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COOPERATIVES VS TRADITIONAL BANKS: THE IMPACT OF INTERBANK MARKET EXCLUSION

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Cooperatives vs Traditional Banks: The impact of Interbank Market Exclusion

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Abstract

In this paper, we analyze the desirability of allowing cooperative banks to participate in the interbank market in Chile. We find that it is desirable, as long as the quality of the cooperative's governance is not too deficient relative to traditional commercial banks. On the one side, when cooperative banks do participate in the interbank market, both, the probability of financial crisis and the volatility of GDP, raise; but on the other, because the cooperative's inclusion generates large efficiency gains in the financial sector, GDP and aggregate welfare substantially increase. We conclude that there is no policy reason to exclude cooperatives from the Chilean interbank market.

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1. Introduction

The literature addressing bank regulations is extensive, but most of it takes all banks as homogeneous legal entities. However, there is a large spectrum of organizational structures. In particular, around 10% of Chilean's financial institutions are organized as cooperative banks. Because of their different legal status, they are not allowed to participate in the interbank market and, as a result, they do not have access to the Lender-of-Last-Result function (LOLR) of the Central Bank either. The purpose of this paper is to analyze and quantify the implications of this exclusion in terms of financial stability and welfare.

To fix ideas, it is useful to understand the main difference between commercial banks and cooperative banks. Commercial banks are mostly corporations (privately owned companies) with limit liability. That means, 1) that the goal of commercial banks is to maximize value and 2) that in general banks are owned by a set of shareholders with voting power (managing power) closely related to the proportion of shares that the shareholder has. In contrast, cooperative banks, 1) do not have as their main goal to maximize either value or profits; instead, they seek to satisfy the needs of a well-defined group and, 2) each member of a cooperative bank has the same voting power independently of the shares that the member owns.

At first sight, since the main goal of these two kinds of banks seems very different, one may think that profit maximization is a key difference. However, because cooperatives must still achieve efficiency to survive and being able to provide their services, there is no much difference in every day's behavior. As a result, the key element that in general worries regulators is the different organizational structure and it implications for accountability. To be concrete, it is argued that because corporations have a concentrated structure, and large shareholders have much at stake, the governance tend to be of good quality. In contrast, in cooperatives the power is atomized, each shareholder has one vote independently of the number of shares, and every shareholder has less at stake. This reduces management's accountability and may lead the cooperative bank to pursue objectives that would compromise financial stability. In this paper, we will not dispute this statement, we will take it as a face value to analyze if this potential drawback is enough to exclude cooperative banks from the interbank market (IM).

The access to the IM has two implications for cooperative banks. The first, and operative one, is that through the IM cooperative banks can borrow and lend from and to other banks on a daily basis in an efficient way. For instance, cooperative banks can allocate (lend) excess of funds at a convenient interest rate, when they have excess liquidity, and can also borrow, whenever they need liquidity. Otherwise, they'll need to borrow from in the retail market, which is more expensive, or keep the excess of funds at zero or very low returns. Second, once cooperative banks have access to the IM they can also obtain loans from the Central Bank; that is, they can obtain funds from the LOLR. These two functions of the IM are connected and are difficult to disentangle.

However, when it comes to the LOLR property of the IM, the potential risks are unclear. Since the Central Bank (CB) still retains the discretionality of the LOLR, this matter is conceptually simple. The CB can always deny additional funds to any bank if it suspects of any wrongdoing. In addition, cooperative banks are subjected to the same rules, regulations and monitoring as any other bank, thus the CB should be as able detecting misconducts performed by cooperatives as by traditional banks. Finally, cooperatives are well integrated with the rest of the financial sector, so any argument that justifies using the LOLR function to aid commercial banks, also applies to cooperative banks. In short, should the CB be allowed to lend to cooperatives? The answer is affirmative: the CB can always choose not to lend. Binding itself ex-ante to not doing it, implies only costs, with no benefits.

Even if cooperative banks are allowed to access to the LORL, there is a less obvious question: should cooperatives be allowed to participate in the IM? For two reasons the answer to this question is not obvious.

On the one hand, it generates a better allocation of resources and better liquidity management, but on the other hand, it can affect the normal functioning of IM and increase the probability of financial crisis. Precluding the access to IM implies that cooperative banks cannot borrow from other banks when "good" projects arise and they don't have enough funds to finance them. Also, cooperatives could lend to other financial institutions, when they don't have good opportunities but other banks do. Finally, as we mentioned before, the IM allows for a more efficient liquidity risk management, otherwise, they must horde large and inefficient amounts of liquidity.

However, the access to IM may increase the probability and impact of a financial crisis. When cooperatives participate, the IM becomes larger and therefore facilitates the expansion of credit in situations in which there is over borrowing. Also, it can disrupt to normal functioning of the IM if cooperatives face more serious moral hazard problem than other financial institutions.

To address these issues, we build on Boissay et al (2016), adding idiosyncratic liquidity shocks and two types of banks: those that can participate in the IM and those which cannot. This is a general equilibrium model with, 1) consumers-savers, 2) corporate sector (production) and 3) financial sector. The consumers hold the capital in the economy and are the only one who can accumulate financial assets. The production is carry over by the firms, which cannot hold capital, and therefore, must borrow to be able to produce. However, the consumers cannot directly lend to the firms either, as they must use financial intermediaries. Here is where banks play an important role: banks borrow from the consumers and lend to the firms.

Banks are heterogeneous in two dimensions, one exogenous and due to nature, the other determined by regulation. First, some banks are "more efficient" than others intermediating, in the sense that less physical resources are needed to produce intermediation services. In addition, banks can borrow and lend to each other in an interbank market. This market is instrumental to smooth liquidity shocks and reallocate resources to other banks if there is a mismatch between banks that have bad/good business opportunities and the availability of funds. The key element of the model is that there are two main types of banks, normal banks that can participate in the IM, and cooperative banks, which cannot. Our main goal is to analyze how the equilibrium is reshaped when we allow all banks to participate in the IM.

To this end, we calibrate the model to replicate important moments of the Chilean economy. The main moments that we target are: the intermediation spread, the probability of a financial crisis, the capital output ratio, the relative efficiency of cooperatives intermediating financial services and the relative size of the IM market. We also calibrate the model to replicate other business cycle properties of the Chilean economy, although less relevant for the question that we are trying to answer.

Once we have calibrated the economy we perform a series of counterfactual experiments. First, we assume that both, cooperative and commercial banks, are characterized by the fundamental parameters, i.e., there is not observable difference between them in terms of either efficiency or moral hazard problems, and we grant access to most financial intermediaries to the IM market. The purpose of this exercise is to isolate the pure general equilibrium effects of increasing the IM market. We find, as expected, that both the probability of financial crisis and the volatility of output increase. At the same time, however, average output, aggregate consumption and welfare increase. That is, even though grating access to the IM market to cooperatives has some negative effects, overall welfare improves. In numbers, despite the increase from 1.93% to 2.43% in the probability of a financial crisis, average output and aggregate welfare increases 0.05% and 1.6%, respectively.

