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Fisher's Theory of Interest Rates and the Notion of "Real": A Critique

By

Éric Tymoigne

California State University, Fresno
Department of Economics

5245 N. Backer Ave. M/S PB 20
Fresno, CA 93720-3121

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ABSTRACT

By providing five different criticisms of the notion of real rate, the paper argues that this concept, as Fisher defined it or as a definition, is not relevant to economic analysis. Following Keynes and other post-Keynesians, the article shows that the notion of real rate is microeconomically and macroeconomically unfounded. Adjusting interest rates for inflation does not protect the purchasing power of wealth, and it is impossible to do so at the macroeconomic level. In addition, an empirical interpretation of the break in the correlation between interest rates and inflation since 1953 is provided.

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Fisher's real rate of interest framework is essential for the inflation-targeting framework. It provides a rationale for the idea that monetary policy should be concerned mainly (if not only) with managing inflation expectations in order to keep real interest rates at a stable level that promotes saving and investment. Some post-Keynesians, like Smithin (2003) or Cottrell (1994), have also promoted the use of this concept, even if the former claimed that it only represents a definition and does not have anything to do with Fisher. Many authors have challenged the notion of real rate at the empirical level but only a few have done it at the theoretical level. Among those exceptions are authors like Keynes, Hahn, Harrod, Davidson, and Kregel.

The present article continues such critique and argues that the notion of real rate is not theoretically relevant for the study of micro- or macroeconomic problems—it does not protect against potential losses of purchasing power and the underlying arbitrage is impossible to do at the macroeconomic level. The paper also contributes to the large empirical literature on the subject by providing an interpretation of the break that occurred in the mid 1960s in the correlation between interest rates and inflation. In the end, we conclude that economic agents are far more concerned with nominal matters (i.e., financial power, or liquidity and solvency) than real problems (purchasing power). Not that the latter is ignored or unimportant, but it included into the broader considerations of the former.

The first four parts of the paper provide a theoretical criticism of Fisher's theory, the fifth part of the paper provides an empirical study of the Fisher's effect, and the paper concludes with an explanation of the relevance of nominal values.

1. ANTICIPATED INFLATION DOES NOT AFFECT NOMINAL INTEREST RATE

The first criticism of Fisher's theory was provided by Keynes in the *General Theory* (1936). This criticism was restated and developed by Harrod (1971) and Davidson (1974, 1986). We know that, for Fisher, at the aggregate level:

$$i = r^* + E(\pi)$$

Thus, given r^* (the required real rate determined independently in the loanable funds market), any expected increase (decrease) in the rate of inflation will lead to an increase (decrease) in the nominal rate of interest via arbitrages between future and present aggregate incomes. Indeed, say that in time t = 0, the economy is at a full employment equilibrium with no inflation expected ($i_0 = r^*$). Suddenly, in time $t = 1$, the central bank is expected to increase the money supply in time 2 so that, following the quantity theory of money, there is some inflation expected: $E_1(\pi_2) = m_2$ so that, in time 1, $i_0 - E_1(\pi_2) <$

r^*. Aggregate real income grows at a faster rate than the expected real amount of money that needs to be reimbursed (and so, too, the expected amount of real aggregate income to give up in the future if one borrows). The willingness to smooth consumption gives an incentive to borrow money now in order to buy some present income while giving up some future income. This puts an upward pressure on the money-rate on money:

> If inflation is going on, he will see rising prices and rising profits, and will be stimulated to borrow capital unless interest rate rises; moreover, this willingness to borrow will itself raise interest rate. (Fisher 1907)

Theoretically, i should grow immediately to compensate for $E_1(\pi_2)$ and no real effect should occur from the rise of money because the required and expected real rates are equal: $i_1 - E_1(\pi_2) = r^*$, with $i_1 > i_0$.[1]

Keynes was the first to have some difficulties with this explanation of the business cycle. His direct criticism rests on three points, with the third one being the consequences of the first two. First, what should be compared are the money-rates, not the real rates, because the former are the only observable and the liquidity of position is essential—capital gain/loss should be included in the yield rate calculation.[2] Second, capital assets are usually not a good substitute for monetary assets as a store of value, whereas there is a high substitutability among monetary assets, and between monetary assets and liquid non-monetary assets. Third, for the two preceding reasons, Fisher's explanation of what drives the interest rate on money is invalid. Changes in interest rates do not reflect changes in the opportunity cost induced by inflation in the present/future consumption arbitrage, they reflect changes in uncertainty that affect the stock equilibrium between liquid and illiquid assets. Stated alternatively:

> The occurrence of a new-found belief firmly held, that a certain rate of inflation will occur, cannot affect the rate of interest. But the growth of *uncertainty* about what rate of inflation, if any, is in prospect, can send up the rate of interest. (Harrod 1971)

Let us look in detail at each criticism.

First, remember that there are three possible assets to choose from to hedge against inflation: money, bonds, and capital assets. At equilibrium, all three money-rates are equal and so no alternative is better than any other. Fisher's theory assumes that r^* is fixed for given time-preference and

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[1] Inflation will occur because of the increase in the money supply by the central bank.

[2] As Kregel (1999) shows, Fisher's conception of income prevents giving some importance to capital gains or capital losses.

technology, and represents what people ultimately want—goods to consume. Of course, r^* does not depend on the actual price of the asset because it is a required physical rate fixed by technology and tastes. However, the price of assets matters for the purchasing power—either directly by affecting the total return obtained after selling an asset or indirectly by affecting the creditworthiness of the asset owner. Thus, the arbitrage analysis should not start with real rate and go to nominal rate, but should start directly with nominal rates and compare cash outflows to cash inflows.

Second, "so long as it is open to the individual to employ his wealth in hoarding or lending money, the alternative of purchasing actual capital assets cannot be rendered sufficiently attractive (especially to the man who does not manage the capital assets and knows very little about them), except by organizing markets wherein these assets can be easily realised for money" (Keynes 1936). Usually, capital assets are illiquid so that they cannot be resold at all or only by recording large capital losses. Thus, illiquid capital assets are "*not* […] a hedge against inflation and hence will be shunned by savers" (Davidson 1986, italics added). This, of course, goes against the more recent Monetarist development of Fisher's theory that assumes that the relevant transmission mechanisms of a monetary shock goes beyond the portfolio adjustments in terms of financial assets to include also "such assets as durable and semi-durable consumer goods, structures, and other real property" like "houses, automobiles, […] furniture, household appliances, clothes, and so on" (Friedman 1974).

The third and essential criticism of Fisher by Keynes is delivered in the following way:

> There is no escape from the dilemma that, if it is not foreseen, there will be no effect on current affairs; whilst, if it is foreseen, the prices of existing goods will be forthwith so adjusted that the advantages of holding money and of holding goods are again equalized, and it will be too late for holders of money to gain or suffer a change in the rate of interest which will offset the prospective change during a period of the loan in the value of the money lent. For the dilemma is not successfully escaped by Professor Pigou's expedient of supposing that the prospective change in the value of money is foreseen by one set of people but not foreseen by another. (Keynes 1936)

Thus, in any case, in the context of Fisher's theory, the money holders (the lenders) will never be able to adjust the interest rate, i.e., the interest rate on bonds, *before* inflation occurs. *After* inflation occurred, money holders will not have any incentive to do any arbitrage because all money-rates will be equal again. In order to understand why, it is first necessary to understand how the rate of interest could go up *because of* perfectly expected inflation. This would not result from an arbitrage between money and bonds because both are monetary assets and so both are affected exactly in the same way by inflation:

> Bonds and cash are two forms of asset denominated in money. Neither has a hedge against inflation. […] The rate of interest represents the rate at which bonds can be exchanged for cash. Since neither contains a hedge against inflation, the new-found expectation that inflation will occur cannot change their relative values or therefore, the rate of interest. […] The idea that new-found expectation can alter the relative value of two money-denominated assets, is logically impossible, and must not be accepted into the corpus of economic theory. (Harrod 1971)

The only reason why the interest rate would go up is because individuals want to switch their portfolio from monetary assets to liquid non-monetary assets. The problem is, then, to know if they actually can do this arbitrage *based on* perfectly expected inflation. Keynes's answer is no. Indeed, on one side, if inflation was not foreseen (if neither borrowers nor lenders saw that a monetary shock occurred and so thought that $i_0 = r^*$), then lenders did not have any incentive to raise the rate of interest and borrowers did not have any incentive to borrow. Once inflation occurred, those who are long in monetary assets record an unexpected loss in real terms ($i_0 - \pi_2 < r^*$), whereas those who are long in capital assets record an unexpected gain in nominal terms ($i_0 < r^* + \pi_2$); it is too late to make up for inflation—money holders record a loss that cannot be avoided by increasing i. At the same time, there is no more incentive for monetary-asset holders to do anymore arbitrages because $i_0 = r^*$ again (assuming that no more inflation is expected).

