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Fisher Equation and Modigliani-Cohn Hypothesis in the Financial Markets

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Abstract

Fisher equation in its conventional form suggests that nominal interest rate is the sum of real interest rate and expected inflation and, as such, it has been utilized as a standard component in economic literature to predict the behavior of nominal and real interest rates or to analyze investment returns. Nevertheless, Fisher equation has its flaws well documented in the empirical literature. This paper focuses on enriching contemporary theoretical underpinnings by paying attention to Fisher´s illusory nature of nominal interest rate, revisiting original roots of Fisher equation, and contrasting them with modern conventional form of Fisher equation. Consequently, implications will be derived for the relevance of a particular form of Fisher equation. Another important contribution is the connection of Fisher's equation with money illusion through Modigliani-Cohn hypothesis (1979). This phenomenon might be responsible for an imperfect adjustment of the interest rate to expected inflation, thereby leading to substantial implications in financial markets.

Keywords: Fisher Equation, Money Illusion, Modigliani-Cohn Hypothesis, Financial Markets, Inflation

Introduction

This paper argues that Fisher equation remains a puzzle for economists since the adjustment of nominal interest rate to changes in inflation without

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significant lags can work only in the world described by rational expectations hypothesis with perfect foresight. Empirical literature proves that the real interest rate is a lot more variable than the nominal interest rate in terms of money (Fisher, 1930; Sarte, 1998). Since Fisher equation exhibits a peculiar behavior, it raises questions about its relevance and it provides motivation for further identification of the reasons for this behavior.

The essence of Fisher equation might be effectively grasped through clear distinction of variables utilized in the original version of equation and the modern conventional version of equation. The former incorporates expected appreciation of money, whereas the latter expect goods appreciation. The devolution of conventional Fisher equation will be subject to more thorough elaboration which will help to identify key flaws that are incompatible with the original Fisher equation and standard rational expectations hypothesis. Paradoxically, conventional Fisher equation in Fisher´s sense seems to be functional for adaptive expectations hypothesis as opposed to the original effect as noted by Rhodes (2008), which suggests the inability of people to adjust promptly the nominal interest rate to change in the price level.

The main goal of this paper is to discuss the relevance of Fisher´s equation. Attention will be paid to Fisher's equation rather than illusory nature of nominal interest rate, which acquires new dimensions under the effect of money illusion, whose potential relevance has been largely dismissed by mainstream economics. However, its potential relevance was brought back to attention with the arrival of behavioral economics and the study of Shafir, Diamond, and Tversky (1997) at individual level and introduced by Fehr and Tyran (2001) at the aggregate level. Growing interest in money illusion was documented by a number of studies in various areas. Potential application of money illusion is discussed in labor markets (Bewley, 1999; Agell & Lundborg, 2003). Growing number of studies demonstrate its relation towards nominal rigidities (Vaona, 2013; Fortin, 2013). In addition, potential effect on consumer behavior was investigated (Hogan, 2013; Blinder, 1995). This is alongside its role in the context of euro introduction (Cannon & Cipriani, 2003; Bittschi & Duppel, 2015; Jureviciene & Markelova, 2016).

The connection of Fisher equation and money illusion is discussed in the context of Modigliani- Cohn hypothesis (1979), which argues that the stock market suffers from money illusion, where people tend to discount real cash flows at nominal discount rates. This also has consequences for pricing of risky stocks relative to safe stocks as suggested by Cohen, Polk, and Vuolteenaho (2005) and Bassak and Yan (2010). It seems that Modigliani-Cohn hypothesis might be partially responsible for the peculiar behavior of Fisher equation with substantial economic implications for the behavior of investors in financial markets.

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The first section of the paper will be used to discuss money illusion as a concept, which accounts for illusory nature of nominal interest rate with substantial economic implications, primarily in financial markets. The second section elaborates more on Fisher equation, which will be put under closer scrutiny, thereby making substantial distinction between the Original and Conventional Fisher´s equation. Lastly, Fisher´s equation, which incorporates money illusion, will be evaluated in the context of Modigliani-Cohn hypothesis followed by economic implications in financial markets.

Fisher's Illusory Nature of Nominal Interest Rate and Fisher Equation

To outline more thoroughly the illusory nature of nominal interest rate, it is worthy to start with illustrative example based on Fisher's book about Money illusion (Fisher, 1928).

