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THE FIRM-BANK INTERACTION REGIME AND "SOFTNESS"

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Abstract: This paper is analyzing a dynamic evolutionary game of firm-bank interaction to underline the importance of the interaction regime for encouraging or discouraging soft-budget phenomena and financial disorder. The poor performance of public sector's firms, which led globally to quests for the contraction of that sector and privatizations, is viewed as an equilibrium situation, ascribed to the inadequate attention of policy to the interaction regime. Moreover, it is found out that the background of the transition economies is such as to require even at equilibrium, a regime fostering much stricter financial discipline than in the mixed economies. Finally, it is argued that the abandonment of central planning was a necessary condition, a prerequisite, for the removal of its softness.

Keywords: Soft-budget, evolutionary games, transition economies.

1. INTRODUCTION

Much has been written about the '"soft budget constraint"' problem since Kornai's (1979, 1980, 1986) seminal work on the subject. Such a problem is given rise by the inability of (mainly state) banks to turn down the financing of a (public company's) bad project once some investment costs have been sunk. It is a problem which usually occurs in central planning and has been held responsible for many decadent phenomena under that economic system; phenomena ranging from thousands of soft prices and taxes to corruption. According to Kornai (1992, 1993), such a problem is only part of a more general mentality of softness and lack of discipline, other than that imposed by compulsion, prevailing in central planning. The reason is the supremacy of the (communist) party and the state in deciding the "solutions"' to the economy's incentive problems, in deciding really the fate of everything, thus turning everything into a political matter.

Nevertheless, a variant of the soft-budget-constraint problem is present in mixed economies too, insofar as public enterprises are concerned, before privatization reforms. As a matter of fact, it will be argued later that these reforms and movements to limit the size of the public sector in mixed economies were acts intended to solve this problem. It is common knowledge that public corporations become less attentive to their finances by comparison with private businesses, either purposefully, being used as a policy instrument, or just because being public is taken to imply impossibility of bankruptcy.[1] They are entities as huge as the corporations of central planning and hence have large sunk costs that, as e.g. Qian and Xu (1993) show, make all projects, good or bad, worthwhile once some of them have been undertaken.

Moreover, we are all aware of Niskanen's (1971, 1973) and Tullock's (1976) theory of bureaucracy, which states that the goal of the bureaucrats of a bureau is to maximize the bureau's budget rather than bureau efficiency, because they have no property rights on the gains from attaining the latter target but enjoy prestige, power, perquisites, even fiddles, from pursuing the former goal. Bureaucracy is thus prone to overstate the benefits of a project and understate the costs, to manipulate a budget in line with its preferences, etc, without much care for "mistakes", as their costs are borne by the public. Now, as soon as a public company is a bureau, it is not difficult to see that the adoption of a bad project may very likely be intentional and not just an unfortunate event.

In this paper, we do not differentiate analytically between private and public firms, but when we elaborate on the real-world relevance of our results, softness is attributed to the enterprises of the public sector. The analysis consists of an application of dynamic evolutionary game theory, as this theory is presented, for instance, by Vega-Redondo (1996). The next section spells out the basic model and establishes the result that softness will be the only stable long-run equilibrium if banks are unable to make a credible commitment to refuse the refinancing of a bad project. This is the case of centrally planned economies. A "mixed-economy equilibrium" emerges, too, but is found to be unstable in the sense that certain firms (public ones) may view banks' toleration of some loan defaulting as a sign of soft loan tolerance, and proceed with requests for such loans. Section 3 introduces into the basic analytical framework the element of the firm-bank interaction regime, and shows how the appropriate manipulation of this regime by policymakers may promote a healthy financial environment in connection with both transition as well as mixed economies. The paper concludes with further thoughts on the subject under investigation.

