Financial Integration, Capital Misallocation and Global Imbalances

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Abstract

The paper shows that in a stylized model with two countries, characterized by different levels of financial development, the following facts can be replicated: 1) persistent current account surpluses and 2) high TFP growth in China. Because of liquidity shocks and credit constraints, investment by entrepreneurs with long-term projects is depressed. The behavior of these entrepreneurs has two other important features: (i) their demand for bonds is “excessive”; (ii) bonds and long-term investment are complements, in the sense that a decrease in the price of bonds (i.e. an increase in the interest rate) has a positive effect on investment in long-term projects, while it has a negative effect on investment in short-term projects which are not subject to liquidity shocks. The first feature depresses the autarky price of bonds, so the emerging economy experiences an increase in the interest rate and capital outflows when financial markets integrate. The second one makes short-term and long-term investments move in opposite directions, so financial integration generates TFP gains through a better allocation of capital.

Key Words: International Finance, Growth, Capital flows, Credit constraints, Financial globalization.

JEL codes: F36, F43, O16, O33.

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1 Introduction

The purpose of this paper is to explain two stylized facts that have attracted the economists’ attention. The first one is the so called global imbalances: 1) China has accumulated a considerable amount of net foreign assets. Figure 1 (a) shows that its net external position, as a share of world GDP, has increased steadily since 1996. Actually, this surge can be dated back to 1990-1993 when the most illiquid assets, FDI, are excluded. This accumulation of net foreign assets in China is the main counterpart of the negative external position of the US, as illustrated in Figure 1 (a). The second fact is illustrated in Figure 1 (b): 2) growth of total factor productivity (TFP) in China relatively to the US has accelerated. Figure 1 (b) shows that China’s relative TFP increased steadily during the period.\footnote{Between 1980 and 1989, TFP moved from 10% of the US value to 13%, which corresponds to an average catch-up rate of 2.5% per year. From 1990 to 2007, it moved from 13.5% to 32%, which corresponds to an average catch-up rate of 5%. This relative TFP growth contributed to two thirds of the relative growth of output per worker in China during that last period.}

This paper lays down a three-period stylized model to explain this conjunction of TFP growth and capital outflows in the form of liquid assets as the endogenous outcome of financial integration. It focuses on the role of financial integration between US and China. Indeed, despite limited de jure financial integration, apparent in Figure 2 through the stability of the Chinn and Ito (2007) index, China have experienced a significant trend of de facto integration during the period. Financial integration increases steadily before 1990, then accelerates after 1990 and stabilizes in the end of the nineties at approximately 50% of the US level.\footnote{As another evidence of de facto financial integration, see Cheung et al. (2006). They examine the...} This apparent contradiction between de jure and de facto integration...
Figure 1: Stylized facts - Global imbalances and relative growth in China

(a) Global imbalances

(b) TFP in China

Source: World Bank (World Development Indicators), Lane and Milesi-Ferretti (2006) and Penn World Tables 6.3 (Heston et al., 2009). Chinese data correspond to the Version 2 of the Penn World Tables.
has to be related to the increasing role of public flows. Figure 1 (a) shows that reserves constitute the bulk of financial outflows. Despite legal restrictions on capital flows, private agents indirectly hold foreign assets thanks to the intermediation role played by the Central Bank.³

The key feature of the framework is the interaction between financial development, financial integration and capital misallocation. Both capital outflows and efficiency gains from capital reallocation in the emerging country come from a differing price of liquidity with the industrial country. This price differential stems from financial frictions which increase the demand for liquidity by some entrepreneurs and stimulates its autarky price. Financial integration then decreases the price of liquidity in the emerging market, which both reduces misallocations and generates capital outflows.

More specifically, two types of entrepreneurs invest in decreasing return to scale technologies and in a liquid bond. Some entrepreneurs have access to short-term projects while the others have access to long-term projects. Long-term projects, because they take more time to mature, can be subject to liquidity shocks that might threaten the completion of the projects, as in Holmstrom and Tirole (1998) and Aghion et al. (2010). The presence of credit constraints in the emerging country makes these projects illiquid. Entrepreneurs with long-term projects have then an excessive demand for liquid bonds for precautionary purposes and they under-invest in their projects. As a result, under autarky, liquid assets are more expensive (the interest rate is lower) in the emerging country than in the industrial country, where financial markets function well. Therefore, financial integration of bond markets enables agents with long-term projects in the developing economy to invest more by holding cheaper liquid assets in the industrial economy. At the same time, investment in the short-term projects decrease, because the interest rate rises. This translates into higher TFP and a positive current account.

deviations from real interest parity, uncovered interest parity, and relative purchasing power parity, and find that China is surprisingly financially integrated. They also document that the magnitude of deviations from the parity conditions is shrinking over time.

³See also Song et al. (forthcoming). They document the parallel trend of bank deposits and reserves, which is consistent with the idea of savings-driven accumulation of reserves by the Central Bank.
Because of liquidity shocks and credit constraints, the investment behavior of entrepreneurs with long-term projects has two features that are key to our results: the demand for bonds is “excessive”, in the sense that it is larger than in the absence of credit constraints; bonds and long-term investment are complements, in the sense that a decrease in the price of bonds (i.e. an increase in the interest rate) has a positive effect on investment in long-term projects.\textsuperscript{4} The first feature is crucial since it depresses the autarky price of bonds. The second one is key to make short-term and long-term investments move in opposite directions when the interest rate increases.

The remainder of the paper is organized as follows: Section 2 reviews the related literature; Section 3 lays down model while Section 4 compares the autarky and financial globalization equilibria.