On the other side, if, in $t = 1$, inflation is foreseen perfectly with total confidence then, following the rational expectation approach, $\pi_1 = E_1(\pi_2)$; the price of non-monetary assets adjusts instantaneously by the expected amount. The interest rate has no time to adjust and stays at i_0—a loss in purchasing power is recorded by money holders, whereas a gain is recorded by holders of non-monetary assets. Then, in $t = 2$, assuming that no inflation is expected and knowing that the growth of the money supply by m_2 has already been included in decisions in $t = 1$, $i_0 = r^*$ again without any arbitrage to smooth consumption having been completed. Therefore:

> The monetarist theory of a real versus nominal interest rate is mired in its own logical mudhole. If expectations of inflation […] which create the difference between the real and nominal interest rates do "fully anticipate" the future so that, in Fisher's term, inflation is "foreseen" […], then the existing stock of real durables can never be a better *ex ante* inflation hedge than before the change in expectations occurred. (Davidson 1986)

Immediately after inflation is known to occur in the future, *everybody* bids up the price of capital goods that are resalable so that the price of durable is the only one to adjust—if the market is one-sided, no transaction occurs. Once the adjustment is done, there is no more incentive for anybody to make any transactions because "the holding of money versus bonds versus resaleable durables will again be equalized" (Davidson 1986).

One of the main responses provided to these criticisms is that Keynes had a "curious misunderstanding of Professor Fisher's celebrated proposition" (Roberston 1940). The misunderstanding comes from the fact that an expected inflation will lead, theoretically, to an instantaneous increase in i to compensate for the expected real loss, but:

> In actual practice, for the very lack of this perfect theoretical adjustment, the appreciation or deprecation of the monetary standard does produce a real effect on the rate of interest […]. […] This effect is due to the fact that the money rate of interest […] does not usually change enough to compensate fully for the appreciation or depreciation. The inadequacy in the adjustment of the rate of interest results in an unforeseen loss of the debtor, and an unforeseen gain to the creditor, […]. (Fisher 1930)

Thus, expected inflation, even if perfect, is incorporated only progressively into the nominal rate of interest proposed by lenders, so when the central bank increases the money supply, $i_2 - \pi_2 < r^*$. This gives more incentive to borrow money and the equilibrium is restored when nobody has any incentive to borrow. Assuming the inflation stays the same after time 2, this means that the equilibrium is restored when $i_3 - \pi_2 = r^*$ with $i_3 > i_0$. In the end, money holders have recorded a loss during the adjustment process because statistics show that "there is very little direct and conscious adjustment through foresight" (Fisher 1930). Therefore, there is a possible stimulating effect of inflation from the discrepancy between "the marginal productivity of investable funds *to the user* and the rate of interest 'in the strict sense' which he is compelled to pay" (Roberston 1940). Money is not neutral in the short run.

This kind of counter-criticism is, however, very *ad hoc* and goes against the arbitrage principle that Fisher previously laid down, namely that expected inflation matters not actual inflation—people want to *avoid* purchasing power loss, not compensate for the loss. Forward/spot market transactions are involved (Fisher 1930). This arbitrage process is essential for Fisher's theory because it leads directly to the notion of real rate of interest. In addition, stating the theory in the *ad hoc* way shows that liquidity matters more than purchasing power—what individuals care about is the monetary net cash-flow that they can make. Indeed, if individuals really cared about the purchasing power of their income, it would seem irrational for them not to adjust their position with expected inflation.[3] On the other side, if people care about the liquidity of their position, inflation expectation is a concern, but not a concern

[3] See Carmichael and Stebbing (1983) and Cottrell (1994) for some literature that tries to rationalize this paradox.

as important as matching nominal inflows and outflows of money. In the latter case, it is not inflation that leads to an adjustment of interest rate, but an expectation that outflows will increase or a current increase in outflows. This may or may not be related to inflation in goods and services.

Cottrell (1994), while rejecting the "vulgar" Fisherian view for the reasons advanced by post-Keynesians (Cottrell 1997), provides another criticism of Davidson and Harrod by stating that their point of view relies on partial equilibrium. For Cottrell, the two preceding authors do not take into account the fact that an increase in the marginal efficiency of capital induced by higher expected inflation (the relevant channel through which inflation will affect economic activity for Keynes) will generate what is sometimes called in IS-LM terms a "financial feedback" on the rate of interest. That is, higher investment will generate higher income, and so higher demand for money for transactions. Therefore, given the money supply and liquidity preference, it will also generate higher interest rates. For Cottrell, by reasoning in terms of general equilibrium, one can show that inflation expectations *will* generate, indirectly, higher interest rates. This criticism, however, forgets about the important remark that Keynes made to Hicks—contrary to the loanable funds theory and IS-LM, an increase in investment *does not need* to increase interest rate (Keynes 1937). Therefore, Harrod and Davidson do not reason in terms of partial equilibrium. What they argued is that there is no automatic pressure on the rate of interest; it will depend, as Harrod said, on the effect of uncertainty on liquidity preference. The ultimate effect on the rate of interest will also depend on the way the money supply is affected by higher aggregate spending and monetary policy—IS and LM curves are not independent (Davidson 1978). The willingness of the central bank to accommodate the need at an unchanged interest rate is, thus, one condition for producing or not producing a result similar to Fisher, as Cottrell recognized (Cottrell 1997).

In conclusion, the idea that interest-rate variations on monetary assets are the result of expected future inflation seems doubtful. Another explanation is required and Keynes provided one via the notions of liquidity preference and marginal efficiency of capital (the *money* rate of return on non-monetary assets). In this case, the uncertainty about the future liquidity of financial positions created by inflation *may* lead to an increase in interest rate because of the higher liquidity premium attached to money in front of the unknown future. The only direct effect of inflation is that it increases the marginal efficiency of capital. Contrary to Fisher, it is the rate on non-monetary assets that adjusts for inflation.

2. FISHER'S CONDITION OF INDIFFERENCE IS NOT THE RELEVANT ONE

2.1. Fisher's Condition of Indifference

Following Fisher, say that individuals have a choice between two assets, gold and wheat. Table 1 shows the real rates on gold and wheat:

Table 1: Real Rates on Wheat and on Gold

Assets	Today	Future	Real-rates
Gold (dollars)	D	$D(1 + r_g)$	r_g
Wheat (bushels)	B	$B(1 + r_w)$	r_w

Individuals can choose between lending (borrowing) B bushels of wheat today and getting from the crop (having to pay) $B(1 + r_w)$ bushels of wheat in the future, or lending (borrowing) D dollars at r_g and getting (paying) $D(1 + r_g)$ dollars in the future. Individuals will be indifferent if:

$$B(1 + r_w) \text{ bushels} \Leftrightarrow D(1 + r_g) \text{ dollars}$$

However, the comparison cannot be done in this way because the denomination is not the same. In the real world, all rates are money-rates, so it is necessary to calculate the money-rate (or, in this case, the gold-rate) on wheat. In order to do so, the arbitragers must take into account the change in the price of a bushel of wheat (p_w) in terms of dollars during the carrying (or production) period so that purchasing power is not altered. Say that p_w changes by π_w, then, in order to obtain B bushels of wheat in the future, arbitragers will have to pay $D(1 + \pi_w)$ dollars, or, stated alternatively, D dollars will buy $B/(1 + \pi_w)$ bushels of wheat. Therefore, if individuals lend (borrow) D dollars today, they know that getting (paying) $D(1 + r_g)$ will allow them to buy (to deliver) $B(1 + r_g)/(1 + \pi_w)$ bushels of wheat in the future. If the latter amount is superior (inferior) to $B(1 + r_w)$ bushels, individuals buy/lend (sell/borrow) gold. Thus, individuals are indifferent when they will obtain (pay) the same amount of wheat (or gold) by lending/borrowing in gold or wheat:

$$B(1 + r_w) = B(1 + r_g)/(1 + \pi_w)$$

That is:

$$(1 + r_w)(1 + \pi_w) = (1 + r_g)$$

By developing, we have:

$$r_w + \pi_w + r_w \cdot \pi_w = r_g$$

Thus, the gold-rate on wheat is $R_w \equiv r_w + \pi_w + r_w \cdot \pi_w$ and, when no arbitrage is profitable, it is equal to the gold-rate on gold ($R_g \equiv r_g$). However, today, π_w is unknown, so individuals can only base their decisions on expectations about the change in the price of wheat. Thus, the process of arbitrage involves expectations of prices and the actual condition of indifference is not the previous one but:

$$r_w + E(\pi_w) + r_w \cdot E(\pi_w) = r_g$$

Therefore, if today in $t = 0$, $R_{w0} > R_{g0}$, then it is profitable for individuals to borrow gold to buy wheat spot[4] and to sell wheat forward. At the settlement date, individuals sell wheat for gold, obtaining a rate of return R_{w0}, and reimburse their gold loan (contracted at R_{g0}). This arbitrage process leads to an increase (decrease) in the spot price (S) of wheat (gold), and a decrease (increase) in the forward price (F) of wheat (gold), so that $E(\pi_w)\ (= \dfrac{F_w/F_g - S_w/S_g}{S_w/S_g})$ decreases, and so R_w decreases, until $R_w = R_g$.