Next, we incorporate the fact that cooperatives are on average more efficient and we assess how different strength of the moral hazard problem affect the outcomes. There are many reasons to believe that cooperatives could be more efficient providing intermediation services. First, cooperatives tend to have niche strategies, they focalized on some markets to the point where they can better assess the risk profile of the potential clients. Second, cooperative banks have the feature, by law, of being able to retrieve a larger fraction of the loans installments payments directly from the paycheck of the clients (25%, instead of the 15% that traditional banks may to retrieve). Regarding the moral hazard problem, as we mentioned before, we don't have a direct measure of the deepness of the problem for cooperatives respect to commercial banks. Thus, we take as a given, that cooperatives are always worst in this dimension and show how the equilibrium outcomes vary as we continuously worsen the deepness of the problem for cooperatives relative to the other banks.

As expected, if cooperatives are subject to exactly the same moral hazard problems as the other banks, the welfare gains of granting access to cooperatives become only bigger. There are two contributing factors to the improvement. On the one hand, there are some cooperatives that are very efficient, since, on average, they are more efficient than the rest of the banks. The reason, as already mentioned, is that they could finance very good projects, but are not able to do it due to their limited funding capacity. To finance the good projects, these efficient cooperatives would have to borrow from other banks, at an interest rate that is too high for them render it worth it, and therefore they just lend the deposits that they receive. Instead, when they are granted access to the IM market, the efficient cooperatives can borrow from other less inefficient banks/cooperatives at a convenient interest rate, increasing the supply of loans to the private sector. Also, cooperatives that cannot find good business opportunities benefit from the IM market. Without the access to the IM the less efficient cooperatives must keep their funds on very inefficient, low return, financial instruments. Instead, when they have access to the IM they can lend those funds to other banks that can make a better use of it. All in all, the crisis probability falls to 1.45%, the GDP increases and additional 0.75% and welfare an extra 0.47%.

When we take into account the heterogeneity in the moral hazard problems, the desirability of grating access to the IM becomes less obvious. Here the effect stems from the negative externality that the cooperative's moral hazard problems impose on the other banks through the IM. For this effect, it is important to keep in mind that the quality of the banks participating in the IM is private information, and therefore, not observed by other participants. Thus, if cooperatives are "worst" than other banks, their participation lowers the average quality of the borrowers in the IM, which in turn diminishes the willingness of the lenders to provide funds. The presence of some lower quality borrowers, since the quality is not perfectly observed, affects the ability of all banks to borrow in the IM. As a result, fewer banks become lenders and the size of loans decreases. In the extreme, if the new participants are sufficiently bad, the IM completely shut down. However, we show that for reasonable values, the potential severity of the moral hazard problems by cooperatives it is insufficient to generate welfare loses. It is still optimal to grant cooperatives the access to the IM market.

The following section presents the model and its general equilibrium solution. Then, Section 3 simulates the alternative economies, one with cooperative bank restricted and another with all financial institutions having access to the interbank market. Finally, Section 4 concludes.

2. Model

There is a representative consumer that consumes and saves by depositing her unspent resources in the financial sector. The financial sector is composed of two types of financial intermediaries: traditional banks and cooperatives banks. From now on we will refer to the former as just banks and to the latter as cooperatives. The main difference between them is that banks can participate in the interbank market, while cooperatives cannot. We also consider other differences that are not defining characteristics. For instance, we'll allow for one type of intermediary to be more efficient than the other, and/or, one to be subject to stronger moral hazard problems than the other. We will discuss these possibilities later and show the quantitative implications of it.

The financial sector lends the deposits from the consumers to a representative firm with standard Cobb-Douglas production function:

$$y = k^{\alpha}h^{1-\alpha} + (1-\delta)k$$

Where k is aggregate capital, h is the total supply of labor and δ is the capital's depreciation rate. Notice that under this framework the financial sector does not provide important services as insurance, consumer credit, etc. Therefore, we interpret the production function as encompassing the value of all these services.

2.1 The Financial Sector

To model the financial sector, we build on Boissay et al (2016). We first describe the equilibrium with only traditional banks and then we show how the presence of cooperatives alters the framework.

There is a continuum of banks indexed by $p \in [0,1]$. From now on p will represent the bank's efficiency. Bank's types are distributed with cumulative distribution $\mu(p)$, with $\mu(0) = 0$, and $\mu(1) = 1$. All banks are ex-ante identical, and they only live for one period. Thus, we can interpret p as the type of the project rather than the type of bank. That is, each time that a bank receives a potential lender, she comes with an inherent "intermediation" cost. This cost could represent not only physical costs associated with the lending process but also with cost incurred in the loan recovering process. It is important to consider that the spread between the borrowing and lending rates are not only determined by p but also by the liquidity cost.

The timing of activities in the financial sector is as follows:

1. Banks are born in period $t-1$ and receive deposits a.
2. They observe the idiosyncratic shock p, and lend to the corporate sector with return R.
3. With probability π some banks loose ϵ deposits and with probability $1-\pi$ other banks receive extra deposits ϵ.
4. Banks can operate in the interbank market, where they borrow and lend at rate ρ
5. At the end of period t all banks die.

Because banks are ex-ante identical, when the consumer deposits the quantity a there is no difference across banks, so all banks receive the same amount of deposits. Since the parameter p determines the efficiency of the bank, a proportion $(1-p)R$ of the loan must be used to pay for the intermediation cost. Thus, the net return on a loan is $p\,R$.

Banks also have an outside option, they can always invest in a project that yields a gross return γ independently of the state of the economy and independently of p. We will refer to this outside option as "storage", although it could have alternative interpretations, for example, in terms of subprime lending. This storage technology will play an important role in the working of the banking sector.

Absent liquidity shocks, bank (project) heterogeneity gives rise to an intra-periodic interbank market, where the least efficient banks lend to the most efficient ones at gross rate ρ. In equilibrium, this rate must be lower than the corporate loan rate, R. Similarly, the interbank rate ρ must be bigger than the return on storage, γ; otherwise no bank would lend to other banks. It follows that in equilibrium it must be that $\gamma < R$. In other words, storage is an inefficient technology. Point 3) of the timing is an extension respect to the original timing in Boissay et al (2016). In this way, we extend the reallocation function of the interbank market to serve also as market for liquidity provision for financial institutions. As we'll see later both components and their interaction play an important role generating inefficiencies when the cooperatives are excluded from the interbank market. Instead, because banks can participate in the interbank market, the presence of a liquidity shock is inconsequential for them.

Banks take the rates ρ and R as given. Given these rates, and after receiving the liquidity shock ϵ, bank p decides whether, and how much, it borrows or lends. We will call the banks that supply funds on the interbank market the "lenders" and those that borrow the "borrowers." This terminology can lead to a confusion when we consider the corporate sector. To avoid misunderstanding, the reader should keep in mind that "lenders" only lend to other banks, while "borrowers" borrow from other banks and lend to the corporate sector. The corporations only borrow from banks.

Let $\phi \geq 0$ be the endogenous, and publicly observable, amount borrowed on the interbank market per unit of original deposit (that is per unit of deposit before the liquidity shock is reveled) by a borrower p. Since ϕ is the ratio of market funding to traditional funding, we will refer to it as banks' "market funding ratio."

