Noisy Implementation Cycles
and the Informational Role of Policy

by

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Abstract

Macroeconomic models of fluctuations based on self-fulfilling equilibria require that expectations and beliefs are common knowledge to all economic agents. If instead we assume that there is some noise in the firms' perception of the fundamentals then the results change significantly, even if the noise is small. Using Shleifer's (1986) implementation cycle model, we show that, in the presence of uncertainty, agents will be slow to adjust to changing fundamentals, and that endogenous co-ordination on short cycles will occur. Thus, the indeterminacy result of models with self-fulfilling equilibria could be a very fragile feature of these models. The possibility of longer cycles (which could be Pareto-efficient under some of Shleifer's assumptions) could however be restored, if a credible announcement (for instance by the policy authorities) can act as a co-ordinating device. Moreover, a long cycle becomes focal in the light of the announcement. By providing an explicit model which explains why firms are slow to adjust to changing fundamentals we are therefore able to gain useful insights into the type of policies which can significantly affect firm behaviour.

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1. Introduction

A highly influential approach to the analysis of economic fluctuations and growth is based on the view that expectations drive the behaviour of the economy. The importance of expectations and beliefs in macro models has been stressed al least since Keynes (1936) argued that "animal spirits" may be a crucial determinant of the business cycle. Expectations of booms or recessions can be self-fulfilling, as agents bring forward or postpone their investment decisions depending on their perception of how the economy will evolve in the future. If some firms anticipate an increase in aggregate demand, they might decide not to invest in the present period, but rather to delay their investment to some future date. This would enable firms to maximise the revenue from their sales during a boom. However, if all firms in the economy share the same expectations about future demand, they will all postpone their investment to the future. This will bring about a recession in the current period and a boom at a later date. Hence, firms' expectations will drive the business cycle.

There is by now a large literature on self-fulfilling prophecies, stemming from the original work by Azariadis (1981) and Cass and Shell (1983): see also the textbook by Farmer (1993) and the survey articles by Silvestre (1993) and Matsuyama (1995). What is common to these models is that, under some conditions, the economy could co-ordinate to any equilibrium in which the expectations by the agents are realised. In principle, therefore, the economy admits any of a number of equilibria, and there is indeterminacy about which equilibrium the economy actually inhabits. However, in models of self-fulfilling equilibria co-ordination to a particular equilibrium can only be achieved under extremely restrictive assumptions on the informational structure in the economy. More precisely, co-ordination requires the implicit assumption that agents have common knowledge about the fundamentals of the economy and about the beliefs (of all orders) by all the other agents. In particular, agents must have common knowledge about the expectations of all the agents in the economy. This is arguably a very unrealistic assumption to make in macro models. A more satisfactory assumption is that agents have an imperfect knowledge of the fundamentals of the economy and of the beliefs held by everybody else. Their knowledge is however correlated in the economy: individuals learn about the other agents' information and beliefs by observing their actions and share access to public information, for instance released by the media and by official government agencies.

Abandoning the common knowledge assumption, however, turns out to be critical for the indeterminacy result. In fact, indeterminacy could be completely destroyed by the introduction of a small amount of correlated noise in the economy. Under quite general conditions, agents will endogenously co-ordinate their choices to what they perceive as their least risky course of action. As a consequence, in the presence of uncertainty some of the equilibria in the economy can be ruled out. In particular, in the absence of any external co-ordination device – for instance, a credible announcement by the government – agents will not necessarily co-ordinate on the socially efficient outcome.

The main goal of this paper is to investigate the implications of information structures to macroeconomic fluctuations and policy. We illustrate the endogenous selection of equilibria by using the influential model of implementation cycles developed by Shleifer (1986). This set-up is particularly appropriate for looking at the role of information about fundamentals and beliefs, since the cycle is entirely guided by expectations about expectations. Firms generate inventions, and must decide whether to implement their inventions immediately or wait for a period of high aggregate demand. Firms can thus either innovate immediately, or decide to delay innovation to some future period. There could exist multiple short-cycle equilibria, and sometimes also longer cycles. The cycle is entirely driven by the firms' expectations about the timing of a boom.

In Shleifer's model, the rate of technological progress is a known constant. Shleifer posits that the economy would co-ordinate to a focal point, and suggests that this could consist of the socially efficient cycle length. However, in this paper we show that, if there is a small uncertainty over the rate of technological progress, and if this uncertainty is correlated amongst agents, then endogenous co-ordination by all agents does take place, but is guided by risk aversion rather than by the welfare properties of focal points. We establish that, under relatively unrestrictive conditions, immediate implementation is the only undominated strategy for firms. According to this result, it would never prove profitable for firms to delay the implementation of innovations.

