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Gianluca Benigno, Luca Fornaro and Martin Wolf

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Abstract

Since the late 1990s, the United States has received large capital flows from developing countries - a phenomenon known as the global saving glut - and experienced a productivity growth slowdown. Motivated by these facts, we provide a model connecting international financial integration and global productivity growth. The key feature is that the tradable sector is the engine of growth of the economy. Capital flows from developing countries to the United States boost demand for U.S. non-tradable goods, inducing a reallocation of U.S. economic activity from the tradable sector to the non-tradable one. In turn, lower profits in the tradable sector lead firms to cut back investment in innovation. Since innovation in the United States determines the evolution of the world technological frontier, the result is a drop in global productivity growth. This effect, which we dub the global financial resource curse, can help explain why the global saving glut has been accompanied by subdued investment and growth, in spite of low global interest rates.

JEL Codes: E44, F21, F41, F43, F62, O24, O31.

Keywords: global saving glut, global productivity growth, international financial integration, capital flows, U.S. productivity growth slowdown, low global interest rates, Bretton Woods II, export-led growth.

*Gianluca Benigno: HEC Lausanne and CEPR; gianluca.benigno@unil.ch. Luca Fornaro: CREI, Universitat Pompeu Fabra, Barcelona School of Economics and CEPR; LFornaro@crei.cat. Martin Wolf: University of St Gallen and CEPR; martin.wolf@unisg.ch. We thank Ricardo Caballero, Ernest Liu, Guido Lorenzoni, Vincenzo Quadrini, Romain Ranciere, Helene Rey, Felipe Saffie, Paul Schaudt, Liliana Varela, Ivan Werning and seminar/conference participants at the 2020 AEA Annual Meeting, the University of Tübingen, the University of Vienna, the University of St. Gallen, LSE, CREI, University of Michigan, MIT, Northwestern University, Royal Holloway, LBS, NBER IFM meeting, SED meeting, National University of Singapore, EU Commission, University of Maryland and Peking University for very helpful comments. We thank Diego Bohorquez, Lauri Esala, Camilo Marchesini and Serra Pelin for excellent research assistance. Luca Fornaro acknowledges financial support from the European Research Council Starting Grant 851896 and the Spanish Ministry of Economy and Competitiveness, through the Severo Ochoa Programme for Centres of Excellence in R&D (SEV-2015-0563).

1 Introduction

There is a large literature in international macroeconomics studying the impact of productivity growth on the pattern of international capital flows. In this paper, we reverse this classic perspective by considering how international capital flows shape global productivity growth. We are motivated by the fact that since the late 1990s the United States has received large capital flows from developing countries, mainly China and other Asian countries, a phenomenon known as the global saving glut (Figure 1a). Although much has been written about the causes and macroeconomic consequences of this saving glut, its implications for global productivity growth are yet poorly understood.

Conventional wisdom suggests that cheap capital inflows should, at least in part, help firms to finance investment and increase their productivity. One could then expect that the global saving glut coincided with a rise in U.S. investment and productivity growth. Since the early 2000s, however, the United States has experienced a productivity growth slowdown (Figure 1b).[1] Moreover, the international evidence shows that episodes of large capital inflows are often followed by slowdowns in productivity growth, calling into question the conventional logic.[2] So could it be that capital flows from developing countries to the United States ended up not contributing much - or even depressing - U.S. productivity growth? If so, given the U.S. status as one of the world technological leaders, what would be the effect of the saving glut on global growth?

In this paper, we tackle these questions by providing two main contributions. First, we develop a novel endogenous growth model to study the impact of international financial integration on global productivity growth.[3] Second, we explore a channel through which a global saving glut originating from developing countries may, perhaps paradoxically, depress productivity growth in the United States, and eventually in the rest of world as well. For reasons that will become clear below, we dub this effect the global financial resource curse.

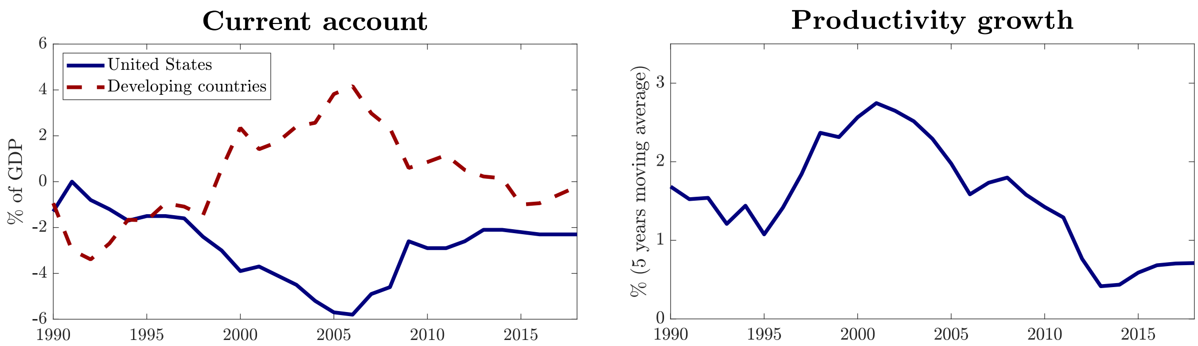
Our model is composed of two regions: the United States and developing countries. As in standard models of technology diffusion (Krugman, 1979; Grossman and Helpman, 1991), innovation activities by the technological leader, i.e. the United States, determine the evolution of the world technological frontier. Developing countries, in contrast, grow by absorbing knowledge originating from the United States. Therefore, investments by firms in developing countries affect their proximity to the technological frontier.

Compared to standard frameworks of technology diffusion, our model has two novel features. The first one is that sectors producing tradable goods are the engine of growth in our economy.

[1] Of course, the literature has described several factors - independent of capital flows - that have contributed to the U.S. productivity growth slowdown. We discuss the relationship of our paper to this body of work in the literature review, at the end of the introduction.

[2] For instance, Gourinchas and Jeanne (2013) observe that among developing countries the fast growers are typically characterised by capital outflows, while slow growers tend to receive capital inflows. Benigno and Fornaro (2014) and Gopinath et al. (2017) discuss the case of euro area peripheral countries during the first ten years of the euro, in which large capital inflows have coincided with productivity growth slowdowns.

[3] To clarify, in this paper we are interested in isolating the impact of financial integration on global growth. We abstract, instead, from other forces commonly linked to globalization, most notably trade integration. Hence, throughout our analysis we hold the level of trade integration constant.



(a) Global saving glut. **(b) U.S. productivity growth slowdown.**

Figure 1: Motivating facts. Notes: The left panel shows the large current account deficits experienced by the United States since the late 1990s, accompanied by current account surpluses from developing countries. The right panel illustrates the productivity growth slowdown affecting the United States since the early 2000s. See Appendix A for the procedure used to construct these figures.

That is, in both regions productivity growth is the result of investment by firms operating in the tradable sector. The non-tradable sector, instead, is characterized by stagnant productivity growth. As we explain in more detail below, this assumption captures the notion that sectors producing tradable goods, such as manufacturing, have more scope for productivity improvements compared to sectors producing non-tradables, for instance construction.[4] The second feature is that agents in developing countries have a higher propensity to save compared to U.S. ones. Again as we discuss below, the literature has highlighted a host of factors contributing to high saving rates in developing countries, such as demography, lack of insurance or government interventions.

Against this background, we consider a global economy moving from a regime of financial autarky to international financial integration. Due to the heterogeneity in propensities to save across the two regions, once financial integration occurs the United States receives capital inflows from developing countries. Capital inflows allow U.S. agents to finance an increase in consumption. Higher consumption of tradables is achieved by increasing imports of tradable goods from developing countries, and so the United States ends up running persistent trade deficits. But non-tradable consumption goods have to be produced domestically. Hence, in response to the rise in demand for non-tradable goods, factors of production migrate from the tradable sector toward the non-tradable one. As the share of global demand captured by tradable firms in the U.S. declines, their profits drop, reducing their incentives to invest in innovation. The consequent drop in investment results in a slowdown in U.S. productivity growth. Therefore, in contrast with the conventional wisdom, cheap capital inflows depress investment and productivity growth, because they end up financing a boom in the non-tradable sector.[5]

[4]In Section 5 we explore a version of the model in which productivity grows endogenously also in the non-tradable sector. There we show that our key results hold, as long as the tradable sector is characterized by faster productivity growth than the non-tradable one. As we discuss in that section, this is the case in the data.

[5]In the model, a second force is at work. Capital inflows lower firms' cost of funds, thus fostering their incentives to invest. However, as we will show, this effect is dominated by the fall in the return to investment caused by lower economic activity and profits in the tradable sector.

To some extent, developing countries experience symmetric dynamics compared to the United States. Financial integration leads developing countries to run persistent trade surpluses. This stimulates economic activity in the tradable sector, at the expense of the non-tradable one. In turn, higher profits in the tradable sector induce firms in developing countries to increase their investment in technology adoption. The proximity of developing countries to the technological frontier thus rises. But this does not necessarily mean that financial integration benefits productivity growth in developing countries. Following financial integration, indeed, productivity growth in developing countries initially accelerates, but then it slows down below its value under financial autarky. The explanation is that the drop in innovation activities in the U.S. reduces the productivity gains that developing countries can obtain by absorbing knowledge from the frontier. Therefore, in the long run the process of financial integration - and the associated saving glut - generates a fall in global productivity growth.[6]

Perhaps paradoxically, in our framework cheap access to foreign capital by the world technological leader depresses global productivity growth in the long term. The reason is that capital inflows lead to a contraction in economic activity in tradable sectors, which are the engine of growth in our economies. In this respect, our model is connected to the idea of natural resource curse (Krugman, 1987; Van der Ploeg, 2011). However, our mechanism is based on financial - rather than natural - resources. Moreover, the forces that we emphasize are global in nature. In fact, lower innovation by the technological leader drives down productivity growth also in the rest of the world, including in those countries experiencing capital outflows and an expansion of their tradable sectors. For these reasons, we refer to the link between capital flows toward the world technological leader and weak global growth as the *global financial resource curse*.

Relatedly, it has been argued that the United States' ability to attract foreign capital represents an exorbitant privilege, which benefits U.S. citizens by allowing them to consume more than what they produce. Our model paints a more nuanced picture, in which the impact of capital inflows on welfare is a priori ambiguous. The reason is that capital inflows may exacerbate private firms' tendency to underinvest in innovation and knowledge creation compared to the social optimum. When this effect is strong enough, capital inflows end up lowering welfare, and the exorbitant privilege morphs into an exorbitant burden.[7]

Our model also helps to rationalize the sharp decline in global rates observed over the last three decades. Some commentators have claimed that the integration of high-saving developing countries in global credit markets has contributed to depress interest rates around the world, by triggering a global saving glut (Bernanke, 2005). This effect is also present in our framework, but in a magnified form. In standard models, after two regions integrate financially the equilibrium interest rate lies somewhere between the two autarky rates. In our model, instead, financial integration induces a drop in the equilibrium interest rate below both autarky rates. In fact, lower global growth leads

[6]In Appendix A.3 we show that productivity growth in a sample of developing countries accelerated in the early phases of the global saving glut, but later experienced a mild slowdown.

[7]Our concept of exorbitant burden is related to the view put forward by Pettis (2011), that the exorbitant privilege hurts the U.S. by reducing the competitiveness of its manufacturing sector.

agents to increase their saving supply, exerting downward pressure on interest rates. Because of this effect, financial integration and the global saving glut lead to a regime of superlow global rates, in which investment and productivity growth are depressed.

We then revisit some prominent debates in international macroeconomics. First, we consider the impact of capital inflows from developing countries to the U.S. on the dollar (Obstfeld and Rogoff, 2005). We show that the response may be non-monotonic, and characterized by an initial appreciation of the dollar, giving way to a depreciation in the medium to long run. We then consider export-led growth by developing countries, that is the idea that technology adoption can be fostered by policies that stimulate trade balance surpluses and capital outflows (Dooley et al., 2004). We show that export-led growth might be successful at raising productivity growth in developing countries in the medium run. However, this comes at the expenses of a fall in innovation activities in the United States, which eventually produces a drop in global productivity growth. We finally turn to innovation policies. We show that policies that sustain innovation activities can play a crucial role in insulating U.S. - and more broadly global - productivity growth from the adverse impact of the global saving glut.

In the last part of the paper, we provide evidence in support of the economic forces highlighted by our model. First, we show that in the data capital inflows are associated with lower economic activity in the manufacturing sector and lower productivity growth. These empirical correlations are in line with our notion of financial resource curse. Second, we perform a quantitative analysis by calibrating our model to match some key statistics for the United States. The robust result of this exercise is that capital inflows may trigger a substantial decline in economic activity in the tradable sector and in aggregate productivity growth. The precise magnitude of these effects, however, depends on how the innovation process is specified.

Related literature. This paper unifies two strands of the literature that have been traditionally separated. First, there is a literature studying the macroeconomic consequences of financial globalization, and in particular of the integration of high-saving developing countries in the international financial markets. For instance, Caballero et al. (2008) and Mendoza et al. (2009) provide models in which the integration of developing countries in global credit markets leads to an increase in the global supply of savings and a fall in global rates. Caballero et al. (2015), Eggertsson et al. (2016) and Fornaro and Romei (2019) show that in a world characterized by deficient demand financial integration can lead to a fall in global output. This paper contributes to this literature by studying the impact of the global saving glut on global productivity growth.

Second, there is a vast literature on the impact of globalization on productivity growth. One part of this literature has argued that globalization increases global productivity growth by facilitating the flow of ideas across countries (Howitt, 2000). Another body of work has focused on the impact of trade globalization on productivity (Grossman and Helpman, 1991; Rivera-Batiz and Romer, 1991; Atkeson and Burstein, 2010; Akcigit et al., 2018; Cuñat and Zymek, 2019). We complement this literature by studying the impact of *financial globalization* on productivity growth.

The paper is also related to a third literature, which connects capital flows to productivity. In Ates and Saffie (2016), Benigno et al. (2022) and Queralto (2019) sudden stops in capital inflows depress productivity growth. In Gopinath et al. (2017) and Cingano and Hassan (2019) capital flows affect productivity by changing the allocation of capital across heterogeneous firms. Studying an episode of capital account liberalization in Hungary, Varela (2018) finds that better access to credit helped financially constrained firms to increase their investment in technology adoption and their productivity.[8] Rodrik (2008), Benigno et al. (2022); Benigno and Fornaro (2014) and Brunnermeier et al. (2018) study single small open economies and show that capital inflows might negatively affect productivity by reducing innovation activities in the tradable sector.[9] Rodrik and Subramanian (2009) argue that this effect explains why the integration of developing countries in the international financial markets has been associated with disappointing growth performances. Our paper builds on this insight, but takes a global perspective. In particular, due to their impact on the world technological frontier, in our model capital flows out of developing countries can induce a drop in global productivity growth. Coeurdacier et al. (2020) study the impact of financial integration on global growth, using a two-country neoclassical growth model. Their framework focuses on capital accumulation and takes productivity growth as an exogenous force, while in our model the endogenous response of productivity growth to financial integration is crucial.

The paper is also connected to the literature studying the impact of capital flows on the sectoral allocation of production. Benigno et al. (2015) and Kalantzis (2015) analyse empirically episodes of large capital inflows, and find that they are characterized by a shift of labor and capital out of the manufacturing sector.[10] Pierce and Schott (2016) document a sharp drop in U.S. employment in manufacturing starting from the early 2000s, and thus coinciding with the surge in capital inflows from developing countries.[11] Interestingly, over the same period, productivity growth in

[8]Notice that this finding is consistent with our framework. In our model, keeping everything else constant, better access to credit fosters firms' investment in innovation. The negative relationship between capital inflows and productivity growth arises because - through a general equilibrium effect - capital inflows depress the return from investing in innovation in the tradable sector.

[9]The notion of financial resource curse, defined as the joint occurrence of large capital inflows and weak productivity growth, was introduced in Benigno and Fornaro (2014) by a subset of the authors of this paper. There are, however, stark differences between this paper and Benigno and Fornaro (2014). Benigno and Fornaro (2014) focus on a single small open economy, receiving an exogenous inflow of foreign capital. Instead, here we take a global perspective, and study the impact on the global economy of capital flows from developing countries to the technological leader. We show that in this case also those countries experiencing capital outflows, which should grow faster according to the logic of Benigno and Fornaro (2014), will eventually see their productivity growth slowing down. Moreover, in the current framework we consider the implications for global interest rates, which were taken as exogenous in Benigno and Fornaro (2014), and study the global impact of export-led growth by developing countries, of a sudden stop hitting the U.S., and of restrictions on capital inflows by the United States. Another difference is that in Benigno and Fornaro (2014) growth was the unintentional byproduct of learning by doing. Here, as in the modern endogenous growth literature, productivity growth is the result of investment in innovation by profit-maximizing firms.

[10]Relatedly, Broner et al. (2019) find that exogenous rises in capital inflows in developing countries are associated with lower profits earned by firms operating in the tradable sector. Saffie et al. (2020) find that capital inflows following the financial liberalization in Hungary in 2001 led to lower value added and employment in the manufacturing sector, but to higher value added and employment in the service sector.

[11]Of course, due to structural transformation, since the end of WWII in the United States there has been a secular decline in the manufacturing share of employment. The literature on structural transformation usually interprets the decline in manufacturing employment as the outcome of faster productivity growth in manufacturing compared to other sectors (Ngai and Pissarides, 2007). Therefore, the models developed by this literature cannot explain why

manufacturing fell sharply (Syverson, 2016). More broadly, Mian et al. (2019) show that increases in credit supply tend to boost employment in non-tradable sectors at the expenses of tradable ones. In a very interesting recent paper, Müller and Verner (2023) document how credit booms geared toward the non-tradable sector are typically followed by slowdowns in productivity growth, lending empirical support to one of the key mechanisms of the model. Furthermore, Richter and Diebold (2021) find that credit booms financed by foreign capital flows are particularly likely to be followed by drops in output growth in the medium run. All this evidence is consistent with the predictions of our model.

Finally, this paper contributes to the recent literature exploring the causes of the U.S. productivity growth slowdown. This literature has focused on different possibilities, such as rising costs from discovering new ideas (Bloom et al., 2020), slower technology diffusion from frontier to laggard firms (Akcigit and Ates, 2020), rising firms' entry costs (Aghion et al., 2023), falling interest rates leading to low competition (Liu et al., 2019) or discouraging intangible investment financed through internal savings (Caggese and Pérez-Orive, 2020), and weak aggregate demand leading to low profits from investing in innovation (Anzoategui et al., 2019; Benigno and Fornaro, 2018). Our paper provides a complementary explanation, based on the interaction of capital flows and the sectoral allocation of production. Our paper is also different from this literature because it shows how cheap access to capital - which the conventional wisdom would associate with higher investment and faster growth - may surprisingly end up depressing productivity growth.

The rest of the paper is structured as follows. Section 2 introduces the model. Section 3 presents our main results, by studying the impact of financial integration on global growth. Section 4 provides some empirical evidence consistent with the model. Section 5 extends the model in several directions and illustrates its quantitative properties. Section 6 concludes. The proofs to all the propositions are collected in the Appendix.

2 Baseline model

Consider a world composed of two regions: the United States and a group of developing countries.[12] The two regions are symmetric except for two aspects. First, developing countries have a higher propensity to save compared to the United States. Second, innovation in the U.S. determines the evolution of the world technological frontier. Developing countries, instead, experience productivity growth by adopting discoveries originating from the United States. In what follows, we will refer to the U.S. as region u and to developing countries as region d. For simplicity, we will focus on a perfect-foresight economy. Time is discrete and indexed by $t \in \{0, 1, ...\}$.

manufacturing has experienced a fall in both employment and productivity growth during the global saving glut. In Section 5.4, we embed structural change in our framework and show that capital inflows accelerate the decline in the manufacturing employment share, and reduce productivity growth over the medium run.

[12] There is no need to specify the number of developing countries. For instance, our results apply to the case of a single large developing country, or to a setting in which there is a continuum of measure one of small open developing countries.

2.1 Households

Each region is inhabited by a measure one of identical households. The lifetime utility of the representative household in region i is

$$\sum_{t=0}^{\infty} \beta^t \log(C_{i,t}), \tag{1}$$

where $C_{i,t}$ denotes consumption and $0 < \beta < 1$ is the subjective discount factor. Consumption is a Cobb-Douglas aggregate of a tradable good $C_{i,t}^T$ and a non-tradable good $C_{i,t}^N$, so that $C_{i,t} = (C_{i,t}^T)^\omega (C_{i,t}^N)^{1-\omega}$ where $0 < \omega < 1$. Each household is endowed with $\bar{L}$ units of labor, and there is no disutility from working.

Households can trade in one-period riskless bonds. Bonds are denominated in units of the tradable consumption good and pay the gross interest rate $R_{i,t}$. Moreover, investment in bonds is subject to a subsidy $\tau_{i,t}$. This subsidy is meant to capture a variety of factors, such as demography or policy-induced distortions, affecting households' propensity to save. This feature of the model allows us to generate, in a stylized but simple way, heterogeneity in saving rates across the two regions. In particular, we are interested in a scenario in which developing countries have a higher propensity to save compared to the United States. We thus normalize $\tau_{u,t} = 0$ and assume that $\tau_{d,t} = \tau > 0$.[13]

The household budget constraint in terms of the tradable good is

$$C_{i,t}^T + P_{i,t}^N C_{i,t}^N + \frac{B_{i,t+1}}{R_{i,t}(1+\tau_{i,t})} = W_{i,t}\bar{L} + \Pi_{i,t} - T_{i,t} + B_{i,t}. \tag{2}$$

The left-hand side of this expression represents the household's expenditure. $P_{i,t}^N$ denotes the price of a unit of the non-tradable good in terms of the tradable one. Hence, $C_{i,t}^T + P_{i,t}^N C_{i,t}^N$ is the total expenditure in consumption. $B_{i,t+1}$ denotes the purchase of bonds made by the household at time t. If $B_{i,t+1} < 0$ the household is holding a debt.

The right-hand side captures the household's income. $W_{i,t}$ denotes the wage, and hence $W_{i,t}\bar{L}$ is the household's labor income. Labor is immobile across regions and so wages are region-specific. Firms are fully owned by domestic agents, and $\Pi_{i,t}$ denotes the profits that households receive from the ownership of firms. $T_{i,t}$ is a tax paid to the domestic government. We assume that governments run balanced budgets and so $T_{i,t} = \tau_{i,t} B_{i,t+1}/(R_{i,t}(1+\tau_{i,t}))$. Finally, $B_{i,t}$ represents the gross return on investment in bonds made at time $t-1$.

There is a limit to the amount of debt that a household can take. In particular, the end-of-

[13] This feature of the model captures the direction of capital flows, from developing countries to the United States, observed in the data from the late 1990s (see Figure 1a). The literature has proposed several explanations for this fact. In Caballero et al. (2008) developing countries export capital to the U.S. because they are unable to produce enough stores of value to satisfy local demand, due to the underdevelopment of their financial markets. Mendoza et al. (2009) argue that lack of insurance against idiosyncratic shocks contributes to the high saving rates observed in several developing countries. Gourinchas and Jeanne (2013) and Alfaro et al. (2014) show that policy interventions by governments in developing countries - aiming at fostering national savings - explain an important part of the capital outflows toward the United States. For our results we do not need to take a stance on the precise source of high saving rates in developing countries. Our model is thus consistent with all these possible explanations.

period bond position has to satisfy

$$B_{i,t+1} \geq -\kappa_{i,t}, \tag{3}$$

where $\kappa_{i,t} \geq 0$. This constraint captures in a simple form a case in which a household cannot credibly commit in period t to repay more than $\kappa_{i,t}$ units of the tradable good to its creditors in period $t+1$.

The household's optimization problem consists in choosing a sequence $\{C^T_{i,t}, C^N_{i,t}, B_{i,t+1}\}_t$ to maximize lifetime utility (1), subject to the budget constraint (2) and the borrowing limit (3), taking initial wealth $B_{i,0}$, a sequence for income $\{W_{i,t}\bar{L}+\Pi_{i,t}-T_{i,t}\}_t$, and prices $\{R_{i,t}(1+\tau_{i,t}), P^N_{i,t}\}_t$ as given. The household's optimality conditions can be written as

$$\frac{\omega}{C^T_{i,t}} = R_{i,t}(1+\tau_{i,t})\left(\frac{\beta\omega}{C^T_{i,t+1}} + \mu_{i,t}\right) \tag{4}$$

$$B_{i,t+1} \geq -\kappa_{i,t} \quad \text{with equality if} \quad \mu_{i,t} > 0 \tag{5}$$

$$\lim_{k\to\infty} \frac{B_{i,t+1+k}}{R_{i,t}(1+\tau_{i,t})...R_{i,t+k}(1+\tau_{i,t+k})} \leq 0 \tag{6}$$

$$C^N_{i,t} = \frac{1-\omega}{\omega}\frac{C^T_{i,t}}{P^N_{i,t}}, \tag{7}$$

where $\mu_{i,t}$ is the nonnegative Lagrange multiplier associated with the borrowing constraint. Equation (4) is the Euler equations for bonds. Equation (5) is the complementary slackness condition associated with the borrowing constraint. Equation (6) is the terminal condition for bond holdings, ensuring that the household consumes asymptotically all its income.[14] Equation (7) determines the optimal allocation of consumption expenditure between tradable and non-tradable goods. Naturally, demand for non-tradables is decreasing in their relative price $P^N_{i,t}$. Moreover, demand for non-tradables is increasing in $C^T_{i,t}$, due to households' desire to consume a balanced basket between tradable and non-tradable goods.

2.2 Non-tradable good production

The non-tradable sector represents a traditional sector with limited scope for productivity improvements. The non-tradable good is produced by a large number of competitive firms using labor, according to the production function $Y^N_{i,t} = L^N_{i,t}$. $Y^N_{i,t}$ is the output of the non-tradable good, while $L^N_{i,t}$ is the amount of labor employed by the non-tradable sector. The zero profit condition thus requires that $P^N_{i,t} = W_{i,t}$.

