

Wicksell's Cumulative Process in Theory and Practice ⁽¹⁾

It is for me a particularly gratifying experience to be able to lecture today within these halls. And I hope it will not be considered presumptuous on my part to take advantage of this opportunity to discuss the work of Knut Wicksell himself.

Let me begin with a few words of general background. One of the oldest of monetary theories is the Quantity Theory. By this I mean the theory which claims that — tastes and output remaining constant — changes in the quantity of money generate proportionate changes in the average price level. The rationale of this theory can be most simply presented in terms of the fact that if p represents the average price level — or the number of units of money that one must pay out in order to obtain an "average basket" of goods — then its reciprocal, or $1/p$, represents the proportion of that "basket" which can be obtained for one unit of money. That is, it represents the relative value of a unit of money as measured in terms of its purchasing power over commodities. Hence just as an increase in the supply of any commodity reduces its relative price in terms of other commodities, so an increase in the quantity of money reduces its relative price, $1/p$ — which means that it increases the average price level, p .

This is one simple and familiar theme of classical and neoclassical monetary theory. Another and equally familiar one is that a change in the quantity of money is like a change in the monetary unit. Thus, for example, when the French Government in 1960 introduced the New Franc — and defined it as equal to 100 Old Francs — it effectively reduced the number of units of money in the economy to 1 per cent of its former quantity; correspondingly,

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prices (in terms of the unit of money) were also reduced to 1 per cent of their former level.

There is, however, one fundamental difference between this case and that in which the monetary unit is left unchanged, but the quantity of money is reduced to 1 per cent of its former level. For to refer again to the French case, when the Government issued its decree on the New Franc, it also effectively proclaimed the new level of prices: it effectively informed the grocers by how many places to move over the decimal point on their price tags. There was, thus, no need for these new prices to be determined by the market. In the case of a change in the quantity of money with an unchanged unit, however, the new level of market prices is of necessity determined by market forces. And it is the nature of these forces which were of primary concern to classical and neoclassical economists in general — and to Wicksell in particular (2).

It will thus be seen that I have placed Wicksell squarely in the ranks of the adherents of the quantity theory — and in this I fear that I differ with other students of Wicksell's work. Wicksell, however, raised a specific problem with reference to the applicability of the quantity theory to an economy with a fractional reserve banking system. In particular, he claimed that the traditional quantity theory envisaged that monetary increases were received by individuals who — finding their cash holdings in excess of their needs — then spent them on goods, thus driving prices upward. But — Wicksell pointed out — in a modern banking economy an increase in money in the form of gold (and this is the form which was of primary concern to the traditional quantity theory) was usually deposited in the banks and was thus primarily devoted to increasing bank reserves. It was thus necessary to explain how this increase in reserves ultimately acted to raise the price level. And this was the role of Wicksell's famous "cumulative process".

A basic element of this process is Wicksell's equally famous distinction between the "money" or "market" rate of interest, on the one hand, and the "real" or "natural" rate, on the other. Since this material is all well known, I can summarize the process briefly.

(2) For detailed evidence from the literature in support of this contention, see my *Money, Interest, and Prices* (second ed., New York, 1965), Supplementary Notes A, F:1, G:1, and J. On the specific interpretation of Wicksell's theory presented here and in what follows, see Note E:4.

Because of the pressure of excess reserves created by the monetary increase, banks will reduce the rate at which they are willing to lend money. This will reduce this rate below the natural rate — which reflects the unchanged marginal productivity of capital. Hence entrepreneurs will be induced to increase their borrowings and hence the demand for the goods and services which they purchase, thus driving their prices upwards. This process is “cumulative”: that is, it continues as long as the money rate is below the natural rate. And the former will continue to be below the latter as long as the banks have excess reserves; until finally — and this is the equilibrating mechanism of the process — this excess will disappear as a result of the internal drain on bank reserves caused by the price rise generated by the expansion of bank credit.

