Universidad de San Andres

DEPARTAMENTO DE ECONOMIA

FINANTIAL MARKETS AND INFLATION

Federico Sturzenegger
University of California
Los Angeles

CICLO DE SEMINARIOS 1993
Cuaderno 93/12
Día: Martes 10 de agosto, 9:15 horas

Financial Markets and Inflation I: A Partial Equilibrium Example

José De Gregorio
Research Department, IMF

Federico Sturzenegger
Department of Economics, UCLA, and NBER

First Draft: July 1993

Comments Welcome

Abstract

This paper studies the effects of inflation on the operation of financial markets, showing, in a simple partial equilibrium model, how the ability of financial intermediaries to screen among heterogenous firms is reduced as inflation rises.

1 Introduction

Although there has been considerable work on the effects of inflation on economic activity and welfare, policymakers remain skeptical about which are the most relevant answers. Following Friedman (1969) celebrated prescription of zero nominal interest rate to insure full liquidity, many economists have analyzed the effects of inflation on the ability of money to provide liquidity services. Others have argued that the most important effect of inflation is through its effects on uncertainty, although generally informal, the argument is that inflation is a proxy for the degree of macroeconomic uncertainty, which in turn, reduces the incentives to invest and save. Finally, the frictions that inflation induces in the trading process, has been studied in the context of search theory. Despite the solid microfoundations of this approach, the results are rather disappointing, since the welfare effects of inflation are generally ambiguous (e.g., Bénabou (1992)).

An area that has received little attention, but that seems to be well known by practitioners—specially in high-inflation countries—, is the effects of inflation on the functioning of financial markets and their ability to channel funds to the most efficient activities. Indeed, one of the most visible effects after the Cavallo plan in Argentina was the reemergence of credit to the private sector. Sharp contractions of credit are also usually observed in experiences of extreme inflation.

There are several channels through which inflation may affect the functioning of credit markets. An important mechanism is that the amount of funds that banks have available to lend may fall with inflation. For example, private agents may be discouraged to hold deposits, and thus, the supply of funds may decline (Azariadis and Smith (1993)). However, the decline of credit seems to be sharper than the decline in deposits, which suggests that there are also important effects on the demand side, that may create some form of credit rationing. Indeed, the decline of credit availability occur despite the existence of deposit insurance and indexed instruments. McKinnon (1991) has also argued that distortions in the financial markets stemming from moral hazard and adverse selection problems, generating credit rationing as that of Stiglitz and Weiss (1981), may be exacerbated in an unstable macroeconomic environment.

The purpose of this paper is to develop a formal model that links inflation and the operation of financial markets. Based on the conventional wisdom is that inflation increases uncertainty, it can be argued that banks face more difficulties in distinguishing the riskiness of different customers as inflation rises. This reasoning is the key of our analysis, but we argue that the difficulties of financial intermediaries to distinguish among clients stem from the incentives that risky customers have to act as safe customers in order to receive better credit arrangements.

We present a model where there are two types of firms. One type of firms is more productive and safe, while the other is more risky and unproductive. A central element of our model is that inflation makes both types of firms to look more similar. For example, the productivity of safe firms may decline with inflation, or due to higher search costs the demand of riskier firms may increase relative to that of safe firms. We show that when inflation is low, there is a fully revealing equilibrium, in which banks can perfectly identify each type of firm and charge interest rate according to their own riskiness. However, as inflation rises, low-productivity firms have more incentives to look like high-productivity firms in order to pay a lower interest rate.

On the other hand, high-productivity firms have less incentives to signal that they are of the good type. Thus, high inflation may induce a pooling equilibrium in which banks are unable to distinguish the type of each firm.

The paper follows in three sections. Section 2 presents the basic model. In section 3 we describe the equilibrium, and the effects of inflation in the type of equilibria (separating versus pooling). Finally, section 4 presents the conclusions.

2 The Model

In this section we present a simple partial equilibrium model that captures the informational problems induced by inflation alluded in the introduction. In order to provide a minimum framework to illustrate our approach, we postulate the demand functions and assume that real wages do not change with inflation.

2.1 Firms

There are two type of firms, indexed by $i = h$ and l, to denote high and low, respectively, productivity and demand. For convenience, henceforth, they are called h-firms and l-firms. The mass of firms is normalized to 1 and h-firms represent a fraction α of the total.

