RECENT CONTROVERSIES IN MONETARY THEORY

Irving Fisher and Autoregressive Expectations

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The purpose of this paper is to show that Irving Fisher's work on inflation expectations—from *Appreciation and Interest* (1896) through *The Theory of Interest* (1930)—has been seriously misinterpreted in the recent literature. This misinterpretation will be attributed to the failure of recent writers to recognize Fisher's key distinction between situations in which inflation is fully anticipated (full equilibrium) and situations in which inflation is not fully anticipated (the transition period). Fisher's empirical work was an attempt to examine the disequilibrium properties of the interest-inflation relationship. Modern writers, in contrast, interpret Fisher's empirical work as evidence concerning his theory of appreciation and interest in full equilibrium.

In particular, two propositions central to the modern interpretation of Fisher's interest theory were not, in fact, held by Fisher. Fisher did NOT assume that real rates of interest are determined independently of past inflation rates, and did NOT interpret the distributed lag weights in regressions of nominal interest on past inflation as autoregressive price expectations parameters.

I. Fisher's Full Equilibrium Theory

Fisher stressed that the effect of appreciation on interest rates depended fundamentally on whether or not the appreciation was foreseen, and chose to present the theoretical relation in a model assuming full loan market equilibrium, i.e., perfect foresight.

> We must begin by noting the distinction between a foreseen and unforeseen change in the value of money . . . . At present we wish to discuss what will happen, ASSUMING THIS FORESIGHT TO EXIST. [1896, p. 6]

> The rate of interest in the relatively depreciating standard is equal to the sum of three terms, viz., the rate of interest in the appreciating standard, the rate of appreciation itself, and the product of these two elements, . . .
>
> $$j = i + a + ia$$
>
> Thus to offset appreciation, the rate of interest must be lowered by slightly more than the rate of appreciation. [1896, p. 9]

The foregoing analysis, that interest rates will rise by the expected rate of inflation, is the essence of most modern interpretations of Fisher's work. Indeed, the proposition that real interest rates remain constant while the nominal rate adjusts for expected inflation is known as the "Fisher Relation." Modern writers, unfortunately, typically fail to note the assumption of perfect foresight, and apply this analysis to disequilibrium situations. As we shall see in Section III, Fisher supplied a very thorough analysis of the effects of imperfectly foreseen inflation on interest rates during the transition period.

Empirical evidence presented by Fisher to test the theory of interest adjustment under perfect foresight yielded two important results. Market interest rates were high during periods of inflation and low during periods of deflation. Thus, on qualitative grounds, the theory must be accepted. Fisher found, however, that interest rates responded slowly and incompletely to inflation. The rate of interest expressed in commodities was many times more variable than the

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money rate and was often negative during periods of rapid inflation. Since traders had the option of simply hoarding commodities—and earning zero commodity interest—Fisher concluded that the evidence "must mean that price movements were inadequately foreseen" (1896, p. 67). Fisher analyzed the inadequacy of interest adjustment largely in terms of money illusion.

> When prices begin to rise, money interest is scarcely affected. It requires the cumulative effect of a long rise, or of a marked rise in prices, to produce a definite advance in the interest rate. If there were no money illusion and if adjustments of interest rates were perfect, unhindered by any failure to foresee future changes in the purchasing power of money or by custom or law or any other impediment, we should have found a very different set of facts. [1896, p. 416]

II. Fisher's Theory of the Transition Period

Forced to reject the perfect foresight model, Fisher presented an alternative model of the effects of inflation on nominal interest rates based on imperfect foresight, i.e., a disequilibrium model of interest adjustment in which transitory changes in real variables—profits, investment, volume of trade—play a central role.

Fisher's view of interest adjustment in *Appreciation and Interest* is based on his empirical judgments that firms are net debtors, that owners of firms are endowed with foresight superior to that of bondholders, and that entrepeneurs forecast profits autoregressively.

> Suppose an upward movement of prices begins. Business profits (measured by money) will rise, for profits are the difference between gross income and expense, and if both these rise, their difference will also rise. Borrowers can now afford to pay higher "money interest." If, however, only a few persons see this, the interest will not be fully adjusted and borrowers will realize an extra margin of profit after deducting interest charges. This raises an expectation of a similar profit in the future, and this expectation, acting on the demand for loans will raise the rate of interest. [1896, p. 75]

Thus borrowers, expecting to pay back loans in depreciated currency, will increase their demand for loans. Lenders, however, are unable to forecast the inflation; hence—as long as the supply of loans is not perfectly inelastic—the rate of interest will only be partially adjusted upwards. The result is that firms pay lower actual commodity interest on their borrowings, and there is a windfall increase in profits. This leads firms to revise forecasts of future profits upward, hence increases the demand for loans still further.