Recall that banks choose how much to lend to the private sector before knowing the liquidity shock. Given the quantity lent, if a bank receives a bad liquidity shock, it borrows from the interbank market, while if it gets a good liquidity shock it lends. Thus, if it decides to exhaust the borrowing capacity, bank p's gross unit return on deposits is equal to:

$$p\,R(1+\phi)\ -\rho[\,\pi\,(\phi+\epsilon)+\ (1-\pi)\,(\phi-\epsilon)]$$

If instead bank p decides to lend to other banks receives a return to $\rho\,(\pi(1-\epsilon)+(1-\pi)(1+\epsilon))$. Denoting the gross return on deposits by $r(p)$, one therefore gets

$$r(p) = max\,\{p\,R(1+\phi)\ -\rho[\phi+\ (2\pi\ -1)\epsilon], \rho\,(1+(1-2\pi)\epsilon)\} \qquad (1)$$

A bank chooses to be a borrower when:

$$p\,R(1+\phi) - \rho[\phi + \,(2\pi\, - 1)\epsilon] \geq \rho\,(1 + (1 - 2\pi)\epsilon) \Longrightarrow \,p \geq \,\overline{p}\, = \frac{\rho}{R}$$

Which is the same as in Boissay et al (2016).

As in Boissay et al (2016) we assume that the proceeds of the storage technology are not traceable and cannot be seized by creditors. Therefore, interbank loan contracts are not enforceable and banks may renege on their interbank debt by walking away from the lenders. A bank that walks away with $(1\, + \epsilon\, + \phi)a$ and invests in the storage technology gets $\gamma(1 + \theta(\epsilon\, + \phi))a$ as payoff, where $\theta \in\, [0, 1]$ captures the cost of walking away from the debt (the higher θ, the lower this cost).

Banks' intermediation skills (p) are privately known, and lenders can neither observe them ex ante nor verify them ex post. Lenders therefore ignore borrowers' private incentives to divert funds. As a result, the loan contracts signed on the interbank market are the same for all banks and neither the market funding ratio (ϕ) nor the interbank rate (ρ) depends on p.

Lenders want to deter borrowers from diverting. They can do so by limiting the quantity of funds that borrowers can borrow so that even the most inefficient banks with $p\, < \,\bar{p}$ - those that should be lending - have no interest in demanding a loan and diverting it:

$$\gamma(1 + \theta(\phi + \epsilon)) \leq\, \rho\,(1 + \epsilon); \quad for\ banks\ with\ high\ liquidity$$

$$\gamma(1 + \theta(\phi - \epsilon)) \leq\, \rho\,(1 - \epsilon); \;\; for\ banks\ with\ low\ liquidity$$

Notice that the above are computed ex-post. We want to prevent the banks from diverting after observing the liquidity shock. The last determine the borrowing capacity of each bank, which is:

$$\phi = \frac{\rho(1+\epsilon)-\gamma}{\theta\gamma} - \epsilon \;\; ; \quad for\ banks\ with\ high\ liquidity \;\; (2.1)$$

$$\phi = \frac{\rho(1-\epsilon)-\gamma}{\theta\gamma} + \epsilon \;\; ; \quad for\ banks\ with\ low\ liquidity \quad (2.2)$$

Here is important the observational assumptions about the liquidity shock. If the liquidity shock is publicly observed then we'll have two debt limits, one for each type of bank. If the liquidity shock is not observable, that is, private information, we can always choose the tighter one and that would make it incentive compatible for all banks. Since the maximum debt limit should incentive compatible for all types of banks we choose the smallest between (2.1) and (2.2), which is 2.2 as long as $\rho > \gamma$ and $\theta < 1$. Therefore, the funding ratio is:

$$\phi = \frac{\rho(1-\epsilon)-\gamma}{\theta\gamma} + \epsilon \quad (2)$$

In addition, since we are interested in equilibria with $\phi > 0$, we impose the additional restriction:

$$\epsilon \leq \frac{\rho - \gamma}{\rho - \theta\gamma}$$

2.2 Equilibrium

The equilibrium of the interbank market is characterized by the gross interbank rate ρ that clears the market. We look for an equilibrium in which the interbank rate exceeds the return on storage ($\rho > \gamma$) so that trade takes place. Since a mass $\mu(\bar{p})$ of banks lend and the complement $1 - \mu(\bar{p})$ of banks borrow ϕ per unit of deposit, the market clears when:

$$a\,[\pi\,\mu(\bar{p})(1-\epsilon) + (1-\pi)\mu(\bar{p})(1+\epsilon)] \\ = a\,[\pi(1-\mu(\bar{p}))(\phi+\epsilon) + (1-\pi)\big(1-\mu(\bar{p})\big)(\phi-\epsilon)\,]$$

Using the threshold definition and (2)

$$\mu\left(\frac{\rho}{R}\right)[\pi\,(1-\epsilon) + (1-\pi)(1+\epsilon)] = \left(1-\mu\left(\frac{\rho}{R}\right)\right)[\pi\,(\phi+\epsilon) + (1-\pi)(\phi-\epsilon)]$$

Now, notice that we don't want to have aggregate effects of the liquidity shock, that is, we want $-\pi\epsilon + (1-\pi)\epsilon = 0$, which immediately implies $\pi = \frac{1}{2}$. Alternative we would assume that the negative shock $abs(-\epsilon_L) \neq \epsilon_H$. This would allow us to have $\pi \neq \frac{1}{2}$, but for the time being assume $\pi = \frac{1}{2}$. Then we have:

$$\mu\left(\frac{\rho}{R}\right) = \left[1-\mu\left(\frac{\rho}{R}\right)\right]\phi \quad (3)$$

Then:

$$\mu\left(\frac{\rho}{R}\right) = \frac{\phi}{1+\phi}$$

Therefor the equilibrium interest rates are determined by:

$$R = \frac{\rho}{\mu^{-1}\left(\frac{\phi}{1+\phi}\right)} \tag{4}$$

Since, ϕ depends on ρ, equation (4) determines the equilibrium mapping between R and ρ. We later show that the presence of the liquidity shock does not affect the qualitative properties of the equilibrium mapping of the original model.

As in Bossai et al (2016) there will be two equilibria, one in normal times and one with market freezing in bad times (we need to analyze that). The return on deposits is:

