Fisher and Wicksell on the Quantity Theory

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The quantity theory of money, dating back at least to the mid-sixteenth-century Spanish Scholastic writers of the Salamanca School, is one of the oldest theories in economics. Modern students know it as the proposition stating that an exogenously given one-time change in the stock of money has no lasting effect on real variables but leads ultimately to a proportionate change in the money price of goods. More simply, it declares that, all else being equal, money's value or purchasing power varies inversely with its quantity.

There is nothing mysterious about the quantity theory. Classical and neoclassical economists never tired of stressing that it is but an application of the ordinary theory of demand and supply to money. Demand-and-supply theory, of course, predicts that a good's equilibrium value, or market price, will fall as the good becomes more abundant relative to the demand for it. In the same way, the quantity theory predicts that an increase in the nominal supply of money will, given the real demand for it, lower the value of each unit of money in terms of the goods it commands. Since the inverse of the general price level measures money's value in terms of goods, general prices must rise.

In the late nineteenth and early twentieth centuries, two versions of the theory competed. One, advanced by the American economist Irving Fisher (1867–1947), treated the theory as a complete and self-contained explanation of the price level. The other, propounded by the Swedish economist Knut Wicksell (1851–1926), saw it as part of a broader model in which the difference, or spread, between market and natural rates of interest jointly determine bank money and price level changes.

For helpful comments, thanks go to Mike Dotsey, Alice Felmlee, Bob Hetzel, Rowena Johnson, Elaine Mandaleris, Ben McCallum, Ned Prescott, and Alex Wolman. The views expressed are those of the author and not necessarily those of the Federal Reserve Bank of Richmond or the Federal Reserve System.

The contrasts between the two approaches could hardly have been more pronounced. Fisher's version was consistently quantity theoretic throughout and indeed focused explicitly on the received classical propositions of neutrality, equiproportionality, money-to-price causality, and independence of money supply and demand. By contrast, Wicksell's version contained certain elements seemingly at odds with the theory. These included (1) a real shock explanation of monetary and price movements, (2) the complete absence of money (currency) in the hypothetical extreme case of a pure credit economy, and (3) the identity between deposit supply and demand at all price levels in that same pure credit case rendering prices indeterminate.

Despite these anomalies, Wicksell was able to derive from his analysis essentially the same conclusion Fisher reached. Both concluded that the monetary authority bears the ultimate responsibility for price level stability, a responsibility it fulfills either by determining some nominal variable—such as dollar price of gold, monetary base, bank reserves—under its control or by adjusting its lending rate in response to price level deviations from target.

The story of how Fisher and Wicksell reached identical policy conclusions from seemingly distinct models is instructive. It reveals that models appearing to be substantially different may be only superficially so. In the case of Fisher and Wicksell, it reveals that their models may not have been as dissimilar as often thought. Indeed, the alleged non-quantity-theory elements in Wicksell's work prove, upon careful examination, to be entirely consistent with the theory. In an effort to document these assertions and to establish Wicksell's position in the front rank of neoclassical quantity theorists with Fisher, the paragraphs below identify the two men's contributions to the theory and show how their policy conclusions derived from it.

1. FISHER'S VERSION OF THE QUANTITY THEORY

In his 1911 book *The Purchasing Power of Money*, Fisher gave the quantity theory, as inherited from his classical and pre-classical predecessors, its definitive modern formulation. In so doing, he accomplished two tasks. First, he expressed the theory rigorously in a form amenable to empirical measurement and verification. Indeed, he himself fitted the theory with statistical data series, many of them of his own construction, to demonstrate its predictive accuracy.

Second, he spelled out explicitly what was often merely implicit in the work of John Locke, David Hume, Richard Cantillon, David Ricardo, John Wheatley, and other early quantity theorists, namely the five interrelated propositions absolutely central to the theory. These referred to (1) equiproportionality of money and prices, (2) money-to-price causality, (3) short-run nonneutrality and long-run neutrality of money, (4) independence of money supply and demand, and (5) relative-price/absolute-price dichotomy attributing relative price

movements to real causes and absolute price movements to monetary causes in a stationary fully employed economy.[1]

Fisher enunciated these propositions with the aid of the equation of exchange $P = (MV + M'V')/T$, which he attributed to Simon Newcomb even though Joseph Lang, Karl Rau, John Lubbock, and E. Levasseur had formulated it even earlier. Here P is the price level, M is the stock of hard or metallic money consisting of gold coin and convertible bank notes, V is the turnover velocity of circulation of that stock, M' is the stock of bank money consisting of demand deposits transferable by check, V' is its turnover velocity, and T is the physical volume of trade. Fisher's assumption that metallic money divides in fixed proportions between currency and bank reserves and that reserves are a fixed fraction of deposits allowed him to treat checkbook money as a constant multiple c of hard money. His assumption allows one to simplify his expression to $P = MV^*/T$, where $V^* = V + cV'$.