[14] Often, this optimality condition is coupled with a constraint ruling out Ponzi schemes to obtain a transversality condition (see for example Obstfeld and Rogoff, 1996). Here, the presence of the borrowing limit (3) makes the no-Ponzi condition redundant. We elaborate further on this point in footnote 26.

2.3 Tradable good production

The tradable good is produced by competitive firms using labor and a continuum of measure one of intermediate inputs $x^j_{i,t}$, indexed by $j \in [0,1]$. Intermediate inputs cannot be traded across the two regions.[15] Denoting by $Y^T_{i,t}$ the output of tradable good, the production function is

$$Y^T_{i,t} = \left(L^T_{i,t}\right)^{1-\alpha} \int_0^1 \left(A^j_{i,t}\right)^{1-\alpha} \left(x^j_{i,t}\right)^{\alpha} dj, \tag{8}$$

where $0 < \alpha < 1$, and $A^j_{i,t}$ is the productivity, or quality, of input j.[16]

Profit maximization implies the demand functions

$$(1-\alpha)\left(L^T_{i,t}\right)^{-\alpha} \int_0^1 \left(A^j_{i,t}\right)^{1-\alpha} \left(x^j_{i,t}\right)^{\alpha} dj = W_{i,t} \tag{9}$$

$$\alpha\left(L^T_{i,t}\right)^{1-\alpha} \left(A^j_{i,t}\right)^{1-\alpha} \left(x^j_{i,t}\right)^{\alpha-1} = P^j_{i,t}, \tag{10}$$

where $P^j_{i,t}$ is the price in terms of the tradable good of intermediate input j. Due to perfect competition, firms producing the tradable good do not make any profit in equilibrium.

2.4 Intermediate goods production and profits

Every intermediate good is produced by a single monopolist. One unit of tradable output is needed to manufacture one unit of the intermediate good, regardless of quality. In order to maximize profits, each monopolist sets the price of its good according to

$$P^j_{i,t} = \frac{1}{\alpha} > 1. \tag{11}$$

This expression implies that each monopolist charges a constant markup $1/\alpha$ over its marginal cost.

Equations (10) and (11) imply that the quantity produced of a generic intermediate good j is

$$x^j_{i,t} = \alpha^{\frac{2}{1-\alpha}} A^j_{i,t} L^T_{i,t}. \tag{12}$$

Combining equations (8) and (12) gives:

$$Y^T_{i,t} = \alpha^{\frac{2\alpha}{1-\alpha}} A_{i,t} L^T_{i,t}, \tag{13}$$

[15] We make this assumption, following the literature on technology diffusion, to generate asymmetries in productivity across the two regions. In the case of a single large developing country, this is equivalent to assuming that intermediate goods are non-tradables. If several developing countries are present, instead, we are effectively assuming that intermediate inputs can be perfectly traded among developing countries. This assumption simplifies the exposition, but our results would hold also if trade of intermediate goods across developing countries was not possible.

[16] More precisely, for every good j, $A^j_{i,t}$ represents the highest quality available. In principle, firms could produce using a lower quality of good j. However, as in Aghion and Howitt (1992), the structure of the economy is such that in equilibrium only the highest quality version of each good is used in production.

where $A_{i,t} \equiv \int_0^1 A^j_{i,t} dj$ is an index of average productivity of the intermediate inputs. Hence, production of the tradable good is increasing in the average productivity of intermediate goods and in the amount of labor employed in the tradable sector. Moreover, the profits earned by the monopolist in sector j are given by

$$P^j_{i,t} x^j_{i,t} - x^j_{i,t} = \varpi A^j_{i,t} L^T_{i,t},$$

where $\varpi \equiv (1/\alpha - 1)\alpha^{2/(1-\alpha)}$. According to this expression, the profits earned by a monopolist are increasing in the productivity of its intermediate input and in employment in the tradable sector. The dependence of profits on employment is due to a market size effect. Intuitively, high employment in the tradable sector is associated with high production of the tradable good and high demand for intermediate inputs, leading to high profits in the intermediate sector.

2.5 Innovation in the United States

In the United States, firms operating in the intermediate sector can invest in innovation in order to improve the quality of their products. In particular, a U.S. firm that employs in innovation $L^j_{u,t}$ units of labor sees its productivity evolve according to[17]

$$A^j_{u,t+1} = A^j_{u,t} + \chi A_{u,t} L^j_{u,t}, \tag{14}$$

where $\chi > 0$ determines the productivity of research. This expression embeds the assumption, often present in the endogenous growth literature, that innovators build on the existing stock of knowledge $A_{u,t}$. This assumption captures an environment in which existing knowledge is non-excludable, so that inventors cannot prevent others from drawing on their ideas to innovate.[18]

Defining firms' profits net of expenditure in research as $\Pi^j_{u,t} \equiv \varpi A^j_{u,t} L^T_{u,t} - W_{u,t} L^j_{u,t}$, firms producing intermediate goods choose investment in innovation to maximize their discounted stream of profits

$$\sum_{t=0}^{\infty} \frac{\beta^t C^T_{u,0}}{C^T_{u,t}} \Pi^j_{u,t},$$

subject to (14). Since firms are fully owned by domestic households, they discount profits using the households' discount factor $\beta^t C^T_{u,0}/C^T_{u,t}$.

From now on, we assume that firms are symmetric and so $A^j_{u,t} = A_{u,t}$. Moreover, we focus on equilibria in which investment in innovation by U.S. firms is always positive. Optimal investment in research then requires

$$\frac{W_{u,t}}{\chi A_{u,t}} = \frac{\beta C^T_{u,t}}{C^T_{u,t+1}} \left(\varpi L^T_{u,t+1} + \frac{W_{u,t+1}}{\chi A_{u,t+1}} \right). \tag{15}$$

[17]In Appendix C we demonstrate that our results are robust toward assuming that investment in innovation is done in terms of the tradable final good (a lab equipment model) rather than in terms of labor.

[18]This assumption, however, is not crucial for our results. We explore the case of partially excludable knowledge in Section 5.

Intuitively, firms equalize the marginal cost from performing research $W_{u,t}/(\chi A_{u,t})$ to its marginal benefit discounted using the households' discount factor. The marginal benefit is given by the increase in next period profits ($\varpi L^T_{u,t+1}$) plus the savings on future research costs ($W_{u,t+1}/(\chi A_{u,t+1})$).

As it will become clear later on, a crucial aspect of the model is that the return from innovation is increasing in the size of the U.S. tradable sector, as captured by $L^T_{u,t+1}$. This happens because higher economic activity in the tradable sector boosts the profits that firms producing intermediate goods enjoy from improving the quality of their products. In this sense, the tradable sector is the engine of growth in our model.

2.6 Technology adoption by developing countries

In developing countries, firms producing intermediate goods improve the quality of their products by adopting technological advances originating from the United States.[19] Following the literature on international technology diffusion (Barro and Sala-i Martin, 1997), we formalize this notion by assuming that firms in developing countries draw on the U.S. stock of knowledge when performing research. Productivity of a generic intermediate input j thus evolves according to

$$A^j_{d,t+1} = A^j_{d,t} + \xi A^{\phi}_{u,t} A^{1-\phi}_{d,t} L^j_{d,t}, \tag{16}$$

where $\xi > 0$ captures the productivity of research in developing countries, and $0 < \phi \leq 1$ determines the extent to which developing countries' firms benefit from the U.S. stock of knowledge. Since we think of the United States as the technological leader and developing countries as the followers, we will focus on scenarios in which $A_{u,t} > A_{d,t}$ for all t.[20]

Firms producing intermediate goods in developing countries choose investment in research to maximize their stream of profits, net of research costs, subject to (16). We restrict attention to equilibria in which firms in developing countries are symmetric ($A^j_{d,t} = A_{d,t}$), and their investment in technology adoption is always positive. Optimal investment in research then requires

$$\frac{W_{d,t}}{\xi A^{\phi}_{u,t} A^{1-\phi}_{d,t}} = \frac{\beta C^T_{d,t}}{C^T_{d,t+1}} \left(\varpi L^T_{d,t+1} + \frac{W_{d,t+1}}{\xi A^{\phi}_{u,t+1} A^{1-\phi}_{d,t+1}} \right). \tag{17}$$

As it was the case for the U.S., optimal investment in research equates the marginal cost from investing to its marginal benefit.[21] The difference is that for developing countries the marginal cost

[19] This assumption captures the idea that, due to institutional features, the United States enjoys a strong comparative advantage in conducting innovation activities compared to developing countries. In fact, available empirical evidence on international patents citations suggests that the U.S. is a major knowledge exporter, while developing countries tend to import knowledge from abroad (Liu and Ma, 2021). In Appendix E we study a version of the model in which innovation may take place in developing countries too.

[20] In Appendix E we consider an alternative scenario, in which developing countries technologically leapfrog the U.S. in the long run.

[21] Notice that we are assuming that profits are discounted at rate $\beta^t C^T_{d,0}/C^T_{d,t}$. This corresponds to a case in which the subsidy on savings τ is restricted to investment in bonds only. Alternatively, we could have assumed that the subsidy on savings applies also to investment in research. Our main insights would also apply to this alternative setting. The only wrinkle is that then we would have to assume, as in Benigno and Fornaro (2018), that every firm has a constant probability of losing its stream of monopoly profits (perhaps because its technology is copied by

of performing research is decreasing in their distance from the technological frontier, as captured by the term $A_{u,t}/A_{d,t}$. This force pushes toward convergence in productivity between the two regions. Moreover, as it was the case for the U.S., the benefit from investing in research is increasing in the size of the tradable sector ($L^T_{d,t+1}$). Also in developing countries, therefore, the tradable sector is the source of productivity growth.

2.7 Aggregation and market clearing

Value added in the tradable sector is equal to total production of tradable goods net of the amount spent in producing intermediate goods. Using equations (12) and (13) we can write value added in the tradable sector as

$$Y^T_{i,t} - \int_0^1 x^j_{i,t} dj = \Psi A_{i,t} L^T_{i,t}, \tag{18}$$

where $\Psi \equiv \alpha^{2\alpha/(1-\alpha)} \left(1 - \alpha^2\right)$.

Market clearing for the non-tradable good requires that in every region consumption is equal to production, so that

$$C^N_{i,t} = Y^N_{i,t} = L^N_{i,t}. \tag{19}$$

The market clearing condition for the tradable good can be instead written as

$$C^T_{i,t} + \frac{B_{i,t+1}}{R_{i,t}} = \Psi A_{i,t} L^T_{i,t} + B_{i,t}. \tag{20}$$

To derive this expression, we have used the facts that domestic households receive all the income from production, and that governments run balanced budgets every period. Moreover, global asset market clearing requires that

$$B_{u,t} = -B_{d,t}. \tag{21}$$

Finally, in every region the labor market must clear

$$\bar{L} = L^N_{i,t} + L^T_{i,t} + L^R_{i,t}. \tag{22}$$

In this expression, we have defined $L^R_{i,t} = \int_0^1 L^j_{i,t} dj$ as the total amount of labor devoted to research in region i.

2.8 Equilibrium

In the balanced growth path of the economy some variables remain constant, while others grow at the same rate as $A_{u,t}$.[22] In order to write down the equilibrium in stationary form, we normalize

another firm, or for some other shock that leads to the firm's death). This would be needed to maintain firms' value finite, even in environments in which the interest rate is persistently higher than the growth rate of the economy.

[22] Our baseline model abstracts from the forces linked to structural transformation, meaning that the sectoral employment shares are constant along the balanced growth path. Therefore, some of the variables in our model can be interpreted as the deviation of their actual value from the structural transformation path. We introduce explicitly structural change in Section 5.4.

this second group of variables by $A_{u,t}$. To streamline notation, for a generic variable $X_{i,t}$ we define $x_{i,t} \equiv X_{i,t}/A_{u,t}$. We also denote the growth rate of the technological frontier as $g_t \equiv A_{u,t}/A_{u,t-1}$, and the proximity of a region to the frontier by $a_{i,t} \equiv A_{i,t}/A_{u,t}$ (of course, $a_{u,t} = 1$).

The model can be narrowed down to three sets of equations or "blocks". The first block describes the path of tradable consumption and capital flows. Using the notation spelled out above, the households' Euler equation becomes

$$\frac{\omega}{c^T_{i,t}} = R_{i,t}(1+\tau_{i,t})\left(\frac{\beta\omega}{g_{t+1}c^T_{i,t+1}} + \tilde{\mu}_{i,t}\right), \tag{23}$$

where $\tilde{\mu}_{i,t} \equiv A_{u,t}\mu_{i,t}$. To ensure the existence of a balanced growth path, we assume that the borrowing limit of each region is proportional to productivity ($\kappa_{i,t} = \kappa_t A_{i,t+1} > 0$), where κ_t is a time-varying parameter with steady state value $\kappa > 0$. Condition (5) can thus be written as

$$b_{i,t+1} \geq -\kappa_t a_{i,t+1} \quad \text{with equality if} \quad \tilde{\mu}_{i,t} > 0. \tag{24}$$

Moreover, the optimality condition for asymptotic bond holdings (6) becomes

$$\lim_{k\to\infty} \frac{b_{i,t+1+k}g_{t+1}...g_{t+1+k}}{R_{i,t}(1+\tau_{i,t})...R_{i,t+k}(1+\tau_{i,t+k})} \leq 0. \tag{25}$$

Finally, the market clearing conditions for the tradable good and for bonds become

$$c^T_{i,t} + \frac{g_{t+1}b_{i,t+1}}{R_{i,t}} = \Psi a_{i,t}L^T_{i,t} + b_{i,t} \tag{26}$$

$$b_{u,t} = -b_{d,t}. \tag{27}$$

These equations define the path of $c^T_{i,t}$, $b_{i,t}$ and $R_{i,t}$ given a path for productivity and tradable output. In a financially integrated world, these equations determine the behavior of capital flows across the two regions.

The second block of the model describes how productivity evolves. Throughout, we will focus on interior equilibria in which $L^N_{i,t} > 0$ for every i and t. In this case, as it is easy to verify, $W_{i,t} = (1-\alpha)\alpha^{2\alpha/(1-\alpha)}A_{i,t}$. In equilibrium, equation (15) then becomes

$$g_{t+1} = \frac{\beta c^T_{u,t}}{c^T_{u,t+1}}\left(\chi\alpha L^T_{u,t+1} + 1\right). \tag{28}$$

This equation captures the optimal investment in research by U.S. firms, and implies a positive relationship between productivity growth and expected future employment in the tradable sector. Intuitively, a rise in production of tradable goods is associated with higher monopoly profits. In turn, higher expected profits induce entrepreneurs to invest more in research, leading to a positive impact on the growth rate of productivity.[23] This is the classic market size effect emphasized by

[23]To be more precise, higher growth reduces households desire to save, leading to an increase in the cost of funds

the endogenous growth literature, with a twist. The twist is that the allocation of labor across the two sectors matters for productivity growth.[24] Moreover, productivity growth is decreasing in the growth rate of normalized tradable consumption, $c^T_{u,t+1}/c^T_{u,t}$. A rise in expected consumption growth, the reason is, leads households to discount more heavily future dividends, which translates into a fall in firms' investment.

Following similar steps, we can use (17) to obtain an expression describing the evolution of productivity in developing countries

$$a^{\phi}_{d,t} = \frac{\beta c^T_{d,t}}{g_{t+1} c^T_{d,t+1}} \left(\xi \alpha L^T_{d,t+1} + a^{\phi}_{d,t+1} \right). \tag{29}$$

This equation describes how the proximity of developing countries to the technological frontier evolves in response to firms' investment in research. As in the U.S., a larger tradable sector induces more investment in research by developing countries and thus leads to a closer proximity to the frontier.

The last block describes the use of productive resources, that is how labor is allocated across the production of the two consumption goods and research. To derive an expression for $L^N_{i,t}$, we can use $Y^N_{i,t} = L^N_{i,t}$ and $W_{i,t} = P^N_{i,t}$ to write equation (7) as

$$L^N_{i,t} = \frac{1-\omega}{\omega(1-\alpha)\alpha^{\frac{2\alpha}{1-\alpha}}} \frac{c^T_{i,t}}{a_{i,t}} \equiv \Gamma \frac{c^T_{i,t}}{a_{i,t}}. \tag{30}$$

The interesting aspect of this equation is that production of non-tradable goods is positively related to consumption of tradables, because of households' desire to balance their consumption across the two goods. Hence, as tradable consumption rises more labor is allocated to the non-tradable sector. As we will see, this effect plays a key role in mediating the impact of capital flows on productivity growth.

Expressions for $L^R_{i,t}$ can be derived by writing equations (14) and (16) as

$$L^R_{u,t} = \frac{g_{t+1} - 1}{\chi}$$

$$L^R_{d,t} = \frac{g_{t+1} a_{d,t+1} - a_{d,t}}{\xi a^{1-\phi}_{d,t}}.$$

As it is intuitive, faster productivity growth or a closer proximity to the frontier requires larger innovation effort, and hence more labor allocated to research.

for firms investing in research. In fact, in the new equilibrium the rise in growth and in the cost of funds are exactly enough to offset the impact of the rise in expected profits on the return from investing in research.

[24] To clarify, what matters for our main results is that productivity growth is increasing in the share of labor allocated to the tradable sector. This means that our key results would also apply to a setting in which scale effects related to population size were not present. For instance, in the spirit of Young (1998) and Howitt (1999), these scale effects could be removed by assuming that the number of intermediate inputs available inside a country is proportional to population size.

Plugging these expressions in the market clearing condition for labor then gives

$$L^T_{u,t} = \bar{L} - \Gamma c^T_{u,t} - \frac{g_{t+1} - 1}{\chi} \tag{31}$$

$$L^T_{d,t} = \bar{L} - \Gamma \frac{c^T_{d,t}}{a_{d,t}} - \frac{g_{t+1} a_{d,t+1} - a_{d,t}}{\xi a^{1-\phi}_{d,t}}. \tag{32}$$

These equations can be interpreted as the resource constraints of the economy.

We collect these observations in the following lemma.

Lemma 1 *In equilibrium the paths of real allocations* $\{c^T_{i,t}, b_{i,t+1}, \tilde{\mu}_{i,t}, a_{i,t+1}, L^T_{i,t}\}_{i,t}$*, interest rates* $\{R_{i,t}\}_{i,t}$ *and growth rate of the technological frontier* $\{g_{t+1}\}_t$*, satisfy* (23)*,* (24)*,* (25)*,* (26)*,* (27)*,* (28)*,* (29)*,* (31) *and* (32) *given a path for the borrowing limit* $\{\kappa_t\}_t$ *and initial conditions* $\{b_{i,0}, a_{i,0}\}_i$*.*

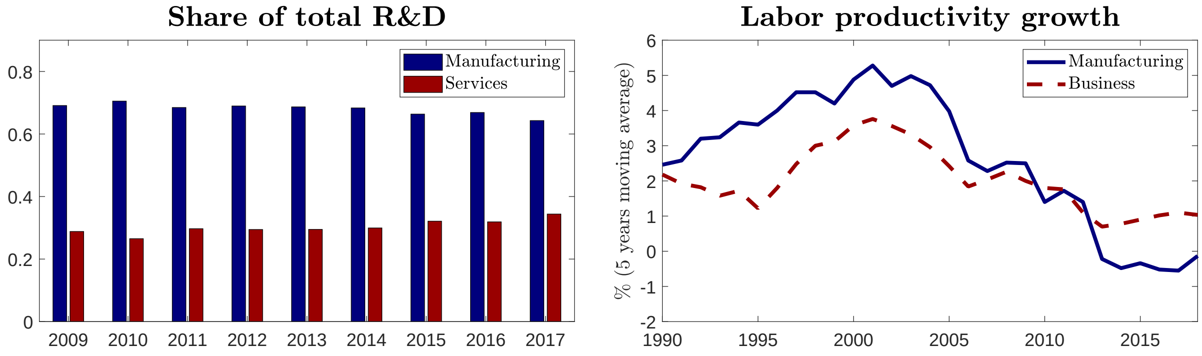
2.9 Discussion of key elements

Our assumptions about innovation and international technology diffusion effectively imply that the tradable sector is the economy's engine of growth. We now provide some empirical underpinnings for this feature of our model.

Empirically, tradable sectors are characterized by higher productivity growth compared to sectors producing non-tradable goods. For instance, Duarte and Restuccia (2010) study productivity growth at the sectoral level, using data from 29 OECD and developing countries over the period 1956-2004. They find that productivity grows faster in manufacturing and agriculture - two sectors traditionally associated with production of traded goods - compared to services, the sector producing the bulk of non-traded goods. Hlatshwayo and Spence (2014) reach the same conclusion using U.S. data for the period 1990-2013, even after accounting for the fact that some services can be traded. In our baseline model, we capture this asymmetry by assuming that productivity growth is fully concentrated in the tradable sector. In Section 5, however, we introduce investment in innovation and endogenous growth in the non-tradable sector as well. There we show that our main results hold as long as non-tradable sectors are characterized by a smaller scope for productivity improvements compared to tradable ones.

Figure 2 provides two additional pieces of evidence consistent with our focus on the tradable sector as driver of productivity dynamics in the United States. First, the left panel shows that the manufacturing sector, which represents about 10% of value added, accounts for about 70% of total R&D spending done by U.S. firms. This fact points toward the central role played by manufacturing in U.S. innovation activities. Second, the right panel shows that the U.S. productivity growth slowdown has coincided with a sharp drop in productivity growth in the manufacturing sector. This suggests that, in order to understand the U.S. productivity growth slowdown, one should place particular attention on the behavior of manufacturing, and so on sectors producing tradable goods (Syverson, 2016).

In our model the tradable sector also represents the source of knowledge spillovers from ad-



(a) Spending on R&D. **(b) Productivity growth.**

Figure 2: U.S. labor productivity growth and R&D, by sector. Notes: The left panel shows firms' R&D spending as a share of total spending in the U.S. contrasting manufacturing and services. The right panel shows annual U.S. labor productivity growth in manufacturing and private business, respectively. See Appendix A for the procedure used to construct these figures.

vanced to developing countries. Grossman and Helpman (1991) provide an early theoretical treatment of knowledge flows across countries, while Klenow and Rodriguez-Clare (2005) show that international knowledge spillovers are necessary in order to account for the cross-countries growth patterns observed in the data. Several empirical studies point toward the importance of trade in facilitating technology transmission from advanced to developing countries. Just to cite a few examples, Coe et al. (1997), Keller (2004) and Amiti and Konings (2007) highlight the importance of imports as a source of knowledge transmission, while Blalock and Gertler (2004), Park et al. (2010) and Bustos (2011) provide evidence in favor of exports as a source of productivity growth. Rodrik (2012) considers cross-country convergence in productivity at the industry level and finds that this is restricted to the manufacturing sector. This finding lends support to our assumption that knowledge spillovers are concentrated in sectors producing tradable goods.

Another characteristic of our framework is that innovation activities in the United States shape the world technological frontier. Liu and Ma (2021) provide some empirical evidence consistent with this assumption. They study the pattern of international patents' citations, and find that the United States is the major exporter of knowledge at the global level.

Finally, let us stress that our main results would go through even under alternative assumptions about the productivity growth process characterizing the tradable sector. For instance, as in Krugman (1987), we could assume that productivity growth is increasing in the size of the tradable sector because of the presence of learning by doing effects. The key insights of the model would apply also to this case.

3 Financial integration and global productivity growth

In this section we study the impact of financial integration on global productivity growth. We start by characterizing the balanced growth path - or steady state - of the model. Focusing on steady states, and thus on the long-run behavior of the economy, allows us to derive analytically our key results about the impact of financial integration on global productivity growth. Thereafter, we consider transitional - or medium-run - dynamics. In the last part of the section, we use the model to shed light on three prominent debates in international macroeconomics. We discuss, first, how the dollar adjusts following financial liberalization, second, why export-led growth by developing countries can backfire, and third, how innovation policies can shield U.S. and global growth from financial globalization.

Steady state equilibria can be represented using two simple diagrams. The first diagram connects global productivity growth to the size of the tradable sector in the United States. Start by considering that in steady state $c^T_{i,t}$, $L^T_{i,t}$ and g_{t+1} are all constant. We can then write equation (28) as

$$g = \beta \left(\chi \alpha L^T_u + 1 \right), \tag{GG_u}$$

where the absence of a time subscript denotes the steady state value of a variable. The GG_u schedule captures the incentives to innovate for U.S. firms. Due to the market size effect described above, optimal investment in innovation in the United States gives rise to a positive relationship between g and L^T_u. A second relationship between g and L^T_u can be obtained by writing equation (31) as

$$L^T_u = \bar{L} - \Gamma c^T_u - \frac{g-1}{\chi}. \tag{RR_u}$$

The RR_u schedule captures the resource constraint of the U.S. economy. Faster productivity growth requires more research effort, leaving less labor to be allocated to production. This explains why the RR_u schedule describes a negative relationship between g and L^T_u. Together, these two schedules determine the equilibrium in the United States for a given value of c^T_u (Figure 3a).

