THE COORDINATION PROBLEM WITH BANKS*

by

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ABSTRACT

Consider a two-period situation. In the first period a consumer and a firm bargain over the price of a bond. The objective is a project which takes one period to come on stream. Both agents prefer production but the consumer is less patient than the firm. The outcome is underproduction. A condition for the intervention of a bank exists. It is shown that intermediation is unstable. The potentially stabilising role of money is discussed.

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1. Introduction

The coordination problem in large complex systems is brought about by the existence of money on one side of every transaction in a market economy. Potential Pareto-improving barter bargains of goods today for goods tomorrow might exist but they would be of no interest to households as a class and firms as a class. In order to command consumer goods in the future, households must acquire a store of value. Saving means an increase in the demand for goods sometime in the future. However, the emergence of notional excess demand for future dated commodities cannot be effectively communicated to producers. It is not that information is imperfect or dispersed in the private information sets of agents but that the circuits do not exist. Furthermore, savers do not evaluate their wealth only in terms of the income stream units that they command but are equally concerned with the liquidity of their portfolios. Therefore consumers will demand portfolios with an average holding period shorter than that of their life cycle saving plans. In other words, portfolios will comprise assets that will be periodically reinvested before they are cashed in to finance consumption in the retirement stage of the life cycle.

Existing markets do not perform any consistency check on the multi-period plans of consumers and producers. Markets for current commodities exist. There is no market or price for savings. However, a market for credit exists. Given a certain willingness to give and take credit on the part of the agents concerned, the law of one interest rate prevails in a free market. The price of bonds and therefore the long-term interest rate is determined by the interaction of demand and supply. According to Myrdal and the Swedish school, the 'natural rate of interest' is not related to technical productivity but must be understood as expected profitability. The latter, in turn, must approximate Keynes' marginal efficiency of capital. The rate of interest on a loan of given quality and maturity must be established at the level which, in the opinion of wealth-holders equalises, on the margin, the attractions of holding cash and holding the bond. The rate of interest is simply the price of credit and can therefore be influenced by the banking system. The profit-maximising behaviour of banks as they operate on both sides of their balance-sheets is an important concomitant to the determination of ‘the’ rate of interest (Lindahl, 1950).

It has been indicated above that traditionally the coordination problem was couched in the ex ante – ex post apparatus of the Swedish school. Actions derived from strategies framed at the beginning of a period. In aggregative analysis, since the plans of individuals were not synchronized, the time interval during which the actions of all agents were constant had to be shorter than the interval during which the plans of a single agent were unaltered. Planned savings and planned investment diverged leading to a sequence and a recursive structure. It is clear that the stability of such a model needs to be established. In the standard Walrasian model all quantities are flows. In pure flow models, realised sales are regarded as current income. Any disturbance to the realised income flow will result in multiplier expectations. In stock-flow models, on the other hand, stocks serve as buffers between financial income and expenditure flows (Leijonhufvud, 1973). Cash balances, in particular, allow a certain level of expenditures to be maintained even when receipts fall off. A formal treatment of this argument is conducted below.

2. Coordination Failures

Consider two periods: period 1 and period 2. At the beginning of period 1 two parties know how much they will gain from trading. If they choose to do so, the supplier realises a project. It takes one period for the project to come on stream. Both parties value the project although the household is less patient than the firm (has a lower discount rate). Some bargaining occurs in the first period. The variable to be determined is the bond rate and therefore belongs to the unit interval. Take any strictly positive point in the interval as a potential offer from one party to the other. We assume that conditions of individual optimality must obtain for the offer to be accepted. Since the profit function of the firm is convex and therefore continuously decreasing in the input price, any price infinitesmally less than the given price will not reduce the utility of the household. The only equilibrium is at a price of zero. The project will not be realised. Ex post the volume of trade is inefficient.

3. Stable Intermediation

The literature suggests that multimarket contact, often in the case when the rate of time-preference is not high enough, might sustain cooperative outcomes. For the present purpose, it is sufficient that a loan market exists. A financial intermediary offers a deposit contract to the household and a loan contract to the firm. For any r_f and r_c that are individually optimal interest rates for the firm and the household respectively, it is sufficient that the spread for the bank satisfy

$$r_c \leq r_D \leq r_L \leq r_f$$

where the subscripts *D* and *L* stand for deposit and loan respectively.