Of the equation's components, Fisher ([1911] 1963, p. 155) assumed that, in long-run equilibrium, the volume of trade is determined at its full-capacity level by real forces including the quantity and quality of the labor force, the size of the capital stock, and the level of technology. Save for transition adjustment periods in which the variables interact, these real forces and so the level of trade itself are independent of the other variables in the equation. Likewise, institutions and habits determine aggregate velocity, whose magnitude is fixed by the underlying velocity turnover rates of individual cashholders, each of whom has adjusted his turnover to suit his convenience (Fisher [1911] 1963, p. 152). Like the volume of trade, velocity is independent of the other variables in the equation of exchange. And with trade and velocity independent of each other and of everything else in the equation, it follows that equilibrium changes in the price level must be due to changes in the money stock.

Classical Propositions

All the fundamental classical quantity theory propositions follow from Fisher's demonstration. Regarding proportionality, he writes that "a change in the quantity of money must normally cause a proportional change in the price level" ([1911] 1963, p. 157). For, with trade and velocity independent of the money stock and fixed at their long-run equilibrium levels, it follows that a doubling of the money stock will double the price level.

Fisher realized, of course, that proportionality holds only for the ceteris paribus thought experiment in which trade and velocity are provisionally held fixed. In actual historical time, however, trade and velocity undergo secular changes of their own independent of the money stock. In that case, proportionality refers to the *partial* effect of money on prices. To this partial effect must

[1] For a discussion of these classical propositions, see Blaug (1995) and Patinkin (1995).

be added the parallel effects of coincidental changes in velocity and trade (see Niehans [1990], p. 277). The sum of these separate effects shows the influence of all on the price level. Thus if M, V^*, and T evolve secularly at the percentage rates of change denoted by the lowercase letters m, v^*, and t, respectively, then the price level P evolves at the percentage rate $p = m + v^* - t$. Fisher ([1911] 1963, pp. 246–47) himself expressed the matter precisely when he declared that the history of the price level is a history of the race between increases in the money stock and increases in the volume of trade.

Fisher was equally adamant on the neutrality of money other than during transition adjustment periods. Regarding long-run neutrality, he says that "An inflation of the currency cannot increase the product of . . . business" since the latter "depends on natural resources and technical conditions, not on the quantity of money" ([1911] 1963, p. 155). In short, trade's long-run independence of money in the equation of exchange means that money cannot permanently influence real activity.

Money can, however, influence real activity temporarily. Indeed, the classical proposition regarding the short-run nonneutrality of money posits that very point. Fisher ([1911] 1963, pp. 58–72), in his theory of the cycle, attributes such nonneutrality to delays in the revision of lenders' inflation expectations and the resulting sluggish adjustment of nominal interest rates. A monetary shock sets prices rising. Rising prices generate inflation expectations among business borrowers whose perceptions of current and likely future price changes are superior to those of lenders. These inflationary expectations engender corresponding expectations of higher business profits. Sluggish nominal loan rates, however, fail to rise enough to offset these rising expectations. Consequently, real loan rates fall. Spurred by the fall in real rates, business borrowers increase their real expenditure on factor inputs. Employment and output rise. Eventually, nominal loan rates catch up with and surpass business profit (and inflation) expectations. Real rates rise thereby precipitating a downturn.[2]

As for the proposition of unidirectional money-to-price causality, Fisher established it two ways. First, he denied that causation, under the gold standard then prevailing, could possibly run in the reverse direction from prices to money ([1911] 1963, pp. 169–71). To demonstrate as much, he supposed prices miraculously to double, the other variables in the exchange equation initially remaining unchanged. Far from inducing an accommodating expansion in the money stock, the price increase would, in an open trading economy, actually prompt that stock to contract. The stock would contract as the price increase, by rendering domestic goods expensive in relation to foreign ones, engendered

[2] As we will see, such nonneutralities are absent from Wicksell's work. Adhering as he did to a real theory of the cycle, he denied that business fluctuations stem from monetary shocks (see Leijonhufvud [1997]). Such shocks in his view leave the economy always at full employment. Consequently, he held that neutrality of money prevailed in the short run as well as the long.

a trade balance deficit and a resulting external drain of monetary gold. The upshot is that the price increase would not cause a supporting rise in the money stock as reverse causation implies. Nor for that matter could the price increase spawn validating changes in the other variables of the exchange equation. The independence of those variables with respect to the price level rules out this possibility. In short, the price level is "the one absolutely passive element in the equation" (Fisher [1911] 1963, p. 172). Its movements are the result, not the cause, of prior changes in the quantity of money per unit of trade.

Alternatively, Fisher demonstrates *M*–to–*P* causality by showing that no variables in the exchange equation can intervene to absorb permanently the impact of a change in *M* and thus prevent the force of that impact from being transmitted to *P*. No compensating changes in trade will occur to blunt *M*'s impact since the two variables are independent in long-run equilibrium. Nor will *M* exhaust its effect in reducing velocity permanently. For cashholders have already established velocity at its desired level, a level independent of *M*.