2. THE SOFT-BUDGET AS AN EQUILIBRIUM PHENOMENON

In what follows, a formal dynamic treatment of softness is advanced. Suppose that if ever a firm wanted a loan, it would like it to be a "soft-budget loan". Also, all

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[1] This might have been a symptom of the concessions of post-war capitalism to socialism (welfare state).

firms can advance a hard-budget loan request, but only a percentage f_1 of them conduct healthy business and can cope with such a loan successfully. A hard loan request is always welcomed by banks, which are known to approve soft loan applications, too, with a probability no larger than p, but the percentage of banks that actually does so is b_1. Hence, the firm-bank population profile is $h=\{(f_1, f_2),(b_1, b_2)\}$, where $f_2=1-f_1$ and $b_2=1-b_1$, since we are dealing with percentages. Thus, a loan request involves a game whose one component is the normal-form game described by Table 1. The strategy combination "Soft-Approve" yields a higher payoff to the firm and a lower one to the bank by comparison with the case "Hard-Approve": G>C, S<Y. Of course, a bank can never monitor a firm perfectly while the payoffs under rejection are nil to both parties. Nevertheless, a hard loan request will never be rejected and this is why the payoff associated with "Hard-Reject" is C, Y as well. The unique solution to the game of Table 1 is "Soft-Approve", but note that the whole game involves in addition the mixed strategy of "approving soft with probability p at most ". Moreover, what would be of interest is how the game described above affects the intertemporal behavior of the population profile.

Table 1: A normal-form game of firm-bank interaction

		Bank	
		Approve	Reject
Firm	Hard	C, Y	C, Y
	Soft	G, S	0, 0

In other words, our complete game is a dynamic evolutionary one, with the following replicator dynamics:

$$\dot{f}_1 = f_1(1-f_1)(C-Gb_1) \tag{1}$$

$$\dot{b}_1 = Sb_1(1-f_1)(1-b_1) \tag{2}$$

where all variables are functions of time, which is deleted for simplicity, and the dot (ṅ) denotes time derivative.[2] These dynamics are depicted in Fig. 1, in which all trajectories converge to the population state $h^*=\{(f_1=0, f_2=1),(b_1=1, b_2=0)\}$ that is also asymptotically stable. Trajectories that are not attracted by h^* must converge to the set Φ whose boundary is $\{(f_1=1, f_2=0),(b_1=p, b_2=1-p)\}$. Outside this set the configuration "Soft-Approve" continues to be the equilibrium state even in the long-run

[2] All expressions in the text are in their final form, i.e. after all manipulations. To rationalize replicator dynamics note that (1), for instance, is a rearrangement of the expression $\dot{f}_1 = f_1\{C-[Cf_1+Gb_1(1-f_1)]\}$, which says that the change of healthy enterprises over time depends on the percentage of such firms at any instant multiplied by deviation of the certain payoff, C, from the expected one in case a bank approving soft loans happens to be found.

and despite the presence of the mixed strategy. This is a very important conclusion which will be evaluated in the light of an appreciation of Φ as well. The set Φ means technically that the percentage b_1 becomes over time equal to that expected. In view of $f_1 = 1$, however, b_1 and p should be reinterpreted as reflecting the amount of loan-default risk banks are willing to take, i.e. as part of normal bank behavior, since there are no soft loan requests. Recall that not all firms are healthy enough to handle a hard loan, though they can apply for one. Based then on real-world experience, which condemns softness, we may safely assert that the set Φ describes a more prudent state of affairs than h^*.

This is perhaps why all states in Φ are asymptotically unstable. A "default-risk mentality" on the part of banks cannot survive, because its existence and only tempts firms to default by requesting and getting soft loans. This mentality of banks simply lends itself to circumvention by making borrowers reason that banks are prepared to confront any state of the world in the sense of being able to bear the costs even of softness. In fact, such would be the interpretation of bank behavior under an assessment of Φ advanced by drawing an analogy with classical (nonevolutionary) game theory. It thus appears that widespread softness is inescapable. It is not strange then that it became the sine qua non of public corporations, as a modus vivendi, i.e. as an equilibrium state like h^*, under central planning, and as the aftermath of bureaucracy's improper dealings with banks, i.e. as a destabilizing factor resembling that in Φ, in mixed economies. Presumably Φ is more like a "mixed-economy equilibrium".