Each firm is a monopolist that faces the following demand function:

$$y_i = n_i p_i^{-\epsilon} \quad \text{for} \quad i = h, l, \tag{1}$$

where $\epsilon > 1$, to insure an interior solution to the monopolist's problem. The parameter n_i corresponds to a scale parameter of the demand function, and we assume that $n_h > n_l$, which implies that for the same price h-firms face more demand than l-firms.

Labor is the only factor of production and each firm produces according to the following production function:

$$y_i = a_i \ell_i, \tag{2}$$

where ℓ is labor and a_i its marginal productivity. h-firms are also more productive, thus $a_h > a_l$.

Wages (w) have to be paid before production is sold. Thus, firms need working capital to initiate production. As discussed later, if banks are able to distinguish the type of firms they will charge different interest rates since firms' probabilities of default are different. The interest factor (interest payment plus principal) applied to i-firms ($i = h, l$) when each firm reveals its type is denoted by r_i.

When financial intermediaries can perfectly identify the type of each firm, firms will solve the following optimization problem:

$$\max_{\ell_i} n_i^{1/\epsilon}(a_i\ell_i)^{(\epsilon-1)/\epsilon} - r_i w\ell_i. \tag{3}$$

The optimal solution to this problem, which we call *unrestricted optimum*, is given by:

$$\ell_i^* = n_i \left[\frac{\epsilon-1}{\epsilon}\frac{a_i^{(\epsilon-1)/\epsilon}}{r_i w}\right]^\epsilon \tag{4}$$

and profits are

$$\pi_i^* = \theta n_i a^{\epsilon-1}((1+r_i)w)^{1-\epsilon}, \tag{5}$$

where $\theta = (\epsilon-1)^{\epsilon-1}/\epsilon^\epsilon$.

2.2 The effects of inflation on firms

A crucial assumption we make is that n's are a function of the rate of inflation. More precisely, we assume that as inflation rises the difference between the demand for h-firms goods and l-firms goods becomes smaller. As a normalization, and without loss of generality, we set $n_h = 1$ and $n_l = n(\pi)$, where π is the rate of inflation, $0 < n < 1$, $n' > 0$ and $\lim_{\pi\to\infty} n = 1$. The importance of this assumption is that inflation reduces the "profitability" gap between high- and low-productivity firms. This assumption can be justified in a search-theoretic framework (De Gregorio and Sturzenegger (1993)). Suppose that consumers have to search before buying a good and they face high- and a low-productivity firms, and consequently low- and high-price stores. If inflation is high, consumers become eager to buy, thereby increasing the average reservation value at which they decide to buy. Consequently, the relative demand for goods from the low-productivity firms increases with respect to the demand for goods from the high-productivity firms.

Another dimension in which h- and l-firms are different is in their productivity. Thus, an alternative approach to model the effects of inflation would be to assume that n is the same across firms, but inflation affects the marginal productivity of labor, a's, in such a way that the differential $a_h - a_l$ falls with inflation. This case would occur in an economy where there are two types of firms: one that has comparative advantage in producing goods (h-firms) and the other comparative advantage in avoiding the costs of inflation (l-firms). Thus, by summarizing this productive advantages in $a_h - a_l$, one can justify why this difference declines with inflation. The analysis is similar to the case of difference in n, since in both cases inflation makes firms to be more similar.

Our main concern in this paper is with the *relative* position of h-and l-firms, and hence, we do not focus on the levels of the parameters. For example, in an environment where inflation affects negatively economic activity, we would expect not only the difference between n_h and n_l, or alternatively between a_h and a_l, decline, but the values of all those parameters also decline.

2.3 Financial intermediaries

Financial institutions are perfectly competitive and offer debt contracts, i.e. they offer to lend at a given interest rate, which will be given by a zero profits condition. Banks obtain their funds from an infinitely elastic supply (e.g., foreign investors) at an interest factor equal to ρ. h-firms always pay the loan, and if they can be unequivocally identified by banks, they will be charged an interest rate $r_h = \rho$. In contrast, l-firms default with probability $1 - q$. Default is the result of a bad draw that makes l-firms completely unproductive, making them unable to repay any part of the loan.[1] Therefore, the zero profit condition for banks on loans to l-firms implies that the interest rate is $r_l = \rho/q$.