When r_w and $E(\pi_w)$ are small, the condition of indifference can be simplified into:

$$R_g = r_w + E(\pi_w) \Leftrightarrow r_w = R_g - E(\pi_w)$$

Assuming the condition of arbitrage between two commodities also holds at the aggregate level,[5] then the arbitrage can be reduced to a choice between one "commodity" (aggregate real income) and money. The arbitrage equalizes the (expected) real rate $r \equiv i - E(\pi)$ on real income and the required real rate r^* on real income:

$$i = r^* + E(\pi) \Leftrightarrow r^* = i - E(\pi)$$

In addition, at the aggregate level, the adjustment does not go via $E(\pi)$, but via i: r^* is still given by technology and inflation expectations are derived from the identity $MV \equiv PT$. A high nominal rate of interest on money (i) is, thus, explained by high expectations of inflation $E(\pi)$ and/or by high preference for the present [and so high required real return on aggregate real income (r^*)].

2.2. Breakeven Point, Duration, and the Right Condition of Arbitrage

The second criticism of Fisher's real rate was also provided by Keynes in the *General Theory,* even if he did not relate it to Fisher's theory. This criticism was also developed by Kahn (1954) and Kregel (1998, 1999) and is directly related to the notion of breakeven point.

The breakeven point reflects the absolute or relative variation in interest rate for which the capital loss (gain) is exactly compensated by the total gain (loss) from the reinvestment income. This breakeven point can be calculated for different periods of time. The duration term is the time necessary for a capital gain (loss) to be exactly compensated by a reinvestment income loss (gain) so that the

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[4] The rate on wheat can then be obtained either by growing wheat or lending the wheat to a producer. More generally, one can write contracts specified in terms of quantity of wheat.

[5] That is to say, assuming that an arbitrage between present and future incomes is possible at the macroeconomic level (a hypothesis that has been criticized by Keynes, as shown below).

actual rate of return is at least equal to a targeted rate—it is the time necessary to reach the breakeven point.

The calculation of the sensitivity of the fair price to the rate of interest requires to determine the duration of the bond,[6] and to deduce from it the modified duration that measures the volatility of a bond price. The duration of a bond is equal to:

$$D = \frac{C}{Vi}\left(\frac{1-(1+i)^{-T}}{1-(1+i)^{-1}} - \frac{T}{(1+i)^{T}}\right) + \frac{M}{V}\frac{T}{(1+i)^{T}}$$

The coupon being paid yearly, this gives a measure in terms of years and, for all bonds except zero-coupon bonds, the duration term is always inferior to the time to maturity.

For perpetual bonds ($T \to \infty$), the duration is given by $D_P = (1 + i)/i$ and the modified duration is $MD \equiv D_P/(1 + i) = 1/i$. Knowing that the fair price of a consol is given by C/i, and knowing that $dV/V = -MD \cdot di$, then, for a given variation in the market yield, one has:

$$\Delta V \approx -(C/i^2) \cdot \Delta i.$$

Of course, for consols, the first derivative of the price gives the same result and no duration calculation is necessary. But, for more complex bonds, the result is not straightforward and the formula of duration provides an easy way to approximate the sensitivity of a bond price.

In addition, the calculation of the duration allows implementing what is called in portfolio management an "immunization strategy." Indeed, one portfolio strategy consists in targeting a yield rate $\bar{i}$ (and so a certain sum of money) for a given holding period, and to buy bonds that have a duration equal to the holding period for the targeted interest rate. This will guarantee that reinvestment income and capital gain will compensate at least for each other so that the actual yield obtained (and so the actual amount of money obtained) will be equal to or higher than the targeted rate (amount of money). We know that the reinvestment income obtained at the time a bond is sold is:

$$RI = C \cdot \left[\frac{(1+i)^{h} - 1}{i}\right] - hC$$

with h the holding period. Therefore:

$$\Delta RI \approx (C/i^2) \cdot [1 + hi(1 + i)^{h-1} - (1 + i)^{h}] \cdot \Delta i,$$

and so for $h = D_P$, $\Delta RI \approx -\Delta P \approx |(C/i^2) \cdot \Delta i|$. Thus, one can conclude that, if the rate of interest goes below (above) a targeted rate, capital gains (losses) will be realized and *more* (*less*) than offset the reinvestment income losses (gains) so that the actual yield $\breve{i}$ will be superior to $\bar{i}$. If i stays the same, then the yield obtained will be $\breve{i} = \bar{i}$.

The notions of breakeven point and duration are, thus, important to try to cope with liquidity risk induced by an unforeseen capital losses or an unforeseen decrease in interest rates. This can also be applied at the balance-sheet level in order to match the cash flows from the asset and liability sides. Keynes was the first to show the importance of these notions for economic theory. The notion of breakeven point is essential to the understanding of the *General Theory*, and was presented in the following way by Keynes:

> [E]very fall in i reduces the current earnings from illiquidity, which are available as a sort of insurance premium to offset the risk of loss on capital account, by an amount equal to the difference between the *squares* of the old rate of interest and the new. For example, if the rate of interest on a long-term debt is 4 per cent., it is preferable to sacrifice liquidity unless on balance of probabilities it is feared that the long-term rate of interest may rise faster than by 4 per cent. of itself per annum, *i.e.,* by an amount greater than 0.16 per cent. per annum. (Keynes 1936)

The "square rule" (Kregel 1998) implies that a person who expects that the level of the rate of interest will increase by more than its square in absolute terms should increase his/her preference for money. Indeed, say that an individual bought a perpetual bond and decides to sell it after one coupon period. The nominal return obtained is:

$$R = C + \Delta V$$

Which is approximately equal to:

$$R \approx C - (C/i^2)\cdot di$$

Consistent with Keynes's liquidity preference theory in which money rules the roost, one placement strategy consists, then, in determining what change in the nominal market rate is expected to lead to a null nominal return ($E(R) = 0$):

$$C - (C/i^2)\cdot E(di) = 0 \Rightarrow \underline{E(di) = i^2}$$

Thus, for a consol, the short-term breakeven point (corresponding to one coupon period) is reached when the level of the rate of interest varies by its square (i.e., when it grows at the level of itself). Therefore, if i is expected to increase and $E(\Delta i) < i^2$, then holding a bond will provide a net gain in the short run because the capital loss is expected to be inferior to the income gain. This condition of indifference may include the concerns about inflation via the introduction of an inflation premium in nominal rates, but these concerns are included in the broader concerns of liquidity and solvency.

The condition of indifference proposed by Fisher does *not* guarantee a protection against losses of purchasing power. Indeed, in Fisher's theory, the condition of indifference is given by $r^* + E(\pi) +$

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[6] For large variations in i, a better approximation is obtained by adding the convexity.

$r^* \cdot E(\pi) = i$. In Fisher's terms, this would imply that the best way to protect purchasing power if inflation is expected is to raise the interest rate on monetary assets. This, however, completely eludes the impact of rising interest rate on the price of assets; it is true that the income portion of the asset will have its purchasing power preserved, but this will also lead to a potential capital loss. This, then, has several consequences. First, if one sells the income-providing assets, the capital loss may be so high that the total net dollar gain from an increase in interest rate may become negative; the purchasing power gain is, thus, completely wiped out. Second, even if assets are kept, the potential capital loss is reflected in net wealth and so in the creditworthiness of the asset holders, and so ultimately on their capacity to get loans (and so their capacity to smooth income over time, which is the all point of Fisher's theory). In the end, therefore, the rise in the rate of interest may be counterproductive.

3. THE TRANSFER OF REAL INCOME OVER TIME

Fisher assumes that the arbitrage that goes on at the microlevel between present and future income can be applied at the macroeconomic level with aggregate real income. This has, again, been criticized by Keynes (1936):

> Aggregate demand can be derived only from present consumption or from present provision for future consumption. The consumption for which we can profitably provide in advance cannot be pushed indefinitely into the future. *We cannot, as a community, provide for future consumption by financial expedients but only by current physical output.* In so far as our social and business organisation separates financial provision for the future from physical provision for the future so that efforts to secure the former do not necessarily carry the latter with them, financial prudence will be liable to diminish aggregate demand and thus impair well-being, as there are many examples to testify. (Keynes 1936, italics added)

Thus, not only is Fisher's condition of indifference wrong at the microlevel, it is also wrong at the aggregate level. In the former case, it does not automatically protect individuals against purchasing power loss, and in the second case, arbitrage is impossible because there are no spot and forward markets for a "commodity" called "aggregate income." Therefore, saving can only come in monetary terms, not in real terms. However, saving in financial terms today does not lead automatically to the production or the provision for the production of future goods and services. The only way to save for the future in real terms is to invest today.