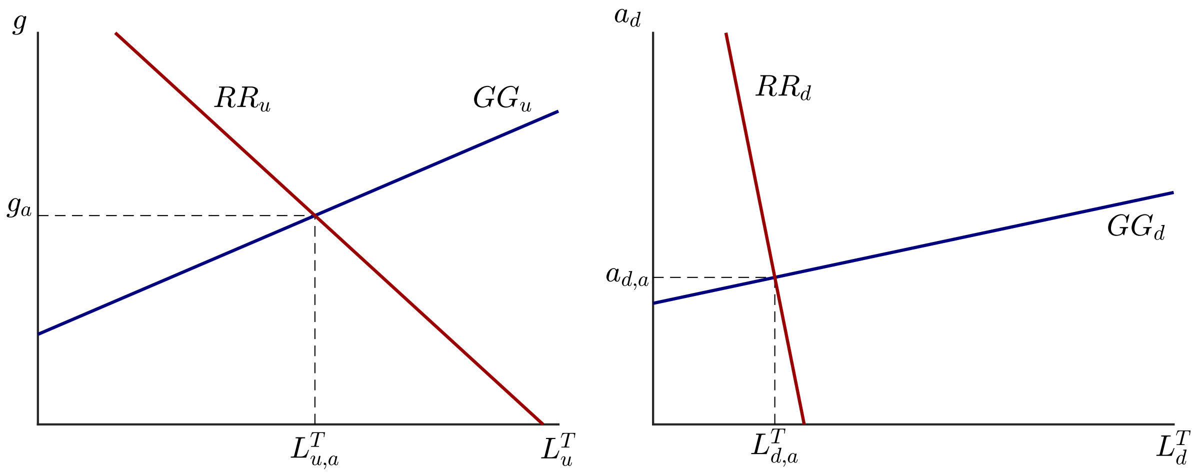
A similar approach can be used to describe the equilibrium in developing countries. Recall that we are focusing on equilibria in which investment in research by developing countries is always positive. This implies that in steady state productivity in developing countries grows at rate g, and so their proximity to the technological frontier is constant. Hence, in steady state (29) reduces to

$$a^\phi_d = \frac{\beta \xi \alpha L^T_d}{g - \beta}. \tag{GG_d}$$

The GG_d schedule captures the incentives of firms in developing countries to adopt technologies from the frontier. As production of tradables by developing countries increases, the return to increasing productivity rises, leading to higher investment in research and a closer proximity to the frontier. Instead, the steady state counterpart of (32) is

$$L^T_d = \bar{L} - \Gamma \frac{c^T_d}{a_d} - \frac{(g-1)a^\phi_d}{\xi}. \tag{RR_d}$$

Intuitively, maintaining a closer proximity to the frontier requires more research labor, leaving less labor to production of tradable goods. This explains the negative relationship between a_d and L^T_d implied by the RR_d schedule, for a given value of c^T_d/a_d. The intersection of these two schedules determines the equilibrium value of a_d and L^T_d (Figure 3b) - again holding constant c^T_d/a_d. To



(a) United States. **(b) Developing countries.**

Figure 3: Steady state equilibria.

fully characterize the equilibrium we need to specify a financial regime. We turn to this task next.

3.1 Financial autarky

Under financial autarky, financial flows across the two regions are not allowed. Since households inside every region are symmetric, it must then be that $b_{u,t} = b_{d,t} = 0$. We can thus define an equilibrium under financial autarky as follows.

Definition 1 *An equilibrium under financial autarky satisfies the conditions stated in Lemma 1 and $b_{i,t} = 0$ for all i and t.*

In each region consumption of tradable goods must be equal to output, and so $c^T_{i,t} = a_{i,t}\Psi L^T_{i,t}$. It is then a matter of simple algebra to solve for the steady state values of g and a_d. Combining the GG_u and RR_u equations one gets that

$$g_a = \beta \left(\frac{\alpha \left(\chi \bar{L} + 1 - \beta\right)}{1 + \Gamma\Psi + \alpha\beta} + 1 \right), \tag{33}$$

where the subscript a denotes the value of a variable under financial autarky. According to this expression, a higher productivity of research in the U.S. (i.e. a higher χ) leads to faster growth in the world technological frontier. Moreover, as the tradable sector share of value added rises (i.e. as ω increases, and so Γ falls), more resources are devoted to innovation leading to faster productivity growth.

To solve for the equilibrium in developing countries we can combine equations GG_d and RR_d to obtain

$$a^{\phi}_{d,a} = \frac{\alpha\beta\xi\bar{L}}{(g_a - \beta)(1 + \Gamma\Psi) + (g_a - 1)\alpha\beta}. \tag{34}$$

Naturally, a higher ξ is associated with a more efficient process of technology adoption in developing countries, and thus to a closer proximity to the frontier in steady state.[25] Moreover, a larger size of the tradable sector (i.e. a lower Γ) is associated with a closer proximity to the frontier, because technology adoption is the result of research efforts by firms in the tradable sector.

Finally, under financial autarky the two regions feature different interest rates. Recalling that $\tau_{u,t} = 0$, using U.S. households' Euler equation gives

$$R_{u,a} = \frac{g_a}{\beta}.$$

Instead, since $\tau_{d,t} = \tau > 0$, the households' Euler equation in developing countries implies that

$$R_{d,a} = \frac{g_a}{\beta(1+\tau)} < R_{u,a}.$$

Hence, in the long run developing countries feature a lower interest rate compared to the United States. This is just the outcome of the higher propensity to save characterizing households in developing countries compared to U.S. ones.

Proposition 1 *Suppose that*

$$i) \quad \beta\left(\frac{\alpha\left(\chi\bar{L}+1-\beta\right)}{1+\Gamma\Psi+\alpha\beta}+1\right) > 1 \quad \text{and} \quad ii) \quad \xi < \chi. \tag{35}$$

Then under financial autarky there is a unique steady state in which productivity in both regions grows at rate $g_a > 1$, given by (33), and developing countries' proximity to the frontier is equal to $a_{d,a} < 1$, given by (34). Moreover, $R_{u,a} = g_a/\beta$ and $R_{d,a} = g_a/((1+\tau)\beta) < R_{u,a}$.

Proposition 1 summarizes the results derived so far. The role of condition (35) is to guarantee that in steady state productivity grows at a positive rate ($g_a > 1$), and that developing countries do not catch up fully with the technological frontier ($a_{d,a} < 1$). This second condition is satisfied if the ability of developing countries to adopt U.S. technologies is sufficiently small compared to the productivity of research in the United States.

3.2 Financial integration

What is the impact of financial globalization on growth? To answer this question, we now turn to a scenario in which the two regions are financially integrated. Since capital flows freely across the two regions, interest rates must be equalized and so $R_{u,t} = R_{d,t}$. We are now ready to define an equilibrium under financial integration.

Definition 2 *An equilibrium under financial integration satisfies the conditions stated in Lemma 1 and $R_{u,t} = R_{d,t}$ for all t.*

[25] $a_{d,a}$, instead, is decreasing with the growth rate of the technological frontier g_a. This happens because a faster pace of innovation in the U.S. requires more resources devoted to research by developing countries in order to maintain a constant proximity to the frontier.

Recall that households in developing countries have a higher propensity to save compared to U.S. ones. In the long-run U.S. households thus borrow up to their limit and $b_{u,f} = -\kappa$, where the subscript f denotes the value of a variable in the steady state with financial integration. Conversely, households in developing countries have positive assets in the long run. Their Euler equation thus implies that in steady state

$$R_f = \frac{g_f}{\beta(1+\tau)}, \tag{36}$$

where R_f denotes the steady state world interest rate under financial integration. We can then use equation (26) to write

$$c_{u,f}^T = \Psi L_{u,f}^T + \kappa \left(\frac{g_f}{R_f} - 1 \right) = \Psi L_{u,f}^T + \kappa \left(\beta(1+\tau) - 1 \right). \tag{37}$$

This equation highlights how the U.S. trade balance in steady state ($\Psi L_{u,f}^T - c_{u,f}^T$) crucially depends on the ratio g_f/R_f, which is in turn determined by $\beta(1+\tau)$.

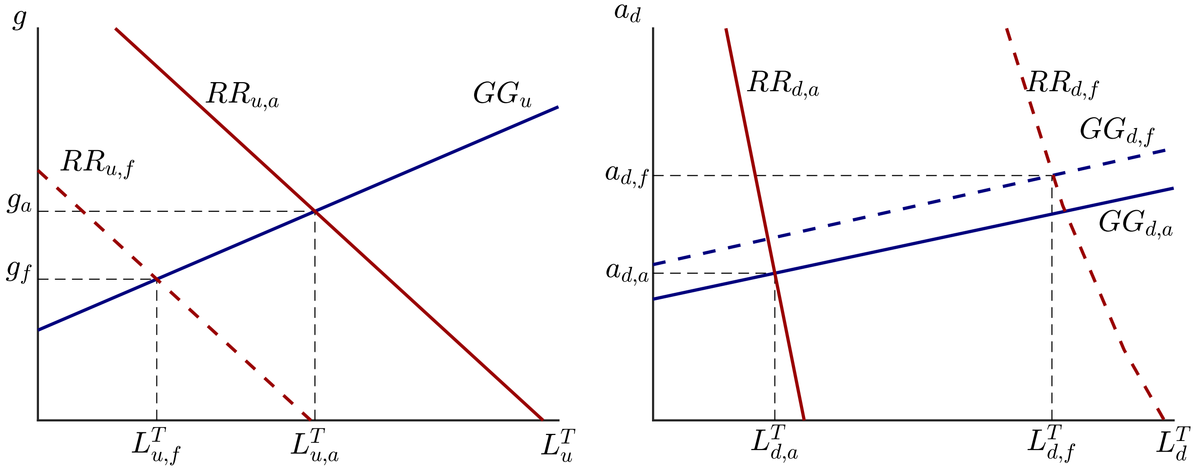
In what follows, we will focus on the case $g_f > R_f$ by assuming that $\beta(1+\tau) > 1$.[26] Empirically, at least if one interprets R_f as the return on U.S. government bonds, this condition is in line with the experience of the United States since the mid-1990s. Moreover, under this assumption, in steady state the U.S. trade balance is in deficit. This feature of the model is consistent with the fact that the U.S. has been running persistent trade deficits over the last 30 years (Figure 1) without significantly raising its external-debt-to-GDP position.[27] To be clear, our main insights do not rely on this assumption. In Appendix D, we consider an economy in which $g_f < R_f$, and we show that in this case a global financial resource curse can arise during the transition toward the final steady state.

Perhaps the best way to understand the impact of financial integration on productivity growth is to employ the diagrams presented in Figure 4. Let us start from the United States. In a financially integrated world, since $\beta(1+\tau) > 1$, the United States ends up running trade deficits in the long run. In turn, trade deficits sustain consumption of tradable goods, which rises above production ($c_{u,f}^T > \Psi L_{u,f}^T$). Higher consumption of tradable goods pushes up demand for non-tradables. In order to satisfy this increase in demand, labor migrates from the tradable sector toward the non-

[26] As is well known, studying economies in which the interest rate is lower than the growth rate of output might be tricky, since the present value of the economy's resources might be unbounded (see the discussion on page 65 of Obstfeld and Rogoff (1996)). Luckily, our model can accommodate this case. Let us start by considering households in developing countries. The interest rate faced by these households is $R_f(1+\tau)$, which, by equation (36), is larger than g_f. Hence, from the point of view of households in developing countries, the present value of income is finite and the terminal condition (25) is satisfied with equality.

Things are a bit more complicated for households in the United States. Since they face an interest rate lower than the growth rate of output, the present value of their expected income is infinite. Still, the utility enjoyed by U.S. households is finite, since the borrowing limit (3) prevents them from fully frontloading the consumption of their expected stream of future income. What about the no-Ponzi condition usually imposed by lenders? Notice that here the lenders are households in developing countries, which receive an interest rate equal to $R_f(1+\tau)$. Moreover, consider that, due to the borrowing limit (3), in steady state U.S. households' liabilities cannot grow at a rate larger than g_f. It follows that, since $R_f(1+\tau) > g_f$, the borrowing limit (3) is more stringent than the conventional constraint imposed by lenders to rule out Ponzi schemes.

[27] As documented by Mehrotra and Sergeyev (2019), the rate of return on U.S. government bonds has been lower than the growth rate of the U.S. economy for most of the post-WWII period.



(a) United States. **(b) Developing countries.**

Figure 4: Impact of financial integration.

tradable one, and so L_u^T falls. Graphically, this is captured by the leftward shift of the RR_u curve. This is not, however, the end of the story. As the tradable sector shrinks, firms' incentives to innovate fall - because the profits appropriated by successful innovators are now smaller.[28] The result is a drop in productivity growth in the United States.[29] Therefore, paradoxically, cheap access to capital inflows depresses investment and productivity growth, because these inflows end up financing a boom in the non-tradable sector.

All these results can be derived analytically, by combining the GG_u and RR_u equations with (37) to obtain

$$g_f = g_a - \frac{\alpha\beta\chi\Gamma}{1+\Gamma\Psi+\alpha\beta}\kappa\left(\beta(1+\tau)-1\right). \tag{38}$$

Because we assume $\beta(1+\tau)>1$, this expression shows that financial integration depresses g below its value under financial autarky. Moreover, this effect is stronger the larger the capital inflows toward the United States, here captured by a higher value of the parameter κ.

[28]For completeness, let us mention that the model embeds a second effect that could lead to a positive relationship between capital inflows into the United States and investment in innovation by U.S. firms. Indeed, capital inflows lead to a reduction in the cost of funds for U.S. firms, and so to a fall in the cost of investing in innovation. Hence, the model is consistent with the empirical finding by Varela (2018), who documents that capital inflows foster investment in innovation by credit-constrained firms, relative to unconstrained ones. In steady state, however, it turns out that this cost of funds effect is always dominated by the profit effect described in the main text. We further elaborate on this point in Section 3.3.

[29]Besides lower innovation in the tradable sector, there is also a composition effect depressing productivity growth in the United States. Since productivity growth is lower in the non-tradable sector, the shift of factors of production from the tradable to the non-tradable sector mechanically lowers productivity growth. To streamline the exposition, in this section we focus on the - less mechanical and arguably more interesting - behavior of productivity in the tradable sector. Empirically, the productivity growth slowdown in the United States has been characterized by a sharp fall in productivity growth in manufacturing (Syverson, 2016). We will elaborate further on the composition effect in Section 5.

In some respects, the impact of financial integration on developing countries is the mirror image of the U.S. one. In developing countries, tradable consumption is given by

$$c^T_{d,f} = \Psi a_{d,f} L^T_{d,f} - \kappa \left(\beta(1+\tau) - 1\right). \tag{39}$$

Naturally, to finance trade surpluses consumption of tradables has to fall below production ($c^T_{d,f} < \Psi a_{d,f} L^T_{d,f}$).[30] This causes a drop in demand for non-tradable goods, which induces labor to shift out of the non-tradable sector toward the tradable one. Graphically, this effect corresponds to a rightward shift of the RR_d curve.[31] As the tradable sector grows larger, firms in developing countries increase their spending in research. They do so in order to appropriate the now higher profits derived from upgrading their productivity. As illustrated by Figure 4*b*, this process pushes developing countries closer to the technological frontier.

More precisely, by combining the GG_d and RR_d equations with (39) one finds that

$$a^{\phi}_{d,f} = \frac{\alpha\beta\xi\left(\bar{L} + \Gamma\frac{\kappa(\beta(1+\tau)-1)}{a_{d,f}}\right)}{(g_f - \beta)(1+\Gamma\Psi) + (g_f - 1)\alpha\beta}. \tag{40}$$

Comparing this expression with (34) shows that, since $\beta(1+\tau) > 1$ and $g_f < g_a$, financial integration increases developing countries' proximity to the frontier. Again, this effect is stronger the larger the capital flows out of developing countries, i.e. the higher κ.

In spite of the increase in a_d, however, it is far from clear that financial integration generates long run productivity improvements in developing countries. The reason is that developing countries absorb technological advances originating from the United States. Therefore, lower innovation activities in the United States translate into a drop in the steady state rate of productivity growth in developing countries. Hence, at least in the long run, the process of financial integration generates a fall in global productivity growth.

Proposition 2 *Suppose that $\beta(1+\tau) > 1$ and that*

$$i) \quad \kappa\left(\beta(1+\tau) - 1\right) < \frac{(g_a - 1)\left(1 + \Gamma\Psi + \alpha\beta\right)}{\alpha\beta\chi\Gamma} \quad \textit{and} \quad ii) \quad \kappa\left(\beta(1+\tau) - 1\right) < \frac{\bar{L}(\chi - \xi)}{\Gamma(\chi + \xi)}, \tag{41}$$

where g_a is given by (33). Then under financial integration there is a unique steady state in which productivity in both regions grows at rate g_f, given by (38), satisfying $1 < g_f < g_a$. Developing countries' proximity to the frontier is equal to $a_{d,f}$, given by (40), with $a_{d,a} < a_{d,f} < 1$. Both regions share the same interest rate given by $R_f = g_f/((1+\tau)\beta)$.

Proposition 2 summarizes our observations about the impact of financial integration on productivity. As it was the case under financial autarky, the role of condition (41) is to guarantee that in steady state productivity grows at a positive rate ($g_f > 1$), and that developing countries do

[30] We restrict the analysis to values of κ small enough so that tradable consumption in developing countries is always positive.

[31] The shift in the GG_d curve, instead, is due to the impact of financial integration on U.S. productivity growth.

not catch up fully with the technological frontier ($a_{d,f} < 1$). Because financial integration reduces g_f and raises $a_{d,f}$ relative to their values under financial autarky, this amounts to assuming that capital flows, captured by the variable $\kappa(\beta(1+\tau)-1)$, are not too large.

Our framework also gives a new perspective on the impact of financial integration on interest rates. In standard models, after two regions integrate financially, the equilibrium interest rate lies somewhere in between the two autarky rates. This is not the case here. In fact, it is easy to see that the interest rate under financial integration lies below both autarky rates ($R_f < R_{d,a} < R_{u,a}$). This happens because financial integration depresses the rate of global productivity growth. Lower productivity growth boosts households' supply of savings, and drives down the world interest rate below the values observed under financial autarky.

Corollary 1 *Suppose that (41) holds and that $\beta(1+\tau) > 1$. Then the world interest rate under financial integration is lower than the two autarky rates ($R_f < R_{d,a} < R_{u,a}$).*

Several commentators have argued that the integration in the international financial markets of developing countries, by giving rise to a global saving glut, had a large negative impact on global interest rates (Bernanke, 2005). In our model this effect is present, but it is magnified by the drop in global productivity growth associated with financial globalization. Hence, here the global saving glut leads to a regime of superlow global interest rates, characterized by weak investment and low growth.

What about the return to investment? It turns out that financial globalization opens up a wedge between the interest rate on U.S. bonds and the return to investment in innovation. To see this point, note that the return enjoyed by U.S. firms on their investment is equal to

$$R^I_{u,t+1} \equiv \frac{\varpi L^T_{u,t+1} + \frac{W_{u,t+1}}{\chi A_{u,t+1}}}{\frac{W_{u,t}}{\chi A_{u,t}}}.$$

Using equation (15), it is easy to see that in steady state $R^I_u = g/\beta$. Therefore, under financial autarky, the return to investment in innovation is equal to the U.S. interest rate ($R^I_{u,a} = g_a/\beta = R_{u,a}$). Following financial globalization, however, the return to investment ends up being higher than the world rate ($R^I_{u,f} = g_f/\beta > R_f$). This happens because, due to the presence of financial frictions, the high demand for bonds coming from developing countries translates into an only mild decline in the U.S. return to investment. This feature of the model is consistent with the fact that, since the early 2000s, there has been a rise in the spread between the interest rate and the return to capital in the United States (Farhi and Gourio, 2018).[32]

Before concluding this section, two remarks are in order. First, in our model inflows of foreign capital depress productivity growth in the recipient country because they reduce economic activity in the tradable sector. Due to its similarities with the notion of natural resource curse, in Benigno

[32] The increase in the spread between bonds, which are associated with safety, and capital, whose return is instead inherently risky, has often being attributed to a rise in investors' risk aversion. It would be straightforward to capture these type of considerations in the model. We would just need to assume, as done for instance in Aghion and Howitt (1992), that investment in innovation is risky.

and Fornaro (2014) this effect has been dubbed the *financial resource curse.* Here, however, the implications are much more dramatic. In fact, one could naively think that countries experiencing capital outflows - and so an expansion of their tradable sector - would enjoy faster productivity growth. But, as we have just shown, this conclusion is not correct. In our model the slowdown in productivity growth affects capital-exporting countries too, giving rise to a *global financial resource curse.*

Second, a common view is that the United States' ability to attract foreign capital represents an exorbitant privilege, which benefits U.S. citizens by allowing them to consume more than what they produce. Our model paints a more nuanced picture, in which the impact of capital inflows on welfare is a priori ambiguous. To see this point, consider that in steady state the lifetime utility of U.S. households can be expressed as

$$\frac{1}{1-\beta}\left(\log\left(c_u^T\right)+\frac{\beta\omega}{1-\beta}\log\left(g\right)\right).$$

Holding productivity constant, capital inflows increase welfare by boosting c_u^T. This is the standard exorbitant privilege effect. But in our framework capital inflows also depress productivity growth g, which has a negative effect on welfare. As we will see in Section 5, the second effect may very well dominate the first one, and capital inflows may end up lowering welfare in the recipient country. In this case the exorbitant privilege morphs into an exorbitant burden.[33] How can a transfer of resources from abroad lower welfare? This paradoxical finding is due to the presence of inter-firms knowledge spillovers. Intuitively, knowledge spillovers depress the private return from innovating below the social one, causing private firms to underinvest in innovation compared to the social optimum (Aghion and Howitt, 1992). Capital inflows may lower welfare because they exacerbate private firms' tendency to underinvest.

3.3 Medium-run dynamics

So far, we have focused our analysis on steady states, that is on the long run behavior of the economy. In this section, instead, we focus on the medium run, that is on the transition from a regime of financial autarky to financial integration. To anticipate our main finding, during the transition developing countries can experience an acceleration in productivity growth, as they push themselves closer to the technological frontier.[34] Therefore, when developing countries start joining the international credit markets, global productivity growth might accelerate. But this growth acceleration might only be temporary and, due to the logic of the global financial resource curse, global productivity growth might eventually slow down in the long run.

To make these points we resort to some simple numerical simulations. To be clear, our goal here is not to be quantitative, but to illustrate the forces at the heart of the model for some reasonable

[33] Pettis (2011) coined the term exorbitant burden, to describe the notion that the exorbitant privilege hurts U.S. manufacturing.

[34] This is consistent with the experience of several developing countries, in which capital outflows were coupled with fast productivity growth (Gourinchas and Jeanne, 2013).

values of the parameters.[35] We perform the following experiment. The economy is in the financial autarky steady state in period $t = 0$. In period $t = 1$ international credit markets open up, and the economy transits toward the steady state with financial integration. We model the opening of the international credit markets as a gradual increase in the borrowing limit κ_t, which follows the path

$$\kappa_t = \frac{1}{1+\rho}\kappa_{t-1} + \frac{\rho}{1+\rho}\kappa, \tag{42}$$

where $\kappa > 0$ continues to denote the steady state value of the borrowing limit, and $\kappa_0 = 0$.[36] The parameter ρ determines the speed with which restrictions on cross-border capital flows are lifted. We set $\rho = 0.15$ so that the transition lasts about 25 years. This assumption guarantees that the global economy experiences a protracted period of sizable current account imbalances, in line with the pattern of capital flows shown in Figure 1a.

Figure 5 displays the economy's transitional dynamics, following the opening of international credit markets to developing countries.[37] The top-left panel shows that the process of financial integration is characterized by large capital flows out of developing countries and toward the United States. As a result, the United States experiences a persistent spell of sizable trade balance deficits, which result in a consumption boom. Moreover, the rise in U.S. consumption induces a reallocation of labor in the United States toward the non-tradable sector, at the expense of the tradable one (top-right panel). As economic activity in the tradable sector falls, U.S. firms cut back their investment in innovation, resulting in a drop in productivity growth in the U.S. tradable sector.[38] These dynamics are all in line with the steady state analysis discussed in Section 3.

Turning to developing countries, financial integration is associated with large trade balance surpluses, and thus with an increase in economic activity in the tradable sector. Higher profits in the tradable sector lead firms in developing countries to increase their investment in technology adoption. Initially, this effect generates an acceleration in productivity growth in developing countries, which pushes them closer to the technological frontier. Hence, in the medium run, the model reproduces the positive correlation between productivity growth and capital outflows documented for developing countries by Gourinchas and Jeanne (2013). Eventually, however, pro-

[35] We defer a quantitative analysis to Section 5.

[36] Financial integration is modeled as an unexpected shock, in the sense that in periods $t < 1$ agents expect the world to remain in financial autarky forever. From period $t = 1$ on agents have perfect foresight.

[37] To construct the figure, we target an initial growth rate in the U.S. of 2%, a share of R&D expenditure to GDP of 2.5%, a share of tradables in consumption of 25%, and a trade balance deficit in the financial integration steady state of 2% relative to GDP. In developing countries, we target an initial proximity to the frontier of 50%, and we set $\phi = 1$ for the degree of knowledge spillovers. Moreover, we normalize $\bar{L} = 1$. This yields the parameters $\beta = 0.96$, $\omega = 0.25$, $1 - \alpha = 0.53$, $\chi = 0.74$, $\xi = 0.32$, $\kappa = 0.045$, $\tau = 0.11$. As we noted before, this parameterization is purely illustrative and not meant to be quantitative. For instance, our simulations feature an excessively large drop in the U.S. interest rate upon financial integration. This is due to the fact that in our model the United States earns the same return on its foreign assets and liabilities, and so to generate a sizable trade balance deficit in steady state an interest rate far below the growth rate of the economy is needed. In reality, the United States earns large excess returns on its foreign portfolio (Gourinchas and Rey, 2007). It would be easy to introduce this feature in the model, which would reconcile persistent U.S. trade balance deficits with a realistic drop in the interest rate.

[38] Productivity growth drops with a lag relative to the emergence of trade deficits in the simulation, because it takes time for investment in innovation to affect productivity. In their empirical analysis, Aghion et al. (2022) find that the effect of investments in innovation on productivity materializes after 2 to 5 years.