Instead, Fisher ([1911] 1963, pp. 153–54) argued that money will transmit its full effect to prices through the following cash-balance adjustment mechanism. Let the money stock double from *M* to 2*M*, the price level initially remaining unchanged. With prices and trade given, actual velocity $V^* = PT/2M$ falls to one-half the level cashholders desire it to be, or PT/M. In an effort to restore actual velocity to its desired level, cashholders will increase their rate of spending. The increased spending will, because trade is fixed at its full-capacity level, put upward pressure on prices. Prices will continue to rise until actual and desired velocities are the same ($V^* = 2PT/2M = PT/M$). At this point, prices will have doubled equiproportionally with money.

The remaining classical propositions follow directly from Fisher's analysis. Regarding the relative-price/absolute-price dichotomy, he denied that real factors change the absolute price level in a stationary, fully-employed economy. In particular, he insisted that price level changes cannot be caused by cost-push forces emanating from trade-union militancy, business-firm monopoly power, commodity shortages, and the like ([1911] 1963, pp. 179–80).[3] Such forces, he says, drive relative prices, not absolute ones. In other words, given the money stock, velocity, and trade, real shock-induced changes in some relative prices produce compensating changes in others, leaving the absolute price level unchanged. Real shocks, if they are to affect absolute prices as well as relative ones, must somehow also cause changes in M, V^*, or T. Fisher saw little reason to expect them to do so. And even if they did, their effect would always be so

[3] In his 1920 book *Stabilizing the Dollar,* Fisher listed 41 frequently cited nonmonetary causes of inflation and noted that "while some of them are important factors in raising particular prices, none of them . . . has been important in raising the general scale of prices" (p. 11). In his view "no explanation of a general rise in prices is sufficient which merely explains one price in terms of another price" (p. 14).

small as to be swamped by exogenous changes in money.

Finally, with respect to independence of money supply and demand, Fisher attempts to establish it by arguing that the money stock owes its determination to "influences outside the equation of exchange," that is, to influences other than the trade-to-velocity ratio $T/V^*(= M/P)$ which constitutes the public's real demand for money ([1911] 1963, p. 90). For a closed gold-standard economy, these outside influences include the rate of gold production as influenced by new gold discoveries and technological innovations, both of which temporarily lower the metal's production cost below its market value and so give a profit boost to mining. For open economies operating on the gold standard, additional external influences include foreign price levels. These, when high or low relative to the domestic price level, induce specie flows through the balance of payments. Such specie flows in turn raise or lower the domestic money stock and through it the domestic price level. From the viewpoint of the open domestic economy, money-stock changes are predetermined exogenously by the height of the foreign price level. These money-stock changes then endogenously affect domestic prices. As Fisher put it, "the price level outside of New York City . . . affects the price level in New York City only *via* changes in the money in New York City. Within New York City it is the money which influences the price level, and not the price level which influences the money" ([1911] 1963, p. 172).

Today, of course, we would say that an open economy's money stock is endogenously determined by the requirement that domestic price levels move in step with foreign ones to maintain equilibrium in the balance of payments (see Friedman and Schwartz [1991], p. 42). But Fisher, by contrast, argued that the open economy's money stock is determined exogenously by the *given* state of the balance of payments resulting from the *given* foreign (relative to domestic) price level.

We will see in Section 4 below, however, that he did correctly apply the exogeneity, or independence, proposition to so-called compensated dollar and inconvertible paper standard regimes. He recognized that, in such regimes, the policy authority governs money exogenously either through control of the gold weight of the dollar or through the high-powered monetary base consisting of the authority's own liabilities. Through these instruments, the authority renders the money stock independent of money demand.

2. WICKSELL'S INTERPRETATION OF THE QUANTITY THEORY

Knut Wicksell's perception of the classical quantity theory, as expounded in his 1898 *Interest and Prices* and Volume 2 of his 1906 *Lectures on Political Economy,* was less comprehensive than Fisher's. Wicksell understood the

theory to mean only the proposition that prices are proportional to hard money, or metallic currency, in long-run equilibrium. This proportional relationship was, he believed, established through the operation of a real balance effect. In his view, cashholders had a well-developed demand for a constant stock of real cash balances. This demand together with the given nominal money supply ensured price level determinacy.