It should be noted — as Wicksell himself conceded (3) — that this type of interest-price interaction is to be found in Ricardo. Indeed, it is part of classical and neoclassical monetary theory in general — even though there are differences of opinion with respect to the forces which equilibrate the process. But Wicksell developed the theory with a degree of vigor and clarity — and with a clear specification of the problem — that are not to be found in the literature before him.

What is the empirical evidence on Wicksell's theory? Wicksell himself discussed in detail that finding which seems to be inconsistent with his theory: namely, the fact that historically interest rates and the price level have moved up and down together — or what Keynes was later to call “Gibson's paradox”. Wicksell's interpretation of these data, however, was that the prime mover here was the natural rate: that technological advances or other developments raised this rate, while banks lagged behind in making corresponding upward adjustments in their lending rate. Hence even though the money rate of interest was rising, it was still below the natural rate — thus causing an expansion of bank credit and hence a continuous rise in prices. Thus the facts, claimed Wicksell, accord exactly with what his theory predicted (4).

Wicksell's interpretation has recently been rejected by Phillip Cagan on the basis of his study of the U.S. experience. According

(3) To Professor DAVID DAVIDSON, *Lectures on Political Economy*, trans. E. Classen (London, 1935), Vol. II, p. 200.

(4) *Ibid.*, pp. 205-7; *Interest and Prices*, trans. R. F. Kahn (London, 1936), pp. 107, 167-68.

to Cagan, Wicksell's interpretation implies that during the upward swing of prices and interest — and hence of bank credit and money — the reserve ratio of the banking system should be declining, while the opposite should occur during a downward swing. As against this implication, Cagan places “the facts for the United States before 1914, which provide the clearest evidence of the Gibson paradox” — and which show that changes in the banks' reserve ratio did not account “for any sizable part of the long-run movements in the U.S. money stock before 1914” (5). More specifically, Cagan shows that the growth in the U.S. money stock from 1875 and until World War I was due 90 per cent to the growth in bank reserves, and only 10 per cent to a reduction in the reserve ratio (6).

It seems to me, however, that this criticism is not well taken. For Wicksell interpretation implies a decline in banks' reserve ratios during the expansionary period *on the assumption that total reserves are constant*: for then the expansion of bank credit which drives prices upwards can take place only if the banks reduce their reserve ratio. But, as Cagan's own work shows, total bank reserves in the U.S. during the prewar I period grew — as a result both of the growth in the gold stock and of a decrease in the ratio of currency to demand deposits (7). Hence banks could have expanded their credit — in accordance with Wicksell's interpretation — even though the decline in the reserve ratio made only a minor contribution to the expansion in the money stock.

There is, however, a more fundamental point — one that revolves about the question of how we are to measure “importance” or “unimportance” of the role of changes in the reserve ratio. As a determinant of the change in the money stock, changes in the reserve ratio were indeed small. But what is really relevant for Wicksell's analysis is not “importance” in this sense, but the movement in the reserve ratio itself. And here Cagan's own data show that the average reserve ratio of commercial banks almost halved in the period 1875-1915 — from approximately 20 per cent to 11 per

(5) PHILIP CAGAN, *Determinants and Effects of Changes in the Stock of Money in the U.S., 1875-1960* (National Bureau of Economic Research, New York, 1965), p. 254.

(6) *Ibid.*, p. 19, Table 2. The 90 per cent figure is the residual obtained after deducting from 100 per cent the 10 per cent increase provided by the change in the reserve ratio. Because of rounding errors, it differs from the sum of the relative contributions recorded in the table for “high powered money” (68 per cent) and the currency ratio (25 per cent).

(7) *Ibid.*, pp. 19 and 51.

cent (8). Surely such a marked fall is consistent with Wicksell's argument.

I should like to emphasize that the evidence cited here does not prove that Wicksell's interpretation is correct. For we are all familiar with the basic methodological position that empirical evidence can only refute hypotheses, not establish them. Correspondingly, my main point here is that the evidence which Cagan cites does not provide such a refutation. At the same time I share with Cagan (9) the reluctance to believe that the explanation of the *long-run* trends described by the Gibson paradox lies in the continued failure of banks to adjust their lending rates upwards with sufficient rapidity. Thus the validity of Wicksell's interpretation of the Gibson paradox rests on the assumption that bankers never learn — even in the long run!