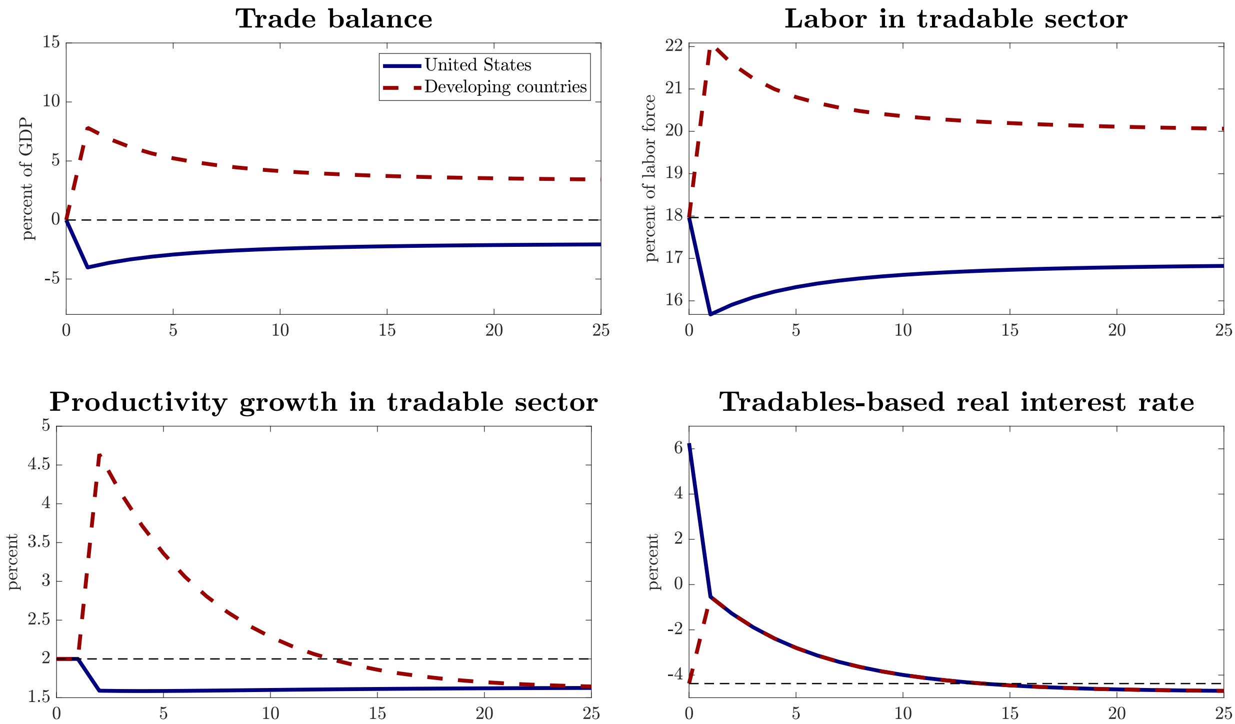


Figure 5: An example of transition from autarky to financial integration steady state. Notes: the process of financial integration is captured by a gradual rise in κ_t, which is governed by (42). Financial integration is not anticipated by agents in periods $t < 1$. From period $t = 1$ on agents have perfect foresight.

ductivity growth in developing countries slows down falling below the growth rate in the initial autarky steady state. The reason, of course, is that low productivity growth in the United States reduces the scope for technology adoption in developing countries. The model thus qualifies the view that developing countries can boost technology adoption and productivity growth by running trade balance surpluses, that is the Bretton Woods II view popularized by Dooley et al. (2004). We will go back to this point in Section 3.5.

The bottom-right panel of Figure 5 shows the path of interest rates, measured in units of the tradable good. Financial globalization leads to interest rate equalization between the United States and developing countries. As standard frameworks would predict, on impact the world interest rate lies between the two autarky rates. This means that the United States experiences a fall in its interest rate, while the interest rate in developing countries increases above its autarky value. This situation, however, is only temporary. As global growth slows down the world interest rate keeps falling. After a few years since the start of financial globalization, in fact, the world interest rate falls below both autarky rates. Therefore, in the long run the world enters a state of superlow interest rates, in which both the United States and developing countries experience a drop in their interest rate below the autarky values.[39]

To close this section, let us spend a few words on the behavior of U.S. productivity during the

[39] Similar to what happens in steady state, the return to investment in innovation in the United States instead experiences only a mild fall. It follows that along the transition triggered by financial globalization a positive spread between the return to investment in the U.S. and the world interest rate opens up.

transition. Under our baseline parametrization, financial integration is associated with an immediate drop in U.S. productivity growth. However, one can design examples in which productivity growth in the United States rises at the start of the transition, and then gradually declines below its value in the initial steady state. To gain intuition, it is useful to go back to the equilibrium condition on the market for innovation (28)

$$g_{t+1} = \frac{\beta c_{u,t}^T}{c_{u,t+1}^T} \left(\chi \alpha L_{u,t+1}^T + 1 \right).$$

According to this expression, there are two contrasting channels through which capital inflows influence firms' incentives to invest in innovation. As discussed above, by causing a drop in $L_{u,t+1}^T$ capital inflows depress profits in the tradable sector, and so the return to investment. But capital inflows also induce a consumption boom and a rise in $c_{u,t}^T / c_{u,t+1}^T$ - or equivalently a drop in the rate at which U.S. households discount future profits. Through this channel, capital inflows reduce U.S. firms' cost of funds and increase firms' incentives to invest.

It turns out that the persistency of capital inflows is the key determinant of which effect prevails. To see why, notice that the profit effect depends on future capital flows, since investment decisions are based on future expected profits. The cost of funds effect, instead, is determined by current capital flows, since firms' cost of investment depends on current consumption. The profit effect, therefore, tends to dominate when capital inflows are persistent - as it has been the case for the United States since the late 1990s.[40] The cost of funds effect, instead, tends to dominate when movements in capital flows are abrupt and short-lived. For instance, our model would predict U.S. productivity growth to fall during a sudden stop in capital inflows toward the United States.

3.4 The real exchange rate

There is a long-standing interest in international macroeconomics on the consequences of capital flows in and out of the U.S. for the dollar (Obstfeld and Rogoff, 2005). We now revisit this issue with the help of our model.[41] It turns out that, in our framework, capital flows toward the United States affect the U.S. real exchange rate through two contrasting channels. On the one hand, a surge in capital inflows sustains demand for U.S. goods and appreciates the U.S. real exchange rate.[42] On the other hand, capital inflows depress U.S. productivity relative to developing countries in the tradable sector, pointing to a depreciation of the U.S. real exchange rate due to the Balassa-Samuelson effect. As we will see, these two effects tend to operate at different horizons, implying a non-monotonic response of the U.S. real exchange rate to changes in capital flows.

To make these results stand out, we modify our baseline model in one direction. We assume

[40] In fact, as we discussed in footnote 28, in steady state the profit effect always dominates the cost of funds effect.

[41] In a very interesting recent contribution, Gornemann et al. (2020) study exchange rate dynamics in an endogenous growth model. In their model, movements in the exchange rate are driven by changes in the terms of trade. Our framework, instead, connects the exchange rate to the relative price of traded and non-traded goods. Integrating these two approaches is a promising area of future research.

[42] The reason is that capital inflows foster demand for non-traded goods more than their supply. This channel is also present in Karabarbounis (2014) and Gornemann et al. (2020).

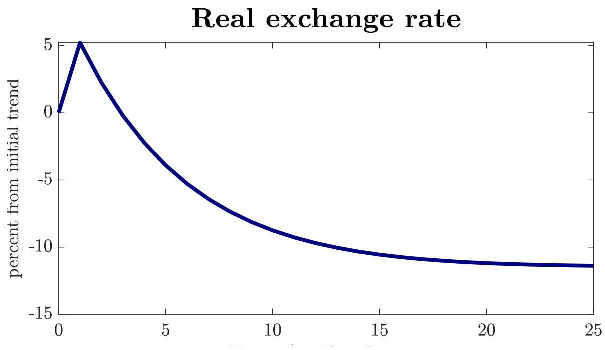


Figure 6: Transition from autarky to financial integration: real exchange rate Notes: the process of financial integration is captured by a gradual rise in κ_t, which is governed by (42). Financial integration is not anticipated by agents in periods $t < 1$. From period $t = 1$ on agents have perfect foresight.

that firms operating in the tradable sector face diminishing returns from employing labor in production.[43] The production function (8) is therefore replaced by

$$Y_{i,t}^T = \left(\left(L_{i,t}^T\right)^{1-\alpha}\right)^{\gamma} \int_0^1 \left(A_{i,t}^j\right)^{1-\alpha} \left(x_{i,t}^j\right)^{\alpha} dj, \tag{43}$$

where $0 < \gamma \leq 1$ captures the extent of decreasing returns. The real exchange rate is proportional to the relative price of consumption in the two groups of countries. In particular, the U.S. real exchange rate is given by

$$\left(\frac{P_{u,t}^N}{P_{d,t}^N}\right)^{1-\omega} = \left(\frac{1}{a_{d,t}}\right)^{1-\omega} \left(\frac{L_{d,t}^T}{L_{u,t}^T}\right)^{(1-\omega)(1-\gamma)}, \tag{44}$$

where recall that $a_{d,t} \equiv A_{d,t}/A_{u,t}$ denotes the proximity of developing countries to the technological frontier.

Equation (44) captures the two competing effects which shape the real exchange rate adjustment. On the one hand, higher demand for non tradables in the U.S. relative to developing countries appreciates the U.S. exchange rate. This effect is encapsulated by the term $L_{d,t}^T/L_{u,t}^T$ which increases when consumption of non tradables rises in the U.S. relative to developing countries.[44] On the other hand, a rise in developing countries' proximity to the frontier - i.e. a rise in $a_{d,t}$ - depreciates the U.S. real exchange rate. This is the Balassa-Samuelson effect.

We illustrate these effects in Figure 6, which shows the equilibrium path of the U.S. real exchange rate following financial integration. Specifically, in the figure, we repeat the experiment from Section 3.3, but we assume for the sake of illustration that $\gamma = 0.8$, such that labor is characterized by decreasing returns. The figure shows that the U.S. real exchange rate first appreciates, but eventually depreciates.[45] This happens because it takes time for firms' investment to affect

[43] Results would be similar if we modified the production function in the non-tradable sector, or if we modified both production functions simultaneously.

[44] Note that in our baseline model ($\gamma = 1$), this effect is not visible in equilibrium. Intuitively, when the production function is linear, the sectoral labor allocation adjusts exactly so as to offset the impact of changes in demand on the relative price of non-tradable goods.

[45] The empirical evidence, in fact, suggests that on impact capital inflows are associated with real exchange rate

productivity. So, on impact, only the demand effect operates. The Balassa-Samuelson effect, instead, becomes stronger over time, and it dominates the demand one in the long run. Our model thus shows that, due to the endogenous productivity dynamics, the exchange rate response to capital flows may be non-monotonic and time dependent.

3.5 Export-led growth by developing countries

A widespread belief, especially in policy circles, is that productivity growth in developing countries can be fostered by policies that stimulate trade surpluses.[46] Perhaps surprisingly, little research has been devoted to assess the viability of this growth strategy when implemented on a global scale. In this section, we revisit this question through the lens of our framework. To do so, we trace the impact on the global economy of an increase in τ, that is an increase in the subsidy provided by governments in developing countries on capital outflows.

Let us start by focusing on the steady state. Combining (38) and (40) gives

$$a_{d,f}^{\phi} = \frac{\xi\left(\bar{L} + \frac{\Gamma\kappa(\beta(1+\tau)-1)}{a_{d,f}}\right)}{\chi(\bar{L} - \Gamma\kappa(\beta(1+\tau)-1))}. \tag{45}$$

This expression implies that a rise in τ increases developing countries' proximity to the technological frontier. This result squares well with the notion of export-led growth. By subsidizing capital outflows, governments in developing countries increase economic activity in the tradable sector. As a consequence, investment in technology adoption rises, growth accelerates in the medium run, and the gap with the technological frontier gets smaller. An export-led growth strategy might thus be successful in raising productivity growth in the medium run.

The story, however, does not stop here. From equation (38), it is immediate to see that a rise in τ lowers the rate of productivity growth in the United States. Capital inflows cause the tradable sector in the United States to shrink, inducing a drop in investment in innovation by U.S. firms. Through this effect, the export-led growth strategy pursued by developing countries depresses productivity growth in the United States. But U.S. innovation determines the world technological frontier, and thus the scope for technology adoption by developing countries. The result is that over time productivity growth in developing countries declines, and eventually converges to the U.S. one. In the long run, therefore, an export-led growth strategy might backfire and cause a drop in global productivity growth.

These negative effects of export-led growth arise when this strategy is implemented on a global scale. To see this point, imagine that the developing countries region is composed of a continuum

appreciations (Benigno et al., 2015).

[46] For instance, Dooley et al. (2004) put this notion at the center of their Bretton Woods II perspective on the international monetary system. They argue that governments in East Asian countries have based their development strategy on export-led growth, supported by policies - such as capital controls and accumulation of foreign reserve assets - encouraging capital outflows toward the United States. Consistent with this hypothesis, Alfaro et al. (2014) show that the positive correlation between capital outflows and productivity growth observed in developing countries is driven by public flows - especially in the form of large foreign reserve accumulation by the public sector of fast-growing East Asian economies.

of small open economies. Then, an increase in the subsidy to capital outflows by a single country does not affect the rest of the world at all. Capital outflows from a single small open economy, in fact, are not large enough to affect economic activity in the United States. But this logic suggests that developing countries may fall in a coordination trap. A single small country, in fact, does not internalize the impact of its policies on the growth rate of the world technological frontier.[47] Therefore, avoiding the negative side effects triggered by export-led growth might require coordination among developing countries.

3.6 Innovation policies in the United States

Governments frequently implement policies to foster innovation activities (Bloom et al., 2019b). While innovation policies have been studied in the context of trade liberalization (Akcigit et al., 2018) or business cycle stabilization (Benigno and Fornaro, 2018), little is known about their relationship with capital flows. We now take a first stab at this issue, by showing how innovation policies can be designed in order to insulate U.S. productivity growth from the negative impact of financial globalization.

Imagine that the U.S. government subsidizes spending on innovation at rate $\iota_{u,t}$, so that equation (15) is replaced by

$$(1-\iota_{u,t})\frac{W_{u,t}}{\chi A_{u,t}} = \frac{\beta C^T_{u,t}}{C^T_{u,t+1}}\left(\varpi L^T_{u,t+1} + (1-\iota_{u,t+1})\frac{W_{u,t+1}}{\chi A_{u,t+1}}\right) \tag{46}$$

The subsidy $\iota_{u,t}$ is financed with lump-sum taxes on U.S. households. Now assume that, once the financial integration steady state is reached, the U.S. government subsidizes spending on innovation at rate

$$\iota_{u,f} = \frac{\chi\Gamma(1-\alpha\beta+\Gamma\Psi)}{(1+\Gamma\Psi)(\chi\bar{L}+1-\beta)}\kappa(\beta(1+\tau)-1). \tag{47}$$

This policy intervention implies that $g_f = g_a$,[48] and so that steady state growth is not affected by international capital flows. Notice that $\iota_{u,f}$ is increasing in the U.S. trade deficit, as captured by the term $\kappa(\beta(1+\tau)-1)$. As argued above, in steady state a larger U.S. trade deficit is associated with lower incentives to innovate by U.S. firms. To counteract this effect, the U.S. government has to respond to larger capital inflows with more aggressive subsidies to innovation.

Interestingly, with this policy in place financial globalization is associated with an acceleration in global growth in the medium run. The reason is that financial globalization triggers an expansion in the tradable sector in developing countries, encouraging technology adoption by developing

[47] Even the government of a country, large enough to internalize the impact of its policies on the world technological frontier, would have no incentives to take into account how its actions affect welfare in the rest of the world. Hence, also large developing countries might gain from coordinating their policy interventions.

[48] With the subsidy in place, equation (GG_u) is replaced by

$$g(1-\iota_u) = \beta(\chi\alpha L^T_u + (1-\iota_u)).$$

To derive the result for $\iota_{u,f}$, we re-derive equation (38) by assuming that $\iota_{u,a} = 0$, but that $\iota_{u,f} > 0$. We then set $g_f = g_a$ in this equation and solve for the implied level of $\iota_{u,f}$.

countries' firms and pushing them closer to the technological frontier. These results suggest that it is possible to couple financial globalization and a global saving glut with robust productivity growth. However, for this to happen, governments might need to implement policies supporting investment in innovation.

4 Empirical implications and evidence

In contrast with conventional wisdom, in our theory capital inflows may be associated with productivity growth slowdowns. This effect is the result of two economic forces: i) persistent capital inflows lead to lower economic activity in the tradable sector, ii) lower economic activity in the tradable sector reduces productivity growth. Is there something about it in the data? We address this question by presenting some empirical evidence consistent with these implications of the model. In doing so, we draw on a recent empirical literature studying the relationship between capital flows, sectoral allocation of productive resources and productivity. Our contribution here is mainly to reorganize this evidence in a consistent fashion, and to relate it to our theory.

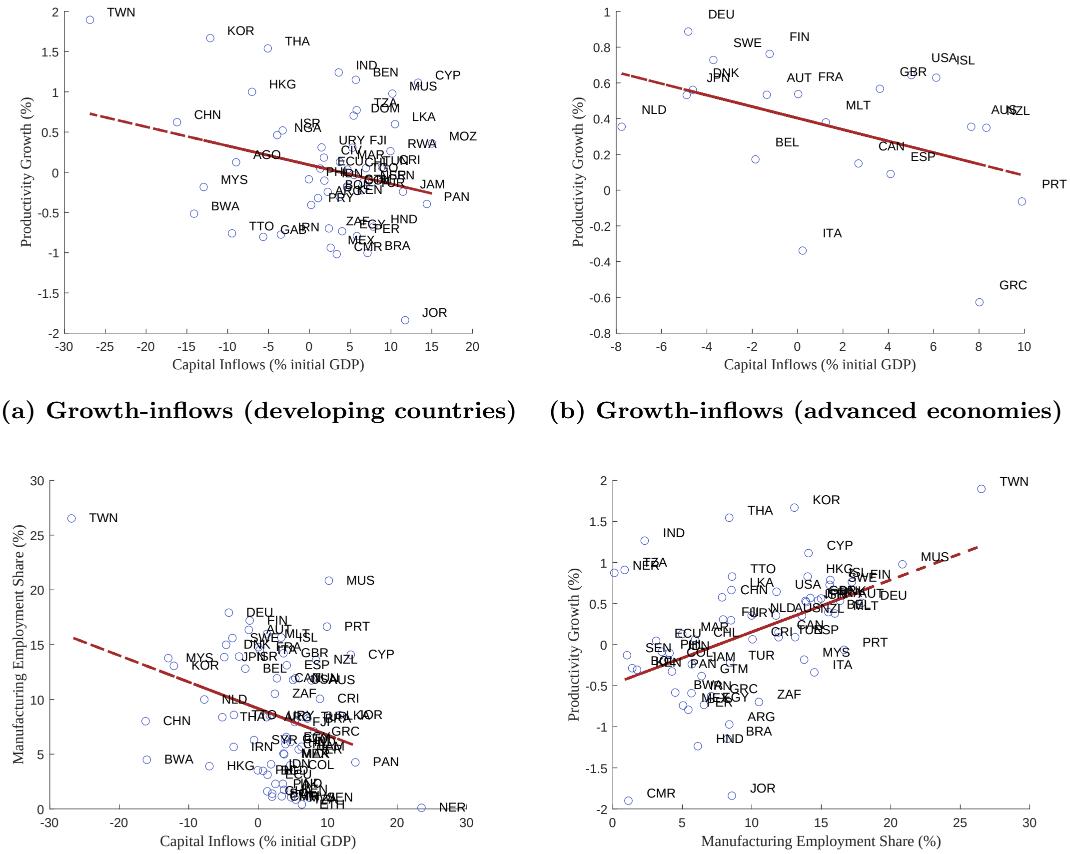
4.1 Cross-sectional evidence

In a seminal paper, Gourinchas and Jeanne (2013) use a cross-sectional empirical analysis to show that fast-growing developing countries tend to export capital abroad. This finding is hard to square with the standard neoclassical growth model, which predicts that capital should be allocated where productivity growth is highest. That is why Gourinchas and Jeanne dub it the *allocation puzzle*. However, the existence of a negative relationship between capital inflows and growth is exactly in line with our framework. We thus take it as the starting point of our empirical analysis.

In Figure 2 of their paper, Gourinchas and Jeanne inspect the raw correlation between average yearly capital inflows (in percent of initial GDP) and average yearly total factor productivity growth over the period 1980-2000 in a sample of developing countries. We perform a similar analysis, but extending the sample to 1980-2019.[49] As in Gourinchas and Jeanne (2013), the correlation between the two variables is negative (Figure 7a). For instance, East-Asian countries - which experienced fast growth and capital outflows - are clearly visible in the upper left portion of the panel. We then extend the analysis to advanced economies, which are not part of Gourinchas and Jeanne's sample, and show that the allocation puzzle applies also to them (Figure 7b). As an example, notice the contrast between peripheral euro area countries, characterized by low productivity growth and sizable capital inflows, and Germany with its distinctive combination of current account surpluses and fast productivity growth. To save space, in the remainder of this section we pool all countries together.[50]

[49] Specifically, our measure of capital inflows for a generic country i is $capinf_i \equiv -\sum_{t=0}^{T_i} CA_{i,t}/(T_iY_{i,0})$, where T_i is the lenght of the sample for country i, $CA_{i,t}$ denotes the current account in year t, while $Y_{i,0}$ denotes GDP in the initial year. Both variables are expressed in 1980 constant dollars. Productivity growth is instead measured as $growth_i \equiv \log(TFP_{i,T_i}/TFP_{i,0})/T_i$, where TFP denotes total factor productivity. In Appendix F, we describe in detail all data sources and data manipulation done in this section.

[50] That said, the main results hold also when we analyse separately advanced and developing economies.



(a) Growth-inflows (developing countries) **(b) Growth-inflows (advanced economies)**

(c) Activity-inflows (full sample) **(d) Growth-activity (full sample)**

Figure 7: Raw cross-sectional correlations. Notes: Panel (a) shows the correlation between average yearly TFP growth and average yearly capital inflows (in percent of initial GDP) during the period 1980-2019 across a sample of developing countries. Panel (b) does the same for a sample of advanced economies. Panel (c) shows the correlation between the average share of employment in manufacturing and capital inflows across our full sample of countries. Panel (d) shows the correlation between average TFP growth and the average share of employment in manufacturing across our full sample of countries. Solid lines refer to a linear OLS regression between the two variables in each panel.

Our theory proposes a possible explanation for the allocation puzzle: capital inflows reduce economic activity in the tradable sector, while a smaller tradable sector implies lower productivity growth. In our model, the size of the tradable sector is thus negatively correlated with capital inflows, and positively correlated with productivity growth. To measure these correlations in the data, we take the share of employment in manufacturing as our headline measure of economic activity in the tradable sector.[51] Figure 7c shows that capital inflows are associated with a smaller manufacturing sector, while Figure 7d shows that countries with a large manufacturing sector also feature fast productivity growth. Both correlations are consistent with our model.

We next run some additional regressions and report the results in Table 1. In all regressions, the dependent variable is the average yearly growth rate of total factor productivity. Column (1) shows that the negative correlation between capital inflows and productivity growth is statistically

[51] We measure the employment share in manufacturing as $share_i \equiv \frac{1}{T_i}\sum_{t=0}^{T_i} \frac{employment\ manufacturing_{i,t}}{employment_{i,t}}$.

Table 1: **Cross-sectional growth regressions**

Dependent variable: Total factor productivity growth	(1)	(2)	(3)	(4)
capital inflows	-0.0253	-0.0253	-0.0166	-0.0123
	(0.0103)	(0.0104)	(0.0113)	(0.0105)
employment share manufacturing			0.0495	0.0744
			(0.0161)	(0.0170)
initial productivity		-0.0027		-0.0521
		(0.0152)		(0.0142)
initial productivity squared		-0.0000		0.0003
		(0.0001)		(0.0001)
# observations	72	72	62	62
R^2	0.0791	0.1110	0.2160	0.3820

Notes: Standard errors in parentheses. All variables are in expressed in percent.

significant. In column (2) we control for initial productivity relative to the United States, in levels and squared, as a way to account for a country's distance from the technological frontier. Even after adding these controls, the negative correlation between capital inflows and growth remains statistically significant.[52] Interestingly, the coefficients on initial productivity themselves are not statistically significant, consistent with the lack of unconditional convergence documented by the literature (Rodrik, 2012).

We repeat the same analysis in columns (3)-(4), but adding the share of employment in manufacturing as an additional control. There are three interesting observations. First, economic activity in the tradable sector is positively related to productivity growth, and the relationship is highly statistically significant. Second, after controlling for the size of the manufacturing sector, capital inflows are no longer significantly associated with productivity growth.[53] This finding is consistent with our theory, in which capital inflows affect growth through their impact on economic activity in the tradable sector. Third, the coefficients on initial productivity are now strongly statistically significant and in line with productivity convergence. This pattern, previously uncovered by Rodrik (2012), suggests that international productivity convergence is mediated by the size of the tradable sector. This is one of the key features of our model.

In Appendix F.2, we show that the results presented in Table 1 are robust to a number of alternative specifications. In particular, we confirm that the results hold if we replace TFP with labor productivity growth, or the employment share in manufacturing with value added in manufacturing relative to GDP. We also show that the results hold up once we look at labor productivity growth in *manufacturing*, rather than economy-wide growth. Hence, consistent with our model, our results for economy-wide growth do not just reflect sectoral composition effects.

[52] Gourinchas and Jeanne (2013) show that the allocation puzzle is robust to the addition of a battery of controls.

[53] Notice that, due to data availability, the sample size shrinks slightly when we add economic activity in manufacturing as a control. However, also in this restricted sample the raw correlation between capital inflows and productivity growth is negative and statistically significant.

Of course, this evidence cannot be used to establish any causality link and does not represent a formal test of the model. Still, the fact that the data exhibit the long-run correlations implied by our model is encouraging.