\section{Related literature}

This paper is related to the literature on capital misallocation. In particular, Matsuyama (2007); Aghion et al. (2010, 2007); Song et al. (forthcoming); Midrigan and Xu (2010); Buera et al. (2009); Jeong and Townsend (2007) have stressed the impact of financial development on the allocation of capital. These studies assume that more financially demanding investments are also more productive. However, misallocations emerge even in the absence of TFP differences between firms. Indeed, with decreasing returns to scale, efficiency requires the equalization of marginal returns across firms. When these returns are not equalized, as Hsieh and Klenow (2007) show, there are aggregate TFP losses.\textsuperscript{5} In the model, we do not make any assumption regarding the relative productivity of long-term and short-term investments. Under-investment in the long-term investment naturally creates a wedge with the return of the short-term technology.

The paper’s focus on the role of decreasing returns rather than TFP differences is

\textsuperscript{4}Bacchetta and Benhima (2010) also highlight this property of bonds in the presence of credit constraint and working capital but they develop a representative agent model that does not allow them to study misallocations.

\textsuperscript{5}See also Banerjee and Duflo (2005) and Restuccia and Rogerson (2007).
Figure 2: Financial integration of China

(a) Chinn-Ito’s index

(b) Gross external assets and liabilities/GDP

Source: Chinn and Ito (2007), World Bank (World Development Indicators), Lane and Milesi-Ferretti (2006) and Penn World Tables 6.3 (Heston et al., 2009). Chinese data correspond to the Version 2 of the Penn World Tables.
motivated by the literature on the effects of financial integration on growth. In particular, Levchenko et al. (forthcoming) find that financial integration do not increase the relative size of high TFP sectors. Since, as they document, financial integration does not have any effect on sectoral TFP growth, this finding is puzzling given the positive aggregate effects of financial opening (Bonfiglioli, 2008). However, these apparently contradicting empirical results can be reconciled in the presence of decreasing returns to scale. Indeed, the reallocation of capital from a sector with over-investment to a sector with under-investment has positive aggregate effects on production because the output losses in the sector with over-investment are smaller than the gains in the sector with under-investment, because the marginal returns are larger in the latter.\(^6\)

This paper is also close to the rich literature on the “saving glut”. Possible explanations include a transition process with financial frictions (Song et al., forthcoming; Sandri, 2010), the difficulties of developing economies to protect themselves from episodic financial crises (Bernanke, 2005; Gruber and Kamin, 2007; Obstfeld et al., 2008; Rancière and Jeanne, 2006; Caballero et al., 2008), but also financial integration of countries with high demand for safe and liquid assets (Mendoza et al., 2007\(^a\),\(^b\); Matsuyama, 2005; Ju and Wei, 2006, 2007). This last explanation is closest to mine. It is backed by the empirical results of Forbes (2008): she finds that financial development and capital controls are the main determinants of investment in US assets.\(^7\)

Some of these papers deal with the link between growth and capital outflows, but with different approaches. In our paper, as in Caballero et al. (2008), high growth economies have a limited supply of domestic assets, but growth is endogenous in our framework. Even closer to our approach, Song et al. (forthcoming) explain the improvement in aggregate TFP in China by a better allocation of capital, but the mechanism hinges on

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\(^6\) Abiad et al. (2008) document the decrease in variation in marginal returns following financial liberalization, including restrictions on international transactions.

\(^7\) Another way to interpret excess savings in China is exchange rate management and export-led growth (Dooley et al., 2004, 2005; Rodrik, 2006, 2007). However, this view is not exclusive of the other two finance-based views. Indeed, high domestic savings helps the government maintain a low exchange rate through sterilized interventions.
a different composition effect: productive firms converge slowly to the balanced growth path because they are credit-constrained and crowd out the financially integrated but less productive firms only in the long run.\textsuperscript{8} In our paper, aggregate TFP effects arise even though the relative wealth of constrained and unconstrained firms is constant. Here, what matters is the effect of financial integration on the firms’ investment decisions, for a given wealth. The static framework is useful to isolate this effect from the long-run composition effects.\textsuperscript{9} Finally, in Antràs and Caballero (2009), financial integration generates both capital outflows from the emerging country and a better allocation of resources, but, contrary to our approach, the effects come from an adjustment in labor between sectors, not in capital.

3 A model with liquidity needs

3.1 Economic environment

The economy is populated by two continuaums of entrepreneurs, each of length 1: $S$ entrepreneurs, with short-term, or liquid projects, and $L$ entrepreneurs, with long-term, or illiquid projects. There are 3 periods, $t = 0, 1, 2$.

Entrepreneur are endowed with wealth $w$. At date 0, they allocate these resources between capital, denoted $k$ for short term projects and $z$ for long term projects, and bonds, denoted respectively $b^S$ and $b^L$. At date 1, $S$ entrepreneurs get the return from their portfolio $f(k) + k + rb^S$, where $f$ is positive, increasing and concave, while $L$ entrepreneurs get only $rb^L$. Between date 1 and date 2, firms have access to a storage technology that yields one unit of good for one unit invested. We are interested in the domestic supply of liquid assets by firms and how it interacts with investment in the illiquid project at date 0, so we assume that there is no storage technology between date 0 and date 1.

The long-term projects are more sophisticated than the short-term projects and therefore they are more risky and submitted to possible hazards. This kind of investment can

\textsuperscript{8}A similar mechanism is at play in Sandri (2010) since growth comes from structural reforms.