Thus a random shock to the price level that temporarily raised it above its equilibrium level would, by making actual real balances smaller than desired, induce cashholders either to cut their expenditure on or to increase their sales of goods in an effort to restore the desired level of real balances. The resulting excess supply of goods on the market would put downward pressure on prices until they reestablished their initial proportional relationship to the unchanged money stock, thus restoring real balances to equilibrium. In Wicksell's own words:

> suppose that for some reason or other commodity prices rise while the stock of money remains unchanged . . . . The cash balances will gradually appear to be *too small in relation to the new level of prices* . . . . I therefore seek to enlarge my balance. This can only be done . . . through a *reduction* in my *demand* for goods and services, or through an *increase* in the *supply* of my own commodity . . . or through both together. The same is true of all other owners and consumers of commodities. But in fact nobody will succeed in realizing the object at which each is aiming—to increase his cash balance; for the sum of individual cash balances is limited by the amount of the available stock of money, or rather is identical with it. On the other hand, the universal reduction in demand and increase in supply of commodities will necessarily bring about a continuous fall in all prices. This can only cease when prices have fallen to the level at which the cash balances are regarded as *adequate*, [that is, when] prices . . . have fallen to their original level. ([1898] 1965, pp. 39–40)

This same stability condition, Wicksell noted, ensured that a decrease in the money stock would, by rendering real balances smaller than desired, induce a proportional fall in spending, and therefore prices, to restore real balances to their desired level. For Wicksell, then, the classical quantity theory implied money stock and price level proportionality achieved through real balance effects.

Pure Cash Economy

Wicksell found the theory to be perfectly valid for hypothetical pure cash economies in which no banks exist to issue checkable deposits, all transactions being mediated entirely by gold currency. In such economies, a demand for a fixed quantity of real gold balances ensures that prices move proportionally to money in long-run equilibrium. Thus newly discovered gold in a closed economy will, at initially unchanged prices, make real balances larger than

desired. Cashholders will spend the excess, thereby putting upward pressure on prices which rise proportionally to the increased monetary gold stock.

In an open trading economy, cashholders' adjustments will induce equilibrating real balance effects abroad as well as at home. For let all goods worldwide be tradeables—exportables and importables—whose prices are, by the law of one price, kept everywhere the same by the operation of commodity arbitrage. Then the increased home expenditure on these goods, induced by the gold discovery and resulting excess cash balance, will raise prices abroad thus eroding real balances there. In an effort to rebuild their balances, foreigners cut their spending on and increase their offer of tradeables. The resulting trade surplus is financed by a specie inflow that restores foreign real balances to their desired level. Real balance effects operate to establish proportionality between money and prices throughout the world (see Myhrman [1991], pp. 269–70).

Mixed Cash-Credit Economy

To Wicksell, however, the classical quantity theory, applying as it did to pure cash economies, seemed much too narrow and antiquated. It omitted banks and the deposit liabilities they issue by way of loan. It therefore could account neither for the influence of checking deposits on the price level, nor for how both variables move from one equilibrium level to another. Nor for that matter could it account for the forces inducing their movement. To overcome these deficiencies, Wicksell sought to supplement the quantity theory with a description of the mechanism through which monetary equilibrium is disturbed and subsequently restored in mixed cash-credit, or currency-deposit, economies. Thus was born his celebrated analysis of the cumulative process (see Jonung [1979], pp. 166–67, Laidler [1991], pp. 135–39, Leijonhufvud [1981], pp. 151–60, and Patinkin [1965], pp. 587–97).

That analysis attributes deposit and price level movements to discrepancies between two interest rates. One, the market or money rate, is the rate banks charge on loans and pay on deposits. The other is the natural or equilibrium rate that equates desired saving with intended investment at full employment and that also corresponds to the expected marginal yield or internal rate of return on newly created units of physical capital. Or, equivalently, it is the rate that equates aggregate demand for real output with the available supply.

When the loan rate lies below the natural rate such that the cost of capital is less than capital's expected rate of return, planned investment will exceed planned saving. Entrepreneur investors seeking to finance new capital projects will wish to borrow more from banks than savers deposit there. Since banks accommodate these extra loan demands by creating checking deposits, a deposit expansion occurs. This expansion, by underwriting the excess *desired* aggregate demand implicit in the investment-saving gap, transforms it into excess *effective* aggregate demand that spills over into the commodity market to put upward

pressure on prices. In so doing, the deposit expansion produces a persistent and cumulative rise in prices for as long as the interest differential lasts.

Now Wicksell argued that, in mixed cash-credit economies using currency and bank deposits convertible into currency, the rate differential would quickly vanish. The public's demand for real cash balances ensures as much. For let cashholders transact a certain portion of their real payments in currency. Then a rise in prices stemming from the rate differential necessitates additional currency to satisfy that real transaction demand. The ensuing public conversion of deposits into currency and the resulting drain on bank reserves induces banks to raise their loan rates until they (loan rates) equal the natural rate. This last step stems the reserve drain and also brings the price rise to a halt. If banks, because they initially possessed excess reserves, were willing to let reserves run down a bit, then prices would stabilize at the new, higher level. But if banks possessed no excess reserves and so had to restore reserves to their initial level following the price rise, then they (banks) would continue to raise the market rate above the natural rate until prices returned to their pre-existing level. Either way, a quantity theory element in the form of the public's demand for currency works to anchor the price level in the mixed cash-credit economy. Nominal determinacy prevails in that economy as it did in the pure cash economy.