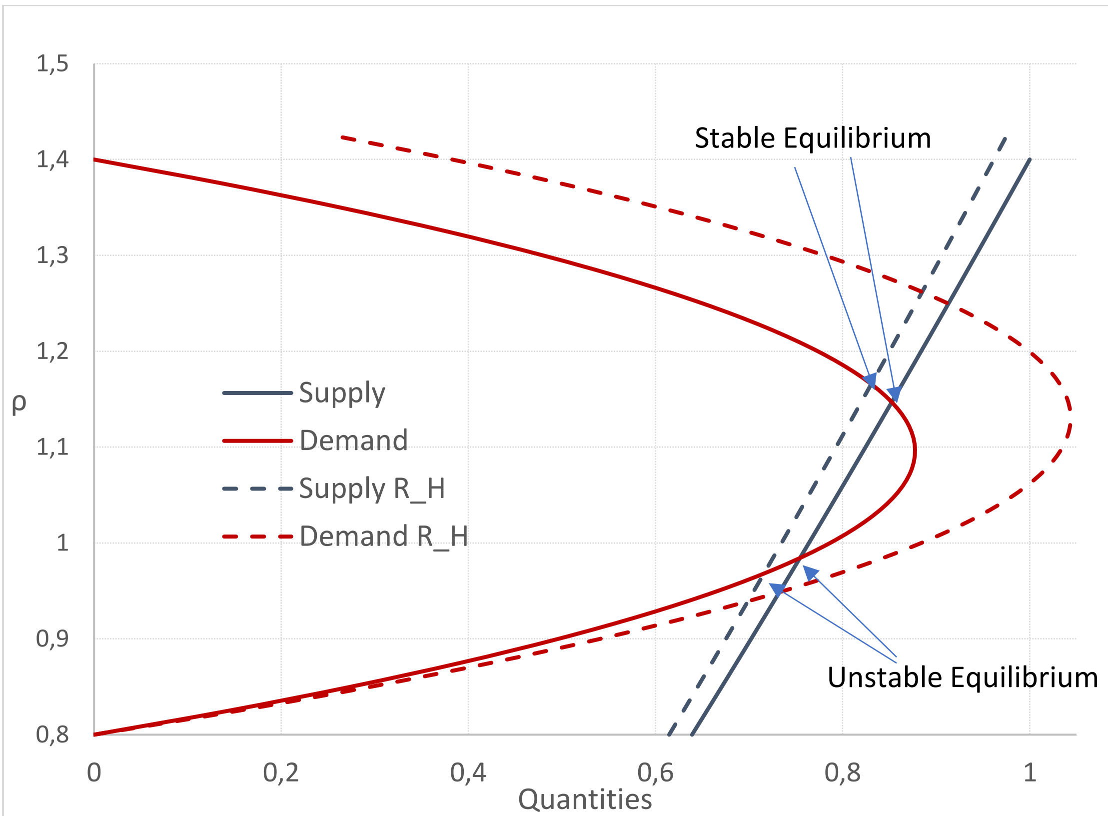
$$r = \int_0^1 r(p)d\mu(p)$$

Using (1)

$$r = \begin{cases} \mathrm{R} \displaystyle\int_{\bar{\mathrm{p}}}^{1} \frac{p}{1-\mu(\bar{\mathrm{p}})}\, \mathrm{d}\mu(\mathrm{p})\,, & \textit{if the interbank works} \\ \mathrm{R}\left[\dfrac{\gamma}{R}\mu\left(\dfrac{\gamma}{R}\right) + \displaystyle\int_{\frac{\gamma}{R}}^{1} \mathrm{p}\, \mathrm{d}\mu(\mathrm{p})\right], & \textit{otherwise} \end{cases}$$

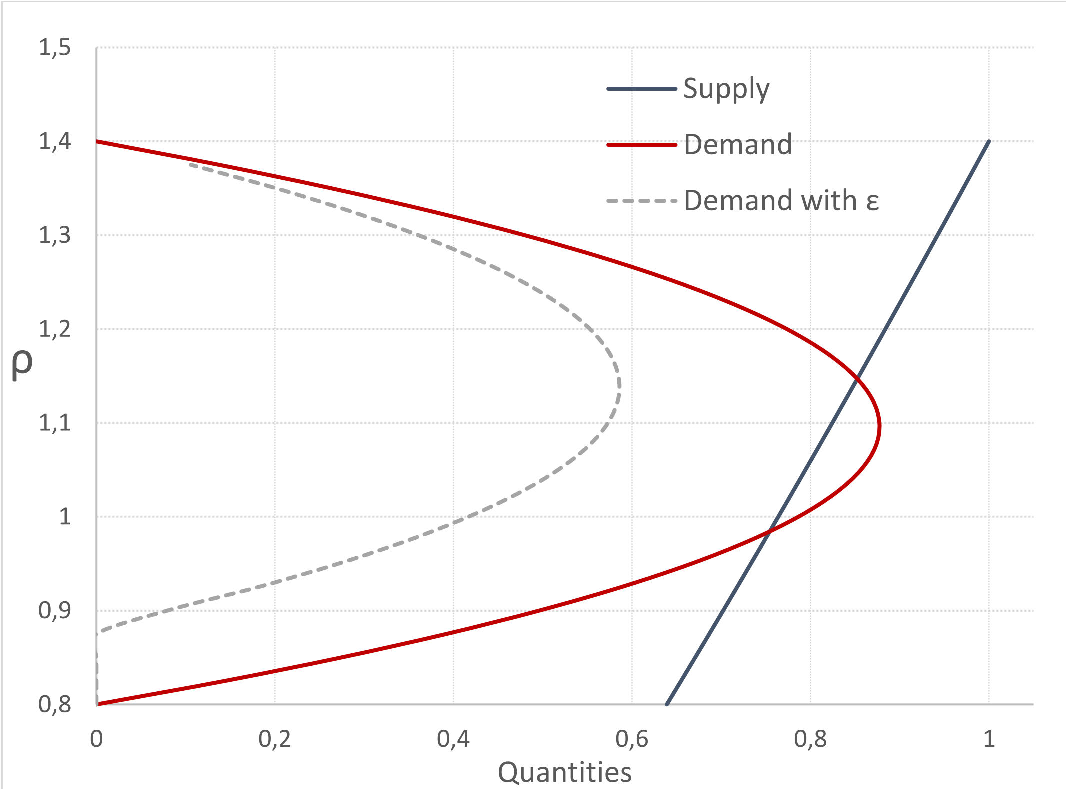
It is important to analyze the equilibrium behavior arising from equation (3). The mechanism the same as in Bossai (2016), which is sketch in Figure 1. There we plot the equilibrium interbank market rate, ρ, as a function of the aggregate demand and supply of funds, for a given interest rate R. First focus on the continuous lines. The straight line is the supply of fund, which corresponds to the left hand side of equation (3), while the curve that bends backwards is the demand of funds, the right hand side of equation (3). The reason why the demand of funds bends backwards is because of the interaction between the extensive and intensive margin of the demand. As the interbank rates increases the demand for fund decreases, more banks decide to switch from borrowers to lenders. This is given by the term $1-\mu\left(\frac{\rho}{R}\right)$. But at the same time, as the interbank rate increases, the borrowers are able to borrow more (intensive margin), which is capture but the increase in ϕ. For high ρ's the extensive margin dominates and therefore the demand has a standard negative slope. However, for low interest rates, the intensive margin dominates, which generates an upward sloping demand curve.

Figure 1



This shape of the demand curve has two important implications. First, as we can see in Figure 1, there are potentially two equilibrium interest rates. However, as shown in Bossai et al, the equilibrium in the region where the demand curve is upward sloping is unstable. Thus, from now on we focus only on the stable equilibrium. Second, notice that the curves do not need to intersect. If they intersect or not, depends on the value of R. To see this, in figure 1 we have plot the same supply and demand but with a higher corporate loan's rate R_H. As we can see this generates a larger demand for loans and a smaller supply (dashed lines), which in turn increased the interbank market rate. As the interest rate on loans to the corporate sector increases, more banks want to lend to the firms, which generates a switch from the lending to the borrowing side in the interbank market.

