



Expectations in Austrian Business Cycle Theory: An Application of the Prisoner's Dilemma

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Abstract. The standard account of Austrian Business Cycle theory posits that central bank manipulations of interest rates fool bankers and investors into believing that there has been an increase in the real supply of loanable funds available for capital investment. However, reliance on “foolishness” ignores the entrepreneurial emphasis within the Austrian tradition and fails to produce the strongest possible case for Austrian Business Cycle theory. We use the prisoner's dilemma framework to model the profit maximizing behavior of bankers and the investors under uncertainty when the market rate of interest is below the underlying rate of time preference.

JEL classification: E30, E50.

Introduction

The standard account of the Mises-Hayek theory of cyclical fluctuations, also known as Austrian Business Cycle Theory, posits an increase in bank reserves, created by a central bank, that drives a wedge between nominal savings available for investment and real savings based on the time preference schedules of market participants. This increase in nominal, as opposed to real, savings is characterized by a market rate of interest that is held below the natural rate due to the process of money expansion. An artificial boom develops, driven by a temporary increase in investment spending, but is doomed to eventual failure because of the lack of real savings (i.e. resources) to sustain it. Thus, an inevitable bust occurs as firms are forced to revise their investment plans.

This version of ABC theory, originally proposed by Mises [1971 (1912)] and further developed by Hayek (1933, 1935, 1939) and Garrison (1986, 1989), among others, has some important strengths. Perhaps its foremost strength is the explicit recognition of the institutional characteristics of the credit system and their importance on the macroeconomic level. Central to the traditional ABC theory is the particular manner in which money is injected into the credit system of the modern economy, giving rise to the relatively large swings in investment spending that characterize most cyclical fluctuations in business activity.

Despite numerous (and enlightened) attempts at development, however, the traditional account continues to suffer from many shortcomings. Most of these shortcomings can be subsumed into three categories: (1) problems involving the formation of expectations

by economic actors, (2) a dependence upon exogenous factors in the explanation of the boom-bust sequence, and (3) a lack of generality with respect to the cycle's origins and propagation. In regard to expectations, there has been very little discussion as to how a market rate of interest below the natural rate may be sustained for any length of time in spite of market forces that would tend to eliminate such disparities. The question of how the "bust" becomes an inevitable consequence of this state of affairs must also be analyzed in terms of expectations about future movements in interest rates, output, money stock, and the like. The reluctance of many Austrian economists to place the theory within a predictive framework has hindered efforts to rigorously examine the detailed processes by which the cycle must evolve.

Furthermore, there is little evidence that the business cycle can be explained entirely, or even primarily, in terms of fluctuations in reserves. A reserve-based theory of fluctuations does not provide an endogenous explanation of the boom-bust sequence, relying instead on repeated mistakes in policy by the central bank. In addition, theory suggests that it is the total money stock that should be the focus of any monetary theory of the business cycle, and recent evidence suggests that minimizing fluctuations in nonborrowed reserves or the monetary base would be insufficient to smooth cyclical fluctuations.¹

Finally, much of the evidence that is consistent with the traditional ABC theory is mutually consistent with other theories.² For example, the sharp decrease in output caused by a monetary contraction can be explained in the context of both the Austrian and monetarist cycle theories, with the latter approach being more direct and involving fewer assumptions as to the cause of the disturbance. This suggests the possibility that ABC theory could be more usefully integrated into a general, monetary approach to cyclical fluctuations rather than focused on the narrow and (some would say unnecessarily) specific set of phenomena that provided its original basis.

Lest we be misunderstood, however, we do not believe the shortcomings of the traditional ABC theory to be fatal. In this paper, we present a model of the theory, based on Hayek (1933), that works toward a resolution of these problems. As such, we do not propose an *alternative* theory of fluctuations, but rather a more general version of the traditional account based on the dynamic conditions of the modern macroeconomy.