Firms' type is private information: only individual firms know their own type, and it cannot be verified by banks. Therefore, whenever the equilibrium does not induce firms to reveal their type, banks will charge a uniform interest rate to all firms ($\bar{r}$), which is given by:

$$\bar{r} = \frac{\rho}{\alpha + (1-\alpha)q}. \tag{6}$$

[1] Implicitly our analysis assumes that l-firms maximize expected profits, and with probability $1 - q$ they earn zero profits. Therefore, they only care about profits in the event that they do not fail.

2.4 Firms again

Since $r_h < \bar{r} < r_l$, l-firms have the incentive to look like h-firms, since they will be charged a lower interest rate. However, l-firms need to act as h-firms in order to be charged a lower interest rate. In particular, they need to apply for a loan of the same size as that of h-firms: l-firms can reduce their interest payments at the cost of having a larger loan. We assume that banks can monitor employment, and therefore for given a loan L, l-firms have to hire L/w units of labor. Then, l-firms' decision of whether or not to mimic h-firms will depend on the tradeoff between receiving a low interest rate and requesting an excessive amount of credit.

Since h-firms produce $a_h \ell_h$ units of goods, the following condition has to be satisfied in order for l-firms to be willing to mimic (demanding a loan of the same magnitude) h-firms:

$$n^{1/\epsilon}(a_l \ell_h)^{(\epsilon-1)/\epsilon} - \bar{r}\ell_h w \geq n a_l^{\epsilon-1}(r_l w)^{1-\epsilon}\theta. \tag{7}$$

Condition (7) establishes that l-firms will prefer to mimic h-firms whenever profits obtained by producing the same as h-firms are greater than producing at a level equal to the fully revealing optimum. The LHS of (7) is decreasing in ℓ_h, by the concavity of profits and because $\ell_l^* < \ell_h$.[2] Therefore, equality in equation (7) defines the maximum value of ℓ_h, denoted by $\bar{\ell}$, at which l-firms prefer a pooling equilibrium, because the benefits from paying a lower interest rate more than offset the costs of overproduction. Then, $\bar{\ell}$ is defined by:[3]

$$n^{1/\epsilon}(a_l \bar{\ell})^{(\epsilon-1)/\epsilon} - \bar{r}\bar{\ell} w = n a_l^{\epsilon-1}(r_l w)^{1-\epsilon}\theta. \tag{8}$$

When $\bar{\ell}$ is less than ℓ_h^*, the unrestricted optimal decision of h-firms prevents l-firms from acting like h-firms, that is, h-firms do not need to expand their borrowing and employment beyond the unrestricted optimum in order to be distinguished from l-firms. Consequently the value of ℓ_h that maximizes profits of h-firms when they want to prevent l-firms from pooling is:

$$\ell_h = \begin{cases} \bar{\ell} & \text{for } \bar{\ell} > \ell_h^* \\ \ell_h^* & \text{for } \bar{\ell} \leq \ell_h^*. \end{cases} \tag{9}$$

[2] As should be clear later, h-firms will produce at least $a_h \ell_h^*$, since in order to signal their type they may choose a level of employment greater than ℓ_h^*, and consequently, we can focus in cases where $\ell_h \geq \ell_h^* \geq \ell_l^*$.

[3] For all $\ell_h > \bar{\ell}$ equation (7) does not hold and l-firms do not want to pool. Since signaling is costly for h-firms, they will never choose employment greater than $\bar{\ell}$

Finally, given this value of ℓ_h we can ask the following question: Under which conditions h-firms will prefer to separate from l-firms? The condition for this to happen is that profits from overproducing an amount that prevents l-firms from mimicking are greater than profits in a pooling equilibrium. Formally, this condition is:

$$(a_h \ell_h)^{(\epsilon-1)/\epsilon} - r_h \ell_h w \geq a_h{}^{\epsilon-1} (\bar{r} w)^{1-\epsilon} \theta. \tag{10}$$

Again, since the LHS is decreasing in ℓ_h, equality in equation (10) defines the maximum value of ℓ at which h-firms want to separate.

