THE NEW PERSPECTIVE ON KEYNESIAN COORDINATION FAILURE: THEORY AND EVIDENCE

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ABSTRACT

Starting with the work of Diamond (1982), Hart (1982), Weitzman (1982) and Bryant (1983), a number of authors have employed models which exhibit potential coordination failure to show that many features of the Keynesian framework can be captured in models consistent with the microfoundations approach. In a recent paper Cooper and John (1988) argue that one property shared by many of these models is the presence of strategic complementarity, and that this is the critical feature which lies behind the finding of Keynesian type results. In this paper we derive a prediction of the strategic complementarity approach concerning how an economy should respond to false pieces of information, and test the prediction by looking at expectational shocks measured by revisions of the series of leading economic indicators. We find that the response of the macro economy to false pieces of information matches almost perfectly the prediction of the strategic complementarity approach.

I. Introduction

One of the major changes in macroeconomics over the last twenty years has been the movement towards a microfoundations approach. That is, rather than the positing of ad hoc behavioral assumptions, the accepted methodology now is to solve for the equilibria of models in which agents attempt to maximize well specified utility functions. The early authors who took this approach were in general critical of Keynesian macroeconomics, and their argument had a large impact on the status of the Keynesian viewpoint within the profession. However, starting with the work of Diamond (1982), Hart (1982), Weitzman (1982) and Bryant (1983), the Keynesians struck back. These authors employed models which exhibit potential coordination failure to show that many features of the Keynesian framework can be captured in models consistent with the microfoundations approach. For example, in the context of a search model Diamond demonstrates the existence of equilibria with "too low" a level of aggregate activity, while Hart captures this feature and the simultaneous existence of multipliers in a model of monopolistic competition.

These early papers stimulated a number of authors to look for other models which exhibit Keynesian features, and soon there were numerous papers which show that the Keynesian viewpoint is not at all inconsistent with a micro oriented approach (see for example Howitt (1985), Heller (1986), Shleifer (1986), and Blanchard and Kiyotaki (1987)).[1,2] More recently there has been an important contribution by Cooper and John (1988) which investigates the relationship between many of these papers. What Cooper and John argue is that most of these models are driven by the presence of the same factor, i.e., they rely on the presence of what is termed strategic complementarity. A macroeconomic environment which exhibits strategic complementarity is simply

one where, the higher is aggregate production, the larger is the incentive for any particular agent to produce. Cooper and John first demonstrate that the presence of strategic complementarity is a characteristic of most of the models mentioned, and then go on to argue persuasively that this is the critical feature which lies behind the finding of Keynesian type results.

The next important step in the literature is to test for empirical relevance, i.e., does the macro economy actually exhibit strategic complementarity? One paper along these lines is that of Cooper and Haltiwanger (1987). These authors construct two simple macroeconomic models – one being of the strategic complementarity type and one being of the real business cycle type – and then compare the two models in terms of the co-movement of employment across sectors over the business cycle. They find that predictions from the two models concerning the co-movement of employment over the cycle may differ, and then present evidence concerning the actual behavior of employment which is consistent with the predictions of the strategic complementarity approach.

This paper presents a test of strategic complementarity in the macro setting which is more direct than the approach taken by Cooper and Haltiwanger. Rather than focusing on the co-movement of employment over the cycle, we attempt to directly test whether positive information concerning the production plans of other agents in the economy has a positive impact on output. As we will discuss in more detail in the following sections, the test is based on expectational shocks measured by revisions of the series of leading economic indicators. What we find is that the response of the macro economy to these expectational shocks matches almost perfectly the prediction of the strategic complementarity approach. That is, if agents in the economy

receive information that aggregate production is likely to be high in the following periods – even when that information is false – the information is positively correlated with future movements in output. Given the theoretical literature discussed above which links strategic complementarity and Keynesian type results, this finding suggests that the Keynesian predictions, if not the Keynesian model, may be an accurate description of the economy after all.

The outline for the paper is as follows. Section II presents a simple theoretical framework wherein we derive a prediction concerning how an economy would respond to false pieces of information given the presence of strategic complementarity. Section III describes the data and presents results of a number of tests of the prediction derived in section II. Section IV investigates the economic significance of the expectational shocks on which we focus. Section V first discusses the extent to which our results are either consistent or inconsistent with alternative theories concerning the workings of the macro economy, and then discusses one anomaly concerning our findings. Section VI presents some concluding remarks.

II. Strategic Complementarity and its Implications for "False" Information

A. The Model

In this sub-section we construct a simple macroeconomic model similar to one analyzed in Haltiwanger and Waldman (1988). In the following sub-section we analyze the model under various assumptions concerning the information available to agents when they make their production decisions.

The economy consists of a continuum of agents each of whom must decide whether or not to undertake a production project. If agent i decides to undertake a project, then he produces y units of output at cost c_i, where

$c_i=\alpha_i b_i$. One can think of this heterogeneity in costs as representing the idea that, prior to deciding whether or not to produce, each agent i draws a production project from the distribution of projects. It is assumed that the distribution of b_i's is described by a density function h(.) which is positive over the interval $[0,\infty)$, and equals zero elsewhere. On the other hand, α can only take on two values, $\bar{\alpha}$ and $\underline{\alpha}$, $\bar{\alpha}>\underline{\alpha}$, where an individual's realization for α_i is independent of his realization for b_i.[3]

The distribution of α_i's in the population captures the aggregate state of the economy. In particular, it is assumed that there are two realizations for the aggregate state of the economy. With probability p the aggregate state of the economy is "good" in which case a proportion q_1 of the agents have a realization $\alpha_i=\bar{\alpha}$, while a proportion $(1-q_1)$ have a realization $\alpha_i=\underline{\alpha}$. On the other hand, with probability (1-p) the aggregate state of the economy is "bad". In this case a proportion q_2 of the agents have a realization $\alpha_i=\bar{\alpha}$, while a proportion $(1-q_2)$ have a realization $\alpha_i=\underline{\alpha}$, where $q_2>q_1$. Each agent before making his production decision observes his own realization for cost, i.e., he observes his own values for for α_i and b_i. We initially assume, however, that an agent does not observe the aggregate state of the economy, although he does know that it is good with probability p and bad with probability (1-p).

Let Y be aggregate production. The gross return to an agent for undertaking a production project is given by $R=r(Y)y$. We consider three cases. The economy can exhibit strategic complementarity ($r'>0$), i.e., an increase in aggregate production raises the incentive for each individual agent to produce. The economy can exhibit strategic substitutability ($r'<0$), i.e., an increase in aggregate production lowers the incentive for each individual agent to produce. The economy can exhibit neither strategic

complementarity nor strategic substitutability ($r'=0$).