Hayek's (1933) Monetary Theory of the Trade Cycle

Unsurprisingly, F. A. Hayek anticipated each of the aforementioned problems. Hayek (1939) explicitly addresses the question of expectations in attempting "to show how important a place they do play" in his trade cycle theory.³ Hayek also repeatedly makes reference to the general nature of his theory, at one instance framing it as a step in the direction of a "complete theory of social economy" that "would embrace all new phenomena arising from the addition of money to the conditions assumed in elementary equilibrium theory."⁴ Finally, in regard to the endogeneity issue, Hayek (1933) finds fault with the "special" assumption, attributed to Mises, that "Central Banks, under the pressure of an inflationist ideology, are always trying to expand credit and thus provide the impetus for a new upward swing of the Trade Cycle" although, he admits, "this assumption may be correct in many cases."⁵ Says Hayek,

By disregarding those divergences between the natural and money rate of interest which arise automatically in the course of economic development, and by emphasizing those caused by an artificial lowering of the money rate, the Monetary Theory of the Trade Cycle deprives itself of one of its strongest arguments; namely, the fact that the process which it describes *must* always recur under the existing credit organization, and that it thus represents a tendency inherent in the economic system, and is in the fullest sense of the word an *endogenous* theory.⁶

What was the “existing credit organization” to which Hayek referred, and in what way did it lead to an inherent tendency in the economic system? The answers to these questions involve two aspects of the prevailing system of credit. First, there is the *fractional reserve system* of credit creation whereby the level of the money stock is at least partially independent of the level of base money, be it gold (as it was at the time of Hayek’s writing) or central bank reserves (as it is today). Second, there is the effective *monopolization of money* by a central bank or government. Commercial banks issuing notes (or providing additional deposit balances) to creditors on the basis of fractional reserves are able to externalize the costs of this money issue while retaining the benefits in the form of greater net interest income. Thus, the business cycle is in many ways analogous to a common property problem, resulting in all of the distortionary effects such conditions are normally expected to produce, including an overuse of the property (i.e. credit money) in question.

An important aspect of this theory is that, given the aforementioned characteristics of the credit system, the consequences predicted by the theory can be expected in the course of normal, dynamic economic conditions. For example, suppose that an increase in the productivity of capital leads to an increase in the profitability of capital (investment) projects.⁷ Assuming an initial correspondence between the natural and market rates of interest, and no increase in base money supplied by the central bank, the commercial banks that first feel the effects of the increased demand for credit will be faced with two choices: raise the interest rate on loans to the point necessary to protect existing reserve ratios, or extend credit at the prevailing rate (or, for that matter, any rate that is lower than the new *natural* rate) and, as a result, draw down the ratio of reserves to deposits. If each commercial bank was responsible for redemption of all notes and deposit balances created as a result of its own expansion of credit, the second option would be clearly inferior, given that such banks would be extending credit beyond their own profit-maximizing means to provide savings and continue to meet depositor demands for withdrawal of funds. If, on the other hand, the costs of credit expansion can be externalized to other banks (and their customers) without loss of the benefits of such expansion, the second option becomes superior from the standpoint of the individual bank, although not, we shall see, from the standpoint of the system as a whole. It is the monopolization of money that allows the initial credit-expanding banks this opportunity which, as seekers of profit, they cannot afford to ignore.⁸ The following section characterizes the decision of the commercial banks that feel the initial effects of an expansion of investment opportunities in the context of fractional reserve system and a single monopoly money unit.

Why Do Banks Lower Reserve Ratios to Continue Extending Credit?