Figure 2



This effect is intuitive and clear, but a more important feature is that as R decreases, both the interbank rate and the funding ratio decrease, to the point that eventually the curves no longer intersect. At this point, the interbank market freezes, ρ collapses to γ and there is no more borrowing and lending in the interbank market $\phi = 0$. In this case, there is financial crisis. This is an important feature of the model that generates cyclical crisis. The dynamics in generally are the following. As economy is shocked by successive positive TFP shocks, the private sector accumulates capital and the production also increases. Despite the accumulation of capital, because R is increasing in TFP, the returns in the private sector also increase. As a result, the interbank market expands. There is a virtuous cycle of savings-lending and production. In other words, a lending boom. Notice, however, that the accumulation of capital tends to decrease R, the only reason why it does not fall is because the direct effect due to the increase in productivity more than compensates the indirect effect due to the accumulation of capital (recall that the technology exhibits decreasing returns on each factor). Nevertheless, R becomes more sensitive to shock on TFP, in the sense that smaller changes to TFP can drive R below the threshold below which the interbank market freezes. Indeed, that is the mechanism generating financial crisis in this economy: after long periods of growth and lending booms, the financial sector becomes more sensitive to reversions on the business cycle. Eventually, the economy is hit by a negative shock and the financial markets collapse.

It is key for this mechanism the “savings glut” generated positive productivity shocks, which is exacerbated by interbank market. This generates and important trade off, the more efficient the interbank market, the larger the GDP, but the more sensitive the economy to negative shocks.

This mechanism is the same as in Bossai et al (2016), the addition of the liquidity needs does not alter the main mechanism. This can be seen in Figure 2, where we plot the net demand with $\epsilon = 0$, (the continuous line) and the net demand with $\epsilon > 0$ (the dashed line). We can see that the possibility of liquid shocks does not affect the qualitative implications of the model, only the average demand for funds decreases, but everything else remains the same.[2] This changes the way in which we have to calibrate the economy only.

2.3 Equilibrium with cooperatives

Suppose that a proportion λ of financial intermediaries, which share the same features of traditional banks, do not have access to the interbank market. The timing for cooperatives is the same as for banks, the only difference is the lack of access to the interbank market. They can still borrow and lend when they have liquidity shocks, but they do so borrowing from the other banks paying the same rate as the productive corporate sector. That is, they must pay the interest rate R instead of ρ. In addition, because they cannot lend in the interbank market, all funds not lent to the private sector are kept in the “vaults”, so they obtain the return on the storage technology, γ_c. This rate could be equal to γ but for the time being we keep it different.

This fact has two implications. First, recall that cooperatives lend after knowing the efficiency shock, but before knowing the liquidity shock. If the cooperative does not meet the needs generated by the liquidity shock it fails, and failing is not an option.

Given efficiency p, when the cooperative decides how to allocate the funds, it would not leverage, that is, ϕ_c =0. This follows from the fact that when the cooperative borrows, it must pay R, while the return on any loan to the corporate sector is $p\ R$, which delivers a net return $(p-1)R < 0$. Thus, cooperatives do not leverage. The question is whether the cooperative would borrow the maximum amount or resources that it could get, or less than that.

The cooperative has four options: 1) not to lend anything to get a return γ_c for the deposits. 2) To lend only $(1-\epsilon)$ and avoid borrowing in the case of a bad liquidity shock. 3) To lend only the deposits that it received and borrow in case of a bad liquidity shock and 4) To borrow $(1+\epsilon)$ and bet that with probability $1-\pi$ it could receive extra funds due to a good liquidity shock.

The returns per unit of deposit are, respectively:

[2] When liquidity shocks are absent, ϕ represents the individual and average demands for funds in the interbank market. However, when $\epsilon > 0$, the average demand for funds is still ϕ, but the individual demand is $\phi + \epsilon$ for some banks and $\phi - \epsilon$ for other banks.

1. γ_c
2. $p\,R(1-\epsilon) + 2(1-\pi)\epsilon\,\gamma_c$
3. $p\,R - \pi\,\epsilon\,R + (1-\pi)\epsilon\,\gamma_c$
4. $p\,R(1+\epsilon) - 2\pi\epsilon\,R$

The above assumes that when the cooperative keeps funds without lending to the private sector, they generate the return of the storage technology. For instance, in the second case if the cooperative is hit by a bad liquidity shock it loses ϵ deposits, but since it lent only $1-\epsilon$ it has ϵ left in the vault to compensate, and they cancel out. In the case in which the cooperative observes a good liquidity shock, with probability $1-\pi$, it receives extra ϵ funds. Since already has ϵ in the vault, it remains with 2ϵ, that when using the storage technology generate a return of γ_c.

In the third case the cooperative lends all the deposits that originally has and decides to borrow if the bad liquidity shock arrives. Thus, with probability π the bad shock arrives and it must borrow ϵ at the rate R to pay for it (notice that banks in this case pay only $\rho < R$). With probability $1-\pi$ the good shock arrives and the cooperative is left with ϵ extra funds that then generate the return of the storage technology. The last option can be constructed using these arguments.

Since the returns on each case are linear in p, it is easy to see that there would be some intervals for p with ranges where the cooperative would take different decisions. It is straightforward to show that the following happens (recall that $\pi = \frac{1}{2}$):

1. If $p \in \left[0, \frac{\gamma_c}{R}\right]$ the cooperative keeps everything on storage. *Option 1.*
2. If $p \in \left[\frac{\gamma_c}{R}, \frac{\gamma_{c+R}}{2R}\right]$ the cooperative lends only $(1-\epsilon)$ and keep ϵ on storage. *Option 2*.
3. If $p \in \left[\frac{\gamma_{c+R}}{2R}, 1\right]$ the cooperative lends all its potential $(1+\epsilon)$ and it borrows in case of a bad liquidity shock. *Option 3.*

This choice of strategies allows us to assess the difference with banks that have access to the interbank market. First, the cooperatives with poor opportunities (low p) allocate the funds out of the private-corporate market lending. So, these resources never reach the production sector. In contrast, the banks that have access to the interbank market lend to other banks when p is low. Thus, they pass the resources to other banks which are more efficient (they have better opportunities) and in that way the resources eventually make it to the right agents.

Second, cooperatives with intermediate p do not lend at their full capacity. They are afraid that a bad liquidity shock could arrive, in which case they would have to pay a high lending rate R, and therefore keep some resources in storage. This do no happen with banks that have access to the interbank market since they can borrow at a lower interest rate $\rho < R$, if needed it. These are two sources of inefficiencies that arise due to the lack of access to interbank market.

Notice here that there is an interaction between the two functions that interbank market serves. First, the fact that cooperatives do not have access to the interbank market has a *direct effect*. When cooperatives do not have good "opportunities" they are forced to store the assets with the inefficient technology γ_c. Thus, those funds never reach the corporate sector. Instead, banks can transfer the assets to other banks, which in turn lend it to the corporate sector. Second, there is also an *indirect effect*. Because cooperatives do not have efficient means to hedge the risk of liquidity shocks, they lend to the corporate sector less than it would be efficient, keeping some funds as a buffer stock.

Finally, only the cooperatives with very high p use their full lending capacity $(1+\epsilon)$, which still could be less than the bank with equivalent efficiency when it has access to the interbank market if $\epsilon < \phi$. Nevertheless, because they must borrow at a very high interest rate R when they have liquidity issues, the return that they pay to the depositors must be necessarily smaller.

