The Financial Resource Curse*

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Abstract

This paper presents a model of *financial resource curse*, i.e. episodes of abundant access to foreign capital coupled with weak productivity growth. We study a two-sector, tradable and non-tradable, small open economy. The tradable sector is the engine of growth, and productivity growth is increasing in the amount of labor employed by firms in the tradable sector. A period of large capital inflows, triggered by a fall in the interest rate, is associated with a consumption boom. While the increase in tradable consumption is financed through foreign borrowing, the increase in non-tradable consumption requires a shift of productive resources toward the non-tradable sector at the expenses of the tradable sector. The result is stagnant productivity growth. We show that capital controls can be welfare-enhancing and can be used as a second best policy tool to mitigate the misallocation of resources during an episode of financial resource curse.

Keywords: Capital flows, capital controls, financial resource curse, endogenous growth.
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1 Introduction

The recent years have seen a growing skepticism toward the beneficial impact on economic performance of episodes of abundant and unregulated capital inflows. For instance, in the wake of the global financial crisis that started in August 2007 several emerging countries have adopted measures to limit the inflows of foreign capital.[1] Often, these interventions are justified on the ground that large accumulation of foreign debt can put the economy at risk of a financial crisis in the event of a sudden stop, i.e. an abrupt loss of access to foreign financing.[2] Indeed, a growing literature shows how capital controls can improve welfare in economies at risk of a sudden stop.[3]

In this paper we depart from this perspective and we focus on another channel through which a surge in capital inflows can have a negative impact on economic performance. Periods of sustained current account deficits might be associated with movements of productive resources toward non-tradable sectors, such as construction, in which the scope for productivity gains is limited. This allocation of resources may prevent the development of a dynamic export sector and hinder the long run competitiveness of the economy. In fact, this concern is often mentioned by policymakers as a justification for the imposition of controls on capital flows. Despite the relevance of this channel in policy debates, we do not have a simple model of how capital flows affect the sectoral allocation of productive resources and the long run growth performance of the economy. The objective of this paper is to fill this gap in the literature.

We argue that episodes of cheap and abundant access to foreign capital may be associated with an inefficient allocation of resources. In fact, in our framework dynamic productivity gains are sector-specific and concentrated in the tradable sectors. Periods of large capital inflows can be coupled with a rise in the importance of the non-tradable sectors at the expenses of the tradable sectors, which translates into stagnant productivity growth. We refer to the link between cheap and abundant access to foreign capital and weak productivity growth as the *financial resource curse*.

In our view, Spain represents a case of financial resource curse. Following the accession to the European Monetary Union in 1999 and until 2007, Spain has financed its external imbalances with low interest rates and has experienced low financing rates in the mortgage market.[4] The top-left panel of figure 1 shows the marked fall in the interest

[1] One example is Brazil, which in October 2009 introduced a tax of 2% on all capital inflows, but foreign direct investment. Another well known example of controls on capital inflows is the Chilean *encaje* of the 1990s.

[2] Magud et al. (2011) review the main motives behind capital controls from a policymakers perspective. They list four fears: fear of appreciation, fear of hot money, fears of large inflows and fear of loss of monetary independence.

[3] See Benigno et al. (2012), Bianchi (2011), Bianchi and Mendoza (2010), Jeanne and Korinek (2010) and Korinek (2010). In these papers welfare gains from capital controls arise because of the presence of collateral constraints, giving rise to pecuniary externalities that make the competitive equilibrium inefficient.

[4] The low interest rates experienced by Spain during these years are part of the process of convergence in interest rates across members of the European Monetary Union characterizing the period before the

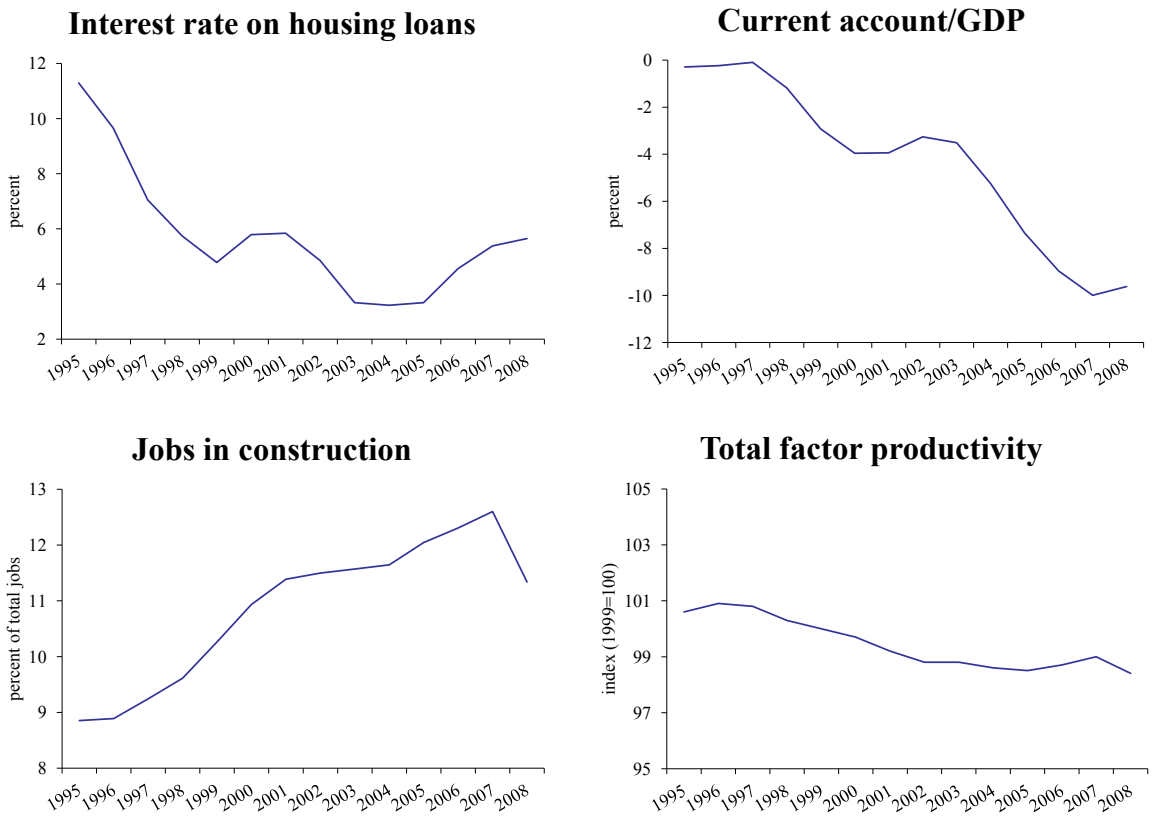

Figure 1: Motivating facts, Spain 1995-2008. Notes: Data are from Eurostat.

rate on mortgages during the 2000s. As displayed by the top-right panel of figure 1, this period was also characterized by abundant capital inflows giving rise to prolonged current account deficits. In fact, Spain went from an almost balanced current account position at the inception of the Euro to a deficit close to 10 percent of GDP in 2007. The continuous worsening of the Spanish current account was accompanied by a steady rise of employment in the construction sector, and the share of jobs in the construction sector as a percentage of total jobs went from 9 percent in 1995 to almost 13 percent at its peak in 2007 (bottom-left panel of figure 1).[5] During the same period Spain experienced a declining pattern for total factor productivity. The bottom-right panel of figure 1 shows that total factor productivity fell by around 2 percentage points between 1995 and 2007.[6]

adoption of the euro. Many authors have linked the convergence in interest rates with the process of financial integration and harmonization of financial market rules within the European Union, as well as with the elimination of currency risk due to the creation of the European Monetary Union. For instance, this view is maintained by Blanchard and Giavazzi (2002).

