with the capital intensity of the industry. Each 1-percentage point increase in capital intensity is estimated to reduce South's market share by 0.75 percent in 2006. Between the period 1989-2006, South's "RCA" in capital-intensity fell from -0.47 to -0.75, with the largest drop occurring between 1989-93. The opening up of China and India over this period may have contributed to the fall in capital intensity of developing countries, as these countries were largely labor abundant. The model performs well for the aggregate South and therefore for the aggregate North.

Using α_c, the "RCA" in capital-intensive goods, I proceed to examine whether there is a systematic relationship between a country's capital-intensity of exports and the current account in a panel regression model. The regression specification considered is[37]

$$CA_{ct} = \alpha + \beta_1 \cdot \alpha_{ct} + \gamma' Z_{ct} + u_{ct} \tag{27}$$

where CA_{ct} is the current account to GDP ratio, α_{ct} is country c's coefficient on capital intensity,[38] Z_t is a vector of controls, and u_{ct} is a disturbance term. The sample period covers 1989, 1993, 1998, 2002 and 2006. Control variables are taken from the standard literature, provided in both Gruber and Kamin (2005) and Chinn and Prasad (2003).[39] These include per capita income, GDP growth rate, demographic variables (population growth and the share of working age population to total population), and openness.

Panel regression estimates are presented in Table 5. The first column shows the OLS estimates of β_1 in a regression that pools all country/year observations. The estimate obtained from the pooled regression uses all the available variation in α_c's and current accounts. A 1-percentage point higher market share of U.S. imports for every 1-percentage point increase in capital intensity is associated with a 0.19-percentage point fall in the Current-Account/GDP ratio. To give

[36]North comprises of Australia, Austria, Belgium, Canada, Denmark, Spain, Finland, France, Greece, Hong Kong, Ireland, Iceland, Israel, Italy, Japan, Netherlands, Norway, New Zealand, Singapore, Sweden, and the United Kingdom.

[37]I assume that the measurement error arising from estimating α_{ct} is uncorrelated with u_{ct}.

[38]It is derived based on normalized shares of import, $\tilde{x_{cz}}$, where by the import share in country c in industry z is divided by the average value of x_{cz}, so as to make α_c comparable across countries.

[39]Unlike these papers, I do not include measures for financial crisis, financial deepeness and fiscal balances.

a sense of the meaning of this magnitude, consider a concrete example. In 2002, India's coefficient α_c was -0.7, and China's -2.19. Their actual current account/GDP ratio was respectively 1.38% and 2.4%. By contrast, Great Britain's α_c was 2.9, and Australia's was 1.1. Their current account/GDP ratio were respectively -1.56% and -3.7%. The regression results imply that had India attained U.K's degree of specialization in capital-intensive goods, 25% of the actual difference between their CA/GDP ratios is explained by differences in specialization. Similarly, had China reached Australia's degree of specialization, 20% of the actual current account difference between the two countries is explained.

The OLS estimates, however, omit variables that vary across countries but are constant across time (such as institutions, macroeconomic environment), and those that are constant across countries but vary across time (such as oil prices). For this reason, fixed-effects panel regressions are performed. Another reason for using fixed-effect estimation is to separate the between-country variation from the within-country variation, which is the focus of the empirical analysis as it most closely reflects the central theoretical prediction that countries which become more specialized in capital-intensive industries *over time* run greater current account deficits. Column (6) reports the coefficient estimate that use both between-country and within-country variation. The estimate in column (4) uses only the between-country variation, while the estimate in (5) uses only the within-country variation. The coefficients are negative and highly significant. The magnitudes of the fixed-effect coefficient and the within coefficient are similar, suggesting that both between-country and within-country variation are important in explaining current account dynamics. The within-regression coefficient suggests that countries that become more capital-intensive over time run higher current account deficits.

These results are clearly preliminary, and a more thorough empirical analysis of the relationship between specialization and the current account needs to take into account the possibility that countries' current account dynamics may vary, and that there may be omitted variables that are correlated with the capital-intensity of exports and also affect the current account. For instance, countries with better financial institutions may be net exporters of more capital-intensive goods while at the same time being better producers of quality assets, which some believe to have caused the large current account deficits in the U.S. The extent of the analysis conducted in the paper can only serve as a starting point, but at the very least, these initial results seem to suggest that there is a systematic negative relationship between specialization patterns and current account dynamics, one which that has not been examined before, and one which is consistent with the predictions of the theoretical framework.

7 Final Remarks

International commodity trade and asset trade are inherently intertwined processes of globalization, yet the workhorse international-macro model has neglected to analyze them jointly. The capital-intensity of a country's export and production structure affects its demand for financial capital, and financial capital inflows into a country can affect its extent of specialization in capital-intensive industries. This interaction is key in determining global allocations of capital and the behavior of asset prices. A simple and yet more realistic enrichment of the standard model to include multiple sectors thus compels us to reassess the way a variety of shocks impinge on the world economy.

In the framework that I develop, a novel force that coexists with the convergence force in shaping global capital flows emerges: capital tends to flow towards countries that become more specialized in capital-intensive sectors. This implies that the integration of developing South and industrialized North, or faster labor force/productivity growth in the former can lead to capital flows from South to North. This stands in sharp contrast to the prediction of the standard one-sector model, and is consistent with the existing global current account patterns.