4.2 Time-series evidence

We next exploit the panel structure of our data, and study how capital flows correlate with productivity growth and economic activity in the traded sector within each country over time. We take Müller and Verner (2023) as the starting point of our time-series analysis. Looking at a panel of advanced and developing countries, they show that credit booms directed towards the non-tradable sector are followed by declines in productivity growth. We follow their approach, but focus on capital inflows rather than credit. In particular, we run a panel regression akin to equation (4) in their paper

$$\Delta_3 tfp_{i,t+h} = \alpha_i^h + \beta_h \times capinf_{i,t} + \varepsilon_{i,t+h}, \tag{48}$$

where the dependent variable is the annualized change in log TFP from year $t-3+h$ to $t+h$. As we did in the last subsection, we use cumulated current account deficits scaled by initial GDP as our capital inflow measure: $capinf_{i,t} = -\sum_{k=0}^{2} CA_{i,t-k}/(3Y_{i,t-2})$.[54] In turn, α_i^h is a country fixed effect, allowing for different trends across countries, and β_h is our coefficient of interest.

Table 2 shows the results. Consistent with our model, capital inflows are associated with persistent slowdowns in productivity growth. For instance, the estimate $\beta_0 = -0.098$ implies that, over a three-years window, a current account deficit equal to 1% of GDP is associated with a drop in productivity growth of about 0.1 percent.

In the bottom rows of the table, we compute the correlation between capital inflows and the share of employment in manufacturing by replacing $\Delta_3 tfp_{i,t+h}$ in (48) with $share_{i,t+h} - share_{i,t-4}$. Again consistent with our model, we find that episodes of capital inflows are accompanied by persistent declines in economic activity in manufacturing.

We study the robustness of our results in Appendix F.3. We first show that the results hold up once we replace TFP growth with real GDP per capita growth, labor productivity growth, and labor productivity growth in manufacturing. We also show that the results are robust to measuring economic activity in the tradable sector with the value added share of manufacturing in GDP. We then conduct an event analysis, by studying episodes of large capital inflows. Precisely, following Benigno et al. (2015), we identify events of large capital inflows as years when the current account ratio is more than one standard deviation below its trend. We then show that during episodes of large capital inflows the manufacturing sector shrinks and productivity growth slows down.

This evidence suggests that, on average, capital inflows are associated with a smaller size of the tradable sector and lower productivity growth. A few other studies have documented similar empirical regularities. The first fact is related to Benigno et al. (2015) and Kalantzis (2015),

[54] In line with Müller and Verner (2023), we focus on medium-run variations in capital flows by considering the average current account deficit over a three-years window, normalized by initial GDP.

Table 2: Time-series growth regressions

Panel A. Dependent variable: Total factor productivity growth					
	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$
capital inflows	-0.098	-0.106	-0.084	-0.041	-0.003
	(0.022)	(0.017)	(0.013)	(0.010)	(0.012)
# observations	2057	1985	1920	1852	1790
R^2	0.14	0.18	0.21	0.26	0.31
Panel B. Dependent variable: Employment share manufacturing					
	$h = 0$	$h = 1$	$h = 2$	$h = 3$	$h = 4$
capital inflows	-0.049	-0.051	-0.047	-0.038	-0.024
	(0.0188)	(0.021)	(0.021)	(0.022)	(0.020)
# observations	2057	1985	1920	1852	1790
R^2	0.14	0.18	0.21	0.26	0.31

Notes: Regression analysis according to equation (48). Driscoll and Kraay (1998) standard errors in parentheses with lag-length $ceil(1.5(3 + h))$. All variables are in expressed in percent.

who show that episodes of large capital inflows are associated with a reallocation of productive activities out of manufacturing and towards the non-tradable sectors. The second fact is consistent with the evidence by Mian et al. (2019) and Müller and Verner (2023), who show that credit supply expansions geared toward the household and non-tradable sectors are accompanied by a shift of productive resources out of tradable sectors and lower future GDP growth. Bergin et al. (2023) provide yet more related evidence. Their empirical analysis shows that current account surpluses, driven by accumulation of foreign reserves, are associated with increases in economic activity in manufacturing and accelerations in productivity growth.

Again, this evidence does not establish any causal relation, and cannot be used as a direct test of our model. Still, we think that these empirical regularities are intriguing, because they challenge the standard notion that capital inflows should boost investment and productivity growth. The evidence that we just reviewed suggests a more complex - and less benign - picture, that should be further investigated in future empirical work.[55]

5 Model extensions and quantitative implications

In this section, we extend the model in several directions and perform a simple calibration exercise. To be clear, the objective of this exercise is not to provide a careful quantitative evaluation of the framework or to replicate any particular historical event. In fact, both of these tasks would require a much richer model. Rather, our aim is to show that the magnitudes implied by the model are

[55]For instance, it would be interesting to study empirically the impact of capital inflows on sectoral innovation activities, captured by indicators such as R&D spending and patenting. That said, though this is the channel that we chose to emphasize in our model, there are other economic forces that may connect the size of the tradable sector to aggregate productivity growth. Learning by doing externalities in the tradable sector is one example (Krugman, 1987).

quantitatively relevant and reasonable. Throughout, we will focus on the United States - that is the country shaping the world technological frontier - and consider the impact of an increase in the steady state trade deficit. The robust result is that capital inflows may trigger a substantial decline in economic activity in the tradable sector and in aggregate productivity growth. The precise magnitude of these effects, however, depends on how the innovation process is specified. In the interest of space, we limit ourself to sketch out the analysis in the main text, and relegate the details to Appendix G.

5.1 Innovation in the tradable sector only

We start by considering a version of the model close to the baseline one, in which innovation activities take place in the tradable sector only. Growth in the tradable sector is now given by

$$g_{u,t+1}^T = \beta \frac{c_{u,t}^T}{c_{u,t+1}^T} \left(\chi^T \alpha L_{u,t+1}^T + 1 + \lambda (g_{u,t+2}^T - 1) \right), \tag{49}$$

where $g_{u,t+1}^T$ and χ^T denote respectively productivity growth and the productivity of research in the tradable sector. λ is a parameter determining the share of knowledge internal to the firm. We introduce it to calibrate a realistic degree of inter-firms knowledge spillovers.[56] As in the baseline model, productivity growth in the non-traded sector is exogenous and constant

$$g_{u,t+1}^N = g_u^N. \tag{50}$$

The only difference is that we allow g_u^N to differ from 1.

As a measure of aggregate growth, we consider the growth rate of real value added in each sector weighted by each sector's employment share.[57] Consistent with national accounting practice (Crawford et al., 2014), we compute aggregate growth by assuming that productivity in the research sector grows at the same rate as in the rest of the economy. Using this definition, aggregate productivity growth $g_{u,t}$ evolves according to

$$g_{u,t} = \frac{L_{u,t}^T}{\bar{L}} g_{u,t}^T + \frac{L_{u,t}^N}{\bar{L}} g_{u,t}^N + \frac{L_{u,t}^R}{\bar{L}} g_{u,t}. \tag{51}$$

The labor market clearing condition is unchanged relative to the baseline model

$$\bar{L} = L_{u,t}^T + L_{u,t}^N + L_{u,t}^R, \tag{52}$$

[56] More precisely, we now assume that productivity of firm j evolves according to

$$A_{u,t+1}^{j,T} = A_{u,t}^{j,T} + \chi^T (A_{u,t}^{j,T})^{\lambda} (A_{u,t}^T)^{1-\lambda} L_{u,t}^{j,T},$$

where $0 \le \lambda \le 1$. So, when investing in innovation, a firm now builds up on its own stock of knowledge ($A_{u,t}^{j,T}$) and on the aggregate stock of knowledge in its sector ($A_{u,t}^T$). A higher λ corresponds to a higher weight on the internal stock of knowledge. Our baseline model corresponds to the case $\lambda = 0$.

[57] We focus on growth weighted by employment shares to obtain analytic insights. We verified numerically that the results are not much different if we use the Fisher index to compute the growth rate of aggregate GDP, in line with NIPA methodology.

where $L^R_{u,t} = (g^T_{u,t+1} - 1)/\chi^T$. Moreover, labor allocated to the production of non-tradable goods is now

$$L^N_{u,t} = \frac{1-\omega}{\omega \Psi} c^T_{u,t}, \tag{53}$$

which replaces equation (30). Evaluated on the balanced growth path, these five equations determine $g^T_u, g^N_u, g_u, L^T_u, L^N_u$, for given consumption of tradable goods c^T_u.

How large is the effect of capital inflows on productivity growth in the United States? To obtain some analytic insights, consider a case in which the research sector is small ($L^R_{u,t} \approx 0$). Under this approximation, one can show that

$$\frac{L^T_{u,t}}{\bar{L}} = \omega - (1-\omega) T_t, \tag{54}$$

where T_t denotes the trade deficit relative to GDP, which we will take as our measure of capital inflows. As in our baseline model, a higher trade deficit induces a reallocation of labor from the tradable sector to the non-tradable one.

Now consider the impact of a permanent increase in T on aggregate productivity growth. Combining (49), (51) and (54), and using again the approximation $L^R_u \approx 0$, gives

$$\frac{\partial g_u}{\partial T} = -(1-\omega) \left(\underbrace{g^T_u - g^N_u}_{\text{reallocation}} + \underbrace{g^T_u - \frac{\beta(1-\lambda)}{1-\beta\lambda}}_{\text{impact on } g^T_u} \right). \tag{55}$$

There are two effects at play. First, holding constant g^T_u, the reallocation of labor between the two sectors has a marginal impact on aggregate productivity growth equal to $g^T_u - g^N_u$. The second effect, encapsulated by the term $g^T_u - \frac{\beta(1-\lambda)}{1-\beta\lambda}$, captures the negative impact of capital inflows on innovation activities within the tradable sector. In the empirically relevant case $g^T_u > g^N_u$, both forces point toward a depressive impact of capital inflows on productivity growth.

To assess the magnitudes involved, we move away from the approximation $L^R_u \approx 0$ and perform a simple calibration exercise. We set the length of a period to one year, and choose parameters values so that the model under financial autarky matches some statistics inspired by U.S. data. We set $\beta = .96$, a standard value at annual frequencies. In the late 1990s, that is at the onset of the global saving glut, the share of manufacturing in GDP in the United States was about 15%. We match this statistic by setting $\omega = .15$. We set $\alpha = .122$, so that spending in innovation by firms in the tradable sector is equal to 1.3% of GDP. This is in line with expenditure in R&D by U.S. manufacturing firms in the late 1990s.[58] Kehoe et al. (2018) estimate that between 1992 and 2012 productivity in U.S. manufacturing grew on average by 4.4% per year. We thus set $\chi^T = 3.02$

[58]Following standard practice in the endogenous growth literature, we use R&D spending as the data counterpart of the model's investment in innovation. One could argue that innovation activities include other types of investment, often difficult to measure, and so that R&D spending understates actual investment in innovation. That said, targeting a higher level of investment in innovation would not change substantially the results of our calibration exercise.

so that $g_u^T = 1.044$ under financial autarky. Again following the empirical evidence provided by Kehoe et al. (2018), we set $g_u^N = 1.011$.[59] The implied aggregate productivity growth under financial autarky is 1.6%. We set λ following the empirical estimates provided by Bloom et al. (2019a) on knowledge spillovers within U.S. firms. They find that, due to knowledge externalities, the social return to R&D is about four times larger than the private one. We match this statistic by setting $\lambda = .75$.[60]

We consider the economy's response to a permanent capital inflows shock, defined as follows. The economy starts from the financial autarky steady state. From period 0 on, the economy starts running a permanent trade deficit equal to 2% of GDP. In response, the economy immediately jumps to a new steady state. Table 3 compares the steady state under financial autarky against one with a 2% trade deficit-to-GDP ratio.

Trade deficits induce a drop in the share of labor allocated to the production of traded goods from 14.8% to 13.2%. This number is in the ballpark of the estimates provided by Kehoe et al. (2018) on the impact of the global saving glut on manufacturing employment in the United States.[61] As a result of this sectoral labor reallocation, productivity growth in the tradable sector falls from 4.4% to 2.4%, while aggregate productivity growth drops from 1.6% to 1.3%. So not only capital inflows depress productivity growth, which runs contrary to conventional wisdom, but they do so by a significant amount. We also find that capital inflows generate sizable welfare losses, corresponding to a permanent 4.3% drop in financial-autarky consumption.[62] As we noted in

[59] We take services and construction as the empirical counterparts for the model's non-tradable sector. Kehoe et al. (2018) estimate productivity growth in construction and services to be equal respectively to -0.84 and 1.3 percent per year. Construction in the United States is about 5% of value added. Given that in our calibration manufacturing is 15% of GDP, we then assign the remaining 80% of value added to services. This implies $g_u^N = 1.013 * .8/.85 - 0.9916 * .5/.85 = 1.011$.

[60] To set λ, we use the fact that on the balanced growth path the private return from R&D is given by

$$r^p \equiv \frac{g_u^T}{\beta} - 1 = \frac{\chi^T \alpha L_u^T + 1 - \lambda}{1 - \beta\lambda} - 1,$$

while the social return, which internalizes the inter-firms knowledge spillovers, is given by

$$r^{sp} \equiv \frac{\chi^T \alpha L_u^T}{1 - \beta} - 1.$$

We set $\lambda = .75$ so that $r^{sp} = 4r^p$.

[61] According to their simulations, between 1992 and 2012 the global saving glut on average increased the yearly trade deficit-to-GDP ratio by 3 percentage points, while it lowered the share of employment in manufacturing by 1.2 percentage points. Dix-Carneiro et al. (2023), using a structural model, find a quantitatively similar impact of trade deficits on manufacturing employment in the United States. These estimates are one order of magnitude bigger than the empirical correlations between capital flows and manufacturing employment that we reported in Section 4.2. However, these empirical correlations do not have a causal interpretation, and they pool a variety of episodes heterogeneous both in terms of underlying shocks driving capital flows and countries. It is then not obvious to map these empirical correlations with our quantitative exercise.

[62] We compute the welfare gains from capital inflows as the proportional increase in consumption that households living under financial autarky must receive in order to be indifferent between remaining under financial autarky and switching to an economy receiving capital inflows. Formally, the consumption equivalent η is defined as

$$\sum_{t=0}^{\infty} \beta^t \log\left((1+\eta)\, C_{u,t}^a\right) = \sum_{t=0}^{\infty} \beta^t \log\left(C_{u,t}^f\right),$$

where the superscripts a and f denote allocations respectively in the financial autarky economy and in an economy receiving capital inflows.

Table 3: Calibrated examples

	Exogenous g_u^N		*Endogenous* g_u^N		*Intersectoral spillovers*	
Trade deficit/GDP	0.0	2.0	0.0	2.0	0.0	2.0
Productivity growth:						
Aggregate	1.6	1.3	1.6	1.5	1.6	1.3
Tradables	4.4	2.4	4.4	2.2	1.6	0.1
Non-tradables	1.1	1.1	1.1	1.4	1.6	1.4
Employment share:						
Tradables	14.8	13.2	14.4	12.7	14.4	12.8
Non-tradables	83.7	86.0	81.7	83.4	81.6	83.9
Research	1.5	0.8	3.9	3.9	4.0	3.3
Welfare gains	0.0	-4.3	0.0	0.8	0.0	-3.0

Notes: All the values are expressed in percentage points. Welfare gains are expressed as consumption equivalents with respect to financial autarky.

Section 3, this perhaps surprising result can be explained by the fact that trade deficits exacerbate private firms' underinvestment in innovation.

5.2 Innovation in both sectors

In our baseline model, firms in the non-tradable sector do not invest in innovation. In reality, however, even if the lion's share of investment in innovation occurs within tradable sectors (see Figure 2a), productivity-enhancing activities take place in non-tradable sectors as well. We now revisit the impact of capital inflows on U.S. productivity growth allowing firms in both sectors to invest in innovation.

In this version of the model the two sectors are symmetric, except for the parameter governing the productivity of research labor. The growth equation (50) is thus replaced by

$$g_{u,t+1}^N = \beta \frac{c_{u,t}^T}{c_{u,t+1}^T} \left(\chi^N \alpha L_{u,t+1}^N + 1 + \lambda (g_{u,t+2}^N - 1) \right), \tag{56}$$

where $\chi^N > 0$ denotes the productivity of research in the non-tradable sector. All the other equations remain unchanged relative to the previous section, once we define $L_{u,t}^R \equiv L_{u,t}^{R,T} + L_{u,t}^{R,N}$, where $L_{u,t}^{R,s} = (g_{u,t+1}^s - 1)/\chi^s$ for $s \in \{T, N\}$.

The key difference with respect to the baseline model is that now capital inflows foster productivity growth in the non-tradable sector, because firms producing non-traded goods invest more in innovation when the non-traded sector expands. Therefore, capital inflows reallocate innovation activities from the tradable to the non-tradable sector, meaning that the effect on *aggregate* productivity growth is a priori ambiguous.

To make progress, we again consider the approximation $L_u^R \approx 0$. Going through the same steps as in the last section, we can trace the impact of a marginal permanent rise in capital inflows on aggregate growth as

$$\frac{\partial g_u}{\partial T} = -(1-\omega)\left(\underbrace{g_u^T - g_u^N}_{\text{reallocation}} + \underbrace{g_u^T - \frac{\beta(1-\lambda)}{1-\beta\lambda}}_{\text{impact on } g_u^T} - \left(\underbrace{g_u^N - \frac{\beta(1-\lambda)}{1-\beta\lambda}}_{\text{impact on } g_u^N}\right)\right). \tag{57}$$

A new term appears relative to equation (55), which captures the positive impact of capital inflows on productivity growth within the non-tradable sector. However, notice that expression (57) can be further simplified to $\frac{\partial g_u}{\partial T} = -2(1-\omega)(g_u^T - g_u^N)$. In the empirically relevant case $g_u^T > g_u^N$, a marginal rise in capital inflows thus depresses productivity growth.

What is the intuition behind this result? Again, there are two effects at play. The first one is the mechanic reallocation effect captured by the term $g_u^T - g_u^N$. Second, and more interestingly, if $g_u^T > g_u^N$ then the elasticity of productivity growth with respect to market size is higher in the traded sector compared to the non-traded one. In fact, consider that for a generic sector s

$$\frac{\partial g_u^s}{\partial L_u^s} L_u^s = g_u^s - \frac{\beta(1-\lambda)}{1-\beta\lambda}.$$

Hence, the sector characterized by faster growth is also the one in which productivity growth is more sensitive to changes in employment. Both effects point toward a negative impact on aggregate growth of a reallocation of labor from the tradable to the non-tradable sector.

We now have two parameters determining the productivity of research to calibrate, χ^T and χ^N. We set them to hit the two sectoral productivity growth rates $g^T = 1.044$ and $g^N = 1.011$, which yields $\chi^T = 3.10$ and $\chi^N = .45$. This calibration strategy thus implies that research is more productive in the tradable sector compared to the non-traded one, i.e. $\chi^T > \chi^N$. That is the way in which the model rationalizes faster productivity growth in the traded sector, in spite of a smaller market size compared to the non-traded one. The remaining parameters are unchanged relative to Section 5.1.

Table 3 shows the impact of a capital inflows shock causing a permanent trade deficit equal to 2% of GDP. There are three points to highlight. First, capital inflows lower aggregate productivity growth from 1.6% to 1.5%. So, in line with the intuition delivered by the approximation underlying expression (57), the rise in productivity growth in the non-traded sector is not large enough to counteract the drop in the tradable one. Second, the drop in economy-wide growth takes place even though the aggregate amount of labor devoted to research remains constant. Hence, the decline in productivity growth is purely driven by the fact that research labor reallocates to the sector in which it is less productive. Finally, in spite of the fact that the U.S. effectively receives a large transfer of resources from abroad, the welfare gains from capital inflows are modest. Once again, this happens because trade deficits amplify the inefficiencies characterizing the innovation process.

5.3 Knowledge spillovers across sectors

A recent literature argues that intersectoral knowledge spillovers are an important aspect of technological progress (Liu and Ma, 2021). Interestingly, this literature suggests that the manufacturing sector emanates particularly strong knowledge spillovers to the rest of the economy. To incorporate this notion in our model, we assume that when performing research firms build on a weighted average of the knowledge stocks in the two sectors: $(A^T_{u,t})^{\phi^T}(A^N_{u,t})^{1-\phi^T}$ in the tradable sector, and $(A^N_{u,t})^{\phi^N}(A^T_{u,t})^{1-\phi^N}$ in the non-tradable one.[63] When $\phi^T = \phi^N = 1$ intersectoral knowledge spillovers are shut off, and the model collapses to the one studied in the previous section. We now move away from this benchmark and consider scenarios in which $0 < \phi^T < 1$ and $0 < \phi^N < 1$.

As in Liu and Ma (2021), intersectoral knowledge spillovers act as a force toward productivity convergence between the two sectors. In fact, on the balanced growth path productivity in both sectors grows at rate

$$g_u = \frac{\beta\left((\chi^N \alpha L^N_u)^{\frac{1-\phi_T}{2-\phi_T-\phi_N}}(\chi^T \alpha L^T_u)^{\frac{1-\phi_N}{2-\phi_T-\phi_N}} + 1 - \lambda\right)}{1-\beta\lambda}. \tag{58}$$

Aggregate productivity growth thus depends on each sector's market size, weighted by the strength of the intersectoral knowledge spillovers. Now consider a permanent rise in capital inflows, inducing a reallocation of labor out of the tradable sector and toward the non-tradable one. Using again the approximation $L^R_u \approx 0$, the marginal impact on productivity growth is given by

$$\frac{\partial g_u}{\partial T} = -(1-\omega)\left(g_u - \frac{\beta(1-\lambda)}{1-\lambda\beta}\right)\frac{(1-\phi^N)\frac{\bar{L}}{L^T_u} - (1-\phi^T)\frac{\bar{L}}{L^N_u}}{2-\phi^T-\phi^N}. \tag{59}$$

So capital inflows depress aggregate productivity growth if

$$\frac{1-\phi^N}{L^T_u} > \frac{1-\phi^T}{L^N_u}. \tag{60}$$

that is if the tradable sector generates sufficiently large knowledge spillovers compared to the non-tradable one. Moreover, when this condition holds, capital inflows depress productivity growth also within the non-tradable sector. Indeed, while capital inflows boost market size and firms' incentives to invest in the non-traded sector, in the long run this effect is outweighed by the drop in the knowledge spillovers received from the tradable one.

Empirical estimates of the parameters ϕ^T and ϕ^N can be obtained using the approach proposed by Liu and Ma (2021), which is based on the pattern of intersectoral patent citations. Using manufacturing and services as empirical counterparts respectively of the tradable and non-tradable

[63] To be precise, the law of motion for technology in sector s is now

$$A^{j,s}_{u,t+1} = A^{j,s}_{u,t} + \chi^s (A^{j,s}_{u,t})^\lambda \left((A^s_{u,t})^{\phi^s}(A^{-s}_{u,t})^{1-\phi^s}\right)^{1-\lambda} L^{j,s}_{u,t},$$

where $0 \le \lambda^s \le 1$ and $0 \le \phi^s \le 1$. Hence, individual firms innovate building on their internal stock of knowledge $(A^{j,s}_{u,t})$ and on the aggregate stock of knowledge in both sectors, ($A^T_{u,t}$ and $A^N_{u,t}$).

sector, this approach implies $\phi^T = 0.84$ and $\phi^N = 0.4$.[64] Hence, manufacturing produces much stronger knowledge spillovers toward services, compared to the other way around. We are left to choose values for χ^T and χ^N. Given that in this model version $g_u^T = g_u^N$, we set $\chi^T = \chi^N = 1.83$ so that under financial autarky $g_u = 1.016$ (as in the other two model versions). The remaining parameters are unchanged from before.

Once again, we consider the impact of a capital inflows shock causing a permanent trade deficit equal to 2% of GDP. As we describe in detail in Appendix G.3, in this version of the model this shock triggers a slow transition toward a new steady state. In Table 3 we summarize these dynamics by showing the average values of all variables over the first 50 years since the start of the transition.

The main result is that now capital inflows depress productivity growth not only in the tradable sector, but in the non-tradable one too. Interestingly, this happens despite the fact that the non-tradable sector expands, giving firms in this sector more incentives to invest. This positive market size effect, however, is dominated by the drop in knowledge spillovers that non-tradable firms receive from the tradable sector. The consequence is that capital inflows trigger a sizeable decline in aggregate productivity growth, by 0.3 percentage points.[65] We get a similar result for welfare, as we find that capital inflows cause a welfare loss equal to a permanent 3% drop in financial-autarky consumption.[66] Taking stock, these results suggest that capital inflows may trigger a significant decline in productivity growth and welfare, even if research activities take place in the non-traded sector too.

5.4 Semi-endogenous growth and structural change

In Appendix G we consider two additional extensions to our framework. First, we study a semi-endogenous growth model. As is well understood, in this class of models long-run growth is not affected by policy variables (Jones, 2022). This result extends to capital inflows, which also leave the long-run growth rate unaffected. However, we show that capital inflows may depress productivity growth in the medium run, while the economy transits toward its balanced growth path. Moreover, since transitional dynamics tend to be slow for reasonable calibrations (e.g., Jones, 2022), capital inflows can trigger very persistent productivity growth slowdowns.

Second, we embed structural change in our model. We take a supply side view of structural change, as in Ngai and Pissarides (2007). That is, we assume that structural change takes place because of differences in the rate of technological progress across sectors, coupled with a demand

[64] We are grateful to Ernest Liu for providing us these estimates.

[65] One interesting result, on which we elaborate in Appendix G.3, is that the market size and the knowledge spillovers effects operate at different horizons. Initially, the market size effect dominates, and productivity growth actually accelerates in the non-tradable sector when the capital inflows episode starts. Eventually, however, the drop in knowledge spillovers from the tradable sector drags productivity growth in the non-traded sector down. So, the longer the horizon considered the bigger is the negative impact of capital inflows on productivity growth (for instance, in the final steady state productivity growth is just 0.6%). There is an obvious parallel with the case of developing countries discussed in Section 3.3, in which productivity growth slows down because of lower knowledge spillovers originating from the world technological frontier.