Given that the additional credit demanded is not based on an increase in “real” savings, why do banks proceed to lend out additional excess reserves? This question remains largely unanswered in Austrian business cycle theory. One possible answer is that the bankers are fooled into believing that the increase in credit truly represents an increase in real savings. This type of answer, however, is unsatisfactory, especially for critics.⁹ Says Hayek: “A theory which has to call upon the *deus ex machina* of a false step by bankers, in order to reach its conclusions is, perhaps, inevitably suspect.”¹⁰ Answers that rely on “foolishness” also fly in the face of the strong tradition of entrepreneurship in the Austrian tradition and fail to produce the strongest possible case for Austrian theory.¹¹ The Austrian tradition tells us that successful entrepreneurs are adept at steering through the fog of ignorance. While some may be fooled some of the time, it is hard to believe that all (or a majority) will be fooled some of the time, and repeatedly at that. A more satisfactory answer requires that profit-maximizing bankers, behaving like profit-maximizing bankers, lend more than the current consumption-saving ratio would justify. That is, we must assume that bankers are maximizing profit by making all those loans for which the expected marginal revenue exceeds the expected marginal cost. If we can explain why an individual banker will make loans, even though he knows that the current level of saving does not justify the loans, we create a stronger case for ABC theory. The theory is strengthened because the seed of the cycle is sown not in foolishness, but rather in bankers’ profit-maximizing behavior.

The assumption of profit maximizing behavior allows us to conclude that a bank will make only those loans expected to be profitable, i.e., loans where the expected marginal revenue exceeds expected marginal cost. We can not conclude, however, that banks will not make any bad loans. With an uncertain future, mistakes are part and parcel to the lending process. What we need to understand is why all (or many) banks, in unison, tend to make loans that are not profitable. The prisoner’s dilemma offers a possible answer. The prisoner’s dilemma occurs where the incentive structure is such that the individuals involved in a decision process choose to make decisions that will leave them, collectively, worse off than if each had made a different choice. In this context, each banker is faced with the choice of whether to lend or not lend on the basis of an increase in money supply alone. The prisoner’s dilemma is not an issue if the potential increase in credit is entirely the result of higher “real” saving.

The decision on the level of excess reserves to hold is related to the decision of how many loans to make. The bank will lend excess reserves as long as the expected marginal benefit of lending exceeds the expected marginal cost. The most important marginal cost involved in the decision of whether to lend excess reserves is the cost of being faced with an inability to meet the obligations of deposit withdrawals, i.e., liquidity risk. Let us assume that all banks realize that the increase in credit demanded is not due to an increase in saving, so each bank knows the “best” strategy, in the aggregate, is not to lend as much as the prevailing (lower) rate allows. But each bank also knows that if it does not attempt to increase its loans at this rate, others will increase their lending and, thus, draw its own customers to themselves. Even if there were an agreement, explicit or tacit, amongst the banks not to lend, it would still benefit each individual bank to cheat. This is the prisoner’s dilemma. It

is in the best interest of each bank to cheat (lend) so that it can increase its profit. If each banker “knows” that all the others will cheat, it will have to cheat. Thus, through the profit maximizing behavior of individual banks, the boom is started.

Each bank will be enticed to cheat (make “unjustified” loans) partly because each does not have to pay the full cost of its bad decisions. If each bank issued its own notes, it would have to bear the full cost of lending including the possibility of not being able to meet its demand deposit liabilities. In other words, if there were no monopolization of the currency each bank would have to bear all liquidity risk associated with increasing its “money supply.” With a monopoly currency, however, part of the cost of lending can be passed on to the rest of the banks. This happens because the original loan becomes only a small part of the monopoly money supply. Thus, we see that, under a monopoly currency, the profit-maximizing behavior of individual banks can lead to the artificial boom. Austrian business cycle theory does not require that individual banks be “fooled” into believing that real savings has increased, only that each bank follows a strategy of profit-maximization.

To illustrate, we offer the following example. Consider Figure 1 where the market interest rate is below the natural rate (the underlying rate of time preference). An individual bank, Bank X, can choose to decrease its reserve ratio or maintain its reserve ratio. A decrease in Bank X’s reserve ratio is tantamount to loaning at the market rate, i_m .¹² Bank X can instead choose to raise its loan rate to i_n , that is, to maintain its reserve ratio. Bank X makes this decision against the background of other banks making the same decision. If Bank X makes new loans (decreases its reserve ratio) while all other banks do the same, it will maintain its profit (return) while increasing its liquidity risk. If all other Banks maintain reserve ratios while Bank X decreases its reserve ratio, Bank X will increase its return but *maintain* its liquidity risk relative to other banks by passing some of the liquidity risk onto them. Now consider the payoffs if Bank X chooses to lend at i_n . If all other Banks choose to loan at i_m , Bank X will find its return lower (because some its customers will leave for other banks) and its risk increase (because it is bearing part of the liquidity risk of the other banks’ loans).