By looking at unrestricted profits, profits in pooling equilibrium, and profits when h-firms overborrow to separate themselves from l-firms, the optimal choice of ℓ of h-firms, ℓ_h^{**}, is:

$$\ell_h^{**} = \begin{cases} \ell_h^* & \text{for } \bar{\ell} \leq \ell_h^* \\ \bar{\ell}_h & \text{for } \bar{\ell} > \ell_h^* \text{ and (10) holds} \\ \ell_h^* & \text{for } \bar{\ell} > \ell_h^* \text{ and (10) does not hold.} \end{cases} \tag{11}$$

Given this optimal choice of h-firms, and the fact that they are the ones that ultimately decide whether or not the equilibrium is pooling or separating, the optimal choice of l-firms is determined as follows:

$$\ell_l^{**} = \begin{cases} \ell_l^* & \text{for } \bar{\ell} \leq \ell_h^*, \text{ or } \bar{\ell} > \ell_h^* \text{ and (10) does not hold} \\ \ell_h^* & \text{otherwise.} \end{cases} \tag{12}$$

According to (11)–(12) there are three possible equilibria:

- *Natural separation.* This is the case where $\bar{\ell} \leq \ell_h^*$, and h-firms can achieve their unrestricted optimum without effort in signalling their type, since l-firms have no incentives to mimic h-firms when the former demand ℓ_h^* units of labor. Therefore, l-firms choose also their unrestricted optimum. Total credit in this equilibrium is $w[\alpha \ell_h^* + (1-\alpha)\ell_l^*]$ and each type of firm is charged a different interest rate.

- *Separation.* In this case $\bar{\ell} > \ell_h^*$, and hence, h-firms have to produce more than their unrestricted optimum in order to separate from l-firms. In addition, h-firms will be willing to separate, at a cost of overproducing, since equation (10) holds. Because h-firms decide to produce $\bar{\ell}$, l-firms will have no incentive to mimic h-firms behavior, and hence, they choose their unrestricted optimal level of production. In this equilibrium total credit is equal to $w[\alpha\bar{\ell} + (1-\alpha)\ell_l^*]$.[4] This equilibrium can also be called *costly separation.*

- *Pooling.* This case is also characterized by $\bar{\ell} > \ell_h^*$, but it does not payoff to h-firms to overproduce in order to separate from l-firms, since (10) does not hold at $\ell_h = \bar{\ell}$. Under these conditions there is a pooling equilibrium, where h-firms choose the unrestricted optimum (for an interest rate equal to $\bar{r}$), and l-firms mimic this behavior because (7) holds. Note that in this equilibrium, the choice of ℓ is the optimal one for h-firms for the pooling interest rate. In contrast, l-firms overborrow, and overproduce, in order to be charged the pooling interest rate. Total credit in a pooling equilibrium is $w\ell_h^*$, and without further restrictions on α and the other parameters, it cannot be compared with total credit in the previous cases.

Finally, because the conditions that define each possible outcome are mutually exclusive, the equilibrium is unique and will depend on the value of the parameters. This issue is addressed in the next section.

3 Equilibria and Comparative Statics

In this section we characterize the three equilibria, and show the main effects that changes in the parameter have on likelihood that those equilibria occur. More specifically, we define ranges of n, and implicitly inflation, at which each possible outcome is the equilibrium, and how do they change with the values of q and α. For the rest of this section we consider the case of $a_l = a_h = 1$, so no firm has a productive advantage, and they only differ on their demands and probability of default.

3.1 Equilibria

Before characterizing the ranges of inflation and n at which the different equilibria occur, it is useful to show the following result:

[4] Note that in this equilibrium h-firms overborrow, thus total credit increases, but this result is particular to our assumption that the demand faced by l-firms grows with inflation ($n' > 0$), while the demand faced by h-firms remains constant ($n_h = 1$). More in general, one could assume that both demands fall, but more rapidly that of h-firms. Therefore, financial intermediation would unambiguously decline with inflation.