Under the assumption of strategic complementarity, this model can be directly interpreted in terms of a number of the existing macroeconomic models of coordination failure which were discussed in the previous section. For example, consider Diamond (1982). In that model the key restriction on behavior is that each individual cannot consume what he himself produces, but must rather trade his output for that which is produced by others. Under this interpretation, $r(Y)$ denotes the probability of successfully completing a trade, and $r'>0$ indicates the presence of positive trading externalities. That is, the larger is the number of traders, the higher is the probability that any particular trader will find an agent to trade with.

One can also interpret $r'>0$ as arising from demand linkages between imperfectly competitive producers in a multisector economy (see for example Hart (1982)). Under this interpretation, $r(Y)$ denotes the marginal revenue from undertaking a production project, and $r'>0$ indicates that demand linkages cause the marginal revenue function facing a producer in a particular sector to shift out as the output of other sectors increase.

It is assumed that agents are risk neutral. Hence, agent i will (will not) undertake a production project if

$$r_i^e y > (<) c_i, \tag{1}$$

where r_i^e is agent i's expectation concerning the return associated with undertaking a production project.

Finally, under the assumption of strategic complementarity, the model described above may display multiple equilibria. It is easy to demonstrate, however, that multiple equilibria can only arise if r' is above some critical

value over some range of values for Y. Hence, since we want to abstract away from the possibility of multiple equilibria, it is assumed that r' is everywhere below this critical value.

B. Analysis

The focus of the analysis is on how the economy responds to announcements concerning the aggregate state of the economy which are made prior to individuals making their production decisions. In particular, as will become clear, the most important case we consider is how the economy responds to announcements which turn out to be false.

If there are no announcements then the economy works very simply. Each agent will make his production decision knowing his own cost realization, and given his knowledge that the aggregate state of the economy is good with probability p and bad with probability (1-p). The result is two values for aggregate production, each one corresponding to a different aggregate state of the economy. Y^G will denote aggregate production when the aggregate state of the economy is good, while Y^B will denote aggregate production when the aggregate state of the economy is bad. It is easy to show that $Y^G > Y^B$.

We begin our analysis by considering what happens with the introduction of an announcement made prior to individuals making their production decisions, where this announcement perfectly reveals what the true aggregate state of the economy is. That is, the announcement is accurate with probability one, and all the agents know that it is accurate with probability one. $\tilde{Y}^G$ ($\tilde{Y}^B$) will denote aggregate production given that the true aggregate state of the economy is good (bad), and given that such an announcement is made. Note, all proofs are relegated to the Appendix.

Proposition 1:

i) $\tilde{Y}^G > \tilde{Y}^B$

ii) If $r'>0$, then $\tilde{Y}^G > Y^G$ and $\tilde{Y}^B < Y^B$.

iii) If $r'<0$, then $\tilde{Y}^G < Y^G$ and $\tilde{Y}^B > Y^B$.

iv) If $r'=0$, then $\tilde{Y}^G = Y^G$ and $\tilde{Y}^B = Y^B$.

Proposition 1 tells us that the introduction of a perfect announcement does not affect the qualitative relationship between aggregate production in the good and bad states of the world, i.e., aggregate production in the good state of the world continues to exceed aggregate production in the bad state. More interesting is the relationship between aggregate production when no announcement is made and when one is introduced. ii) and iii) indicate that the effect of such an announcement depends crucially on whether the economy exhibits strategic complementarity or strategic substitutability. ii) tells us that when strategic complementarity is present, then the introduction of a perfect announcement raises aggregate production in the good state but lowers it in the bad state. In contrast, iii) tells us that when strategic substitutability is present the results are exactly reversed. That is, the introduction of a perfect announcement lowers aggregate production in the good state but raises it in the bad state.

The intuition for these results is rather simple. When strategic complementarity is present, each individual has a higher incentive to produce when he thinks aggregate production will be high. Hence, a perfect announcement that the state of the economy is good will increase each individual's incentive to produce ($\tilde{Y}^G > Y^G$), while an announcement that the state of the economy is bad will decrease each individual's incentive to produce ($\tilde{Y}^B < Y^B$). On the other hand, when strategic substitutability is

present each individual has a lower incentive to produce when he thinks aggregate production will be high, and this change exactly reverses the argument and the results.

Proposition 1 highlights an interesting difference between the effect of announcements in a world characterized by strategic complementarity and the effect in a world characterized by strategic substitutability. However, although of interest, it is nevertheless of limited use if one's goal is to test empirically whether the actual macro environment is characterized by strategic complementarity or strategic substitutability. For example, consider announcements of the leading economic indicators. These announcements are of the basic type which is the focus of proposition 1. That is, announcements of the leading indicators are predictions of future growth in aggregate activity which become available prior to individuals making their production decisions.[4] What proposition 1 tells us is that the effect of the introduction of such announcements depends crucially on whether the environment is characterized by strategic complementarity or strategic substitutability. However, to use this fact to test whether the economy is characterized by strategic complementarity or strategic substitutability would seem to be a very difficult task. One would need estimates of what production would be if no announcements of leading indicators were made, and it is not at all clear how reliable estimates of this counter-factual could be derived.

We now turn our attention to a slightly different assumption concerning the nature of announcements which turns out to be more useful from the testing perspective. Assume that an announcement is still made prior to individuals making their production decisions, but that the announcement is no longer perfect. Rather, if the announcement is that the state of the economy is

good then there is a probability s, 1>s>p, that the actual state of the economy is good, while if the announcement is that the state of the economy is bad then there is a probability t, 1>t>(1-p), that the actual state of the economy is bad. $\tilde{Y}_G^G$ ($\tilde{Y}_B^G$) will denote aggregate production when the announcement is that the state of the economy is good (bad) and the actual state is good, while $\tilde{Y}_G^B$ ($\tilde{Y}_B^B$) will denote aggregate production when the announcement is that the state of the economy is good (bad) and the actual state is bad.

Proposition 2:

i) $\tilde{Y}_G^G > \tilde{Y}_G^B$ and $\tilde{Y}_B^G > \tilde{Y}_B^B$

ii) If $r' > 0$, then $\tilde{Y}_G^G > Y^G > \tilde{Y}_B^G$ and $\tilde{Y}_G^B > Y^B > \tilde{Y}_B^B$.

iii) If $r' < 0$, then $\tilde{Y}_G^G < Y^G < \tilde{Y}_B^G$ and $\tilde{Y}_G^B < Y^B < \tilde{Y}_B^B$.

iv) If $r' = 0$, then $\tilde{Y}_G^G = Y^G = \tilde{Y}_B^G$ and $\tilde{Y}_G^B = Y^B = \tilde{Y}_B^B$.

On one level, proposition 2 tells us that the imperfect announcement works in a manner quite similar to the perfect announcement of proposition 1. First, holding the announcement fixed, aggregate production is higher when the state of the economy is good than when it is bad (condition i). Second, given the presence of strategic complementarity and holding the true state of the economy fixed, a positive announcement increases aggregate production while a negative announcement decreases it (condition ii). Third, given the presence of strategic substitutability and holding the true state of the economy fixed, a positive announcement decreases aggregate production while a negative announcement increases it (condition iii).