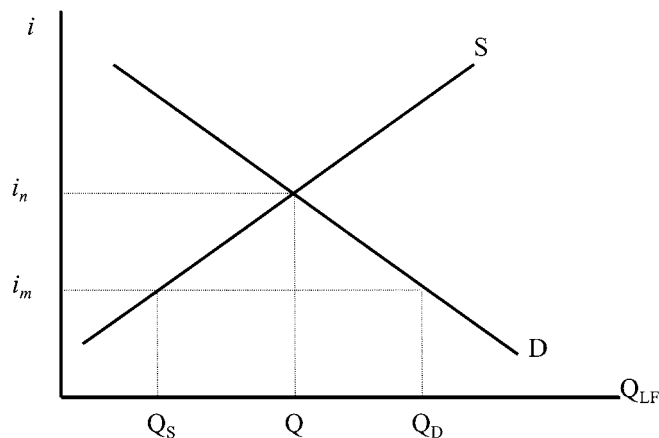


Figure 1. Market for loanable funds.

		All Other Banks	
		Decrease Reserve Ratio (Maintain i)	Maintain Reserve Ratio (Increase i)
Bank X	Decrease Reserve Ratio (Maintain i)	$\Delta\text{Return} = 0$ $\Delta\text{Risk} > 0$	$\Delta\text{Return} > 0$ $\Delta\text{Risk} = 0$
	Maintain Reserve Ratio (Increase i)	$\Delta\text{Return} < 0$ $\Delta\text{Risk} > 0$	$\Delta\text{Return} = 0$ $\Delta\text{Risk} = 0$

Figure 2. Banks' payoff matrix: Change in relative risk and return.

Finally, if all other banks loan at i_n , and Bank X also loans at i_n , neither its risk position nor its return will change. This payoff matrix is illustrated in Figure 2.

Faced with this type of uncertainty, Bank X can use the maximin criteria to reach its optimal decision.¹³ If Bank X chooses to decrease its reserve ratio, the worst state of the world occurs when all other banks also decrease their reserve ratios. If Bank X chooses to maintain its reserve ratio, the worst state of the world occurs when all other banks decrease their reserve ratios. The best of these worst states occur when Bank X chooses to decrease its reserve ratio. Therefore, the maximin criteria will lead Bank X to make loans when faced with the situation where the market rate of interest is below the underlying rate of time preference regardless of the underlying reason for the difference. Thus, we have shown that individual banks need not be fooled or tricked into increasing lending.¹⁴

Monetary Contraction and the End of the Investment Boom

There are a number of reasons for the unsustainability of the investment boom brought about by this expansion of the money supply. First, as the credit expansion develops, the potential risk-adjusted revenue from each new loan diminishes until, eventually, the marginal benefit of such loans falls below even the small portion of the total costs of monetary expansion borne by each individual bank.¹⁵ Those banks that feel the effects of increased demand for loans later in the cycle are more likely to raise rates to the level that preserves existing reserve ratios *or* engage in credit rationing rather than lend at the prevailing rate because the net benefits of the latter have become negligible.¹⁶ Second, the additional money created eventually finds its way into the hands of consumers who demonstrate their

(unchanged) preferences for current goods by increasing their spending on those goods. This development would certainly result in higher consumer price levels, except for the fact that it is typically accompanied by greater holdings of *currency relative to deposits*, which is in itself deflationary. The simple reason for this tendency is that consumers generally conduct a larger proportion of their transactions in cash than do investment spenders.¹⁷ Finally, and related to the aforementioned tendency, the increased proportion of cash withdrawn from banks by consumers may cause even those banks that formerly lowered their reserve ratios to again increase them in order to deal with the heightened level of withdrawals.

