From Loan Pushing to Credit Rationing: A Brief Note on Interest Shocks in a Model by Basu

by

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Basu [1991], in his introduction, argues that the 1982 debt crisis can be interpreted as a transition from loan pushing to credit rationing induced by an interest shock. He analyzes how in international lending there can be equilibria with credit rationing and with loan pushing. He, and in fact the international credit literature, does not study how one of these regimes can give way to the other although this is crucial for his suggested interpretation of the debt crisis. In this brief note, the conditions for such a transition from loan pushing to credit rationing are formulated within the framework of Basu’s model. (JEL: F34)

I. Introduction

Eaton and Gersovitz [1981] showed in an econometric investigation that 56 of 81 countries were credit rationed in 1970 and 1974 with a probability of 50%. This result can also be interpreted to say that 25 of 81 countries were not credit rationed. Dillon et al. [1985] suggest that there had been excessive lending before the 1982 debt crisis. Economic historians suggest that bank behavior was characterized by “overexposure” (Fishlow [1985, 408 and 423]) and loan pushing (Eichengreen [1989, 122]) prior to the 1982 debt crisis. Darby [1986] and Basu [1991] summarize much anecdotal evidence pointing in the same direction. These preliminary empirical findings raise the question whether or not the theory of sovereign debt is merely a theory of credit rationing (Eaton, Gersovitz and Stiglitz [1986]) or, alternatively, whether it could also be linked to other results such as loan pushing. To be able to discuss this question, a necessary first step is to define a benchmark relative to which credit exposure can be defined to be excessive or rationing credit.

Basu [1991] chooses the neoclassical equilibrium – where credit demand is satisfied at a given world market interest rate – as a benchmark. If credit rationing occurs, a debtor receives less credit than the volume demanded. Loan

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pushing, on the other hand, can be defined as a credit supply that is higher than the amount on the demand curve of the debtor. The crucial question, then, is why borrowers accept more credit than they want to have according to their demand curve. Basu assumes that banks can form a consortium or syndicate which acts as a monopolist making take-it-or-leave-it offers. The debtor does not reject such an offer as long as he is not getting less utility than he would have with no credit at all. Such a take-it-or-leave-it offer may consist of a credit volume that is higher than values on the demand curve for a given interest rate.

Basu interprets the 1982 debt crisis as a transition from loan pushing to credit rationing. However, his model, that will be restated in the next section, shows both regimes separately, but not the transition from loan pushing to rationing. It is the purpose of this brief note to derive conditions in section 3 under which interest shocks lead from a loan-pushing equilibrium to a credit-rationing equilibrium.

2. The Basu Model Briefly Restated

Opportunity costs of a creditor are assumed to be \( rL \), with \( L \) as the volume of credit and \( r \) as the rate of interest received on the world market. The gross return is \( iL \), with \( i \) as a percentage rate of the credit volume. The net profit is \( (i - r)L \). If the debtor does not pay the debt service, interest and repayment after one period, he can increase his consumption by \( (1 + i)L \) in the next period. By assumption, only a punishment which is equal to or larger than this value can ensure that he pays. This punishment, \( b \), is specified to be an increasing function of the credit volume. It is zero if there is no repudiation because otherwise international norms would be violated (see Basu [1991, 6–10] for a longer explanation). The punishment is a concave function of the credit volume with an upper bound: \( b = b(L), b^* > 0, b'' < 0, \lim_{L \to \infty} b = \bar{b} \). Moreover, the utility of the debtor must be as high as without a contract: \( U(\hat{C}_1, \hat{C}_2) \) – henceforth abbreviated \( U \) – denotes the utility from consumption in periods 1 and 2 without a credit contract; with a credit contract the utility is denoted as \( U[\hat{C}_1 + L, \hat{C}_2 - (1 + i)L] \). The problem of the monopolistic creditor can be stated as follows:

\[
\begin{align*}
\text{(1)} & \quad \max_{i, L} \quad \frac{(i - r)L}{L} \\
\text{subject to} & \quad b(L) \geq (1 + i)L \quad \text{and} \\
& \quad U[\hat{C}_1 + L, \hat{C}_2 - (1 + i)L] \geq U.
\end{align*}
\]

Basu shows (i) that credit rationing is the outcome if the first constraint is binding and the second is not, and (ii) that loan pushing results if the second is binding but the first is not. This will be restated below. Although it is
fundamental for his interpretation of the debt crisis, Basu does not show how an interest shock shifts the economy from the loan-pushing regime to the regime of credit rationing. Conditions under which this happens will be derived below, because Basu's suggestion that the 1982 debt crisis has driven the debtor countries from a loan-pushing to a credit-rationing equilibrium has some support from the preliminary evidence mentioned in the introduction.