The main intuition for our results can be summarised as follows. Suppose we are in a situation where the fundamentals of the economy are only consistent with very short cycles. Immediate implementation of innovation is therefore the dominant strategy for firms. Suppose now that the fundamentals change slightly, and that immediate implementation is only "almost" dominant. Firms can now delay the implementation of their innovations. However, if there is some noise about the fundamentals, and if agents are uncertain regarding the beliefs of the other agents in the economy, then delaying the implementation is a "riskier" strategy than immediate implementation. Hence, firms will endogenously co-ordinate to the shortest-cycle equilibrium of the economy. In general, the optimal investment policy depends on what other firms will do in nearby states of the world, including those in which immediate implementation is a dominant strategy. Taking these into account, it becomes *ex ante* dominant for firms not to wait for a boom. The argument can be shown to apply also to circumstances in which the fundamentals of the economy are not close to the "almost dominance" of immediate implementation. The indeterminacy regarding the length of the cycle therefore collapses, as the economy will endogenously settle to the cycle characterised by the shortest period.

The above conclusion might appear to be a negative one, since one might be tempted to infer that the possibility of expectation-driven cycles of different lengths is necessarily ruled out. This conjecture would be unwarranted. If agents could all observe a signal, which is possibly related to fundamentals, and if this signal were common knowledge to all agents, then they could co-ordinate to any of the Nash equilibria of the economy. In principle, therefore, there is a potential role for policy in revealing information about the true value of the fundamentals in the economy.

In the specific model we consider, uncertainty involves the exact rate of technological progress. In general, the role of policy would be to identify the source of uncertainty and to convey this information to the economy. A public announcement, due to the fact that it is commonly observed, has the desirable property that it makes the current state of the world commonly known. If the fundamentals are such that they would support a long cycle, then such a cycle could be endogenously implemented by firms. Moreover, since the purpose of the announcement is to re-introduce the possibility of a particular cycle – *e.g.* the welfare maximising one – it will become focal and is likely to be the selected equilibrium.

In the paper, the source of noise in the economy is the uncertainty about the rate of technological progress. In general, the investment behaviour of firms will depend both on fundamentals and on expectations. Our methods can easily be used in many similar macroeconomic models of the business cycle by introducing a small amount of correlated noise to the firms' perception of (some of) the fundamentals.

The structure of the paper is as follows. Section 2 describes the model of implementation cycles based on Shleifer (1986). Section 3 shows the endogenous co-ordination of the economy to the shortest cycle, in the presence of a small degree of uncertainty about the rate of technical progress. Section 4 concludes.

2. Implementation cycles

The structure of the model is identical to Shleifer (1986). An infinitely-lived representative consumer maximises utility:

(1) $$\sum_{t=1}^{\infty} r^{t-1} \frac{\left(\prod_{j=1}^{N} x_{tj}^{l}\right)^{1-g}}{1-g}$$

where $0<r<1$ is the subjective rate of time preference, x_{tj} is the consumption of good j in period t, N is the number of commodities, and $l \equiv 1/N$, where N is a large number. The lifetime budget constraint of the representative agent is:

(2) $$\sum_{t=1}^{\infty} \frac{y_t - \sum_{j=1}^{N} p_{tj} x_{tj}}{D_{t-1}} = 0$$

where p_{tj} is the price of commodity j in period t, y_t is income, and $D_t = (1+r_1)\ldots(1+r_t)$ is the inverse of the discount factor, where $1+r_t$ is the rate of interest paid in period $t+1$ and where D_0 is set equal to unity.

Prices and income are expressed in wage units. Consumption at time t is given by $c_t = \sum_{t=1}^{N} p_{tj} x_{tj}$. The structure of preferences implies constant expenditure shares:

(3) $$p_{tj} x_{tj} = l c_t$$

No storage technology is assumed to exist: hence, y_t=c_t and the consumer is neither a borrower nor a saver. Equilibrium interest rates are therefore:

(4) $$1 + r_t = \frac{1}{r} \cdot \left(\frac{y_{t+1}}{y_t} \right)^{g} \cdot \left(\frac{\prod_{j=1}^{N} p_{j,t+1}^{l}}{\prod_{j=1}^{N} p_{j,t}^{l}} \right)^{1-g}$$