[66] Just as in the previous two version of the model, the welfare loss is computed by taking into account utility since the start of the transition to the infinite future.

elasticity smaller than 1.[67] We consider the empirically relevant scenario in which initially productivity grows faster in the tradable sector compared to the non-tradable one. As in Ngai and Pissarides (2007), this productivity growth differential causes labor to move from the tradable to the non-tradable sector. The difference is that in our framework the reallocation of labor slows down innovation in the tradable sector, so that in the long run convergence in productivity growth between the two sectors occurs. We then show that capital inflows depress productivity growth over the medium run, resulting in a permanent reduction in the level of productivity in the tradable sector. Moreover, in accordance with Kehoe et al. (2018), we find that while the forces of structural change account for the bulk of the decline in employment in the traded sector over the long run, capital inflows lead to additional significant declines of employment in the traded sector over the medium run.

6 Conclusion

In this paper, we have presented a model to study the impact of the global saving glut on global productivity growth. We have shown that capital flows from developing countries to the United States can generate a global productivity growth slowdown, by triggering a fall in economic activity in the U.S. tradable sectors. We have dubbed this effect the global financial resource curse.

This paper represents just a first step in a broader research agenda. For instance, here we have just touched on the issue of policy interventions. But the world that we describe is ripe with externalities and international spillovers. It would then be interesting to use our model to design optimal policies to manage financial globalization. Moreover, in this paper we have abstracted from the impact of demand factors on aggregate employment and output. However, low interest rates are a key feature of our narrative. If equilibrium interest rates are too low, monetary policy might be unable to maintain full employment because of the zero lower bound constraint on nominal rates. To study these effects one should integrate nominal rigidities in this framework, in the spirit of the Keynesian growth model developed by Benigno and Fornaro (2018). This represents a promising area for future research.

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[67] The analysis in Kehoe et al. (2018) suggests that this is the most important channel to understand the shift of employment out of manufacturing and toward services in the United States during the global saving glut.

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Appendix (for online publication)

A Motivating evidence

A.1 Figure 1

To construct the current-account-to-GDP ratio of developing countries in Figure 1a, we draw on current account data from the World Economic Outlook (WEO) 2019. Specifically, we extract current-account-to-GDP data for all countries which WEO classifies as "analytical group: Emerging market and developing economies" (a total of 154 countries).

Thereafter, we use real GDP data of these countries - in terms of 2018 dollars and converted by using PPP exchange rates - to construct weights in each year. Last, we construct an average current account ratio by using the formula

$$\left(\frac{CA}{GDP}\right)_{\text{Developing countries},t} \equiv \sum_{i\in\text{Developing countries}} \frac{GDP_{i,t}^{real}}{\sum_{i\in\text{Developing countries}} GDP_{i,t}^{real}} \left(\frac{CA}{GDP}\right)_{i,t}$$

for each year $t \in \{1985, ..., 2018\}$.

To construct Figure 1b, we extract a labor productivity growth series (GDP per hours worked) from the 2019 IMF World Economic Outlook.

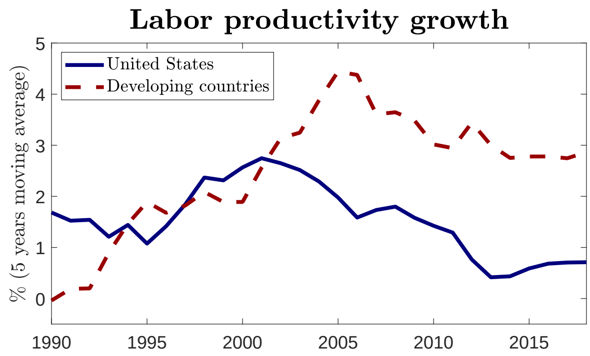


Figure 8: Productivity growth dynamics in developing countries.

A.2 Figure 2

The data underlying Figure 2a has been obtained from the OECD, series name "Business enterprise R&D expenditure by industry". The series is expressed in millions of U.S. dollars. We obtain shares of total spending by dividing sectoral R&D spending by total R&D spending.

To construct Figure 2b, we download annual growth rate data from the U.S. Bureau of Labor Statistics, series name "Labor productivity (output per hour)". We extract data for "manufacturing" and for "business". We then plot a 5-year moving average.

A.3 Productivity growth dynamics in developing countries

Figure 8 compares labor productivity growth in the United States and in our sample of developing countries. During the early phases of the global saving glut, productivity growth in developing countries accelerated, while later on it experienced a mild slowdown.

To construct the time series for labor productivity growth in developing countries, we extract Employment data (number of workers) for 132 out of the 154 developing countries in our sample (recall Appendix A.1). The data sources used are Conference Board, HAVER analytics and Penn World Table. Thereafter, we compute labor productivity as real GDP divided by employment, and take log changes to compute growth rates. We then construct an average growth rate by using the same weighting scheme as for the average current account to GDP ratio in developing countries.

B Proofs

This Appendix contains the proofs of all propositions.

B.1 Proof of Proposition 1

Proof. Existence of the steady state has been discussed in the main text. Moreover, in the financial autarky steady state, the terminal condition (25) holds with equality in all countries because $b_{i,t} = 0$ for all t.

We now prove uniqueness. First, consider that (RR_u) and (GG_u), once $c^T_{u,a}$ is substituted out, imply respectively a positive and negative relationship between $L^T_{u,a}$ and g_a. This means that there can be at most one value for $L^T_{u,a}$ and g_a consistent with equilibrium. Likewise, (RR_d) and (GG_d), once $c^T_{d,a}$ is substituted out, imply respectively a positive and negative relationship between $L^T_{d,a}$ and $a_{d,a}$. Again, this means that the equilibrium values of $L^T_{d,f}$ and $a_{d,f}$ are uniquely pinned down.

It is immediate to see that the first part of condition (35) implies $g_a > 1$, since the expression appearing in (35) equals exactly the equation for g_a in (33).

We now show that $\xi < \chi$ implies $a_{d,a} < 1$. Inserting g_a given by (33) into (34) yields

$$a^{\phi}_{d,a} = \frac{\beta\xi\alpha\bar{L}}{\frac{\alpha\beta(\chi\bar{L}+1-\beta)}{1+\Gamma\Psi+\alpha\beta}(1+\Gamma\Psi) + \alpha\beta\left(\frac{\alpha\beta(\chi\bar{L}+1-\beta)}{1+\Gamma\Psi+\alpha\beta} + \beta - 1\right)}.$$

Canceling $\alpha\beta$ and multiplying with $1 + \Gamma\Psi + \alpha\beta$, this can be written as

$$a^{\phi}_{d,a} = \frac{\xi\bar{L}(1+\Gamma\Psi+\alpha\beta)}{(1+\Gamma\Psi)(\chi\bar{L}+1-\beta) + \alpha\beta(\chi\bar{L}+1-\beta) - (1-\beta)(1+\Gamma\Psi+\alpha\beta)}.$$

The denominator can be simplified to $\chi\bar{L}(1+\Gamma\Psi+\alpha\beta)$. Canceling variables then leads to

$$a^{\phi}_{d,a} = \frac{\xi}{\chi}.$$

Since $\phi > 0$, then $\xi < \chi$ implies $a_{d,a} < 1$.

We are left with determining $R_{u,a}$ and $R_{d,a}$. Since households inside each region are symmetric and financial flows across regions are not allowed, it must be that $b_{i,t} = 0$. Credit market clearing inside each region then requires $\tilde{\mu}_{i,t} = 0$.[68] Using the households' Euler equations evaluated in steady state then gives $R_{u,a} = g_a/\beta$ and $R_{d,a} = g_a/(\beta(1+\tau))$. ■

B.2 Proof of Proposition 2

Proof. We first show that $R_f = g_f/((\beta(1+\tau))$. From the Euler equation in both regions (23), evaluated in steady state

$$\frac{\omega}{c^T_{u,f}} = R_f\left(\frac{\beta\omega}{g_f c^T_{u,f}} + \tilde{\mu}_{u,f}\right)$$
$$\frac{\omega}{c^T_{d,f}} = R_f(1+\tau)\left(\frac{\beta\omega}{g_f c^T_{d,f}} + \tilde{\mu}_{d,f}\right).$$

[68] Strictly speaking, if $\kappa = 0$ then $\tilde{\mu}_{i,t} = 0$ is not a necessary condition for credit markets to clear. This implies that with $\kappa = 0$ interest rates are not uniquely pinned down in equilibrium. This source of multiplicity, however, disappears as soon as $\kappa > 0$. We therefore impose the equilibrium refinement condition $\tilde{\mu}_{i,t} = 0$ also for the case $\kappa = 0$.

Since $\tau > 0$, it must be that $\tilde{\mu}_{u,f} > 0$ and $\tilde{\mu}_{d,f} = 0$ to ensure the credit markets clear.[69] U.S. households are therefore borrowing constrained in steady state, and so $b_{u,f} = -\kappa$. Moreover, developing countries' Euler equation implies

$$R_f = \frac{g_f}{\beta(1+\tau)}. \tag{36}$$

Since $b_{u,f} = -\kappa = -b_{d,f}$, tradable consumption in both regions is

$$c^T_{u,f} = \Psi L^T_{u,f} - \kappa\left(1 - \frac{g_f}{R_f}\right) = \Psi L^T_{u,f} + \kappa\left(\beta(1+\tau) - 1\right)$$
$$c^T_{d,f} = \Psi a_{d,f} L^T_{d,f} + \kappa\left(1 - \frac{g_f}{R_f}\right) = \Psi a_{d,f} L^T_{u,f} - \kappa\left(\beta(1+\tau) - 1\right),$$

where we have used (36). To complete the proof of existence, note that the terminal conditions (25) are satisfied for all countries in the financial integration steady state described. For households in developing countries, this equation becomes

$$\lim_{k\to\infty} \frac{b_{d,f} g_f^k}{R_f^k (1+\tau)^k} = \lim_{k\to\infty} \beta^k b_{d,f} = 0,$$

where we have used equation (36). For households in the U.S., instead, this equation becomes

$$\lim_{k\to\infty} \frac{b_{u,f} g_f^k}{R_f^k} = \lim_{k\to\infty} \frac{(-\kappa) g_f^k}{R_f^k} = -\infty < 0,$$

where we used that $\beta(1+\tau) > 1$ implying that $R_f < g_f$. In the U.S., the terminal condition is thus satisfied with strict inequality.

We next prove uniqueness. First, consider that (RR_u) and (GG_u), once $c^T_{u,f}$ is substituted out, imply respectively a positive and negative relationship between $L^T_{u,f}$ and g_f. This means that there can be at most one value for $L^T_{u,f}$ and g_f consistent with equilibrium. Likewise, (RR_d) and (GG_d), once $c^T_{d,f}$ is substituted out, imply respectively a positive and negative relationship between $L^T_{d,f}$ and $a_{d,f}$. Again, this means that the equilibrium values of $L^T_{d,f}$ and $a_{d,f}$ are uniquely pinned down.

We now turn to the condition (41) stated in Proposition 2. From combining (GG_u) and (RR_u) the growth rate under financial integration is given by

$$g_f = \beta\left(\frac{\alpha(\chi\bar{L} + 1 - \beta - \chi\Gamma\kappa(\beta(1+\tau)-1))}{1 + \Psi\Gamma + \alpha\beta} + 1\right),$$

which corresponds to (38) in the main text after inserting (33). Therefore, the first part of condition (41) guarantees that $g_f > 1$. Moreover, it is easy to check that if $g_f > 1$ then it must be that $L^T_{u,f} > 0$.

[69] More precisely, if $\kappa = 0$ then $\tilde{\mu}_{d,f} = 0$ is not a necessary condition for credit markets to clear. This implies that with $\kappa = 0$ interest rates are not uniquely pinned down in equilibrium. This source of multiplicity, however, disappears as soon as $\kappa > 0$. We therefore impose the equilibrium refinement condition $\tilde{\mu}_{d,f} = 0$ also for the case $\kappa = 0$.

We are left to prove that $a_{d,f} < 1$. Start by combining (GG_d) and (RR_d) to derive an equation for $a_{d,f}$

$$a_{d,f}^{\phi} = \frac{\alpha\beta\xi\left(\bar{L} + \Gamma\frac{\kappa(\beta(1+\tau)-1)}{a_{d,f}}\right)}{(g_f - \beta)(1 + \Gamma\Psi) + (g_f - 1)\alpha\beta}, \tag{40}$$

which corresponds to (40) from the main text. Inserting g_f using (38) and taking identical steps as in Appendix B.1 this can be written as

$$a_{d,f}^{\phi} = \frac{\xi\left(\bar{L} + \frac{\Gamma\kappa(\beta(1+\tau)-1)}{a_{d,f}}\right)}{\chi(\bar{L} - \Gamma\kappa(\beta(1+\tau)-1))}.$$

The left-hand side of this expression is increasing in $a_{d,f}$, while the right-hand side is decreasing in it. Hence, $a_{d,f} < 1$ if and only if

$$\frac{\xi\left(\bar{L} + \Gamma\kappa(\beta(1+\tau)-1)\right)}{\chi(\bar{L} - \Gamma\kappa(\beta(1+\tau)-1))} < 1,$$

which, after rearranging, corresponds to the second part of condition (41). ■

C Lab equipment model

In this Appendix we consider a lab equipment model, in which investment in R&D requires units of the final tradable good, rather than labor. To anticipate our main result, this version of the model preserves all the insights of the one in the main text.

C.1 Changes to economic environment

The only change, with respect to the model in the main text, is that here investment in innovation requires units of the traded final good. In particular, the law of motion for productivity of a generic U.S. firm j now becomes

$$A_{u,t+1}^{j} = A_{u,t}^{j} + \chi I_{u,t}^{j},$$

where $I_{u,t}^{j}$ captures investment in research - in terms of the tradable final good - by intermediate goods firm j. This equation replaces (14) of the baseline model. Thus firms' profits net of expenditure in research become

$$\Pi_{u,t}^{j} = \varpi A_{u,t}^{j} L_{u,t}^{j} - I_{j,t}.$$

As in the main text, firms choose investment in innovation to maximize their discounted stream of profits

$$\sum_{t=0}^{\infty} \frac{\omega\beta^{t}}{C_{u,t}^{T}} \Pi_{u,t}^{j}.$$

In an interior optimum ($I_{u,t}^j > 0$), optimal investment requires

$$\frac{1}{\chi} = \frac{\beta C_{u,t}^T}{C_{u,t+1}^T} \left(\varpi L_{u,t+1}^T + \frac{1}{\chi} \right)$$

which replaces (17). Similarly, we replace (16) for developing countries with

$$A_{d,t+1}^j = A_{d,t}^j + \xi \left(\frac{A_{u,t}}{A_{d,t}} \right)^{\phi} I_{d,t}^j.$$

Profit maximization leads to the first order condition

$$\frac{1}{\xi} \left(\frac{A_{u,t}}{A_{d,t}} \right)^{-\phi} = \frac{\beta C_{d,t}^T}{C_{d,t+1}^T} \left(\varpi L_{d,t+1}^T + \frac{1}{\xi} \left(\frac{A_{u,t+1}}{A_{d,t+1}} \right)^{-\phi} \right).$$

Aggregation and market clearing works as follows. First, value added in the tradable sector is still given by (18). Market clearing for the non-tradable good is still given by (19). However, the market clearing condition for tradable goods is now given by

$$C_{i,t} + I_{i,t} + \frac{B_{i,t+1}}{R_{i,t}} = \Psi A_{i,t} L_{i,t}^T + B_{i,t},$$

where $I_{i,t} = \int_0^1 I_{i,t}^j dj$ is the total amount of tradable goods devoted to investment in region i. This equation replaces (20) in the main text. Finally, asset market clearing is still given by (21), whereas labor market clearing (22) is replaced by

$$\bar{L} = L_{i,t}^N + L_{i,t}^T.$$

C.2 Equilibrium

As it was the case for the baseline model, the model can be cast in terms of three "blocks" . These blocks capture, in turn, the paths of tradable consumption and capital flows, the behavior of productivity, and the resource constraint.

First, the households' Euler equation becomes

$$\frac{\omega}{c_{i,t}^T} = R_{i,t}(1 + \tau_{i,t}) \left(\frac{\beta \omega}{g_{t+1} c_{i,t+1}^T} + \tilde{\mu}_{i,t} \right),$$

where the borrowing limit is given by

$$b_{i,t+1} \geq -\kappa_t a_{i,t+1} \quad \text{with equality if} \quad \tilde{\mu}_{i,t} > 0.$$

and where the market clearing conditions for the tradable good and for bonds are

$$c_{i,t}^T + i_{i,t} + \frac{g_{t+1} b_{i,t+1}}{R_{i,t}} = \Psi a_{i,t} L_{i,t}^T + b_{i,t}$$

$$b_{u,t} = -b_{d,t}.$$

Second, optimal investment in innovation by U.S. firms implies

$$g_{t+1} = \frac{\beta c^T_{u,t}}{c^T_{u,t+1}} \left(\chi\varpi L^T_{u,t+1} + 1\right),$$

while optimal investment in technology adoption by firms in developing countries requires

$$a^{\phi}_{d,t} = \frac{\beta c^T_{d,t}}{g_{t+1} c^T_{d,t+1}} \left(\xi\varpi L^T_{d,t+1} + a^{\phi}_{d,t+1}\right).$$

The law of motion for productivity can be written as

$$g_{t+1} = 1 + \chi i_{u,t},$$

in the U.S., and as

$$g_{t+1} a_{d,t+1} = a_{d,t} + \xi a^{-\phi}_{d,t} i_{d,t},$$

in the developing countries.

Third and last, the labor market clearing condition can be written as

$$L^T_{u,t} = \bar{L} - \Gamma c^T_{u,t}$$

for the U.S., as well as

$$L^T_{d,t} = \bar{L} - \Gamma \frac{c^T_{d,t}}{a_{d,t}}$$

for the developing countries.

C.3 Results

We now provide a brief comparison of the steady states under financial autarky and financial integration. To do so, we next derive the analogues of the (GG_u), (RR_u) as well as (GG_d) and (RR_d) curves. Starting with the U.S., note that the (GG_u) curve is now given by

$$g = \beta(\chi\varpi L^T_u + 1), \tag{GG_u}$$

and is thus almost identical as in the baseline model (the only difference being that α is replaced by the composite parameter ϖ).

In turn, the (RR_u) curve is now given by

$$L^T_u = \bar{L} - \Gamma\left(\Psi L^T_u + b_u\left(1 - \frac{g}{R}\right)\right) + \Gamma\frac{g-1}{\chi}, \tag{RR_u}$$

the term $b_u(1 - g/R)$ capturing capital flows. Notice that $b_u = 0$ under financial autarky, but $b_u =$

$-\kappa$ under international financial integration. Moreover, in the latter case $1 - g/R = \beta(1+\tau) - 1$.

Relative to the baseline model, a key difference of the current environment is that (RR_u) posits another positive relationship between L_u^T and g, i.e. both (GG_u) and (RR_u) are upward sloping lines in (L_u^T, g) space. However, the slope of (RR_u) is necessarily larger than the slope of (GG_u), since

$$\chi \frac{(1+\Gamma\Psi)}{\Gamma} = \chi\left(\Psi + \frac{1}{\Gamma}\right) = \chi\left(\frac{1+\alpha}{\alpha}\varpi + \frac{1}{\Gamma}\right) > \chi\beta\varpi,$$

which follows from $0 < \alpha < 1$, $\beta < 1$, $\chi > 0$, $\varpi > 0$ and $\Gamma > 0$.[70]

Therefore, the impact of financial integration is as in the baseline model: a shift of the (RR_u) curve to the left triggered by capital inflows reduces g and L_u^T. Formally,

$$g_a = \beta\left(\frac{\varpi(\chi\bar{L} - (1-\beta)\Gamma)}{1+\Gamma(\Psi - \beta\varpi)} + 1\right)$$

under financial autarky (compare (33) from the main text), but

$$g_f = g_a - \frac{\varpi\beta\chi\Gamma}{1+\Gamma(\Psi-\beta\varpi)}\kappa(\beta(1+\tau)-1) < g_a$$

under international financial integration (compare (38) from the main text). The last inequality follows again from $\Psi > \varpi$ (as argued above) and all parameters being positive.

The impact of financial integration on developing countries is also the same as in the baseline model. In fact, the (GG_d) curve is now given by

$$a_d^\phi = \frac{\beta\xi\varpi L_d^T}{g-\beta}, \tag{GG_d}$$

and is therefore almost identical as in the baseline model. In turn, the (RR_d) curve is given by

$$L_d = \bar{L} - \Gamma\left(\Psi L_d^T + \frac{b_d}{a_d}\left(1 - \frac{g}{R}\right)\right) + \Gamma\frac{(g-1)a_d^\phi}{\xi}. \tag{RR_d}$$

Compared with the baseline model, the difference is (again) that (RR_d) in the current model posits a positive relationship between a_d^ϕ and L_d^T, with a slope coefficient strictly larger than that of (GG_d). Therefore, capital outflows which shift (RR_d) to the right necessarily raise both a_d and L_d^T - as in the baseline model. Formally,

$$a_{d,a}^\phi = \frac{\varpi\beta\xi\bar{L}}{(g_a-\beta)(1+\Gamma\Psi) - (g_a-1)\varpi\beta\Gamma}$$

under financial autarky (compare (34) from the main text), but

$$a_{d,f}^\phi = \frac{\varpi\beta\xi\left(\bar{L} + \Gamma\frac{\kappa(\beta(1+\tau)-1)}{a_{d,f}}\right)}{(g_f-\beta)(1+\Gamma\Psi) - (g_f-1)\varpi\beta\Gamma} > a_{d,a}$$

[70]Recall the definitions of $\Psi \equiv \alpha^{\frac{2\alpha}{1-\alpha}}(1-\alpha^2)$ and $\varpi \equiv \alpha^{\frac{2}{1-\alpha}}(1/\alpha - 1)$. Hence $\Psi/\varpi = (1+\alpha)/\alpha$.

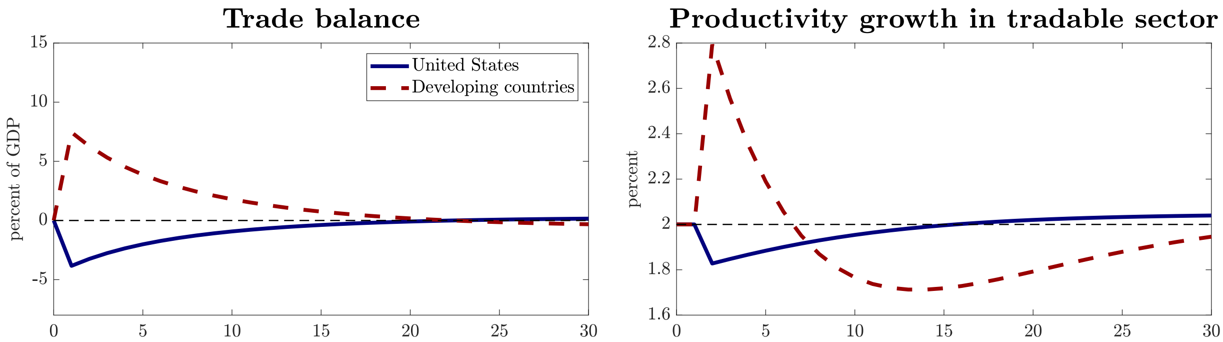


Figure 9: Transition from autarky to financial integration when $\beta(1+\tau) < 1$. Notes: the process of financial integration is captured by a gradual rise in κ_t, which is governed by (42). Financial integration is not anticipated by agents in periods $t < 1$. From period $t = 1$ on agents have perfect foresight.

under financial integration (compare (40) from the main text). Hence, our qualitative results on the impact of financial integration on steady state productivity growth are robust to the assumption that investment in innovation is done in terms of the traded final good.

D The case $R_f > g_f$

In the main text, we had assumed that developing countries' propensity to save, captured by $\tau > 0$, is large enough to guarantee that the return on U.S. bonds is below the growth rate of the economy in the financial integration steady state ($R_f < g_f$). As we argued in the main text, this is the empirically relevant case at least in the last decades. Nonetheless, there remains substantial uncertainty about whether interest rates will remain persistently low in the future. In this Appendix, we therefore ask how our results would change if we instead assume that $R_f > g_f$ in the long run following financial integration.

As it is easy to see, in the financial integration steady state our results would flip, as growth would accelerate in the U.S. (and therefore globally) due to persistent capital outflows giving rise to a larger U.S. tradable sector. This happens because, being a net debtor, the U.S. is forced to run trade balance surpluses in order to maintain a constant net-liabilities position in steady state. In the long run, financial integration therefore leads to a regime of higher productivity growth.

However, this does not imply that the global financial resource curse does not play a role in this case, as it still arises in the medium run. To illustrate this, we repeat the numerical exercise from Section 3.3, but we now assume that the U.S. runs a trade balance *surplus* equal to 0.25% of GDP in the financial integration steady state. From equation (37), a U.S. trade balance surplus requires that $\beta(1+\tau) < 1$ or, equivalently, that $R_f > g_f$.[71]

Figure 9 shows the result. We find that, in the medium run, the model exhibits the same dynamics as in our baseline parametrization. As the two regions integrate financially, capital starts

[71] Targeting a trade balance surplus of 0.25% to GDP leads to $\tau = 0.033$, rather than $\tau = 0.11$ as in our baseline (see footnote 37). As it turns out, because developing countries' households are more patient under this alternative calibration, the adjustment after financial liberalization is somewhat slowed down relative to our baseline. We therefore plot results until 30 years (rather than 25 years) after the start of financial integration.

flowing toward the U.S. which generates a fall in the growth rate of U.S. productivity. Again as in the baseline model, developing countries experience an initial productivity growth acceleration.