\textsuperscript{9}See Benhima (2010) for a dynamic version of the model.
be interpreted as R&D expenses, or as the cost of adopting a new technology that has to be adapted or involves more human capital. This type of investment can be subject to a liquidity shock threatening the completion of the production process. For example, the new machines have to be adapted to a new legislation or the entrepreneur that has acquired new skills falls ill. In either case, all the investment expenditure can be lost if the liquidity shock is not overcome. We therefore assume that, at date 1, L entrepreneurs incur a temporary liquidity shock $\rho z$, $\rho > 0$, with probability $1/2$. If the cost is paid, then the long-term investment yields $g(z) + (1 + \rho)z$, where $g$ is positive, increasing and concave. If not, then the long-term investment yields 0. With probability $1/2$, the entrepreneur receives $\rho z$ and the long-term investment yields $g(z) + (1 - \rho)z$.\textsuperscript{10} By construction, the liquidity shock is equal to zero in expectations. This assumption is made in order to insure that, under perfect financial markets, there is no aggregate shortage of liquidity. We assume also that the shock is temporary and has no impact on the final profit, so it is not a shock on fundamentals. These assumptions enable us to focus on the consequences of malfunctioning financial markets.

Projects $S$ and $L$ differ in terms of the maturing time, but also in terms of the pledge-ability of assets. Namely, when they borrow, $L$ entrepreneurs can pledge only a fraction $0 < \phi < 1$ of their capital, while $S$ entrepreneurs can pledge the totality of their assets. So $\phi z$ is the maximum amount that creditors can extend to $L$ entrepreneurs. This can be justified by the fact that long term production involves intangible assets that cannot be seized by creditors. For example, technologically intensive projects take more time to produce and rely more on human capital, which is an intangible asset.

3.2 Entrepreneurs with short term projects

At date 0, $S$ entrepreneurs can invest $w$ only in the short term asset $k$ and in bonds $b^S$. At date 1, they invest the return of this portfolio in the storage technology. Since the return on storage is 1, they consume $f(k) + k + rb^S$ at date 2, where $b^S = w - k$. We

\textsuperscript{10}The assumption of equal probabilities of good and bad shocks is made to simplify the presentation of the model but is without loss of generality.
focus on equilibria with $r \geq 1$, so that $k \geq -r(w - k)$, which means that $S$ entrepreneurs are never constrained.\footnote{Indeed, in equilibrium, $f'(k) + 1 = r$. Since $f'(k) \geq 0$, then $r \geq 1$.} Their program is then the following:

$$\max_k \{ f(k) + k + r(w - k) \}$$

which yields:

$$f'(k) + 1 = r$$

The interest rate pins down the first-best investment in short-term capital. We denote this investment level by $k^*(r)$. Bonds are then defined by the difference between wealth and investment needs: $b^{S*}(r) = w - k^*(r)$.

### 3.3 Entrepreneurs with long term projects

At date 0, $L$ entrepreneurs invest in the long term capital $z$ and in short-term bonds $b^L$. At date 1, they receive $\rho z$ with probability 1/2. In that case, they store $rb^L + \rho z$ and consume $g(z) + z + rb^L$ in period 2. With probability 1/2, they have to pay $\rho z$. If the cost is paid, they consume $g(z) + z + rb^L$ at date 2. If not, they consume $rb^L$. Throughout the process, total borrowing should never exceed $\phi z$. In other words, the condition for firms to be able to finance the liquidity shock is:

$$r(w - z) \geq (\rho - \phi)z$$

which amounts to $z \leq \bar{z}(w, r, \phi)$, with $z$ defined as follows:

$$\bar{z}(w, r, \phi) = \frac{r}{r + \rho - \phi}w$$

This condition is more restrictive than the period 0 credit constraint:

$$r(w - z) \geq -\phi z$$

which is equivalent to $z \leq z_{max}(w, r, \phi)$, with

$$z_{max}(w, r, \phi) = \frac{r}{r - \phi}w$$
$z_{\text{max}}$ is the maximum amount of long-term investment that can be invested without violating the borrowing constraint. $\bar{z}$ is the maximum amount that can be secured by liquid bonds.

In order to further describe the entrepreneur’s program, define the safe and risky profits as follows:

\[
\pi^*(z) = g(z) + z + r(w - z)
\]
\[
\pi^{**}(z) = \frac{1}{2}(g(z) + z) + r(w - z)
\]

$\pi^*$ represents expected profits when the entrepreneur has sufficient funds to secure the long-term production process, i.e., the financing constraint (2) is satisfied. When (2) is not satisfied, then the long-term production process becomes risky, and yields its full return only with probability $1/2$. In that case, profits are given by $\pi^{**}$.

The entrepreneur’s program can be written as follows:

\[
\max \left\{ \max \{ \pi^*(z) \} ; \max \{ \pi^{**}(z) \} \right\}
\]

Entrepeneurs choose whether to satisfy or not the financing constraint. When choosing the first case, they can overcome the bad shock and therefore get the long-term production in all states of nature. Their objective in then to maximize $\pi^*(z)$. In the second case, they lose the long-term production in the bad state. Their objective is then to maximize $\pi^{**}(z)$. Indeed, if $z$ is sufficiently productive with regards to the liquid bond, it can be profitable to choose not to satisfy the constraint, even with the risk of losing $g(z)$.

It is useful to define the following variables:

\[
z^*(r) = g^{-1}(r)
\]
\[
z^{**}(w, r, \phi) = \min \left\{ z_{\text{max}}(w, r, \phi), g^{-1}(2r) \right\}
\]

$z^*$ is the first-best level of long-term investment, defined by $g'(z^*) = r$. It maximizes $\pi^*$. $z^{**}$ is the level that maximizes $\pi^{**}$, subject to $z \leq z_{\text{max}}(w, r, \phi)$. $z^{**}$ is the investment level when the entrepreneur chooses the risky strategy.