Proposition 1 *As n increases, the minimum value of ℓ at which l-firms do not have incentives to mimic h-firms increases, that is,*

$$\frac{d\bar{\ell}}{dn} > 0.$$

Proof: Define the following expressions:

$$A(\ell) \equiv \frac{1}{\epsilon}\left(\frac{\ell}{n}\right)^{\frac{\epsilon-1}{\epsilon}} - (r_l w)^{1-\epsilon}\theta, \tag{13}$$

$$B(\ell) \equiv \bar{r}w - \frac{\epsilon-1}{\epsilon}\left(\frac{\ell}{n}\right)^{\frac{-1}{\epsilon}}. \tag{14}$$

Differentiating equation (8) we have that:

$$\frac{d\bar{\ell}}{dn}B(\bar{\ell}) = A(\bar{\ell}). \tag{15}$$

$B(\ell)$ corresponds to minus the derivative of profits with respect to ℓ. The first order condition for maximization of h-firms implies that B evaluated at ℓ_h^* is zero. Since separation occurs at an ℓ greater or equal than ℓ_h^*, the second order condition implies that B is positive. Therefore,

$$\text{sign}\,\frac{d\bar{\ell}}{dn} = \text{sign}\,A(\bar{\ell}). \tag{16}$$

Note that $A(\bar{\ell}) > A(\ell_h^*)$, because A is an increasing function of ℓ and $\bar{\ell} > \ell_h^*$. Then, it is enough to show that $A(\ell_h^*) > 0$.

Substituting $\bar{\ell}$ by ℓ_h^* from (4), and after some algebra, it can be shown that $A(\ell_h^*)$ can written as follows:

$$A(\ell_h^*) = \theta r_l^{1-\epsilon}\left[\left(\frac{r_l}{\bar{r}}\right)^{\epsilon-1} - 1\right] > 0, \tag{17}$$

which is positive since $r_l > \bar{r}$. ‖

This proposition shows a very intuitive result, namely, if the demands of both types of firms get closer, the effort needed by h-firms in order to separate (measured in terms of required loan and implied employment) must increase. While (7) is not binding, h-firms will produce at their unrestricted optimum, but once they cannot naturally separate they must increase ℓ when n rises if they want to prevent l-firms from pooling.

Now, the main result about the characteristics of each equilibrium can be stated as follows:

Proposition 2 *Define n_s by:*

$$n_s^{1/\epsilon}(a_l\ell_h^*)^{(\epsilon-1)/\epsilon} - \bar{r}\ell_h^* w = n_s a_l^{\epsilon-1}(r_l w)^{1-\epsilon}\theta, \tag{18}$$

and n_p by:

$$n_p^{1/\epsilon}(a_l\tilde{\ell})^{(\epsilon-1)/\epsilon} - \bar{r}\tilde{\ell} w = n_p a_l^{\epsilon-1}(r_l w)^{1-\epsilon}\theta, \tag{19}$$

where $\tilde{\ell}$ is defined by:

$$(a_h\tilde{\ell})^{(\epsilon-1)/\epsilon} - r_h\tilde{\ell} w = a_h^{\epsilon-1}(\bar{r}w)^{1-\epsilon}\theta. \tag{20}$$

Then,

(i) *n_s exists and for all $n \in [0, n_s]$ the equilibrium is natural separating.*

(ii) *For all $n \in [n_s, \min\{n_p, 1\}]$ the equilibrium is separating.*

(iii) *If $n_p < 1$ exists, then for $n \in [n_p, 1]$ the equilibrium is pooling.*

Proof: (i) Note first that for $n = 0$ there is, trivially, natural separation. At the other extreme, when $n = 1$, the RHS of (7) is equal to $(r_l w)^{1-\epsilon}\theta$, while the LHS evaluated at ℓ_h^* is equal to $(\bar{r}w)^{1-\epsilon}\theta$, and is greater than the RHS. Therefore, at the unrestricted optimum for h-firms, l-firms prefer to pool, and hence, natural separation cannot prevail at $n = 1$. Finally, the proof of existence of a unique value of $n_s < 1$ is completed by noting that the LHS of (7) increase faster than the RHS (see proof to proposition 1).

(ii) n_s is defined when (7) holds for ℓ_h^*, and hence natural separation is no longer feasible. To show that the equilibrium is separating, instead of jumping straight to pooling equilibrium, one needs to show that for n slightly greater than n_s h-firms prefer to separate. This is a consequence of the envelope theorem: a small increase in ℓ_h implies a second order loss, while the decline in profits is discrete since r would rise from r_h to $\bar{r}$.