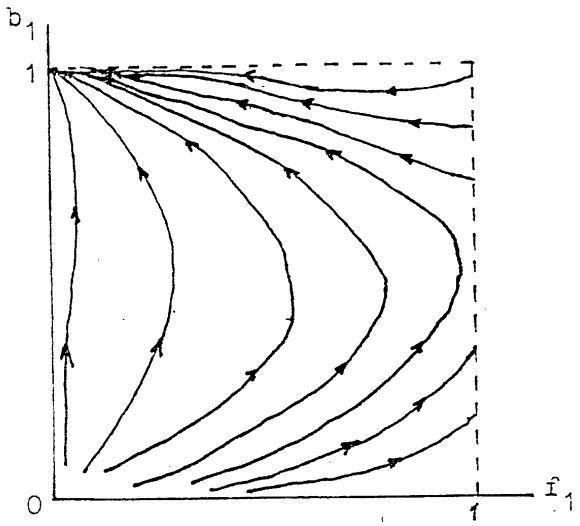

Figure 1: The dynamics of the basic model

To gain more insight, let us examine more closely the nature of the game's mixed strategy. Such a strategy introduces an element of uncertainty, namely the prospect of having a soft loan request turned down. In view also of the element of time, this prospect is equivalent to a punishment threat that should elicit healthy collaboration in the long-run as it happens with the single-population case of the repeated prisoner's dilemma model. But, in our case, the threat seems to be noncredible within the set Φ or to be eliminated during the course towards h^*. Indeed, central planning removed all obstacles to softness while credit controls to public companies in mixed economies are, to put it mildly, relaxed. One reason for the disappointing performance of these companies that adversely affected overall economic activity was precisely this situation. The subsequent world-wide quests and steps for privatization and for the contraction of the public sector were really moves purporting to change the (public) firm-bank interaction regime so as to "correct things" by restoring the credibility of the threat of punishment for borrowing soft.

In terms of our modeling, these considerations imply that modifications should be made to take into account that interaction regime. An examination of a perturbed game is called for, in which behavior is altered by the regime governing the interaction among the concerned parties. The perturbation refers, of course, to the dynamics given by (1) and (2), but only to the extent that behavior in Φ is concerned, since it can have no qualitative effect elsewhere in the system. At the one end, the interaction regime may be influencing only firms' attitude by discouraging them explicitly or implicitly from putting forward soft loan requests. At the other end, the influence may be only on banks by encouraging them to increase the rejection rate. It is thus straightforward that the dynamics of the perturbed model is a sensitive issue, depending on the rates of behavior alteration characterizing each population.

3. THE WOULD-BE DYNAMICS OF THE TRANSITION ECONOMIES

We shall now show how the appropriate manipulation of the firm-bank interaction regime may promote a healthy financial environment in connection not only with transition but also with mixed economies.

Let the rate at which the interaction regime alters firm behavior be $0 < m_f < 1$ while the rate corresponding to bank behavior alteration is assumed to be $0 < m_b < 1$. These rates capture the extent to which the regime discourages firms from borrowing soft and banks from approving soft loans. To start the analysis, assume a "neutral" regime and a disorientation of firms and banks, inducing them to adopt initially their available strategies with equal probability.[3] The replicator dynamics thus become

[3] This is, of course, a hypothetical situation, serving only as a starting point for our discussion.

$$\dot{f}_1 = (1-m_f)f_1(1-f_1)(C-Gb_1) + m_f(\frac{1}{2}-f_1) \tag{3}$$

$$\dot{b}_1 = (1-m_b)Sb_1(1-f_1)(1-b_1) + m_b(\frac{1}{2}-b_1) \tag{4}$$

Setting $\dot{f}_1 = 0 = \dot{b}_1$ to find the rest points of the perturbed system, yields

$$m_f(f_1 - \frac{1}{2}) = (1-m_f)f_1(1-f_1)(C-Gb_1) \tag{5}$$

$$m_b(b_1 - \frac{1}{2}) = (1-m_b)Sb_1(1-f_1)(1-b_1) \tag{6}$$

Taking the ratio of the two last expressions, one obtains that

$$w = \frac{m_f(1-m_b)}{m_b(1-m_f)} = \frac{f_1(1-2b_1)(C-Gb_1)}{Sb_1(1-2f_1)(1-b_1)} \tag{7}$$

