Rural Credit Rationing and National Development Banks in Developing Countries

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Abstract

A common problem in agricultural credit markets in developing countries is the coexistence of a competitive market equilibrium interest rate and credit rationing. The literature typically explains the existence of credit rationing in competitive credit markets using adverse selection and moral hazard. Unfortunately these analyses are not consistent with the empirical reality that developing countries deal with in terms of subsidized credit, especially in the agricultural sector. This paper presents an alternative explanation for credit rationing in the agricultural sector in developing countries based on the fact that the requested loans are usually for small amounts, with many farmers making applications. As a result, the costs of operation increase with the number of loans given, so that inefficiencies in credit allocation occur when national development banks are present. It is shown that credit rationing can be reduced if shutting-down the national development bank is a feasible policy. Two other cases show that a national development bank is welfare-improving if an incentive compatible contract is used.

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1. Introduction

Competitive equilibrium entails market-clearing prices that eliminate any excess of supply or demand. In that case, there should not be any quantity rationing. It is the consensus to think of the interest rate as the price for loans. Then, how can we justify the existence of an equilibrium interest rate in the credit market and, at the same time, coexistence of credit rationing[1]? This phenomenon has been studied by Freimer and Gordon (1965), Jaffee (1971), Keeton (1979), and, Stiglitz and Weiss (1981) –among others-. Stiglitz and Weiss were the first to formally introduce agency issues such as adverse selection and moral hazard into the credit rationing literature.

Unfortunately the agricultural credit sector in developing countries is no exception. Far from the information-related constraints, bank spreads in developing countries cause a huge gap between the returns from inefficient agricultural activities and the interest rate banks charge[2]. In contrast, bringing information asymmetries into the discussion, Binswanger and Deininger in their 1997 paper comment that the adverse selection and hidden action problems within developing countries show their ugly faces not because they are "intrinsically less productive" but due to the prohibitive agency costs of supervision and monitoring. In addition, they argue that despite that local lenders may acquire information about the "creditworthiness" of their borrowers, and regardless of the relative little cost of the undertaken projects, their ability to

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[1] Bester (1985) defines credit rationing as "Credit rationing is said to occur when some borrowers receive a loan and others do not, although the latter would accept even higher interest payments or an increase in the collateral".

[2] See Brock and Rojas-Suárez (2000) for a further discussion on this issue.

differentiate risk is limited. On the other hand, Blackman (2001) explains why lenders not even distinguish between financing traditional investments and give loans to adopt new high-return technologies. This is because of the high probability of intentional default due to what he calls the "lack of formality" of farmers in developing countries. This informality emanates from the fact that these farmers are both firms and households so they will finance household consumption as well. Since consumption yields a very high time preference rate, therefore intended default shows up. The other concern that increases the credit constraints in developing countries is the partial, limited or total lack of enforceability. Cooley, Marimon and Quadrini (2001) discuss the loss of welfare when limited contract enforceability is present in a general equilibrium framework. They treat this credit constraint as an endogenously-generated general-equilibrium market-incompleteness in an infinite horizon model. The model is applied to firms in developed countries when entrepreneurs and investments undertake long-term relationships.

Hoff and Stiglitz (1995) elaborate a theoretical approach treating the empirical fact that an increment in the subsidies to agricultural credit in developing countries aggravates the farmers' credit conditions, stressing the role of informal credit entities.

Banerjee, Besley and Guinnane (1994) propose the use of credit cooperatives in developing countries as a better allocation mechanism than the conventional banking arrangements. They use Germany's nineteenth century cooperative framework methodology and provide reasons such as social sanctions, more long-term repeated

interactions between economic actors as a way to improve the information asymmetries of the credit problem in the developing countries. Unfortunately this does not seem to be a helpful solution at all in terms of optimal allocation of resources to develop the agricultural sector. Binswanger and Deininger (1997) argue that the allocation of public expenditures, in this case, subsidized low-interest rate credits to rural areas in developing countries, in hands of large farmers who are politically-active, namely, the cooperatives, increase inequality and reduce productivity and long-run growth.

The purpose of the paper is to explain why there are problems allocating subsidized credit in developing countries, emphasizing the presence of an inefficient national development bank[3] as a source of credit rationing. This analysis applies a theoretical credit-rationing model that differs to the current state of the literature on credit rationing. The current state of the literature does a good job explaining credit rationing in the competitive credit market bringing up adverse selection and moral hazard as fundamental sources of credit rationing. They bring up issues such as interest rate floors (Stiglitz and Weiss, 1981), the size of the loans (Freixas and Laffont, 1990), the timing and observability of the agents endowments (Azariadis, 1993), and the presence of informal credit entities (Hoff and Stiglitz, 1995). Some others have based their work mainly on these four frameworks. Unfortunately, except for Hoff and Stiglitz (1995), they are not consistent with the well-known empirical fact that developing countries deal in terms of the inverse relationship between welfare and subsidized credit,

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[3] Although Bravermand and Guasch (1989) already recognize the inherent inefficiencies of the national development banks in developing countries, as well as their possible effects on credit rationing, they do not provide a formal theoretical treatment of this issue.