The interaction between goods trade and asset trade is worthy of further investigation. For example, a natural implication of the framework is that trade liberalization and financial asset liberalization have differential impact on emerging market's asset prices. Whereas simultaneous trade and financial liberalization may cause asset prices to fall in emerging markets, for the reason that capital flows towards North where the capital-intensity of production is higher, trade liberalization alone can cause a rise in asset prices in emerging markets through its positive impact on wages and aggregate savings.

Looking towards the future, emerging markets' lagging demographic transitions combined with faster productivity growth can emerge as a potential remedy to the age mismatch of the industrialized economies. Higher global demand for North's assets as it becomes more capital-intensive can help sustain asset prices despite the imminent reduction of its labor force. Yet this outcome depends critically on the extent of financial and trade integration of world economies. Impediments to the free flow of goods and capital among countries, along with rising protectionism in certain parts of the world, will inevitably curtail the ability to share these shocks on a global level. But if we believe that greater interdependence is the direction towards which the world is heading, all the more important is a synthesized framework that takes into account a comprehensive set of forces that shape our global economy.

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A Appendix: Initial Equilibrium

The Open Economy: Assuming $\theta = 1$, the integrated equilibrium is one in which a constant fraction of world resources is spent in each sector: $\tilde{N}_i^g = \frac{\gamma_i(1-\alpha_i)}{s_l}\tilde{N}^g$ and$K_i^g = \frac{\gamma_i\alpha_i}{s_k}K^g$, where $s_k = \sum_i \alpha_i\gamma_i$, and $s_l = 1 - s_k$. In the open-economy steady state, goods price and factor prices are independent of domestic factor endowments and determined entirely by world endowments: $\frac{p_i}{p_j} \propto \left(\frac{K^g}{\tilde{N}^g}\right)^{\alpha_j-\alpha_i}$ where $\tilde{N}_i^g = A^n N_i^n + A^s N_i^s$. Factor prices are given by: $w \propto A\left(\frac{K^g}{\tilde{N}^g}\right)^{\sum \alpha_i\gamma_i}$, $R \propto \left(\frac{K^g}{\tilde{N}^g}\right)^{\sum \alpha_i\gamma_i - 1}$.

Autarky: Assume that North and South differ by total factor productivity, $A^s < A^n$, and are initially in autarky. The autarkic equilibrium is one in which the equalization of factor prices across sectors, together with the goods market clearing condition, give rise to the result that a constant fraction of resources is spent on each sector $N_i = \frac{\gamma_i(1-\alpha_i)}{s_l}N$, and $K_i = \frac{\gamma_i\alpha_i}{s_k}K$, and where the absolute price of any good k is $p_k \propto \left(\frac{K}{N}\right)^{\sum_i \alpha_i\gamma_i - \alpha_k}$.[40] Similarly, $w \propto A\left(\frac{K}{N}\right)^{\sum_i \alpha_i\gamma_i}$, $R \propto A\left(\frac{K}{N}\right)^{\sum_i \alpha_i\gamma_i - 1}$.[41] International goods prices after opening up to trade is the weighted average of the autarky prices in each country, and therefore trade liberalization raises all prices of goods k in North such that $\alpha_k > \sum_i \alpha_i\gamma_i$.

B Special Case: A Closed-Form Solution

Proof of Proposition 1:

Proof. Guess that $\frac{K_{it}^h}{K_{it}^g} = \eta_{it}$, and using $K_{i,t+1} = aI_{it}^{\phi}K_{it}^{1-\phi}$, $\frac{I_{it}^h}{I_{it}^f} = \frac{\eta_{it}}{(1-\eta_{it})}$ by construction, $\frac{Y_{i,t+1}^h}{Y_{i,t+1}^g} = \frac{K_{i,t+1}^h}{K_{i,t+1}^g} = \frac{1}{1+\frac{K_{i,t+1}^f}{K_{i,t+1}^h}} = \frac{1}{1+\frac{(1-\eta_{it})^{\phi}}{\eta_{it}^{\phi}}\frac{(K_{it}^f)^{1-\phi}}{(K_{it}^h)^{1-\phi}}} = \eta_{it}$. This shows that if $\frac{K_{it}^h}{K_{it}^g} = \eta_{it}$, we naturally have $\frac{K_{i,t+1}^h}{K_{i,t+1}^g} = \eta_{it}$. By induction, $\frac{K_{i,t+m+1}^h}{K_{i,t+m+1}^g} = \eta_{i,t+m} = \eta_{i,t+m-1} = ... = \eta_{i0}$, for any $k \geq 0$, so that $\frac{Y_{i,t+m+1}^h}{Y_{i,t+m+1}^g} = \eta_{i0}\ \forall k \geq 0$.

This implies that: $\eta_{it} = \lambda\sum_{m=0}^{\infty}(1-\lambda)^k E_t[\frac{K_{i,t+m+1}^h}{K_{i,t+m+1}^g}] = \lambda\sum_{m=0}^{\infty}(1-\lambda)^m E_t[\eta_{i0}] = \eta_{i0}$, which proves that the guess $\eta_{it} = \eta_{i0}$ is a solution that satisfies the contraction mapping. ■

A Sufficient condition for diversification in production: The assumption of Cobb-Douglas demand preferences implies that the output of good 1, $Y_1^{g\prime}$, rises in response to a labor force boom or a TFP shock, since $Y_i^{g\prime} = \gamma_i(Y_i^g)'$ for all i, where "$\prime$" denotes variables after the

[40] Using the price index $1 = \prod_i p_i^{\gamma_i}$ and the relative price formula $\frac{p_i}{p_j} = \frac{\gamma_i}{\gamma_j}\frac{Y_j}{Y_i}$ for any i and j, we find the absolute price for any good k, $p_k = \prod_i (\frac{\gamma_k}{\gamma_i}\frac{Y_i}{Y_k})^{\gamma_i}$. This leads to Eq. 23, where more precisely, $p_k = (s_l/s_k)^{s_k-\alpha_k}\prod_i(\gamma_k/\gamma_i)^{-\gamma_i}(\alpha_i\gamma_i)^{\alpha_i\gamma_i}[(1-\alpha_i)\gamma_i]^{(1-\alpha_i)\gamma_i}(K/N)^{\sum_i \alpha_i\gamma_i-\alpha_k}$.