Since we are interested in the set Φ, we let $f_1 \to 1$ and hence, this ratio becomes

$$w = \frac{(1-2b_1)(C-Gb_1)}{-Sb_1(1-b_1)}$$

We wish to study whether the original system's dynamics change even when the m's are very small. Consequently, we should also let $m_f \to 0$ and $m_b \to 0$ so as to keep the ratio $\{[m_f(1-m_b)]/[m_b(1-m_f)]\} = w$ constant at some benchmark value with respect to the types of the solutions of (7) for b_1.[4] This value turns out to be

$$w = [G + 2\sqrt{C(G-C)}]/S \tag{8}$$

since at that value we have

$$b_1 = \pm\frac{C-\sqrt{C(G-C)}}{G-2\sqrt{C(G-C)}} \tag{9}$$

the positive (negative) sign requiring 2C > G (2C<G) for (9) to be positive. When 2C < G, it can be checked that (7) cannot exceed the critical value of w, because it would imply that for b_1 to be positive, the positive sign should hold, and this is the case when 2C > G rather than the opposite. Therefore, when 2C < G, (7) should be less than the w given by (8), thus giving two solutions, which for stability reasons also, should satisfy

$$\frac{\sqrt{G^2-C(G-C)}-C}{3G} < b_1 \le \frac{G+C-\sqrt{G^2-C(G-C)}}{3G} < b_1'' < \frac{1}{2} = p \tag{10a}$$

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[4] This approach is based on Gale et al. (1995).

By the same line of reasoning, if 2C > G (7) has well-defined solutions when it is less than (8), it yields two solutions, satisfying

$$\frac{1}{2} < \bar{b}_1 < \frac{C - \sqrt{C(G-C)}}{2C-G} < b_1' < p \qquad (10b)$$

when it exceeds the benchmark value of w. It should be remarked that the case of (8) exceeding (7) describes a situation in which behavior alteration is greater for firms than for banks ($m_b \to 0$) whereas the case of (8) being less than (7) is consistent with the opposite alteration pattern ($m_f \to 0$).

The two-by-two Jacobian matrix connected with the vector field defining (3) and (4),

$$\begin{bmatrix} (1-m_f)(1-2f_1)(C-Gb_1)+m_f & -Gf_1(1-m_f)(1-f_1) \\ -Sb_1(1-m_b)(1-b_1) & S(1-m_b)(1-f_1)(1-2b_1)-m_b \end{bmatrix}$$

has been used to assess asymptotic stability. Insofar as (10a) is concerned, multiplying the first column by $(2f_1-1)$, using (5) to substitute for $m_f(2f_1-1)$, and letting $m_b \to 0$ and $f_1 \to 1$, yields the matrix

$$\begin{bmatrix} (1-m_f)(C-Gb_1) & -G(1-m_f) \\ -Sb_1(1-b_1) & S(1-2b_1) \end{bmatrix}$$

whose determinant is equal to $S(1-m_f)[3Gb_1^2-2(G+C)b_1+C]$, with roots $[G+C\pm\sqrt{G^2-C(G-C)}]/3G$ as in (10a) and hence, only $\underline{h}=\{(1,0),(b_1,1-b_1)\}$ is asymptotically stable. This conclusion is depicted in Fig. 2(a). When the stakes for a firm are relatively high from soft loans (G > 2C), the requests for such loans dominate the scene, and it is "natural" that the regime should be discouraging them actively and that the approval rates by banks should be very small, thus leading to a point like F in Fig. 2(a). Next, insofar as (10b) is concerned, multiplying the second column by $(2b_1-1)$, using (6) to substitute for $m_b(2b_1-1)$, and letting $m_f \to 0$ and $f_1 \to 1$, yields the matrix

$$\begin{bmatrix} (C-Gb_1) & G(2b_1-1) \\ Sb_1(1-m_b)(1-b_1) & S(1-m_b)[1-2b_1(1-b_1)] \end{bmatrix}$$

whose determinant is equal to $S(1-m_b)[(2C-G)b_1^2-2Cb_1+C]$, with roots $[C\pm\sqrt{C(G-C)}]/(2C-G)$ as in (10b) and hence, only $\bar{h}=\{(1,0),(\bar{b}_1,1-\bar{b}_1)\}$ is stable. If there is little to be gained from a soft loan (2C>G), firm behavior is expected to be random, choosing each strategy with the same more or less likelihood and hence the

regime should be discouraging soft loan approvals, thus leading to a point like B in Fig. 2(b).