In short, the return on deposits for cooperatives is:

$$r = R\left[\frac{\gamma_c}{R}\mu^c(p_0) + \int_{p_0}^{p_1} p(1-\epsilon)d\mu^c(p) + \int_{p_1}^{1} p(1+\epsilon)d\mu^c(p) + 2(1-\pi)\epsilon\left(\frac{\gamma_c}{R}\right)[\mu^c(p_1) - \mu^c(p_0)] - 2\pi\epsilon\,[1-\mu^c(p_1)]\right]$$

where $p_0 = \frac{\gamma_c}{R}$, $p_1 = \frac{\gamma_{c+R}}{2R}$ and $\mu^c(p)$ is the distribution of efficiency for cooperatives, which could potentially be different from $\mu(p)$. Note that given that the first and second type of cooperatives receive a flat return on the deposits left in the storage technology, and the third type pays a flat price on the borrowed capital, these cumulative distribution functions are given by the return times the distribution function. For the deposits lent to firms by the second and third type, however, the return is a function of p so the cumulative distribution is given by the integrals.

The average return on deposits will then be a convex combination of the cooperative interest rate and the traditional bank interest rate:

$$r = (1-\lambda)r_{bank} + \lambda\, r_{coop}$$

2.4. Equilibrium with banks and cooperatives.

Let λ be the proportion of cooperatives, given a total amount of deposits a, the total supply of loans, l, is:

$$l_t = \begin{cases} (1-\lambda)a_t + \lambda \left[1 - \mu^c\left(\frac{\gamma_c}{R_t}\right) - \epsilon\, \mu^c\left(\frac{\gamma_{c+R}}{2R_t}\right)\right] a_t, & \textit{if the interbank works} \\ (1-\lambda)\left[1 - \mu\left(\frac{\gamma}{R_t}\right)\right] a_t + \lambda \left[1 - \mu^c\left(\frac{\gamma_c}{R_t}\right) - \epsilon\, \mu^c\left(\frac{\gamma_{c+R}}{2R_t}\right)\right] a_t, & \textit{otherwise} \end{cases} \tag{4}$$

Since the capital in production must be equal to the loans, and because markets are competitive, it must be that $1 + f_k(K) - \delta = R$ in general equilibrium. Therefore:

$$f_k^{-1}\left(\frac{R+\delta-1}{z_t}\right) = \begin{cases} (1-\lambda)a_t + \lambda \left[1 - \mu^c\left(\frac{\gamma_c}{R_t}\right) - \epsilon\, \mu^c\left(\frac{\gamma_{c+R}}{2R_t}\right)\right] a_t, & \textit{if the interbank works} \\ (1-\lambda)\left[1 - \mu\left(\frac{\gamma}{R_t}\right)\right] a_t + \lambda \left[1 - \mu^c\left(\frac{\gamma_c}{R_t}\right) - \epsilon\, \mu^c\left(\frac{\gamma_{c+R}}{2R_t}\right)\right] a_t, & \textit{otherwise} \end{cases}$$

The above relation characterizes the equilibrium corporate loan rate R_t as a function of the two aggregate state variables of the model, a_t (savings) and z_t (productivity). It also points to the two-way relationship that exists between the interbank loan and the corporate loan markets, as R_t affects and is affected by whether the interbank market operates.

As discussed before, the crisis happens when the interest rate is too low. That is, there is $\bar{R}$ such that for all $R_t < \bar{R}$ the interbank market freezes. Note that (4), when there is trade, can be written as:

$$f_k^{-1}\left(\frac{R+\delta-1}{z_t}\right) = g(R)a$$

where $g'(R) > 0$. It is straightforward to show that because $f(.)$ is Cobb-Douglas and $g'(R) > 0$, R is decreasing on a. Thus, the interbank market operates if and only if:

$$a_t \leq \bar{a} = \frac{f_k^{-1}\left(\frac{\bar{R}+\delta-1}{z_t}\right)}{g(\bar{R})} \quad \textit{and} \quad z_t \geq \bar{z} = \frac{\bar{R}+\delta-1}{f_k(ag(\bar{R}))}$$

Also, notice that $0 < g(R) < 1$ as long as $\lambda > 0$, and that $g(R;\lambda)$ is decreasing in λ. Thus, the less banks have access to the interbank market, the larger the interest rate and therefore the larger the thresholds for the crisis. This relationship shows the main trade-off implied by the potential inclusion of cooperatives to the interbank market. The smaller λ, the more efficient is the financial sector allocating resources to production, but also the larger the probability of a financial crisis. This trade-off is the key element that we analyze in this paper.

2.5 Measurement.

Since we have a storage technology, that even though is inefficient, sometime is used, we need to properly measure the GDP in our economy. The output must be adjusted for the stored capital of the cooperatives and the potentially different storage return of cooperatives and traditional banks:

$$y = \begin{cases} zk_0^{\alpha} h^{1-\alpha} + (\gamma_c + \delta - 1)(a - k_0), & \textit{if the interbank exists} \\ zk_0^{\alpha} h^{1-\alpha} + (\gamma_c + \delta - 1 + (1-\lambda)(\gamma - \gamma_c)\mu(p_b))(a - k_0), & \textit{otherwise} \end{cases}$$

Bank assets

The size of the banking sector must be adjusted now, representing the total financial sector, i.e. banks and cooperatives. The increase of the banking sector through the interbank market is smaller now as it is multiplied by the share of traditional banks $(1-\lambda)$

$$b_{size} = \begin{cases} \left(1 + (1-\lambda)p_b^{\xi}\right) a, & \text{if interbank market operates} \\ a, & \text{otherwise} \end{cases}$$

the non-core assets held are then straight forward, which must be multiplied now by the share of the traditional banks $(1-\lambda)$

$$ncore = \begin{cases} \left(1 - p_b^{\xi}\right) \phi (1-\lambda) a, & \text{if interbank market operates} \\ 0, & \text{otherwise} \end{cases}$$

and the core assets, which include cash holdings, thus include the assets of the cooperatives which is already reflected in the size of the financial sector

$$core = \begin{cases} \mathrm{b_{size}} - \mathrm{ncore}, & \text{if interbank market operates} \\ a, & \text{otherwise} \end{cases}$$

and the cash holdings are now greater than zero even in normal times due to the cooperatives

$$cash = \begin{cases} \left((1-\epsilon)\mathrm{p}_{0,\mathrm{c}}^{\xi} + \epsilon\, \mathrm{p}_{1,\mathrm{c}}^{\xi}\right) \lambda\, \mathrm{a}\,, & \text{if interbank market operates} \\ \left((1-\epsilon)\mathrm{p}_{0,\mathrm{c}}^{\xi} + \epsilon\, \mathrm{p}_{1,\mathrm{c}}^{\xi}\right) \lambda\, \mathrm{a} \,+\, (1-\lambda)\mathrm{p}_{\mathrm{b}}^{\xi}\, \mathrm{a}, & \text{otherwise} \end{cases}$$

3. Calibration

We calibrate the model to satisfy stylized facts for the Chilean economy.