especially in the agricultural sector. Usually subsidized credit for technology involves interest rates lower or at least equal to the marginal product of capital, so interest rate need not be a powerful argument. The size of the loan is certainly not an issue because subsidized credit encompasses many low-amount loans. On the other hand, while timing of the endowments and the observable concern are important standpoints, they do not fully explain the credit rationing problem with subsidized credits. Despite Hoff and Stiglitz (1995) offer explanations that are consistent with the empirical facts of the subsidized credit system in developing countries, they overlook the important role of the presence of an inefficient national development bank in their research. As a final remark on this brief literature review, limited enforceability is indeed an important issue but, as shown by Cooley, Marimon and Quadrini (2001), with long-term relations this can be minimized. In this paper, only credit to purchase capital goods will be considered[4]. For this reason, full enforceability will be assumed through out the paper.
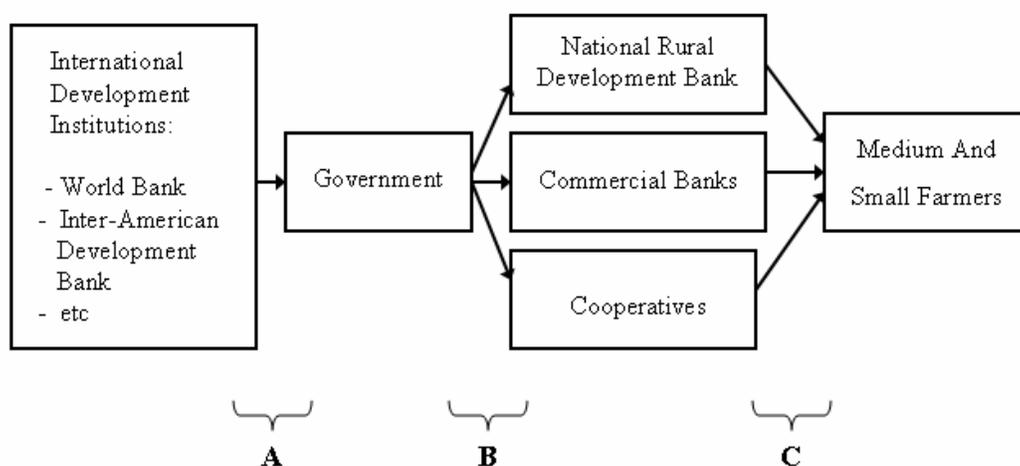

Fig. 1 A generic view of the international development rural credit system

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[4] These concerns can be dealt giving the farmers the capital good itself by reaching an agreement between the supplier of the capital good and the bank, instead of giving the individuals the money to buy it.

Figure 1 (above) shows a basic structure of how the subsidized rural credit system works in developing countries. International financial institutions such as the World Bank (WB) and other regional entities such as the Inter-American Development Bank (IADB) lend money at preferred interest rates (below the international market interest rate) to governments or certain decentralized national institutions[5] (relationship *A*). At this stage, the government distributes the money among the three basic identified formal credit channels: a national development bank, commercial banks, and cooperatives (relationship *B*). Through these three basic channels, medium and small farmers are supposed to have access to subsidized credit for their agricultural operations (relationship *C*).

The aim of this research is to bring to the policymaker's attention the issue that the presence of an inefficient national development bank and nonobservability of marginal costs of operation of both development and commercial banks are an important source of credit rationing for purchasing capital goods in developing countries. As a result, this paper will focus only on the formal credit sector.

Cooperatives are left out of the model presented in this paper following Binswanger and Deininger's (1997) argument on the negative effects in economics growth when the allocation of subsidized credits is in hands of the co-ops.

This paper presents an alternative explanation based on the fact that these credits are usually many low-amount loans. Costs of operation increase with the quantity of loans given so the inefficiencies to allocate credit when national development banks are present play an important role in the subsidized credit provision.

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[5] In the case of Mexico, it is called Fideicomisos Instituidos en Relación con la Agricultura (FIRA). It is worth to mention that in this case, FIRA is not a retail bank. The rural national development bank in Mexico was the Banco Nacional de Crédito Rural (Banrural). Banrural was officially closed on December 13th, 2002 due to extreme inefficiencies. According to the international consulting firm KPMG's audit report on Banrural (Ceballos, 2002), for every four pesos, only one actually reached the farmers.

It is shown that credit rationing can be reduced if shutting-down the national development bank is a feasible policy. Two more cases in which the government must keep the development credit entity are shown to be welfare-improving.

To facilitate the presentation of this research, the paper is divided in three sections. In section 2, a theoretical framework to explain subsidized credit rationing based on the crucial assumption on how a certain number of low-amount loans are allocated and the intrinsic inefficiency of national development banks is presented. This model emphasizes that the presence of an inefficient national development bank and nonobservable marginal costs of operation in the overall banking industry are a major source of subsidized credit rationing in developing countries.

Given the importance of obtaining an optimal amount of the capital loan as well as an optimal interest rate that should be charged to the final credit user to ensure growth, section 3 develops an endogenous growth model[6] of small farmers using Blackman's (2001) assumption that small farmers in developing countries are both, firms and households at the same time. In addition, homogeneity of the farmers' credit needs is also assumed. Finally, some concluding remarks are exposed in the last section.

2. A dynamic principal-agent model: The government-retail banks relationship[7]

This section develops a model where the existence of an inefficient national development bank and the nonobservability of the banks' costs of operation are an important source of subsidized credit rationing for capital goods.

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[6] Acemoglu, Aghion, and Zilibotti (2003) use a similar methodology, namely, asymmetric information modeling techniques mixed with endogenous growth models, to assess economic growth and technology adoption.
[7] This model tackles relationship *B* in Figure 1.

2.1 Environment

Assume an economy of $N > 0$ infinitely-lived small homogeneous farmers[8], at every time t. A benevolent government wants to allocate a number I_t of subsidized loans[9] to acquire capital goods, via two types of financial institutions: development banks and commercial banks. For simplicity, let's say, there is only one entity per type of bank[10]. Time is assumed to be discrete.

The subsidized government interest rate r^G is defined as an interest rate lower than the central bank rate and/or the rate at which the banks borrow money from the public that takes into account the international financial institution's interest rate, the marginal costs of allocation, and the economic growth situation of the small and medium farmers. Although it will be endogenously derived in section III, right now it is set exogenously by the government and it is assumed to be fixed for both types of banks[11] and for all t.

The subsidized credit costs of operation is denoted by C that is assumed to be a continuous, differentiable, increasing, and convex function of the number of loans I_t,

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[8] N is a large fixed number. This implies that population growth is zero. On first sight this appears to be an unrealistic assumption, but according to (Binswanger and Deininger, 1997) population has not increased significantly in the agricultural sector in the last eighty years. This is due to the fact that migration from rural to urban areas has offset the population growth in the agricultural sector. Homogeneity among farmers in the sense of having the same amount of land, same technology, same cost function, and same utility function. This is still consistent with the crucial assumption that small farmers in developing countries are "a lot" of them needing low-amount capital loans. On the other hand, this setup can be also used to address issues in other segments of the economy such as non-agriculturally related family businesses. (The same structure, "a lot" of them with low-amount of credit needs).