The following Proposition describes the decisions of the entrepreneur:
Note: The solid lines denote the values of $z$ and $\pi$ that characterize the behavior of the entrepreneur.
Proposition 1 For each \((r, \phi)\):

(i) There exists \(w^*(r, \phi)\) strictly positive such that \(z = z^*\) for all \(w \geq w^*(r, \phi)\) and \(z = z^{**}\) or \(\tilde{z}\) otherwise;

(ii) If \(\rho \geq \phi\), then there exists \(\bar{w}(r, \phi)\), \(\bar{w}(r, \phi) < w^*(r, \phi)\), such that \(z = \bar{z}\) for all \(\bar{w}(r, \phi) \leq w < w^*(r, \phi)\);

(iii) \(\bar{w}(r, \phi)\) and \(w^*(r, \phi)\) are both decreasing in \(r\).

Results (i)-(ii) of Proposition 1 are summed up in Figure 3. When \(w\) is larger than \(w^*\), the entrepreneur is sufficiently rich to both implement the optimal level of long-term investment \(z^*\) and to secure it by the appropriate amount of liquid bonds. This is the case as long as \(w \geq w^*\), where \(w^*\) is the amount of wealth for which the maximum level of “secured” long-term investment coincides with the first-best level, that is \(\bar{z}(w^*, r, \phi) = z^*(r)\). For \(w < w^*\), the first-best long-term investment cannot be achieved and secured at the same time: \(\bar{z}(w^*, r, \phi)\) is strictly lower than \(z^*(r)\). At that point, however, the risk of output loss is too high as compared to the opportunity cost of liquidity, so the entrepreneur prefers to lower the investment level in order to be able to secure it by holding bonds. This is the case as long as \(w \geq \bar{w}\), where \(\bar{w}\) is the amount of wealth for which the secured strategy gives the same profit as the risky one, that is \(\pi^*(\bar{z}(\bar{w}, r, \phi)) = \pi^{**}(z^{**}(r))\). However, when \(w\) decreases further, the secured investment \(\bar{z}\) decreases and it becomes more costly to hoard liquidity than to apply the risky strategy. For \(w < \bar{w}\), the entrepreneur gets a higher profit by ignoring the financing constraint and investing more in the long-term technology, even though this makes the production process more risky.\(^{12}\)

Actually, the investment behavior becomes more complex when \(w < \bar{w}\), and it becomes impossible to establish whether \(L\) entrepreneurs invest in the constrained or risky allocation in the general case. However, in the rest of the paper, we will consider only

\(^{12}\)In the example showed in the Figure, \(z\) is equal to \(g^{-1}(2r)\) for \(w^{**} < w < \bar{w}\) and it is equal to \(z^{bar}\) for \(0 < w < w^{**}\), meaning that the entrepreneur is credit-constrained.
“standard” cases where they invest in the constrained or risky allocation, that is where $w > \bar{w}$. This is why (iii) is useful: it tells us whether changes in the interest rate moves us out of the standard zone.

The intuition for (iii) is as follow. $\partial \bar{w}(r, \phi)/\partial r < 0$ means that the constrained allocation can be sustained for lower levels of wealth when the interest rate increases. This is because, as apparent in Equation (3), and as will be explained further, a higher interest rate alleviates the financing constraint by allowing a higher long-term investment, which has a positive effect on the constrained profits. $\partial w^*(r, \phi)/\partial r < 0$ means that the first-best allocation holds for lower levels of wealth when the interest rate increases. This is because a rise in the interest rate both increases the constrained long-term investment and decreases the first-best one, which makes it easier for a constrained entrepreneur to achieve the first-best.

3.4 Specificities of constrained economies

Several aspects of constrained economies (that is, countries where $L$ entrepreneurs are constrained) are worth highlighting at that point, since they will have important consequences on the effect of financial integration. First, if the entrepreneur is constrained, we have $\bar{z} \leq z^*$. $L$ entrepreneur under-invest in the more productive technology as compared to the first-best solution because they have to hold an additional amount of bonds in order to satisfy the financing constraint. Second, and correlatively, the entrepreneurs over-invest in short-term bonds. Namely, if we denote the aggregate demand for short term bonds $b = b^s + b^L$, we have $\bar{b} \geq b^*$, since $\bar{b}^L \geq b^{L*}$. Third, while the supply of short-term capital $k$ is standard and depends negatively on the interest rate, the effect of the interest rate on the supply of long-term capital $z$ is positive. Fourth, the effect of the interest rate on the domestic excess demand for bonds $b$, which also represents net foreign assets, is ambiguous. However, under some condition, which we will justify later, the interest rate has a standard positive effect on bond demand. While the first two points are straightforward, the last two deserve more explanation.
The positive effect of the interest rate on long-term capital can be uncovered by differentiating the financing constraint (3):

\[
\frac{\partial \bar{z}}{\partial r} = \frac{w - z}{r + \rho - \phi} > 0 \tag{9}
\]

This comes from an income effect: when the interest rate increases, less bonds are necessary to secure the long term investment, because the period 1 revenues from bond holdings increase mechanically. This generates more resources to invest in long-term capital.

Indeed, when the entrepreneur invests in \( z \) units of long term capital, he needs an amount of liquidity equal to \((\rho - \phi)z\) to face the liquidity shock in period 1, so long-term capital and liquidity are complements. Therefore, a decrease in \( 1/r \), which is the cost of liquidity, amounts to a decrease in the average cost of \( z \). In other words, more resources become available to invest in \( z \).

This income effect is stronger the larger \( w \). Indeed, the potential price effects are stronger when bond holding and therefore \( w \) are large. However, a stringent financing constraint \((\rho - \phi)\) mitigates this effect because increasing \( z \) increases period 1 risk, which counteracts the beneficial income effect.