Thus, the inevitable result of the initial monetary expansion is what every good monetarist will recognize as a monetary *contraction* because of offsetting movements in the money multiplier. The corresponding drop in investment spending, and the typical credit crunch that follows, can be appropriately considered a proximate result of the contraction, but the ultimate cause is that the initial credit expansion is unsustainable due to the *elasticity* of the money supply in its relation to base money. Furthermore, if business expectations are sufficiently elastic and capital sufficiently specific, the demand for investment funds will fall even farther, putting *downward* pressure on interest rates and turning the decrease in investment spending from a mere adjustment in the market for savings to a new set of market conditions with a lower equilibrium level of investment.

Demand for Loans under Credit Expansion

We have explained why bankers acting as profit-maximizers will attempt to increase the amount of loans they make in the face of below-equilibrium interest rates. A banker cannot lend without a borrower, however, so we must also explain why entrepreneurs will accept the extension of credit by the lenders. The traditional account of the ABC requires that entrepreneurs be fooled by the increase in credit into believing that there has been a decrease in the consumption-saving ratio.¹⁸ This point has troubled critics¹⁹ and sympathizers²⁰ alike, and we are in agreement with them. It is not at all satisfying to assume entrepreneurs are foolish, especially within the Austrian paradigm. In this section we present an alternative to this standard assumption. First, however, we outline the traditional account of entrepreneurial action.

If the underlying rate of time preference is reflected correctly in the “market interest rate,” then the level of investment will be compatible with the consumption ratio–saving. The intertemporal consumption plans of consumers will match the intertemporal investment plans of entrepreneurs. That is, entrepreneurs will be willing to invest in capital goods at the same rate at which consumers prefer to defer consumption. In this case, the structure of production is stable. Entrepreneurs are maximizing the present value of the future stream of profits, workers are being paid their discounted marginal value products, and the supply of loanable funds equals the demand for loanable funds.

An increase in the availability of credit that does not have its origin in a change in the consumption-saving ratio has the outward appearances of a change in the underlying rate of time preference. An entrepreneur who does not know the difference between a change in the availability of credit and a change in the underlying rate of time preference will react to the increase in the availability of credit in the same way as he would a change in

the consumption-saving ratio. As entrepreneurs react to an increase in the availability of credit by deepening and narrowing the structure of production, the artificial boom begins. The expansion cannot be sustained because the real resources necessary to lengthen the production process are not available and the boom will end in recession.

This version of the ABC requires that the entrepreneurs be fooled by the credit expansion. We argue that the same result can occur even if the entrepreneurs are aware that the change in interest rates is the result of a credit expansion and not the result of a lowering of the underlying rate of time preference. Garrison (1989) hints at this when he writes, "macro-economic irrationality does not imply individual irrationality. An individual can rationally choose to initiate or perpetuate a chain letter ... even though he knows that the pyramiding is ultimately unsustainable."²¹ Each entrepreneur is faced with the prospect of being able to finance projects that were heretofore unprofitable or to let profitable opportunities pass. Each entrepreneur knows that some of the new investment projects undertaken will prove to be unprofitable. In an uncertain world, no entrepreneur can know which specific projects will prove unprofitable. If each entrepreneur were the only one faced with this decision, he would have to bear the entire cost of investment decisions that are not compatible with the underlying rate of time preference. Instead, each entrepreneur is faced only with part of the increased risk. This is a commons problem that can be modeled by the prisoner's dilemma.

Assume that the market rate of interest has fallen below the natural rate of interest. Assume that a particular firm, Firm X, knows that the decrease in the market rate of interest is the result of an increase in the availability of credit and not the result of a decrease in the underlying rate of time preference. That is, assume Firm X knows that the market rate of interest is lower than the natural rate of interest. Firm X is faced with the decision to either increase investment or maintain the current level of investment. Assume Firm X does not know what the other firms will do and that Firm X wishes to maximize its profits relative to all other firms. The effect on Firm X's profit relative to all other firms will depend on Firm X's decision and the state of the world (i.e., what the other firms decide).