[9] Since farmers are homogeneous and, therefore, have the same credit needs, allocating a certain number of subsidized loans instead of an aggregate loan seems to be "good" objective for the benevolent government. Furthermore, due to this fact, public press in the developing countries usually talks about number of loans instead of a certain aggregate loan goal (See Zúñiga's, Reforma Article, 2002).

[10] This assumption makes sense since usually national development banks' objectives in developing countries do not overlap, so they do not compete for clients and projects. On the other hand, commercial banks will show the same behavior is we assume a competitive structure, so it is rational to use a representative agent approach. Therefore, the commercial bank entity is the sum of a certain finite number of homogenous commercial banks.

[11] That is the case of Mexico, where FIRA lends to both types of banks at the same interest rate.

for both types[12], and linear in the given r^G. Development banks are assumed to be a high-cost entity, with cost function $\overline{C}$. According to the so-called "Meltzer Report"[13], many development banking operations are characterized by high cost and low effectiveness. Conversely, commercial banks are considered to be a low-cost subsidized credit allocation entity, due to the assumed competitive structure of that industry. $\underline{C}$ stands for the commercial bank cost function. Consequently, the total and the marginal costs of the less efficient entity (development bank) are strictly grater than the total and marginal costs of the efficient (commercial) bank for all t, i.e. $\overline{C} > \underline{C}$, and $\overline{C}' > \underline{C}'$, for every $\overline{I}$ and $\underline{I}$. Therefore, the total operation cost is the sum of aggregate credit allocation cost for both types, at time t, i.e. $C(I_t; r^G) = \overline{C}(\overline{I}_t; r^G) + \underline{C}(\underline{I}_t; r^G)$.

According to De Meza and Webb (2000), sometimes credit rationing does not imply insufficient lending. In this case, it is assumed that, if credit rationing exists, it does imply insufficient lending. Thus, if credit rationing occurs, the condition $I < N$ is satisfied at every point in time[14].

2.2 Government preferences

The Government preferences are denoted by the loss function W_t:

$$W_t = W_t\left(L_t, C(I_t); L_t^*\right) \tag{1}$$

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[12] $C'. > 0$, $C''. > 0$

[13] This report emerged from the International Financial Institution Advisory Commission formed in 1998 by the U.S. Congress to consider the future roles of several international financial institutions such as the World Bank (WB), the International Monetary Fund (IMF) –amongst others-, Meltzer, Allan H. (2000)

[14] This implies that the all the N group of farmers are willing to apply for a subsidized credit at a certain interest rate that, for the time being, is assumed to be optimal.

where L_t is the aggregate subsidized loan for both types of bank at time t, *i.e.*

$L_t = \sum_{\bar{i}_t}^{\bar{I}_t} \bar{\ell}_{i,t} + \sum_{\underline{i}_t}^{\underline{I}_t} \underline{\ell}_{i,t}$, I_t is the total number of loans for both types at time t, *i.e.*

$I_t = \bar{I}_t(\bar{i}_t) + \underline{I}_t(\underline{i}_t)$. L_t^* is the targeted aggregate subsidized loan. Shutting-down policy is ruled out: $I > 0$ for both types[15], for all t.

The welfare function is linear in costs of operation and quadratic in aggregate loan amount:

$$W_t\left(L_t, I_t, C(I_t); L_t^*, \omega\right) = \frac{1}{2}\left(L_t - L_t^*\right)^2 + \omega C(I_t) \qquad (2)$$

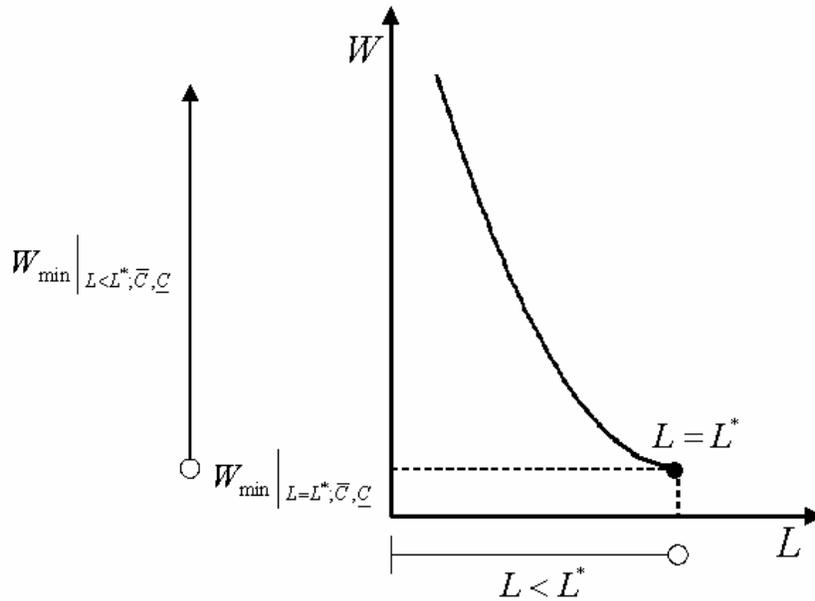where ω is the relative weight on costs of operation with respect to the aggregate subsidized loan target.

Fig. 2 Government Preference Function

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[15] No shutting down policy in the commercial banks is irrelevant since under the assumptions already set in the model there is no need for further explanation. Thus, it is more interesting is to explain the no shut-down policy in the development banks. If the national development bank is inefficient, welfare will be improved if the shutting down policy takes place, given that the competitive structure of the commercial bank would lead to improve welfare. The problem is that sometimes is not feasible either because of sunk costs or because of political reasons. Usually these institutions encompass a big bureaucratic body not easy to get rid off.

This penalty function has been commonly used by several models (Kydland and Prescott, 1977, Barro and Gordon, 1983, Svensson, 1997, among others[16]) to represent the government preferences where the achievement of positive targets comes along with other negative outcomes that have to be reduced. In this case, this function takes into account the *trade-off* between number of loans that the government would like to give (as many as possible) in order to accomplish a political achievement in the agricultural sector, and, on the other hand, the operation (and/or allocation) costs this subsidized loan provision involves (that wish to be minimized).