In summary, Fisher argued that the transition period would be characterized by an increase in the nominal rate, a decrease in the realized commodity rate of interest, an increase in real business profits and an increase in the real value of investment. Fisher regarded this abnormally low commodity rate of interest and the resulting overinvestment as the major determinant of the "trade cycle."

> In the view here presented periods of speculation and depression are the result of *inequality* of foresight. If all persons underestimated a rise of price in the same degree the non-adjustment of interest would merely produce a transfer of wealth. . . . It would not influence the volume of loans. . . . In the actual world, however, foresight is very unequally distributed. Only a few persons have the faculty of always "coming out where they look." Now it is precisely these persons who make up the borrowing class. Just because of their superior foresight, society delegates to them the management of capital. It is they who become "captains of industry." . . . It therefore happens that when prices are rising, borrowers are more apt to see it than lenders. . . . This will of course raise the rate of interest. But it will also cause an increase of loans and investments. This constitutes part of the stimulation to business which bimetallists so much admire. [1896, p. 77]

We see, then, that Fisher's theory of the transition period is of a qualitatively different sort than the theory of perfect foresight described in Section I. Fisher recognized that during the adjustment period changes in the rate of inflation will have important effects on *real* variables, commodity interest, the rate of investment spending, and the volume of trade, rather than causing a simple adjustment of the money rate.

In the *Purchasing Power of Money* Fisher presented his most thorough analysis of the dynamics of interest adjustment.

> As prices rise, profits of business men, measured in money will rise also, even if the costs of business were to rise in the same proportion . . . But, as a matter of fact, the business man's profits will rise more than this because the rate of interest he has to pay will not adjust itself immediately. Among his costs is interest, and this cost will not, at first, rise. Thus the profits will rise faster than the prices. Consequently he will find himself making greater profits than usual, and be encouraged to expand his business by increasing his borrowings. [1912, pp. 58–59]

Since Fisher's primary concern here was the relationship between inflation and the trade cycle, he paid particular attention to the effects of interest adjustment on real investment and the volume of trade. The sequence of interest adjustment, credit expansion, and inflation is formally similar to Wicksell's cumulative process, which Fisher appropriately cited. Fisher argues:

> These borrowings are mostly in the form of short-term loans from banks; and, as we have seen, short-term loans engender deposits. As is well-known, the correspondence between loans and deposits is remarkably exact. Therefore deposit currency (M′) will increase, but this extension of deposit currency tends further to raise the general level of prices. . . . Hence prices, which were already outstripping the rate of interest, tend to outstrip it still further, enabling borrowers, who were already increasing their profits, to increase them still further. More loans are demanded, and though nominal interest may be forced up somewhat, still it keeps lagging below the normal level. Yet nominally the rate of interest has increased; and hence the lenders, too, including banks, are led to become more enterprising. Beguiled by the higher nominal rates into the belief that fairly high interest is being realized, they extend their loans, deposit currency (M′), already expanded, expands still more . . . . In other words, a slight initial rise of prices sets in motion a train of events which tends to repeat itself. Rise of prices generates rise of prices, and continues to do so as long *as the interest rate lags behind its normal figure*. [1912, pp. 59–60]

These effects, together with the decrease in the demand for money due to higher nominal interest rates (1912, p. 63), result in a temporary increase in real output, due to the excess of investment over savings. Thus the interest rate is unable to adjust to the normal level and Fisher concludes that,

> Trade . . . will be stimulated by the easy terms of loans. This effect is always observed during rising prices, and people note approvingly that "business is good" and "times are booming." [1912, p. 61]

Unfortunately, once the adjustment of interest to its normal level is completed, the stimulus to trade is removed. In fact, Fisher maintains, the lags in interest adjustment may precipitate a contraction of trade.

III. Fisher's Empirical Work

In each of his books on interest rates Fisher devotes an early chapter to a discussion of the steady-state properties of the interest inflation relationship. Fisher felt that steady-state—or full equilibrium—properties were of great interest. Long-run conditions provide us with information about where a given system *would* come to rest, if all exogenous variables were to remain fixed; hence, they help us to identify the major directions of adjustment in endogenous variables to expect, which may ultimately aid us in formulating policies.

Fisher did not, however, call on the steady-state properties of interest rates to explain any given set of observed market interest rates. The world is simply not kind enough to change slowly enough to observe the steady state.