Overall, this exercise suggests that the emergence of a global financial resource curse does not depend on whether the U.S. trade balance is in deficit or surplus in the final steady state. In fact, even if financial integration generates U.S. trade balance surpluses and faster global productivity growth in the long run, the transition might still be characterized by a long-lasting global productivity growth slowdown.

E Technological leapfrogging by developing countries

Our baseline model focuses on a scenario in which the United States permanently retains its technological leadership, so that $A_{u,t} > A_{d,t}$ for all t. In this Appendix, we consider an alternative scenario in which developing countries may technologically leapfrog the U.S. in the long run. Our formalization follows closely Barro and Sala-i Martin (1997).

Let us start by allowing innovation activities to take place in developing countries as well. If firms in developing countries choose to innovate, their productivity evolves according to

$$A^j_{d,t+1} = A^j_{d,t} + \xi A_{d,t} L^j_{d,t}. \tag{E.1}$$

If instead firms in developing countries choose to adopt technologies originating from the U.S. their productivity evolves according to equation (16). Clearly, it is profitable for firms in developing countries to innovate rather than imitate if and only if $A_{d,t} > A^{\phi}_{u,t} A^{1-\phi}_{d,t}$, or equivalently, if $A_{d,t} > A_{u,t}$.[72] Symmetrically, we assume that U.S. firms can imitate technological discoveries made in developing countries, in which case their technology evolves as

$$A^j_{u,t+1} = A^j_{u,t} + \chi A^{1-\phi}_{u,t} A^{\phi}_{d,t} L^j_{u,t}. \tag{E.2}$$

Comparing this with equation (14) reveals that imitation is cheaper than innovation for U.S. firms if and only if $A_{u,t} < A^{1-\phi}_{u,t} A^{\phi}_{d,t}$, or $A_{u,t} < A_{d,t}$. In sum, if $A_{d,t} > A_{u,t}$ the world technological leadership passes from the U.S. to developing countries, and investment in innovation by developing countries becomes the driver of improvements in the world technological frontier.

Under what conditions does technological leapfrog occur in equilibrium? Using equation (40), one can see that under financial integration developing countries eventually become the technological leaders if

$$\kappa(\beta(1+\tau)-1) > \frac{\bar{L}}{\Gamma}\frac{\chi-\xi}{\chi+\xi}. \tag{E.3}$$

There are two reasons why developing countries may become the technological leaders in the long run. First, independently of the size of capital flows, this occurs if firms in developing countries

[72] For simplicity, we assume that ξ captures the efficiency of both innovation and imitation activities in developing countries. By allowing different efficiencies of innovation and imitation, one could capture a scenario in which developing countries start innovating before or after they reach the level of productivity in the U.S. (Barro and Sala-i Martin, 1997).

are intrinsically better at innovation activities than firms in the United States (i.e. if $\xi > \chi$). In this case, developing countries would eventually leapfrog the U.S. even under financial autarky. The second, and perhaps more interesting, case is one in which leapfrogging occurs due to financial integration. That is, if capital flows are sufficiently large (i.e. if $\kappa(\beta(1+\tau)-1)$ is big enough), developing countries may eventually become the global technological leaders even if investment in innovation is more productive in the United States (i.e. if $\xi < \chi$). As we argued before, this happens because capital outflows increase the profitability of investing in innovation for firms in developing countries. If this effect is strong enough, financial integration can be the trigger of a change in the world's technological leadership.

Let us now revisit the impact of financial integration on global growth. There are two cases to consider. First, imagine that $\xi > \chi$, so that developing countries are more productive in performing research than the United States. In this case, regardless of the financial regime, in the balanced growth path developing countries are the technological leaders and global productivity growth is equal to

$$g = \beta(\xi \alpha L_d^T + 1).$$

Now recall that, in developing countries, financial integration is associated with capital outflows and a larger size of the tradable sector (i.e. higher L_d^T). Hence, in this scenario financial integration boosts global growth.

But now imagine that $\xi < \chi$, so that the U.S. have an advantage in performing research compared to developing countries. Under financial autarky, it is the United States who retain the global technological leadership, so that global growth is given by expression (33), which we rewrite here for convenience

$$g_a = \beta \left(\frac{\alpha \left(\chi \bar{L} + 1 - \beta \right)}{1 + \Gamma \Psi + \alpha \beta} + 1 \right).$$

Now consider a case in which condition (E.3) holds, so that upon financial integration developing countries leapfrog the United States in the new balanced growth path. It is then easy to show that under financial integration global growth is equal to

$$g_f = g_a - \alpha \beta \frac{(\chi - \xi)\bar{L} - \xi \Gamma \kappa \left(\beta(1+\tau) - 1 \right)}{1 + \Gamma \Psi + \alpha \beta}. \tag{E.4}$$

This expression reveals that now financial integration may lead to a drop in global growth. The reason is that developing countries are less efficient at performing research compared to the United States. So now the global financial resource curse takes a new form, in the sense that financial integration may push developing countries to become the world technological leaders, even if they have a disadvantage in performing research compared to the United States.

F Empirical implications and evidence

In this Appendix, we detail the data sources used for our empirical analysis in Section 4, and also show some robustness of our main results.

F.1 Data sources and sample

Productivity. We take data on TFP and labor productivity from the Penn World Tables, version 10 (Feenstra et al., 2015). For TFP, we use the two series rtfpna and ctfp, the former to compute TFP growth across time within countries, the latter to make comparisons across countries within years (to compute initial conditions, as in Table 1). For labor productivity, we use the two series rgdpo and emp, the former measuring real GDP, the latter measuring the level of employment. We then compute labor productivity as the ratio of the two series. To compute labor productivity in the manufacturing sector, we extract value added and employment data from UNIDO INDSTAT2 (see "Economic activity in the tradable sector" below). We then divide value added by employment. Because the value added series is measured in current U.S. dollars, it needs to be deflated to obtain a real series. We do so by using the U.S. GDP deflator, to express productivity in manufacturing in 1980s U.S. dollars (see "Capital inflows" below).

Real GDP per capita. For real GDP per capita, we again turn to the Penn World Tables. We extract the two series rgdpo and pop. Real GDP per capita is the ratio of the two series.

Capital inflows. Our datasource for capital inflows is the External Wealth of Nations database (Lane and Milesi-Ferretti, 2018). From this database we use the current account balance and the nominal GDP series, both expressed in current U.S. dollars. To express both series in 1980s dollars, we extract the time series pl_gdpo for the U.S. from Penn World Tables. This time series corresponds to the U.S. GDP deflator. We then deflate, for each country, the current account and nominal GDP series by using the U.S. GDP deflator. Our capital inflow measure in Figure 7 and Tables 1-2 is then constructed as cumulated current account deficits divided by initial GDP.

Economic activity in the tradable sector. Our datasource for measuring economic activity in the tradable sector is the UNIDO INDSTAT2 database. From this database we extract employment and value added in current U.S. dollars for total manufacturing. Our headline measure is employment in manufacturing relative to total employment (recall we take total employment from the Penn World Tables, see "Productivity" above). To compute economic activity in value added terms, we take the ratio between the value added series and total nominal GDP in current U.S. dollars (recall we take total nominal GDP in current U.S. dollars from the EWN database, see "Capital inflows" above).

Developing countries. Our starting point is the same set of developing countries considered by Gourinchas and Jeanne (2013), a total of 68 countries. The countries are AGO, ARG, BGD, BEN, BOL, BWA, BRA, CMR, CHL, CHN, TWN, COL, COG, CRI, CYP, CIV, DOM, ECU, EGY, SLV, ETH, FJI, GAB, GHA, GTM, HTI, HND, HKG, IND, IDN, IRN, ISR, JAM, JOR, KEN, MDG, MWI, KOR, MYS, MUS, MEX, MAR, MOZ, NPL, NER, NGA, PAK, PAN, PNG,

PRY, PER, PHL, RWA, SEN, SGP, ZAF, LKA, SYR, TZA, THA, TTO, TUN, TUR, UGA, URY, VEN, MLI and TGO. From this list of countries, we exclude PNG (no PWT data available), SGP (outlier, 90% capital inflows relative to initial GDP during our sample period), and VEN (outlier due to hyperinflation, on average -3% TFP growth during our sample period).

Advanced economies. Our sample of advanced economies is composed of AUS, AUT, BEL, CAN, DNK, FIN, FRA, DEU, GRC, ISL, ITA, JPN, MLT, NLD, NZL, PRT, ESP, SWE, GBR and USA.

Unbalanced panel. Our panel is unbalanced. For instance, manufacturing employment data is not available for all countries in all years. To deal with this, in all the regressions and figures we keep only countries for which at least 15 (out of a maximum 40) years of data are available.

F.2 Robustness for the cross-sectional analysis

In this Appendix, we redo the analysis underlying Table 1 using two alternative measures of productivity, and using an alternative measure of economic activity in the tradable sector: value added in manufacturing relative to total GDP. Table 4 shows the results.

First, we replace TFP growth with labor productivity growth, and show that our main conclusions still hold. Second, we use value added in manufacturing relative to total GDP as a measure of economic activity in the tradable sector, rather than the share of employment in manufacturing. The results are essentially unaffected.

Last, we also experimented with labor productivity growth in manufacturing. Once again, our main conclusions are not affected by the use of this alternative measure. Moreover, when using manufacturing productivity as dependent variable the coefficients capturing convergence effects are highly significant, even without controlling for economic activity in the tradable sector. This is in line with Rodrik (2012), who provides evidence in favor of unconditional convergence in the manufacturing sector. It is also consistent with our model, as we assume knowledge spillovers across countries in the tradable sector.

F.3 Robustness for the time-series analysis

In this Appendix, we complement the analysis in Section 4.2 by looking at the behavior of real GDP per capita growth, labor productivity growth, labor productivity growth in manufacturing and the value added share of manufacturing in total GDP.[73] Table 5 shows that the results hold also for this alternative set of variables.

We also perform an event analysis by considering episodes of large capital inflows. Specifically,

[73]Specifically, we run the panel regression (48), but replacing $\Delta_3 tfp_{i,t+h}$ with $\Delta_3 gdp_{i,t+h}$, $\Delta_3 labprod_{i,t+h}$ and $\Delta_3 labprodman_{i,t+h}$, denoting respectively the change in log real GDP per capita, log labor productivity, and log labor productivity in manufacturing (all annualized). In turn, for the share of manufacturing value added in total GDP, we again replace $\Delta_3 tfp_{i,t+h}$ by $share_{i,t+h} - share_{i,t-4}$, where $share_{i,t}$ now refers to the value added share of manufacturing in total GDP.

Table 4: Robustness for cross-sectional analysis.

Panel A. Dependent variable: Labor productivity growth

	(1)	(2)	(3)	(4)
capital inflows	-0.0458	-0.0551	-0.0518	-0.0370
	(0.0184)	(0.0181)	(0.0194)	(0.0172)
employment share manufacturing			0.0071	0.1210
			(0.0256)	(0.0328)
initial productivity		-0.0106		-0.0648
		(0.0176)		(0.0216)
initial productivity squared		-0.0000		0.0004
		(0.0002)		(0.0002)
# observations	85	85	69	69
R^2	0.0696	0.1472	0.1147	0.3655

Panel B. Dependent variable: Total factor productivity growth

	(1)	(2)	(3)	(4)
capital inflows	-0.0253	-0.0253	-0.0184	-0.0178
	(0.0103)	(0.0104)	(0.0130)	(0.0127)
value added manufacturing			0.0332	0.0352
			(0.0161)	(0.0158)
initial productivity		-0.0027		-0.0355
		(0.0152)		(0.0155)
initial productivity squared		-0.0000		0.0002
		(0.0001)		(0.0001)
# observations	72	72	62	62
R^2	0.0791	0.1110	0.1597	0.2322

Panel C. Dependent variable: Labor productivity growth in manufacturing

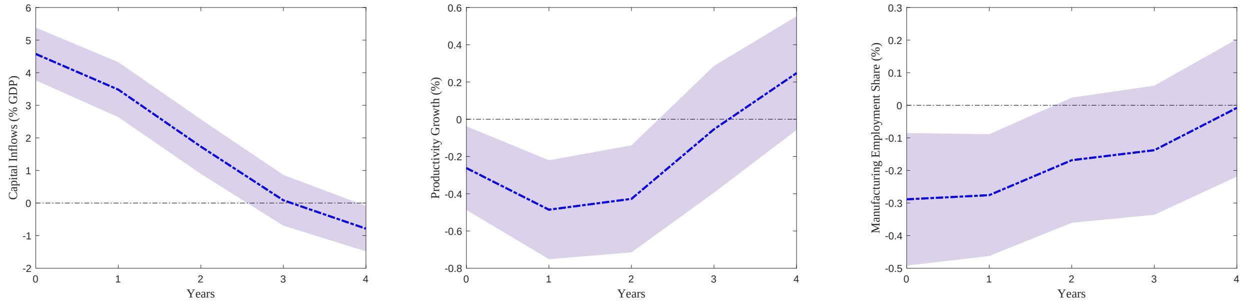
	(1)	(2)	(3)	(4)
capital inflows	-0.0341	-0.0413	-0.0267	-0.0229
	(0.0292)	(0.0267)	(0.0308)	(0.0268)
employment share manufacturing			0.0319	0.0945
			(0.0401)	(0.0390)
initial productivity		-0.1103		-0.1244
		(0.0294)		(0.0289)
initial productivity squared		0.0010		0.0011
		(0.0003)		(0.0003)
# observations	65	65	65	65
R^2	0.0212	0.2216	0.0311	0.2910

Notes: Standard errors in parentheses. All variables are expressed in percent.

Table 5: Robustness for time-series analysis.

Panel A. Dependent variable: Real GDP per capita growth					
	$h=0$	$h=1$	$h=2$	$h=3$	$h=4$
capital inflows	-0.173	-0.154	-0.120	-0.081	-0.072
	(0.059)	(0.056)	(0.050)	(0.042)	(0.036)
# observations	3348	3264	3180	3096	3012
R^2	0.10	0.10	0.09	0.09	0.08
Panel B. Dependent variable: Labor productivity growth					
	$h=0$	$h=1$	$h=2$	$h=3$	$h=4$
capital inflows	-0.160	-0.127	-0.084	-0.045	-0.042
	(0.058)	(0.057)	(0.051)	(0.042)	(0.034)
# observations	3336	3256	3176	3096	3012
R^2	0.09	0.09	0.08	0.07	0.07
Panel C. Dependent variable: Labor productivity growth in manufacturing					
	$h=0$	$h=1$	$h=2$	$h=3$	$h=4$
capital inflows	-0.070	-0.256	-0.353	-0.357	-0.305
	(0.091)	(0.080)	(0.076)	(0.078)	(0.087)
# observations	2283	2228	2172	2114	2057
R^2	0.03	0.04	0.05	0.05	0.05
Panel D. Dependent variable: Value added share manufacturing					
	$h=0$	$h=1$	$h=2$	$h=3$	$h=4$
capital inflows	-0.064	-0.064	-0.072	-0.068	-0.051
	(0.023)	(0.021)	(0.021)	(0.025)	(0.026)
# observations	2579	2496	2412	2329	2248
R^2	0.10	0.12	0.15	0.18	0.21

Notes: Regression analysis according to equation (48). Driscoll and Kraay (1998) standard errors in parentheses with lag-length $ceil(1.5(3+h))$. All variables are in expressed in percent.



(a) Capital inflows **(b) Productivity growth** **(c) Manufacturing employment**

Figure 10: Episodes of large capital inflows. Notes: Regression outcome based on equation (F.1). Shaded areas represent 90% confidence bounds from standard errors computed as in Driscoll and Kraay (1998), with lag length $ceil(1.5(3+h))$.

we estimate the regression equation

$$y_{i,t+h} = \alpha_i^h + \beta_h \times \mathbb{1}_{i,t} + \varepsilon_{i,t+h}, \tag{F.1}$$

where $\mathbb{1}_{i,t}$ is an indicator variable which equals 1 when our capital inflow measure is at least one standard deviation above its trend. The trend is defined by HP-filtering the original series with a smoothing coefficient of 100. With this specification, we therefore study the dynamic evolution of our variables of interest during periods of *large* capital inflows. Benigno et al. (2015) and Müller and Verner (2023) perform similar analyses.

Figure 10 shows what a period of large capital inflows looks like. The left panel shows that the current account is persistently in deficit, initially by more than 4% of GDP.[74] The other two panels show a significant and persistent decline in productivity growth and the employment share in manufacturing. These results are in line with our dynamic correlation analysis.

G Extended model and quantitative implications

In this Appendix, we detail the analysis sketched out in Section 5. We first outline the three model versions used to evaluate the quantitative implications of our framework, summarized in Table 3. We then outline two additional model extensions: a semi-endogenous growth version of our model, and a model with structural change.

G.1 Innovation in the tradable sector only

The production structure of the tradable sector is unchanged relative to the baseline model presented in Section 2. Value added in this sector is therefore $\Psi A_{u,t}^T L_{u,t}^T$, and firms' monopoly rents

[74] We obtain this figure by replacing $y_{i,t+h}$ in equation (F.1) with our capital inflow measure.

are $\varpi A^{j,T}_{u,t} L^T_{u,t}$. The law of motion for productivity is now given by

$$A^{j,T}_{u,t+1} = A^{j,T}_{u,t} + \chi^T (A^{j,T}_{u,t})^{\lambda} (A^T_{u,t})^{1-\lambda} L^{j,T}_{u,t}. \tag{G.1}$$

Hence, when innovating firms build on their internal stock of knowledge $A^{j,T}_{u,t}$ and on the aggregate sectoral one $A^T_{u,t}$. Recall that firms' problem is to maximize $\sum_{t=0}^{\infty} \frac{\beta^t C^T_{u,0}}{C^T_{u,t}} \Pi^{j,T}_{u,t}$, where $\Pi^{j,T}_{u,t} \equiv \varpi A^{j,T}_{u,t} L^T_{u,t} - W_{u,t} L^{j,T}_{u,t}$, subject to (G.1). Ignoring corner solutions, optimal investment implies

$$\begin{aligned} &\frac{W_{u,t}}{\chi^T (A^{j,T}_{u,t})^{\lambda} (A^T_{u,t})^{1-\lambda}} \\ &\quad = \beta \frac{C^T_{u,t}}{C^T_{u,t+1}} \left(\varpi L^T_{u,t+1} + \frac{W_{u,t+1}}{\chi^T (A^{j,T}_{u,t+1})^{\lambda} (A^T_{u,t+1})^{1-\lambda}} \left(1 + \chi^T \lambda \left(\frac{A^{j,T}_{u,t+1}}{A^T_{u,t+1}} \right)^{\lambda-1} L^{j,T}_{u,t+1} \right) \right). \end{aligned}$$

In a symmetric equilibrium with $A^{j,T}_{u,t} = A^T_{u,t}$ this expression simplifies to

$$\frac{W_{u,t}}{\chi^T A^T_{u,t}} = \beta \frac{C^T_{u,t}}{C^T_{u,t+1}} \left(\varpi L^T_{u,t+1} + \frac{W_{u,t+1}}{\chi^T A^T_{u,t+1}} \left(1 + \lambda \frac{A^T_{u,t+2} - A^T_{u,t+1}}{A^T_{u,t+1}} \right) \right),$$

where we used (G.1) to replace $L^{j,T}_{u,t+1}$. From firms' labor demand, we know that

$$W_{u,t} = (1-\alpha) \alpha^{\frac{2\alpha}{1-\alpha}} A^T_{u,t} = \frac{\varpi}{\alpha} A^T_{u,t}.$$

Defining $g^T_{u,t+1} \equiv A^T_{u,t+1}/A^T_{u,t}$, we obtain equation (49)

$$g^T_{u.t+1} = \beta \frac{c^T_{u,t}}{c^T_{u,t+1}} \left(\chi^T \alpha L^T_{u,t+1} + 1 + \lambda (g_{u,t+2} - 1) \right). \tag{49}$$

With respect to the non-tradable sector, we slightly deviate from the baseline model by assuming the same production structure as in the traded sector. Value added in the non-tradable sector is thus $P^N_{u,t} \Psi A^N_{u,t} L^N_{u,t}$, while firms' labor demand implies $W_{u,t} = P^N_{u,t} (1-\alpha) \alpha^{\frac{2\alpha}{1-\alpha}} A^N_{u,t}$. Due to wage equalization between the two sectors, the relative price of the non-traded good is then pinned down by $P^N_{u,t} = A^T_{u,t}/A^N_{u,t}$. Productivity growth in the non-tradable sector is constant and equal to g^N_u.

Households' optimal allocation of expenditure between the two goods implies

$$C^N_{u,t} = \frac{1-\omega}{\omega} \frac{C^T_{u,t}}{P^N_{u,t}} = \frac{1-\omega}{\omega} c^T_{u,t} A^N_{u,t}. \tag{G.2}$$

Using $C^N_{u,t} = \Psi A^N_{u,t} L^N_{u,t}$, we thus obtain

$$L^N_{u,t} = \frac{1-\omega}{\omega \Psi} c^T_{u,t}, \tag{53}$$

which is (53) in the main text.

From now on, let's focus on the approximation $L^R_{u,t} \approx 0$. First, notice that GDP in terms of tradable goods is given by

$$GDP_{u,t} = \Psi A^T_{u,t} L^T_{u,t} + P^N_{u,t} \Psi A^N_{u,t} L^N_{u,t} = \Psi A^T_{u,t} \bar{L}.$$

Tradable consumption in the U.S. is

$$c^T_{u,t} = \Psi L^T_{u,t} + \Psi \bar{L} T_t,$$

where T_t denotes the trade deficit-to-GDP ratio. Finally, labor market clearing implies

$$\bar{L} = L^T_{u,t} + L^N_{u,t} = L^T_{u,t} + \frac{1-\omega}{\omega\Psi} c^T_{u,t}.$$

These three expressions combined give (54) from the main text.

To obtain equation (55) from the main text, simply insert (49) in the definition of aggregate growth (51), use again the approximation $L^R_{u,t} \approx 0$, and evaluate on the balanced growth path

$$g_u = \frac{L^T_u}{\bar{L}} \frac{\beta \chi^T \alpha \frac{L^T_u}{\bar{L}} \bar{L} + 1 - \lambda}{1 - \lambda\beta} + \left(1 - \frac{L^T_u}{\bar{L}}\right) g^N_u.$$

Differentiating this expression gives

$$\frac{\partial g_u}{\partial \frac{L^T_u}{\bar{L}}} = g^T_u - g^N_u + \frac{L^T_u}{\bar{L}} \frac{\beta \chi^T \alpha \bar{L}}{1 - \lambda\beta}.$$

Using $\frac{\beta \chi^T \alpha L^T_u}{1-\lambda\beta} = g^T_u - \frac{\beta(1-\lambda)}{1-\lambda\beta}$, and recognizing that $\partial(L^T_u/\bar{L})/\partial T = -(1-\omega)$, yields the result.

G.2 Innovation in both sectors

The only difference with respect to the model in the previous section is that productivity in the non-traded sector is endogenous and evolves according to

$$A^{j,N}_{u,t+1} = A^{j,N}_{u,t} + \chi^N (A^{j,N}_{u,t})^\lambda (A^N_{u,t})^{1-\lambda} L^{j,N}_{u,t}. \quad \text{(G.3)}$$

Ignoring corner solutions and imposing symmetry, optimal investment by firms in the non-traded sector implies

$$\frac{W_{u,t}}{\chi^N A^N_{u,t}} = \beta \frac{C^T_{u,t}}{C^T_{u,t+1}} \left(P^N_{u,t+1} \varpi L^N_{u,t+1} + \frac{W_{u,t+1}}{\chi^N A^N_{u,t+1}} \left(1 + \lambda \frac{A^N_{u,t+2} - A^N_{u,t+1}}{A^N_{u,t+1}} \right) \right).$$

Using $P^N_{u,t} = A^T_{u,t}/A^N_{u,t}$, and $W_{u,t} = (\varpi/\alpha)A^T_{u,t}$ gives

$$\frac{A^N_{u,t+1}}{A^N_{u,t}} \equiv g^N_{u,t+1} = \beta\frac{c^T_{u,t}}{c^T_{u,t+1}}\left(\chi^N\alpha L^N_{u,t+1} + 1 + \lambda(g^N_{u,t+2} - 1)\right), \tag{56}$$

which is equation (56) in the main text.

Using the approximation $L^R_{u,t} \equiv L^{R,T}_{u,t} + L^{R,N}_{u,t} \approx 0$, aggregate growth is now defined by

$$g_u = \frac{L^T_u}{\bar{L}}\frac{\beta\chi^T\alpha\frac{L^T_u}{\bar{L}}\bar{L} + 1 - \lambda}{1-\lambda\beta} + \left(1 - \frac{L^T_u}{\bar{L}}\right)\frac{\beta\chi^N\alpha\left(1 - \frac{L^T_u}{\bar{L}}\right)\bar{L} + 1 - \lambda}{1-\lambda\beta}.$$

Straightforward differentiation along the lines of the previous section yields equation (57).