There are two other types of empirical evidence in support of Wicksell's cumulative process that I would like to present. The first is based on econometric investigations of the behavior of the banking system in the U.S. These show that — other things being equal — banks respond to an increase in the demand for loans by raising their lending rates; and that this rise lags behind that of other short-term rates in the market (10). This is precisely what we should expect on the basis of Wicksell's argument.

The second type of evidence stems from a simulation of the U.S. economy. Consider the cumulative process in the case in which the initial disturbance takes the form of an increase in bank reserves. As we have seen, Wicksell argues that — other things equal — this should in the first instance drive interest down, which in turn strengthens the upward movement of prices; and that once prices have increased in the same proportion, interest will return to its original level. Now, in the real world, other things are never equal, and so it should not surprise us to find that the actual movement of the interest rate and the price level in times of monetary expansion actually differs from the foregoing. What is, then, a proper test of Wicksell's analysis is to see if the foregoing monetary expansion

(8) *Ibid.*, pp. 356-57.

(9) *Ibid.*, p. 255.

(10) S. M. GOLDFELD, *Commercial Bank Behavior and Economic Activity* (Amsterdam, 1966), pp. 37-43, 62-68. See also FRANK DE LEEUW, "A Model of Financial Behavior", in the *Brookings Quarterly Econometric Model of the United States*, ed. J. S. Duesenberry *et al.* (Chicago, 1965), pp. 506-19, especially pp. 513-15.

will cause the rate of interest to be lower — and the price level higher — *than it would otherwise be*. This, of course, is the same approach which Wicksell adopted in his discussion of the Gibson paradox (11).

Obviously, we cannot rerun history in order to check the validity of this contention — though it might be noted that all empirical analysis of historical events is implicitly an attempt to describe how history would have been different, if only certain exogenous factors had been different. We can, however, obtain some answer to our question by simulating the effects of the foregoing monetary expansion in an econometric model. More specifically, we can compute from an econometric model the "control values" — or the values of the endogenous variables corresponding to the values of the exogenous variables which actually prevailed; and then compare these control values with the "simulated values" — or the values of the endogenous variables corresponding to exogenous variables whose values have been modified in a specified manner.

Such a simulation has been carried out with the Wharton Econometric Model, constructed by Professor Lawrence Klein and his associates at the University of Pennsylvania on the basis of quarterly data in the United States for the period from the third quarter of 1952 to the second quarter of 1964, inclusive (12). This is a model of 47 equations, which decomposes the three major categories of aggregate demand (consumption, investment, and government expenditure) into more detailed subcategories (consumption of non-durable goods and services, consumption of durable goods, investment in plant and equipment, investment in housing, and the like), and which then specifies the income, wealth, price, and interest

(11) Cf. in particular the following passage from *Interest and Prices* (p. 107, italics in original):

Our problem is, therefore, to show that in those periods when upward movements of prices have been observed, the contractual rate of interest — the money rate — was *low* relatively to the natural rate, and that at times of falling prices it was relatively *high*. It is only in this relative sense that the money rate of interest is of significance in regard to movements of prices. It can at once be seen that it is quite useless to try to demonstrate the existence of any direct relation between absolute movements of the rate of interest or of the discount rate and movements of prices.

(12) I am greatly indebted to Professor Klein and to Professor Michael Evans for the carrying out of the simulation, as well as for their invaluable advice and assistance at every stage.

variables which in turn determine these components. For our purposes, the critical equation of the model is the one which states that

$$i_s = 0.42 + 0.994 i_a - 0.0895 FR,$$

where i_s is the short-term rate of interest, as represented by the rate on 4-6 month commercial paper; i_a is the Federal Reserve Discount rate; and FR represents the ratio of net free reserves of the banking system (i.e. excess reserves less member bank borrowings from Federal Reserve Banks) to total required reserves. A monetary increase in this model can only take the form of an increase in free reserves; conversely, the foregoing equation is the only one of the model which directly reflects the impact of such an increase.

