



Labor market frictions, investment and capital flows

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HIGHLIGHTS

- Economic theory predicts that high productivity growth leads to sharp increases in investment.
- These sharp increases are then followed by rapid declines.
- Such an investment behavior contrasts with the empirical evidence of a rather hump-shaped response.
- I present a two-country general equilibrium model with labor market frictions.
- This model generates the empirically observed investment behavior.

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ABSTRACT

The standard neoclassical model predicts that countries with higher productivity growth rates experience sharp increases in investment that are followed by rapid declines. This monotonic investment response contrasts with the empirical evidence that suggests a rather hump-shaped investment behavior. In this paper, I present a two-country general equilibrium model that generates hump-shaped investment responses from labor market frictions. In the model, I decompose investment into tradable and non-tradable components and show that an increase in the growth rate of a country results in scarcities of the non-tradable components which raise the relative price of investment goods. These scarcities occur because labor is unable to reallocate quickly between sectors within economies. This mechanism has two main implications. First, the induced movement in relative prices equates cross-country returns to capital and thus greatly reduces initial investment. Second, domestic saving now plays a more important role in financing investment, inducing a co-movement between these variables.

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1. Introduction

In the standard neoclassical model capital moves from slow- to fast-growing countries. [Gourinchas and Jeanne \(2013\)](#), among others, show that the empirical relation between growth and capital inflows is, contrary to what the standard model predicts, negative. As a potential explanation, recent literature emphasizes the role of underdeveloped financial markets in fast-growing countries (e.g. [Caballero et al. \(2008\)](#), [Mendoza et al. \(2007\)](#) and [Coeurdacier et al. \(2015\)](#)). While financial market limitations may well explain why consumers in fast-growing developing countries cannot borrow against their future income, this argument does not restrict global firms, which do not rely on domestic financial markets to finance themselves, from making massive front-loaded investments in fast-growing countries. These investments should lead to sizable capital inflows which remain unobserved empirically.

This paper discusses frictions in economic restructuring, i.e. slow reallocations of production factors within the economy, as a mechanism to generate investment responses to growth shocks that are consistent with the empirical evidence.

The main takeaway from my analysis is that economic restructuring results in a hump-shaped response of investment to economic growth. I illustrate this mechanism in a two-country general equilibrium model. The mechanism is the direct result of an interaction between two frictions: non-tradable components in investment goods and slow labor reallocations within economies. In my framework, an increase in the growth rate of a country raises its demand for both tradable and non-tradable investment components. Scarcities occur because the domestically produced non-tradable components are in short supply relative to the globally produced tradable components. Labor therefore strives to reallocate to the non-tradable sector. But since labor can reallocate only slowly between sectors, it takes time for the supply of non-tradable components to catch up. Meanwhile, the non-tradable good has a

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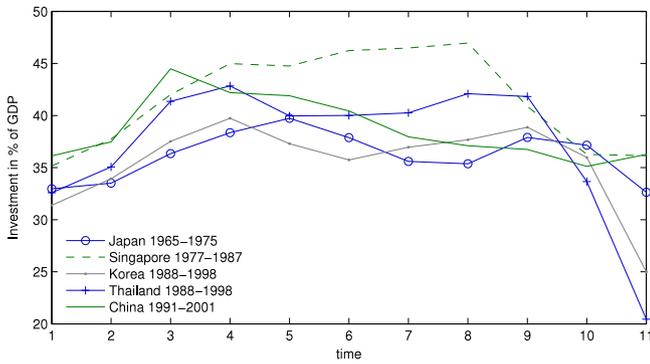


Fig. 1. Asian Investment-to-GDP ratios during economic take-off periods. Source: Worldbank Development Indicators, The Economist.

temporarily higher price which depresses returns to capital and very much mutes initial investment. As a result we observe a hump-shaped investment response that contrasts with the large, front-loaded increase in investment and the sharp decline that follows it that the standard model predicts.

The intuition behind this mechanism is quite simple. Fast-growing developing countries, for instance, are initially scarce of human capital and structures (non-tradable investment goods). These scarcities deter global investors because the kinds of tradable investment goods that come from global firms (equipment, blueprints) complement non-tradable investment goods. Only when the supply of non-tradable investment goods improves is investment fruitful for a global firm. Because the supply of the non-tradable investment goods can only be gradually raised with growth and after some restructuring of the domestic economy, the investment profile is hump-shaped. This profile is, for example, coherent with the experience of Asian emerging market countries during economic take-off periods in Fig. 1.