If Firm X increases its investment while all other firms increase investment its profit level will remain unchanged relative to all other firms; that is, the change in Firm X's relative profit is zero. If Firm X increases its investment while all other firms maintain current levels of investment, Firm X will find its relative profits increasing. If Firm X maintains its current level of investment while all other firms increase their levels of investment, Firm X's profits will fall relative to all other firms. If Firm X and all other firms maintain their current levels of investment, there will be no change in relative profits. These outcomes are displayed in Figure 3. The optimal decision for Firm X will be reached by applying the maximin criterion. If Firm X chooses to increase its level of investment, the worst state of the world occurs when all other firms increase their levels of investment. If Firm X chooses to maintain its current level of investment, the worst state of the world occurs when all other firms increase their levels of investment. The best of these worst states of affairs occur when Firm X chooses to increase investment. Therefore, under the maximin criteria Firm X will choose to increase investment.

A decrease in the market rate of interest that is not consistent with a decrease in the natural rate of interest may sow the seeds of the boom even when any given firm knows there has

		All Other Firms	
		Increase Investment	Maintain Investment
Firm X	Increase Investment	$\Pi_A = 0$ $\Pi_X = 0$	$\Pi_A < 0$ $\Pi_X > 0$
	Maintain Investment	$\Pi_A > 0$ $\Pi_X < 0$	$\Pi_A = 0$ $\Pi_X = 0$

Figure 3. Firms payoff matrix: Change in relative profits.

been no change in the underlying rate of time preference. We can see that the boom need not be the result of individual entrepreneurs being fooled into believing the natural rate of interest equals the market rate. Again we see that profit maximizing behavior on the part of individual entrepreneurs rather than their foolishness can explain the start of the boom.

Toward a General Monetary Theory of the Business Cycle

What we have outlined in the previous sections is a process by which unsustainable monetary expansions, coupled with expectations formed in the face of a significantly uncertain future, lead to a series of “second-best” solutions on the part of the banking system. The resulting monetary fluctuations lead, in turn, to the investment patterns that characterize business cycles as well as longer periods of economic stagnation. We have alluded to the fact that this theory is not inconsistent with a general monetary approach to cyclical fluctuations. A number of points in this regard seem to be particularly relevant. First, the element of effective uncertainty in ABC theory can be illustrated in the context of a prisoner’s dilemma faced by lending institutions and entrepreneurs. The “second-best” solutions that cause the unsustainable expansion and, thus, eventually lead to economic stagnation are not the result of “foolishness” or unreasonableness in the formation of expectations, but rather from the fact that each instance is a non-repeatable game in which an important data set (i.e. the future actions of competitors) is unavailable. The short-run non-neutrality of money is magnified, not lessened, by the monopolization of the money unit.

Second, the monetary contractions that tend to characterize the downturn in economic activity can be explained in the context of ABC theory without resort to any *deliberate* action by the Central Bank to that effect. This doesn’t mean that *all*, or even any, monetary

contractions are necessarily due to previous, unsustainable expansions. But it does provide an element of endogeneity that is missing from the traditional account.

Finally, the essence of ABC theory is the *self-reversing* nature of an unsustainable monetary expansion. The cause of the initial monetary expansion (central bank policy, increased demand for loaned funds, or decreased supply of real savings) is a peripheral issue, albeit an important one. Furthermore, the fact that the proximate cause of the downturn is a monetary contraction does not invalidate the theory. Thus, the next logical step in this line of analysis is the development of methods for distinguishing between monetary contractions that are part of this self-reversing process and those that are not.

Conclusion

We have attempted to bring together many strands of research and relate them in the context of one of Hayek's earliest versions of the Austrian Business Cycle theory. In doing so, we have not intended to displace the traditional reserve-based account, but have rather sought to illuminate particular areas in which inconsistency or confusion is prevalent and to provide a framework that deals explicitly with some these problems. This version of ABC theory, based heavily on Hayek (1933), explains economic fluctuations in the context of changes in the money supply induced in the course of the dynamic economy with a fractional reserve system of credit and a governmentally monopolized money unit. It is hoped that this research will serve as a catalyst for a more rigorous and detailed program of analysis in the area of Austrian monetary theory and macroeconomics.