> . . . we shall consider the temporary effects during the period of transition separately from the permanent or ultimate effects. . . . These permanent or ultimate effects follow after a new equilibrium is established,—if, indeed, such a condition as equilibrium may be said ever to be established. [1930, pp. 55–56]

Thus, Fisher stressed, the *observable* world is in continual disequilibrium, and the appropriate framework for analyzing real-world data is dynamic—or transition period—rather than static.

> . . . practically there is almost always some occurrence to prevent perfect equilibrium. Oscillations are set up which, though tending to be self-corrective, are continually perpetuated by fresh disturbances. . . . A ship in a calm sea will 'pitch' only a few times before coming to rest, but in a high sea the pitching never ceases. While continually seeking equilibrium the ship

> continually encounters causes which accentuate the oscillation. . . . Since periods of transition are the rule and those of equilibrium the exception, the mechanism of exchange is almost always in a dynamic rather than a static condition. [1930, pp. 70–71].

Fisher accordingly took great care to separate his discussions of steady-state properties from those of empirical work on interest adjustment.

Fisher's most sophisticated, and most frequently cited, empirical work on the effects of inflation on interest was presented in Chapter XIX of *The Theory of Interest*. In the first five sections of this chapter Fisher gave qualitative evidence showing that interest rates expressed in different standards are different when those standards are diverging in value; inflation resulted in high interest rates, but the adjustment was very slow. Then, in Sections 6 and 7, Fisher presented results of correlating nominal interest rates with lagged inflation rates for both Great Britain and the Unites States. He convincingly argues (pp. 418–20) that a distributed lag of past inflation rates should be employed rather than a discrete lag, and presented simple correlation coefficients which would correspond to a regression equation of the form,

$$(1) \qquad r_t = a + b \sum_{i=1}^{T} w_i \pi_{t-i} + e_t,$$

where a and b are constant, $w_i : i = 1, \ldots, T$ are distributed lag weights, T is the order of the estimated lag distribution, and e_t is the error term. For ease in calculation Fisher constrained the lag weights to decline arithmetically and to sum to unity. The results were striking. Correlations between long-term bond rates and distributed lags of past changes were extremely high. Even more striking, however, was the length of time required for complete adjustment. After estimating (1) for various values of T, Fisher concluded that,

> for Great Britain in 1898-1924, the highest value of r (+0.980) is reached when effects of price changes are assumed to be spread over 28 years or for a weighted average of 9.3 years, while for the United States the highest r (+0.857) is for a distribution for the influence due to price changes over 20 years or a weighted average of 7.3 years. [1930, p. 423]

Using quarterly data on *U.S.* commercial paper rates Fisher found similar results:

> . . . . in the period 1915-27, r reaches its maximum (+0.738) only when a total of 120 quarters, or thirty years, is included in the period subject to the influence of price changes upon i. [1930, p. 427]

In contrast to modern writers, Fisher was not surprised to find that it took, in the most extreme case, 120 quarters for full adjustment of interest to inflation. He interpreted the lag as largely representing adjustments in real variables, real interest, profits, and the volume of trade, and *not* as a simple measure of the delay in expectations formation.

> It seems fantastic, at first glance, to ascribe to events which occurred last century any influence affecting the rate of interest today. And yet that is what the correlations with the distributed effects of (inflation) show. A little thought should convince the reader that the effects of bumper wheat crops, revolutionary discoveries and inventions, Japanese earthquakes, Mississippi floods, and similar events project their influence upon prices and interest rates over many future years *even after the original causal event has been forgotten* . . . . A further probable explanation of the surprising length of time by which the rate of interest lags behind price changes is that between price changes and interest rates a third factor intervenes. This is business, as exemplified or measured by the volume of trade. It is influenced by price changes and influences in turn the rate of interest. [1930, p. 428–29]

On this point Fisher further elaborates,

> Two facts have, I think, now been well established. The first, that price changes influence the volume of trade, has been shown in earlier studies made by me. The second, that the volume of trade influences the rate of interest, has been shown by Carl Snyder, Ayres, Mitchell, and others. The evidence for both relationships is not only empirical, but rational. Rising prices increase profits both actual and prospective, and so the profit taker expands his business. His expanding or rising income stream requires financing and increases the demand for loans. [1930, p. 439]

Fisher sums up the adjustment of both real and nominal interest.