Actually, in his own terms, Fisher seems aware of this. He recognizes that *a person* can change his/her real income streams in two ways (Fisher 1930)—via their impatience (borrowing and lending) and via investment. However, *at the aggregate level*, the first solution is not possible:

> Borrowing and lending, the narrower method of modifying income streams, cannot be applied to society as a whole, since there is no one outside to trade with; and yet society does have opportunities radically to change the character of its income stream by changing the employment of its capital. (Fisher 1930)

Stated alternatively, the arbitrage process that leads to the condition of indifference cannot be applied at the aggregate level. Or, again, the loanable funds supply and demand functions do not exist at the aggregate level. He should have concluded that the market interest rate cannot be determined in this way, but he did do so and instead continued his analysis by assuming that all the results obtained from microeconomic reasoning apply at the macroeconomic level.

4. THE THEORY OF RATE OF INTEREST

Keynes (1937, 1936), Kregel (1988, 1999), and Kahn (1984) already made a criticism based on the same lines. Fisher assumes that r^* is given by technology and tastes. r^* is a physical rate of return. However, in his analysis, Fisher recognizes that r^* is actually calculated in money terms and that price expectations matter for the decision—the rate of return over cost is the monetary expression of r^* and is the essential variable for investment (Fisher 1930). Later, Keynes explicitly stated that the marginal efficiency of capital and the rate of return are identical concepts. One could then wonder if it is justified to criticize Fisher's analysis for not taking into account the importance of money and monetary expectations.

In fact, in Fisher's theory, money is a veil and Keynes should not have confounded marginal efficiency of capital and marginal rate of return over cost as depicted by Fisher. Indeed, in Fisher, the real return is guaranteed because it depends on the technical capacity of the productive assets. Stated alternatively, the rate of return over cost is concerned with the "profit" obtained from the produced output expressed in monetary terms, whereas the marginal efficiency of capital is concerned with the profit obtained from the *sale* of the production. This should be clear if one reads the following quote:

> In the real world our options are such that if present income is sacrificed for the sake of future income, the amount of future income *secured* thereby is greater than the present income sacrificed. […] Man can obtain from the forest or the farm more by waiting than by premature cutting trees or by exhausting the soil. […] Nature offers man may opportunities for future abundance at trifling present cost. So also human technique and invention tend to produce big returns over cost. (Fisher 1930, italics added)

Thus, the rate of return is just a monetary expression of the "primitive cost and return typified by labor and satisfaction" (Fisher 1930). On the other side, Keynes was very careful to state that the marginal efficiency of capital does not rest *directly* on technical concepts (Kregel 1988): "If capital becomes less scarce, the excess yield will diminish, without its having become less productive—at least in the physical sense" (Keynes 1936).

5. THE FISHER INDIFFERENCE CONDITION AS A DEFINITION

Some post-Keynesian authors, like Smithin (2003) or Cottrell (1994), even if they reject the notion of real rate of return, agree that the real rate of interest is a useful concept in terms of definition:

> Interest rates are determined in the financial sector proximately by the decision of the ultimate provider of credit, in other words the central bank. This institution also sets the pace for real interest rates, and not just for nominal rates. The real interest rate (on Fisher's definition) is just the nominal rate minus expected inflation. Hence the central bank can set the real rate, if it wishes, simply by adjusting the setting of the nominal rate to offset changes in expectation of inflation (Smithin 2003).

This position is, however, quite problematic for several reasons. First, it puts a real concept into the monetary framework. It is the relationship between nominal cash inflows and nominal cash outflows that matters, rather than the notion or "real" income. "Real" assumes that cash outflows are only linked to consumption and that the cash outflows of different economic agents are equally affected by inflation. It does not take into account the fact that the structure of spending, as well as financial commitments, are crucial for the effect of prices on cash-outflows. As Pigeon notes, for example, unionized workers in Canada have wage demands that "are anchored on expected inflation and interest rates" (Pigeon 2004). In itself, the real wage is an inefficient way to protect the purchasing power of wage; the whole range of cash outflows should be accounted for so as to protect the *financial* power of wage. It is the same with financial income earners whose consumption outflow is far less important in proportion than cash outflows due to financial commitments like interest, margin calls, or off-balance sheet commitments.

Second, the idea that Fisher's real rate of interest is "just" a definition is not what Fisher had in mind. Fisher's indifference condition reflects a hypothesis about the behavior of individuals and their method of selecting assets. It also reflects a particular conception of income (Kregel 1999). However, as shown above, this condition is problematic for several reasons. In addition, if one assumes that the real rate of interest is just a definition, one must assume that there is a clear correlation between inflation and nominal interest rates. However, as shown above, Fisher was the first to recognize that this is not the case. In fact, many studies, including Fisher, have shown that the "Fisher effect" does not hold.[7] The following confirms the conclusion of Fisher. The analysis is divided in two parts. In the first part, the correlation between variables are checked and some conclusions are drawn. In the second part, a Granger causality test is performed to substantiate the previous conclusions.

5.1. Analysis of Correlations

Figure 1 shows that there is no relationship between inflation measured by the CPI and any of the interest rates, whatever the maturity, until the mid 1950s. After that, interest rates are more closely related to the inflation rate, as measured by the CPI inflation. Figure 1 tends, thus, to show that individuals do not adjust at all for inflation, at least until 1953,[8] despite the high rates of inflation and deflation going from +20% to -15%. On can then wonder why suddenly the interest rates tend to be more related to inflation, as if individuals suddenly could better account for changes in the price level. However, if one looks at Table 2, it is easy to understand why interest rates became more closely correlated with inflation. Before 1953, the correlation is around 0 or *negative*, despite very high price movements, but after 1953 the correlation is high, between 0.65 and 0.79, especially for short-term papers.[9] There is, thus, a break in the relationship. One the other side, the close correlation between

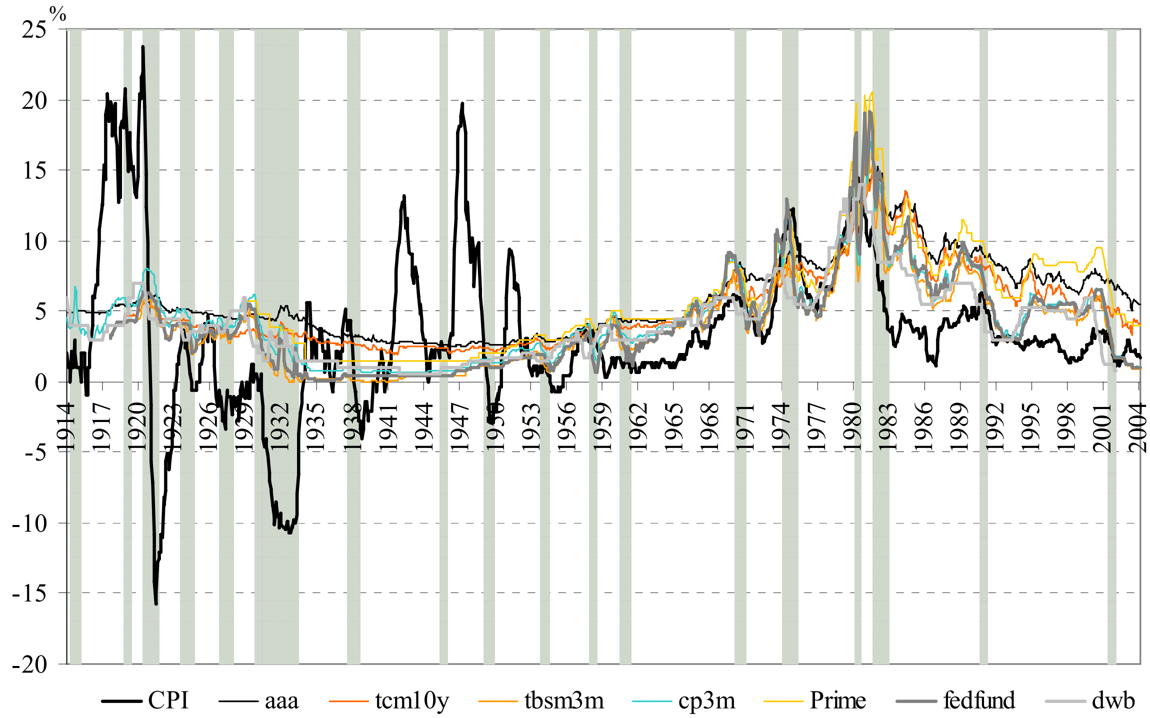
[7] The estimation of the "Fisher effect" has been subject to numerous studies, which, like many econometric tests of macroeconomic theory, do not give any clear results—the latter depending on the period, the country tested, and the method employed. Ghazali and Ramlee (2003) provide a summary of the main recent studies on the subject, and evidence that goes against the Fisher effect for the G7 countries. The confusion on the subject is, maybe, the greatest with Carmichael and Stebbing (1983), who try to "rationalize" the inconsistency of Fisher's theoretical and empirical results by, in fact, validating Keynes's (what they call the "Inverted Fisher Hypothesis"). They show that nominal rates are far less volatile than the real rates and argue that this indirectly validates Fisher's theory. For them, the latter cannot be tested directly, or is prevented from working, because of data or regulation problem. In the latter case, they state that money-rates are stickier because of regulation on interest rate payments on money. However, the true reason why interest rates on money are stickier is because they are, at least partly, exogenously controlled (Moore 1988; Wray 1990). The central bank cannot control money supply directly, but only via the price of credit, and if it chooses to do so, interest rates of all maturities are closely linked to the policy rates of the central bank.