[41] More precisely, $w = M{s_l}^{-s_l}{s_k}^{-s_k}{\alpha_k}^{\alpha_k}(1-\alpha_k)^{1-\alpha_k}A(K/N)^{s_k}$, and $R = M(s_k/s_l)^{s_k-1}{\alpha_k}^{\alpha_k}(1-\alpha_k)^{1-\alpha_k}A(K/N)^{s_k-1}$.

shock. This implies that

$$N_1^{h\prime} + N_1^{f\prime} > N_1^h + N_1^f. \tag{28}$$

Since wages fall at Home, from above, we know that (i): $\Delta \tilde{k}_i^j < 0 \forall i \neq 1$, and (ii): $\Delta \tilde{N}_1^h < 0, \Delta \tilde{N}_1^f > 0, \Delta \tilde{N}_i^j < 0 \quad \forall i \neq 1$. For non-specialization to occur, it must be that both countries produce the most labor-intensive good, good 1, so that$N_1^{s\prime} - N_1^s < \epsilon$, $N_1^{n\prime} > 0$. From Eq. 28,$N_1^{f\prime} - N_1^f < \epsilon \Leftrightarrow N_1^h - N_1^{h\prime} < N_1^{f\prime} - N_1^f < \epsilon$, which implies $N_1^{h\prime} > N_1 - \epsilon$. A sufficient condition for which $N_1^{h\prime} > 0$, and hence, diversification in production, is therefore

$$\epsilon < N_1^h.$$

C Derivation of the General Model and Numerical Method

This section derives the two-sector general case and provides the computational method. The analog for the multiple-sector case follows directly.

C.1 Factor and Goods Prices

A high $\epsilon_{N,t}^f$: The impact effect of a labor force boom in Foreign on factor and goods prices can be analyzed analytically in the case of $\theta = 1$ in the two-sector case. Denoting hat variables as percentage changes, we have, in any country j:

$$\hat{w_1^j} = \hat{p_1} - \alpha_1 \hat{N_1^j} \tag{29}$$
$$\hat{w_2^j} = \hat{p_2} - \alpha_2 \hat{N_2^j} \tag{30}$$
$$\hat{R_1^j} = \hat{p_1} + (1 - \alpha_1)\hat{N_1^j} \tag{31}$$
$$\hat{R_2^j} = \hat{p_2} + (1 - \alpha_2)(\hat{N_2^j}), \tag{32}$$

where we assume that $\epsilon_{A,t}^j = 0$ for all j. Capital is predetermined and therefore a fixed factor in period t. Since $\hat{p_2} > 0$ and $\hat{p_1} > 0$ following a high a labor force boom in Foreign, only one configuration of the change in goods and factor prices is possible:

$$\hat{R_2^h} > \hat{p_2} > \hat{w^h} ? 0 > \hat{p_1} > \hat{R}_1 \tag{33}$$
$$\hat{R_1^f} > \hat{R_2^f} > \hat{p_2} > 0 > \hat{p_1} > \hat{w^f}. \tag{34}$$

To determine wage behavior at home, first observe that wage equalization within a country at any point in time implies $\hat{w}_1 = \hat{w}_2$, which, in conjunction to the condition that $\gamma \hat{p}_1 + (1 - \gamma)\hat{p}_2 = 0$, implies that $\hat{w}_2 = (\gamma - 1)\alpha_2(\hat{N}_2) - \gamma \alpha_1 \hat{N}_1$. The condition that determines whether wages rise or fall in Home amounts to:

$$\hat{w_t^h} < 0 \Leftrightarrow \frac{N_{1,t-1}^h}{N_{2,t-1}^h} < \frac{\gamma}{1-\gamma}\frac{\alpha_1}{\alpha_2} \tag{35}$$

For standard parameter values, wages tend to fall at Home while it falls unambiguously in Foreign.

A Globalization Shock: A similar analysis shows that in response to a globalization shock:

$$\hat{R_2^h} > \hat{p_2} > 0 > \hat{w_1^h}, \hat{w_2^h} > \hat{p_1} > \hat{R_1^h} \tag{36}$$

$$\hat{R_1^f} > \hat{p_1} > \hat{w_1^s}, \hat{w_2^s} > 0 > \hat{p_2} > \hat{R_2^s} \tag{37}$$

where wages falls unambiguously in North, since condition 35 is satisfied in the closed-economy equilibrium, where $\frac{N_1^h}{N_2^h} = \frac{\gamma(1-\alpha_1)}{(1-\gamma)(1-\alpha_2)}$ (from Appendix A).