The analytical framework of this paper is based on the large open economy stochastic growth setup of Backus et al. (1992) and Backus et al. (1994). I integrate into this framework stochastic shocks to the growth rate of productivity à la Aguiar and Gopinath (2007). The paper otherwise mainly relates to the literature on global imbalances and, more generally, the direction of capital flows. One branch of research approaches global imbalances from the perspective of financial market frictions. Examples of this approach are Caballero et al. (2008), Mendoza et al. (2007) and Coeurdacier et al. (2015). Another line of research emphasizes the return equalizing effects of goods markets frictions on capital flows. This paper differs from these approaches in that it places central emphasis on trade and labor market frictions. My argument is close to Obstfeld and Rogoff (2000) and Eaton et al. (2016) in emphasizing the role of trade costs. It differs from these papers in that it assigns a key role to output composition shifts. It finds that the interaction of labor market and trade frictions can explain why the massive initial investments that the standard theories predict remain empirically unobserved in fast-growing countries. Instead, it suggests an alternative investment response that is hump-shaped and more in line with the empirical behavior.

2. The model

Consider a world with two countries, Home (H) and Foreign (F), each populated by an infinitely lived, representative consumer. Each country produces a tradable (T) and a non-tradable (N) intermediate good with the same technology. The tradable good is traded between countries at zero cost. The representative consumes an aggregate good that may differ in its composition from an aggregate good that is used for investment in each country.

2.1. Firms

The representative firm in the perfectly competitive intermediate sector $n \in [T, N]$ in country $i \in [H, F]$ maximizes profits in every period t ,

$$\pi_{n,t}^i = P_{n,t}^i Y_{n,t}^i - r_{n,t}^i K_{n,t}^i - w_{n,t}^i L_{n,t}^i, \quad (1)$$

where $r_{n,t}^i$ and $w_{n,t}^i$ denote the marginal return to capital and labor, respectively. Output of good n in country i , $Y_{n,t}^i$, is produced with capital, $K_{n,t}^i$, and labor, $L_{n,t}^i$ and is given by:

$$Y_{n,t}^i = [K_{n,t}^i]^\alpha [A_0^i \Gamma_t^i L_{n,t}^i]^{1-\alpha} \quad (2)$$

where $\Gamma_t^i = e^{g_t^i} \Gamma_{t-1}^i = \prod_{s=0}^t e^{g_s^i}$; α is the share of capital and is identical across countries and sectors. The growth rate of productivity is g_t^i . Γ_t^i represents the history of growth since period 0 and follows a stochastic process,

$$g_t^i = (1 - \rho_g)\mu + \rho_g g_{t-1}^i + \epsilon_g^i, \quad (3)$$

where ϵ_g^i represents independently and identically distributed draws from a normal distribution with zero mean; μ is the long-term growth rate; ρ_g governs the persistence of the growth shock. The initial level of labor-productivity, A_0^i , can vary across countries. Firm n 's choice of capital and labor maximize profits and imply the following returns:

$$r_{n,t}^i = \alpha P_{n,t}^i \frac{Y_{n,t}^i}{K_{n,t}^i}; \quad w_{n,t}^i = (1 - \alpha) P_{n,t}^i \frac{Y_{n,t}^i}{L_{n,t}^i}.$$

2.2. Consumers

The representative consumer in country i maximizes the discounted utility from future consumption,

$$U_0^i = E_0 \sum_{t=0}^{\infty} \beta^t \frac{C_{i,t}^{1-\phi}}{1-\phi} \quad (4)$$

where β denotes the discount factor and ϕ the inverse of the intertemporal elasticity of substitution. $C_{i,t}$ denotes the aggregate consumption in country i at time t . Intermediate goods are combined with an elasticity of substitution θ to form two final goods, which are used for consumption, C_t^i , and investment, I_t^i . The consumption good takes the form of

$$C_t^i = [\gamma]^\frac{1}{\theta} [C_{T,t}^i]^{1-\frac{1}{\theta}} + (1 - \gamma)^\frac{1}{\theta} [C_{N,t}^i]^{1-\frac{1}{\theta}}]^\frac{\theta}{\theta-1}, \quad (5)$$

where γ is the share of the tradable good in aggregate consumption. The investment good differs from the consumption good in its share of the intermediate good γ_I and takes the form of