G.3 Knowledge spillovers across sectors

The law of motion for productivity in the tradable sector is now given by

$$A^{j,T}_{u,t+1} = A^{j,T}_{u,t} + \chi^T(A^{j,T}_{u,t})^\lambda\left((A^T_{u,t})^{\phi^T}(A^N_{u,t})^{1-\phi^T}\right)^{1-\lambda}L^{j,T}_{u,t}.$$

Ignoring corner solutions and imposing symmetry, optimal investment by firms in the tradable sector implies

$$\frac{W_{u,t}}{\chi^T A^T_{u,t}}a_{u,t}^{(1-\lambda)(1-\phi^T)} = \beta\frac{C^T_{u,t}}{C^T_{u,t+1}}\left(\varpi L^T_{u,t+1} + \frac{W_{u,t+1}}{\chi^T A^T_{u,t+1}}a_{u,t+1}^{(1-\lambda)(1-\phi^T)}\left(1 + \lambda\frac{A^T_{u,t+2} - A^T_{u,t+1}}{A^T_{u,t+1}}\right)\right),$$

where $a_{u,t} \equiv A^T_{u,t}/A^N_{u,t}$. Substituting out $W_{u,t}$, this expression becomes

$$g^T_{u,t+1}a_{u,t}^{(1-\lambda)(1-\phi^T)} = \beta\frac{c^T_{u,t}}{c^T_{u,t+1}}\left(\chi^T\alpha L^T_{u,t+1} + a_{u,t+1}^{(1-\lambda)(1-\phi^T)}\left(1 + \lambda(g^T_{u,t+2} - 1)\right)\right). \tag{G.4}$$

In the non-tradable sector productivity evolves according to

$$A^{j,N}_{u,t+1} = A^{j,N}_{u,t} + \chi^N(A^{j,N}_{u,t})^\lambda\left((A^N_{u,t})^{\phi^N}(A^T_{u,t})^{1-\phi^N}\right)^{1-\lambda}L^{j,N}_{u,t}.$$

Optimal investment by firms implies

$$\frac{W_{u,t}}{\chi^N A^N_{u,t}}a_{u,t}^{-(1-\lambda)(1-\phi^N)} = \beta\frac{C^T_{u,t}}{C^T_{u,t+1}}\left(P^N_{u,t+1}\varpi L^N_{u,t+1} + \frac{W_{u,t+1}}{\chi^N A^N_{u,t+1}}a_{u,t+1}^{-(1-\lambda)(1-\phi^N)}\left(1 + \lambda\frac{A^N_{u,t+2} - A^N_{u,t+1}}{A^N_{u,t+1}}\right)\right).$$

Substituting out $W_{u,t}$ and $P^N_{u,t}$, this expression becomes

$$g^N_{u,t+1}a_{u,t}^{-(1-\lambda)(1-\phi^N)} = \beta\frac{c^T_{u,t}}{c^T_{u,t+1}}\left(\chi^N\alpha L^N_{u,t+1} + a_{u,t+1}^{-(1-\lambda)(1-\phi^N)}\left(1 + \lambda(g^N_{u,t+2} - 1)\right)\right). \tag{G.5}$$

We evaluate the impact of capital inflows on growth by studying the balanced growth path (BGP). The first thing to notice is that on the BGP productivity grows at the same rate in both sectors. This follows straight from the law of motion for productivity. For instance, on the BGP productivity growth in the tradable sector is

$$g_u^T = 1 + \chi^T a_u^{-(1-\lambda)(1-\phi^T)} L_u^R.$$

Constant growth thus implies that a_u is constant. But since $a_{u,t} \equiv A_{u,t}^T / A_{u,t}^N$, $A_{u,t}^T$ and $A_{u,t}^N$ must grow at the same rate. This common growth rate also equals the aggregate growth rate of the economy, and so $g_u^T = g_u^N = g_u$.

Using this fact, we can evaluate (G.4)-(G.5) on the BGP:

$$g_u = \frac{\beta(a_u^{-(1-\lambda)(1-\phi^T)} \chi^T \alpha L_u^T + 1 - \lambda)}{1-\lambda\beta}$$
$$g_u = \frac{\beta(a_u^{(1-\lambda)(1-\phi^N)} \chi^N \alpha L_u^N + 1 - \lambda)}{1-\lambda\beta}.$$

Combining the two by substituting out a_u yields equation (58) from the main text

$$g_u = \frac{\beta\left((\chi^N \alpha L_u^N)^{\frac{1-\phi_T}{2-\phi_T-\phi_N}} (\chi^T \alpha L_u^T)^{\frac{1-\phi_N}{2-\phi_T-\phi_N}} + 1 - \lambda\right)}{1-\beta\lambda}. \tag{58}$$

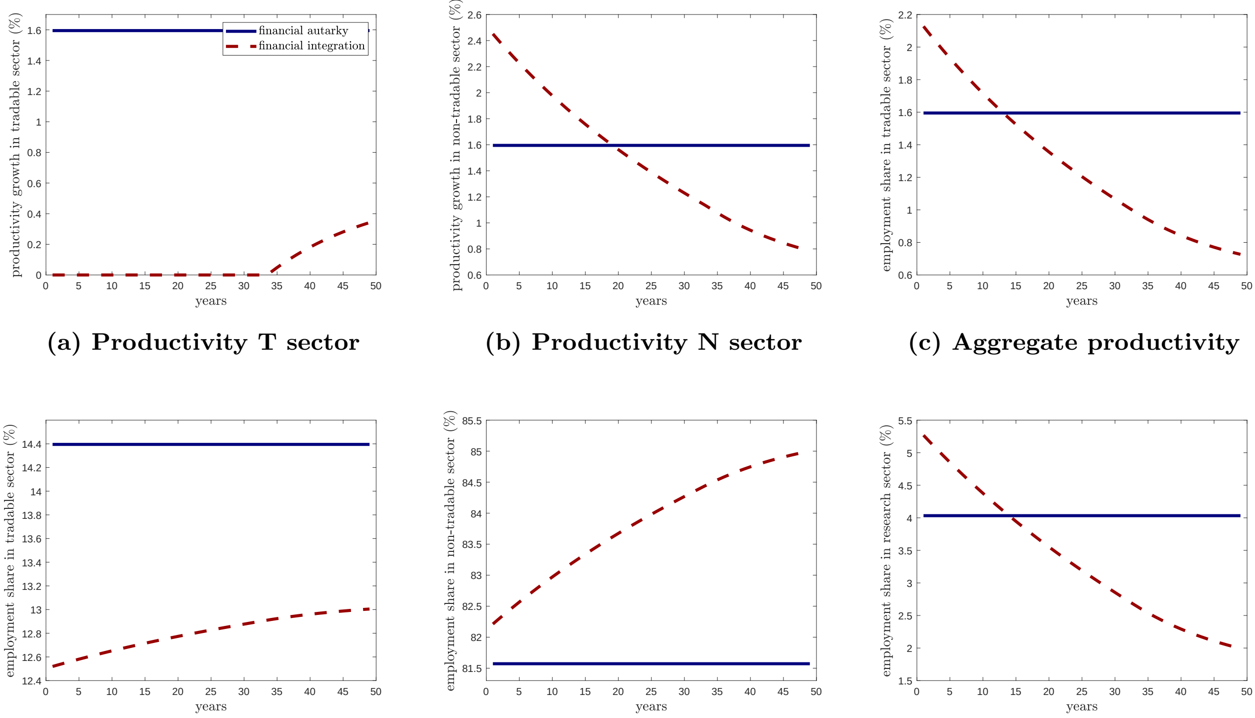
We now use again $L_u^R \approx$ to write (58) as

$$g_u = \frac{\beta\left(\left(\chi^N \alpha \bar{L}\left(1 - \frac{L_u^T}{\bar{L}}\right)\right)^{\frac{1-\phi_T}{2-\phi_T-\phi_N}} \left(\chi^T \alpha \bar{L} \frac{L_u^T}{\bar{L}}\right)^{\frac{1-\phi_N}{2-\phi_T-\phi_N}} + 1 - \lambda\right)}{1-\beta\lambda}.$$

We then take the derivative with respect to $L_u^T/\bar{L}$, and use again that $\partial(L_u^T/\bar{L})/\partial T = -(1-\omega)$, to obtain equation (59) from the main text.

Figure 11 shows how the economy - starting from the financial autarky steady state - responds to a permanent trade deficit equal to 2% of GDP. This experiment underlies Table 3 in the main text. As expected, capital inflows make the tradable sector shrink, reducing innovation activities and productivity growth there. In fact, firms' incentives to invest drop by so much that investment drops to zero and productivity in the tradable sector stagnates during the first part of the transition.[75] In contrast, the non-tradable sector expands as a result of capital inflows. Initially, this effect implies a productivity growth acceleration in the non-traded sector. Over time, however, lower knowledge spillovers from the tradable sector drag productivity growth in the non-tradable one below its value under financial autarky. As a result, aggregate growth initially accelerates, but

[75]Formally, the growth equation (G.4) holds only when firms' investment is expected to be positive forever in the future. Along the transition shown, this equation would predict growth to be initially negative, violating firms' non-negativity constraint on investment. We thus replace this equation by $g_{u,t+1}^T = 1$ until the period where investment turns again positive.



(a) Productivity T sector **(b) Productivity N sector** **(c) Aggregate productivity**

(d) Employment T sector **(e) Employment N sector** **(f) Employment R sector**

Figure 11: Productivity dynamics with knowledge spillovers. Notes: Financial autarky refers to balanced trade. Financial integration refers to a permanent trade deficit-to-GDP ratio equal to 2%.

eventually falls below its value under financial autarky.

G.4 Semi-endogenous growth

We next turn to a version of the model in which growth is semi-endogenous. In this class of models, long-run growth is driven by population growth and the parameters characterizing the ideas production function (Jones, 2022). As a consequence, when growth is semi-endogenous capital flows affect the long-run level of productivity, but not its growth rate. As we will see, however, capital inflows can trigger a very persistent decline in productivity growth while the economy transits toward its balanced growth path.

To keep the analysis tractable, let us go back to the assumption of exogenous growth in the non-traded sector. In the traded sector, the law of motion for productivity is now given by

$$A^{j,T}_{u,t+1} = A^{j,T}_{u,t} + \chi^T (A^{j,T}_{u,t})^{\lambda} (A^T_{u,t})^{\kappa} L^{j,T}_{u,t}, \tag{G.6}$$

where $\lambda + \kappa \equiv \phi < 1$ brings us to the class of semi-endogenous growth models (the case $\lambda + \kappa = 1$ corresponds to the endogenous growth framework that we studied so far). In a symmetric equilibrium, this law of motion for productivity implies

$$g^T_{u,t+1} = 1 + \chi^T (A^T_{u,t})^{\phi-1} L^R_{u,t}. \tag{G.7}$$

This expression embeds a well known result from the semi-endogenous growth literature: a constant growth rate of productivity can be sustained only if the number of workers allocated to research rises over time. Since in our model population is constant, it follows immediately that there is no balanced growth path with positive productivity growth in the traded sector.[76]

Instead, provided that $A^T_{u,0} < \bar{A}$ where $\bar{A}$ is a threshold value for productivity to be defined below, the economy converges asymptotically to a steady state in which productivity stops growing and the research sector disappears.[77] Along the transition, optimal investment by firms implies

$$(A^T_{u,t})^{1-\phi} g^T_{u,t+1} = \beta \frac{c^T_{u,t}}{c^T_{u,t+1}} \left(\chi^T \alpha L^T_{u,t+1} + (A^T_{u,t+1})^{1-\phi} \left(1 + \lambda (g^T_{u,t+2} - 1)\right)\right). \tag{G.8}$$

Using the fact that in the no growth steady state $g^T_{u,t} = g^T_{u,t+1} = 1$ and $c^T_{u,t} = c^T_{u,t+1}$, the equation above implies that in the long run productivity converges to

$$A^T_u = \left(\frac{\beta \chi^T \alpha L^T_u}{1-\beta} \right)^{\frac{1}{1-\phi}} \equiv \bar{A}. \tag{G.9}$$

From this equation it is easy to see that a permanent increase in capital inflows, which is associated with a lower L^T_u, reduces the long-run level of productivity in the tradable sector, rather than the growth rate as in our baseline model. That said, capital inflows do depress productivity growth during the transition to the no growth steady state. Moreover, since transitional dynamics are typically slow in calibrated semi-endogenous growth models, the impact of capital inflows on productivity growth can be very persistent.

To make this point we resort to a numerical simulation. First we fix some parameters at the same levels as in Section 5, namely $\beta = .96$, $\alpha = .122$, $\omega = .15$ and $\lambda = .75$. The parameter χ^T determines the long-run level of productivity (see (G.9)), but does not affect the path of productivity growth. We thus normalize it to $\chi^T = 1$. The key parameter to calibrate is ϕ, which determines the shape of the ideas production function. Using a semi-endogenous growth model calibrated to the U.S., Jones (2002) argues that a typical value for the half-life of multifactor productivity is 25.7 years. We set ϕ to reproduce this number in our model under financial autarky, which yields $\phi = .867$.[78]

We then contrast the transitional dynamics under financial autarky versus financial integration. In the latter case, we scale capital inflows to maintain a trade deficit equal to 2% of GDP throughout the transition. Under both scenarios, we set the initial productivity level $A^T_{u,0}$ so that productivity

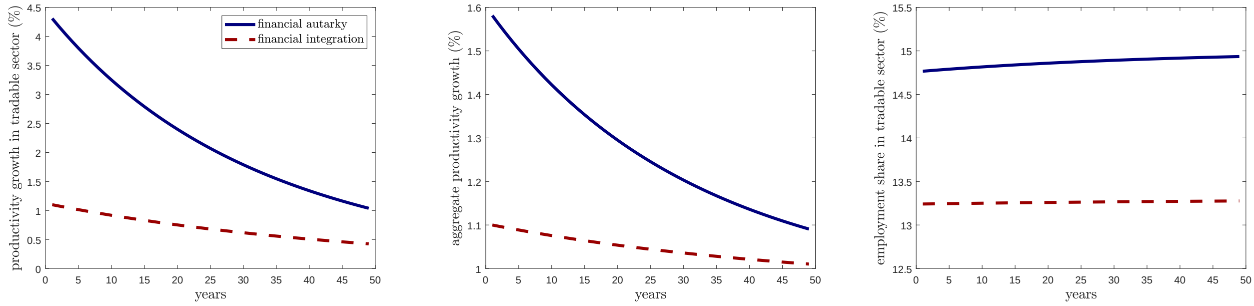
[76] To be clear, we focus on an economy with constant population purely to minimize the deviations from the baseline model, and we could easily introduce a positive rate of population growth. However, the main insights of this section do not depend on whether population is constant or growing over time.

[77] If $A^T_{u,0} \geq \bar{A}$ the economy jumps immediately to a steady state in which $g^T_{u,t} = 1$ and $L^R_{u,t} = 0$.

[78] To obtain this number, we consider a log-linearization of the model under financial autarky, yielding the difference equation

$$\beta \lambda \hat{g}_{u,t+2} - \hat{g}_{u,t+1} + \frac{\beta \alpha \omega \bar{L}}{1-\beta} (\beta \hat{g}_{u,t+2} - \hat{g}_{u,t+1}) = -(1-\phi)(\beta \hat{A}_{u,t+1} - \hat{A}_{u,t}),$$

where $\hat{g}_{u,t+1} = \hat{A}_{u,t+1} - \hat{A}_{u,t}$. We use hats above a variable to denote log-deviation. Solving this equation yields a policy function $\hat{A}_{t+1} = \xi \hat{A}_t$. Half lives of productivity levels are then given by $\log(1/2)/\log(\xi)$.



(a) Productivity T sector **(b) Aggregate productivity** **(c) Employment T sector**

Figure 12: Productivity dynamics with semi-endogenous growth. Notes: Financial autarky refers to balanced trade. Financial integration refers to a permanent trade deficit-to-GDP ratio equal to 2%.

grows initially at 4.4% in the tradable sector under financial autarky. For the non-tradable sector, we assume an exogenous growth rate of 1.1% throughout. Both numbers are in line with our analysis in Section 5.

The left panel of Figure 12 shows the dynamics of productivity growth in the tradable sector, the middle panel shows aggregate productivity growth, and the right panel shows the dynamics of the share of employment in the tradable sector. We find that capital inflows reduce growth rates substantially, and in a very persistent manner. For example, capital inflows depress aggregate productivity growth by 0.5%-0.3% during the first decade of the transition. Over time, as the economy approaches its zero growth steady state, the impact of capital inflows on productivity growth gradually fades away. This happens slowly, however, and capital flows visibly affect growth even 50 years after the start of the transition. In turn, the decline in growth comes about by a permanent decrease of employment allocated to the tradable sector.

G.5 Structural change

We next embed structural change in our model. We take a supply side view of structural change, as in Ngai and Pissarides (2007). That is, we assume that structural change takes place because of differences in the rate of technological progress across sectors, coupled with a demand elasticity smaller than 1. The difference with respect to Ngai and Pissarides (2007) is that in our setting productivity growth is endogenous. In fact, we are among the first to combine structural change and endogenous growth. As we will see, this implies that long-run productivity growth is common across all sectors. The reason is that high productivity growth sectors experience a drop in market size, which endogenously reduces their investment in innovation and hence their rate of productivity growth. We will also see that capital flows affect the long-run level of productivity, as well as productivity growth during the transition toward the final steady state.

Relative to the baseline model, the difference is that now households bundle consumption according to

$$C_{u,t} = \left(\omega^{\frac{1}{\epsilon}} \left(C^T_{u,t}\right)^{\frac{\epsilon-1}{\epsilon}} + (1-\omega)^{\frac{1}{\epsilon}} \left(C^N_{u,t}\right)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}}, \tag{G.10}$$

where $\epsilon > 0$ is the elasticity of substitution across the two goods. Our baseline model corresponds to $\epsilon = 1$, in which case (G.10) becomes $C_{u,t} = (C^T_{u,t})^{\omega}(C^N_{u,t})^{1-\omega}$. To replicate the pattern of structural change observed in the data, in what follows we restrict attention to the case $\epsilon < 1$.

The Euler equation (4) is replaced by

$$\frac{\omega^{\frac{1}{\epsilon}}}{(C^T_{u,t})^{\frac{1}{\epsilon}}(C_{u,t})^{1-\frac{1}{\epsilon}}} = R_{u,t}\left(\frac{\beta\omega^{\frac{1}{\epsilon}}}{(C^T_{u,t+1})^{\frac{1}{\epsilon}}(C_{u,t+1})^{1-\frac{1}{\epsilon}}} + \mu_{u,t}\right), \tag{G.11}$$

and the optimal allocation of expenditure between tradable and non-tradable goods (7) becomes

$$P^N_{u,t} = \left(\frac{1-\omega}{\omega}\frac{C^T_{u,t}}{C^N_{u,t}}\right)^{\frac{1}{\epsilon}}. \tag{G.12}$$

The firm sector is the same as in Section G.1. That is, for simplicity, we assume growth in the non-traded sector to be exogenous. The investment problem of firms in the traded sector is also unchanged, except that households' discount factor which firms use to evaluate their profits is now different. As a result, the investment first order condition (in the symmetric equilibrium) is now given by

$$\frac{W_{u,t}}{\chi^T A^T_{u,t}} = \beta\frac{(C^T_{u,t})^{\frac{1}{\epsilon}}(C_{u,t})^{1-\frac{1}{\epsilon}}}{(C^T_{u,t+1})^{\frac{1}{\epsilon}}(C_{u,t+1})^{1-\frac{1}{\epsilon}}}\left(\varpi L^T_{u,t+1} + \frac{W_{u,t+1}}{\chi^T A^T_{u,t+1}}\left(1+\lambda\frac{A^T_{u,t+2}-A^T_{u,t+1}}{A^T_{u,t+1}}\right)\right). \tag{G.13}$$

Combining (G.10) and (G.12) we see that

$$C_{i,t} = \omega C^T_{i,t}\left(\omega + (1-\omega)\left(P^N_{i,t}\right)^{1-\epsilon}\right)^{\frac{\epsilon}{\epsilon-1}},$$

which implies that

$$\left(C^T_{u,t}\right)^{\frac{1}{\epsilon}}\left(C_{u,t}\right)^{1-\frac{1}{\epsilon}} = C^T_{u,t}\left(\omega + (1-\omega)\left(P^N_{u,t}\right)^{1-\epsilon}\right).$$

Inserting this in (G.13), and using again that $W_{u,t} = (\varpi/\alpha)A^T_{u,t}$, we obtain the growth equation for this model version

$$g^T_{u,t+1} = \beta\frac{c^T_{u,t}\left(\omega + (1-\omega)\left(P^N_{u,t}\right)^{1-\epsilon}\right)}{c^T_{u,t+1}\left(\omega + (1-\omega)(P^N_{u,t+1})^{1-\epsilon}\right)}\left(\chi^T\alpha L^T_{u,t+1} + 1 + \lambda(g_{u,t+2}-1)\right). \tag{G.14}$$

We can use (G.14) to understand some properties of the balanced growth path. On the balanced growth path, g^T_u, c^T_u, L^T_u and P^N_u are all constant. Now consider that firms' profit maximization, coupled with free sectoral labor mobility, implies that

$$P_{u,t}^{N}=\frac{A_{u,t}^{T}}{A_{u,t}^{N}}, \tag{G.15}$$

just as in the baseline model. Therefore, on the balanced growth path the two sectors share the same rate of productivity growth, and so g_u^T converges to the (exogenous) rate of productivity growth in the non-traded sector g_u^N

$$g_u^T=g_u^N. \tag{G.16}$$

To see how inter-sectoral convergence in productivity growth occurs, imagine that initially conditions are such that productivity grows faster in the tradable sector than in the non-tradable one. As in Ngai and Pissarides (2007), in response labor migrates toward the low productivity growth sector, i.e. out of the tradable sector and into the non-tradable one.[79] But lower market size in the traded sector leads to a drop in g_u^T. This process goes on until productivity growth is equalized across the two sectors and the economy reaches it balanced growth path. On the balanced growth path, the amount of labor allocated to the production of traded goods is equal to

$$L_u^T=\frac{1}{\chi^T\alpha}\left(g_u^N\frac{1-\lambda\beta}{\beta}-(1-\lambda)\right). \tag{G.17}$$

while relative sectoral productivity is given by

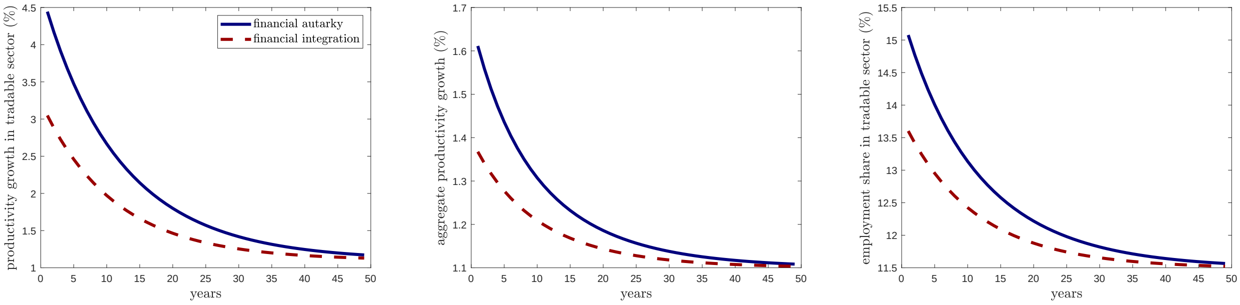
$$\frac{A_{u,t}^{N}}{A_{u,t}^{T}}=\left(\frac{1-\omega}{\omega}\frac{c_u^T}{\Psi L_u^N}\right)^{\frac{\epsilon}{\epsilon-1}}. \tag{G.18}$$

What is the effect of capital inflows in this economy? As in our baseline model, capital inflows tend to reduce the amount of labor allocated to the production of traded goods, and so investment in innovation in the traded sector. But now there is also a second, counteracting, effect. Lower productivity growth in the traded sector induces a migration of labor out of the non-traded sector and into the traded one. In the long run, these two conflicting forces balance out, and capital flows do not affect sectoral labor allocation or productivity growth (see again (G.16) and (G.17)). Capital inflows do, however, reduce productivity growth in the traded sector during the transition, and therefore the long-run level of productivity in the tradable sector.[80]

We illustrate these results with a numerical simulation. As in previous simulations, we set $\beta=.96$, $\alpha=.122$ and $\lambda=.75$. Turning to the utility function, we set $\omega=.15$ and $\epsilon=.15$, in the range of values commonly considered by the structural change literature (Ngai and Pissarides,

[79] The intuition is standard. Due to the Balassa-Samuelson effect, the relative price of tradables falls over time, sustaining their demand. If the elasticity of substitution between the two goods is one, as in our baseline model, the rise in demand is exactly such that sectoral labor allocation is not affected. If the elasticity of substitution between the two goods is smaller than one, instead, demand for tradables increases more slowly than productivity, causing a fall in employment in the tradable sector.

[80] This can be intuitively gauged by looking at expression (G.18). In the long run, capital inflows increase c_u^T, but leave L_u^N unchanged. It follows that capital inflows induce a drop in A_u^T/A_u^N. Since the growth rate of A_u^N is exogenous, this means that productivity growth in the tradable sector must have been low during the transition.



(a) Productivity T sector **(b) Aggregate productivity** **(c) Employment T sector**

Figure 13: Dynamics of productivity and employment with structural change. Notes: Financial autarky refers to balanced trade. Financial integration refers to a permanent trade deficit-to-GDP ratio equal to 2%.

2008; Herrendorf et al., 2013). We then set $\chi^T = 3.2$ and $A^T_{u,0}/A^N_{u,0} = 1.06$, so that initially, under financial autarky, productivity growth is around 4.4% and employment is around 15% of the total labor force in the tradable sector.

Figure 13 shows the results, by comparing an economy with balanced trade against one running a permanent trade deficit equal to 2% of GDP. Initially, productivity grows faster in the tradable sector than in the non-tradable one. As a consequence, during the transition toward the final balanced growth path, labor moves from the traded to the non-traded sector, and convergence in productivity growth between the two sectors occurs. As expected, capital inflows lead to a persistent reduction in employment in the traded sector, which causes a persistent slowdown in productivity growth.

Quantitatively, the first thing to notice is that it takes a significant amount of time, around 50 years, for the economy to reach its final balanced growth path. Over this period, the forces of structural change account for the bulk of the decline in employment in the tradable sector (around 3.5 percentage points). However, capital inflows play an important role too. For instance, on impact capital inflows cause an additional 1.5 percentage point decline in the share of labor allocated to the tradable sector. This result is in line with the numbers reported by Kehoe et al. (2018). Similarly, capital inflows have a significant impact on productivity growth during the transition. Indeed, capital inflows cause on impact a 0.25 percentage point drop in aggregate productivity growth.