[5]Giavazzi and Spaventa (2010) highlight the link between deficits in the current account and booms in the construction sector in countries at the Eurozone periphery. Moreover, this period was also characterized by a sharp increase in house prices. Since houses represent the most important source of collateral for households, the rise in house prices might have amplified the inflows of capital and the expansion in credit. Coimbra (2010) provides a model describing this mechanism and explores empirically the link between house prices, capital inflows and credit expansion in Spain and Portugal in the aftermath of the creation of the European Monetary Union.

[6]The pattern of productivity in Spain during the last two decades is discussed in Felgueroso and Jiménez-Martín (2009).

We propose a framework that rationalizes all these facts. We study a two-sector small open economy producing tradable and non-tradable consumption goods. The tradable sector is the engine of growth in our economy. First, firms in the tradable sector can reap productivity gains by importing technological knowledge from abroad. In particular, the rate at which foreign knowledge is absorbed is increasing in the amount of labor employed by firms in the tradable sector. Second, technological improvements generate spillovers that are not internalized by atomistic firms. Indeed, in our framework the non-excludability of knowledge generates externalities, in the spirit of the seminal endogenous growth models of Romer (1986, 1990), Grossman and Helpman (1991) and Aghion and Howitt (1992). In contrast, the non-tradable sector has no scope for productivity improvements.

We show, not surprisingly, that the amount of labor allocated to the tradable sector is inefficiently low in the competitive equilibrium. The social planner allocates more labor to the tradable sector compared to the competitive equilibrium, because it internalizes the positive impact of labor employed in the production of traded goods on the absorption of foreign knowledge. Indeed, during the transition toward the steady state an unregulated economy grows at a slower rate and allocates less productive resources towards the tradable sector compared to the first best. A benevolent government can replicate the social planner allocation and attain the first best by subsidizing firms in the tradable sector.

We then consider an episode of cheap and abundant access to foreign capital, triggered by a fall in the world interest rate. This experiment captures the persistent fall in real interest rates characterizing countries at the Eurozone periphery in the aftermath of the launch of the euro. A decrease in the world interest rate leads to a consumption boom, affecting both tradable and non-tradable consumption goods. While the increase in tradable consumption is financed with foreign borrowing, the increase in non-tradable consumption occurs through a shift of productive resources toward the non-tradable sector. This reallocation of labor away from the tradable sector slows down the process of foreign technology absorption and generates a period of low productivity growth.

In our framework, not only a period of large capital inflows is associated with stagnant productivity growth, but it could also be costly in welfare terms. In fact, capital inflows exacerbate the externality arising from the non-excludability of knowledge. The result is that if the externality is sufficiently strong a drop in the interest rate could have a negative impact on welfare.

From a policy perspective, a benevolent government reacts to low interest rates by increasing the subsidy to firms in the traded sector, so as to counteract the impact of capital inflows on the allocation of labor. If sectoral subsidies are not available, capital controls can be used as a second best policy tool to mitigate the negative impact of low interest rates on productivity growth. In fact, if the government responds to the fall in the interest rate by imposing a tax on capital inflows, it discourages foreign borrowing,

limiting the consumption boom, the reallocation of productive resources toward the non-tradable sector and the consequent fall in productivity growth. In this sense, our model helps to rationalize the use of capital controls to preserve competitiveness in the tradable sector in countries undergoing a period of abundant access to foreign capital.[7]

The rest of the paper is structured as follows. We start by discussing the process of knowledge absorption at the heart of our model and the related literature. We introduce the model in section 2. Section 3 derives the social planning allocation and shows how sectoral subsidies can restore the first best. We then analyze the properties of the model using numerical simulations. Section 4 presents the baseline parametrization and compares the transition toward the steady state in the competitive equilibrium and in the social planning allocation. Section 5 considers the impact of a period of low interest rates and shows that under the competitive equilibrium the effect on welfare can be negative. Section 6 discusses the role of capital controls. Section 7 concludes.

Discussion of growth process. Our analysis has both a positive and a normative component. Our positive analysis rests on one key element: faster productivity growth in the tradable sectors compared to the sectors producing non-tradable goods. Instead, the key assumption behind our normative implications is the presence of stronger externalities in the process of knowledge accumulation in the tradable sectors compared to the non-tradable sectors. Here we discuss the empirical evidence that underpins these assumptions.

The existing empirical evidence points toward faster productivity growth in the tradable sectors compared to the non-tradable sectors. De Gregorio et al. (1994) using data from OECD countries during the period 1970-1985 find that total factor productivity grows faster in the tradable goods sector relative to the non-tradable sectors. Duarte and Restuccia (2010) reach the same conclusion using data from 29 countries, including both OECD and emerging economies, for the period 1956-2004. They find that labor productivity grows faster in manufacturing and agriculture, the two sectors producing the bulk of tradable goods, while productivity growth is smaller in services, the sector traditionally associated with non-tradable goods.[8]

The engine of growth in our model is the absorption of foreign knowledge.[9] Pro-

[7]To be clear, our notion of competitiveness is based on technical efficiency. The term competitiveness could also design the ability to maintain the price of exports low compared to other countries, a topic on which our analysis is silent.

[8]Faster productivity growth in tradable sectors also characterizes Spain between 1999 and 2007. During this period labor productivity in tradable sectors grew on average by 1.4 percent per year, against a -0.4 percent average growth rate for non-tradable sectors. We computed these statistics using data from Eurostat, and defining non-tradable sectors as the aggregate of construction, wholesale and retail trade, financial services and public services, while tradable sectors are the aggregate of the residual sectors, that is agriculture and industry excluding construction. We thank Nathan Converse for help with the data.

[9]There is a vast literature emphasizing the role of cross-country knowledge spillovers. Early theoretical contributions to this literature are Grossman and Helpman (1991) and Parente and Prescott (1994). Klenow and Rodriguez-Clare (2005) conclude that international knowledge spillovers are key in explaining

ductivity grows faster in the tradable sector because firms in the non-tradable sector do not benefit from foreign knowledge spillovers. This stark assumption simplifies the exposition, but our qualitative results would hold as long as foreign knowledge spillovers are more pronounced in the tradable sectors compared to the non-tradable ones. In a recent paper Rodrik (2013) considers cross-country convergence in productivity at the industry level and finds that this is present only in the manufacturing sectors. Similarly, Duarte and Restuccia (2010) find that convergence in productivity takes place in agriculture and manufacturing, but not in services. These findings are consistent with the idea that international knowledge spillovers are more intense in the sectors producing tradable goods.[10]

Moreover, there is a literature that emphasizes the role of trade in fostering the cross-country diffusion of knowledge. The literature has focused on two channels: absorption of foreign knowledge through imports of foreign capital goods or through exports. Empirical evidence in support of knowledge absorption through imports of intermediate goods is provided by Coe et al. (1997) and Amiti and Konings (2007), while the role of exports in fostering productivity growth has been documented by Blalock and Gertler (2004) and by Park et al. (2010).[11] Importantly for our purposes, this literature indicates that a well developed tradable sector is a precondition for foreign knowledge absorption.[12]

In our model, the absorption of foreign knowledge increases with the amount of labor employed in the tradable sector. This feature of the model links our paper to the literature emphasizing the role of human capital in boosting the absorption of foreign technology. This literature, pioneered by Nelson and Phelps (1966) and later developed by Benhabib and Spiegel (2005), provides empirical evidence in favor of a role of the stock of human capital in the absorption of foreign knowledge. Different from this literature, we emphasize the impact of the sectoral allocation of productive resource on the ability to absorb foreign knowledge. Indeed, in many cases episodes of abundant capital inflows ended up financing investment in the construction sector.[13] This is a low skilled sector and its development can have a negative impact on the stock of human capital

the cross-country growth patterns observed in the data.

[10]In addition, Rodrik (2008) provides some indirect evidence consistent with the assumption of more intense knowledge accumulation in the tradable sectors. In fact, he finds that real exchange rate depreciations are associated with faster productivity growth in developing countries and that this effect is increasing in the size of the tradable sector. However, as suggested by Woodford (2009) more research is needed to assess the direction of causality.