Cumulative Process Model

Expressed symbolically and condensed into a simple algebraic model, Wicksell's cumulative process can be put through its paces to reveal the exact workings of its constituent quantity theory elements. Since these elements have provoked so much controversy in the Wicksell literature, it is important to specify precisely how Wicksell used them.[4] Assume with Wicksell that all saving is deposited with banks, that all investment is bank-financed, that banks lend solely to finance investment, and that full employment prevails such that shifts in aggregate demand affect prices but not real output. Then his model reduces to the following equations linking the variables investment I, saving S (both planned, or ex ante, magnitudes), loan rate i, natural rate r, loan demand L_D, loan supply L_S, excess aggregate demand E, change in the stock of checkable deposits dD/dt, price level change dP/dt, and market-rate change di/dt.

The first equation says that planned investment exceeds saving when the loan rate of interest falls below its natural equilibrium level (the level that equilibrates saving and investment):

$$I - S = a(r - i), \tag{1}$$

[4] For similar attempts to model algebraically the cumulative process see Brems (1986), Eagly (1974), Frisch (1952), Laidler (1975), Niehans (1990), and Uhr (1960).

where the coefficient a relates the investment-saving gap to the interest differential that creates it.

The second equation states that the excess of investment over saving equals the additional checkable deposits newly created to finance it,

$$dD/dt = I - S. \tag{2}$$

In other words, since banks create new checkable deposits by way of loan, deposit expansion occurs when banks lend to investors more than they (banks) receive from savers. Thus equation (2) admits of the following derivation. Denote the investment demand for loans as $L_D = I(i)$, where $I(i)$ is the schedule relating desired investment spending to the loan rate of interest. Similarly, denote loan supply as the sum of saving plus new deposits created by banks in accommodating loan demands. In short, $L_S = S(i) + dD/dt$. Equating loan demand and supply and solving for the resulting gap between investment and saving yields equation (2).

The third equation says that the new deposits, being spent immediately, spill over into the commodity market to underwrite the excess aggregate demand for goods E implied by the gap between investment and saving:

$$dD/dt = E. \tag{3}$$

The fourth equation says that this excess aggregate demand bids up prices, which rise in proportion to the excess demand:

$$dP/dt = bE, \tag{4}$$

where the coefficient b is the factor of proportionality between price level changes and excess demand.

Substituting equations (1), (2), and (3) into (4), and (1) into (2), one obtains

$$dP/dt = ab(r - i) \tag{5}$$

and

$$dD/dt = a(r - i), \tag{6}$$

which together state that price inflation and the deposit growth that underlies it stem from the discrepancy between the natural and market rates of interest.

Finally, since bankers must at some point raise their loan rates to protect their gold reserves from inflation-induced cash drains into hand-to-hand circulation, one last equation,

$$di/dt = gdP/dt, \tag{7}$$

closes the model. This equation says that bankers, having worked off excess reserves, now raise their rates in proportion to the rate of price change (g being the factor of proportionality). The equation ensures that the loan rate

eventually converges to its natural equilibrium level, as can be seen by substituting equation (5) into the above formula to obtain

$$di/dt = gab(r - i). \tag{8}$$

Solving this equation for the time path of the loan rate i yields

$$i(t) = (i_0 - r)e^{-gabt} + r, \tag{9}$$

where t is time, e is the base of the natural logarithm system, i_0 is the initial disequilibrium level of the loan rate, and r is the given natural rate. With the passage of time, the first term on the right-hand side vanishes and the loan rate converges to the natural rate. At this point, monetary equilibrium is restored. Saving equals investment, excess demand disappears, deposit expansion ceases, and prices stabilize at their new, higher level.[5]

3. WAS WICKSELL A QUANTITY THEORIST?

At first glance the preceding model, especially equation (5), appears to attribute price level changes directly to the interest rate differential rather than to monetary causes. This point is sometimes cited as evidence that Wicksell was not a quantity theorist (see Greidanus [1932], p. 83, and Adarkar [1935], p. 27, as cited in Marget [1938], pp. 183, 187). But it is patently obvious that the model is perfectly consistent with the quantity theory when monetary shocks generate the rate differential. Under these conditions the differential and the resulting price movements clearly have a monetary origin.

Indeed, Wicksell himself described how a monetary impulse would trigger the cumulative process consistent with the classical quantity theory. Assuming the monetary impulse took the form of a gold inflow from abroad, he noted that the new gold ordinarily would be deposited in banks. So deposited, the gold would augment bank reserves beyond the level banks desired to hold. The resulting pressure of excess reserves would, he argued, induce banks to lower their loan rate below the natural rate, thus precipitating the cumulative rise in the volume of bank money (deposits) and prices. Under these conditions, one could confidently attribute changes in both the stock of deposits and the price level to preceding changes in the monetary gold stock.