[8] The break date was taken for two reasons. First, Fama (1975) starts his estimate at this date, and, second, the Federal Reserve changed its operating procedure at this time by concentrating its interest-rate policy on the short-term range ("bills only" policy).

[9] A strict test of Fisher's theory would imply taking time ranges for inflation expectations that are equal to the maturity term of each asset.

interest rates, and federal funds, and Discount Window rates has always been very high, between 0.83 and 0.99.

Figure 1: Nominal Interest Rates and Inflation: Jan. 1914–Feb. 2004



Sources: Federal Reserve of New York, NBER, BLS
Note: aaa: Corporate bonds AAA. tcm10y: T-Bonds 10 years. tbsm3m: T-Bills 3 months. cp3m: Commercial papers 3 months.

Table 2: Yield Rates, Inflation, and Monetary Policy: Jan. 1914–Feb. 2004

Monthly Rates		Corporate Bonds AAA	T-Bonds 10 Years	T-Bills 3 Months	Commercial Papers 3 Months	Prime	Fed Funds	Discount Window
Correlation between CPI inflation and interest rates	1914-2004	0.250	0.338	0.326	0.381	0.381	0.352	0.287
	1914-1952	-0.070	-0.125	0.076	-0.104	-0.464	0.077	-0.044
	1953-2004	0.652	0.677	0.777	0.761	0.738	0.779	0.798
Correlation between discount rate and interest rates	1914-2002	0.902	0.916	0.975	0.975	0.966	0.973	1.000
	1914-1952	0.902	0.907	0.954	0.943	0.884	0.954	1.000
	1953-2002	0.871	0.908	0.970	0.976	0.950	0.968	1.000
Correlation between fed funds rate and interest rates	1914-2004	0.891	0.913	0.990	0.990	0.969	1.000	0.973
	1914-1952	0.831	0.857	0.985	0.991	0.862	1.000	0.954
	1953-2004	0.845	0.885	0.993	0.987	0.951	1.000	0.968

Sources: BLS, NBER, Federal Reserve of New York (ftp website), www.wrenresearch.com.au.
Notes: Due to changes in the Discount Window operations in January 2003, the Discount Window data stops in December 2002. Data for Discount Window start in November 1914, data for T-Bonds start in January 1919, data for T-Bills start in January 1920, data for the Fed Funds start in August 1917, and data for the Prime rate start in January 1929. CPI data are for 12-month changes and start in January 1914.

What happened is in fact very simple. In front of the growing concerns about inflation and the renewal of Monetarist ideas, the central bank oriented its policy toward "fighting inflation" by raising or lowering its interest rates with the change in the consumer-price index (or other closely related index) (Seccareccia 1998; Clarida, Gali, and Gertler 2000; Orphanides 2004). Therefore, changes in policy rates became more closely related to changes in prices, which the discount rate correlation shows perfectly with the highest correlation of 0.8. The federal funds rate also became highly correlated with the CPI inflation.

One of the immediate implications is that the other rates also became, to a lower degree, more correlated with the rate of inflation. Therefore, the higher correlation does not reflect the fact that people suddenly became more preoccupied with inflation when they fixed interest rates. On the contrary, it reflects the continuity of economic behaviors—the concern about liquidity, not purchasing power. Changes in short-term rates create instability in the long-term range by creating large fluctuation in prices and reinvestment income, and the profitability to borrow short-term for speculation.

Evidence, therefore, seems to show that there is no very close correlation between interest rates and inflation, even if there has been a partial one after the 1950s (Cottrell 1997). One could argue that it is expected inflation that matters, but Table 3 shows that interest rates are, to a small extent, more correlated with inflation than with expected inflation. Again, the correlation between the discount rate and the inflation variables is the highest and higher with actual inflation.

Table 3: Interest Rates, Expected Inflation, and Inflation: Jan. 1978–Dec. 2003

Monthly Rates		Corporate Bonds AAA	T-Bonds 10 Years	Commercial Papers 3 Months	T-Bills 3 Months	Prime	Fed Funds	Discount Window
Correlation between interest rates and expected inflation	1978-2003	0.549	0.610	0.726	0.723	0.681	.723	0.756
Correlation between interest rates and CPI inflation	1978-2003	0.598	0.640	0.771	0.764	0.766	.777	0.805

Sources: BLS, Survey of Consumers of the University of Michigan.

One can further confirm those results and obtain more insights by doing a more systematic econometric analysis.

5.2. Cointegration, VAR Analysis and Granger Causality

One can perform a VAR analysis on all the preceding variables and check the Granger causality. A nonrejection of our preceding conclusions would show that the policy rates of the Federal Reserve Granger cause all the other rates while the market rates do not Granger cause the policy rates. In addition, the policy rates should be Granger caused by inflation or its expected value. We will assume that the federal funds rate is a policy rate of the Federal Reserve. Indeed, even though it is market determined, the Federal Reserve has a strong control over this market. In addition, we know that theory tells us that market rate depends partly on expected policy rates (Hicks 1939; Kaldor 1939).[10] Below expectation of federal funds rate are determined by assuming that financial-market participant make perfect expectations of next month federal funds rate: $E_t(i_{FFRt+1}) = i_{FFRt+1}$. This variable is I(1).

Before going any further, a word of caution is in order. Indeed, one central problem of the Granger causality procedure is that it is very sensitive to the preliminary tests necessary to perform the causality test. The preliminary tests concern the lag-structure of the VAR and the stationary of the variables (order of integration and cointegration). Recent developments in the econometrics of time-series have tried to provide several solutions, but there is still large room for future developments and improvements (Clarke and Mirza 2006).

5.2.1. Preliminary Test

The Dickey-Fuller tests show that all the variables except inflation are I(1) variables; the inflation rate is stationary. The next step is to check the cointegration between variables. This will give the first indication of the presence of Granger causality because if two variables are cointegrated, there are Granger causalities in at least one direction (Granger 1988). In addition, this will tell us if we need to estimate an error-correction model before performing the Granger causality test.

Starting with interest rates, we concentrate our analysis on market-determined rates, the prime rate having a straightforward relationship to the cost of central bank money via a mark-up. In order to check the cointegration, one first needs to determine the appropriate lag by looking at the VAR in levels (Enders 2004). Table 4 shows that, following the Schwartz criteria, a 3-month lag structure is best.

[10] Expectations of long-term rates are also very important for the determination of long-term rates (Kahn 1954; Robinson 1953; Kregel 1998).

Table 4: Lag Test

VAR Lag Order Selection Criteria
Endogenous variables: EXPFEDFUNDS CP3M TBI3M TB10Y AAA
Exogenous variables: C
Sample: 1914:01 2004:02
Included observations: 1001

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-6011.595	NA	0.114381	12.02117	12.04569	12.03049
1	977.3816	13894.17	1.04E-07	-1.892870	-1.745755	-1.836959
2	1453.538	941.8477	4.21E-08	-2.794282	-2.524570	-2.691777
3	1543.565	177.1758	3.70E-08	-2.924206	-2.531897*	-2.775108
4	1595.979	102.6296	3.50E-08	-2.978980	-2.464075	-2.783289
5	1637.360	80.61244	3.39E-08	-3.011709	-2.374208	-2.769426
6	1698.118	117.7513	3.15E-08	-3.083152	-2.323055	-2.794276
7	1761.501	122.2074	2.92E-08	-3.159842	-2.277149	-2.824373*
8	1804.962	83.36215*	2.81E-08*	-3.196727*	-2.191438	-2.814666

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

The cointegration results are relatively insensitive to the lag structure chosen and Table 5 shows that Johansen's cointegration test suggests three cointegrations at 1% of confidence.