The aggregate demand for bonds of the constrained economy is obtained by subtracting the supply by \( S \) entrepreneurs from the demand from \( L \) entrepreneurs:

\[
\bar{b} = \frac{\rho - \phi}{r + \rho - \phi} w - (f^{-1}(r) - w)
\]

The derivative of \( \bar{b} \) with respect to \( r \) is:

\[
\frac{\partial \bar{b}}{\partial r} = -\frac{(\rho - \phi)w}{(r + \rho - \phi)^2} - \frac{1}{f''(k(r))} \tag{10}
\]

The sign of this derivative is ambiguous because the supply and demand for liquidity move in the same direction. The total demand for liquidity purposes \( \frac{\rho - \phi}{r + \rho - \phi} w \) is decreasing in \( r \) through the same income effect described above: less short-term assets are needed to face the liquidity shock; while the total supply \( f^{-1}(r) - w \) is decreasing in \( r \) too through a standard arbitrage effect. Both the demand and supply are depressed by the interest rate. In the remainder of the paper, we assume that the following condition holds:
Condition 1 There exists $X > 0$ such that $|f''(k)| < X$ for all $k \geq 0$ and $wX < (\rho - \phi)$.

Under Condition 1, the derivative in (10) is strictly positive, which is a standard assumption about the demand for bond. This condition states that the standard supply effect dominates the unconventional demand effect. This is the case when the supply of capital is elastic to the interest rate ($|f''(k)|$ is small), when the income effects are small ($w$ is small and $\rho - \phi$ is large).

4 Global imbalances

We consider two countries indexed by $i \in \{I, E\}$, $I$ denoting the industrial country and $E$ the emerging one. The approach here is to compare the investment decisions under autarky and financial globalization, defined by cross-border trade in bonds. As in Mendoza et al. (2007a), the two countries are supposed to be identical, except for the level of financial development $\phi$. The industrial country $I$ is financially developed while the emerging one $E$ is not. In order to be more specific, we define the two following situations:

Definition 1 Perfect financial markets (PFM): $w > w^*(1, \phi)$. According to Proposition 1, this condition is sufficient for the first-best decisions to apply for all $r$, since $r \geq 1$.

Definition 2 Imperfect financial markets (IFM): $\rho > \phi$ and $\bar{w}(\bar{r}^a, \phi) < w < w^*(\bar{r}^a, \phi)$, where $r^a^*$ is the autarky interest rate that would prevail under PFM, and $\bar{r}^a$ is the autarky interest rate that prevails with $z = \bar{z}$.

We assume that the industrial country $I$ has PFM, while the emerging country $E$ has IFM. The IFM condition insures that $w$ is not too high or too low so the constrained allocation is a solution under autarky and financial integration.\footnote{According to Proposition 1, $w < w^*(r^a^*, \phi)$ insures that the first-best allocation is ruled out under autarky, but, as we will see, it will also be ruled out under financial integration. This will hold as long as the interest rate under financial integration $r^w$ is higher than the autarky interest rate $\bar{r}^a$, since $w^*(r, \phi)$...}
We first examine the allocation of capital under autarky, then we study the impact of financial integration between $I$ and $E$. We are interested in the way financial globalization affects the net external position $b = b^S + b^L$, and investment in both kinds of capital $k$ and $z$.

4.1 Autarky

Consider the investment decisions under perfect and imperfect financial markets when the economy is under autarky. For any variable $X$, $X^{a*}$ denotes its autarky value under PFM and $\bar{X}^a$ its autarky value under IFM.

Under autarky, the domestic bond market is in equilibrium, so $b^a = b^{Sa} + b^{La} = 0$. Combining this condition with the date 0 budget constraints of $S$ and $L$ entrepreneurs, we get the aggregate resource constraint of the economy:

$$2w = k^a + z^a$$

The total resources are allocated between the short term and the long term assets.

Under PFM, the optimal allocation satisfies $g'(2w - k^{a*}) = f'(k^{a*})$, which defines the level of short term investment $k^{a*}$. Then we can infer the level of long-term investment $z^{a*} = 2w - k^{a*}$ and the autarky interest rate $r^{a*} = f'(k^{a*})$.

To understand what happens under IFM, assume first that the constrained allocation holds. As highlighted earlier, the constrained economy has an excessive demand for bonds as compared to the first-best: $\bar{b} > b^*$. Under Condition 1, the bond demand responds negatively to the interest rate, so the autarky interest rate should be lower in a constrained economy. Namely, to diminish the excess demand for bonds, the interest rate must decrease in order to stimulate the supply of short term capital, which serves as a store of liquidity for the economy.

$w$ is decreasing in $r$. Additionally, we rule out the risky allocation under autarky in $E$ by assuming that $w > w(r^a, \phi)$. According to Proposition 1, this condition is sufficient to rule out the risky allocation under the autarky interest rate $r^a$. This ensures that the constrained solution is an equilibrium solution under autarky. As we will see, it implies that the constrained solution is also an equilibrium under financial integration.
A low interest rate implies that the constrained economy invests excessively in the short-term capital. As a consequence, less resources are available for the long-term capital, according to the aggregate resource constraint. This is in line with the findings of the empirical literature: in financially repressed countries, industries dependent on external finance are less developed.\textsuperscript{14} This constitutes therefore another justification for Condition 1. Indeed, suppose that the aggregate bond demand $b$ was decreasing in $r$. The interest rate would then be higher in a constrained economy in order to depress the demand for bonds. This implies that, compared to an unconstrained economy, $L$ entrepreneurs over-invest in long-term capital and $S$ entrepreneurs under-invest in short-term capital.