There is an advantage associated with proposition 2, however, in that there is now one additional and quite important result. We now have a result concerning what happens when the announcement is wrong, i.e, when for example

the actual state of the economy is bad but the announcement is that it is good. What the proposition tells us is that mistakes work much differently in a world characterized by strategic complementarity than in a world characterized by strategic substitutability. Condition ii) states that when strategic complementarity is present aggregate production is positively related to mistakes which are made. For example, if the actual state of the economy is bad, then aggregate production is higher if the announcement mistakenly states that it is good ($\tilde{Y}^B_G > \tilde{Y}^B_B$). In contrast, condition iii) states that in an environment characterized by strategic substitutability, aggregate production will be negatively related to mistakes. For example, if the actual state of the economy is bad, now aggregate production is <u>lower</u> if the announcement mistakenly states that it is good ($\tilde{Y}^B_G < \tilde{Y}^B_B$).

The intuition for this new result is similar to the intuition given earlier for proposition 1. Again, when strategic complementarity is present each individual has a higher incentive to produce when he thinks aggregate production will be high. Hence, a positive mistake increases the incentive for individuals to produce, while a negative mistake lowers it. In contrast, when strategic substitutability is present each individual has a lower incentive to produce when he thinks aggregate production will be high, and this change exactly reverses the argument and the results.

The important aspect of the above discussion is that this new result can be used to test whether the economy is characterized by strategic complementarity or strategic substitutability. Consider again the series of leading economic indicators. This new result tells us that, to the extent that there are mistakes associated with the announcements of the leading indicators, these mistakes should be positively correlated with future output

if strategic complementarity is present but negatively correlated if instead there is strategic substitutability. This new prediction is testable because of the revision process associated with the leading indicators. Consider the value for the leading indicators announced in January 1989. That January number will be revised at the end of each of the following eleven months, and a positive (negative) revision is equivalent to the statement that there was a negative (positive) mistake associated with the initial announcement. In other words, our theory suggests that the finding of a negative correlation between revisions and future output would be evidence of strategic complementarity, while a positive correlation would be evidence of strategic substitutability.

One point which is important to note here is that the theory does not necessarily suggest that each of the eleven monthly revisions will be equally correlated with future output. Suppose that final production decisions are not made at the time of the initial announcement of the leading indicators, but rather are made after the first few revisions have been announced. The theory would then predict that, since agents will have taken into account these early revisions in making their production decisions, these first few revisions should have little or no correlation with future output. In contrast, since later revisions will not have been observed before production decisions are made, these later revisions should have a strong negative correlation with future output if strategic complementarity is present, and a strong positive correlation if instead there is strategic substitutability.

Finally, one interesting aspect of the test being proposed here is that it is close to being a <u>direct</u> test for the presence of strategic complementarity. Remember that the definition of strategic complementarity

is that, the higher is aggregate production, the larger is the incentive for any particular agent to produce. The direct implication is that the release of say positive information concerning future aggregate production should have a positive effect on future output. This direct implication cannot be used to test for the presence of strategic complementarity when the information being released is true, because then a positive movement in future output could simply be due to the fact that the information predicted a positive movement. However, if the information is false, then the observation of a positive movement would be direct evidence for the presence of strategic complementarity.

III. Data and Results

A) Data

In our empirical work we employ three different types of data. For our measure of aggregate production we use seasonally adjusted values for the quarterly growth rate in industrial production. We also employ components of this measure such as the quarterly growth rates of durables and nondurables, and the growth rates of consumer goods, intermediate goods, and equipment.

Our other two types of data are constructed from the composite index of leading economic indicators (hereafter referred to simply as leading indicators). The first such variable is the quarterly growth rate of the leading indicators which is computed from the true or final announced values of the indicators. The other type of variable concerns revisions of the leading indicators. As discussed earlier, after an initial announcement the value of the leading indicators for that quarter is revised at the end of each of the following eleven months. The cumulative revision will refer to the

change in the value of the leading indicators from the first announcement to the last announcement divided by the value at the last announcement. We also break up the cumulative revision into four quarterly revisions, where the first quarterly revision is the summation of the first two monthly revisions, the second quarterly revision is the summation of monthly revisions three through five, etc. The data indicates that there is little or no systematic correlation across the quarterly revisions, and there is little or no autocorrelation for either the quarterly or cumulative revisions.[5]

In our analysis we consider the time period October 1976 to July 1988. The reason we choose this time period is that in November 1975 there was a major change in the method by which the value for the leading indicators was constructed, and we want to focus on a time period over which the method of construction was relatively constant.[6]

B. Results

The theory presented in the previous section states that, to the extent the environment exhibits strategic complementarity and the leading indicators predict future aggregate production, revisions of the leading indicators should be negatively correlated with future output. The first step is thus to investigate the extent to which leading indicators predict future production. Regression results concerning the relationship between the growth rate for the true value of the leading indicators and growth in future production are reported in table 1. The table tells us that the leading indicators are positively related with growth in future production for the first four quarters following the initial announcement, while for quarters five through eight there is a negative relationship although all these coefficients are

insignificant. There are also two other aspects of the table worth noting. First, for the first four quarters following the initial announcement the coefficient on the leading indicator variable falls monotonically, to the extent that for the fourth quarter the coefficient is not significant at the 90% level. Second, since the coefficient on the leading indicator variable falls monotonically as does the value for the t statistic, it is not surprising that the adjusted value for R^2 also falls monotonically.

Table 1

	I	LI_t	Adj R^2
IP_{t+1}	.003	.621	.51
	(1.51)	(6.82)	
IP_{t+2}	.005	.335	.14
	(1.70)	(2.79)	
IP_{t+3}	.006	.237	.06
	(1.86)	(1.88)	
IP_{t+4}	.006	.169	.02
	(1.91)	(1.30)	
IP_{t+5}	.003	-.116	-.006
	(2.54)	(.87)	
IP_{t+6}	.007	-.105	-.009
	(2.29)	(.80)	
IP_{t+7}	.007	-.038	-.02
	(2.01)	(.29)	
IP_{t+8}	.007	-.058	-.02
	(1.93)	(.42)	

I: intercept

LI_t: true growth rate in the leading indicators in quarter t

IP_{t+j}: growth rate in industrial production in quarter t+j

(t statistics are reported inside the parentheses)

Applying the theory of the previous section we now have that revisions of the leading indicators should be negatively correlated with growth in future output for the first four quarters following the initial announcement. The

next step is to proceed to tests of this prediction. We begin with a regression specification of the following form.

$$IP_{t+j}=b_1+b_2LI_t+b_3R_t+e_t, \quad (2)$$

where IP_{t+j} is the growth rate in industrial production in quarter t+j, LI_t is the growth rate in the true value for the leading indicators in quarter t, R_t is the cumulative change in the value for the leading indicators in quarter t from the initial announcement to the final announcement, and e_t is an error term.[7] Table 2 reports results for j=1,...8.