We believe that this version of ABC theory is framed in a manner that lends itself to verification via appropriately designed empirical tests. For example, the prominent role of the money multiplier in bringing about short-term fluctuations in money supply has some empirical support, but its specific effects in regard to the timing of boom and bust may be explored further. Another line of testing might focus on the competitiveness of different banking sectors (perhaps grouped by country, region, or state) and the corresponding incentive for engaging in the "strategic behavior" that our theory posits as the key to the expectations problem.

In concluding, we should point out that we have not specifically addressed some admittedly important aspects of ABC theory in regard to the evolution of the bust and subsequent adjustment. Although the effects of monetary contraction are enough to end the investment boom and lead to a general decline in economic activity, Austrian theory insists that all is not complete with regard to the cycle once this has occurred. In particular, the ABC posits *supply-side* effects of the bust that warrant at least some comparison with the "real business cycle" theories of new classical economics. Another step toward a viable, rigorous Austrian theory of fluctuations requires that ABC theorists provide a logical framework by which the dis-coordination of investment plans resulting from the process of boom and bust leads to persistent effects on the level and growth rate of production. It should be obvious that these supply-side effects need not bear a *direct* relationship to the observed cycle, but may rather be more accurately characterized as long-term aspects of the cycle-prone modern economy.

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Notes

1. Fackler and McMillin (1998).
2. See Yeager (1986).
3. P. 155.
4. Hayek (1933), pp. 131–132.
5. *Ibid.*, p. 150.
6. *Ibid.*, pp. 146–147 (emphasis original).
7. We are not making the mistake of assuming, as many mainstream analyses do, that greater productivity of capital *necessarily* leads to increased profitability of investment. Let it suffice to say, however, that we can conceive of plausible conditions under which such an expansion of investment activity (relative to the amount of real savings) could take place in an expanding economy.
8. Note that a sudden decrease in real savings or a less-than-fully anticipated increase in base money could produce similar incentives for fractional reserve banks sharing a monopolized money unit. The cause of the initial monetary disturbance is irrelevant to the discussion that follows.
9. See, for example, Cowen (1997), Tullock (1998), and Yeager (1986).
10. Hayek (1933), pp. 144–145.
11. We do not wish to imply that there is no “knowledge” problem associated with an economic actor’s ignorance of the underlying natural rate of interest. Certainly such problems can and do exist, and their implications for Austrian cycle research have been dealt with at length by others. Our approach, which focuses on the “incentive” problem facing economic actors, can be thought of as complementary to those that focus on knowledge problems. We thank an anonymous reviewer for thoughtful comments on this issue.
12. Note the fact that a disequilibrium market rate of this sort may imply that reserve ratios have climbed above levels associated with the previous equilibrium, so that “decreasing” the reserve ratio merely means bringing it back into line with the previous level.
13. Under the maximin rule the decision-maker determines the worst outcome for state of the world and chooses the course of action consistent with the best of these worst outcomes.
14. It is also important to note that the money supply increase need not manifest itself entirely, or even predominantly, as a decrease in reserve ratios. The fact that most new lending will be to commercial interests for investment purposes causes an additional expansionary effect due to the anticipation of decreasing currency-deposit ratios, perhaps dominating the effect of lower reserve ratios.
15. Also, the marginal costs of lending attributed to informational asymmetries may be expected to rise as the banks reach farther into the credit pool because the first loans will be to the more creditworthy borrowers and the later loans to less creditworthy ones.
16. This tendency for rates to rise near the end of the boom, along with the depressing effect on rates caused by the collapse of investment during the bust, provides at least part of the explanation for the procyclical behavior of rates so often observed.
17. See Hayek (1933), p. 175.
18. See, e.g., Garrison (1989).
19. See, e.g., Cowen (1997) pp. 76–101 and Tullock (1988) p. 73.
20. See, e.g., Wagner (1998) p. 69.
21. P. 9.

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