Labour is inelastically supplied at L. The wage rate is normalised to unity, and all prices are expressed in terms of the wage. Let P_t be aggregate profits. The income identity is therefore:

(5) $$y_t = P_t + L$$

There are N ordered sectors in the economy. In the first period, one firm in each of the sectors $1, 2, ..., n$ generates an invention. In the second period, one firm in each of the sectors $n+1, n+2, ..., 2n$ generates an invention. In period T^*=mod(N/n), one firm in each of the sectors $(T^*–1)\cdot n+1$, $(T^*–1)\cdot n+2$, ..., $T^* \cdot n$ invents, and so forth. An invention in period t enables firms to produce output using a fraction $1/m_t$ of the labour input which was previously required, where $m_t > 1$ is the rate of technical progress. Shleifer (1986) assumes m_t=m, that is, the rate of technical progress is a deterministic constant.

Firms who invent have the options of either implementing immediately their invention or of postponing implementation. When it implements its invention, a firm becomes a monopolistic supplier in its sector. Its profits are

(6) $$p_t = m_t y_t$$

where $m_t \equiv l(1-1/m_t)$. In the period following the implementation, imitators enter the market and drive the profits of the innovating firm down to zero. Hence, firms have an inventive to maximise the short-run returns from implementing the innovation. They will trade off the opportunity cost of delaying the innovation to the future with the potential gains from implementing during a period of high aggregate demand.

The main result of Shleifer's model is that cycles of period $T£T^*$ are an equilibrium if and only if $\Pi_T / D_{T-1} > \Pi_1$, or

(7) $$f(T) \equiv r^{T-1}(1-nTm)^{g-1} > 1$$

where Π_T and D_T are computed on the assumption that everybody believes that everybody else will invest at T.

3. Noise and co-ordination

Contrary to Shleifer (1986), we assume here that m_t is a non-singular random variable. This means that firms are uncertain about the function $f(T)$ in (7). The corresponding value of m_t will therefore also be a random variable. Firms observe the noisy signal $m_{it} = m_t + x_i$, with support $m_{it} \in [\underline{m}, \overline{m}]$, i=1,2,…,N, t = 1,2,...,T^* where x_i are random variables independent of each other and of m_t and $E(x_t)$=0. It is useful to think of the x_i as having a small bounded support, say $x_i \in [-e, e]$ where e is small and positive. However, the only relevant property of x_i we need is that the x_i*'s* are symmetrically distributed [1]. We assume that the value of m_{it} that solves equation (7) as an equality,

[1] Assuming a small bounded support only strengthens our result: the possibility of long cycles is a fragile feature of Shleifer's model if, even for "very little" noise, such cycles can no longer occur in equilibrium. We come back to this point later in this section.

$m^* = \frac{1}{n \cdot T} \cdot (1 - r^{\frac{1-T}{g-1}}) = \frac{T^*}{N \cdot T} \cdot (1 - r^{\frac{1-T}{g-1}})$, lies in the interval $(\underline{m}, \overline{m})$. Note that when $m_{it} > m^*$ immediate implementation is the dominant strategy. To see why, note that equation (7) is computed under the most favourable conditions for waiting: both P_1 and P_T are computed under the assumption that all other firms wait. Since in Shleifer's model payoffs are proportional to output, while the discount factor is proportional to output raised by *g*, then if any number of firms choose not to wait for a *T*-boom, P_1 will increase, while P_T/D_{T-1} will decrease, and the incentives from waiting will therefore be lower.

We assume that the random variable m_t follows a random walk. Under this assumption, combined with the assumption of symmetry of the idiosyncratic noise, x_i, the conditional probability that a given firm attaches to another firm receiving a signal greater than its own is one half:

(8) $$P(m_{i,t} > m_{j,t'} \mid m_{i,t}) = \frac{1}{2}$$

$\forall\, i, j \in \{1, 2, \ldots, N\}$ and $\forall\, t, t' \in \{1, 2, \ldots, T^*\}$.

A pure strategy for player *i* is denoted by $s_{it}(m_{it})$ where $s_{it} : [\underline{m}, \overline{m}] \rightarrow \{0,1,2,\ldots,T^*\}$ and where 0 = immediate implementation, 1 = implementation after one period, *etc*. The vector of players' strategies at time *t* is denoted by $s_t = (s_{1t}, s_{2t}, \ldots, s_{Nt})$, $s_{-it} = (s_{1t}, \ldots, s_{i-1,t}, s_{i+1,t}, \ldots, s_{Nt})$. Clearly $s_{it}(m_{it}) = 0$ for $m_{it} > m^*$, because this is a dominant strategy. Shleifer (1986) shows that for any $m \leq m^*$, any *T*-boom ($T = 1, 2, \ldots, T^*$) can be a Nash Equilibrium. We now show that when noise is introduced into the model this result no longer holds.