(iii) Comparing equations (18) and (20) it can be seen that $\tilde{\ell} > \ell_h^*$, and hence, by proposition 1, $n_p > n_s$. The variable $\tilde{\ell}$ is the maximum value at which h-firms want to separate. As n increases slightly above n_p, ℓ_h must rise above $\tilde{\ell}$ (proposition 1), which is not in the interest of h-firms because (10) would not hold, and hence, they prefer to pool. ||

This proposition establishes that when the demand functions, and hence profitability, of both firms are far apart, the equilibrium is natural-separation. Since l-firms need to overproduce a large amount of goods to mimic h-firms when n is low, the benefits from obtaining a low interest rate do not offset the costs of overproducing.

Then, the proposition shows that when natural separation is not feasible, h-firms still prefer to separate, but for this to happen, they need to produce beyond their unrestricted optimum, instead of willing to accept pooling. The proof is straightforward, since it relies on the envelope theorem: a small change in ℓ_h around its optimum leads to second order losses, while a step increase in the interest rate leads to a first order loss. Finally, the proposition establishes that there may be a point at which separation becomes too expensive for h-firms, so they "give up" and accept the pooling equilibrium. However, the existence of this region depends on the parameter values, issue which we discuss below.

The result of proposition 1 is summarized in figure 1. The demand for loans when n is low, and hence inflation is different for each type of firms. Thus the type of each firm is fully revealed by the size of the loan requested. As inflation increases, and consequently n also increases, h-firms have to borrow above their unrestricted optimal to signal that they are of the high type. Finally, for $n = n_p$ separation is too costly and the equilibrium is pooling.

3.2 Comparative Statics

There are two comparative exercises that are relevant to study. First, the effects of α, the fraction of h-firms in the total, on n_s and n_p, and, second, the effects of q, the probability of no default, on the same variables. The effects of changes in α can be summarized in the following proposition:

Proposition 3

$$\frac{dn_s}{d\alpha} < 0 \quad and \quad \frac{dn_p}{d\alpha} < 0.$$

Proof: For $dn_s/d\alpha < 0$, it is enough to take derivatives to equation (18) and use the fact that $A(\ell_h^*) > 0$ (see proof of proposition 1).

For $dn_p/d\alpha < 0$ note that the LHS of (20) is decreasing in $\tilde{\ell}$, and so if α, and consequently $\bar{r}$, declines, the value of $\tilde{\ell}$ will decrease, which requires a decline in n_p

to preserve the equality. $\|$

The intuition for this result is simple. If α is low, there are few h-firms, in which case r_l is not too different from $\bar{r}$, so l-firms do not have much incentive to pool. In contrast, when α is high, l-firms have a big incentive to look like h-firms, since they may enjoy a big reduction in interest rates by pooling. This implies that (costly) separation and pooling are more likely to occur. Figure 2 summarizes the effects of α on n_s and n_p. As α goes to zero n_s goes to one, since there is no incentive for pooling. It can be easily shown that for α close to one there is a region in which pooling exists, which also proves that under certain parameter configurations pooling equilibrium exists.

The comparative statics results for q are less clear cut, because changes in q affect $\bar{r}$, in the same way as the effects of α, and also affects r_l. An increase in q reduces $\bar{r}$, increasing the incentives for pooling. But, contrary to the case of a change in α, an increase in q also reduces r_l, reducing the incentives for pooling. In general, both effects operate in different directions, but it can be shown that for q around zero the following results hold:

Proposition 4 *For q close to zero,*

$$\frac{dn_s}{dq} > 0 \quad and \quad \frac{dn_p}{dq} > 0.$$

Proof: Differentiating equation (18):

$$\frac{dn_s}{dq}\left[\frac{1}{\epsilon}\left(\frac{\ell_h^*}{n_s}\right)^{\frac{\epsilon-1}{\epsilon}} - (r_l w)^{1-\epsilon}\theta\right] = \ell_h^* w \frac{d\bar{r}}{dq} - (\epsilon-1) n_s w (w r_l)^{-\epsilon}\theta \frac{dr_l}{dq}, \qquad (21)$$

the term in square brackets is positive (because $A(\ell_h^*) > 0$), while the first term at the RHS is negative, and the second positive. However, for q around zero the RHS goes to ∞, since dr_l/dq goes to $-\infty$. This shows that dn_s/dq around zero is positive.