As we can see on Figure 2 (above), at a certain t, an increase in the number of loans up to $L = L^*$ -where you reach the global minimum- reduces W_t. The left-hand side of the quadratic graph is not shown since governments' money constraints in developing countries usually do not allow to give a larger number of loans than the target.

$$\sum_{t=0}^{\infty} \gamma^t W_t\big(L_t, I_t, C(I_t); L_t^*, \omega\big), 0 < \gamma < 1 \tag{3}$$

The government minimizes (3) choosing the current and future number of loans for the two types of banks, subject to a *minimum-loan constraint*, $\ell_{it} \geq \ell_t$, for both types, for all i,t. And a *proportion constraint* $R_t \leq (1/N)$, for both types, for all t, where R_t is the proportion of the (rural) population that will be positively affected by getting a loan, $0 < R_t \leq 1$. R_t is assumed to be constant[17] for all t. γ is the government discount factor.

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[16] Blinder (1998) discusses this type of loss functions in terms of who provides the government's objective function and how. Since, practically, legislative and other political authorities never give explicit instructions; governments must create their own social welfare function based on their legal directives as well as their own value judgments.

[17] We assumed that the rural population was large and fixed. Therefore, since the amount of money needed to affect a huge proportion of the rural population is way too large, it seems rational to assume a small and constant R such that $\lim_{t \to \infty} R_t = 1$. It can also be seen as if the government achieved the goal of $R = 1$ in a finite time T but then it starts again with another type of capital good. Anyway, this

Both constraints are needed to have a fair description of a rational benevolent government because, in the case of the "minimum-loan" restriction, although farmers are willing to apply for a low amount loan, it also has to be sufficiently enough to buy some piece of technology to improve the farmer's production techniques. Let's say, the quantity of money needed to buy a generic tractor[18]. If we do not impose the minimum-loan restriction then, one equilibrium would be to give infinitesimal amounts of money to everybody and, definitely, that would not be an adequate description of a benevolent policymaker's preferences. On the other hand, if we do not impose the "proportion" constraint, then the optimization process would yield an equilibrium in which just one farmer gets the whole aggregate subsidize credit (L^*) because that would satisfy the "minimum loan constraint" and also would minimize the costs of operation.

Recall that we have already assumed that all farmers are homogenous. Therefore, since all farmers have the same needs, then everybody applies for the same amount of loan, which would make a binding minimum-loan constraint, *i.e.* $L_t = \sum_{i=1}^{I} \ell_{i,t}$, and $\ell_{i,t} = \ell$, implies $\sum_{i=1}^{I} \ell = I\ell$, for both types. On the other hand, let's assume the proportion constraint is also binding[19], *i.e.* $(\bar{I} + \underline{I})/N = R$.

The subsidized loan target L_t^* will be exogenously determined by the government at every point in time[20] and is fixed for every period of time[21]. These two assumptions and the fixed population and fixed amount of loan suppositions, imply that $L^* = N\ell$.

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assumption is relaxed at the end of section III and it yields important results in terms of the gradualism of openness in the agricultural sector in developing economies towards international trade.

[18] Buying better seed, fertilizer or pesticide and other input financing loans are not considered in this framework since the focus is on capital loans.

[19] It is rational to assume that a benevolent government wants to hit the proportion target.

[20] Later on (in section III), we will relax this assumption by obtaining an optimal amount of aggregate subsidized loan for every period of time using an endogenous growth model.

[21] Despite that the optimal amount of the aggregate subsidized loan is determined by an endogenous growth model (section 3), this assumption is still realistic since the optimal targeted subsidized aggregate loan is stable in time, due to the assumptions of fixed population and fixed amount of loan.

2.3 Banks' participation constraints

The banks' individual rationality constraint is the banks' profit function greater or equal to zero, *i.e.*:

$$\Pi\left(I, C(I), r_t^F; r^G\right) \geq 0 \text{, for both types, for all } t \tag{4}$$

where $\Pi(\bullet)$ is the bank's profit for both types and r_t^F is the interest rate at which the loans given to the farmers are set. The banks' profit function –namely, equation (4)- takes the following functional form: $\Pi\left(I, C(I), r_t^F; r_t^G\right) = r_t^F g(I) - C'\left(I; r^G\right)I$, g is assumed to be linear.

The profit functions for both types of bank are:

$$\overline{\Pi}\left(\bar{I}, \overline{C}(\bar{I}), \bar{r}_t^F; r^G\right) = \left(\bar{r}_t^F - \overline{C}'\left(\bar{I}; r^G\right)\right)\bar{I} \tag{5}$$

$$\underline{\Pi}\left(\underline{I}, C(\underline{I}), \underline{r}_t^F; r^G\right) = \left(\underline{r}_t^F - \underline{C}'\left(\underline{I}; r^G\right)\right)\underline{I} \tag{6}$$

The national development bank is a government non-profit organization, so it makes sense that $\overline{\Pi} = 0$. We have assumed a competitive configuration for the commercial banking sector, hence $\underline{\Pi} = 0$ is also a rational supposition.

The optimal interest rate and the optimal subsidies make the bank participation constraint for both types binding at all times. Since r^G, I, and the marginal cost functions are constant for both types, and for all t, it implies that r^F is also constant for all t.

$$\bar{r}^F = \overline{C}'\left(\bar{I}; r^G\right) \tag{7}$$

$$\underline{r}^F = \underline{C}'\left(\underline{I}; r^G\right) \tag{8}$$

Given that $\overline{C}'\left(\overline{I}; r^G\right) > \underline{C}'\left(\underline{I}; r^G\right)$, therefore $\overline{r}^F > \underline{r}^F$. Assuming that the optimal rate at which the farmer should get the subsidized credit equals the interest rate that the commercial banks charge, *i.e.* $\underline{r}^F$, the government has to give an extra subsidy S^D to the development bank so they can charge the same rate to ensure that the farmer receives a credit at an interest rate $\underline{r}^F$ equal to his/her marginal product of capital[22]. Thus, expression (7) becomes:

$$\underline{r}^F = \overline{C}'\left(\overline{I}; r^G\right) - S^D, \text{ where } S^D = \Delta r^F, \text{ and } \Delta r^F = \overline{r}^F - \underline{r}^F \tag{7'}$$

It is important to mention that the bank calculates and gives the subsidy S^D once the distribution of the number of loans has already taken place.