Having recognized potential monetary origins of the cumulative process as a theoretical possibility, however, Wicksell rejected this possibility on empirical grounds. His study of nineteenth-century British prices and interest rates had

[5] Of course if there were no excess reserves to begin with, prices would have to stabilize at their pre-existing level. Bankers, having no excess reserves to lose, would adjust their loan rates either to forestall all reserve drains or to reverse (annul) drains that had already occurred. Either way, prices would stabilize at their initial level.

convinced him that the cumulative process typically originated not in monetary shocks to the loan rate but rather in real shocks to the natural rate. His consequent stress on real shocks in the form of wars, technological progress, innovations, and the like has spurred some scholars to ask: if real shocks predominate over monetary shocks in generating the rate differential, doesn't it follow that the resulting price level movements are real rather than monetary phenomena, contrary to the quantity theory?

In answering this question in the affirmative, these scholars imply that Wicksell may have done more to subvert the theory than to support it. Thus Lars Jonung states:

> Wicksell's approach emphasizes nonmonetary developments, that is "real" factors, as the principal sources of price changes. Although the monetary sector has a central position in the transmission mechanism from "real" developments to changes in prices, there is a tendency to ignore monetary factors in a theory that assumes that movements in the real rate are the driving force behind deflations and inflations. It is thus easy to end up with a theory of the price level that relates the behavior of prices directly to variables that influence the real rate, such as changes in the flow of innovations and technological improvements. Here Wicksell's theory has much in common with the Schumpeterian "longwave explanation," which associates price level changes with the introduction of new production techniques, which implies that nonmonetary factors are the causes behind long-run changes in prices. (Jonung [1979], p. 179; see also Cagan [1965], p. 253, and Laidler [1997], p. 5)

What such interpretations overlook, however, is that Wicksell himself always saw his cumulative process model as embodying the quantity theory and being entirely consistent with it. His model was to him nothing less than a full-scale extension of the theory to account for the influence of bank deposits on the price level. In particular, his equations (3) and (4) upon substitution reduce to $dP/dt = b(dD/dt)$. In so doing, they reveal that a price level change could never occur without the accompanying change in the supply of deposits to support it.

In short, real shocks and the resulting rate differential alone could never sustain price level changes. Instead, something else is required to translate shocks into commodity price inflation. Something, in other words, must finance the excess demand for goods that keeps prices rising. That something is deposit expansion. Without it, excess demand and price increases could never occur and the cumulative process would be abortive. The upshot is that Wicksell thought the key factor underlying and permitting price movements was deposit expansion, not real shocks and rate differentials.

Of the few commentators who underscore this point, none are more emphatic than Charles Rist and Arthur Marget. Rist ([1938] 1966, p. 300) likens Wicksell to Voltaire's sorcerer, whose incantations could kill a herd of cattle if accompanied by a lethal dose of arsenic. In Wicksell's case, the arsenic—the

true cause—was an elastic supply of deposits. The incantations took the form of rate differentials. Similarly, Marget (1938, p. 183) cites "abundant passages in Wicksell's writings which show that he did think of the 'plentiful creation of money' (that is, bank-credit, or the M' of our equation) as being the crucial link in the [cumulative] process." In short, changes in the stock of deposits were to Wicksell the one absolutely necessary and sufficient condition for price level movements.

Critique of Tooke's Interest Cost-Push Theory

Nowhere did Wicksell express this view more forcefully than in his famous critique of Thomas Tooke (Wicksell [1898] 1965, pp. 99–100, and [1906] 1978, pp. 180–87). Tooke, author of the celebrated *History of Prices* and leader of the English Banking School, had disputed, indeed scorned, the quantity theoretic doctrines of the rival Currency School. In opposition to those doctrines, Tooke, in his 1844 volume *An Inquiry into the Currency Principle* (Tooke [1844] 1959), argued that price level changes stem from cost-push forces originating in the real economy rather than from disturbances originating in the monetary sector. In particular, he argued that interest rate increases, by raising the cost of doing business, would raise general prices as the increased costs were passed on to buyers. The resulting price inflation, Tooke implied, would occur even in the face of a constant money stock.

Wicksell, however, maintained that such price level increases could never occur unless underwritten by expansion of that stock. According to him, it is deposit growth stemming from a two-rate differential, and not interest cost-push per se, that constitutes the necessary condition for general prices to rise. Without the accommodating monetary growth, the interest cost-push forces would, he insisted, exhaust themselves in changing relative, not absolute, prices ([1906] 1978, p. 180). The prices of interest-intensive goods would rise relative to the prices of non-interest-intensive ones. But the general price level would remain unchanged. For if the money stock were constant and banks possessed no excess reserves, any rise in the natural rate would force bankers to engineer a matching rise in the loan rate to protect their reserves from cash drains into hand-to-hand circulation. The two rates would remain equal and prices would stay constant. Only if banks initially possessed excess reserves could a positive shock to the natural rate permanently raise the equilibrium price level. And even here the price increase is attributable to the monetary factor—the excess reserve—that permits it to occur. All of which is consistent with the quantity theory and confirms Wicksell's adherence to it.