The following Lemma will be useful for proving our main result.

Lemma 1. There exists a fraction $k \geq 1/2$ such that the payoff from waiting for a *T*-boom, where $T>1$, is greater than the payoff from immediate implementation if and only if the number of other firms delaying their implementation to time *T* is greater than kN.

Proof. Denote by β_i the fraction of firms receiving an invention at time *i* which implement immediately. Using Shleifer's set-up, we obtain

$$\Pi_1 = \frac{mL}{1-b_1 nm}, \ \Pi_T = \frac{mL}{1-n\cdot(T-\sum_{i=1}^{T-1} b_i)\cdot m}$$

and

$$D_{T-1} = (1+r_1)\cdot(1+r_2)\cdot ....\cdot(1+r_{T-1}) = \frac{1}{r^{T-1}}\cdot\left(\frac{1-b_1 nm}{1-n\cdot(T-\sum_{i=1}^{T-1} b_i)\cdot m}\right)^g \cdot m^{ln(g-1)\sum_{i=1}^{T-1} b_i}$$

As noted earlier, in Shleifer's model payoffs are proportional to output, whereas the discount factor is proportional to output raised by g. Therefore, P_1 is monotonically increasing and continuous in b_1 while P_T/D_{T-1} is monotonically decreasing and continuous in $\sum b_i$.

Next we show that $P_T/D_{T-1} \leq P_1$ (or $(P_T/D_{T-1})/P_1 \leq 1$) when exactly half of the firms implement immediately, and half delay implementation until time T. Substituting $b_1 = b_2 = ... = 1/2$ we have:

(9) $$\frac{\Pi_T / D_{T-1}}{\Pi_1} = r^{T-1}\cdot m^{ln(1-g)\frac{T-1}{2}} \cdot (1-n\cdot\frac{T-1}{2}\cdot m)^{g-1}\cdot(1-\frac{nm}{2})^{1-g}$$

Shleifer assumes $rm^{ln(1-g)} < 1$ (equation 14, page 1173), and therefore

$$r^{T-1}\cdot m^{ln(1-g)\frac{T-1}{2}} = r^{\frac{T-1}{2}}\cdot\left(rm^{ln(1-g)}\right)^{\frac{T-1}{2}} < 1$$

Substituting back into (8), we obtain

$$\frac{\Pi_T / D_{T-1}}{\Pi_1} \leq (1-n\cdot\frac{T-1}{2}\cdot m)^{g-1}\cdot(1-\frac{nm}{2})^{1-g} = \left(\frac{1-n\cdot\frac{T-1}{2}\cdot m}{1-\frac{nm}{2}}\right)^{g-1} \leq 1$$

which, combined with the continuity argument and with the fact that $(P_T/D_{T-1})/P_1 > 1$ when *all* firms wait, completes the proof of Lemma 1.

QED

Lemma 1 establishes that delaying implementation is riskier (in the game theoretic sense) then implementing immediately, since it requires a higher degree of correlation. Specifically, it shows that more than half the number of the firms need to wait before waiting becomes optimal.

The following definition will be useful in proving our main result.

Definition 1. Define $f_i(m_i, s_{-i})$ as the probability firm i attaches to the event that all other firms wait for a T-boom, when its own signal is m_i and their equilibrium strategies are s_{-i}.

We can prove the following proposition.

Proposition 1. In the implementation cycle model with noise, the only possible equilibrium cycles are of period T=1.

Assume, contrary to the statement in the proposition, that there exists a symmetric Nash equilibrium S where any firm i receiving an invention at time t and a signal $m_i \leq \tilde{m} < m^*$ delays its implementation until time T>1. In order to establish Proposition 1 we need to prove the following Lemma.

Lemma 2. If S is a T-boom equilibrium as defined above for T>1, then $f_i(m_i, S_{-i}) > \frac{1}{1 + f(T(m_i))}$ for all i and for every $m_i \leq \tilde{m}$ where $f(T(m_i))$ is given in equation (7).