Technology is represented by a constant returns to scale production function of the form $z_t k_t^{\alpha}(\Psi_t h_t)^{1-\alpha}$, where the term Ψ_t captures labor augmenting technological progress, which is exogenous and grows at the constant gross rate $\psi > 1$. The household is endowed with preferences over consumption, c_t, and hours worked, h_t, represented by a Greenwood et al. (1988) utility function,

$$u(c_t, h_t) = \frac{1}{1-\sigma}\left(c_t - \vartheta \Psi_t \frac{h_t^{1+\nu}}{1+\nu}\right)^{1-\sigma}$$

where $\nu > 0$ is the inverse Frisch labor supply elasticity and ϑ is a parameter governing the average utility of leisure. As such, it would be instrumental pinning down the level of labor's aggregate supply. The presence of the technological progress term in the utility function ensures the existence of a balanced growth path with constant labor supply. Without productivity growth in the utility function, and because with GHH preferences there is not income effect on labor supply, there would be an always increasing labor supply, which is counterfactual. Also, this specification is instrumental generating a closed form solution for the banking sector's detrended absorption capacity, which greatly simplifies the numerical solution of the equilibrium,

The calibration is reported in Table 1. We set the discount factor β, so that the household discounts the future at an annual rate of 4% in the detrended economy. We set $\nu = 1$ so that the labor supply elasticity is equal to 1. As shown by Coble and Faundez (2016), the Frisch elasticity of labor supply is relatively low in Chile compared to other countries. The labor disutility parameter ϑ is such that the household would supply one unit of labor in a deterministic version of the model. The risk aversion parameter σ is set to 4.5, which lies within the range of estimated values. The capital income share is set to 0.3, and we assume that capital depreciates at 9 percent.

To calibrate the data-generating process of TFP, we first back out a model-consistent series of the logarithm of TFP, for the Chilean economy over the period 1980–2015:

$$\log(TFP_t) = \log(y_t) - \alpha \log(k_t) - (1-\alpha)\log(h_t)$$

where y_t is real GDP and h_t is total annual hours worked as reported by University of Chile survey. The series of physical capital k_t is constructed by the inventories method. We follow Bergoeing (2015) to construct to capital stock and TFP. Note that in this economy, the capital output ratio $\frac{k}{y} = \frac{\alpha\beta}{[\psi-\beta(1-\delta)]}$, which we set to a value of 2.9. Finally, we fit a linear trend to the (log) TFP series and use the deviations from this trend to estimate the AR1 process for TFP in the last equation; we obtain $\rho_z = 0.85$ and $\sigma_z = 2.5$ percent as estimates.

The remaining parameters pertain to the banking sector and include the return on storage γ, the diversion technology, θ, and the distribution of banks $\mu(.)$. For tractability, we assume that $(p) = p^{\xi}$, with $\xi > 0$. The parameters of the banking sector are calibrated jointly so that (i) the spread between the real corporate loan rate and the implicit real risk-free rate equals 2.8 percent, (ii) the real corporate loan rate equals 4.6 percent, and (iii) a financial recession occurs on average every 42 years (which depends on the facts of the economy) For statistics (i) and (ii), we use the real lending rate on midsize business loans for the United States between 1990 and 2011, as reported in the US Federal Reserve Bank's Survey of Terms of Business Lending and the real Federal Fund rate. We obtain $\gamma = 0.942$, $\xi = 25$ and $\theta = 0.085$. On the basis of this calibration, the model generates an average interbank loan rate of 0.90 percent and an implied threshold for the real corporate loan rate of 2.72 percent (i.e., $\bar{R} = 1.0272$).

Table 1

Parameter	Variable	Value	Moment
Discount Factor	β	0.97	Risk free interest rate
Inverse Frisch elasticity	ν	1	From micro data
Labor	ϑ	0.9686	Normalize h=1
Risk Aversion	σ	4.5	Equity premium (literature)
Capital income share	α	0.3	From national accounts
Depreciation rate	δ	0.09	To match k/y=3
Growth	ψ	1.013	From GDP growth
TFP volatility	σ_z	0.025	Fitting log regression

TFP persistence	ρ_z	0.85	Fitting log regression
Bank's distribution $\mu(p) = p^{\xi}$	ξ	25	Jointly to match 1) Lending risk free rate spread =1.7 2) lending rate =4.4, and 3) two recessions per century
Diversion cost	θ	0.085	
Storage Technology	γ	0.942	

For the baseline calibration we assume that the proportion of cooperatives, λ, is 10%, and that they share the same fundamental parameters, ξ and θ, as the rest of the banks. Later, in the counterfactual scenarios we maintain the same functional form for the distribution of cooperatives, that is, $\mu^c(p) = p^{\xi_c}$, but we calibrate ξ_c to an alternative value. To this end we use information provided by Coopeuch, a Chilean credit union, to compute the spread for the portfolio of loans, and we choose ξ_c to match the difference in spreads. This generates a value of 27, consistent with a spread that is 0.3% smaller. Regarding θ_c, since we do not have a direct measure of its value respect to θ, we consider alternative ratios θ/θ_c.

4. Results

In this Section, we present the main results of the paper. As we mentioned before, the first exercise consists on comparing the benchmark economy with $\lambda = 10\%$, versus the counterfactual scenario in which most financial institutions (traditional banks and cooperatives) are granted access to the IM, $\lambda = 3\%$. These results are shown in Table 2.

When $\lambda = 10\%$, we are in the benchmark case, which tell us what is the situation if only traditional banks are allowed to participate in the IM. Then we solve the model with $\lambda = 3\%$. This change generates two opposing forces. On the one hand, because of (4) the supply of loans increases, increasing capital accumulation and output. This is the positive effect of the policy. However, the higher level of capital generates a smaller equilibrium interest rate R, increasing the probability of a crisis, which in turn, generates more volatility of output and consumption. This trade-off implies an ambiguous outcome for welfare

In Table 2 we show the main variables of interest plus three measures of welfare. For the first measure of welfare, in present value, we compute the present value of utility for different simulated paths. The second measure of welfare is the mean utility over all the simulated paths (50.000 simulations). This measure is an approximation to the long run value of welfare. One drawback with these two measures is the special form assumed for utility of leisure. This choice was made to simply the calculations but it has also implications for welfare. To deal with this issue we compute a third measure in which we compute the average value of the utility of consumption only (i.e., we assume $\vartheta = 0$ for this calculation). Then, to compute the proportion changes we use the consumption equivalent approach. For how much the life time consumption of an individual in this economy should be increased in the benchmark economy to be indifferent to the counterfactual? For instance, the last raw in table 2 should be interpreted as that a representative consumer would be willing to give up 1.62% of his life time consumption to move to an equilibrium where COPEUCH is allowed to participate in the IM.

Table 2

	Counterfactual	**Benchmark**	
Variable	**Cooperatives $\lambda = 3\%$**	**Cooperatives $\lambda = 10\%$**	**Change**
Capital	3.2291	3.1987	0.95%[1]
Output	1.4419	1.4412	0.05%[1]
Labor	1.0151	1.018	-0.28%[1]
Consumption	1.0978	1.0797	1.68%[1]
Risk free rate	2.793%	2.79%	0.003%[2]
Lending rate	4.4865%	4.61%	-0.12%[2]
Spread	1.6934%	1.82%	-0.13%[2]
Probability of a crisis	2.43%	1.93%	0.5%[2]
Cash	0.0328	0.049	-0.016[2]
Welfare Present value	-52.5543	-59.5028	3.49%[3]
Welfare Average	-64.0468	-70.9707	2.89%[3]
Welfare Consumption	-7.6523	-8.1008	1.62%[3]

1) Percentage differences. 2) Absolute differences in numbers. 3) This is consumption equivalent changes. Because preferences are homothetic the number in this column is calculated as: $x = \left(\frac{W_0}{W_1}\right)^{\frac{1}{1-\sigma}} - 1$. Where W_0 and W_1 are the total utility in the benchmark and counterfactual equilibrium, respectively.