$$I_t^i = [\gamma_I]^\frac{1}{\theta} [I_{T,t}^i]^{1-\frac{1}{\theta}} + (1 - \gamma_I)^\frac{1}{\theta} [I_{N,t}^i]^{1-\frac{1}{\theta}}]^\frac{\theta}{\theta-1}, \quad (6)$$

where γ_I is the share of the tradable good in aggregate consumption. Since the tradable intermediate good is traded without frictions between countries, the price of this good is the same in both countries. Let $P_{N,t}^i$ denote country i 's price of the non-tradable good N in terms of the tradable good, T . Normalize the price of the tradable good $P_{T,t}$ to 1 so that country i 's consumption and investment price indexes are, respectively:

$$P_{C,t}^i = [\gamma 1^{1-\theta} + (1 - \gamma) [P_{N,t}^i]^{1-\theta}]^\frac{1}{1-\theta} \quad (7)$$

$$P_{I,t}^i = [\gamma_I 1^{1-\theta} + (1 - \gamma_I) [P_{N,t}^i]^{1-\theta}]^\frac{1}{1-\theta}. \quad (8)$$

Consumption and investment demand are, respectively, given by

$$C_{T,t}^i = \gamma \left[\frac{1}{P_{C,t}^i} \right]^{-\theta} C_t^i, \quad C_{N,t}^i = (1 - \gamma) \left[\frac{P_{N,t}^i}{P_{C,t}^i} \right]^{-\theta} C_t^i, \quad (9)$$

$$J_{T,t}^i = \gamma_I \left[\frac{1}{P_{I,t}^i} \right]^{-\theta} I_t^i, \quad J_{N,t}^i = (1 - \gamma_I) \left[\frac{P_{N,t}^i}{P_{I,t}^i} \right]^{-\theta} I_t^i, \quad (10)$$

where $J_{n,t}^i$ denotes the amount of good n used for investment and $C_{n,t}^i$ the amount used for consumption. The capital stock evolves over time subject to the following capital adjustment technology:

$$K_{n,t+1}^i = (1 - \delta)K_{n,t}^i + I_{n,t}^i - \frac{\psi_K}{2} \left[\frac{K_{n,t+1}^i}{K_{n,t}^i} - e^{\mu g} \right]^2 K_{n,t}^i \quad (11)$$

where δ denotes the depreciation rate. Aggregate investment equals the sum of the sectoral investments in each country, i ,

$$I^i = \sum_n I_{n,t}^i. \quad (12)$$

For simplicity, I assume a simple bond economy. Let B_t^i denote country i 's holdings of international bonds. Let ζ_t denote the price of the international bond. In this system the law of motion for bonds is non-stationary. To render the model stationary, I make the bond price dependent on the risk free foreign interest rate, $r_{B,t}$, and a parameter, ψ_B , that makes the price sensitive to the overall level of debt,

$$\zeta_t = \frac{1 - \psi_B B_t}{1 + r_t^B}.$$

Consumer i maximizes expected future utility, given in Eq. (4), subject to the following constraint:

$$w_{N,t}^i L_{N,t}^i + r_{N,t}^i K_{N,t}^i + w_{T,t}^i L_{T,t}^i + r_{T,t}^i K_{T,t}^i = P_{I,t}^i I_{N,t}^i + P_{I,t}^i I_{T,t}^i + P_{N,t}^i C_{N,t}^i + C_{T,t}^i + \zeta_t B_{t+1}^i - B_t^i + \Psi_{L,t}^i,$$

where bonds are denominated in units of the tradable good. The usual transversality condition is assumed to hold. Labor movements within economies are subject to a re-allocation friction,

$$\Psi_{L,t}^i = \Gamma_t^i A_t^i \frac{\psi_L}{2} \left[\frac{L_{T,t}^i}{L_{T,t-1}^i} - 1 \right]^2 L_{T,t-1}^i + \Gamma_t^i A_t^i \frac{\psi_L}{2} \left[\frac{L_{N,t}^i}{L_{N,t-1}^i} - 1 \right]^2 L_{N,t-1}^i, \quad (13)$$

where ψ_L is the labor adjustment cost parameter. I assume that the consumer bears the costs of the labor re-allocations.