Proof of Lemma 2. Compute P_1, P_T, and D_{T-1} under the assumption that all firms wait for a T-boom, and using $m=m_i$ then since S is an equilibrium,

(10) $$\frac{\Pi_T}{D_{T-1}} \cdot f_i(m_i, S_{-i}) > \Pi_1 \cdot (1 - f_i(m_i, S_{-i})) \quad \text{for all } i$$

because otherwise the firm can profitably deviate by implementing its invention immediately: by deviating it will get at least P_1 (using Lemma 1 we know that P_1 only increases if in fact other firms also implement immediately), with probability *1-f*. By waiting for a T-boom the maximum payoff the firm expects to get is P_T/D_{T-1} (again, using Lemma 1, this expression is maximised when we set all b's to be equal zero, i.e. everyone waits), with probability f. Solving (10) for f we obtain the inequality required by Lemma 2.

QED

Proof of Proposition 1. Consider now a firm which receives the signal $\tilde{m}$. We have:

(11) $$f_i(\tilde{m}, S_{-i}) = \text{Prob (at least a fraction } k \text{ of the firms are waiting for a } T\text{-boom)}$$

$$\leq \text{Prob (at least } Nk \text{ firms receive a signal} < \tilde{m}\text{)}$$

$$\leq \text{Prob (at least } N/2 \text{ firms receive a signal} < \tilde{m}\text{)} = 1/2$$

where the first equality in (11) follows from the definition of *f*, the inequality on the second line follows because firms which receive a signal $m_j > \tilde{m}$ implement immediately in *S*, and the last line follows because the probability of $m_{i1} < m_{jt}$ for any given *i, j,* and *t* is 1/2 (equation (8)). Since $\tilde{m} < m^*$ equation (7) is satisfied, or $f(T(\tilde{m}))>1$. However, combining Lemma 2 with the above upper bound on *f* (equation 10) we obtain: $f_i(\tilde{m}, S_{-i}) \geq \frac{1}{1+f(T(\tilde{m}))} > \frac{1}{2} \geq f_i(\tilde{m}, S_{-i})$. Contradiction. Therefore $\tilde{m}$ cannot be smaller than m^*, that is, no cycles of length $T>1$ are possible in equilibrium.

QED

Suppose now that the government makes an announcement that it expects a high level of aggregate demand at time *T* (>1). In other words, the government is predicting a *T*-boom [2]. Such a statement has the informational effect that it can make it common knowledge that $m_t < m^*$ for $t=1,..,T$. In fact, when $m_{i,t} < m^*$ for all *i* and for all *t* (this is guaranteed when $m_t < m^*\text{-}e\ \forall t$), then $m_t < m^*\ \forall t$ *will* become commonly known. By common knowledge it is meant that each firm knows "$m_t < m^*\ \forall t$", that all other firms know "$m_t < m^*\ \forall t$", that all firms know that all other firms know that "$m_t < m^*\ \forall t$", *ad infinitum.*

As we show below, the mere fact that "$m_t < m^*\ \forall t$" is commonly known restores the possibility of multiple cycle equilibria. To see the intuition behind this result, consider a firm (indexed *i*) in the noisy setting which received an invention at time *t* and a signal $m_{i,t} < m^*\text{-}e$. The firm does know for sure that $m_t < m^*$ (because the noise is bounded on [-*e, e*]). Still, in equilibrium, the optimal implementation strategy for this firm will depend on the strategy of other firms for signals $m_{j,t}$ slightly

2 Or perhaps it even contributes to such an outcome by increasing public spending at time *T*. However, in what follows we show that the statement by itself can be sufficient in restoring the possibility of a *T*-boom, and of course in co-ordinating the implementation timing of firms. Notice that in

greater than $m_{i,t}$ (within $2e$ of $m_{i,t}$ to be precise), which in turn will depend on the behaviour of other firms in signals slightly greater than $m_{j,t}$, and so on. Therefore even though firm i knows with probability 1 that $m_t < m^*$, it must take into account what other firms do (and consequently what it will itself do) for signals greater than m^*. Following the government announcement this is no longer true. Behaviour at $m \geq m^*$ no longer matters when deciding when to implement given a signal $m_{i,t} < m^*$.

Proposition 2. If it is common knowledge that $f(T) \geq M > 1$, where $T>1$ and M is a constant, then there is a Nash equilibrium where all firms implement at time T (i.e. a T-boom).

Proof. The proof is identical to that in Shleifer. Assuming all other firms wait, it is sufficient to check that $P_T/D_{T-1} > P_1$ that is, that a firm which receives an invention at time 1 is better off waiting to time T than implementing immediately (see Proposition 1 in Shleifer, 1986, page 1174). This condition is satisfied when $f(T)>1$, hence waiting until time T is a Nash equilibrium.