Similarly, differentiating equation (20):

$$\frac{dn_p}{dq}\left[\frac{1}{\epsilon}\left(\frac{\tilde{\ell}}{n_p}\right)^{\frac{\epsilon-1}{\epsilon}} - (r_l w)^{1-\epsilon}\theta\right] = \left[\frac{\epsilon-1}{\epsilon}\left(\frac{\tilde{\ell}}{n_p}\right)^{\frac{-1}{\epsilon}} - r_h w\right]\frac{d\tilde{\ell}}{dq} - (\epsilon-1) n_p w (w r_l)^{-\epsilon}\theta \frac{dr_l}{dq}. \qquad (22)$$

By differentiating equation (19) it can be shown that $d\tilde{\ell}/dq$ is negative, but bounded, while dr_l/dq goes to $-\infty$ when q goes to zero. Therefore, for q close to zero dn_p/dq is positive, which completes the proof. ||

Note that changes in q have the opposite effects on n_s and n_p than changes in α. Indeed, this proposition shows that the effects of q on r_l are quantitatively more important than the effects of q on $\bar{r}$ when q is close to zero.[5] Figure 3 shows the relationship between n_s and n_p, and q, assuming that the comparative statics result for q close to zero hold for all the other values of q. Note that in the limit, when q goes to one, l-firms have no incentives to mimic h-firms behaviors, and hence, for all values of n natural separation is achieved.

Summarizing, in this section we have shown that an increase in the fraction of h-firms increases the incentives for pooling, reducing the range of values of n for which natural separation is achieved. On the other hand, a decline in the probability of default reduces the incentives for pooling, making more likely natural separation.

4 Conclusions

In this paper we have presented a model where inflation induces informational frictions that affects credit markets equilibrium. Inflation affects the relative profitability among firms, generating incentives for low-productivity firms to mimic the behavior of high-productivity firms. When inflation is low the equilibrium is such that there is full revelation of information. Each type of firm reveals its type when demanding working capital. However, as inflation rises high-productivity firms may need to overborrow, and consequently overproduce, in order to signal their type. In contrast, low-productivity firms have the incentive to mimic high-productivity firms in order to be charged a lower interest rate.

We have shown that depending on inflation, there are three types of equilibria. For low rates of inflation, the equilibrium is fully revealing and neither firm have the incentive to deviate from their unrestricted optimum. At moderate rates of inflation, the equilibrium is fully revealing, but high-productivity firms have to overproduce in

[5] It can be easily verified that while both r_l and $\bar{r}$ fall with q, the difference $r_l - \bar{r}$ also falls with q, showing that the effects of q on r_l are greater than the effects on $\bar{r}$.

order to signal their type, and to receive a better loan contract. Finally, at high rates of inflation it may not payoff for high-productivity firms to signal their type, and hence this may result in a pooling equilibrium, where firms cannot be distinguished in equilibrium. It is important to note that the inefficiencies of inflation identified in this paper occur discretely. That is, small changes in the rate of inflation may not have consequences in the type of equilibrium. Instead, significant changes in the rate of inflation, may not only induce the standard costs of inflation traditionally discussed in macroeconomics, but may also induce costly informational inefficiencies.

Despite the simplifications of this model, we think that the mechanisms we discuss in this paper are potentially relevant for a number of applications. First, it may provide new insights on the effects of inflation on economic growth. The inability of financial intermediaries to distinguish the riskiness associated to different customers may have consequences on the ability of financial markets to allocate credit and foster economic growth. Second, it may also help to explain the marked recovery of credit to the private sector after a stabilization program is successfully implemented. This effect, in turn, may explain why at the onset of some stabilization programs there is a boom rather than, as usually thought, a recession.

References

Azariadis, C. and B. Smith (1993), "Adverse Selection and Inflation in an OLG Model." mimeo, UCLA and Cornell University.

Bénabou, R. (1992), "Inflation and Markups: Theories and Evidence from the Retail Trade Sector," *European Economic Review*, 36: 566–574.