Thus the direct impact of a monetary increase is on the short-term rate of interest. In the Wharton model, this in turn affects the long-term rate (as measured by Moody's average yield on bonds) in accordance with the equation

$$i_L = 0.21 + 0.086 i_s + 0.889 (i_L)_{-1},$$

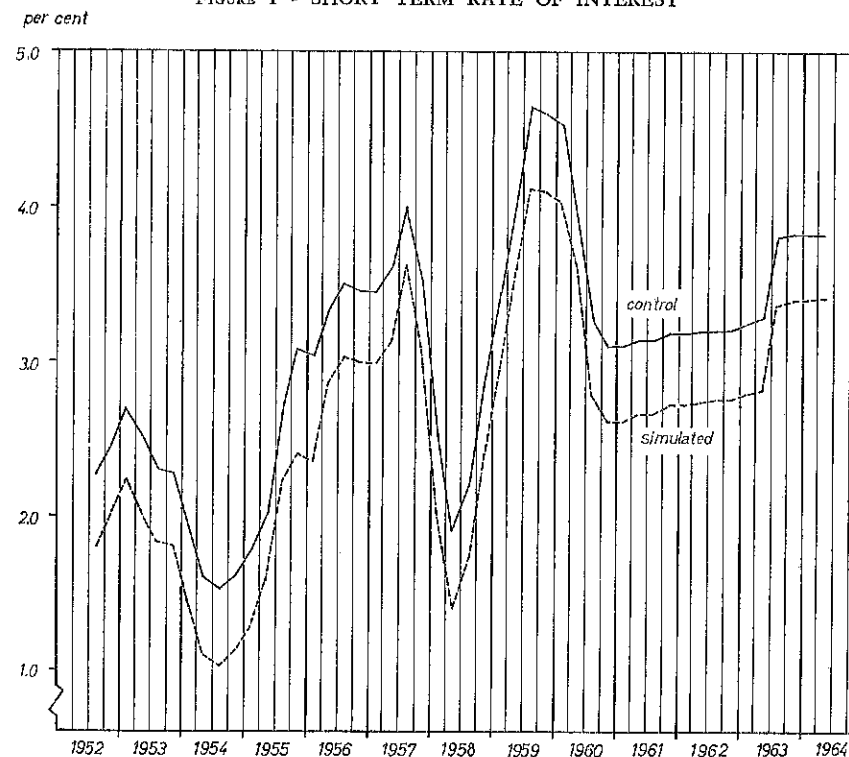
where $(i_L)_{-1}$ represents, of course, the long-term rate in the preceding quarter. And through the effects on the long-term rate of interest, the effect of the monetary increase spreads to the rest of the system, and in particular to investment activity.

The specific simulation which I wish to consider is one in which the free reserves of the banking system are assumed to be \$1.0 billion higher in 1952, than they actually were — and to remain at this higher level afterwards. This represents roughly a 5 per cent increase in total member bank reserves at that time. It might be noted that total reserves during the period in question remained more or less at the same level; correspondingly, excess reserves in the simulated model are roughly 5 per cent above the control values throughout the period.

As might be expected from the description of the foregoing equations, the immediate impact of this monetary increase is to reduce the short-term interest rate. Indeed, it falls sharply by roughly 20 per cent of its control value — from 2.27 per cent to 1.81 per cent. And throughout the period 1952-1964 the simulated value of the short-term interest rate is (with a few exceptions) from 10-25 per cent below the control value (Figure 1). Due to the lag in response, the long-term rate is at first barely affected (it falls from 3.22 per

cent to 3.18 per cent in the quarter in which the monetary increase takes place); after a year, however, the differences between the control (3.41 per cent) and simulated (3.28 per cent) values is 0.13 per cent, and after another half year it reaches 0.18 per cent (= 3.47 per cent - 3.29 per cent), and by the second year it is 0.22 per cent. This relative difference between simulated and control values continues to prevail in subsequent years as well (Figure 2).