2.3. Market clearing

I normalize the aggregate labor supply to unity. The sum of labor allocated across sectors equals the aggregate labor supply:

$$L_t^i = \sum_n L_{n,t}^i. \quad (14)$$

Market clearing for non-tradable goods, N , requires that demand plus adjustment costs equals supply in each country i :

$$P_{N,t}^i Y_{N,t}^i = P_{N,t}^i J_{N,t}^i + P_{N,t}^i C_{N,t}^i + \Gamma_t^i A_t^i \frac{\psi_L}{2} \left[\frac{L_{N,t}^i}{L_{N,t-1}^i} - 1 \right]^2 L_{N,t-1}^i. \quad (15)$$

Table 1
Simulation parameters.

Consumers	$\beta = 0.97, \phi = 2, \gamma = 0.5, \theta = 0.5$
Firms	$\alpha = 0.33, \theta = 0.5, \gamma_I = 0.5$
Labor adjustment	$\psi_L = 2, \psi_K = 2$
Stochastic process	$\rho = 0.9, \mu = 0.02$

Market clearing for tradable goods, T , requires that world demand plus adjustment costs equals world supply:

$$\sum_i Y_{T,t}^i = \sum_i C_{T,t}^i + \sum_i J_{T,t}^i + \sum_i \Gamma_t^i A_t^i \frac{\psi_L}{2} \left[\frac{L_{T,t}^i}{L_{T,t-1}^i} - 1 \right]^2 L_{T,t-1}^i. \quad (16)$$

Finally, bond market clearing implies that

$$\sum_i B_t^i = 0. \quad (17)$$

2.4. Equilibrium

A competitive equilibrium in period t is a combination of quantities $C_{n,t}^i, J_{n,t}^i, K_{n,t}^i, L_{n,t}^i, Y_{n,t}^i, B_{n,t}^i$ and prices $w_{n,t}^i, r_{n,t}^i, P_{n,t}^i, P_{C,t}^i, P_{I,t}^i, \zeta_t$ for $n \in [T, N]$ and $i \in [H, F]$ given a level of development determined by Γ_t^i such that (i) $K_{n,t}^i, L_{n,t}^i$ solve the maximization problem of firm n in perfectly competitive intermediate goods markets taking $P_{n,t}^i$ as given (ii) $C_{t+j}^i, L_{n,t+j}^i, K_{n,t+j+1}^i, I_{n,t+j}^i, B_{n,t+j+1}^i$ solve the representative consumer i 's intertemporal maximization problem (iii) $C_{n,t}^i$ and $J_{n,t}^i$ solve the representative consumer i 's intratemporal maximization problem (iv) markets clear.

As this is a stochastic two-country framework, I cannot obtain an analytical solution. I therefore present the model dynamics employing numerical procedures. In order to simulate the model, I have to make it stationary. I therefore de-trend the system of equations by Γ_{t-1}^F , the productivity growth rate of the faster growing country.

3. Quantitative analysis

To illustrate the main mechanism explained in the introduction, I simulate the model above using a set of standard parameters. Table 1 shows these parameters.

The results presented in the following section can be interpreted as a lower bound of the power of the mechanism. The discount rate β is set to 0.97. The intertemporal elasticity of substitution $1/\phi$ is set to 0.5 and the depreciation rate δ at 0.05. The tradable share in consumption γ is set to 0.5. As in [Stockman and Tesar \(1995\)](#) I assume that tradable and non-tradable goods are complements and, therefore, choose a goods elasticity of substitution θ of 0.5. The debt elasticity parameter ψ_B is set to .001 following [Schmitt-Grohé and Uribe \(2003\)](#) and [Neumeyer and Perri \(2005\)](#). The share of capital in production α is set to 0.33 which reflects a cross-country average based on the estimates in [Gollin \(2002\)](#). The main parameters of interest, the share of tradable investment γ_I , and the degree of labor adjustment costs ψ_L are varied in the simulations. The degree of capital adjustment costs, ψ_K , is varied as well.

As a typical empirical long-run scenario, I simulate a growth shock to Foreign that mimics a persistent growth differential between emerging markets and developed countries. I set the persistence to $\rho = 0.9$ to mimic a multi-year growth differential and the long-run growth rate of both country-groups to $\mu = 0.02$.