> The final result, partly due to foresight and partly to the lack of it, is that price changes do after several years, and with the intermediation of changes in profits and business activity affect interest very profoundly. In fact, while the main purpose of this book has been to show how the rate of interest would behave if the purchasing power of money were stable, *there has never been any long period of time during which this condition has been approximately fulfilled. When it is not fulfilled, the money rate of interest, and still more the real rate of interest, is more affected by the instability of money than by those more fundamental and more normal causes connected with income, impatience, and opportunity, to which this book is chiefly devoted.* [1930, p. 451]

Quite clearly, then, Fisher did not assume a constant real rate, nor did he assume a real rate determined independently of past inflation. It is precisely the variations in real factors, according to Fisher's interpretation, which combine to produce the extremely long adjustment period for nominal interest, quite apart from the way in which price expectations are formed.

During the past decade a large body of empirical work on the interest inflation relationship has been published. These papers typically presented estimates similar to (1) in form, and were widely interpreted as a revival of the work begun by Fisher in 1930. The interpretation of the empirical work, however, was much more naive than that given by Fisher. In fact, in their zeal to obtain estimates of price expectations parameters many writers went so far as to argue that Fisher assumed a real rate which was determined by "productivity and thrift" alone and which was independent of past inflation rates.

But *Fisher did not interpret the lag between inflation and interest in terms of price expectations.* As I have attempted to show above, Fisher felt the major influence of inflation was on real interest, and that the adjustment came largely through profits, investment, and the volume of trade.

> As to the nominal variation in the rate of interest, we found that theoretically, an appreciation of one percent of the standard of value in which the rate of interest is expressed, compared with some other standard, will reduce the rate of interest in the former standard, compared with the latter, by about one percent, . . . Such a change in the rate of interest would merely be a change in the number expressing it, and not fundamentally a real change. *Yet, in actual practice, for the very lack of this perfect theoretical adjustment, the appreciation or depreciation of the monetary standard does produce a real effect on the rate of interest, and that a most vicious one. This effect, in times of great changes in the purchasing power of money, is by far the greatest of all effects on the rate of interest.* [1930, p. 493]

The current interpretation of Fisher's work, however, continues to ignore the effects of inflation on real interest, and to interpret the distributed lag weights in (1) as the parameters of the inflation forecasting mechanism.

IV. Conclusions

The purpose of this paper has been to demonstrate that Fisher's theory of appreciation and interest was much more theoretically innovative and far richer in implications than the version found in the literature today. The modern interpretation of Fisher's work is based on two propositions, both of which are false: 1) Fisher assumed a constant real rate, or a real rate which was orthogonal to past inflation rates; 2) Fisher's distributed lag estimates constituted an attempt to measure the parameters of the inflation forecasting process, implying that long lags are associated with slow revision of price forecasts.

Fisher's theory of appreciation and interest, as he advised his readers many times, was based on the crucial distinction between periods of *full equilibrium* and those of *transition*, or disequilibrium. Fisher explained that in steady-state equilibrium, nominal interest will be bid up by exactly the rate of inflation, and real interest will remain unchanged. But the overwhelming impact of inflation during the transition period is on real variables: real interest, real profit, real investment and real income. In fact Fisher argued that the *real effects* of inflation on interest were the major determinants of booms in business activity.

The neglect of Fisher's rigorous development

of dynamic interest theory is unfortunate for several reasons. It means, first of all, that an important chapter has been left out of modern views on the development of economic thought. Fisher is typically cast as a stubborn classical economist who stuck to his classical comparative static principles of full employment equilibrium, and perfectly flexible prices and interest rates. Yet we have seen how Fisher was fundamentally concerned with statistical analysis of real-world data, and how he skillfully developed a dynamic model of interest and income adjustment which was based on imperfect foresight, money illusions, windfall profit affecting aggregate demand and income, and tardy adjustment of prices—all characterizing the transition period to a new static equilibrium. Thus the work of Irving Fisher must be interpreted as a pioneer effort at understanding the short-run dynamics of macroeconomic disequilibrium, an interpretation recently given to Keynes' *The General Theory* by Axel Leijonhufvud, and others. Indeed, once Fisher's work is recognized, *The General Theory* can no longer be viewed as a hiatus in the development of modern economics, but rather as a continuation of work begun by Fisher several years earlier.

Of more practical importance is the fact that an entire body of literature has grown out of a false interpretation of Fisher's empirical work in *The Theory of Interest*, a body of literature which unanimously interprets long interest-inflation lags in terms of sluggish forecast formation, perhaps resulting in incorrect policy prescriptions. A further consequence of the modern interpretation of Fisher's work, has been the proliferation of autoregressive expectations proxies for a variety of purposes, rather than examining alternative forecasting models.

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