C.2 Model Derivation

Let the relative price of good 1 and good 2 be $p_t = \frac{p_{1t}}{p_{2t}}$, and x_t be the fraction of labor allocated to sector 1 at Home. For notational convenience, home country subscripts are ommitted, and foreign country variables are denoted as subscript f. The wage equalization conditions are:

$$\begin{cases} \frac{p_{1t}}{p_{2t}}\frac{(1-\alpha_1)Y_{1t}}{(1-\alpha_2)Y_{2t}} & = & \frac{x_t}{(1-x_t)} \\ p_t\frac{(1-\alpha_1)Y_{1t,f}}{(1-\alpha_2)Y_{2t,f}} & = & \frac{x_{tf}}{(1-x_{t,f})}. \end{cases}$$

Using Eq. 1 and using the expression for the relative price $p_t = \frac{\gamma}{1-\gamma}\frac{Y_{2t}^g}{Y_{1t}^g}$, these two equations can be rewritten as:

$$\frac{x_t^{\alpha_1}}{(1-x_t)^{\alpha_2}} = \frac{N_{ft}}{N_t}^{\alpha_1-\alpha_2}\frac{K_{1t}^{\alpha_1}K_{2t,f}^{\alpha_2}}{K_{1t,f}^{\alpha_1}K_{2t}^{\alpha_2}}\frac{x_{ft}^{\alpha_1}}{(1-x_t)^{\alpha_2}} \tag{38}$$

$$\frac{\gamma(1-\alpha_1)(1-x_t)}{1+\frac{N_t^{1-\alpha_1}K_{1t,f}^{\alpha_1}}{N_t^{1-\alpha_1}K_{1t}^{\alpha_1}}\frac{x_{ft}^{(1-\alpha_1)}}{x_t^{(1-\alpha_1)}}} = \frac{(1-\gamma)(1-\alpha_2)x_t}{1+\frac{N_{ft}^{1-\alpha_2}K_{2t,f}^{\alpha_2}}{N_{ht}^{1-\alpha_2}K_{2t}^{\alpha_2}}\frac{(1-x_{ft})^{(1-\alpha_2)}}{(1-x_t)^{(1-\alpha_2)}}} \tag{39}$$

At each point in time t, given K_{it}, $K_{if,t}$, A_t, A_{ft}, x_t, $x_{t,f}$ are uniquely pinned down by these two equations.

Summing Eq. 4 across countries, and using $(I_{1t}^g + I_{2t}^g)/\phi = \frac{\beta}{1+\beta}[p_{1t}(1-\alpha_1)Y_{1t}^g + p_{2t}(1-\alpha_2)Y_{2t}^g]$, denoted as S_t^g, the global consumption of the old can be expressed

$$\begin{aligned} C_{o,t+1}^g &= p_{1,t+1}\alpha_1 Y_{1,t+1}^g + p_{2,t+1}\alpha_2 Y_{2,t+1}^g + \frac{1-\phi}{\phi}(I_{1,t+1}^g + I_{2,t+1}^g), \\ &= [\frac{p_{t+1}\alpha_1 Y_{1,t+1}^g + \alpha_2 Y_{2,t+1}^g}{p_{t+1}(1-\alpha_1)Y_{1t+1}^g + (1-\alpha_2)Y_{2t+1}^g} + \frac{\beta(1-\phi)}{1+\beta}](p_{1,t+1}(1-\alpha_1)Y_{1t+1}^g + p_{2,t+1}(1-\alpha_2)Y_{2t+1}^g). \end{aligned}$$

Substituting this into the Euler equations $u'(c_t) = E_t[u'(c_{t+1})R^j_{i,t+1}]$, while letting $\frac{I^g_{1t}}{\phi} = \mu_t S^g_t$, $\frac{I_{1t}}{\phi} = \mu_t \eta_t S^g_t$, and $\frac{I_{2t}}{\phi} = (1-\mu_t)\kappa_t S^g_t$, we have

$$\begin{cases} \mu_t &= E_t[\frac{\frac{p_{t+1}\alpha_1 Y^g_{1,t+1}}{p_{t+1}(1-\alpha_1)Y^g_{1t+1}+(1-\alpha_2)Y^g_{2t+1}} + \frac{\beta(1-\phi)}{1+\beta}\mu_{t+1}}{\frac{p_{t+1}\alpha_1 Y^g_{1,t+1}+\alpha_2 Y^g_{2,t+1}}{p_{t+1}(1-\alpha_1)Y^g_{1t+1}+(1-\alpha_2)Y^g_{2t+1}} + \frac{\beta(1-\phi)}{1+\beta}}], \\ \mu_t\eta_t &= E_t[\frac{\frac{p_{t+1}\alpha_1 Y_{1,t+1}}{p_{t+1}(1-\alpha_1)Y^g_{1t+1}+(1-\alpha_2)Y^g_{2t+1}} + \frac{\beta(1-\phi)}{1+\beta}\mu_{t+1}\eta_{t+1}}{\frac{p_{t+1}\alpha_1 Y^g_{1,t+1}+\alpha_2 Y^g_{2,t+1}}{p_{t+1}(1-\alpha_1)Y^g_{1t+1}+(1-\alpha_2)Y^g_{2t+1}} + \frac{\beta(1-\phi)}{1+\beta}}], \\ (1-\mu_t)\kappa_t &= E_t[\frac{\frac{\alpha_2 Y_{2,t+1}}{p_{t+1}(1-\alpha_1)Y^g_{1t+1}+(1-\alpha_2)Y^g_{2t+1}} + \frac{\beta(1-\phi)}{1+\beta}(1-\mu_{t+1})\kappa_{t+1}}{\frac{p_{t+1}\alpha_1 Y^g_{1,t+1}+\alpha_2 Y^g_{2,t+1}}{p_{t+1}(1-\alpha_1)Y^g_{1t+1}+(1-\alpha_2)Y^g_{2t+1}} + \frac{\beta(1-\phi)}{1+\beta}}] \end{cases}$$