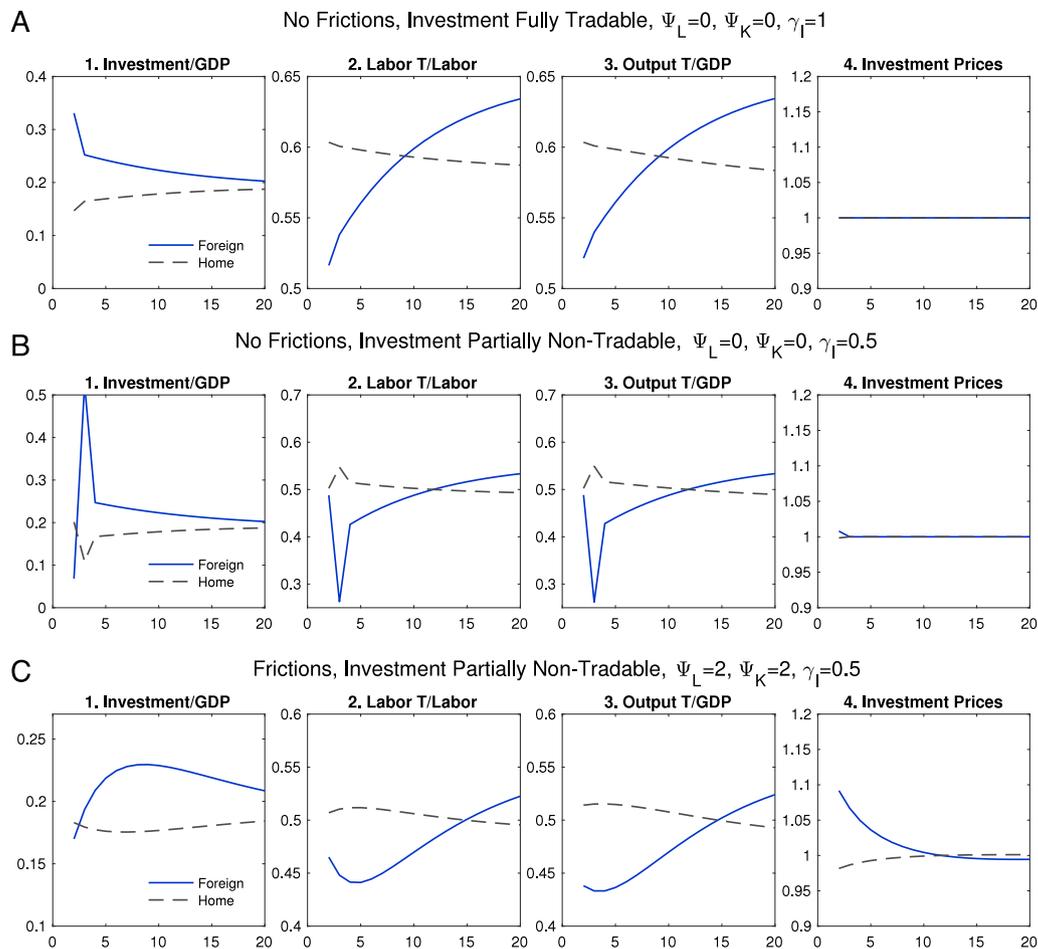


Fig. 2. Note: the table shows the responses to a persistent 4% increase in Foreign's growth rate. The model common parameters are: the discount factor is $\beta = 0.97$; the depreciation rate $\delta = 0.05$; the intertemporal elasticity of substitution is set to $1/\phi = 0.5$; the share of capital in production $\alpha = 0.33$; the shock persistence is $\rho = 0.9$, the long-term growth rate is set to $\mu = 0.02$; All remaining parameters vary across A, B and C. The results are discussed in Section 3.1.

3.1. Model dynamics

I now focus on a sudden (unexpected) 4% increase in Foreign's productivity growth rate. This change fades out slowly over time. Foreign initially starts with a low level of labor productivity relative to Home, i.e. $A_0^H > A_0^F$. More specifically, I set Foreign's initial labor productivity to 20% of Home's. Figs. 2 and 3 display the key impulse responses for Home and Foreign.

Row A of Fig. 2 shows the responses for a frictionless neoclassical model, in which consumption is partially non-tradable but investment is fully tradable. This model serves as my benchmark. More specifically, I use the following parameters: $\beta = 0.97$, $\phi = 2$, $\theta = 0.5$, $\alpha = 0.33$, $\theta = 0.5$, $\gamma = 0.5$, $\gamma_I = 1$, $\psi_L = 0$, $\psi_K = 0$, $\rho = 0.9$ and $\mu = 0.02$. The main takeaway from these simulations is that Foreign experiences a massive, front-loaded increase in investment in response to a growth shock. This increase is inconsistent with the response portrayed by Fig. 1.