2.4 First-best outcome

Recall that the operation cost functional forms are fixed in time. Therefore, the policymaker can find an optimal amount of subsidized loans in year t as the solution to a simple period-by-period problem.

Marginal costs of operation are assumed to be totally observable[23]. The government or subsidized credit allocation institution solves the following static optimization problem[24]:

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[22] An explanation of why both banks have to charge the same interest rate is given in section 3.

[23] This assumption will be relaxed in the second-best outcomes presented later in this section.

[24] Without loss of generality, we have dropped r^G from the banks' cost of operation function since it is constant for both types and for all t and does not affect the first-order conditions, nor the second-order conditions.

$$\min_{\bar{I},\underline{I}} W' \equiv \max_{\bar{I},\underline{I}} - \left\{ \frac{1}{2} \ell^2 \left(\bar{I} + \underline{I} - N \right)^2 + \omega \left[\overline{C}(\bar{I}) + \underline{C}(\underline{I}) \right] \right\} \tag{9}$$

$$s.t.$$

$$\frac{\bar{I} + \underline{I}}{N} = R \tag{10}$$

Solving (10) for $\bar{I}$ and substituting it in (9), the first-order conditions are:

$$\bar{I} = NR - \underline{I} \tag{11}$$

$$\overline{C}'(NR - \underline{I}) = \underline{C}'(\underline{I}) \tag{12}$$

We know that $\overline{C}'_t > \underline{C}'_t$, for all I. Therefore since $\bar{I}, \underline{I} < RN$, $0 < R \le 1$, and $N > 0$, expression (12) holds only if $\bar{I} < \underline{I}$. This implies that $\bar{I} < \underline{I} < RN$. Therefore, in the first-best world, in which the marginal costs of operation are observable, the subsidized loans are distributed among development banks and commercial banks in the following way: the development bank or high-cost entity obtains $\bar{I}$ identical loans of ℓ amount, and the commercial bank or efficient type gets $\underline{I}$ number of ℓ loans[25]. In other words, the commercial bank will get a larger proportion of the feasible government goal –namely NR - than the less-efficient bank.

2.5 Example with explicit functional forms for the costs of operation

In order to find a closed-form solution of this analytically tractable model, let's assume the following functional forms for the costs of operation of the efficient entity

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[25] The second-order sufficient condition $\omega \underline{C}''(\underline{I}) + \omega \overline{C}''(RN - \underline{I}) > 0$ confirms that the results is indeed a minimum since $\omega > 0$, $C'_t > 0$, $C''_t > 0$, $\underline{I} > 0$, and $\underline{I} < RN$.

and the development bank, respectively: $\underline{C} = r^G \underline{I} + (1/4)\underline{I}^2$ and $\overline{C} = r^G \overline{I} + (1/2)\overline{I}^2$. Both functions are consistent with the properties defined earlier in this section[26].

The marginal costs are $\underline{C}' = r^G + (1/2)\underline{I}$ and $\overline{C}' = r^G + \overline{I}$. Thus, the first-order conditions (11) and (12) yield the following outcome[27]:

$$\underline{I} = \frac{2}{3} NR \tag{13}$$

$$\overline{I} = \frac{1}{3} NR \tag{14}$$

Since $0 < R \le 1$, and $N > 0$, $\underline{I} > \overline{I} \Leftrightarrow (2/3)NR > (1/3)NR$.

As we mentioned before, we can observe in expressions (13) and (14) the "nice" result of proportions, given the assumed cost functions: The development bank obtains one third of the total number of credits that will be given and the efficient type gets the remaining two thirds.

This result appears to be rational, *i.e.* the less-efficient bank gets less number of loans than the commercial bank because of their intrinsic difference in marginal costs of operation and the government preferences –at least in the way we have modeled them– comprises the number of loans target-minimize cost of credit allocation *trade-off*. The

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[26] C is a continuous, differentiable, increasing, and convex function of I, and $\overline{C}' > \underline{C}'$, for both types. Also $\overline{C}' > \underline{C}'$, for every $\overline{I}$ and $\underline{I}$.

[27] The second-order conditions prove that the results are a minimum: $\omega \left(\overline{C}'' + \underline{C}'' \right) = \omega \frac{3}{2} > 0$, since $\omega > 0$.

next section will handle the problem when retail agricultural credit allocation marginal costs become unobservable.

2.6 Second-best world

Despite that the central bank and (or) other organizations closely monitor domestic commercial banking activity, nonobservability of the marginal costs of operation in this type of banks is a realistic assumption since it is usually an irrelevant monitoring issue because it is left to banking entity's profit maximization competitive structure.

The problem is that due the nonobservability of marginal costs of operation, commercial banks will have incentives to mimic the development banks behavior in order to obtain abnormal rents. This generates inefficiencies in terms of either higher interest rates or larger government subsidies, both worsening the credit rationing problem at the retail banking-farmer relationship level (relationship C in Figure 1).

Here we are left with three options: One is to shut-down the development bank, so once this is done, the competitive structure of the commercial banks will reduce interest rates eliminating the low-cost entities' incentive to mimic the high-cost behavior, getting rid of the inefficiencies arising from that informational problem. This will also reduce the government's total subsidy[28] to agricultural credit, by (eventually) removing the subvention that was destined to reduce the (implicit) gap between the low-cost and the high-cost entities potential interest rate, *i.e.* $S^D = 0$.

Another choice is to rule-out the possibility of closing the national development bank because of the government political constraints due to the usually large bureaucratic body, and follow the "Meltzer Report" (2000) recommendation to transform the development bank from capital-intensive lenders into sources of technical assistance. It has the same effect as shutting the national development bank down in

terms of giving credits, but perhaps more feasible since you don't have to get rid of all the bureaucratic body in full and you can get advantage of the knowledge it has gained through its years in the market.