Substituting in $p_t = \frac{\gamma}{1-\gamma}\frac{Y^g_{2t}}{Y^g_{1t}}$ yields

$$\begin{aligned} \mu_t &= \frac{\frac{\alpha_1\gamma}{(1-\alpha_1)\gamma+(1-\alpha_2)(1-\gamma)}}{\frac{\alpha_1\gamma+\alpha_2(1-\gamma)}{(1-\alpha_1)\gamma+(1-\alpha_2)(1-\gamma)} + \frac{\beta(1-\phi)}{1+\beta}} + \frac{\frac{\beta(1-\phi)}{1+\beta}}{\frac{\alpha_1\gamma+\alpha_2(1-\gamma)}{(1-\alpha_1)\gamma+(1-\alpha_2)(1-\gamma)} + \frac{\beta(1-\phi)}{1+\beta}} E_t[\mu_{t+1}], \\ &= \lambda_1 + \lambda_3 E_t[\mu_{t+1}]. \\ \mu_t\eta_t &= \frac{\frac{\alpha_1\gamma}{(1-\alpha_1)\gamma+(1-\alpha_2)(1-\gamma)}}{\frac{\alpha_1\gamma+\alpha_2(1-\gamma)}{(1-\alpha_1)\gamma+(1-\alpha_2)(1-\gamma)} + \frac{\beta(1-\phi)}{1+\beta}} E_t[\frac{Y_{1t+1}}{Y^g_{1t+1}}] + \frac{\frac{\beta(1-\phi)}{1+\beta}}{\frac{\alpha_1\gamma+\alpha_2(1-\gamma)}{(1-\alpha_1)\gamma+(1-\alpha_2)(1-\gamma)} + \frac{\beta(1-\phi)}{1+\beta}} E_t[\mu_{t+1}\eta_{t+1}] \\ &= \lambda_1 E_t[\frac{Y_{1t+1}}{Y^g_{1t+1}}] + \lambda_3 E_t[\mu_{t+1}\eta_{t+1}] \\ (1-\mu_t)\kappa_t &= \frac{\frac{\alpha_2(1-\gamma)}{(1-\alpha_1)\gamma+(1-\alpha_2)(1-\gamma)}}{\frac{\alpha_1\gamma+\alpha_2(1-\gamma)}{(1-\alpha_1)\gamma+(1-\alpha_2)(1-\gamma)} + \frac{\beta(1-\phi)}{1+\beta}} E_t[\frac{Y_{2t+1}}{Y^g_{2t+1}}] + \frac{\frac{\beta(1-\phi)}{1+\beta}}{\frac{\alpha_1\gamma+\alpha_2(1-\gamma)}{(1-\alpha_1)\gamma+(1-\alpha_2)(1-\gamma)} + \frac{\beta(1-\phi)}{1+\beta}} E_t[(1-\mu_{t+1})\kappa_{t+1}] \\ &= \lambda_2 E_t[\frac{Y_{2t+1}}{Y^g_{2t+1}}] + \lambda_3 E_t[(1-\mu_{t+1})\kappa_{t+1}] \end{aligned}$$

The first equation implies that μ_t is a constant $\mu = \frac{\lambda_1}{1-\lambda_3} = \frac{\lambda_1}{\lambda_1+\lambda_2} = \frac{\alpha_1\gamma}{\alpha_1\gamma+\alpha_2(1-\gamma)}$, since $\lambda_1+\lambda_2+\lambda_3 = 1$. The two remaining equations become:

$$\begin{cases} \eta_t &= (1-\lambda_3)E_t[\frac{Y_{1t+1}}{Y^g_{1t+1}}] + \lambda_3 E_t[\eta_{t+1}] \\ \kappa_t &= (1-\lambda_3)E_t[\frac{Y_{2t+1}}{Y^g_{2t+1}}] + \lambda_3 E_t[\kappa_{t+1}]. \end{cases}$$

Iterating forward,

$$\begin{cases} \eta_t &= (1-\lambda_3)\sum_{k=0}^{\infty}\lambda_3^k E_t[\frac{Y_{1t+k+1}}{Y^g_{1t+k+1}}] \\ \kappa_t &= (1-\lambda_3)\sum_{k=0}^{\infty}\lambda_3^k E_t[\frac{Y_{2t+k+1}}{Y^g_{2t+k+1}}] \end{cases}$$