The following Proposition summarizes the features of the autarky equilibrium:

**Proposition 2** In autarky, under Condition 1, the constrained allocation is a solution under IFM. The autarky interest rate is lower under IFM than under PFM. Besides, $k$ is higher and $z$ is lower under IFM than under PFM.

The formal proof is available in the Appendix.

Figure 4 illustrates the mechanism. It represents the demand for bonds and for short-term and long-term capital in the Industrial country $I$, with perfect financial markets, and in the Emerging country $E$, with binding financing constraints. These countries differ only with regards to the level of financial development. The short-term investment $k$ is decreasing in $r$ and it is identical in both countries since it follows the same optimality rule. Bonds $b$ are increasing in $r$ in both countries, but, for a given interest rate, the demand for bonds is higher in the constrained economy because of the precautionary hoarding motive. As a corollary, the demand for long-term investment is lower, because less internal resources are available to $L$ entrepreneurs. In order to satisfy the equilibrium on the domestic bond market, the autarky interest rate has to be lower in $E$ than in $I$ so that the demand for bonds is discouraged. The corresponding level of short-term capital is higher in $E$ than in $I$ while the level of long-term capital is lower.

An important aggregate consequence of the binding financing constraint in the emerg-\textsuperscript{14} See Levine (2005) for a survey.
Figure 4: Investment under PFM and IFM

Equilibrium in the bond market

Investment in the Industrial country

Investment in the Emerging country
ing country is the over-accumulation of the short-term investment $k$. Because of financial market imperfections, it has to be used as a store for liquidity. At the aggregate level, because of the resource constraint of the economy, there is an under-accumulation of the long-term investment $z$.

### 4.2 Financial globalization

What is the effect of the possibility to trade bonds between countries on foreign assets, investment and production, from a comparative statics point of view? In order to answer this question, remember that Proposition 2 showed that $\tilde{r}^a < r^a$. Besides, under Condition 1, the aggregate demand for bonds, and thus the external position, are increasing in the Emerging country as well as in the Industrial country. Therefore, for the world bond market to clear, the world interest rate $r^w$ should lay between the two autarky interest rates. We should thus have: $\tilde{r}^a < r^w < r^a$. When capital markets integrate, the industrial country experiences a drop in interest rate and capital inflows while the emerging one experiences a rise in interest rate and capital outflows.

**Proposition 3** Effect of financial integration on investment: When financial markets integrate, under Condition 1, there is a unique solution where the constrained allocation is chosen in $E$ exists and this solution exhibits the following features:

- $I$ experiences a drop in the interest rate. Besides, $k$ and $z$ rise and $b$ becomes negative.

- $E$ experiences a rise in the interest rate. Besides, $k$ falls, $z$ rises and $b$ becomes positive.

The formal proof is provided in the appendix.

As for the effect of financial markets integration in the industrial country, the intuition is as follows: when financial markets integrate, the industrial economy experiences a drop in the interest rate, so the entrepreneurs take advantage of the new financing opportunities by increasing their debt and reallocating their resources in favor of the productive
investments. As for the effect of financial globalization in the emerging country, the mechanisms are different. The Emerging country experiences an increase in interest rate. This increase has a standard crowding-out effect on short term capital, but has a positive crowding-in effect on long-term capital, through the positive income effect discussed above: it becomes easier to secure the long-term investment.

In a nutshell, liquidity is relatively more expensive in the emerging country than in the industrial country. Therefore, when the bond market integrates, \( L \) entrepreneurs in the emerging country benefit from the lower international price of liquidity \( 1/r \) to increase their investment \( z \). Indeed, because of the financing constraint, liquidity and the long-term investment are complements in the emerging economy.

In the appendix, it is also shown that the condition \( \bar{w}(\bar{r}^a, \phi) < w < w^*(r^a, \phi) \), which rules out the first-best and risky allocations for \( r = \bar{r}^a \) in the developing country, is also sufficient to rule them out for \( \bar{r}^a < r < r^a \). Indeed, according to Proposition 1, for \( \bar{r}^a < r < r^a \), the condition \( \bar{w}(r, \phi) < w < w^*(r, \phi) \) holds.

The analysis of Figure 4 can now be complemented. Finally, while in the industrial country the long-term investment \( z \) is decreasing in \( r \) (as \( k \)), in the emerging one, it is increasing. This reflects the income effect described earlier. Any world interest rate between the two autarky rates would then imply a rise in debt and in both investments in \( I \) because their marginal return are higher than the world interest rate. In \( E \), investment in \( k \) decreases and \( b \) increases because the world interest rate is higher than the domestic one. In the meantime, \( z \) increases because of the positive wealth effect. Finally, the general equilibrium is fixed between the two autarky interest rates in order to satisfy \( b^I = -b^E \), leading to the result described in Proposition 3.

Finally, we can derive the consequences of integration on output by differentiating total production \( y = f(k) + g(z) \) with respect to \( r \):

\[
\frac{\partial y}{\partial r} = f'(k) \frac{\partial k}{\partial r} + g'(z) \frac{\partial z}{\partial r}
\]
After rearranging, we find that the effect on output can be decomposed into an aggregate investment effect and an investment composition effect:

$$\frac{\partial y}{\partial r} = f'(k) \frac{\partial (k + z)}{\partial r} + (g'(z) - f'(k)) \frac{\partial z}{\partial r}$$

The composition effect (second term) corresponds to the efficiency gains in the allocation of capital. It can be seen as a “TFP” effect, since it represents the effect on output that is not explained by the change in total investment $k + z$.