For the purpose of incorporating aggregate-demand externalities it is common to resort to a state-space specification of the problem. To that end, we define a state vector $x \equiv (S, I) \in R^2$, where *S* and *I* are savings and investment respectively and the evolution of the state is given by $x_{t+1} = f_t(r_L, r_D)$. The utility function of each player i is $u_t^i = \sum_{t=1}^{2} g_t^i(r_L(x_t), r_D(x_t))$. A standard assumption is that the incentive scheme satisfies the single crossing condition. In the present framework, this is taken to mean either that a higher state variable makes a higher action more desirable or conversely. Efficient contracts are defined as those that satisfy both the individual rationality and incentive compatibility constraints. The latter is defined in the following way. By the definition of equilibrium, player i prefers action (r_L', r_D') to action (r_L'', r_D'') when the state is x'. That is,

$$g_t^i(r_L'(x'), r_D'(x')) \geq g_t^i(r_L''(x'), r_D''(x')).$$

In like manner when the level of macroeconomic activity is given by x'', every agent would prefer action (r_L'', r_D'') to action (r_L', r_D'):

$$g_t^i(r_L''(x''), r_D''(x'')) \geq g_t^i(r_L'(x''), r_D'(x'')).$$

Optimal contracts are given by

$$\pi_B(r_L, r_D) \equiv r_L L - r_D D$$

where L and D are the loan demand functions and deposit supply functions of the firm and the household respectively and π_B is the profit function of the bank. We show that there is a continuum of optimal contracts. Consider a level of macroeconomic activity given by $\tilde{x}$. A higher level of activity x^* would make a higher deposit rate more desirable for the household. Also, the profit function of the bank is convex in the input price. In other words,

$$\tilde{r}_L(\tilde{x})\tilde{L} - \tilde{r}_D(\tilde{x})\tilde{D} \leq \tilde{r}_L(\tilde{x})\tilde{L} - r_D^*(x^*)D^*$$

On identical lines, the following inequality can be written. (The profit function is convex in output price).

$$\tilde{r}_L(\tilde{x})\tilde{L} - \tilde{r}_D(\tilde{x})\tilde{D} \leq r_L^*(x^*)L^* - \tilde{r}_D(\tilde{x})\tilde{D}$$

Adding the two relationships,

$$\tilde{r}_L(\tilde{x})\tilde{L} - \tilde{r}_D(\tilde{x})\tilde{D} \leq r_L^*(x^*)L^* - r_D^*(x^*)D^*$$

For any level of the state vector, therefore, there are Pareto-improving states. The stability of a market-clearing equilibrium is therefore called into question. The existence of intermediation is therefore closely related to the stability of that institution. In this regard, Leijonhufvud has advanced a "corridor hypothesis". There is a zone of stability within large, complex systems within which negative feedback is successful. Outside the corridor, homeostatic controls break down. The discussion below is motivated by N.N. Krasovsky (Krass and Hammoudeh, 1981).

The difference equation above can be converted into the following kinematic equation in the familiar manner. Let the game be described by

$$\dot{x} = \phi(x, r_L, r_D), x(t_0) = x_0,$$

the other components of the description being left intact. For equilibrium, F, a closed set in R^2, the 'coordination set' of both players must exist. Intermediation is said to be stable if there exists a set $W \subset R^2$ such that for any $\tilde{x} \in W, \tilde{t} \geq t_0$ and $\tilde{t} < t^{**} < T$, there exists a solution (r_L^{**}, r_D^{**}) in the jet that starts from $\tilde{x}$ at the moment $\tilde{t}$ and satisfies

$$\dot{x} = \boldsymbol{f}(x, r_L^{**}, r_D^{**})$$

such that $x(\boldsymbol{t}) \in F$ for some $\boldsymbol{t} \in \left[\tilde{t}, t^{**}\right]$. In the opposite case, all players can leave the set by choosing the appropriate level of activity.