What is the intuition in the benchmark model? As alluded to earlier in the introduction, the sudden increase in the expected future growth rate of Foreign means the returns to capital vastly increase. To bring down returns to capital, investment shoots up. Once investment has equalized the returns to capital, it rapidly falls back to its original level. Hence, we observe a monotonically declining response.

Row B of Fig. 2 shows the responses to the same model but this time with investment also being partially non-tradable, i.e. $\gamma_I = 0.5$. The responses are qualitatively very different, as labor has to reallocate initially. In particular, Panels B.1 and B.2 show that only

after labor has reallocated to the non-tradable sector in Foreign, investment spikes. Nonetheless, these responses differ very much from the ones shown by Fig. 1.

Row C of Fig. 2 shows the responses to the model employed in row B but this time with labor and capital market frictions, i.e. $\psi_L = 2$ and $\psi_K = 2$. The responses are qualitatively different, as labor now reallocates slowly. As a result, investment's response is hump-shaped as the ones shown in Fig. 1.

Row D of Fig. 3 shows the responses to the model of row C of Fig. 2 but this time with a higher degree of labor adjustment costs, i.e. $\psi_L = 4$. The responses are qualitatively very similar to before. Yet, the investment price response (Panel D.4) is slightly stronger and therefore the hump is slightly lower.

Row E of Fig. 3 shows the responses to the model of row C of Fig. 2 but this time with lower capital adjustment costs, i.e. $\psi_K = 0.5$. The responses are qualitatively similar to before, yet, the hump-shape of investment is quantitatively more pronounced.

Row F of Fig. 3 shows the responses to the model of row C of Fig. 2 but this time without capital adjustment costs, i.e. $\psi_K = 0.0$. The responses are qualitatively similar to before, yet, the hump-shape of investment is quantitatively more pronounced.

As the simulations show, a hump-shaped investment response can already be generated with a modest degree of labor adjustment costs, i.e. $\psi_L = 2$. Why? In this model, labor has to allocate back and forth in both Home and Foreign. Thus, even if the actual adjustment costs are low, the fact that labor has to move four times is quite costly. Nonetheless, high labor adjustment costs are plausible empirically in my view. Moving between industries is