A third option is to develop an optimal contract in the case where we need to leave the development bank running. This option could be feasible because of sunk costs and political constraints[29]. Heterogeneity of farmers could be introduced assuming that the development bank is less risk-averse than the commercial banks. This option makes sense if we think of the development bank as the one who takes the most risky projects. In other words, the inefficiencies could be derived from the fact that they would be willing to take individuals -farmers- that could not qualify for a commercial bank subsidized credit. However, this is left to be developed in the future.

3. Endogenous determination of the optimal amount of loan and interest rate to ensure economic growth

So far the model has two major weaknesses. The determination of the optimal interest rate and the optimal amount of the loan have been left to be exogenous. On the other hand, the question of the welfare effect of an increase in the number of credits remains unanswered. In this section, a simple dynamic growth model is presented in order to derive those two important components of the model in an endogenous fashion.

Assume that we continue to be in an economy of $N > 0$ infinitely-lived small homogeneous farmers, at every time t. However, in this case, we will model the farmer's preferences.

Usually, neoclassical growth models such as Ramsey (1928), Cass (1965), Koopmans (1965) among others, are criticized in several ways. First, because they assume that the

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[28] As it is presented in section 3, we are still advocates of a subsidy to the interest rate gap between the actual marginal product of capital and the one that is needed to achieve growth.

[29] Usually these rural national development banks are product of a "legacy effect". These banks have a long-history and are usually a major source for jobs, making this decision to be too unpopular for the government in charge.

representative agent is immortal. However this assumption has become unimportant due to Samuelson's work on life-cycle theory[30]. The second supposition is to have sufficient homogeneity among the agents such that a representative agent can be used in the targeted market. In several cases this is quite an unrealistic assumption, but following the empirical facts in the developing countries, small and medium farmers are quite homogenous in terms of their credit needs –a low-amount loan to buy a capital good that they do not own-, it seems to be a feasible assumption. Third, another notion that is criticized in the co called Ramsey-Cass-Koopmans endogenous growth model is that individuals are supposed to be household and firms at the same time. As it was argued by Blackman (2001), empirically, small farmers are indeed both, making this assumption a credible one.

3.1 The dynamic growth model

In this model time is assumed to be discrete as well. Individuals solve the following optimization problem:

$$\max_{x_t} \sum_{t=0}^{\infty} \beta^t u(x_t), \ 0 < \beta < 1 \tag{15}$$

$s.t.$

$$x_t - \left(1 + f'(k_t) - \delta\right)k_t + k_{t+1} \leq w_t \tag{16}$$

where β is the discount factor, x_t is the representative agent –farmer- at time t, the individual's preferences are represented by a standard, increasing and concave function of consumption $u(x_t)$. k is the capital input and δ its depreciation rate that it is assumed to be constant ($0 \leq \delta \leq 1$). The wage rate is denoted by w_t. $f(k)$ is the standard increasing and concave production function of the capital input. Its derivative with respect to capital is the marginal product of capital.

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[30] Samuelson (1975).

We have to add a standard non-Ponzi game condition to avoid perpetual debtors:

$$\lim_{t \to \infty} \frac{x_t}{\Pi_{i=1}^{t}\left(1+f'(k_i)-\delta\right)} \geq 0 \qquad (17)$$

The first-order conditions[31] are:

$$k_{t+1} = f(k_t)+(1-\delta)k_t - x_t \qquad (18)$$

$$1+f'(k_t)-\delta = \beta \frac{u'(x_t)}{u'(x_{t+1})} \qquad (19)$$

This system of difference equations can be represented by the phase diagram in Figure 3. k^{SS} and x^{SS} are the levels of capital and consumption –respectively- at the *steady-state* of the dynamic system.
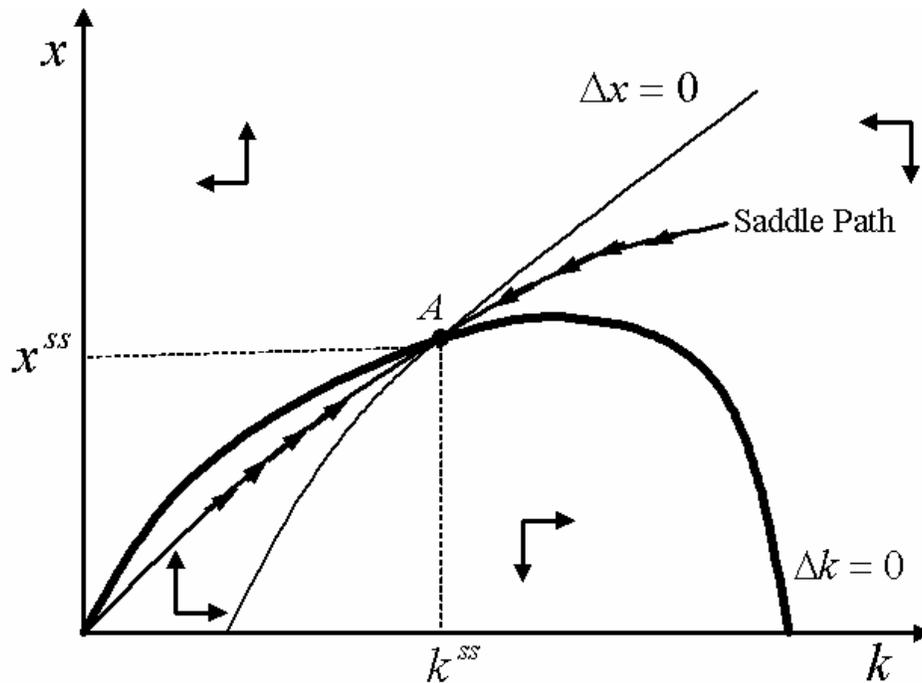

Fig. 3 Phase diagram emphasizing the steady-state (point *A*)

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[31] The optimization process as well as other details can be seen in several macroeconomic textbooks. Azariadis' (1993) version was used here.