Pure Credit Economy

To summarize, Wicksell had shown that the quantity theory applies perfectly to the pure cash economy. He had then shown that, when augmented to account

for the influence of deposit-financed demand on prices, it applies to mixed cash-credit economies as well. In both cases, he had established that a real currency demand together with an independent nominal currency supply are sufficient to pin down the price level. Seeking to extend the theory to its logical limit, he next applied it to the hypothetical extreme case of a pure credit economy in which no currency exists and all transactions are settled by transfers of deposits on the books of banks. Here he showed that the theory fails to hold in the absence of central bank intervention.

According to him, it fails to hold in the first place because the pure credit economy employs no currency to which the theory can apply. With currency absent, no demand for and supply of it exists to determine the price level. Nor can deposit demand and supply be relied upon to determine the price level. For, in the pure credit economy, the two deposit variables are identical to each other at all price levels. Being identical, they cannot exhibit demand-supply independence as price determinacy requires. Wicksell explains:

> in our ideal [pure credit] state every payment . . . is accomplished by means of cheques or *giro* facilities. It is then no longer possible to refer to the supply of money as an independent magnitude, differing from the demand for money. No matter what amount of money may be demanded from the banks, that is the amount which they are in a position to lend . . . . The banks have merely to enter a figure in the borrower's account to represent a credit granted or a deposit created. When a cheque is then drawn and subsequently presented to the banks, they credit the amount of the owner of the cheque with a deposit of the appropriate amount (or reduce his debit by that amount). The "supply of money" is thus furnished by the demand itself. . . . It follows that . . . the banks can raise the general level of prices to any desired height. ([1898] 1965, pp. 110–11)

With deposit supply identical to demand at all prices, there is no unique equilibrium price level or deposit quantity. Rather, there is an infinity of price-quantity equilibria. The price level, in other words, is indeterminate. Wicksell's cumulative process model applied to the pure credit economy cannot determine it.

Instead, his credit economy model specifies the rate of rise of the price level dP/dt (see Leijonhufvud [1997], p. 8). Starting from some historically given position, this rise can continue indefinitely as long as a natural-rate/market-rate disparity persists, that is, as long as banks are under no reserve pressure to raise their rates. Since no currency demand exists to drain reserves in the pure credit economy, banks need hold no reserves other than central bank credit. And even this form of reserve is unnecessary in a banking system—Wicksell's "ideal" system—composed of a single central bank with branches in every town and hamlet (see Uhr [1960], p. 222). As a central bank, the ideal bank need hold no credit reserves with itself. Moreover, as a monopoly institution, the ideal bank can lose no reserves through the clearing house to other banks (of which there

are none) and so need hold no reserves whatsoever. The result is a system totally devoid of reserve constraints to anchor nominal variables. In such a system, deposit supply possesses potentially unlimited elasticity. Consequently prices, in addition to being indeterminate, theoretically can rise (or fall) forever.

Wicksell insisted, however, that it was up to the central bank to impose nominal determinacy in this case. The central bank could do so through control of the market rate. By adjusting the rate when prices threaten to rise or fall, the bank could close and reverse the rate differential. In so doing, the bank could maintain prices and the supporting volume of deposits at fixed, determinate levels. Here the central bank's obligation to impose price determinacy replaces the missing reserve constraint to force equilibrating rate adjustment. Nominal determinacy is preserved, consistent with the quantity theory. In this way, Wicksell ensures that at least one element of the theory survives even in the pure credit case.

4. POLICY REFORM PROPOSALS

The preceding remarks contend that Wicksell was, commentators' views to the contrary notwithstanding, every bit as much a quantity theorist as Fisher. Evidence reveals that he, like Fisher, understood and indeed enriched the theory's postulates.

But there is a simpler way to prove he and Fisher saw things much the same as far as the quantity theory was concerned. That way is to compare the policy views of the two. One can employ a simple litmus test: a person essentially is a quantity theorist if he believes the monetary authority can stabilize the price level through control, direct or indirect, of the stock of money or nominal purchasing power. Both Fisher and Wicksell pass this test with flying colors.

Both advocated price level stability, albeit for different reasons. Fisher thought such stability would smooth, if not eliminate completely, the business cycle. In so doing, it would alleviate the overuse (stress, strain, exhaustion) of labor and capital resources endured in business booms and the loss of output and employment suffered during depressions. By contrast, Wicksell thought price stability would stop the arbitrary and unjust redistribution of income and wealth that unanticipated inflation and deflation produce. In this way, it would prevent the loss in aggregate social welfare that occurs, because of diminishing marginal utility of income, when unanticipated price movements transfer real income from losers to gainers.

Both also advocated that price stability be achieved through feedback policy rules. In this connection, both devoted their best efforts to devising effective rules. Each writer proposed rules directing the monetary authority to adjust its policy instrument in corrective response to price level deviations from target. Such instrument adjustment would in turn produce a corresponding adjustment

in the money stock. This latter adjustment would act to stabilize prices. The money stock was of key importance here. Only by operating through it could instrument adjustment stabilize prices.