Table 2

	I	LI_t	R_t	Adj R^2
IP_{t+1}	.003	.623	.077	.50
	(1.52)	(6.76)	(.30)	
IP_{t+2}	.005	.331	-.178	.12
	(1.59)	(2.72)	(.53)	
IP_{t+3}	.005	.231	-.227	.04
	(1.72)	(1.82)	(.65)	
IP_{t+4}	.005	.148	-.926	.15
	(1.61)	(1.22)	(2.78)	
IP_{t+5}	.008	-.125	-.414	-.001
	(2.36)	(.94)	(1.13)	
IP_{t+6}	.008	-.101	.168	-.03
	(2.31)	(.77)	(.46)	
IP_{t+7}	.007	-.031	.243	-.04
	(2.08)	(.23)	(.64)	
IP_{t+8}	.007	-.051	.228	-.04
	(1.99)	(.37)	(.60)	

The results reported in table 2 are suggestive of our theory, but only weakly so. The coefficient on the revision variable has the predicted sign for future periods two through five, but the coefficient is only significant at the 90% level for the fourth quarter following the initial announcement. The regressions reported in table 2, however, do not take into account "which" revisions should be more significant. As discussed in the previous section,

there is a reason to think that the early revisions will have a smaller correlation with future output than will the later revisions. This is the prediction of the theory if, rather than making final production decisions immediately after the initial announcement, agents make their final production decisions after the early revisions have been released. Tables 3 and 4 test this prediction. In table 3 we break up the cumulative revision into four quarterly revisions, where R_t^1 is the first quarterly revision, R_t^2 is the second quarterly revision, etc. Table 3 reproduces the test of table 2 but with each quarterly revision included as a separate explanatory variable. The results reported there conform very well with our prediction. Consider future quarters two through five which were the quarters in table 2 with the correct sign on the revision coefficient. For the first revision three of the four coefficients have the correct sign, but not one of the three is even close to being significant at the 90% level. In contrast, for the latter three revisions eleven of the twelve coefficients are of the predicted sign, and five of them are either significant or close to significant at the 90% level. Also, if one just looks directly at the relative sizes of the coefficients, it is clear that even when the coefficient on the first revision has the correct sign it tends to be much smaller in absolute value than the coefficients on the other revision variables.

Table 3

	I	LI_t	R_t^1	R_t^2	R_t^3	R_t^4	Adj R^2
IP_{t+1}	.005	.613	-.393	.117	1.212	.098	.56
	(1.97)	(6.56)	(1.06)	(.16)	(2.52)	(.09)	
IP_{t+2}	.002	.438	-.371	-2.124	-.396	1.781	.22
	(.45)	(3.56)	(.76)	(2.16)	(.63)	(1.22)	
IP_{t+3}	.002	.267	.691	-.962	-1.195	-2.005	.11
	(.50)	(2.03)	(1.33)	(.92)	(1.77)	(1.29)	
IP_{t+4}	.003	.179	-.402	-1.672	-1.106	-2.530	.07
	(.70)	(1.36)	(.77)	(1.57)	(1.63)	(1.62)	
IP_{t+5}	.005	-.079	-.070	-1.363	-.691	-.982	-.05
	(1.33)	(.54)	(.12)	(1.15)	(.92)	(.57)	
IP_{t+6}	.007	-.120	.540	.758	-1.040	.641	-.006
	(1.86)	(.85)	(.93)	(.67)	(1.43)	(.37)	
IP_{t+7}	.003	.044	1.237	-1.327	.236	-2.977	.02
	(.82)	(.31)	(2.09)	(1.17)	(.33)	(1.73)	
IP_{t+8}	.005	.004	.386	-.824	.207	.090	-.11
	(1.18)	(.03)	(.61)	(.67)	(.27)	(.05)	

In table 4 we subtract off the first quarterly revision from R_t, where this new variable is denoted R_t^{-1}, and reproduce the tests of table 2. Consistent with table 3, we see that subtracting off the first quarterly revision strengthens the results quite substantially. The coefficient on the revision variable now has the predicted sign for future quarters two through seven, and in comparison with table 2 the coefficient is more negative in each of these quarters. It is also worth noting that for each of quarters three and four the coefficient on the revision variable is significant at the 95% level.

Table 4

	I	LI_t	R_t^{-1}	Adj R^2
IP_{t+1}	.005	.606	.775	.55
	(2.29)	(6.87)	(1.99)	
IP_{t+2}	.004	.344	-.478	.13
	(1.12)	(2.85)	(.90)	
IP_{t+3}	.002	.260	-1.185	.14
	(.75)	(2.15)	(2.23)	
IP_{t+4}	.002	.197	-1.461	.15
	(.68)	(1.62)	(2.72)	
IP_{t+5}	.006	-.099	-.868	.02
	(1.70)	(.75)	(1.49)	
IP_{t+6}	.006	-.097	-.399	-.02
	(1.78)	(.74)	(.68)	
IP_{t+7}	.006	-.031	-.360	-.04
	(1.55)	(.23)	(.61)	
IP_{t+8}	.007	-.058	.042	-.05
	(1.75)	(.42)	(.07)	

In combination, the results reported in tables 3 and 4 provide strong support for the presence of strategic complementarity in the macro environment. Once the first quarterly revision is taken out, the pattern for the coefficients is quite consistent. Revisions are negatively correlated with future production, and for the time period six to twelve months after the initial announcement this negative effect is both large and statistically significant.

The only manner in which the results seem inconsistent with the theory concerns which future quarterly growth rates have the strongest negative correlation with the revisions. One might expect that revisions should have the largest negative correlation with the quarterly growth rates for which the true value for the leading indicators has the largest positive correlation. There are two steps to the argument. First, upon seeing an announcement of the leading indicators, agents should be more likely to change their production plans for those future quarters for which that announcement is a

good predictor of production. Second, in a slightly richer model than the one considered in section II, one could show that revisions of an announcement will have a stronger negative correlation with growth for those future quarters for which production plans are most affected by the announcement. Given this, consider table 1. That table suggests that revisions should be negatively correlated with growth rates for the first four quarters after the initial announcement, and this negative correlation should fall monotonically over this time period. This prediction is contradicted by tables 3 and 4 which state that the largest negative correlation occurs with the growth rates for the third and fourth quarters which follow the initial announcement. However, this discrepancy between data and theory can easily be explained if there is a time lag concerning production decisions. That is, if production decisions made today do not in general affect actual production until six to nine months after the decision, then even given table 1 we would expect revisions to have the largest negative correlation with growth rates for the third and fourth quarters after the initial announcement.[8,9]

C) Further Tests Based on Some Stylized Facts

In the previous sub-section we provided evidence for the notion that agents in the economy have a higher incentive to produce when aggregate production is high, and thus positive information concerning future aggregate production (even if incorrect) has a positive impact on individual production plans. One way to further test whether this is, in fact, what is driving the results of the previous section, is to disaggregate the data and see whether evidence at the disaggrregated level is consistent with the stylized facts of how the economy behaves over the cycle. The logic here is that the stylized

facts of the business cycle should indicate how the economy typically responds to shocks. Hence, if our interpretation of our earlier findings is correct, then the response of the economy to the expectational shocks we are focusing on should be consistent with these stylized facts (see Zarnowitz (1985) for a discussion of the stylized facts typically attributed to the business cycle).