Figure 1
Credit Rationing Under Perfect Competition and Monopoly

\[
\text{Source: Basu [1991].}
\]

Credit Rationing: If the second constraint is not binding, but the first one is, the latter can be inserted into the objective function resulting in the following problem:

\[
(2) \quad \max_{L} b(L) - (1 + r) L.
\]

In this case, the potential punishment \( b(L) \) is equal to the value of revenues because the first constraint is binding, and the opportunity costs must be subtracted. Both parts of this objective function are drawn in figure 1. The distance between both functions must be maximized. The first-order condition \( b'(L) = 1 + r \) says that the distance is maximized where both functions have the same slope. Existence of such an equilibrium requires \( b'(0) > 1 + r \). The ray from the origin to the optimal point A has the slope \( b(L^*)/L^* = 1 + i^* \), where the asterisk indicates an optimal value of the variable in question. The vertical difference between both curves at \( L^* \) is the amount of monopoly profit. At
point B profits are zero; this characterizes the perfectly competitive equilibrium in which a creditor cannot get more than the opportunity revenue.

An increase in the rate of interest makes the line \((1 + r)\) steeper and decreases the credit volume in the monopolistic case (point A) as well as in the competitive case (point B) of credit rationing. The optimal gross rate of return, \(i^*\), increases because the ray from the origin to the new equilibrium is steeper at a lower value of \(L^*\). Both equilibrium points have been determined independently of the debtor's demand function for credit. If credit demand is higher for given values of \(r\) and \(i^*\), the debtor will be rationed. If credit demand is lower, it has to be taken into account explicitly because credit rationing cannot exist (see Basu [1991], figures 2 and 3, and the corresponding explanation).

**Loan Pushing.** If the second constraint is binding, the first one is not and the demand function is ignored, the case of a take-it-or-leave-it offer is obtained. This case will be considered in what follows. To be able to show that the monopoly solution has higher values than those on the demand function, the latter is drawn in figure 2.

**Figure 2**

Monopolistic "Loan-Pushing" Equilibrium

The demand function is obtained from utility maximization with respect to \(L\) for a given rate of interest \(i\). The corresponding first-order condition is \(U_1 - U_2 (1 + i) = 0\). The second-order condition is \(U_{11} - U_{12} (1 + i) - U_{21} (1 + i) + U_{22} (1 + i)^2 < 0\). The indifference curves in the \(i - L\)-space have
the slope $d\pi/dL = [U_1 - U_2/(1 + i)]/(U_2 L)$. The demand curve is defined such that indifference curves have slope zero on the demand curve. Assuming $U_{11}, U_{22} < 0$ and $U_{12} > 0$, the second-order condition is fulfilled and the demand curve $(DD')$ is falling. Credit volumes higher than on the demand curve decrease utility, and the level of utility can only be kept constant if the rate of interest is lower. Therefore, indifference curves (e.g., $KL$) will fall to the right of the demand curve and are an increasing curve to the left of the demand curve. Thus, they are drawn as having an inverted U-shape in Figure 2. Lower indifference curves have higher utility because interest costs are lower. The demand curve intersects the vertical axis where the indifference curve for the utility without credit $(DJ)$ has a maximum on the vertical axis.

The iso-profit lines $(\pi)$ of the monopolist have the slope $d\pi/dL = -(i - r)/L < 0$. At higher curves, profits are higher. As long as profit is positive, the iso-profit line will lie wholly above the interest rate $r$. The profit is at a maximum where an iso-profit line $(\pi^*)$ is tangential to the indifference curve of the reservation level of utility $(U^0)$. This point $(E^*)$ lies to the right of the demand function.

In order to have the same level of profits after an interest shock at a higher value of the world market rate of interest, $r$, and the same value of the volume of credit, $L$, a higher gross rate of return, $i$, is required. The slope of the new iso-profit line at given values of $i$ and $L$ will be flatter than that of the old iso-profit line at that point. A new monopoly solution is therefore obtained at a lower credit volume and a higher rate of interest, if the solution remains in the loan-pushing regime.