What these considerations imply for the transition economies is, I think, quite clear. The mixed economies could be interpreted to be currently at a point like B, with hard budgets on the part of most firms and a policy emphasis on financial discipline. But, transition economies should not be imitating the mixed ones. They should be aiming at a point like F, struggling to undo the legacy of soft budgets and to promote a financial order much stronger than that in the mixed economies. One might say that point F rather than B should be targeted by the transition economies as a means of keeping an eye on a would-be backsliding to the practices of the past. Simply, soft loan requests and approvals will never cease to exist and are more likely to be exploited by public corporations. This is why the equilibrium f_1 in Fig. 2 has been drawn near to $f_1 = 1$ despite the fact that theoretically we have $f_1 = 1$ exactly. Note, finally, that transition has to happen. We have seen that there is no point in discussing the interaction regime outside the set Φ, i.e. under a situation consistent with h^*, as was the case with central planning. Therefore, the abandonment of this form of economic organization is a necessary condition for the removal of its softness. The "sufficient condition" hinges upon issues like those just discussed. We refrain here from expanding further on such issues, as this would not be motivated directly by the results of our analysis. We shall do so, however, immediately in the next section.

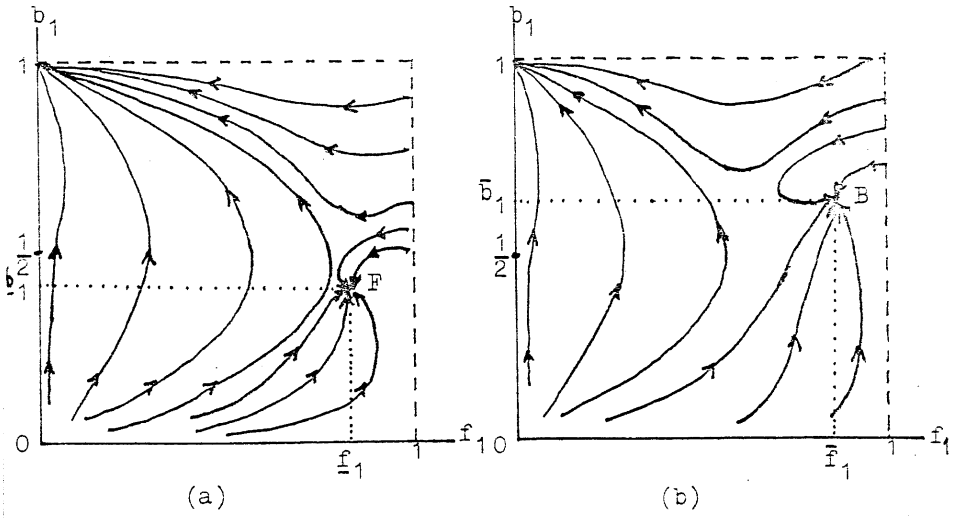

Figure 2: Dynamics under behavior alteration

4. CONCLUDING REMARKS

The nature of our modeling and its results prompts a broader discussion of central planning and the mixed economy than that emanating from the analysis. For

one thing, it leaves one with the impression that any change to the better within central planning is doomed to failure. Just replace "Firm" by "Citizenry", "Soft-Hard" by "Old-New", and the "Bank" by "Nomenklatura": The solution of the resulting game will always be "Old-Approve", (h^*), once the payoff to "Old-Reject" is (0,0), i.e. once it is painful for the nomenklatura to take the initiative to reject the old, its own fabrication that made it in the first place to be nomenklatura and that makes it futile for the rest to seek newness without a revolution. It is not surprising that little, if anything, was achieved by the market reforms of the socialist countries of the past, as manifested by the fact that all of them found themselves in the same position the moment transition was launched regardless of their reform past.[5] Hayek (1935, 1940) could have foreseen such a state of affairs, because he grasped the essence of central planning more than any practitioner of it or any ideological propagandist.

He, Mises (1949), and the Austrians might have argued, at the other extreme, against any sort of government interference even in the face of policy success. But, the same analytical apparatus (our own one) that gives them credit for their view on central planning repudiates them when complete government dismissal is advocated. Of course, replacing "Nomenklatura" by "Ordinary Government", we are led into the realm of the mixed economy of the set Φ, thus confirming Hayek. Yet, were the government to be "extraordinary", pervaded by zeal for successful interaction with its citizens, prosperity and progress would be experienced. Certainly, the outcome of the game is not a matter of semantics, of changing a player's name and particularly the characterization of those in power; it is a matter of changing the quality of behavior associated with the name change, (as in the case of the "Bank" in the analysis where, however, characterizations were avoided).

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5 See e.g. Gaburro and Pettman (1996).

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