[11]See Benigno and Fornaro (2012) for a more detailed discussion of the literature on knowledge spillovers through trade.

[12]The importance of trade for productivity growth is also supported by the empirical analysis of Alcalá and Ciccone (2004), who find evidence in favor of a positive impact of trade on productivity.

[13]Beside Spain following its accession to the European Monetary Union, other examples of surges in capital inflows associated with construction booms are Mexico in the early 1990s (Pickering, 2000), Chile in the early 1980s and several East Asian countries in the run-up to the 1997 financial crisis (Hernández and Landerretche, 2011), and Ireland between 1999 and 2007 (Giavazzi and Spaventa, 2010). More broadly, episodes of abundant capital inflows tend to be coupled with rises in the relative importance of non-tradable sectors vis-à-vis of sectors producing tradable goods, as documented by Tornell and Westermann (2002) and Mendoza and Terrones (2008).

and on the absorption of foreign knowledge.[14] Our growth process captures this channel of transmission, albeit in a very stylized form, if the amount of labor employed by the tradable sector is interpreted as a proxy for the stock of human capital.

The key assumption for our normative results is the presence of stronger externalities in the process of knowledge accumulation in the tradable sectors compared to the non-tradable sectors. In our model externalities arise because knowledge is a non-excludable good, and hence it can be used freely by any firm in the economy. This assumption captures the fact that the knowledge accumulated inside a firm can, at least partly, spill over to other firms, for example through imitation or through the hiring of workers that embody the technical knowledge developed in a rival firm.[15] Indeed, the assumption that knowledge is only partially excludable is a feature of the most influential endogenous growth frameworks, such as the models developed by Romer (1986, 1990), Grossman and Helpman (1991) and Aghion and Howitt (1992). While for simplicity we assume that knowledge is a completely non-excludable good, the mechanism that we describe would still hold in a framework in which knowledge is partially excludable. An open empirical question is whether certain sectors of the economy, notably the ones producing tradable goods, are subject to stronger externalities. Though more research is needed to shed light on this important issue, the existing empirical evidence points toward the presence of externalities in the manufacturing sector (Cingano and Schivardi, 2004; Driver et al., 2006), a sector producing mainly tradable goods.

Related literature. Our paper is related to different strands of literature. First, our paper is related to the literature on the resource curse, also known as the Dutch disease. This literature, surveyed in Frankel (2010) and Van der Ploeg (2011), highlights different channels through which the discovery of natural resources can have a detrimental impact on economic performance or welfare.[16] Our paper is particularly close to models in which the discovery of natural resources impacts negatively economic performance because of the presence of learning-by-doing effects in the tradable sector. Krugman (1987) provides an early formalization of this effect.[17] Different from the existing literature, our resource curse does not arise from the discovery of natural resources or because of an exogenous transfer from abroad, but rather because of a period of abundant access to foreign capital. We dub this effect financial resource curse. The distinction is important, because capital

[14] Going back to the case of Spain, Aparicio (2010) shows that there is a positive link between the rise in employment in the construction sector and the increase in the dropout rate from highschool of young Spaniards during the boom in capital inflows following Spain's accession to the Euro.

[15] Hausmann and Rodrik (2003) claim that a fundamental source of externalities in the process of foreign knowledge absorption is the discovery of what a country is good at producing. Their view is that the private incentives for starting the domestic production of goods that were previously produced abroad are too low from a social perspective, because discovering the cost of producing domestically a new good is a risky activity, whose fruits can be easily appropriated by others through imitation.

[16] Corden and Neary (1982) is an early theoretical study of the natural resource curse.

[17] See also Matsuyama (1992), who discusses the impact of a surge in productivity in agriculture in presence of learning-by-doing in manufacturing.

inflows are endogenous in our model and hence policy tools such as capital controls, which have not been studied by the traditional resource curse literature, can play a role in mitigating the financial resource curse.

Our paper is also related to the literature studying the optimality of capital controls. Capital controls are welfare enhancing in Bianchi (2011), Jeanne and Korinek (2010) and Korinek (2010) because of a pecuniary externality stemming from the presence of a relative price in the borrowing constraint, though Benigno et al. (2012) show that in this context price support policies are superior to capital controls as they achieve the unconstrained allocation. In Costinot et al. (2011) and De Paoli and Lipinska (2012) capital controls can increase welfare by affecting the terms of trade, while Bacchetta et al. (2011) show that capital controls can have a positive effect on welfare when the domestic financial sector is underdeveloped. Capital controls might also be desirable if the nominal exchange rate is fixed and nominal wages are downwardly rigid, as discussed in Schmitt-Grohé and Uribe (2012). Instead, we focus on capital controls as a policy tool to correct the inefficient sectoral allocation of productive resources arising from the combination of knowledge spillovers in the tradable sectors and capital flows.

From an empirical point of view our analysis is inspired by the reading of the Euro area experience in the run-up to the crisis by Giavazzi and Spaventa (2010). They emphasize the link between sectoral allocation of productive resources and external debt sustainability, while we focus on the misallocation of productive resources caused by the interaction between endogenous capital flows and growth externalities.[18] Another channel of resource misallocation has been analyzed theoretically by Aoki et al. (2010). There the misallocation arises from domestic credit frictions that prevent the efficient allocation of resources across firms with different productivity.[19]

Finally, a recent literature (Aizenman and Lee, 2007; Benigno and Fornaro, 2012; Korinek and Servén, 2010) has used models with growth externalities to address the motives behind reserve accumulation. While we share similar assumptions about the growth process of the economy, our analysis focuses on the role of endogenous capital inflows and capital controls, abstracting from policy consideration in terms of reserve accumulation.

2 Model

We consider a perfect foresight infinite-horizon small open economy. Time is discrete and indexed by t. The economy is populated by a continuum of mass 1 of identical households and by a large number of firms.

[18] In their framework the sectoral allocation of resources is indeed efficient.

[19] Reis (2013) uses this framework to explain the low growth characterizing Portugal between 2000 and 2007. As discussed by Aoki et al. (2009) the misallocation of resources can be amplified if collateral depends on asset prices and surges in capital inflows are associated with booom-bust cycles in asset prices.

2.1 Households

The representative household derives utility from consumption and supplies inelastically L units of labor each period. The household's lifetime utility is given by

$$\sum_{t=0}^{\infty} \beta^t \log\left(C_t\right). \tag{1}$$

In this expression, $\beta < 1$ is the subjective discount factor and C_t denotes the consumption of a composite good. C_t is defined as a Cobb-Douglas aggregator of tradable C_t^T and non-tradable C_t^N consumption goods

$$C_t = \left(C_t^T\right)^{\omega} \left(C_t^N\right)^{1-\omega}, \tag{2}$$

where $0 < \omega < 1$ denotes the share of expenditure in consumption that the household assigns to the tradable good.[20]

The budget constraint of the household is

$$C_t^T + P_t^N C_t^N + \frac{B_{t+1}}{R_t} = W_t L + B_t + \Pi_t. \tag{3}$$

The budget constraint is expressed in units of the tradable good, whose price is constant and normalized to 1. The left-hand side represents the household's expenditure. We define P_t^N as the relative price of the non-tradable good in terms of the tradable good, so $C_t^T + P_t^N C_t^N$ is the household's consumption expenditure expressed in units of the tradable good. B_{t+1} is the stock of one-period risk-free bonds purchased by the household at price $1/R_t$. R_t is the gross world interest rate, which is exogenous from the perspective of the small open economy.

The right-hand side represents the income of the household. Throughout the paper, we focus on equilibria in which firms in both sectors produce.[21] This means that firms in both sectors pay the same wage W_t, and so $W_t L$ is the labor income received by the household. B_t is the gross return on the stock of bonds purchased by the household at time $t-1$. Finally, domestic firms in both sectors are wholly owned by domestic households and Π_t denotes the profits received from firms by the representative household.