The more interesting case, as verbally suggested by Basu [1991, 2], is the one in which an interest shock drives the equilibrium solution from the loan-pushing regime into that of credit rationing. However, Basu does not analyze this case even though it is central to his interpretation of the debt crises. Therefore, this is done in the next section.

3. An Interest Shock Leading From Loan Pushing to Credit Rationing

In order to demonstrate the transition from loan pushing to credit rationing, both regimes restated above have to be integrated in a single graph. The analysis to find the conditions for a transition from loan pushing to credit rationing after an interest shock – defined as a rise in $r$ – proceeds in three steps. First, in Figures 3 and 4 both constraints of the monopolist are drawn in the $i - L$-space such that they intersect. Otherwise one of them is never binding, because it follows from the maximization problem of the creditor that the constraint located more inward is always binding. Second, for merely didactic purposes, it is assumed that there is an initial equilibrium in the intersection of the constraints. Third, what happens if the rate of interest becomes higher than in the initial situation will be analyzed.
The explicit form of the first constraint is \( i = b(L)/L - 1 \). For \( L = 0 \) the value of \( i \) is found as \( b'(0) - 1 \) using L'Hôpital’s rule, where \( b'(0) > 1 + r > 1 \) because otherwise the credit-rationing equilibrium of figure 1 could not exist; therefore, this function has a positive vertical intercept and will increase for low values of \( L \) and decrease for high values of \( L \). As \( b \) has an upper bound, \( b/L \) goes to zero for \( L \to \infty \) and \( i \) therefore approaches \(-1\).

The constraint from the debtor’s reservation level of utility in figure 2 has slope \( U_1(\hat{C}_1, \hat{C}_2) - U_2(\hat{C}_1, \hat{C}_2)(1 + i) = 0 \) on the vertical axis. Its vertical intercept is therefore \( i = U_1/U_2 - 1 > 0 \). Depending on \( b'(0) > (<) U_1/U_2 \), this utility constraint has a lower (higher) vertical intercept than the rationing constraint.

In figures 3 and 4 four possible situations are drawn. If the reservation-utility constraint is below the rationing constraint as in the case denoted as \( U^0 \), the reservation utility is the binding constraint because the rationing constraint leaves the debtor with lower utility than a situation with no credit. If the reservation-utility constraint is in a higher position, it cuts the rationing constraint either in the increasing part (\( U^1 \)) or in the decreasing part (\( U^2 \); both in figure 3). It is also possible that the reservation-utility constraint cuts the rationing constraint twice, as in the case denoted as \( U^3 \) (figure 4). In the latter case, at an intersection point with low values of \( L \) the reservation-utility constraint has an algebraically smaller slope than the rationing constraint and at high values of \( L \) it is less steep than the rationing constraint.
The monopoly equilibrium – point B in figure 3 – is chosen as a starting point. Here the iso-profit line is tangential to the reservation-utility constraint, $U^2$, and intersects the rationing constraint. The crucial question then is, how does an interest shock change the equilibrium situation? As shown above, the iso-profit line for the initial profit level is now in a higher position and the new iso-profit line at the initial point is now flatter. The new monopoly equilibrium, therefore, must be to the left of point B on the rationing constraint and below the reservation-utility constraint (for example point R). Although the debtor receives less credit at a higher rate of interest, his utility is larger, because he is closer to his demand curve. His consumption in period 1 is lower, and that of period 2 must be larger than in the initial equilibrium. Therefore, the reduction in the volume of credit must be larger than the increase in the rate of interest. In sum, an interest shock leads from loan pushing to credit rationing if \((i)\) the two constraints intersect, \((ii)\) at the intersection point the reservation-utility constraint is steeper than the rationing constraint, \((iii)\) the starting point is a situation of loan pushing with a rate of return, $i$, larger than the opportunity costs, $r$, and \((iv)\) the interest shock, $dr > 0$, is strong enough to get the situation into the rationing regime on the left hand side of the demand curve (as drawn in figure 3).

Similarly, a decreasing rate of interest makes the new iso-profit line at the initial equilibrium steeper, and the initial profit level now corresponds to a lower iso-profit curve. The new monopoly equilibrium could be a point such as P, which is a loanPushing equilibrium where the rationing constraint is not binding.

Periods in history with low rates of interest, $r$, can be associated with equilibria such as P and periods of high interest rates with equilibria such as R. An interest shock can lead from P to R, i.e. from loan pushing to credit rationing. It is a consistency requirement that the demand curve must pass between P and R, because otherwise these cases could not be considered as pushing and rationing.