C.3 Computational Method

In the two-sector case, solving the model amounts to finding the set of paths η, κ, K, K_f such that:

$$\text{for all time step } t \left\{ \begin{array}{rcl} \eta_t & = & (1-\lambda_3)E_t[\frac{Y_{1t+1}}{Y^g_{1t+1}}] + \lambda_3 E_t[\eta_{t+1}] \\ \kappa_t & = & (1-\lambda_3)E_t[\frac{Y_{2t+1}}{Y^g_{2t+1}}] + \lambda_3 E_t[\kappa_{t+1}] \\ K_{1,t+1} & = & a(\phi\mu\eta_t S^g_t)^{\phi} K_{1t} 1-\phi \\ K_{2,t+1} & = & a(\phi(1-\mu)\kappa_t S^g_t)^{\phi} K^{1-\phi}_{1t} \\ K_{1f,t+1} & = & a(\phi\mu(1-\eta_t)S^g_t)^{(\phi} K^{1-\phi}_{1f,t} \\ K_{2f,t+1} & = & a(\phi(1-\mu)(1-\kappa_t)S^g_t)^{\phi} K^{1-\phi}_{2f,t} \end{array} \right. , \tag{40}$$

with $S^g_t = \frac{\beta}{1+\beta}[p_{1t}(1-\alpha_1)Y^g_{1t} + p_{2t}(1-\alpha_2)Y^g_{2t}]$ and where sector-dependant productivities Y_{it+1} and $Y_{it+1,f}$ are computed from sector-dependant capitals K_{it} and $K_{it,f}$ using the wage equalization conditions:

$$\left\{ \begin{array}{rcl} \frac{x_t^{\alpha_1}}{(1-x_t)^{\alpha_2}} & = & \frac{N_{ft}}{N_{ht}}^{\alpha_1-\alpha_2} \frac{K^{\alpha_1}_{1t} K^{\alpha_2}_{2t,f}}{K^{\alpha_1}_{1t,f} K^{\alpha_2}_{2t}} \frac{x^{\alpha_1}_{t,f}}{(1-x_{t,f})^{\alpha_2}} \\ \frac{\gamma(1-\alpha_1)(1-x_t)}{1+\frac{N^{1-\alpha_1}_{ft} K^{\alpha_1}_{1t,f}}{N^{1-\alpha_1}_{ht} K^{\alpha_1}_{1t}} \frac{x^{(1-\alpha_1)}_{tf}}{x^{(1-\alpha_1)}_t}} & = & \frac{(1-\gamma)(1-\alpha_2)x_t}{1+\frac{N^{1-\alpha_2}_{ft} K^{\alpha_2}_{2t,f}}{N^{1-\alpha_2}_{ht} K^{\alpha_2}_{2t}} \frac{(1-x_{ft})^{(1-\alpha_2)}}{(1-x_t)^{(1-\alpha_2)}}} \end{array} \right. . \tag{41}$$

For every time step t, we define G_t as the contraction mapping:

$$G_t(\eta^{(n)}, \kappa^{(n)}, K^{(n)}_1, K^{(n)}_2, K^{(n)}_{1f}, K^{(n)}_{2f}) \to (\eta^{(n+1)}, \kappa^{(n+1)}, K^{(n+1)}_1, K^{(n+1)}_2, K^{(n+1)}_{1f}, K^{(n+1)}_{2f})$$

such that:

$$\text{for all time } u \geq t \left\{ \begin{array}{rcl} \eta^{(n+1)}_u & = & (1-\lambda_3)\frac{Y^{(n)}_{1u+1}}{Y^{w(n)}_{1u+1}} + \lambda_3 \eta^{(n)}_{u+1} \\ \kappa^{(n+1)} & = & (1-\lambda_3)\frac{Y^{(n)}_{2u+1}}{Y^{w(n)}_{2u+1}}^{(n)} + \lambda_3 \kappa^{(n)}_{u+1} \\ K^{(n+1)}_{1,u+1} & = & a(\phi\mu\eta^{(n)}_u S^{w(n)}_t)^{\phi} K^{(n)1-\phi}_{1u} \\ K^{(n+1)}_{2,u+1} & = & a(\phi\mu\kappa^{(n)}_u S^{w(n)}_t)^{\phi} K^{(n)1-\phi}_{1u} \\ K^{(n+1)}_{1f,u+1} & = & a(\phi\mu(1-\eta^{(n)}_u)S^{w(n)}_t)^{(\phi} K^{(n)1-\phi}_{1f,u} \\ K^{(n+1)}_{2f,u+1} & = & a(\phi(1-\mu)(1-\kappa^{(n)}_u)S^{w(n)}_t)^{\phi} K^{(n)1-\phi}_{2f,u} \end{array} \right.$$

At a specific time t, the solution to the deterministic case is the set of paths$\{\eta, \kappa, K_{1h}, K_{2h}, K_{1f}, K_{2f}\}$ such that $\{\eta_{u\geq t}, \kappa_{u\geq t}, K_{1u\geq t,f}, K_{2u\geq t,h}, K_{1u\geq t,f}, K_{2u\geq t,f}\}$ is the unique fixed-point of the contraction G_t by the contraction mapping theorem.

Table 2: Parameters for Simulation

Benchmark Parameter Values		
Preferences	$\beta = 0.45$	$\gamma = 0.61$
	$\rho = 1$	$\theta = 1$
Technology	$\alpha^l = 0.52$	$\alpha^c = 0.11$
	$b = 0.2$	

D Data Appendix

Factor Intensity: Factor Intensity data are taken from the NBER Manufacturing Industry Productivity Database for the years 1989, 1993, and 1996. This database is based on SIC (1987 Edition) classifications and features 459 industries. Factor intensity estimates are described in Section 6 of the text.

Imports: U.S. import data come from Robert Feenstra's National Bureau of Economic Research Trade Database for 1989, 1993, 1998, 2002, and 2006. In 1989, there were 391 industries by SIC classification, and 156 trading partners. In 1993, there were 391 industries and 156 trade partners; in 1998, 391 industries and 159 trading partners; in 2002, 391 industries and 159 partners, and 452 industries with 174 trading partners in 2006.

Current Account, annual GDP growth, GDP Per Capita at PPP, Imports and Exports : from World Development Indicators.