In the industrial country, both investments increase thanks to the decrease in the interest rate ($\partial r < 0$), but the investment TFP effect is absent because the allocation of investment is always efficient: $g'(z^*) = f'(k^*)$. As a consequence, production increases after financial markets integration:

$$\partial y^* = f'(k^*) \frac{\partial (k^* + z^*)}{\partial r} \frac{\partial r}{<0} + (g'(z^*) - f'(k^*)) \frac{\partial z^*}{\partial r} \frac{\partial r}{<0} > 0$$

In the emerging country, the impact of financial integration on production is ambiguous. The rise in the interest rate ($\partial r > 0$) implies a diminution in aggregate investment and an increase in efficiency:

$$\partial y = f'(\bar{k}) \frac{\partial (\bar{k} + \bar{z})}{\partial r} \frac{\partial r}{>0} + (g'(\bar{z}) - f'(\bar{k})) \frac{\partial z}{\partial r} \frac{\partial r}{>0} > 0$$

On the one hand, the industrial country experiences a deterioration of its external position which results in a current account account deficit. On the other, the aggregate TFP increases in the emerging country. This rise in TFP comes both from the diminution of the less productive investment and from the increase in the more productive one.

5 Conclusion

This paper has shown that the presence of financing constraints on the long-term technology in emerging markets can generate both capital outflows and TFP growth following financial integration. The latter is due to a better allocation of capital enabled by the
replacement of the short-term capital with external bonds in the portfolio of emerging countries. Indeed, since the developed world has better financial markets, its demand for liquid assets for hoarding purposes is lower than that of the developing countries; as a result, when financial globalization occurs, the emerging economies hold external bonds in order to use them as a buffer.

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6 Appendix

**Proof of Proposition 1**

(i) $z^*$ is independent of $w$ while $\bar{z}$ is increasing in $w$ with $\bar{z}(0,r,\phi) = 0$ and $\lim_{w \to +\infty} = +\infty$. Therefore, for given $(r, \phi)$, there exists a unique $w^*$ such that $\bar{z}(w^*, r, \phi) = z^*(r)$. Besides, for $w > w^*$, $\bar{z} > z^*$, so $\min \{z^*, \bar{z}\} = z^*$. $z^*$ is then the solution for $w > w^*$ according to the same argument as Lemma 1. This proves (i).

(ii) For $w < w^*$, $\bar{z} < z^*$, so the solution is either $\bar{z}$ or $z^{**}$. Consider $\Delta \pi(w, r, \phi) = \pi^*(\bar{z}(w, r, \phi)) - \pi^{**}(z^{**}(w, r, \phi)) = g(\bar{z}(w, r, \phi)) - rz(\bar{z}(w, r, \phi)) / 2 - rz^{**}(w, r, \phi)$. $\Delta \pi$ is continuous in $w$ with $\Delta \pi(0,r,\phi) = -[g(z^{**}(0,r,\phi)) / 2 - rz^{**}(0,r,\phi)] = 0$ and $\Delta \pi(w^*, r, \phi) = g(z^*(r)) - rz^*(r) - [g(z^{**}(w,r,\phi)) / 2 - rz^{**}(w,r,\phi)] > 0$. Therefore, for given $(r, \phi)$, there exists at least one value of $w$ such that $\pi^*(\bar{z}(\bar{w}, r, \phi)) = \pi^{**}(z^{**}(r))$. Define $w$ as the largest of these values:

$$\bar{w} = \sup \{w/\pi^*(\bar{z}(w, r, \phi)) = \pi^{**}(z^{**}(w, r, \phi))\}$$

Then, by continuity, $\Delta \pi(w, r, \phi) \geq 0$ for $\bar{w} < w < w^*$. This means that $\pi^*(\bar{z}(w, r, \phi)) > \pi^{**}(z^{**}(r))$, so the solution is $\bar{z}$ for $\bar{w} < w < w^*$. This proves (ii).

(iii) First, by definition, $w^*(r, \phi)$ is such that $\bar{z}(w^*, r, \phi) = z^*(r)$. Differentiating this equation with respect to $r$ and rearranging, we obtain:

$$\frac{\partial w^*}{\partial r} = \frac{\rho - \phi}{g''(z^*)} - \frac{(\rho - \phi)z^*}{r^2} < 0$$

since $g'' < 0$ and $\rho > \phi$.

Second, by definition, $\bar{w}(r, \phi)$ is such that $\pi^*(\bar{z}(\bar{w}, r, \phi)) = \pi^{**}(z^{**}(r))$. Consider the case where $\bar{z}^{max}(w, r, \phi) \neq g^{-1}(2r)$. Then this equation is differentiable. Differentiating it with respect to $r$ in the first case and rearranging, we obtain:

$$\frac{\partial \bar{w}}{\partial r} \frac{\partial \pi}{\partial \Delta \pi} = -\frac{\partial \Delta \pi}{\partial r}$$
In order to derive $\frac{\partial \bar{w}}{\partial r}$, we need to derive $\frac{\partial \Delta \pi}{\partial w}$ and $\frac{\partial \Delta \pi}{\partial r}$.

- $\frac{\partial \Delta \pi}{\partial w}$: For $z^{\text{max}}(\bar{w}, r, \phi) \neq g^{-1}(2r)$, $\frac{\partial \Delta \pi}{\partial w}$ is continuous. We can then establish that $\frac{\partial \Delta \pi}{\partial w} \geq 0$. Indeed, by definition of $\bar{w}$, $\Delta \pi$ is positive in the right neighborhood of $\bar{w}$.

- $\frac{\partial \Delta \pi}{\partial r}$: The expression of $\frac{\partial \Delta \pi}{\partial r}$ depends on the expression of $z^{**}$. There are two cases: $z^{**} = g^{-1}(2r)$ and $z^{**} = z^{\text{max}}$.