Let's assume a minimum level of subsistence consumption $\bar{x} < x^{ss}$ for all t, and a minimum loan amount k_{MIN} for all t, that would be the minimum amount of capital that can lead them to the *steady-state* (Point A in Figure 3) via the *saddle path*.

Since $L^* = \ell N$ and ℓ is generated by an endogenous growth model, *i.e.* $\ell = k_{MIN}$, then the target could be feasible and manageable and predictable with a right calibration of the model for the specific country and the targeted agricultural sector.

The interest rate at the *steady-state* is the marginal product of capital and it is fixed at $f'(k^{ss}) = \rho + \delta$. However, below the *steady-state*, the interest rate is below the sum of the time-preference rate and the depreciation rate, like in the case of k_{MIN}, *i.e.* $f'(k_{\min}) < \rho + \delta$
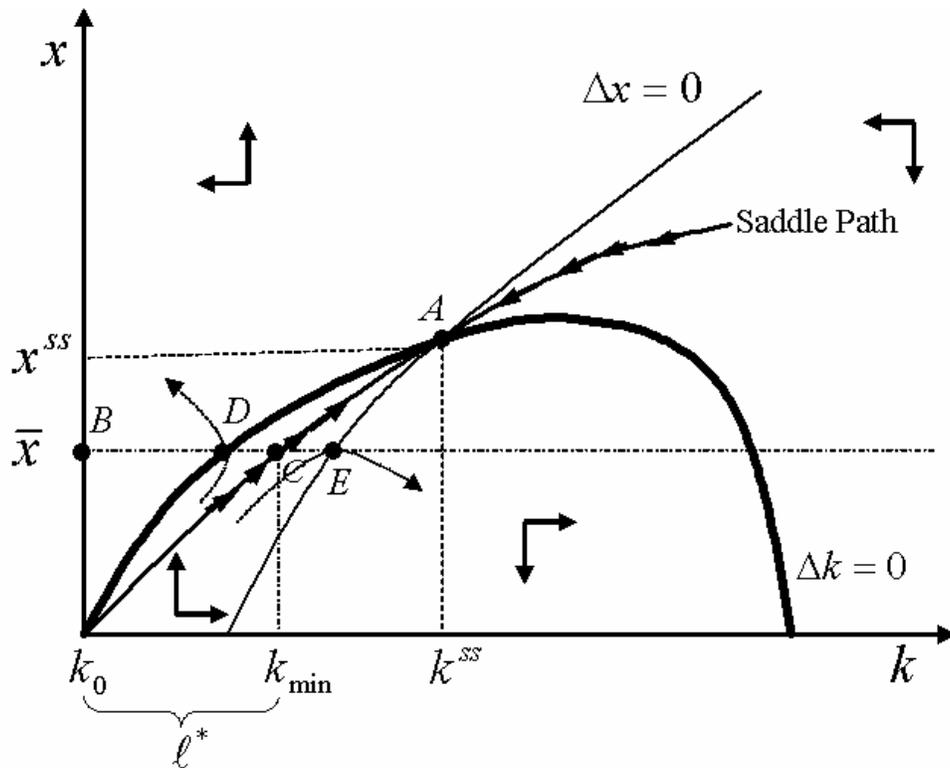

Fig. 4 Steady state, subsistence consumption, and optimal loan amount

As we can observe in Figure 4, individuals consume the minimum level of subsistence $\bar{x}$ either if they do not get the loan (*i.e.* with no capital) –point B - or if they get the loan, *e.g.* at points C, D, and E -just to mention some-. The important issue here is that is the minimum amount of loan is not equal to k_{MIN} -point C - they will take a divergent trajectory within the governing dynamics of the model, like, for example, if the loans amount stands for points D or E. Despite point E is not likely to happen since it will require to give a larger loan than it is supposedly needed. On the other hand, it is not compatible with the credit constraints that developing countries governments meet. Therefore, it is important to emphasize the relevance of giving the right (optimal) amount of loan $\ell = k_{MIN}$, at the right (optimal) interest rate $f'(k_{min}) < \rho + \delta$.

3.2 Welfare implications

So far the model predicts that, regardless of the amount of the loans and the number of credits, if credit allocation marginal costs are not observed by the government (agent), shutting down the national development bank credit operations (if possible) is welfare improving since, given the competitive structure of commercial banks, this action will eliminate their incentives to mimic the high-cost entity, and therefore, reduce the inefficiencies coming from this source.

However, the question on whether an increase in the number of credits will be also welfare improving has not been yet answered. This is where both models the principal-agent model (from section 2), and the endogenous growth model are mixed together. In order to illustrate the welfare implications of an increment in the number of loans, two alternatives are considered: when the minimum-loan restriction is met, and the loan is set equal to the optimal amount of capital k_{MIN}, given the degree of subsistence consumption $\bar{x}$; in contrast when the loan is set equal to an amount k_0, less than k_{MIN}.

In the first case where $\ell = k_{MIN}$, the minimum-loan constraint becomes $\sum_{i=1}^{I} \ell = I k_{MIN}$. Therefore, the loss function will be minimized for all t and the agricultural sector will be benefited period by period, as more rural population is taken into consideration by this subsidized credit program. Moreover, expanding the proportion constraint namely, increasing the number of credits will raise the speed of convergence to the steady-state.