In our testing we focus on three particular stylized facts.

1) The production of durable goods exhibits a larger amplitude in its fluctuation over the cycle than does the production of nondurables.

2) Cyclical movements tend not to be confined to a small number of industries or sectors, but rather most industries and sectors participate in cyclical movements of the economy.

3) Expenditures for new plant and equipment tend to lag behind general cyclical movements in the economy.

The first stylized fact above suggests that the false pieces of information we are focusing on should have a bigger impact on the future production of durable goods than on the future production of nondurables. In other words, the negative correlation between revisions of the leading indicators and growth in future production should be stronger for the production of durables. In table 5 we test this prediction by reproducing the test of table 4 for each of durable goods and nondurable goods production. The first thing to note about the table is that for both sectors the results are consistent with the presence of strategic complementarity. That is, for each sector, the coefficients on the revision variable have the correct sign and are significant at the 95% level for each of quarters three and four. Even more interesting, however, is a comparison across the two sectors concerning the magnitude of the coefficients. Consistent with the prediction just derived, the negative correlation between revisions and growth in future production is stronger for the case of durable goods than for the case of

nondurables. In particular, for each of quarters two through five, the coefficient on the revision variable is larger in absolute value when we are dealing with the production of durable goods.

Table 5

	DURABLES				NONDURABLES			
	I	LI_t	R_t^{-1}	Adj R^2	I	LI_t	R_t^{-1}	Adj R^2
IP_{t+1}	.006	.803	1.283	.56	.005	.490	-.169	.53
	(2.01)	(6.83)	(2.48)		(2.60)	(7.17)	(.56)	
IP_{t+2}	.003	.411	-.818	.10	.005	.274	-.495	.16
	(.74)	(2.48)	(1.12)		(2.08)	(3.02)	(1.24)	
IP_{t+3}	.002	.356	-1.524	.13	.005	.107	-.991	.10
	(.41)	(2.19)	(2.13)		(2.00)	(1.14)	(2.39)	
IP_{t+4}	.002	.254	-1.811	.12	.006	.006	-1.101	.10
	(.41)	(1.53)	(2.47)		(2.18)	(.06)	(2.62)	
IP_{t+5}	.006	-.065	-1.179	.01	.009	-.117	-.174	-.01
	(1.22)	(.36)	(1.50)		(3.11)	(1.14)	(.39)	
IP_{t+6}	.007	-.117	-.718	-.02	.008	-.097	.014	-.03
	(1.34)	(.65)	(.90)		(3.04)	(.94)	(.03)	
IP_{t+7}	.005	.072	-.543	-.04	.007	-.034	-.223	-.04
	(1.06)	(.39)	(.67)		(2.56)	(.32)	(.48)	
IP_{t+8}	.007	-.135	-.232	-.04	.008	.027	.044	-.05
	(1.35)	(.73)	(.29)		(2.58)	(.25)	(.09)	

The other two stylized facts also suggest easily testable predictions. The second fact suggests that there should be a consistent negative correlation between revisions and growth in future production even when future production is broken down more finely than in table 5. On the other hand, the third stylized fact suggests that the negative correlation between revisions and growth in future production should peak in a later quarter for the production of plant and equipment than for other types of production.

In table 6 we test these predictions by reproducing the test of table 4 for each of consumer goods, intermediate goods, and equipment. The results exactly mimic the predictions just discussed. First, for each sector taken

Table 6

	CONSUMER GOODS				INTERMEDIATE GOODS			
	I	LI_t	R_t^{-1}	Adj R^2	I	LI_t	R_t^{-1}	Adj R^2
IP_{t+1}	.005	.368	.512	.35	.007	.572	.304	.55
	(2.54)	(4.61)	(1.45)		(2.47)	(5.55)	(.67)	
IP_{t+2}	.004	.232	-.567	.12	.007	.277	-.498	.07
	(1.42)	(2.50)	(1.39)		(1.89)	(2.15)	(.88)	
IP_{t+3}	.003	.101	-1.145	.14	.005	.182	-1.261	.10
	(1.20)	(1.10)	(2.83)		(1.45)	(1.44)	(2.27)	
IP_{t+4}	.003	.078	-1.158	.13	.005	.118	-1.247	.07
	(1.24)	(.83)	(2.81)		(1.53)	(.91)	(2.18)	
IP_{t+5}	.006	-.079	-.811	.06	.008	-.045	-.591	.02
	(2.12)	(.82)	(1.90)		(2.16)	(.33)	(.97)	
IP_{t+6}	.006	-.158	-.476	.07	.008	-.049	-.427	-.04
	(2.44)	(1.74)	(1.18)		(2.16)	(.35)	(.69)	
IP_{t+7}	.006	-.024	-.073	-.05	.008	-.034	-.578	-.03
	(2.24)	(.25)	(.17)		(1.96)	(.24)	(.93)	
IP_{t+8}	.008	-.093	.338	-.02	.008	.020	-.285	-.05
	(2.83)	(.96)	(.79)		(1.94)	(.14)	(.45)	

	EQUIPMENT			
	I	LI_t	R_t^{-1}	Adj R^2
IP_{t+1}	.012	.383	1.616	.34
	(4.05)	(3.38)	(3.23)	
IP_{t+2}	.008	.331	-.175	.09
	(2.22)	(2.50)	(.30)	
IP_{t+3}	.007	.380	-.373	.14
	(2.03)	(2.95)	(.66)	
IP_{t+4}	.006	.330	-.845	.12
	(1.81)	(2.51)	(1.45)	
IP_{t+5}	.007	.032	-1.341	.07
	(1.92)	(.24)	(2.21)	
IP_{t+6}	.007	.003	-.936	.009
	(1.97)	(.02)	(1.54)	
IP_{t+7}	.008	.105	-.157	-.04
	(2.14)	(.74)	(.25)	
IP_{t+8}	.009	-.129	-.385	-.02
	(2.23)	(.91)	(.62)	

separately there is a negative correlation between revisions and growth in future production. Second, for consumer goods and intermediate goods, this negative correlation is strongest for the third and fourth quarters which follow the initial announcement, while for equipment the negative correlation is strongest for the fifth quarter. That is, just as predicted, the negative correlation peaks later for equipment than for the other sectors.