In the case where $z^{**} = g^{-1}(2r)$, we obtain:

$$\frac{\partial \Delta \pi}{\partial r} = (z^{**} - \bar{z}) + (g'(\bar{z}) + 1 - r) \frac{\rho - \phi}{(r + \rho - \phi)^2}$$

This derivative is strictly positive because $\rho > \phi$, $g'(\bar{z}) + 1 > r$ and $z^{**} > \bar{z}$. The first inequality is an assumption. The second inequality is due to the suboptimality of $\bar{z}$ for $z < z^{*}$. The third inequality is due to the fact that the risky allocation yields a lower expected output. To achieve the same profit, $z^{**}$ must indeed be strictly higher than $\bar{z}$. The following argument establishes this formally: $\pi^*(\bar{z}(\bar{w}, r, \phi)) = \pi^*(z^{**}(r))$ implies that $g(\bar{z}(\bar{w}, r, \phi)) - r\bar{z}(\bar{w}, r, \phi) = g(z^{**}(r))/2 - Rz^{**}(r)$. As a consequence, $g(\bar{z}(\bar{w}, r, \phi)) - R\bar{z}(\bar{w}, r, \phi) < g(z^{**}(r)) - rz^{**}(r)$. $g(z) - rz$ is increasing on $[0, z^{*}]$, so this inequality implies that $\bar{z}(\bar{w}, r, \phi) < z^{**}(r)$.

In the case where $z^{**} = z^{\text{max}}$, we obtain:

$$\frac{\partial \Delta \pi}{\partial r} = (z^{**} - \bar{z}) + (g'(\bar{z}) + 1 - r) \frac{\rho - \phi}{(r + \rho - \phi)^2} + (g'(z^{**}) + 1 - r) \frac{\phi}{(r + \rho - \phi)^2}$$

The two first terms are positive, following the same argument as before. The last term is also strictly positive due to the suboptimality of $z^{**}$ for $z^{**} = z^{\text{max}}$.

Therefore, $\frac{\partial \Delta \pi}{\partial r} > 0$.

As a result, $\frac{\partial \bar{w}}{\partial r} \leq 0$ for all $r$ such that $z^{\text{max}}(\bar{w}, r, \phi) \neq g^{-1}(2r)$. This is the case almost everywhere, which implies that $\bar{w}$ is decreasing in $r$. 

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Proof of Proposition 2

Assume first that the constrained allocation holds under IFM. The constrained economy has an excessive demand for bonds: $\bar{b}(w, r, \phi) > b^*(w, r)$. By definition of $r^a$, $b^*(w, r^a*) = 0$. Therefore, a constrained economy would have a positive net demand for bonds with $r = r^a$: $\bar{b}(w, r^a, \phi) > 0$. Since the autarky interest rate $\bar{r}^a$ is such that $\bar{b}(w, \bar{r}^a, \phi) = 0$, then we have $\bar{b}(w, r^a, \phi) > \bar{b}(w, \bar{r}^a, \phi)$.

Under Condition 1, $\partial \bar{b}/\partial r > 0$. Therefore, the autarky interest rate in a country with the constrained allocation is lower than the first-best one $\bar{r}^a < r^a$. The constrained allocation does constitute an autarky equilibrium since $\bar{r}^a < r^a$ implies that $\bar{w}(\bar{r}^a, \phi) < w < w^*(\bar{r}^a, \phi)$, according to Proposition 1.

Besides, since $\bar{r}^a < r^a$ and $f'(k) = r$, then $\bar{k}^a > k^a$. Finally, since $z^a = 2w - k^a$, then $\bar{z}^a < z^a$.

Proof of Proposition 3

Assume first that $\bar{w}(r^w, \phi) < w < w^*(r^w, \phi)$, so entrepreneurs are constrained under financial integration in the Emerging country.

$b^*$, the demand for bonds in the industrial country, is increasing in $r$. Under Condition 1, the demand for bonds is also increasing in $r$ in the emerging country. Besides, $\bar{b} > b^*$. Therefore, for $r < \bar{r}^a$, both $b^*$ and $\bar{b}$ are negative. For $r > r^a$, both $b^*$ and $\bar{b}$ are positive. For $\bar{r}^a \leq r \leq r^a$, $b^* \leq 0$ and $\bar{b} \geq 0$, so, if there exists a solution $r^w$ verifying $b^*(r^w) = -\bar{b}(r^w)$, it is necessary in the $[\bar{r}^a, r^a]$ interval. Such a solution exists and is unique because $\partial b^*/\partial r$ is strictly positive and $\partial - \bar{b}/\partial r$ is strictly negative under Condition 1.

Now, we can show that for $r = r^w$, the condition $\bar{w}(r^w, \phi) < w < w^*(r^w, \phi)$ is satisfied, so the credit constraint is still binding in the emerging economy. Since $\bar{w}$ is decreasing in $r$ and $r^w > \bar{r}^a$, then $\bar{w}(r^w, \phi) < \bar{w}(\bar{r}^a, \phi)$. Similarly, since $w^*$ is decreasing in $r$ and $r^w < r^a$, then $w^*(r^w, \phi) > w^*(r^a, \phi)$. Therefore, IFM implies that $\bar{w}(r^w, \phi) < w < w^*(r^w, \phi)$.

As a conclusion, there is a unique solution with a binding financing constraint in the emerging markets and it is characterized by an interest rate $r^w$ in the $[\bar{r}^a, r^a]$ interval.
Consider this equilibrium solution. Since the industrial economy experiences a drop in the interest rate when financial markets integrate, $k^*$ and $z^*$ rise and $b^*$ decreases. Since the emerging economy experiences a drop in the interest rate when financial markets integrate, $\bar{k}$ falls while $\bar{z}$. Additionally, since Condition 1 is satisfied, $\bar{b}$ rises.