Millions of middle-class bondholders were ruined after the World War by the fall of the German mark, the Polish mark, the Russian ruble, and the Austrian crown. An example worth the attention is a lady who was left a legacy of 50000 dollars by her father in 1892. During that time, the dollar was worth the most. The money inherited was put in trust and invested into so-called safe bonds. In 1920, when the dollar was worth the least, the lady visited the trustee together with Professor Fisher. The trustee claimed that there was only a loss of 2000 dollars out of 50000 dollars due to unwise investment made by the lady's father. He argued afterward that the principal had been left intact, apart from this minor loss, reaching a value of 48000 dollars. Fisher however argued that 50000 dollars invested in bonds was the equivalent of about 190000 dollars in 1920. The final amount was not 48000 dollars in real terms because of the depreciation of the dollar. The total loss was almost 75 percent since 48000 does not reflect the buying power of 190000 in 1920. The lady was paid rent of 2500 or 3000 a year, which was her consumption of the principal rather than income. Fisher recommended that the trustee should have adopted different investment strategy to fight against the depreciation of the principal. Thus, the concept of social injustice may be applied again since the debtors-stockholders won what the lady in this example lost.

In other words, "*Inflation has picked the pockets of bondholders and put the value into the stockholders pockets, simply through unstable value of the dollar*" (Fisher, 1928, p.79-80).

Fisher asserts that due to uncertainty in the purchasing power of the dollar, public and private businessmen act like unconscious gamblers. They are running the risk and they will either benefit or loose. Hence, losers who were subject to money illusion blame lucky winners of the lottery who won their neighbors pockets without any intend to defraud. The fault is not that of the winners who are the same unconscious gamblers like the rest of the general

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public. They only played the game which should have been stopped (Chytilova, 2018).

Based on the example above, the illusory nature of nominal interest rate is the center of focus. Fisher claimed that the effects of price level on the economy are as a result of changes in real interest rate, which are given by incomplete perception of changing price level and by wrong price expectations held during the time the loan or nominal contract was signed. He mentions the so-called "peculiar behavior of the interest rate", which is largely responsible for the crises and depressions through price movements (Fisher, 1913, p. 56, cited in Dimand, 1993). Money illusion is again the factor which is responsible for this peculiar behavior (Chytilova, 2018).

Fisher describes the situation of the borrower and debtor, whose relationship should be kept the same during rising prices, as before and after. Not only do lenders require higher interest rates, but borrowers are also capable of paying higher interest rates. This however requires higher nominal interest rate than the stationary prices require. Unfortunately, men tend to consider the dollar as a stable thing regardless that the time and the process of adjustment are really slow and imperfect. This is further strengthened by law and custom, keeping the interest rate down (Fisher, 1913, p. 57-58).

According to Fisher (1913), when prices are rising, "the rate of interest rises but not sufficiently". On the other hand, when prices are falling, "the rate of interest falls but not sufficiently" (Fisher, 1913, pp. 60, 68). The insufficient adjustment of nominal interest rate was attributed to confusion between nominal and real variables.

If there were a better appreciation of the meaning of changes in the price level and an endeavor to balance these changes by adjustment in the rate of interest, the oscillations might be very greatly mitigated. It is the lagging behind the rate of interest which allows the oscillations to reach so great proportions. Marshall says on this point: "The cause of alternating periods of inflation and depression of commercial activity is intimately connected with those variations in the real rate of interest which are caused by changes in purchasing power of money". Fisher (1913, pp.71-72), Marshall (1907, p.594), and Fisher (1896, p.79) gave a fuller quotation of the same passage from the 1895 edition of Marshall's Principles, cited in Dimand (1993).

If the public would correctly perceive and anticipate price changes, it would not affect real interest rate and consequently economic activity. According to Dimand (1993), Fisher did not suppose that borrowers dispose more precise information, only that they perceive an increase in money receipts, inducing them to borrow even more, before they find out that the purchasing power had changed. The same holds for lenders who observe rise in demand for loans and only later realize that the price level has changed (Chytilova, 2018).

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As a result, the famous Fisher equation relating the nominal interest rate to the real interest rate was then, according to him, an imperfect description of the real world. It could only work in the world with "foresight", which is very close to rational expectations, as emphasized by Thaler (1997). Extensive empirical research of Fisher (1930) proved a very slow adjustment of the nominal interest rate to changes in inflation and with very long lags. Thaler (1997) or Dimand (1993) indicate that Fisher was a pioneer in inventing distributed lag econometrics. Thaler (1997) analyzed interest rates in five markets (London, New York, Berlin, Calcutta and Tokyo) and concluded that the real interest rate in terms of commodities is from seven to thirteen times as variable as the nominal interest rate in terms of money. Therefore, this shows the inability of people to adjust promptly the nominal interest rate to changed price level (Chytilova, 2018).