Each period the representative household chooses C_t^T, C_t^N and B_{t+1} to maximize utility (1) subject to the budget constraint (3). The first order conditions are

$$\frac{\omega}{C_t^T} = \lambda_t \tag{4}$$

$$\frac{1-\omega}{C_t^N} = \lambda_t P_t^N \tag{5}$$

[20] The assumption of a Cobb-Douglas aggregator of tradable and non-tradable consumption goods ensures the existence of a balanced growth path. See footnote 28 for further discussion.

[21] This is always the case in the numerical simulations presented below.

$$\lambda_t = \beta R_t \lambda_{t+1}, \tag{6}$$

where λ_t denotes the Lagrange multiplier associated with the budget constraint, i.e. the household's marginal utility of wealth. By combining the optimality conditions (4) and (5), we obtain the standard intratemporal equilibrium condition that links the relative price of non-tradable goods to the marginal rate of substitution between tradable and non-tradable goods

$$P_t^N = \frac{1-\omega}{\omega} \frac{C_t^T}{C_t^N}.$$

According to this expression, P_t^N is increasing in C_t^T and decreasing in C_t^N. In what follows we will use P_t^N as a proxy for the real exchange rate.

The last first order condition (6) is the standard Euler equation which determines the intertemporal allocation of tradable consumption between a generic period t and the subsequent period $t+1$.

2.2 Firms

Firms operate in two sectors: one sector produces the tradable good and the other one produces the non-tradable good.

Tradable sector. In the tradable sector there is a large number of firms that produce using labor L_t^T and the stock of knowledge A_t, according to the production function

$$Y_t^T = A_t L_t^T, \tag{7}$$

where Y_t^T is the amount of tradable goods produced in period t.

Knowledge is non-rival and non-excludable and so it can be freely used by firms producing tradable goods. Hence, the only production cost incurred by firms in the tradable sector is the wage bill $W_t L_t^T$. Profits can then be written as

$$\Pi_t^T = Y_t^T - W_t L_t^T,$$

and profit maximization implies that

$$A_t = W_t.$$

This expression says that at the optimum firms equalize the marginal profit from an increase in labor, the left-hand side of the expression, to the marginal cost, the right-hand side.

Knowledge accumulation. The key feature of our small open economy is the endogenous process of knowledge accumulation. In particular, the stock of knowledge available

to firms in the tradable sector evolves according to

$$A_{t+1} = A_t \left(1 + cL_t^T \left(1 - \frac{A_t}{A_t^*}\right)\right), \tag{8}$$

where $c > 0$ is a parameter determining the impact of the sectoral labor allocation on productivity growth, and A_t^* denotes the stock of knowledge of the world technological leader, which grows at the constant rate g^*.[22]

The stock of knowledge in a generic period t depends not only on the past knowledge, but also on the amount of labor employed in the tradable sector. This formulation captures the idea that human capital contributes to the absorption of foreign knowledge, as in Nelson and Phelps (1966) and Benhabib and Spiegel (2005). Moreover, in our model the tradable sector is the source of convergence in productivity, in the spirit of the empirical findings of Duarte and Restuccia (2010) and Rodrik (2013).

Let us start by considering the implications for the steady state. In steady state both A and A^* grow at the common rate g^*. Denoting by $a_t = A_t/A_t^*$ the proximity of the country to the world technological frontier we have that in steady state

$$\bar{a} = 1 - \frac{g^*}{c\bar{L}^T},$$

where an upper bar denotes the steady state value of the corresponding variable. This equation implies that in steady state the proximity of the economy to the world technological frontier is increasing in the stock of workers employed in the tradable sector.[23]

Moreover, the allocation of labor across the two sectors also influences the transition toward the steady state. In particular, in the numerical simulations we will consider the case of a country that starts below its steady-state proximity to the frontier, i.e. $a_0 < \bar{a}$. In this case, during the transition to the steady state the stock of knowledge of the economy grows at a rate higher than the one of the world technological frontier. As we will show, a higher amount of labor employed in the tradable sector implies faster convergence toward the steady state.

As mentioned above, we assume that knowledge is a non-rival and non-excludable good. This assumption, combined with the presence of a large number of firms in the tradable sector, implies that firms do not internalize the impact of their actions on the evolution of the economy's stock of knowledge. This is a typical growth externality: firms do not internalize the social value of allocating labor to the tradable sector, because they don't consider the impact of their actions on the growth rate of aggregate productivity.

[22]The assumption of an exogenous world technological frontier means that the economy under consideration is too small to have an impact on the evolution of the world's stock of knowledge.

[23]This equation also tells us that in order to have a positive productivity in steady state c has to satisfy the condition $c > g^*/\bar{L}^T$. We limit the analysis to values of c such that this condition holds.

Non-tradable sector. The non-tradable good is produced using labor only, according to the production function $Y_t^N = L_t^N$. Y_t^N is the output of the non-tradable good, while L_t^N is the amount of labor employed by firms in the non-tradable sector. Profits in the non-tradable sector are

$$\Pi_t^N = P_t^N Y_t^N - W_t L_t^N.$$

The condition for profit maximization in the non-tradable sector is $W_t^N = P_t^N$.

Combining the optimality conditions of the firms in the two sectors gives

$$P_t^N = A_t. \tag{9}$$

This equation highlights the fact that in the model productivity advances in the tradable sector correspond to real exchange rate appreciations. This is the classic Balassa-Samuelson effect. In fact, the real exchange rate is just a function of relative productivities, and it does not depend directly on the intratemporal allocation of consumption.[24] This is important because in our model the inefficient allocation of resources does not translate into a misaligned real exchange rate.[25]

2.3 Market clearing and competitive equilibrium

Market clearing for the non-tradable good requires that the amount consumed is equal to the amount produced

$$C_t^N = L_t^N. \tag{10}$$

Combining equation (10), with the households' budget constraint (3), the equations for firms' profits and the equilibrium condition $\Pi_t = \Pi_t^T + \Pi_t^N$, we obtain the market clearing condition for the tradable good

$$C_t^T = Y_t^T - \frac{B_{t+1}}{R_t} + B_t. \tag{11}$$

This equation can be rearranged to derive the current account. In fact, the end-of-period net foreign asset position of the country is equal to the end-of-period holdings of bonds of the representative household divided by the world interest rate[26]

$$NFA_t = \frac{B_{t+1}}{R_t}.$$

[24] See Jeanne (2012) for a discussion of capital account policies in a model in which the real exchange rate is determined by the sectoral allocation of consumption.

[25] Of course, the literature has not yet converged on a clear definition of exchange rate misalignment. Here we refer to a misalignment of the real exchange rate as a deviation of the real exchange rate from the trend implied by the Balassa-Samuelson effect, as done for example by Rodrik (2008) in its empirical analysis.

[26] We follow the convention of netting interest payments out of the net foreign asset position.

The market clearing condition for the tradable good can then be rearranged to obtain the law of motion for the stock of net foreign assets, that is the current account

$$NFA_t - NFA_{t-1} = CA_t = Y_t^T - C_t^T + B_t \left(1 - \frac{1}{R_{t-1}}\right),$$

The current account is given by net exports, $Y_t^T - C_t^T$, plus net interest payments on the stock of net foreign assets owned by the country at the start of the period, $B_t(1-1/R_{t-1})$.

Finally, in equilibrium labor supply by households must equal labor demand from firms

$$L = L_t^T + L_t^N. \tag{12}$$

We are now ready to define a perfect-foresight equilibrium as a set of processes $\left\{C_t, C_t^T, C_t^N, P_t^N, B_{t+1}, \lambda_t, Y_t^T, L_t^T, A_{t+1}, L_t^N\right\}_{t=0}^{\infty}$ satisfying (2) and (4)-(12), given the exogenous processes $\{R_t, A_t^*\}_{t=0}^{\infty}$ and initial conditions B_0 and A_0.