Demographic Variables: Population growth, the working age (ages 15-64) to total population ratio are taken from the U.N.'s "World Population Prospects : 2006 Revision".

Initial Capital stock: The capital-stock for all countries in 1989 is taken From Barro and Lee (2000).

Initial TFP: TFP in 1989 for all countries are taken from Hall and Jones (1999).

E Tables and Figures

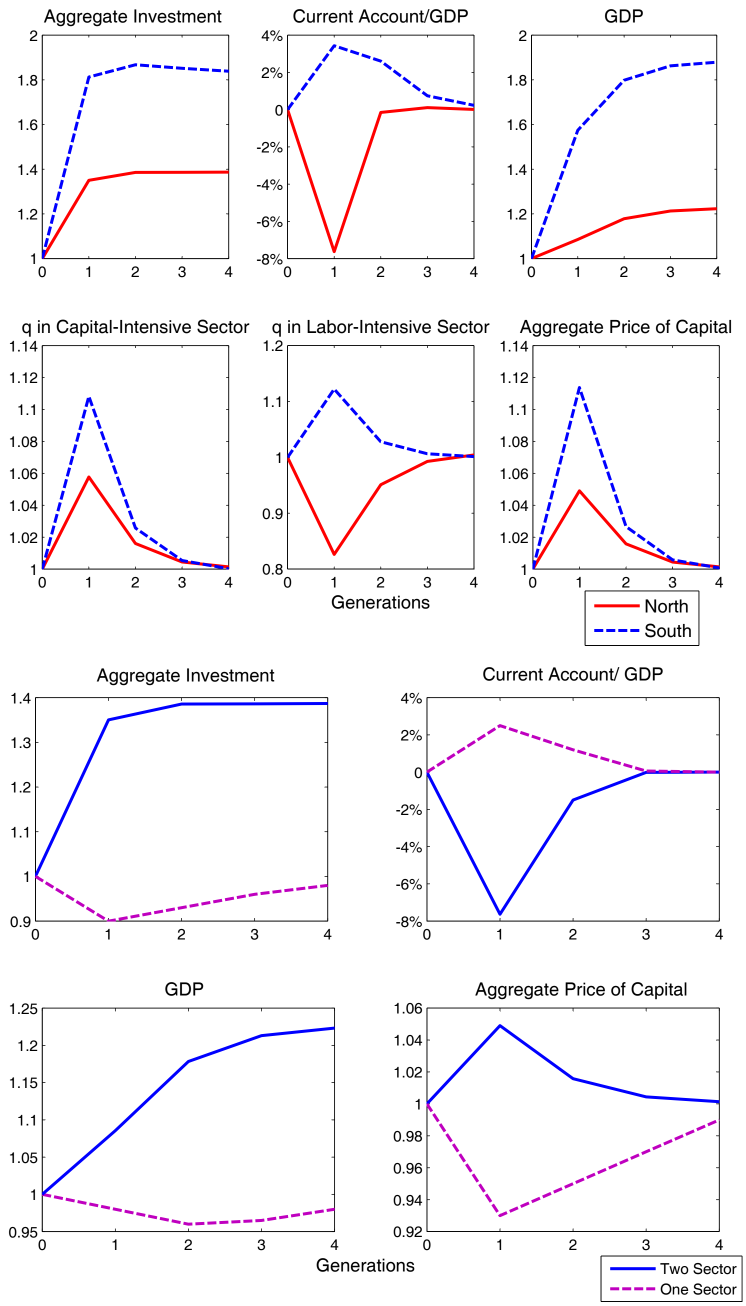

Figure 2: The response to an unexpected doubling of the labor force in South (Foreign) in period 1. The first set of panels displays the behavior of key variables in the two countries; the second set of panels contrasts the behavior of North (Home) in the one sector case and the two sector.

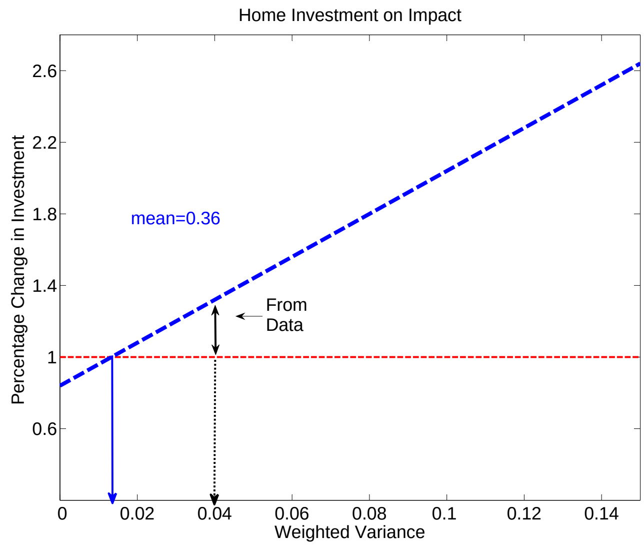

Figure 3: This graph shows North's (Home's) response to an unexpected doubling of South's (Foreign's)labor force in a 5 sector model, holding constant the weighted-mean $\sum_i \alpha_i \gamma_i$, at 0.36, while varying the weighted variance $\sum_i (\alpha_i - 0.36)^2 \gamma_i$.