This finding might be closed by poignant statement: "Erratic behavior of real interest is evidently a trick played on the money market by the money illusion," (Fisher, 1930, p.415).

For instance, it is interesting to add that Rutledge (1977) claimed that Fisher did not interpret the lag between inflation and the full adjustment of nominal interest rates in terms of inflation expectations. He neglected Fisher's book, the Money illusion (1928), showing that Fisher believed that real interest rates depend on past inflation during the period of transition. As Dimand (1993) pointed out, this view is consistent with changes in real interest rates due to slow perception and adjustment of inflation expectations (the nominal interest rate lagging behind the inflation) in Fisher's sense (Chytilova, 2018).

Fisher Equation Revisited

Another phenomenon which has not been mentioned yet might serve as the summary of the erratic behavior of Fisher´s effect. It is crucial to emphasize that Fisher´s equation is not represented by a single equation, but it is essential to distinguish between the original Fisher´s equation and conventional Fisher´s equation as noted by Rhodes (2008).

The original Fisher equation which puts emphasis on theory of rational expectations is described by a key phenomenon called expected appreciation of money. It is evident that the reason for inclusion of this variable is clear based on Fisher´s illustrative example on page 3. Expected appreciation of money is defined as the real return of money (Eden, 1976) and is incorporated in the equation through the expectation's operator *E, i.e., expectations over the value of money E (1/P)*. Supposing that the value of goods is P, then the value of one unit of money v is 1/P. Derivation of original Fisher equation is demonstrated with two period present value model shown below, which neglects taxes and risk neutrality for simplicity (Fisher, 1906; Rhodes, 2008).

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A contract in the economy is described by future payment in paper money (dollars). The present value $P_{B,t}$ of the future money benefit (D) sold at discount at time *t* and at nominal interest rate *i* (expressed in fiat money) is expressed as:

$$P_{B,t} = \frac{D_{t+1}}{1+i} P_{B,t} = \frac{D_{t+1}}{1+i} \quad (1)$$

Similar contract is expressed in bushels B for commodity money (for instance wheat). If consumer is supposed to be indifferent between these two contracts, the number of dollars D required in the money contract must be equal to the number of bushels B paid. Expressing these contracts in future value, the real commodity value of future real money payments $D_{t+i} E v_{t+i} D_{t+i} E v_{t+i}$ equals to the number of future commodities B_{t+1}. Suppose that *j* is the commodity rate of interest and *v* is the terms of trade between money and commodities, the real present value in a commodity standard of a future fiat money payment is expressed as follows:

$$P_{B,t} v_t = \frac{D_{t+1} E v_{t+1}}{1+j} P_{B,t} v_t = \frac{D_{t+1} E v_{t+1}}{1+j} \quad (2)$$

Plugging the price of the asset from (2) to (3) after an adjustment yields:

$$\frac{1+i}{1+j} = \frac{1}{1+a} \frac{1+i}{1+j} = \frac{1}{1+a} \quad (3)$$

After adjustment, this leads to the equation describing the original Fisher effect which expresses a relationship between the nominal interest rate and expected appreciation of money:

$$j = i + a + iaj = i + a + ia \quad (4)$$

where *j* is the ex-ante real return, *i* is nominal interest rate, $a = (E v_{t+1} - v_t / v_t a = (E v_{t+1} - v_t / v_t$)

a is the expected appreciation of money and *ia* is neglected for its small values which results into near one-to-one relationship.

The ex- post real return *j** is present in the Fisher´s identity which is distinct from Fisher original equation:

$$j* = i + a * + ia * \quad (5)$$

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Where i is nominal interest rate, $a *= (v_{t+1} - v_t / v_t a *= (v_{t+1} - v_t / v_t$) is the actual appreciation of money, and $ia * ia *$ is neglected for its small values.

In summary, Fisher original equation incorporates the realized ex-ante real return *j*, whereas Fisher identity works with ex-post real return *j**. The question arises about compatibility of Fisher equation and Fisher identity as noted by Rhodes (2008). In a perfect world as described by rational expectations hypothesis with perfect foresight, it holds that ex ante appreciation of money *a* is equal to ex post appreciation *a**. Hence, this implies that the ex-post real return *j** is equal to the ex-ante real return *j*. However, in the world described by uncertainty with imperfect foresight, the ex-post real return *j** differs from the ex-ante real return *j* in general.

In contrast, *conventional Fisher equation* is described as follows (Mankiw, 2007):

$$i = r + \pi + r\pi \, i = r + \pi + r\pi \tag{6}$$

Where *i* stands for the nominal interest rate, *r* is the ex-ante real interest rate determined by loanable funds market and expected inflation. This is because the nominal interest rate agreed by lender and borrower can adjust only for expected inflation. Expected goods inflation (percent change in E(P)) is defined as EP_{t+1}-$P_t/P_{t,}$ (Rhodes, 2008).