3 Social planner and optimal policy

Since firms do not internalize the effect of their labor choice on the stock of knowledge the competitive equilibrium allocation is not efficient. It is then useful to study first the social planner allocation in order to understand the implications of the growth externality present in the model.

The social planner chooses $\left\{C_t^N, C_t^T, L_t^T, L_t^N, B_{t+1}, A_{t+1}\right\}_{t=0}^{\infty}$ to maximize households' expected utility (1), subject to the economy-wide resource constraints (7), (10), (11) and (12). Importantly, the social planner takes into account the effect that the allocation of labor has on the accumulation of knowledge, and so also the equation describing the evolution of the stock of knowledge (8) enters as a constraint in the planner's problem.

The first order conditions of the planner's problem can be written as

$$\frac{(1-\omega)}{C_t^N} = \hat{\lambda}_t^N$$

$$\frac{\omega}{C_t^T} = \hat{\lambda}_t^T$$

$$A_t \left(\hat{\lambda}_t^T + c\,(1-a_t)\,\gamma_t\right) = \hat{\lambda}_t^N$$

$$\hat{\lambda}_t^T = \beta R_t \hat{\lambda}_{t+1}^T$$

$$\gamma_t = \beta\gamma_{t+1}\left(1 + cL_{t+1}^T\,(1-2a_{t+1})\right) + \beta\hat{\lambda}_{t+1}L_{t+1}^T. \tag{13}$$

$\hat{\lambda}_t^N$, $\hat{\lambda}_t^T$ and γ_t are the Lagrange multipliers respectively on constraints (10), (11) and (8).

As we will see in the numerical experiments presented below, the social planner allocates more labor to the tradable sector compared to the competitive equilibrium. To gain intuition about this result, it is useful to consider the first order condition determining

the social planner's allocation of labor

$$A_t \left(\hat{\lambda}_t^T + \underbrace{c\,(1-a_t)\,\gamma_t}_{\text{externality}} \right) = \hat{\lambda}_t^N.$$

If there is no impact of the labor allocation on productivity growth, then $c = 0$ and defining $P_t^N = \hat{\lambda}_t^N / \hat{\lambda}_t^T$ it is easy to see that the social planning allocation and the competitive equilibrium coincide. Instead, whenever $c > 0$ we have that $\hat{\lambda}_t^N / \hat{\lambda}_t^T > \lambda_t^N / \lambda_t^T$, which implies that consumption of non-traded good, and so the amount of labor allocated to the non-traded sector, is lower in the social planning allocation compared to the competitive equilibrium. This happens because the social planner internalizes the fact that an increase in the amount of labor employed in the tradable sector generates a rise in productivity growth. This effect is increasing in the Lagrange multiplier γ_t. The multiplier γ_t, defined by equation (13), captures the marginal value that the planner attaches to an increase in productivity.

There are a number of ways in which the social planning allocation can be decentralized in the competitive equilibrium. For instance, the social planning allocation can be decentralized by subsidizing employment in the tradable sector. Suppose that the government provides to each firm in the tradable sector a subsidy to production $\sigma_t A_t L_t^T$, financed through lump-sum taxes. Profits of firms in the tradable sector are then given by

$$\Pi_t^T = (1+\sigma_t) A_t L_t^T - W_t L_t^T - T_t,$$

where $T_t = \sigma_t A_t L_t^T$ is a lump-sum tax used by the government to finance the subsidy. Then the first best allocation can be replicated by setting

$$\sigma_t = \frac{c\,(1-a_t)\,\gamma_t}{\hat{\lambda}_t^T}. \tag{14}$$

Everything else held equal, this expression implies that the stronger is the impact of labor allocation on productivity growth, i.e. the higher is c, the higher must be the subsidy given to firms in the tradable sector to attain the first best.

4 Numerical experiments

4.1 Parameters

We study the properties of the model using numerical simulations. We solve the model using a standard shooting algorithm.[27] Our framework is too simple to lend itself to a

[27] More precisely, we make a guess for the path of consumption of the traded good. Using the guess we solve the model and check whether the intertemporal resource constraint of the economy is satisfied. If this is not the case, we update the guess for the consumption of the traded good.

Table 1: Parameters

Parameter	Symbol	Value
Growth rate of the technological frontier	g^*	0.015
World interest rate	R	1.04
Discount factor	β	0.976
Endowment of labor	L	1
Initial NFA	B_0	0
Initial TFP of the technological leader	A_0^*	6.4405
Initial TFP	A_0	4.1384
Constant in knowledge accumulation process	c	0.167
Share of tradable goods in consumption	ω	0.414

careful calibration exercise, hence our strategy consists in choosing reasonable values for the parameters in order to illustrate the model's properties, while we leave the study of a more realistic framework for future research.

A period in the model corresponds to one year. We set the growth rate of the technological frontier to $g^* = 0.015$, to match the average annual growth rate of TFP in the United States between 1960 and 1995 as computed by Benhabib and Spiegel (2005). In the benchmark parameterization the world interest rate is assumed constant and equal to $R = 1.04$. The discount factor is set to $\beta = 0.976$, so that in steady state consumption of tradable goods grows at the same rate of the world technological frontier. This essentially means that the economy shares the same discount factor as the rest of the world. The endowment of labor is normalized to $L = 1$. We assume that the economy starts with zero net foreign assets and we set $B_0 = 0$.

The initial values for the stock of knowledge of the home country and of the world technological leader are chosen following the TFP estimates reported by Benhabib and Spiegel (2005). In particular, we set the initial stock of knowledge of the technological leader to $A_0^* = 6.4405$, which corresponds to TFP in the US in 1995. The initial stock of knowledge in the home country is set to $A_0 = 4.1384$, which corresponds to TFP in Spain in 1995. This calibration implies an initial proximity to the frontier equal to $a_0 = 0.6426$.

We set c and ω to match two historical statistics for Spain: the evolution of TFP between 1960 and 1995 and the ratio of non-tradable-to-tradable GDP in 1986. We simulate the model using as initial conditions $A_0 = 1.8502$ and $A_0^* = 3.7648$, the estimates of TFP in 1960 respectively in Spain and in the US provided by Benhabib and Spiegel (2005). We set $c = 0.167$, so that after 35 periods the model reproduces the TFP observed in Spain in 1995. The share of tradable goods in consumption is chosen equal to $\omega = 0.414$ so that after 26 years the ratio $P_t^N Y_t^N / Y_t^T$ equals 1.69, the ratio of non-tradable-to-tradable GDP in Spain in 1986 as estimated by Fernández de Córdoba and Kehoe (2000).

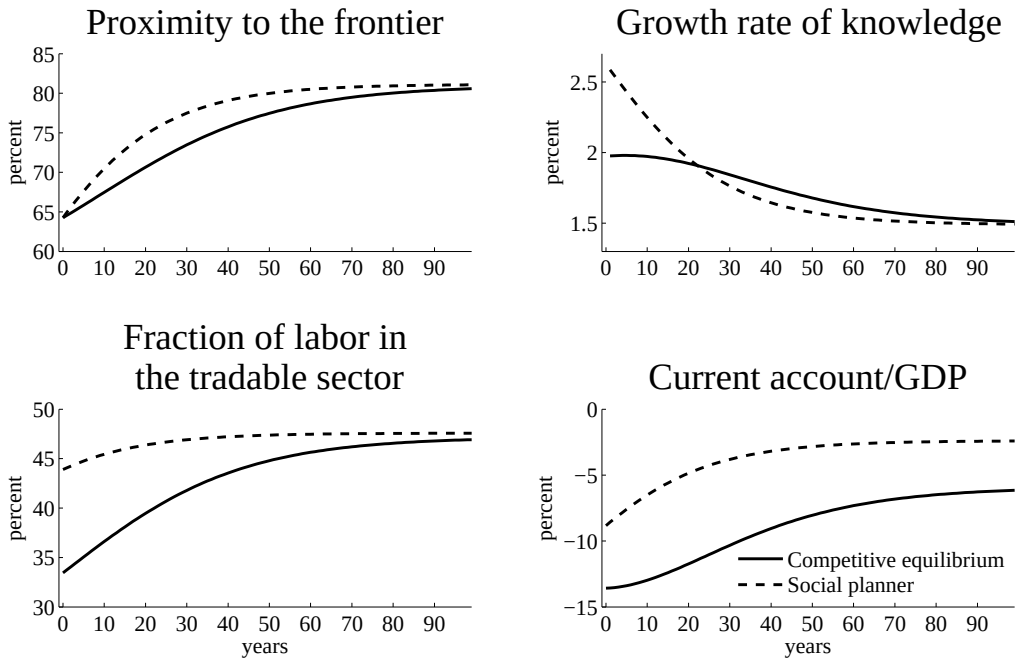

Figure 2: Transition toward the steady state.