IV. The Economic Significance of Expectational Shocks

What we hope to have shown in section III is that revisions of the series of leading economic indicators represent exogenous shocks to expectations which have statistically significant effects on future growth in output. In this section we consider the economic significance of these shocks, as opposed to just their statistical significance.

A) The Issue of Persistence

One issue which bears on the economic significance of these expectational shocks is whether they have persistent effects on aggregate output. On the one hand, the fact that the final revision is announced eleven months after the initial announcement might suggest that these shocks will be associated with limited persistence. On the other hand, there are a number of theoretical models which suggest that, even though the true information becomes known less than one year after the initial announcement, shocks of this sort may exhibit persistent effects. For example, Haltiwanger and Waldman (1988) show that significant persistence can be generated by such shocks if the economy is characterized by strategic complementarity and at least "some" agents in the economy have adaptive rather than rational

expectations, while the work of Kydland and Prescott (1982) suggests that significant persistence can be generated by such shocks if there are lags in the production process.

The analysis of the previous section suggests that errors in the series of leading economic indicators begin to have a significant impact on the growth of industrial production in the third quarter following the initial announcement. To test for persistence we therefore take as our starting point the value for industrial production at the beginning of the third quarter following the initial announcement, and see over what time period revisions have a negative impact on the growth rate defined from that starting point. In table 7 we conduct exactly this test for the first fourteen quarters following the initial announcement, where ΔIP_{t+j} denotes the growth in industrial production from the beginning of the third quarter following the initial announcement to the end of the jth quarter. For each regression the only explanatory variables are LI_t and R_t^{-1}, i.e., no later values for the leading indicators or the revisions are included. What the table indicates is that these expectational shocks are quite persistent. Three and one-half years after the initial announcement (and two and one-half years after the final revision is announced) the revision still has a statistically significant and large effect on the level of industrial production. Because of the short time span of our data we are not confident of the results of this test for quarters much beyond those reported in table 7. It is worth mentioning, however, that our tests did indicate that the revision has a statistically significant and large effect on the level of industrial production for up to six years after the initial announcement.

Table 7

	I_t	LI_t	R_t^{-1}	Adj R^2
ΔIP_{t+3}	.002	.260	-1.185	.14
	(.75)	(2.15)	(2.23)	
ΔIP_{t+4}	.005	.461	-2.66	.22
	(.89)	(2.37)	(3.10)	
ΔIP_{t+5}	.011	.368	-3.641	.17
	(1.44)	(1.35)	(3.02)	
ΔIP_{t+6}	.017	.279	-4.173	.12
	(1.76)	(.80)	(2.72)	
ΔIP_{t+7}	.022	.241	-4.605	.11
	(2.03)	(.60)	(2.62)	
ΔIP_{t+8}	.027	.181	-4.730	.10
	(2.26)	(.41)	(2.46)	
ΔIP_{t+9}	.031	.213	-4.849	.09
	(2.43)	(.46)	(2.37)	
ΔIP_{t+10}	.036	.271	-5.183	.10
	(2.68)	(.57)	(2.46)	
ΔIP_{t+11}	.042	.351	-4.635	.07
	(3.00)	(.71)	(2.12)	
ΔIP_{t+12}	.047	.394	-4.493	.07
	(3.24)	(.77)	(2.01)	
ΔIP_{t+13}	.051	.272	-5.344	.10
	(3.37)	(.52)	(2.32)	
ΔIP_{t+14}	.056	.186	-5.588	.10
	(3.60)	(.35)	(2.35)	

B) What Proportion of the Fluctuation in Aggregate Growth Can Revisions Explain?

A second issue which bears on the economic significance of these expectational shocks is what proportion of the fluctuation in the growth rate of industrial production can be explained by these shocks. Table 4 indicates that revisions have large effects on the growth rates for the third, fourth, and fifth quarters following the initial announcement. Given this, in table 8 we conduct two tests. In the top regression our dependent variable is the quarterly growth in industrial production, and our only explanatory variables are the values for R_t^{-1} from three, four, and five quarters earlier. We see

that by themselves these three revisions explain 20% of the fluctuation in the quarterly growth rate. In the bottom regression we add the true value for the leading indicators which corresponds to the last revision included. Here the three revisions explain approximately 17% of the fluctuation in the quarterly growth rate not explained by the true value for the leading indicators.[10]

We find this result especially interesting in that we have identified expectational shocks which should not at all reflect real changes in either tastes or the technology of production, and shown that these shocks explain on the order of 20% of the fluctuation in the quarterly growth rate in industrial production. Further, what is particularly surprising is that this 20% figure is likely to be a lower bound on the proportion of the fluctuation in growth which can be attributed to expectational shocks of this sort. That is, to the extent that agents look at variables in addition to the leading indicators in their attempt to predict future production, this figure will be a lower bound as long as these other variables also have error components associated with their early announcements.

Table 8

	I_t	LI_t	R_t^{-1}	R_{t-1}^{-1}	R_{t-2}^{-1}	R^2	Adj R^2
IP_{t+3}	.0001		-.885	-.849	-.725	.20	.14
	(.33)		(1.50)	(1.36)	(1.23)		
IP_{t+3}	.0004	.188	-.976	-.717	-.530	.24	.16
	(.11)	(1.48)	(1.67)	(1.16)	(.89)		

V. Discussion

A) Alternative Theories

In previous sections we derived a prediction concerning how an economy should respond to false pieces of information given the presence of strategic

complementarity, and tested the prediction by looking at expectational shocks measured by revisions of the series of leading economic indicators. What we found is that the response of the macro economy to false pieces of information matches almost perfectly the prediction of the strategic complementarity approach. In this sub-section we discuss the extent to which our findings are either consistent or inconsistent with alternative theories concerning the workings of the macro economy.

There is one type of alternative theory which is obviously inconsistent with our results. Our tests are based on expectational shocks which should not at all reflect real changes in either tastes or the technology of production. Yet we find that these shocks have both persistent effects and explain on the order of 20% of the fluctuation in the quarterly growth rate in industrial production. Hence, to the extent our results are correct, one must be doubtful concerning business cycle theories which are based solely on real movements of the fundamentals of the economy.

We do not mean to imply by the above statement that our results are inconsistent with every type of real business cycle theory. For example, consider a real business cycle model which is characterized by real aggregate shocks to the economy. Our results are consistent with such a model under the additional assumption that these shocks are not easily observable, but rather agents look at announcements of the leading indicators for information concerning these aggregate shocks. That is, such a model would make a prediction concerning the correlation between revisions and future production which is identical to the prediction derived in section II. Although beyond the scope of the current paper, in the future we do hope to provide evidence which will allow us to distinguish between this explanation for our empirical

results and the one based on the presence of strategic complementarity.