FIGURE 1 - SHORT TERM RATE OF INTEREST



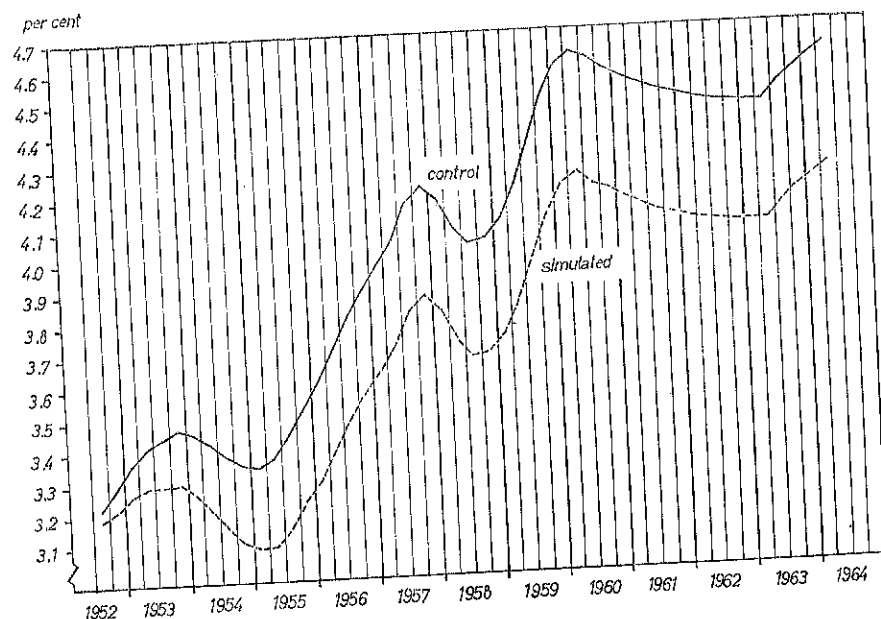
According to the assumption of the model, the long-term rate of interest affects investment (in plant and equipment and in housing) with a lag of half a year; and in view of the lag of the long-term rate behind the short-term, it is not surprising that total gross investment is barely affected during the first three quarters after the monetary increase. A year afterwards, however, it is roughly 3 per cent above the control value, and it remains 2-3 per cent above the control value throughout the period. The level of consumption on

the other hand (which, the model assumes, is not directly affected by the rate of interest) is accordingly insignificantly affected.

As a result of this increase in aggregate demand, real GNP is also greater in the simulated model. In particular, after a lag of three quarters, it increases by roughly 0.5 per cent and remains at this relatively higher level throughout the period.

Let us now consider the price level, as measured by the implicit deflator of GNP. This is unaffected during the first three quarters

FIGURE 2 - LONG TERM RATE OF INTEREST



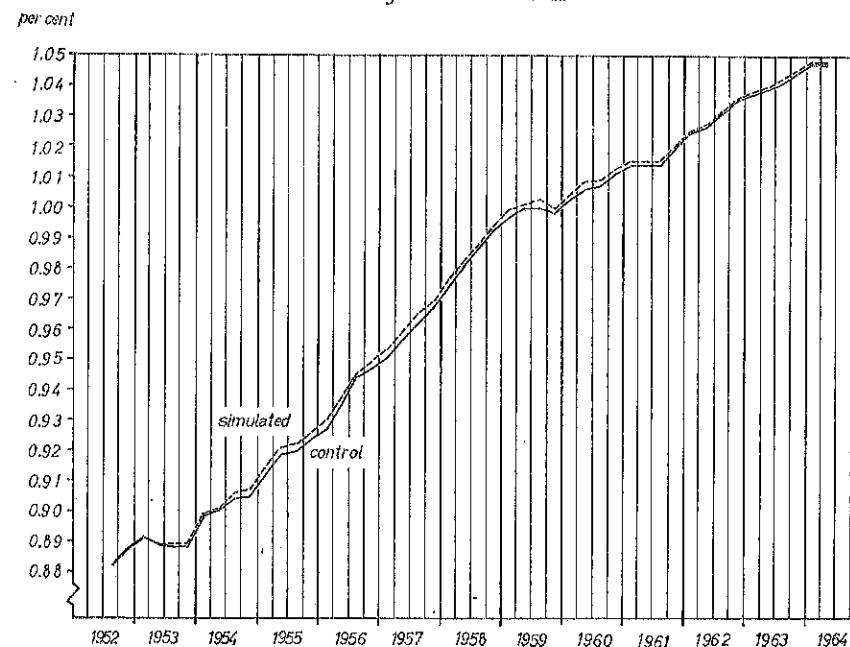
in which, as we saw, investment was also unaffected. It then rises — though not by a significant amount — and remains 0.1 per cent-0.2 per cent above the control value throughout the period. This is represented in Figure 3.