4.2 Transition toward the steady state

In this section we compare the transition toward the steady state in the competitive equilibrium without policy intervention and in the social planner allocation. This comparison is useful to understand the dynamics of the model and the impact of the growth externality.

The solid lines in figure 2 show the transition toward the steady state of the economy without policy intervention. The economy starts below its steady state proximity to the frontier, so during the transition the stock of knowledge grows faster than the growth rate of the world technological frontier and the economy experiences a period of technological catch-up. Indeed, initially annual productivity growth is close to 2 percent, 0.5 percentage points higher than in steady state.

Moreover, while the economy approaches the steady state the fraction of labor allocated to the tradable sector rises. In fact, in steady state the fraction of labor allocated to the tradable sector is around 10 percentage points higher compared to the start of the transition. This happens because as the stock of knowledge available for the production of tradable goods increases, it becomes more profitable to employ labor in the tradable sector. As labor flows toward the tradable sector, production and consumption of non-tradable goods decrease and the relative price of non-tradable goods rises, increasing the profitability of employing labor in the non-tradable sector. In steady state this second effect counteracts the first one and the share of labor allocated to the tradable sector is constant.[28]

[28]In reality, the development process is characterized by a progressive shift of employment toward services, a sector producing mainly non-tradable goods (Duarte and Restuccia, 2010). To reconcile our

Finally, during the transition the economy runs current account deficits. Initially the current account-to-GDP ratio is close to -15 percent, while in steady state the ratio is close to -7 percent. The deficits in the current account are due to the fact that during the convergence process the output of tradable goods grows at a faster rate than in steady state. Since in the benchmark economy consumption of tradables grows at the same rate as the world technological frontier, households want to frontload part of their consumption stream. Hence, households borrow from foreign investors, generating deficits in the current account.

The transition in the social planning allocation, shown by the dashed lines in figure 2, is qualitatively similar to the one in the competitive equilibrium. The main difference is that the speed of convergence toward the steady state is higher in the social planning allocation. In fact, in the competitive equilibrium the fraction of labor allocated to the tradable sector, and hence the rate at which foreign knowledge is absorbed, is systematically lower along the transition path. The differences in the sectoral allocation of labor are due to the fact that the social planner internalizes the process of knowledge accumulation. Moreover, the social planner runs smaller current account deficits compared to the competitive equilibrium during the transition, because the social planner finances traded goods consumption relatively more through production than imports compared to the competitive equilibrium.

5 Low interest rates and the financial resource curse

In this section we consider an episode of abundant capital inflows triggered by a temporary fall in the world interest rate. In particular, we assume that the world interest rate falls to 1 percent for ten years and then returns to its steady state value of 4 percent. This experiment captures in a simple way episodes such as the large capital inflows experienced by countries at the Eurozone periphery in the run-up to the recent financial crisis.

Figure 3 displays the results of our experiment. The solid lines show the transition of the benchmark economy, with constant interest rates, while the dashed lines represent the economy that experiences ten years of cheap credit.

The fall in the world interest rate induces households to increase foreign borrowing and the economy experiences a period of sizable current account deficits. In fact, a fall in the world interest rate of 3 percentage points initially generates a fall in the current account-to-GDP ratio of more than 30 percent.[29]

model with this fact we could follow the literature on structural change and assume an elasticity of substitution between tradables and non-tradables smaller than one, as in Ngai and Pissarides (2007), or other modifications of the utility function that introduce income effects in consumption choices (Matsuyama, 2009; Duarte and Restuccia, 2010). We prefer to abstract from these effects to keep our model simple, and because we are interested in the medium-run impact of an episode of abundant capital inflows, rather than on the long-run growth path of the economy.

[29] Quantitatively the impact of the interest rate drop on the current account seems to be unrealistically large. To get more realistic quantitative implications we could enrich the model by introducing

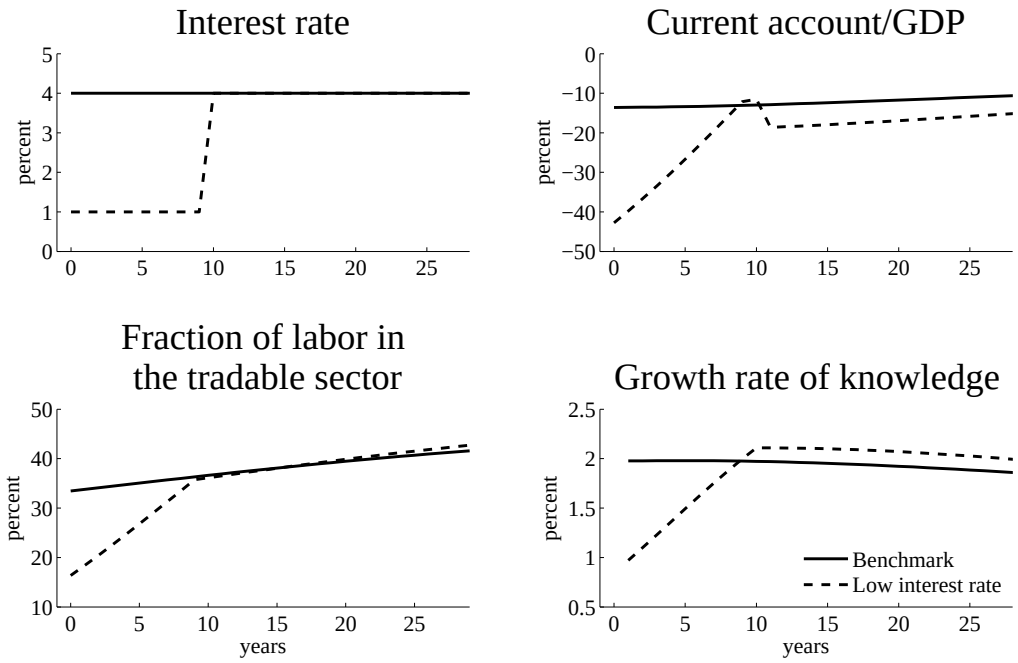

Figure 3: Response to a fall in the world interest rate.

Moreover, low interest rates generate a shift of labor toward the non-tradable sector. This happens because the improved access to foreign financing generates a consumption boom. The increase in tradable consumption is attained through a rise in imports. Instead, the only way to increase the consumption of non-tradables is to increase their production, and so low interest rates imply a shift of labor toward the non-tradable sector compared to the benchmark economy.

The reallocation of labor toward the non-tradable sector reduces the economy's ability to absorb foreign knowledge and slows down the growth rate of productivity compared to the benchmark economy. Through this channel, in our model a period of cheap credit leads to stagnant productivity growth.