QED

The proof of Proposition 1 will fail in the setting of Proposition 2. To see why, denote by m^M the value of m which solves $f(T(m))=M$. The function $f_i(m^M, S_{-i})$ can no longer be bounded from above by 1/2, because i cannot assume that firms which receive signals in the interval $[m^M, m^*]$ will implement their inventions as soon as those are received.

Proposition 1 says that the introduction of some noise in the economy has the effect of eliminating the indeterminacy result in the model of implementation cycles. Immediate implementation is perceived as the least risky course of action, and firms do not wait even if the fundamentals of the economy are consistent with longer cycles. Proposition 2 suggests an informational role for a public announcement, *e.g.* by the policy authorities. By making the state of the world common knowledge, it becomes once more possible to have a long cycle. Moreover, since this result is achieved through the announcement, one might argue that firms will infer that this is the *reason* for the announcement in the

Shleifer's set-up, the T-boom equilibrium Pareto dominates the equilibrium where all firms implement immediately. Hence the government is likely to encourage longer implementations cycles.

first place, and a long cycle is therefore more likely to be selected (this is formally a forward induction argument).

4. Discussion

This paper addresses the issue of how economic agents co-ordinate their expectations over the business cycle. Models with self-fulfilling equilibria require that individual expectations and beliefs are common knowledge to all economic agents. The fragility of some of these equilibria in the presence of uncertainty and correlated signals has recently been analysed by several authors in different contexts. Shin (1995) considers a decentralised economy with search externalities. Scaramozzino and Vulkan (1998) examine a model of local oligopoly with correlated noise about the competitive advantage of firms. Morris and Shin (1998) look at the timing of speculative attacks against a currency. In our view, the issue of co-ordination of agents' actions under uncertainty is particularly relevant for the analysis of economic fluctuations, given the critical importance of expectations in driving the cycle.

This paper shows that, if agents face uncertainty about the fundamentals of the economy and if this uncertainty is correlated amongst agents, then there is endogenous co-ordination to what agents perceive as their least risky equilibrium. Thus, the indeterminacy result of models with self-fulfilling equilibria could be a very fragile feature of these models. The possibility of multiple equilibria could however be restored, if the policy authorities can announce a different outcome. Provided the policy authorities enjoy sufficient credibility, their announcement will act as a co-ordinating device and the economy could settle to any of the existing Nash equilibria and will most likely settle on longer cycles, which under some assumptions (*e.g.* the existence of fixed implementation costs) are Pareto efficient (see Shleifer, 1986).

We have established our results by using Shleifer's model of the business cycle as the framework for the analysis. However, it should be clear from the presentation that these results are more general, as they only rely on the presence of a small amount of correlated noise in the firms' perceptions of the fundamentals of the economy. Understanding why firms are slow to adjust to varying fundamentals is likely to provide us with useful insights into the type of policies which are most powerful in affecting firm behaviour. Our work can be interpreted as a first step in this direction.

References

Azariadis, Costas (1981), "Self-fulfilling Prophecies", *Journal of Economic Theory*, Vol. 25, December, pp. 380-396.

Cass, David, and Karl Shell (1983), "Do Sunspots Matter?", *Journal of Political Economy*, Vol. 91, April, pp. 193-227.

Farmer, Roger E.A. (1993), *The Macroeconomics of Self-Fulfilling Prophecies*, Cambridge (MA) and London, MIT Press.

Keynes, John Maynard (1936), *The General Theory of Employment, Interest and Money*, London, Macmillan.

Matsuyama, K. (1995), "Complementarities and Cumulative Processes in Models of Monopolistic Competition", *Journal of Economics Literature*, Vol. 33, No. 2, pp. 701-729.

Morris, Stephen, and Hyun Song Shin (1998), "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks", *American Economic Review*, Vol.88, No.3, pp.587-597.

Scaramozzino, Pasquale, and Nir Vulkan (1998), "Uncertainty and Endogenous Selection of Macroeconomic Equilibria", Department of Economics, University of Bristol, mimeographed.

Shin, Hyun Song (1995), "Defining a Notion of Confidence in an Economy with Differential Information", University of Southampton, mimeographed.

Shleifer, Andrei (1986), "Implementation Cycles", *Journal of Political Economy*, Vol. 94, No. 6, pp. 1163-1190.

Silvestre, Joachim (1993), "The Market-Power Foundations of Macroeconomic Policy", *Journal of Economic Literature*, Vol. 31, March, pp. 105-141.