A final alternative explanation for our results would be that agents do not actually observe and react to announcements of the leading indicators. Rather they observe and react to announcements concerning one or more of the component series, and they do this for reasons other than the presence of strategic complementarity.[11] In looking at the component series the only obvious candidate to base such an explanation on is announcements of the money supply. However, according to the analysis of Boschen and Grossman (1982), equilibrium models such as that of Lucas (1972) predict that revisions of money supply announcements should be positively correlated with growth in future output. In other words, at least according to the standard theory, it does not seem that the reaction of agents to money supply announcements could be what lies behind our results.[12]

B) An Anomalous Result

Although our results are quite consistent with the strategic complementarity approach, there is one aspect of our findings which is somewhat anomalous. Consider proposition 2 of section II. That proposition tells us that if strategic complementarity is present, then an announcement that the aggregate state of the economy is good should have a larger effect on production when the announcement is true than when it is false, i.e., $\tilde{Y}_G^G - \tilde{Y}_B^B > \tilde{Y}_G^B - \tilde{Y}_B^B$. The logic here is simple. Any effect on output due to individuals reacting to the announcement should be equally applicable to true announcements as to false announcements. Further, since true announcements by definition have an additional association with output which is in the same direction as the announcement effect, the positive correlation between true

announcements and indistrial production should be larger than the positive correlation between false announcements and industrial production.

Tranlating this result into an empirical prediction we have that the correlation between the future growth in industrial production and the true value of the leading indicators should be larger in absolute value than the correlation between the future growth rate and the revision. The problem, however, is that this prediction is contradicted by almost every table. Consider for example table 4. In that table the coefficient on the revision variable is larger in absolute value for each of quarters two through seven (in fact, for quarters five through seven the coefficient on the leading indicator variable does not even have the correct sign), and for quarters three and four in particular the revision coefficient is on the order of four to seven times as large as the leading indicator coefficient.[13]

Currently we do not have a good explanation for this finding, but we certainly find it of interest. Our hope is that in future work we will be able to shed light on this rather surprising result.[14]

VI. Conclusion

Keynesian macroeconomics fell out of favor over the last twenty years for what hindsight would suggest were rather poor reasons. The approach lost its following not because basic features of the approach such as multipliers were found to be empirically invalid, but rather because of a belief that the Keynesian viewpoint is not consistent with a microfoundations approach. Looking back this reason for discarding the Keynesian viewpoint seems incongruous because it is now well understood that Keynesian features are not at all inconsistent with a microfoundations approach. For example, the work

of Cooper and John (1988) states that any model which exhibits strategic complementarity will be characterized by Keynesian features.

Given that this is the history under which the Keynesian viewpoint was abandoned, it seems to us that the pressing issue in macroeconomics is to investigate from an empirical perspective whether this abandonment was warranted. In the current paper we take a step in this direction by deriving a prediction of the strategic complementarity approach concerning how the economy should respond to false pieces of information, and testing the prediction by looking at expectational shocks measured by revisions of the series of leading economic indicators. Our finding is that the response of the macro economy to false pieces of information matches almost perfectly the prediction of the strategic complementarity approach. Given the theoretical link between strategic complementarity and Keynesian type results discussed above, this finding suggests that the Keynesian perspective may be the correct one after all.

Appendix

Proof of Proposition 1: For each announcement there will be two critical values for b_i, denoted $\bar{b}$ and $\underline{b}$, such that if $\alpha_i=\bar{\alpha}$ ($\underline{\alpha}$), then the agent decides to produce if $b_i<\bar{b}$ ($\underline{b}$) and decides not to produce if $b_i>\bar{b}$ ($\underline{b}$). If the announcement is that the aggregate state of the economy is good then these critical values are denoted $\bar{b}^G$ and $\underline{b}^G$, while if the announcement is that the aggregate state of the economy is bad then these critical values are denoted $\bar{b}^B$ and $\underline{b}^B$. Further, these four critical values satisfy the following equations.

(A1) $$r(\tilde{Y}^G)y=\bar{\alpha}\bar{b}^G$$

(A2) $$r(\tilde{Y}^G)y=\underline{\alpha}\underline{b}^G$$

(A3) $$r(\tilde{Y}^B)y=\bar{\alpha}\bar{b}^B$$

(A4) $$r(\tilde{Y}^B)y=\underline{\alpha}\underline{b}^B$$

Given $\bar{\alpha}>\underline{\alpha}$, it is clear from (A1) - (A4) that $\bar{b}^G<\underline{b}^G$ and $\bar{b}^B<\underline{b}^B$. We also know that $\tilde{Y}^G$ and $\tilde{Y}^B$ are defined by

(A5) $$\tilde{Y}^G=y[q_1\int_0^{\bar{b}^G} h(b_i)db_i+(1-q_1)\int_0^{\underline{b}^G} h(b_i)db_i],$$

and

(A6) $$\tilde{Y}^B=y[q_2\int_0^{\bar{b}^B} h(b_i)db_i+(1-q_2)\int_0^{\underline{b}^B} h(b_i)db_i].$$

Suppose $\tilde{Y}^G\leq\tilde{Y}^B$. Given $\bar{b}^G<\underline{b}^G$, $\bar{b}^B<\underline{b}^B$, and $q_2>q_1$, (A5) and (A6) tell us that $\underline{b}^G<\underline{b}^B$ or $\bar{b}^G<\bar{b}^B$. If $r'\leq 0$, this immediately contradicts (A1) - (A4).

Suppose that $r'>0$. (A1) - (A4) immediately implies $\underline{b}^G<\underline{b}^B$ and $\bar{b}^G<\bar{b}^B$. Assume that given the announcement the economy is good the agents behave according to the critical values associated with the announcement the economy is bad. Given $\bar{b}^B<\underline{b}^B$, this would result in a level of aggregate production denoted $\tilde{Y}^{G'}$ such that $r(\tilde{Y}^{G'})y>\underline{\alpha}\underline{b}^B$ and $r(\tilde{Y}^{G'})>\bar{\alpha}\bar{b}^B$. In turn, this implies there

must be a second equilibrium associated with the announcement the economy is good where aggregate production is greater than $\tilde{Y}^G$. This contradicts our assumption of an upper bound on r', and hence $\tilde{Y}^G > \tilde{Y}^B$. This proves i).

Suppose no announcement is made. Then an agent characterized by $\alpha_i = \bar{\alpha}$ ($\underline{\alpha}$) will have an expectation concerning the probability the economy is good which is strictly between zero and one. Denote this value as $\bar{e}$ ($\underline{e}$). There will also be new critical values for b_i which we will denote as $\bar{b}^e$ and $\underline{b}^e$. $\bar{b}^e$ and $\underline{b}^e$ are defined by

$$y[\bar{e}r(Y^G)+(1-\bar{e})r(Y^B)] = \bar{\alpha}\bar{b}^e, \tag{A7}$$

and

$$y[\underline{e}r(Y^G)+(1-\underline{e})r(Y^B)] = \underline{\alpha}\underline{b}^e. \tag{A8}$$

If r'=0, then comparing (A7) and (A8) with (A1) - (A4) yields $\bar{b}^e = \bar{b}^G = \bar{b}^B$ and $\underline{b}^e = \underline{b}^G = \underline{b}^B$, which implies $\tilde{Y}^G = Y^G$ and $\tilde{Y}^B = Y^B$. This proves iv).