Turning to welfare, while in the neoclassical growth model lower interest rates have a beneficial impact on welfare for borrowing economies, in our framework this is not always the case. To highlight this property of the model we compute the impact on welfare of ten years of low interest rates as the percentage increase in consumption that the representative household has to receive in any future date in order to be indifferent between staying in the benchmark economy or moving to the economy with initially low interest rates. Formally, the welfare gain η is defined as

$$\sum_{t=0}^{\infty} \beta^t \log\left((1+\eta)C_t^B\right) = \sum_{t=0}^{\infty} \beta^t \log\left(C_t^{LR}\right), \tag{15}$$

features that dampen the response of the current account to interest rate shocks. For instance, we could assume that debt contracts are not perfectly enforceable, and so that domestic households are subject to borrowing constraints. We could also assume frictions on the mobility of labor between the traded sector and the non-traded sector, as pointed out by Fernández de Córdoba and Kehoe (2000). Finally, we could consider economies characterized by lower values of the intertemporal substitution elasticity.

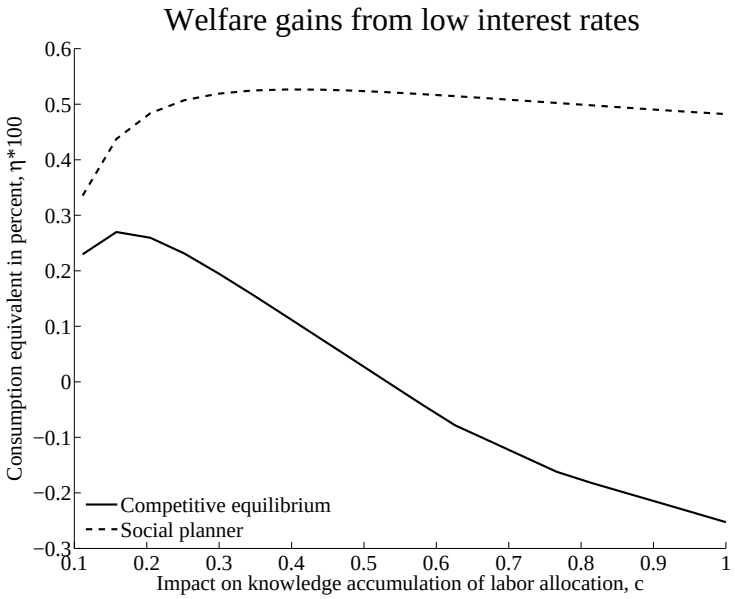

Figure 4: Impact on welfare of low interest rate as a function of c.

where the superscripts B and LR denote allocations respectively in the benchmark economy and in the economy with initially low interest rates.

Figure 4 displays the consumption equivalent η as a function of c, the parameter determining the impact of the labor allocation on growth.[30] The solid lines refer to the competitive equilibrium, while the dashed lines refer to the social planning allocation.

The first thing to notice is that the gains from the low interest rate are larger under the social planning allocation. This happens because the social planner internalizes the impact of labor allocation on growth and hence it reacts to capital inflows by allocating more labor to the tradable sector compared to the competitive equilibrium.

The second result is that, while in general lower interest rates are associated with welfare gains even in the competitive equilibrium, for high values of c a period of cheap foreign credit can produce welfare losses. Indeed, for our benchmark value of $c = 0.167$, the representative household enjoys an increase in utility from ten years of low interest rates equivalent to a 0.2 percent increase in its consumption stream. Instead, if c exceeds a threshold, which is slightly greater than 0.5, η turns negative, meaning that the drop in the interest rate has a negative impact on welfare.

There are two effects at play. On the one hand, a lower interest rate has a positive impact on welfare, since ceteris paribus it leads to an increase in the present value of the economy's output. On the other hand, the drop in the interest rate exacerbates the growth externality by inducing a shift of productive resources away from the tradable sector and slowing down the process of productivity growth. As the parameter c increases the second effect tends to outweigh the first, and the impact on welfare of a drop in the interest rate is more likely to be negative. In contrast, in the social planner allocation

[30] We have restricted attention to values of c large enough so that during the transition the economy grows faster than the technological frontier and runs current account deficits.

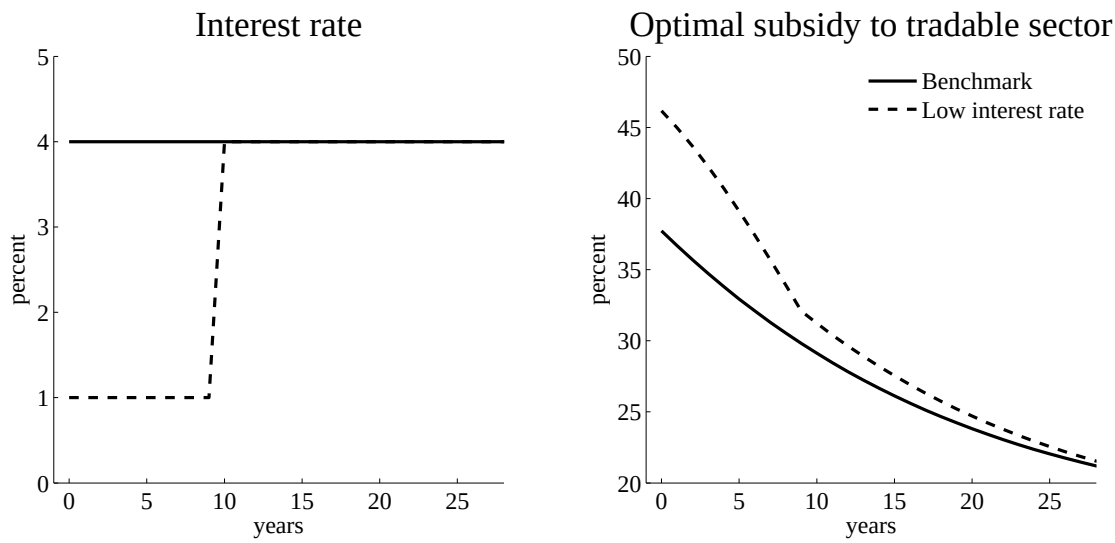

Figure 5: Optimal subsidy to firms in the tradable sector.

the second effect is not present, because the allocation of productive resources is efficient, and the impact on welfare of a drop in the interest rate is always positive.[31]

As we mentioned above, a benevolent government can attain the first best by subsidizing firms in the tradable sector. It is then interesting to think about how the optimal subsidy responds to a fall in the interest rate. Figure 5 displays the path for the optimal subsidy to production in the tradable sector.[32] The figure compares the path of the subsidy in the benchmark economy with constant interest rate, solid lines, to the one of the economy that experiences ten years of low interest rates, dashed lines. In both cases the subsidy decreases over time. This happens because as the economy approaches the technological frontier the gains from the absorption of foreign knowledge diminish.

In addition, the government reacts to a fall in the interest rate by increasing the subsidy to production in the tradable sector. The increase in the subsidy partly counteracts the effect of capital inflows on the allocation of labor, mitigating the negative impact of low interest rates on productivity growth.

[31] Also in the case of the social planner the welfare gains from low interest rates are at first increasing in c, but after a threshold is passed they start to decrease. To understand why this happens, consider that the welfare gains from a drop in the interest rate are increasing in the present value of income. On the one hand, a higher c is associated with faster growth and higher productivity in steady state. This effect points toward a positive relationship between c and the welfare gains from a fall in the interest rate. On the other hand, even in the social planning allocation a drop in the interest rate generates some reallocation of labor toward the non-tradable sector, which slows down the process of productivity convergence and reduces the present value of income. This effect is stronger the higher c, and hence it points toward a negative relationship between c and the welfare gains from a fall in the interest rate. For values of c small enough the first effect prevails, and the positive impact on welfare from low interest rates increases with c. After a threshold is passed, the second effect becomes more important and the welfare gains from low interest rates become decreasing in c.

[32] The figure refers to the baseline value of $c = 0.167$.