Equivalently, assume that $\tilde{x}(\tilde{t}) \in F$. Since F is closed, there must be a sphere with an arbitrary radius such that no other movement exists within the ball for all $\boldsymbol{t} \in \left[\tilde{t}, t^{**}\right]$, given any actions chosen by the players. Specifically, and with reference to our earlier formulation, for some (r_L^*, r_D^*), the point $x^*(t^*)$ must not belong to the ball. However,

$$\left|\boldsymbol{p}_B(\tilde{r}_L, \tilde{r}_D) - \boldsymbol{p}_B(r_L^*, r_D^*)\right| \leq \left|\boldsymbol{p}_B(\tilde{r}_L, \tilde{r}_D) - \boldsymbol{p}_B(\tilde{r}_L, r_D)\right| + \left|\boldsymbol{p}_B(\tilde{r}_L, r_D) - \boldsymbol{p}_B(r_L, r_D)\right| +$$
$$+ \left|\boldsymbol{p}_B(r_L, r_D) - \boldsymbol{p}_B(r_L, r_D^*\right| + \left|\boldsymbol{p}_B(r_L, r_D^*) - \boldsymbol{p}_B(r_L^*, r_D^*)\right|$$

By the uniform continuity of the profit function in both its arguments,

$$\left|\boldsymbol{p}_B(r_L, r_D) - \boldsymbol{p}_B(r_L^*, r_D^*)\right| \leq \tfrac{e}{4} + \tfrac{e}{4} + \tfrac{e}{4} + \tfrac{e}{4}$$

for all

$$\left|\tilde{r}_D - r_D\right| \leq \tfrac{\partial}{4}; \left|\tilde{r}_L - r_L\right| \leq \tfrac{\partial}{4}; \left|r_D - r_D^*\right| \leq \tfrac{\partial}{4}; \left|r_L - r_L^*\right| \leq \tfrac{\partial}{4}.$$

Therefore,

$$\left|\boldsymbol{p}_B(\tilde{r}_L, \tilde{r}_D) - \boldsymbol{p}_B(r_L^*, r_D^*)\right| \leq \boldsymbol{e};$$

for all

$$\left|\tilde{r}_L - r_L^* + \tilde{r}_D - r_D^*\right| \leq \partial.$$

An equilibrium with planned savings equalling planned investment is not stable. Over time, the disequilibrium will be reproduced. Incomes might fall resulting in a lower level of investment ex ante in the next period and so on.

3. On Money

Money is endogenous as deposits are remunerated. In the introduction, mention was made of the stabilising role that money might play in its capacity as a buffer-stock in the portfolio of agents. Indeed, both the household and the firm might seek out yet another multi-market contact in the form of the monetary authority in order to address their coordination problem. The strategies of the central bank could be regarded as tight and easy money. The framework can be viewed as a mixed inside-outside model as both stances must relate to the formation of private sector contracts and the level of macroeconomic activity (Minsky, 1982). In terms of the argument above, if all prices and cash holdings are changed in the same proportion, the budget constraint will not be affected. The maximum level of indirect utility of the household and profits of the firm will be the same. In shorthand,

$$\pi_B(r_L, r_D, m) = \pi_B(\alpha r_L, \alpha r_D, \alpha m) = \pi_B(r_L^*, r_D^*, \alpha m), \alpha > 0.$$

The stabilising properties of money must not be overstated. In a euphoric economy, all agents are willing to extend their asset and liability and structures. Banks will experiment with both sides of their balance sheets. Tight money, in the form of rising interest rates and restrictive terms on covenants, is not likely to bring such portfolio experimentation to a halt. Optimistic expectations may overwhelm the rising rates. The monetary authority will see its reduction of the rate of growth of the money supply overtaken by the willingness of agents to decrease their cash balances. Increases in velocity will overcome constraints in quantity.

4. Conclusion

In disequilibrium sequence analysis the economic process is represented by an array of single periods that are not in equilibrium. In each period, however, there are constant rules of conduct that determine how the ex post results from one period influence the ex ante plans for the next period. These actions of various agents can be regarded as the equilibrium notion within disequilibrium sequence analysis. The inequality between planned savings and planned investment sets in motion a process which makes realised income differ from expected. The difference between the two is unexpected income. The end of the process is not a new equilibrium. The coordination problem remains unsolved.

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