De Gregorio, J. and F. Sturzenegger (1993), "Financial Markets and Inflation II: A Search-Theoretic Model," mimeo, IMF and UCLA.

Friedman, M. (1969), "The Optimal Quantity of Money," in *The Optimum Quantity of Money and Other Essays,* Chicago: Aldine.

McKinnon, R. (1991), *The Order of Economic Liberalization: Financial Control in the Transition to Market Economy*, Baltimore and London: Johns Hopkins University Press.

Stiglitz, J. and A. Weiss (1981), "Credit Rationing in Markets with Imperfect Information," *American Economic Review*71: 393–410.

Figure 1

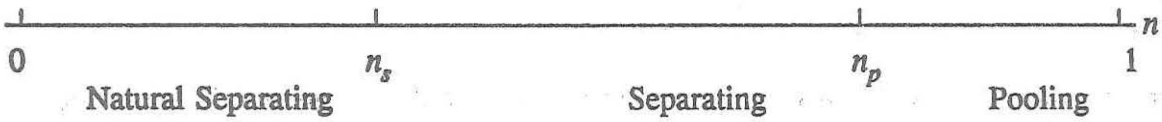
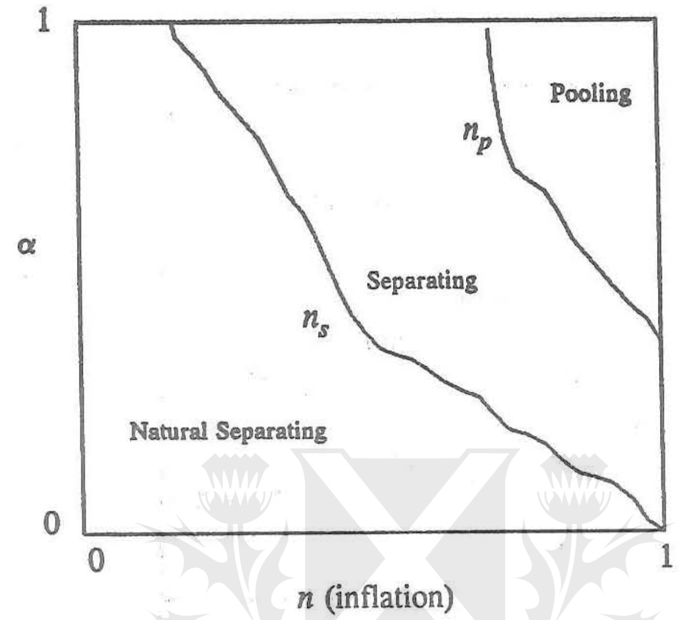
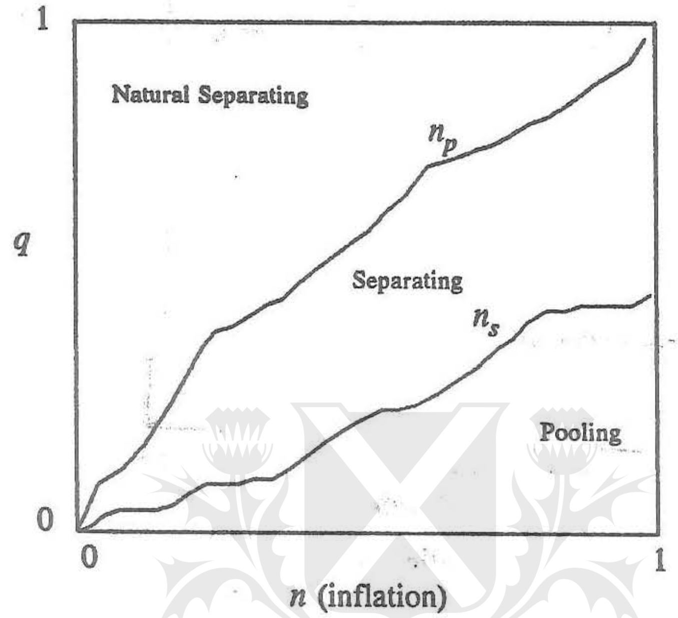


Figure 2



1
0
α
Pooling
n_p
Separating
n_s
Natural Separating
0
1
n (inflation)

Figure 3


1
Natural Separating
n_p
q
Separating
n_s
Pooling
0
0
1
n (inflation)