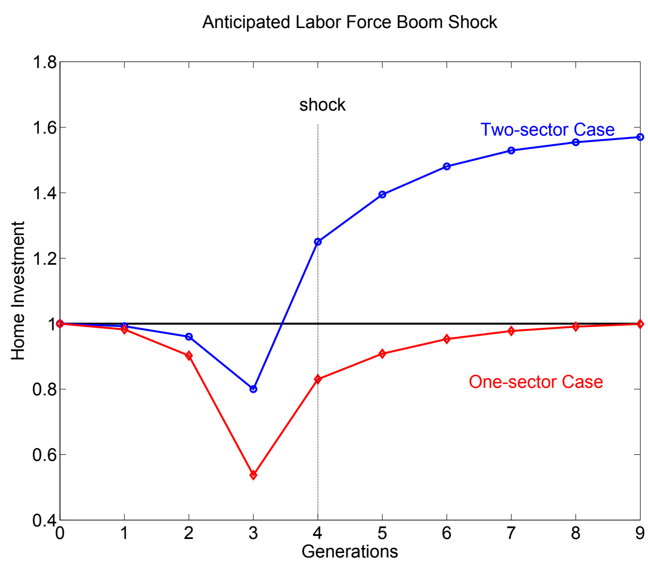

Figure 4: This figure contrasts the response of investment in North (Home) to an anticipated labor force boom in period 4, in the one sector vs. the two-sector case.

Table 3: Sensitivity Anaysis

Sensitivity to the Adjustment Cost Parameter and Factor Intensities				
Two-Sector	**CA**: T=1	**q**:	T=1	T=5
(1) Varying Adjustment Costs				
b=0.05	-8.37%		2.96%	0
b= 0.1	-8%		5.04%	0
b= 0.3	-7.04%		9.41%	0.31%
b= 0.5	-6.43%		11.27%	1.12%
(2) Varying Factor Intensity				
$\alpha^c/\alpha^l = 1$	0.1%		-0.1%	0
$\alpha^c/\alpha^l = 3$	-4.84%		5.88%	0.1%
$\alpha^c/\alpha^l = 9$	-5.06%		6.08%	0.47%
(3) Interaction				
High b and high α^c/α^l	-7.57%		16.75%	4.04%
low b and high α^c/α^l	-9.10%		5.45%	0
high b and low α^c/α^l	-2.95%		5.97%	2.85%
(4) Elasticity of Substitution				
$\theta = 0.8$	-5.77%		6.29%	0.1%
$\theta = 4$	-6.31%		6.41%	0.08%
(5) Risk Aversion				
$\rho = 0.8$	-6.33%		6.71%	0.17%
$\rho = 2$	-4.56%		4.4%	0.44%
One-Sector				
b=0.1	0.01%		-0.3%	0
b= 0.3	0.02%		-1%	0
b= 0.5	1.22%		-4%	0

Response of North's (Home's) current account and the price of capital at different horizons; shock occurs at $T = 1$. The first set of results varies b from 0.05 to 0.5, while holding constant other parameters, in Table 2; The second set of results holds constant all parameters in Table 2 except the factor intensity ratio, α_2/α_1; The levels of α_1 and α_2 are obtained by fixing the weighted mean $\gamma\alpha_1 + (1-\gamma)\alpha_2 = 0.36$ and setting their ratio to each of the values above; The third set of results explores interactions between b and α_2/α_1.

Table 4: South's "RCA" in Capital Intensity Over Time

	1989	**1993**	**1998**	**2002**	**2006**
α_c	-0.47^{***}	-0.73^{***}	-0.60^{***}	-0.67^{***}	-0.75^{***}
	(0.007)	(0.008)	(0.007)	(0.006)	(0.006)
R^2	0.32	0.32	0.29	0.25	0.27

This table shows the estimated coefficient α_c for developing countries as a whole over time. Standard errors are in parentheses; $***$ denotes signification at the 1-percent level.

Table 5: Current Account and "RCA" in Capital Intensity

	Pooled	Pooled	Pooled(2)	Between	Within	F-E
	(1)	(2)	(3)	(4)	(5)	(6)
α_c	-0.193^{***}	-0.19^{***}	-0.181^{**}	-0.30^{**}	-0.12^{***}	-0.23^{***}
	(0.07)	(0.074)	(0.01)	(0.127)	(0.04)	(0.07)
Openness		1.98^{***}	2.47^{***}	1.54	-0.42	1.25
		(0.69)	(0.124)	(1.03)	(0.28)	(1.09)
Annual GDP growth		-0.03	0.29^{***}	2.8	-0.1^{***}	-0.15
		(0.074)	(0.02)	(12.7)	(0.01)	(0.07)
Population growth		-0.67**	-0.65^{***}	-1.3	-0.22	-0.08
		(0.27)	(0.02)	(13.5)	(0.35)	(0.38)
Country Fixed Effect	No	No	No	-	Yes	Yes
Year Fixed Effect	No	No	No	-	No	Yes
R^2	0.01	0.05	0.71	0.07	0.55	0.20
Number of Observations	450	450	450	86	450	450

This table reports the results of estimating $CA_{ct} = \alpha + \beta_1 \cdot \alpha_{ct} + \gamma' Z_t + u_{ct}$. Column (3) uses an alternative definition of the independent variable: the average CA/GDP over a period. The between regression reports the results using country-averages of all variables, and including a constant. The within regression reports results using country fixed effects, and (6) reports results using country and year fixed effects. Constants, country, and year effects are not reported. The sample consists of the years t, 1989, 1993, 1998, 2002, 2006, for all countries. Additional controls include GDP, and GDP per capita.