The value $r\pi$ is negligible and is thereby omitted. This leads us to well-known form:

$$i = r + i = r + \pi^e \tag{7}$$

According to the Conventional Fisher Equation (CFE), the nominal interest rate *i* is a linear function of the ex-ante real interest rate *r* and expected inflation of one-to-one relationship for small values of expected inflation. The conventional Fisher equation is derived from identical framework like the original Fisher equation by incorporating expectations over the value of goods E(P) and expected inflation with respect to the current price level, $\pi = (EP_{t+1} - P_t)/P_t \pi = (EP_{t+1} - P_t)/P_t$ (Rhodes, 2008).

At first sight, it might seem that the conventional Fisher equation might be easily considered as substitute for the original Fisher equation. This is because the original Fisher equation deals with the expected appreciation of money *a*, the commodity real interest rate (ex-ante real return) *j* and nominal interest rate. However, these equations sharply differ in few elements as demonstrated

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by Rhodes (2008) and might be compatible only under special conditions. Some studies such as Hirschleifer (1970) attempted to make a distinction by marking anticipated inflation with the letter "a" to contrast it to Original Fisher equation. First, the interactive terms $r\pi$ and $-ia$ are different and also variables reflecting expected appreciation π and $-a$ are different. Additionally, the reference point which represents the appreciation of money is expressed as the current value of money v_t in Original Fisher equation, whereas in conventional Fisher equation as the future value of money v_{t+1}.The compatibility of two Fisher´s equations might be ensured by the delineation of common ex-post real return equality (j*=r*) which is the case when inflation expectations are in line with the actual (ex-post) inflation. The compatibility is ensured upon satisfying two conditions:

1. Perfect certainty ensures that the current and future price level is known.
2, A common point of reference regarding the appreciation of money is used.

However, due to uncertainty, expected appreciation of money is not equal to expected deflation $-\pi$ due to Jensen´s inequality. The Original Fisher equation was derived by taking expectations over the value of money $\left[E\left(\frac{1}{P}\right)\right].\left[E\left(\frac{1}{P}\right)\right].$

The conventional Fisher equation was derived by taking expectations over the value of goods $E\,(P) E\,(P)$ in the model above. Jensen´s inequality implies that $E\left(\frac{1}{P}\right) \geq \frac{1}{E(P)} E\left(\frac{1}{P}\right) \geq \frac{1}{E(P)}$ holds for a non-degenerate random variable (P) under uncertainty. This formula stems from the original Jensen´s inequality which emphasizes the difference between arithmetic $A(P) A(P)$ and harmonic mean $H(P).H(P) = 1/[A(1/P)$ $H(P).H(P) = 1/[A(1/P)$ $A(P) \geq H(P) = 1/[A(1/P)]$ and $A(P) \geq H(P) = 1/[A(1/P)]$.

This implies: $A(1/P) \geq 1/A(P)\, A(1/P) \geq 1/A(P)$

Replacing the arithmetic operator by expectation operator yields: $E(1/P) \geq 1/E(P) E(1/P) \geq 1/E(P)$. Here, expectation of P described by $E(P)\, E(P)$ is a weighted average of individual prices with the weights of individual prices being probabilities that sum to one. All in all, for

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a given interest rate, the ex-ante real return is different $j \geq rj \geq r$ (Rhodes, 2008).

Incorporation of conventional Fisher´s equation in analysis of financial markets is a standardized procedure. Nonetheless, it provides a biased estimate of the relationship between nominal and real interest rate in times of uncertainty about future prices despite rational expectations. Once the size of bias is reasonably small (i.e., rational expectations hypothesis holds as already mentioned in Chapter 1), the conventional Fisher equation is good approximation to the original Fisher equation. However, the size of the bias is determined by many factors such as the price level volatility (Sarte, 1998) and long expectations horizons (McCulloch & Kochin, 2000) or individual expectations. As a result, it is highly desirable to avoid inflation-uncertainty bias by writing Fisher´s relationship in terms of the expected value of money E(1/P) as suggested by Fama (1975, 1976) or Rhodes (2008). Inclusion of this component brings us back to the Original Fisher equation. Still, conventional Fisher equation is very popular in research literature despite providing biased estimate as suggested by Rhodes (2008) and Sarte (1998).