As we can see, and as expected, that both the probability of financial crisis and the volatility of output increase. At the same time, however, average output, aggregate consumption and welfare increase. That is, even though grating access to the IM market to cooperatives has some negative effects, overall welfare improves. In numbers, despite the increase from 1.93% to 2.43% in the probability of a financial crisis, average output and aggregate welfare increases 0.05% and 1.6%, respectively.

In the next exercise with maintain the assumption that cooperatives are subject to the same moral hazard problems as traditional banks but we introduce the fact that cooperatives are more efficient at producing loans (conditional on the type of loans). We do this by translating the distribution of efficiency toward larger values. In numbers, we assume that the distribution of efficiency for cooperatives is given determined by the parameter $\xi_c = 27$, rather than $\xi = 25$, which is the calibration for the traditional banks. The results are shown in Table 3.

Table 3

Change on the distribution parameter lambda from 25 to 27.

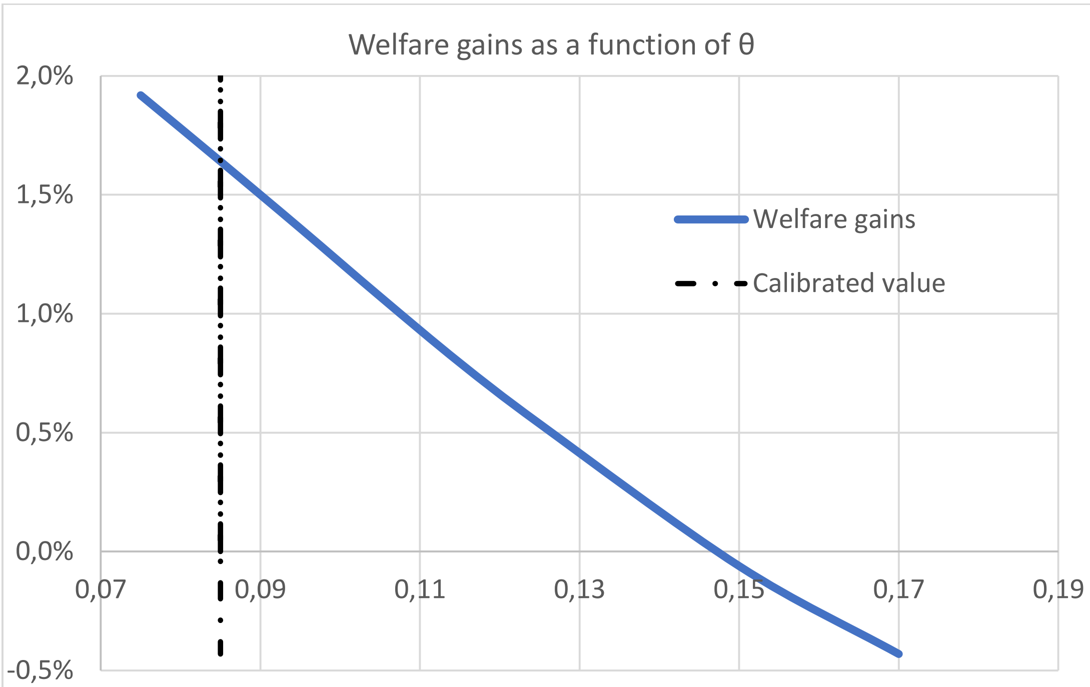
Variable	Cooperatives $\lambda = 3\%$ and $\xi = 27$	Cooperatives $\lambda = 10\%$	Change
Capital	3.3005	3.1987	3.18%[1]
Output	1.4528	1.4412	0.8%[1]
Labor	1.0170	1.018	-0.04%[1]
Consumption	1.1031	1.0797	2.17%[1]
Risk free rate	2.7965%	2.79%	0.0065%[2]
Lending rate	4.308%	4.61%	-0.32%[2]
Spread	1.5116%	1.82%	-0.32%[2]
Probability of a crisis	1.45%	1.93%	-0.38%[2]
Cash	0.0209	0.049	-0.27[2]
Welfare Present value	-52.2180	-59.5028	3.66%[3]
Welfare Average	-63.5054	-70.9707	3.13%[3]
Welfare Consumption	-7.5250	-8.1008	2.09%[3]

1) Percentage differences. 2) Absolute differences in numbers. 3) This is consumption equivalent changes. Because preferences are homothetic the number in this column is calculated as: $x = \left(\frac{W_0}{W_1}\right)^{\frac{1}{1-\sigma}} - 1$. Where W_0 and W_1 are the total utility in the benchmark and counterfactual equilibrium, respectively.

As expected, the welfare gains of granting access to cooperatives become only bigger. There are two contributing factors to the improvement. On the one hand, there are some cooperatives that are very efficient, since, on average, they are more efficient than the rest of the banks. The reason, as already mentioned, is that they could finance very good projects, but are not able to do it due to their limited funding capacity. To finance the good projects, these efficient cooperatives would have to borrow from other banks, at an interest rate that is too high for them render it worth it, and therefore they just lend the deposits that they receive. Instead, when they are granted access to the IM market, the efficient cooperatives can borrow from other less inefficient banks/cooperatives at a convenient interest rate, increasing the supply of loans to the private sector. Also, cooperatives that cannot find good business opportunities benefit from the IM market. Without the access to the IM the less efficient cooperatives must keep their funds on very inefficient, low return, financial instruments. Instead, when they have access to the IM they can lend those funds to other banks that can make a better use of it. All in all, the crisis probability falls to 1.45%, the GDP increases and additional 0.75% and welfare an extra 0.47%.

Finally, we analyze what is the aggregate effect of allowing cooperatives to participate in the IM market when they have different quality of governance θ_c. To that end, we solve different equilibria using the calibration for Table 2 with $\lambda = 0.03$ but varying θ_c from 0.075 to 0.17. Figure 3 shows the computed welfare gains (using the mean value of the utility of consumption only) for different qualities of governance. We can see in Figure 3, that as the quality of governance deteriorates (the moral hazard problem deepens) the welfare gains decrease, to the point that when θ_c is almost doubled the allowing the cooperative banks to participate in the IM market generates welfare loses.

Figure 3



To understand the effect of cooperative's moral hazard problem in the IM market, recall that θ captures the cost of walking away from the debt. If $\theta = 0$, the bank cannot divert any resources, while when $\theta = 1$ a bank can divert all the borrowed resources at no cost. Also recall that, the quality of the banks participating in the IM is private information, and therefore, not observed by other participants. Thus, if cooperatives are "worst" than other banks, their participation lowers the average quality of the borrowers in the IM, which in turn diminishes the willingness of the lenders to provide funds to all the banks. The presence of some lower quality borrowers, since the quality is not perfectly observed, affects the ability of all banks to borrow in the IM. As a result, fewer banks become lenders and the size of loans decreases. In the extreme, if the new participants are sufficiently bad, the IM completely shuts down. Figure 3 shows that when cooperatives are able to divert at least twice as much as traditional banks, their own moral hazard problem, together with the induced negative externality on the other participants, distort the IM market enough such that the efficiency gains are completely compensate by the cost.

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