Table 5: Cointegration

Sample(adjusted): 1920:05 2004:01
Included observations: 1005 after adjusting endpoints
Trend assumption: No deterministic trend (restricted constant)
Series: EXPFEDFUNDS CP3M TBI3M TB10Y AAA
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.096167	216.6055	76.07	84.45
At most 1 **	0.054172	114.9888	53.12	60.16
At most 2 **	0.036798	59.01581	34.91	41.07
At most 3 *	0.018413	21.33605	19.96	24.60
At most 4	0.002642	2.658506	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 4 cointegrating equation(s) at the 5% level
Trace test indicates 3 cointegrating equation(s) at the 1% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None **	0.096167	101.6167	34.40	39.79
At most 1 **	0.054172	55.97300	28.14	33.24
At most 2 **	0.036798	37.67976	22.00	26.81
At most 3 *	0.018413	18.67754	15.67	20.20
At most 4	0.002642	2.658506	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates 4 cointegrating equation(s) at the 5% level
Max-eigenvalue test indicates 3 cointegrating equation(s) at the 1% level

This result holds for lag-structure of 2 to 7 months. The cointegration between the policy rate and inflation and expected inflation was checked in the same way. The following presents the cointegration results for the optimal lag-structure determined by the Schwartz criteria. Table 6 shows no cointegration between the federal funds rate and expected inflation. This result is sensitive to the lag structure chosen (for lags superior to 6 months, one may find one or two cointegrated equations).

Table 6: Interest Rates, Expected Inflation, and Inflation: Jan. 1978–Dec. 2003

Sample(adjusted): 1978:06 2003:12
Included observations: 307 after adjusting endpoints
Trend assumption: No deterministic trend (restricted constant)
Series: FEDFUNDS EXPINFL
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None *	0.049280	20.75923	19.96	24.60
At most 1	0.016938	5.244636	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Trace test indicates 1 cointegrating equation(s) at the 5% level
Trace test indicates no cointegration at the 1% level

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.049280	15.51460	15.67	20.20
At most 1	0.016938	5.244636	9.24	12.97

*(**) denotes rejection of the hypothesis at the 5%(1%) level
Max-eigenvalue test indicates no cointegration at both 5% and 1% levels

The cointegration between inflation and the federal funds rate does not need to be tested because the two variables are integrated of different orders so they cannot be cointegrated.

5.2.2. Granger and VAR Analysis.

The following use the preceding results to perform the Granger analysis. We do the latter with alternative methods and compare their results and reliability. The first method uses a VAR with stationary variables, leaving aside cointegration problems. We know, however, that this method is not appropriate, so a second method takes into account the preceding cointegration results and estimate a VECM model when appropriate.

Granger and VAR with stationary variables: Leaving aside cointegration relationships, a VAR analysis on stationary variables is first performed. All interest rate variables are I(1), so a VAR analysis in first difference is performed on those variables. The first problem is to determine what lag-length is relevant. Taking as reference what the FOMC has done since 1981—meeting every five to eight weeks—this two-month lag is not unreasonable. In addition, Table 7 shows that the Schwarz information criteria confirms this choice.

Table 7: Lag Length

VAR Lag Order Selection Criteria
Endogenous variables: DFEDFUNDS DCP3M DTBI3M DTB10Y DAAA
Exogenous variables: C
Sample: 1914:01 2004:02
Included observations: 997

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1049.067	NA	8.47E-08	-2.094418	-2.069820	-2.085067
1	1317.835	534.3005	5.20E-08	-2.583420	-2.435835	-2.527319
2	1431.409	224.6415	4.35E-08	-2.761101	-2.490528*	-2.658249
3	1480.869	97.33260	4.14E-08	-2.810168	-2.416607	-2.660566
4	1546.396	128.2939	3.82E-08	-2.891466	-2.374918	-2.695113
5	1594.289	93.28926	3.65E-08	-2.937391	-2.297855	-2.694287
6	1675.298	156.9795	3.26E-08	-3.049745	-2.287221	-2.759891
7	1701.322	50.16864	3.25E-08	-3.051800	-2.166288	-2.715194
8	1785.653	161.7255	2.89E-08	-3.170818	-2.162319	-2.787462*
9	1818.221	62.13040	2.85E-08	-3.185999	-2.054512	-2.755892
10	1841.210	43.62649	2.86E-08	-3.181966	-1.927491	-2.705108
11	1867.191	49.04305	2.85E-08	-3.183933	-1.806470	-2.660325
12	1907.218	75.15652*	2.77E-08*	-3.214078*	-1.713628	-2.643719

* indicates lag order selected by the criterion

Table 8 shows the results of a Granger test for all the changes in market rates. One can see that changes in expected federal funds rate Granger causes all other change in market rates, whereas none of the changes in other rates causes changes in the expected federal funds rate at 5% confidence level. This unidirectional Granger causality holds for lags of 1 month to 4 months, even though it concerns only long-term rate for a one-month lag. For other lags, there is no unidirectional Granger causality.

Table 8: Granger Test between Market Rates

PairwiseGrangerCausalityTests
Sample:1914:012004:02

Null Hypothesis:	Obs. (2 lags)	Probability (1 lag)	Probability (2 lags)	Probability (4 lags)	Probability (5 lags)
DAAA does not Granger Cause DEXPFEDFUNDS	1036	0.09901	0.24978	0.31060	8.9E-08
DEXPFEDFUNDS does not Granger Cause DAAA		0.00000	1.40E-15	6.7E-15	1.3E-16
DTB10Y does not Granger Cause DEXPFEDFUNDS	1018	0.66726	0.27286	0.04613	0.00084
DEXPFEDFUNDS does not Granger Cause DTB10Y		0.00000	0	0	0.00000
DTBI3M does not Granger Cause DEXPFEDFUNDS	1006	4.3E-06	0.13437	0.01469	1.2E-05
DEXPFEDFUNDS does not Granger Cause DTBI3M		0.00000	0	0	0.00000
DCP3M does not Granger Cause DEXPFEDFUNDS	1036	2.5E-07	0.05341	0.14340	5.6E-05
DEXPFEDFUNDS does not Granger Cause DCP3M		0.00000	0	0	0.00000
DTB10Y does not Granger Cause DAAA	1019	8.8E-14	1.20E-11	3.7E-14	3.0E-15
DAAA does not Granger Cause DTB10Y		0.02700	0.5385	0.32571	0.58947
DTBI3M does not Granger Cause DAAA	1007	0.97287	0.11173	0.00206	0.01275
DAAA does not Granger Cause DTBI3M		8.6E-05	1.00E-08	1.3E-07	2.8E-07
DCP3M does not Granger Cause DAAA	1072	0.04965	0.18627	0.02506	0.09948
DAAA does not Granger Cause DCP3M		6.6E-09	1.70E-10	3.5E-09	1.9E-08
DTBI3M does not Granger Cause DTB10Y	1007	0.09064	0.0151	2.3E-05	0.00023
DTB10Y does not Granger Cause DTBI3M		2.1E-10	1.00E-11	1.4E-10	1.3E-11
DCP3M does not Granger Cause DTB10Y	1019	0.00062	0.00114	4.3E-07	7.4E-06
DTB10Y does not Granger Cause DCP3M		0.00000	0	7.6E-16	8.9E-16
DCP3M does not Granger Cause DTBI3M	1007	0.51373	0.05658	0.09846	0.13469
DTBI3M does not Granger Cause DCP3M		3.2E-12	1.80E-11	9.8E-14	4.3E-13

The next step is to see if the relationship between the central-bank rate (as defined by the federal funds rate) and inflation (expected or actual) follows any special Granger causality. Taking first the inflation between 1914 and 1952, Table 9 shows that there is no apparent Granger causality between changes in federal funds rates and inflation. This result holds whatever the lag structure used (the best one being a 3 month lag, according to the Schwartz criteria).

From 1953, however, Table 10 shows that changes in federal funds rate Granger causes changes in inflation. This may seem strange, especially for New Neoclassical economists, but the interest rate is a cost that can be built up into prices, so higher interest rates may lead to higher prices and inversely. Thus, even though the Federal Reserve claims to fight inflation (and unemployment) by trying to manage economic activity via its interest-rate policy, it seems that the opposite result was reached (this is true for whatever lag structure).

Table 9: Inflation and Changes in Federal Funds Rate: 1914–1952

Pairwise Granger Causality Tests
Sample: 1914:01 1952:12

Null Hypothesis:	Obs. (3 lags)	Probability (3 lag)	Probability (6 lags)	Probability (12 lags)	Probability (18 lags)
INFLATION does not Granger Cause DFEDFUNDS	421	0.15472	0.28680	0.69304	0.38635
DFEDFUNDS does not Granger Cause INFLATION		0.49973	0.50037	0.69898	0.35111

Table 10: Inflation and Changes in Federal Funds Rate: 1953–2004

Pairwise Granger Causality Tests

Sample: 1953:01 2004:02

Null Hypothesis:	Obs. (3 lags)	Probability (3 lag)	Probability (6 lags)	Probability (12 lags)	Probability (18 lags)
INFLATION does not Granger Cause DFEDFUNDS	614	0.10977	0.13273	0.13679	0.40792
DFEDFUNDS does not Granger Cause INFLATION		6.2E-06	2.7E-05	9.8E-08	3.0E-06

If one considers expected inflation rather than inflation, then, here again the results would be counterintuitive to most economists. Only for a lag of three months or more can we assume that changes in expected inflation Granger cause changes in federal funds rate, but the causality runs also this other way. For smaller lags, only the reverse causality is verified—changes in federal funds rate Granger cause changes in the expected inflation. Table 11 shows the result of the Granger test.