In Fisher's famous compensated dollar plan, the policy instrument is the gold content of the dollar, or official dollar price of gold (see Patinkin [1993]). The monetary authority adjusts this price in response to price level deviations from target. Since the price level, or dollar price of goods, is by definition the dollar price of gold times the world gold price of goods, the authority must offset movements in the gold price of goods with compensating adjustments in the dollar price of gold so as to keep the general price level constant.

Fisher made it clear, however, that his compensated dollar plan would operate on the price level through the money stock. It would do so by changing both the physical amount and the nominal valuation of the nation's stock of monetary gold. Thus when world gold inflation was raising the dollar price of goods, the American policy authority would lower the official buying and selling price of gold. Industry and the arts, finding gold less expensive, would therefore demand more of it. Consequently, part of the nation's gold stock would be diverted from monetary to nonmonetary uses (see Lawrence [1928], p. 432). The resulting shrinkage in the stock of monetary gold would lower the price level. In addition, the reduced official price of gold, by producing a corresponding reduction in the nominal value of physical gold reserves, would lessen the nominal volume of paper money issuable against such backing (see Patinkin [1993], p. 16). This reduced nominal issue too would put downward pressure on prices. In sum, whether through physical reduction or nominal revaluation, the monetary gold stock would shrink and so too would the quantity of money and level of prices it could support.

Later on, in the mid-1930s, Fisher (1935, p. 97) proposed another policy rule. It had the central bank adjusting, via open market operations, the monetary base in response to price deviations from target. In this case, the price level was the goal variable, the monetary base was the instrument, and the money stock was the intermediate variable. To minimize slippage between the base instrument and the money stock, Fisher advocated a system of 100 percent required reserves behind deposit money.

Although Wicksell's preferred policy instrument differed from Fisher's, his activist feedback rule followed exactly the same pattern as Fisher's. The authority would adjust its policy instrument, namely its lending rate, in response to price deviations from target. In Wicksell's own words (1919, p. 183, cited in Jonung [1979], p. 168), "the Riksbank's tool to keep the price level . . . constant is to be found exclusively in its interest rate policy, such that the Riksbank has to increase its rates as soon as the price level shows a tendency to rise and lower them, as soon as it shows a tendency to fall." Such rate adjustments would in turn produce corresponding corrective movements in the money

stock. These latter movements then would stabilize prices.[6] Together, these propositions constitute what Howard S. Ellis, in his classic *German Monetary Theory: 1905–1933,* called Wicksell's "central theorem," namely the theorem "that bank rate controls the price-level through its effect on the amount of available purchasing power" (Ellis 1934, p. 304).

Thus if prices were rising, the central bank would raise the bank rate. The rise in the bank rate would close the gap between it and the natural rate. The closing of the gap would eliminate the differential between the investment demand for and saving supply of loanable funds. The elimination of that differential would arrest growth in the stock of deposits and bring price rises to a halt. Further raising of the bank rate would cause deflationary monetary contraction, thereby reversing the preceding inflationary price movement and restoring prices to target. Here is a classic quantity theoretic prescription for achieving price stability through monetary means. It is proof positive that Wicksell, like Fisher, was a bona fide quantity theorist.

5. CONCLUSION

What then remains of the alleged difference between Fisher's and Wicksell's interpretation of the quantity theory? Not much, in this observer's opinion. Any existing difference seems superficial rather than substantive, more semantic than real. And it virtually vanishes once their policy reform proposals are taken into account.

Commentators typically claim that interest rates are the key to Wicksell's analysis, whereas for Fisher the money stock is pivotal. They likewise claim that real shocks initiate the inflationary process in Wicksell's model, whereas monetary shocks do so in Fisher's. True enough. But these distinctions largely lose force when one realizes that both men saw changes in the stock of monetary purchasing power consisting of bank deposits and currency as the one absolutely indispensable and potentially controllable factor responsible for price level changes. Moreover, both regarded this stock as the crucial intermediate variable connecting policy instruments to price targets. Finally, both concluded that the monetary authority bears the ultimate responsibility for monetary and price level stability, a responsibility it discharges by giving some nominal variable under its control a stable, determinate value. In so doing, both enunciated the principle of nominal determinacy, the sine qua non of the quantity theory. These similarities would seem to outweigh any differences.

One reads Fisher and Wicksell today not so much to note the contrasts in their analytical models as to appreciate the brilliant, prescient, and imaginative

[6] Uhr (1991, p. 94) notes that Wicksell believed that the application of his rule would prevent the price level from varying more than three percentage points above or below its target or base-year level.

ways they applied the quantity theory. In arguing for price stability achievable through monetary means, both were adherents of monetary policy in the classical quantity theory tradition. Their two treatments are complementary rather than competitive.

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