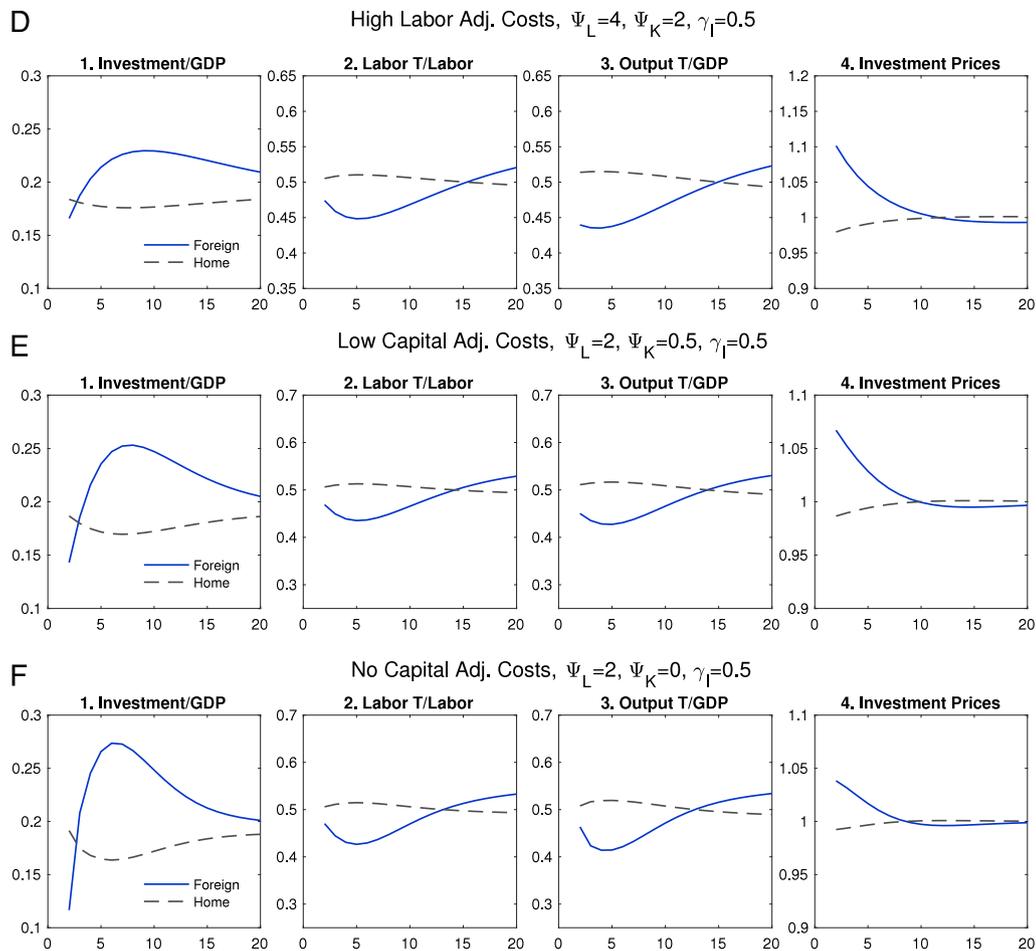


Fig. 3. Note: the table shows the responses to a persistent 4% increase in Foreign's growth rate. The model common parameters are: the discount factor is $\beta = 0.97$; the depreciation rate $\delta = 0.05$; the intertemporal elasticity of substitution is set to $1/\phi = 0.5$; the share of capital in production $\alpha = 0.33$; the shock persistence is $\rho = 0.9$, the long-term growth rate is set to $\mu = 0.02$; All remaining parameters vary across D, E and F. The results are discussed in Section 3.1.

difficult for workers as (in reality) it requires the accumulation of new skills, reallocation and potentially lower career prospects.

4. Conclusion

This paper highlighted the role of labor market frictions in equalizing cross-country returns to capital. It showed that the increase of the productivity growth rate of a country causes a hump-shaped response of investment. This response has empirical support and contrasts with the prediction of the standard neoclassical model of a large initial increase in investment that is followed by a rapid decline. At the core of the mechanism is a price effect. The inability of labor to reallocate quickly within economies results in scarcities of non-tradable goods that are reflected in a temporarily higher non-tradable price. This price movement equalizes returns to capital in the absence of capital inflows.

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References

- Aguiar, M., Gopinath, G., 2007. Emerging market business cycles: The cycle is the trend. *J. Polit. Econ.* 115, 69–102.
- Backus, D.K., Kehoe, P.J., Kydland, F.E., 1992. International real business cycles. *J. Polit. Econ.* 100 (4), 745–775.
- Backus, D.K., Kehoe, P.J., Kydland, F.E., 1994. Dynamics of the trade balance and the terms of trade: The j-curve? *Amer. Econ. Rev.* 84 (1), 84–103.
- Caballero, R.J., Farhi, E., Gourinchas, P.-O., 2008. An equilibrium model of “global imbalances” and low interest rates. *Amer. Econ. Rev.* 98 (1), 358–393.
- Coeurdacier, N., Guibaud, S., Jin, K., 2015. Credit constraints and growth in a global economy. *Amer. Econ. Rev.* 105 (9), 2838–2881.
- Eaton, J., Kortum, S., Neiman, B., 2016. Obstfeld and rogooffs international macro puzzles: a quantitative assessment. *J. Econom. Dynam. Control* 72, 5–23.
- Gollin, D., 2002. Getting income shares right. *J. Polit. Econ.* 110 (2), 458–474.
- Gourinchas, P.-O., Jeanne, O., 2013. Capital flows to developing countries: The allocation puzzle. *Rev. Econom. Stud.*
- Mendoza, E.G., Quadrini, V., Rios-Rull, J.-V., 2007. Financial integration, financial deepness and global imbalances. National Bureau of Economic Research Working Paper Series, No. 12909.
- Neumeyer, P.A., Perri, F., 2005. Business cycles in emerging economies: the role of interest rates. *J. Monetary Econ.* 52 (2), 345–380.
- Obstfeld, M., Rogoff, K., 2000. The six major puzzles in international macroeconomics: Is there a common cause? National Bureau of Economic Research Working Paper Series, No. 7777.
- Schmitt-Grohé, S., Uribe, M., 2003. Closing small open economy models. *J. Int. Econ.* 61 (1), 163–185.
- Stockman, A.C., Tesar, L.L., 1995. Tastes and technology in a two-country model of the business cycle: Explaining international comovements. *Amer. Econ. Rev.* 85 (1), 168–185.