6 Capital controls

A fall in the world interest rate generates an episode of financial resource curse: large capital inflows coupled with stagnant productivity. Moreover, a drop in the interest rate can have a negative impact on welfare, because it induces an increase in borrowing and a shift of productive resources away from the tradable sector that slows down the absorption of foreign knowledge. It is then natural to ask whether policies that counteract the rise in borrowing following a fall in the interest rate can lead to welfare gains. In this section we consider a government that responds to a fall in the world interest rate by imposing controls on capital inflows.

We model controls on capital inflows as a tax that influences households' borrowing decisions. The budget constraint of the household is now

$$C_t^T + P_t^N C_t^N + \frac{B_{t+1}}{R_t \left(1+\tau_t\right)} = W_t L + B_t + \Pi_t + TR_t,$$

where τ is a tax on capital inflows and $TR_t = -\tau_t B_{t+1} / \left(R_t \left(1+\tau_t\right)\right)$ is a lump-sum transfer that the government uses to balance its budget every period. The Euler equation of the household is

$$\lambda_t = \beta R_t \left(1+\tau_t\right) \lambda_{t+1}.$$

This expression highlights how the tax affects borrowing decisions. For instance, a rise in τ increases the effective interest rate faced by the household and reduces the household's incentive to borrow.

To evaluate the impact of capital controls on welfare we perform a simple policy experiment. As in the previous section, we consider the impact on welfare of ten years of low interest rates. Specifically, we compare welfare between an economy that faces a constant interest rate equal to 4 percent and an economy that experiences a low interest rate of 1 percent for ten years, after which the interest rate goes back to its steady state value of 4 percent. Different from the previous section, we now assume that the government reacts to the fall in the interest rate by imposing a constant tax on capital inflows throughout the ten periods of low interest rate. As a measure of welfare, we compute η, the percentage increase in consumption stream that leaves a household indifferent between having a constant interest rate or facing ten years of low interest rates, as defined by equation (15).

Figure 6 plots η as a function of the tax on capital inflows τ.[33] The relation between welfare gains from low interest rates and the tax on capital inflows is an inverted U. Moreover, the figure shows that imposing a tax on capital inflows tend to increase the welfare gains from an episode of low interest rates. In particular, welfare is maximized when the government reacts to the fall in the interest rate by imposing a tax equal to 1.5 percent.

[33]The other parameters are kept to their baseline values. In particular, c is set to 0.167.

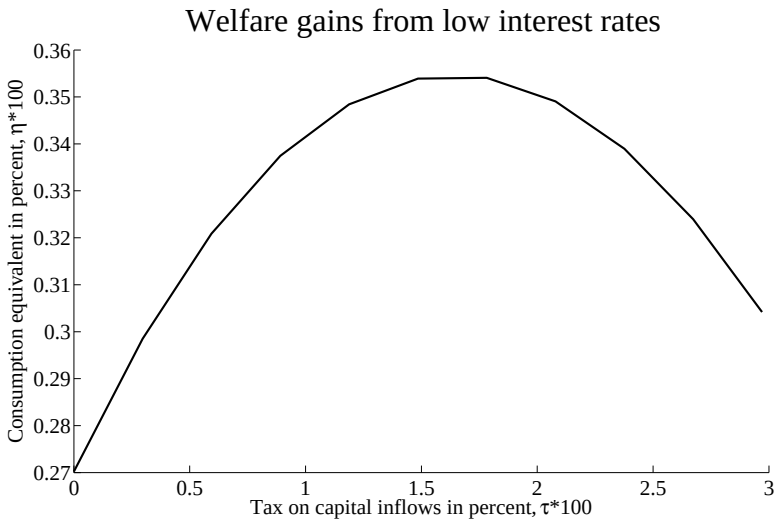

Figure 6: Impact on welfare of low interest rate as a function of τ.

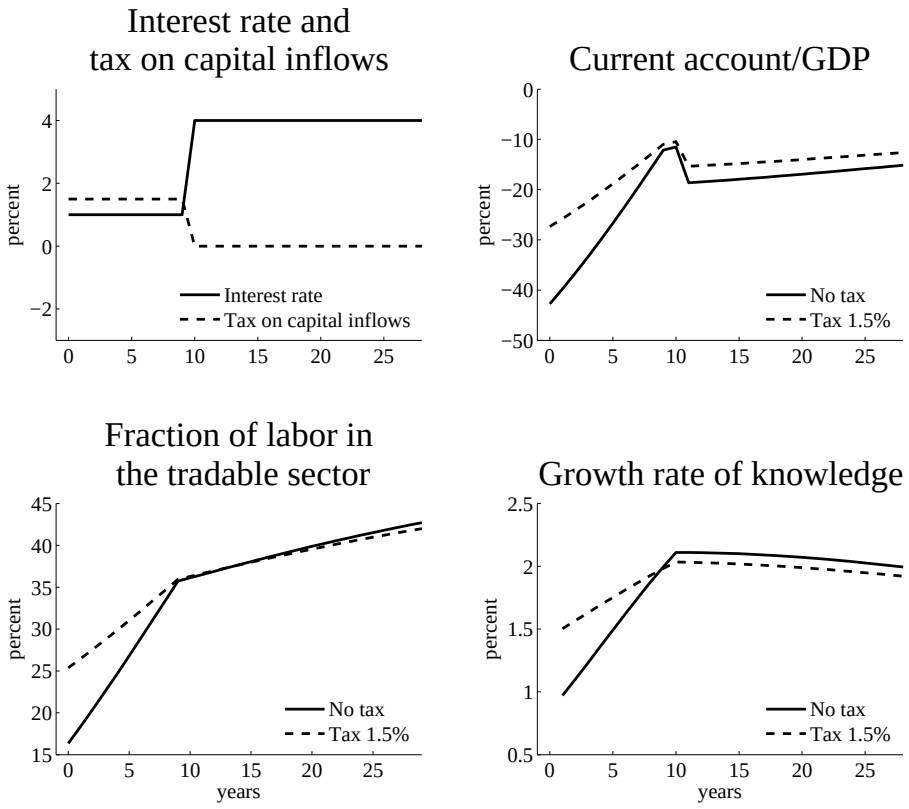

Figure 7: Response to a fall in the interest rate with capital controls.

The intuition is the following. On the one hand, a rise in the tax discourages borrowing, preventing the fall in the production of traded good. This is shown by figure 7, which compares the response to a drop in the interest rate in an economy without policy intervention to an economy with a constant tax rate equal to 1.5 percent. By sustaining employment in the tradable sector the tax has a positive impact on knowledge absorption, growth and welfare. On the other hand, a rise in the tax induces a distortion in the optimal smoothing of the consumption stream, carrying a negative impact on welfare. For initially low levels of the tax the first effect prevails, and welfare rises as the tax increases. After the tax has reached a threshold the second effect outweighs the first one, and further increases in the tax have a negative impact on welfare.

This result suggests that knowledge externalities in the tradable sector can justify the imposition of capital controls. This is particularly true if policies such as sectoral subsidies are not available, for example because of trade agreements that rule out subsidies to firms in the export sector.

7 Conclusions

In this paper we have studied one peril of large capital inflows. When the economy is subject to structural asymmetries so that growth externalities are concentrated in the tradable sector, episodes of large capital inflows might be associated with stagnant productivity growth as resources tend to be inefficiently allocated towards the non-tradable sector.

Scope for policy interventions arises since the resource misallocation results in a lower growth rate of the economy compared to the case in which capital inflows are intermediated efficiently (i.e. the social planner equilibrium). We show how it is possible to design sectoral subsidies to achieve the efficient allocation and we then discuss how second-best policy tools like capital controls could be used to improve upon the unregulated economy.

We label the pattern of large capital inflows, consumption boom and stagnant productivity as the financial resource curse and suggest that this framework could be useful in interpreting the case of Spain in the period going from 1999 to 2007.

Our analysis here has focused only on the resource misallocation aspect of the financial resource curse but, as the past experiences suggest, episodes of large inflows might be followed by a rapid reversal of those flows, associated with crisis events. We plan to study the interaction between the financial resource curse and the possibility of crisis events in future research.

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