Y^G and Y^B are given by

$$Y^G = y[q_1\int_0^{\bar{b}^e} h(b_i)db_i + (1-q_1)\int_0^{\underline{b}^e} h(b_i)db_i], \tag{A9}$$

and

$$Y^B = y[q_2\int_0^{\bar{b}^e} h(b_i)db_i + (1-q_2)\int_0^{\underline{b}^e} h(b_i)db_i]. \tag{A10}$$

Suppose r'<0, the state of the economy is good, and $\tilde{Y}^G \geq Y^G$. Comparing (A7) and (A8) with (A1) - (A4), this implies $\bar{b}^G < \bar{b}^e$ and $\underline{b}^G < \underline{b}^e$. Comparing (A5) and (A9) we now have that $Y^G > \tilde{Y}^G$ which is a contradiction. Using a similar argument we can also get a contradiction for $\tilde{Y}^B \leq Y^B$. This proves iii).

Suppose r'>0, and the state of the economy is good. If $\tilde{Y}^G = Y^G$, then (A1) (A2), (A7) and (A8) imply $\bar{b}^G > \bar{b}^e$ and $\underline{b}^G > \underline{b}^e$. A comparison of (A5) and (A9) then yields $\tilde{Y}^G > Y^G$, i.e., a contradiction. Suppose $\tilde{Y}^G < Y^G$. Given (A1), (A2), (A5), (A7), (A8) and (A9), this implies $\bar{b}^G < \bar{b}^e$ and $\underline{b}^G < \underline{b}^e$. However, given the

announcement the economy is good the agents could have behaved according to the critical values associated with no announcement. Given (A7) and (A8), this would result in a level of aggregate production denoted $\tilde{Y}^{G'}$ such that $r(\tilde{Y}^{G'})y>\bar{\alpha}\bar{b}^{e}$ and $r(\tilde{Y}^{G'})y>\underline{\alpha}\underline{b}^{e}$. In turn, this implies there must be a second equilibrium associated with the announcement the economy is good where aggregate production is greater than $\tilde{Y}^{G}$. This contradicts our assumption of an upper bound on r', and hence $\tilde{Y}^{G}>Y^{G}$. A similar argument can be used to prove $\tilde{Y}^{B}<Y^{B}$.

Proof of Proposition 2: The proof of proposition 2 follows along the same lines as the proof of proposition 1 and is therefore only sketched.

i) follows from the fact that the production decision depends only on the announcement and the value for α_i, and not on the true state of the economy. In other words, given $\bar{b}^{G}<\underline{b}^{G}$ and $\bar{b}^{B}<\underline{b}^{B}$, the fact that $q_2>q_1$ immediately implies $\tilde{Y}^{G}_{G}>\tilde{Y}^{B}_{G}$ and $\tilde{Y}^{G}_{B}>\tilde{Y}^{B}_{B}$.

ii), iii), and iv) follow from the same arguments as ii), iii) and iv) in the proof of proposition 1. The only difference is as follows. Suppose the announcement is that the state of the economy is good (bad). Then the expectation the economy is good does not equal one (zero), but rather equals some value greater (less) than $\bar{e}$ if $\alpha_i=\bar{\alpha}$ and equals some value greater (less) than $\underline{e}$ if $\alpha_i=\underline{\alpha}$. Given this change, the argument proceeds as before.

Footnotes

[1]Other papers include Drazen (1985), Roberts (1986), Startz (1986), Kiyotaki (1988), Shleifer and Vishny (1988), Summers (1988), and Haltiwanger and Waldman (1988). See also Leijonhufvud (1981) for a non-technical analysis which captures many of the same ideas.

[2]An alternative set of papers which derive Keynesian features using a microfoundations approach is the set which incorporates a rationale for prices to be rigid. Papers in this literature include Rotemberg (1982), Mankiw (1985) and Akerlof and Yellen (1985) (see Rotemberg (1987) for a survey). The current paper has nothing to say concerning this alternative theoretical approach.

[3]The assumption that α can only take on two values is not at all important for the qualitative nature of the results, but rather is imposed for expositional clarity.

[4]See Auerbach (1982) and Zarnowiz and Braun (1989) for recent studies concerning the predictive power of the composite index of leading economic indicators.

[5]We have also conducted most of our tests using the monthly growth rate in industrial production, the monthly growth rate of the leading indicators, and monthly revisions. The qualitative nature of the results was unchanged. For expositional convenience we have decided to report the results from the tests conducted on the quarterly data.

[6]During the time period we consider there were several instances in which values for the leading indicators were revised after the eleventh monthly revisions. These late revisions correspond to smaller changes in the method of construction of the leading indicators than occurred in November 1975.

In the three instances in which these late revisions were significant, we adjusted the earlier announcements to account for these late revisions.

[7]We have also conducted our tests without including the LI_t terms and there was no change in the qualitative nature of the results.

[8]Given our findings concerning the unimportance of R_t^1, a production lag of between three to six months may actually be more consistent with our findings.

[9]There is in fact one other puzzling aspect of the results reported in tables 3 and 4. That is, proposition 2 predicts that the coefficients on LI_t should be larger in absolute value than the coefficients on the revision variable(s). This prediction is not supported by the results in either table. We will return to a discussion of this puzzling finding in section V.

[10]The calculation of 17% is based on the value of R^2 for the third regression in table 1 being .08.

[11]One could imagine an environment where agents observe announcements of one or more of the component series, but they do this because of the presence of strategic complementarity and the announcements are useful for predicting future production. We do not consider this an alternative explanation for our findings in that we are not trying to draw conclusions concerning whether agents look at the leading indicators, but rather we are attempting to determine whether strategic complementarity is present.

[12]Also, in their empirical work Boschen and Grossman do not find a negative correlation between revisions of money supply announcements and growth in industrial production for the third and fourth quarters following the initial announcement. Hence, the current state of empirical evidence also suggests that the reaction of agents to money supply announcements is not what lies behind our results.

[13]The alternative explanation for our results discussed in the previous sub-section would also have trouble explaining the relative sizes of the revision and leading indicator coefficients.

[14]One conjecture is that it may be due to the presence of a subset of agents who behave in a limitedly rational fashion with respect to their interpretations of the early announcements. We feel this may be the solution because agents who behave in a limitedly rational manner tend to be disproportionately important in environments which exhibit strategic complementarity (see Haltiwanger and Waldman (1985, 1988)).

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