Thus the results of the simulation are consistent with the Wicksellian cumulative process: the monetary increase depresses the rate of interest and raises prices. In connection with our earlier discussion of the Gibson paradox, it might also be noted that during a good part of the period in question, both the short-term and long-term rates of interest were rising together with the price level. But

this in no way contradicts the validity of the Wicksellian contention as reflected by the comparison between the simulated and control models: a comparison which shows that the monetary increase makes interest lower — and prices higher — than they otherwise would have been.

There are, however, two aspects in which these results differ from the Wicksellian cumulative process: first, in the relatively

FIGURE 3 - PRICE LEVEL



minor upward pressure on prices, even after account is taken of the increase in real GNP; and second, in the fact that the difference between the rate of interest in the simulated and control models, respectively, is not eliminated in the course of time, but after the initial phase remains more or less constant.

With respect to the second of these differences, let me point out that it is a reflection of the fact that bank reserves in the Wharton model are an exogenous variable. That is, the model provides no mechanism by which the developments in the economy can affect the level of these reserves. And in particular it does not provide for

the Wicksellian mechanism in which the monetary expansion ultimately causes an internal drain which causes reserves to decrease and hence forces banks to raise their lending rates once again.

I might note that the same type of simulation (i.e., for an increase in reserves by \$1.0 billion) was carried out with the revised Klein-Goldberger annual model for the U.S. for the period 1929-1941 and 1947-1964 (13). Because of the lower level of reserves in 1929, this increase then represented an increase of over 40 per cent in total reserves. Once again, the pattern is one of a downward pressure on the short- and (with a lag) long-term rates of interest, a significant upward shift in real investment with little effect on consumption, a corresponding increase (after a lag of two years) in real GNP, and an almost insignificant upward effect on the price level.

At this point you might be asking yourself: What, after all, is surprising in the fact that a model which assumes a Wicksellian monetary relation yields Wicksellian results? There is a point to the question. The answer, however, is that the support to the Wicksellian theory is directly related to the extent to which a model with a Wicksellian equation provides a good fit. That is, the validity of the model as a description of reality is what can give support to the contention that the Wicksellian analysis does indeed provide an accurate description of the real world.

Let me conclude by saying that the foregoing econometric models are not Wicksellian in the fullest sense of the term — for they provide for monetary influence only through the interest rate. This does indeed reflect Wicksell's thinking in his *Interest and Prices*, where he concentrated on this indirect effect of a monetary expansion. But in the concluding pages of his *Lectures* we find Wicksell referring to his earlier discussion of the indirect effects of a monetary expansion and saying:

Only in so far as new gold is deposited in the banks in the form of "capital", i.e. without being drawn out in cheques and notes soon after, can it give rise to a lowering of interest rates and in that way affect prices. But this need not happen, and, contrary to Ricardo's

(13) This model is described in L. R. KLEIN, *The Keynesian Revolution* (second ed., New York, 1966), pp. 230-31.
Once again, I am indebted to Professor Klein for providing the results of this simulation.

view, does not happen as a rule. Rather most of the gold flows in payment for goods and should then, in proportion as it exceeds the demand for new gold, have a direct influence in raising prices without lowering interest rates (14).

It would carry us beyond the subject matter of this lecture to discuss the implications of this revision in Wicksell's thinking.

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(14) *Lectures on Political Economy*, Vol. II, p. 215.