Table 11: Changes in Expected Inflation and Changes in Federal Funds Rate

Pairwise Granger Causality Tests

Sample: 1978:02 2004:02

Null Hypothesis:	Obs. (3 lags)	Probability (2 lag)	Probability (3 lags)	Probability (12 lags)	Probability (18 lags)
DFEDFUNDS does not Granger Cause DEXPINFL	308	0.00018	8.7E-06	2.3E-07	4.9E-06
DEXPINFL does not Granger Cause DFEDFUNDS		0.88040	0.00690	2.1E-05	6.5E-08

According to Schwartz criteria obtained from the VAR in levels, table 12 shows that a lag of 3 months is optimal, so it seems that results from the 2-month lag structure should not be trusted.

Table 12: Lag Length

VAR Lag Order Selection Criteria
Endogenous variables: FEDFUNDS EXPINFL
Exogenous variables: C
Sample: 1914:01 2004:02
Included observations: 304

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1347.912	NA	24.66162	8.881002	8.905456	8.890784
1	-586.9013	1507.002	0.169469	3.900667	3.974029	3.930013
2	-544.4584	83.48979	0.131599	3.647752	3.770023	3.696664
3	-530.6025	27.07369	0.123338	3.582911	3.754090*	3.651387
4	-520.3354	19.92629	0.118358	3.541680	3.761767	3.629720
5	-512.0665	15.93941	0.115084	3.513595	3.782591	3.621200
6	-506.5590	10.54396	0.113953	3.503677	3.821581	3.630846
7	-493.3203	25.17095*	0.107239*	3.442896*	3.809708	3.589630*
8	-489.6536	6.923229	0.107482	3.445089	3.860810	3.611387

* indicates lag order selected by the criterion

In conclusion, it seems that there is little reason to believe that interest rates and inflation are automatically related to each other, as long as the central bank itself does not become highly preoccupied with inflation. This close relationship exists either because the central bank responds to inflation by increasing its interest rates, or because inflation increases as the result of an active tightening of monetary policy.

Granger and VECM analysis: The previous conclusion helps not rejecting the conclusion reached previously; the period 1914–2004 does not see financial market participant become Fisherian, the Federal Reserve did. However, these results are not reliable when there is some cointegration. The only really reliable results concern the relationship between inflation and changes in federal fund rates, which does not need more careful study. Below we study Granger causalities by using a VECM approach.

In the VECM approach, variables I(1) are made stationary by expressing the absolute change of each, relative to change in its own lags and lagged changed of other variables (which is similar to the previous VAR analysis that we implemented), but in addition, each change in variables is a function of one or several cointegration equation, which are a stationary linear combination of I(1) variables. Testing for Granger causality implies implementing a F-test on lagged changes and a t-test on the coefficient of the cointegration equation. More formally we have:

$$\Delta X_t = BAX_{t-1} + \Sigma A_i \Delta X_{t-i} + \varepsilon_t$$

where X is a vector of I(1) variables, AX is a stationary linear combination of those variables, and B is the vector of coefficients attached to each cointegration equation (the speed of adjustment parameters). For example, if we want to test that expected federal funds are not caused by any other variable, we have to make sure that the equation for ΔEXPFEDFUNDS does not have any BA coefficient significantly different from zero (which is tested by a t-test on B = 0 or A = 0) and that $A_i = 0$ altogether for the lagged changes of all other rates (which is tested via a block exogeneity test).

Starting first with interest rates, we know that the optimal lag structure is 3 months and that there are 3 cointegration equations. Below we show the result for different lag structure. First, concerning the significance of the B parameters, we obtained the following results shown in Table 13.

Table 13: Cointegration Equations

Vector Error Correction Estimates
(* significant at 10%, **significant at 5%, *** significant at 1%)
Sample(adjusted) (2 lags): 1920:04 2004:01
Included observations (2 lags): 1006 after adjusting endpoints

	2 lags	3 lags	7 lags
CointEq1 in eq. for:			
D(EXPFEDFUNDS)	-0.058194	0.031991	-0.034882
D(AAA)	0.075894***	-0.018824***	-0.002725***
D(TB10Y)	0.096833***	-0.004493***	-0.01242***
D(TBI3M)	0.132329***	0.000593***	0.007203***
D(CP3M)	0.129301***	0.01076***	-0.026556***
CointEq2 in eq. for:			
D(EXPFEDFUNDS)	-0.056979***	0.031104**	-0.038822*
D(AAA)	0.075245***	-0.014489***	-0.013985***
D(TB10Y)	0.097863	0.00266	-0.028655*
D(TBI3M)	0.112937	0.000168	0.006208
D(CP3M)	0.103048	0.016604**	-0.033771
CointEq3 in eq. for:			
D(EXPFEDFUNDS)	-0.010699***	0.018687**	-0.031703***
D(AAA)	0.075281	-0.016015***	-0.011698***
D(TB10Y)	0.091115**	-0.007934***	-0.013345***
D(TBI3M)	0.107636	-0.006127	0.00727
D(CP3M)	0.109493***	0.000423***	-0.017263***

The coefficients for the first equation are not significant in the equation representing changes in federal funds rate, they are significant at 1% to 10% depending on the lag in the second equation, and they are significant at least at 5% in the third cointegration equation, whatever the lag. All this shows that one can say that there is a long-term bidirection-causality between interest rates. Let us now look at the short-term causality, which is given in Table 14.

Table 14: F-test on Lagged Variables

VEC Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1914:01 2004:02
Included observations (2 lags): 1006

Dependent variable: D(EXPFEDFUNDS)

Exclude	Prob. (2 lags)	Prob. (3 lags)	Prob. (7 lags)
D(AAA)	0.5021	0.4076	0
D(TB10Y)	0.0728	0.0129	0.0001
D(TBI3M)	0.0089	0.0143	0
D(CP3M)	0.2461	0.2274	0.324
All	0.0059	0.0003	0

Dependent variable: D(AAA)

Exclude	Prob. (2 lags)	Prob. (3 lags)	Prob. (7 lags)
D(EXPFEDFUNDS)	0.0118	0.0231	0.0003
D(TB10Y)	0	0	0
D(TBI3M)	0.0041	0.0001	0
D(CP3M)	0.0002	0.0005	0
All	0	0	0

Dependent variable: D(TB10Y)

Exclude	Prob. (2 lags)	Prob. (3 lags)	Prob. (7 lags)
D(EXPFEDFUNDS)	0.0007	0.0021	0
D(AAA)	0.7904	0.1153	0.1969
D(TBI3M)	0.1055	0.0074	0.0003
D(CP3M)	0.0003	0.0004	0
All	0	0	0

Dependent variable: D(TBI3M)

Exclude	Prob. (2 lags)	Prob. (3 lags)	Prob. (7 lags)
D(EXPFEDFUNDS)	0	0	0
D(AAA)	0.0056	0.0262	0.3351
D(TB10Y)	0.0002	0.0001	0
D(CP3M)	0.0001	0	0
All	0	0	0

Dependent variable: D(CP3M)

Exclude	Prob. (2 lags)	Prob. (3 lags)	Prob. (7 lags)
D(EXPFEDFUNDS)	0	0	0
D(AAA)	0.078	0.0788	0.2987
D(TB10Y)	0	0	0
D(TBI3M)	0.4003	0.5726	0.0098
All	0	0	0

The results show weak support for the idea that the federal funds rate can be treated as an independent variable. Changes in the 3-month T-bill and the 10-year T-bond are the ones that are the most able to influence the federal funds rate in the short-term. In the end, therefore, the previous VECM partially suggests a unidirectional causality from expected federal funds rate to other market rates, but it is weak. The strongest result we can obtain is by excluding 3-month T-bill for a lag structure of 2 months, as shown in tables 15 and 16. In this case, within the 99% interval of confidence, one can conclude that the federal funds rate Granger causes all the other rates, both in the short-term and the long run.