On the other hand, in the second case where $\ell < k_{MIN}$, since the marginal product of capital, an important component to set the optimal subsidized interest rate[32], is a function of the level of capital, and not a function of the loan amount[33], the depletion of capital due to a temporal increase in consumption over the subsistence level, will increase the interest rate, raising the government needed subsidy and magnifying the loss function. At the same time, also worsens the agricultural credit rationing problem. Figure 5 (below) is intended to present a more intuitive approach of these results.
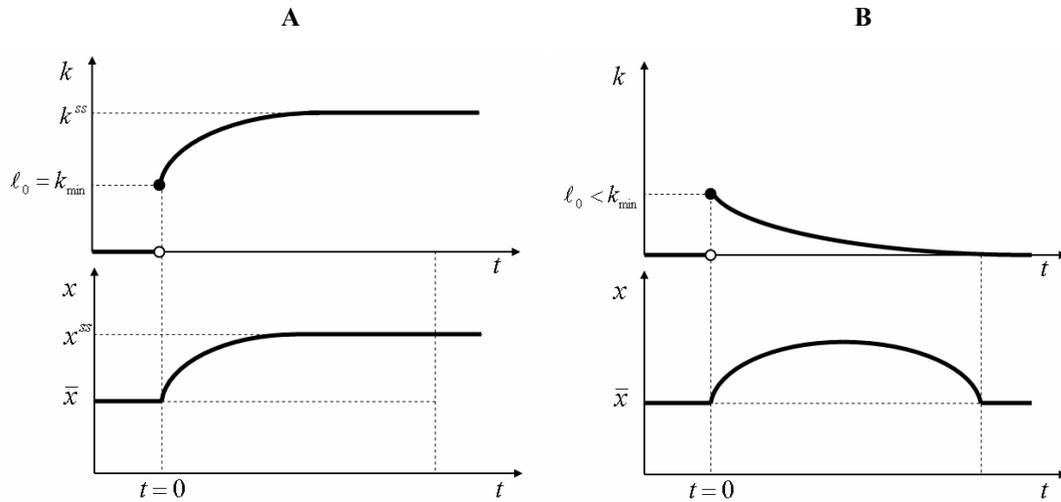

Fig. 5 Dynamic paths of capital and consumption given $\ell = k_{MIN}$ in A and $\ell < k_{MIN}$ in B

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[32] $f'\left(k < k^{SS}\right) < \rho + \delta$, $f'(\bullet) < 0$

[33] The optimal interest rate becomes a function of the loan amount only at time $t = 0$ when the agricultural policy is performed.

The disbursement of the loan given to a representative farmer is represented as a discrete change in capital k in Figure 5. These graphs also illustrate the paths of capital and consumption through time, given the outflow of an optimal loan, *i.e.* the first case, $\ell = k_{MIN}$, on the left (A), and a less than optimal loan $\ell < k_{MIN}$ on the right (B), regardless the number of credits given.

As we can observe, the model predicts that if the loan is less than k_{MIN} welfare will actually decrease no matter how many credits are provided by the government or the retail banking entities. Furthermore, increasing the number of loans will augment the speed of convergence to the initial equilibrium with zero capital and subsistence consumption. In other words, $\ell < k_{MIN}$ creates a poverty trap. On the other hand, if we add farmers' reputation –not formally considered in this model- this could also worsen the credit situation of the farmers since this circumstance will be taken as a bad record.

4. Conclusions

Literature on credit rationing performs a poor job explaining the coexistence of an equilibrium interest rate and credit rationing in the subsidized credit market, because it fails to take into account the major sources of this problem in developing countries. This paper presents an alternative explanation emphasizing that the presence of an inefficient national development bank and nonobservable marginal costs of operation in the overall banking industry are a major source of subsidized credit rationing. The model is based on the fact that these credits are usually many low-amount loans. Costs of operation increase with the quantity of loans given so the inefficiencies to allocate credit when national development banks are present play an important role in the subsidized credit provision.

Assuming observability of the banks' marginal operation costs yields a first-best outcome. Unfortunately, despite that the central bank and (or) other organizations closely monitor domestic commercial banking activity, nonobservability of the marginal

costs of operation in this type of banks is a realistic assumption since it is usually an irrelevant monitoring issue because it is left to banking entity's profit maximization competitive structure.

The problem is that due the nonobservability of marginal costs of operation, commercial banks will have incentives to mimic the development banks behavior in order to get abnormal profits.

It is shown that credit rationing can be reduced if shutting-down the national development bank is a feasible policy. Two more cases in which the government must keep the development credit entity are shown to be welfare-improving.

One option is to shut-down the development bank, so once this is done, the competitive structure will pull prices down plus the government will stop subsidizing the development bank interest rate. But we have already ruled-out this possibility because of the government political constraints due to the usually large bureaucratic body. A second choice is to follow the "Meltzer Report" (2000) recommendation to transform the development bank from capital-intensive lenders into sources of technical assistance. It has the same effect as shutting the national development bank down in terms of giving credits, but perhaps more feasible since you don't have to get rid of all the bureaucratic body in full and you can get advantage of the knowledge it has gained through its years in the market. Another way to go that is not developed in this paper is to create an optimal contract in the case where we need to leave the development bank running, our explanation of why this option could be feasible is because of sunk costs and political issues.

In order to show the welfare effects of an increase in the number of credits, two scenarios were considered: a case where the minimum-loan restriction is met, and the loan is set equal to the optimal amount of capital, given the degree of subsistence

consumption, in contrast when the loan is set equal to an amount less than this optimal amount of capital.

In the former case, the loss function is minimized for all t and the agricultural sector is benefited period by period, as more rural population is taken into consideration by this subsidized credit program and increasing the number of credits, increases the speed of convergence to the desired steady-state. On the latter, since the marginal product of capital is a function of the level of capital, and not a function of the loan amount at all times, the depletion of capital due to a temporal increase in consumption over the subsistence level by the farmer, brings up the interest rate, raising the government needed subsidy and magnifying the loss function. This worsens the agricultural credit rationing problem since the agricultural policy effect is reduced and leaving farmers out of the set of recipients of subsidized credit whereas other farmers, with the same characteristics, with some non-optimal subsidized credit. Thus, the model predicts that if the loan is less than the optimal amount of loan set by the crossing-point where the subsistence consumption meets the saddle path of the endogenous growth model, welfare actually decreases, regardless on how many credits are provided by the government or the retail banking entities. Furthermore, increasing the number of loans will augment the speed of convergence to the initial equilibrium with zero capital and subsistence consumption, creating a poverty trap. Intuitively speaking, if we allow farmers' reputation issues –not formally considered in this model- could also worsen the credit situation of the farmers since this circumstance will be taken as a bad record.

In term of future research, a calibrated model for and simulation for some developing countries and an investigation of the role of R in the gradualism towards international trade issue could be considered as another extension to the present research work.

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