Intuitively one can think of such equilibria existing in every period. If a shock is not anticipated, the credit volume in a loan-Pushing equilibrium lies to the right of the rationing constraint at the moment the shock occurs. This situation is a crisis from the point of view of the theory of sovereign debt (see Gersovitz [1985] and Chowdry [1991]), because the debtor now has an incentive not to pay the interest and principal.

However, going beyond the narrow framework of the model, it is not possible to conclude that the debtor will not pay, because he might be interested in new future loans. Credit contracts agreed upon before the interest shock, and stipulating payment due after the shock, require renegotiations (see Mohr [1991, ch. 9] on renegotiation in a non-monopolistic model). Therefore, it would be desirable to extend this model to include more periods with credit renewal.
If the initial equilibrium is characterized by a point such as B' in figure 4, where the reservation-utility constraint, \( U^3 \), is flatter than the rationing constraint, then lower rates of interest than in the initial equilibrium lead to a point R' with credit rationing. Higher rates of interest lead to a point such as P', which is a loan-pushing equilibrium. In this case, an interest-increasing shock can lead from credit rationing to loan pushing. The demand curve would have to pass below P' and above R'. However, nobody has ever suggested that this case might be relevant. However, its formal existence shows that for the case of a shift from loan pushing to credit rationing, it is crucial that the hypothetical initial equilibrium include a reservation-utility constraint that is steeper than the rationing constraint. For this to be the case, the rationing constraint, \( i = b(L)/L - 1 \), must have a slope, \( di/dL = (b' L - b)/L^2 \), which is greater than the slope of the reservation-utility constraint, \( U_1/(L U_2) - (1 + i)/L \). The latter in turn must equal the slope of the iso-profit line, \( -(i - r)/L \). These considerations result in the central property of the initial equilibrium for having a transition from loan pushing to credit rationing:

\[
(i - r)/L = U_1/(L U_2) - (1 + i)/L < (b' L - b)/L^2 < 0.
\]

Multiplying by L and adding \( b/L = 1 + i \), which holds on the intersection of the constraints, yields

\[
1 + r = U_1/U_2 < b'(L).
\]
The interpretation is that the decrease of the punishment deterring repudiation, if \( L \) decreases after a shock, must be larger than the world market interest rate, \( 1 + r \). The world market interest rate is the decrease of opportunity revenues from the world market. It equals the marginal rate of substitution of the debtor's reference utility curve. This guarantees that the rationing constraint is tighter than the reservation-utility constraint for a lower credit volume \( L \), because a strongly decreasing punishment makes the repudiation a problem for the creditor. Here the problem of repudiation dominates the possibility of losing the debtor as a client when his utility might fall below his reference utility.

4. Conclusion

Basu's model of loan pushing, as summarized in figure 2, has shown that the theory of sovereign debt is more than just a theory of credit rationing. The step added in this note has shown that an interest shock can lead from a monopoly equilibrium with loan pushing to a monopoly equilibrium with credit rationing, and it has derived the exact conditions for this case. This case has often been claimed to exist in historical and other empirical literature. It can be seen as a theoretical formulation of the explanation of Walter Wriston - top manager of one of the great American banks - for the occurrence of the debt crisis (see Darity [1986, 208]): "We're beat upon the fact that we have imprudent moments. But I don't know anyone that knew Volcker was going to lock the wheels of the world."

However, from an empirical point of view, there remains the question of whether or not the two constraints are intersecting. One possibility is that the punishment is so large that repudiation can be ignored for all practical purposes (see Dornbusch citing McNamara in Darity [1986, 217f.]). Another possibility is that the punishment is so low that it is the central constraint, as in the theoretical papers by Eaton, Gersovitz and Stiglitz [1986] or Sachs and Cohen [1982]. The evidence mentioned in the introduction is at best inconclusive and neither strongly supports nor rejects any of the possibilities of intersecting or non-intersecting constraints. Furthermore, if the constraints intersect, there remains the empirical question of whether or not the rationing constraint is flatter than the reservation-utility constraint. If so, the next empirical question is whether or not the initial situation was one of loan pushing. If the answer to all previous questions was "yes," the last question is whether or not the interest shock was strong enough to bring the economy from loan pushing to credit rationing. Whereas this paper has formulated the theoretical conditions for this transition, the empirical questions are suggestions for future research.
References


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