Table 15: Cointegration Equation

Vector Error Correction Estimates (excluding TBI3M), 2 lags
Sample(adjusted): 1919:04 2004:01
Included observations: 1018 after adjusting endpoints
t-statistics in [ ]

Error Correction:	D(EXPFEDFUNDS)	D(CP3M)	D(TB10Y)	D(AAA)
CointEq1	-0.005860	0.117444	0.083801	0.064741
	[-0.18191]	[7.23582]	[5.61722]	[5.74497]
CointEq2	-0.025914	-0.116029	-0.067937	-0.045013
	[-0.79510]	[-7.06610]	[-4.50127]	[-3.94825]
CointEq3	0.080506	-0.003828	-0.040774	-0.009482
	[2.32123]	[-0.21906]	[-2.53869]	[-0.78159]

Table 16: F-Test on Lag Variable

VEC Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1914:01 2004:02
Included observations: 1018

Dependent variable: D(EXPFEDFUNDS)

Exclude	Chi-sq	df	Prob.
D(CP3M)	6.483580	2	0.0391
D(TB10Y)	2.733254	2	0.2550
D(AAA)	0.979088	2	0.6129
All	10.31002	6	0.1122

Dependent variable: D(CP3M)

Exclude	Chi-sq	df	Prob.
D(EXPFEDFUNDS)	894.7633	2	0.0000
D(TB10Y)	28.25997	2	0.0000
D(AAA)	4.021679	2	0.1339
All	1040.065	6	0.0000

Dependent variable: D(TB10Y)

Exclude	Chi-sq	df	Prob.
D(EXPFEDFUNDS)	19.91972	2	0.0000
D(CP3M)	28.84574	2	0.0000
D(AAA)	0.089033	2	0.9565
All	49.37727	6	0.0000

Dependent variable: D(AAA)

Exclude	Chi-sq	df	Prob.
D(EXPFEDFUNDS)	11.94838	2	0.0025
D(CP3M)	24.39055	2	0.0000
D(TB10Y)	49.93347	2	0.0000
All	81.55211	6	0.0000

Looking at the relationship between the federal funds rate and expected inflation, tables 17 and 18 provide the following results (knowing that a 2-month lag structure is the best):

Table 17: Cointegration equation

Vector Error Correction Estimates
(* significant at 10%, **significant at 5%, *** significant at 1%)
Sample(adjusted) (2 lags): 1978:04 2003:12
Included observations (2 lags): 309 after adjusting

	2 lags	6 lags	12 lags
CointEq1 in eq. for:			
D(FEDFUNDS)	-0.051536***	-0.059826***	-0.032787***
D(EXPINFLATION)	0.010032	-0.005175	0.01804*

Table 18: F-test

VEC Pairwise Granger Causality/Block Exogeneity Wald Tests
Sample: 1914:01 2004:02
Included observations (2 lags): 309

Dependent variable: D(FEDFUNDS)

Exclude	Prob. (2 lags)	Prob. (6 lags)	Prob. (12 lags)
D(EXPINFL)	0.3269	0	0
All	0.3269	0	0

Dependent variable: D(EXPINFL)

Exclude	Prob. (2 lags)	Prob. (6 lags)	Prob. (12 lags)
D(FEDFUNDS)	0.0001	0.0001	0
All	0.0001	0.0001	0

The results confirm the analysis that was made in the previous section, that there is a Granger causality that is bidirectional in the short run (except for 2-month lags). However, in the long-run the causality is unidirectional and runs from expected inflation to federal funds rate, that is, the federal funds rate behavior was caused by expected inflation.

6. FINANCIAL POWER VERSUS PURCHASING POWER OF MONEY

The importance of the purchasing power of money for mainstream economists has been restated by Hahn:

> Let us begin with an axiom that I think most economists would accept, and that I have already used in the previous lecture: the objectives of agents that determine their actions and plans do not depend on any nominal value. Agents care only about "real" things, such as goods […] leisure and effort. We know this as the axiom of the absence of money illusion, what it seems impossible to abandon in any sensible analysis. (Hahn 1982)

For the mainstream, what really matters for economic agents are real variables, not nominal variables. Money is a veil. However, because we live in a monetary economy, post-Keynesians argue that the purchasing power of money is a secondary property; what really matters for economic agents is the "financial power" of money. Stated alternatively, it is the liquidity of money that matters the most for economic agents because it protects them against future contingencies. In addition, as long as inflation is not too high, money provides a safe way to postpone decisions—money gives the safe possibility not to make choices (Davidson 1994).

In order to be more concrete, the following example is provided. Say that workers earn a wage of w = \$5 and have to pay CC = \$2 each month to service their debt, and assume that the general price level is P = \$1. The real wage earned by workers is w/P = \$5 and the net wage of workers is the nominal wage less the cash commitments in the form of debt-service payments, $w - CC$ = \$3. Say now that workers obtain a raise that doubles their wage so that w = \$10 and that the general price level is also doubled P = \$2. The real wage of workers is, thus, the same (\$5). The mainstream economists, following Ricardo,[11] Fisher, and Hahn, would say that workers are not better off. On the other side, post-Keynesians would say that the situation of workers has considerably improved. Indeed, the financial power of money, i.e., the capacity of workers to face their debt commitments (the liquidity of their position), is largely improved, $w - CC$ = \$8. This improvement in their financial power increases their financial wealth (assuming that their real consumption level is unchanged)[12] and gives them easier access to bank loans and financial independence. As Keynes says, the recommendations of Classical economists forget about this:

> Nor are they based on indirect effects due to a lower wages-bill in terms of money having certain reactions on the banking system and the state of credit. (Keynes 1936)

Actually, the improvement in the financial wealth is not necessary to conclude that workers are better off. Say that CC also increases by \$2 so that CC/P and w/P are unchanged, still the situation of workers has improved because their position is more liquid ($w - CC$ = \$6). Thus, the real burden of debt or the real wages are not what really matter for economic agents. Note also that the real burden of debts

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[11] "I cannot agree with Adam Smith, or with Mr. Malthus, that it is the nominal value of goods, or their prices only, which enter into the consideration of the merchant." [Ricardo 1820 (1951)]

[12] Say that in the first period $C = PQ_c$ = \$1 × 3 = \$3—workers consume all their net income. In the second period, if Q_c is the same, C = \$6 and so workers can save \$2. This increase in their financial wealth improves the collateral they can offer to bankers when they ask for loans and so the willingness to lend of by bankers is higher. Another way the financial wealth can increase is if P does not change but w rises to \$10, then the real burden of debts (CC/P) is unchanged but still workers are better off because of the lower nominal burden of their debts.

(CC/P) is not a relevant concept for workers because even if prices increase or decrease, their debt burden is unchanged; only wage changes will affect the burden of debt. What matters is the nominal value of their income inflows compared to the nominal value of their income outflows. Therefore, in a monetary production economy, nominal variables matter more than real variables. This does not deny that the purchasing power of money is important indeed, in period of high inflation economic agents do not want to keep money. However, in an economic system working smoothly with a normal level of inflation, the purchasing power of money is of secondary importance and, in all cases (high or low inflation), already included in nominal considerations. Economic agents pay a lot more attention to protecting themselves against insolvency rather than concentrating on the narrow problem of the purchasing power of their monetary hoards or income gains. The role of real variables should be left for historical comparison, not for current economic analysis (Keynes 1939).

One can then wonder how post-Keynesians would respond to Hahn's comment that the axiom of no monetary illusion is largely shared by economists. Monetary illusion is a different matter, it deals with the incapacity of economic agents to determine if the purchasing power of their monetary hoard has increased or not; it does not deal with what is important for economic agents in their normal economic activities. Of course, economic agents are happier if their purchasing power increases, but what really matters is the liquidity of their position. Economic agents pay a lot more attention to protecting themselves against insolvency rather than concentrating on the narrow problem of the purchasing power of their monetary hoards or income gains:

> Liquidity is a fundamental recurring problem whenever people organize most of their income receipt and payment activities on a forward money contractual basis. For real world enterprises and households, the balancing of their checkbook inflows against outflows to maintain liquidity is the most serious economic problem they face everyday of their lives. (Davidson 2002)

In period of high inflation, purchasing power matters are the main source of cash outflows and so deeply affect the liquidity of the positions of consumers, but at other times this source of illiquidity is not the main one. Nominal values are more important and inclusive of real value considerations.

7. CONCLUSION

Fisher's theory of the rate of interest cannot be applied to macroeconomic (business cycle) or microeconomic problems (it does not protect against the loss of purchasing power), and does not reflect the empirical reality. This is true both when the notion of real interest rate is taken as a condition of arbitrage or as a simple definition. Interest rates do not tend to be affected by inflation unless the central bank moves its interest rates in function of inflation. What matters for the setting of interest rates is, thus, not so much inflation, but rather the central bank policy—liquidity matters, not purchasing power. Individuals intervening in the financial markets want to avoid capital losses and problems of solvency induced by borrowing short-term for speculation, or by the need to sale to face some necessary transactions. This implies also that anticipation of long-term rates becomes of crucial importance for the determination of long-term rates, as the square rule shows. In the end, therefore, long-term rates are a function of expected short-term rates and expected long-term rates.

The preceding also implies that the notion of "real," defined in the Fisher sense, is inappropriate. What matters is the relationship between cash inflows and cash outflows, and reducing the latter to inflation is misleading (for example higher, inflation does not necessarily decrease the debt burden of debtors) and partial (they are many other sources of cash outflows).

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