Money Illusion and Conventional Fisher Equation

Paradoxically, economists work with conventional Fisher equation, which has its roots in Fisher´s empirical observation of market participants. Thus, its complex psychological behavior significantly affects outcomes through money illusion and imperfect foresight. Such version which would take into account psychological factors has never been formalized mathematically. Modern version of money illusion that has the inability to distinguish between nominal versus real values is well documented by Fehr and Tyran (2001) or Shafir, Diamond, and Tversky (1997). Fisher´s style of money illusion of that time was about the inability to accurately predict the behavior of the nominal interest rate using a backward-looking specification together with proper measurement of money value. As Rhodes (2008) suggests, measurement problems associated with money value are represented by Patinkin´s money illusion (in Fisher´s language if people fail to adjust the yardstick with the changing size of the king´s girdle and measurement problem is not eliminated by pure realization that the yardstick changes) and Jensen´s inequality problem (using an improper yardstick for computation of the actual and expected rate of change in the king´s girth/money value).

Crucial component in transition from original Fisher equation to conventional Fisher equation is expected in appreciation of money, which stands for the rate of change in the value of fiat money expressed in commodities, thereby reflecting the real return on money. Fisher claimed that the direct impact of expected appreciation on nominal interest rates would be limited and the effect of commodity price changes would be indirect and lagged due to the presence of money illusion and imperfect foresight. Based on empirical observations, Fisher concluded that expected appreciation shall be replaced by lagged inflation (Rhodes, 2008). Implicit form of conventional Fisher equation incorporates money illusion and proper measurement of expected money value on the basis of distributed lag model of inflation (Fisher, 1930). Here, expected money appreciation is replaced by goods appreciation π.

As a result, Rhodes (2008) suggests that analysis employing backward-looking expectations should be more accurate once using conventional Fisher equation which exhibits features of inflation psychology. It is worthy to note that by the early 70´s, Fisher´s distributed lag model of inflation was considered to be the model based on the adaptive expectations hypothesis. This brings us back to Rutledge (1977) who noted that the interpretation of lag between inflation and nominal interest rate was not based on expected inflation. Despite the fact that modern approach to conventional Fisher equation puts emphasis on forward-looking forecasts of goods prices and it attempts to superimpose the rational expectations hypothesis, it is not compatible with the view of Fisher. If people would be able to measure correctly expected money value and would possess unbiased expectations free of money illusion, there would be no dispute about the proper version of Fisher equation. However, Fisher (1930) empirically proved imperfect adjustment of the nominal interest rate to changes in inflation with substantial lags. He gives an example during the period of 1896 to 1920, when the real rate of interest was wiped out, whereas in 1921 in a period of deflation, the nominal interest rate adjusted incompletely and the real interest rate rose as high as 60%. A period of deflation followed by resulting rise in real interest rate was formulated explicitly by Fisher to affect aggregate production and employment, and thereby strengthening the severity of the Great Depression.

Fisher Equation, Money Illusion, and Modigliani-Cohn Hypothesis

Conventional Fisher equation, which incorporates money illusion, might also substantially affect stock returns in financial markets. The study uses Modigliani and Cohn (1979) famous hypothesis to emphasize this aspect. The issue of money illusion in financial markets is rather topical as confirmed by the studies of Ritter and Warr (2002), Lee (2010), Acker and Duck (2013, a,b), Basu, Markov and Shivakumar (2005), and Chordia and Shivakumar (2005). Also, money illusion in financial markets was also experimentally confirmed by the study of Noussair, Richter, and Tyran (2008) with substantial implications on investor´s behavior. According to this hypothesis, investors are unable to free themselves from certain forms of money illusion and tend to price equities in a way that fails to reflect their real economic value. In

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particular, investors in times of inflation discount real stock cash flows at a rate which parallels the nominal interest rate rather than real interest rate. As a result, stock market prices are undervalued in times of high inflation and overvalued in times of low inflation. Investors partially overlook inflation since the cost of this negligence is small at first. However, still mainstream economists could argue that it is rather controversial to assume the presence of money illusion in the market due to high stakes at stock market which should quickly arbitrage away any signs of money illusion and alternative explanations such as proxy effect are needed.

Cohen, Polk, and Vuelteenaho (2005) consider whether a small number of wealthy and rational arbitrageurs (compared to majority of nominally confused stock investors) might eliminate any potential mispricing induced by money illusion. Basically, any attempt of the investor to correct the mispricing exposes him to the uncertain development on the stock market. Slow correction of mispricing requires long holding periods for arbitrage position. This is along with the fact that the variance of the risk grows linearly with time as the investor is significantly exposed to volatility. As Modigliani and Cohn (1979) emphasize, if a rational investor had bet against money illusion in early 1970s and could correctly assess the extent of the undervaluation of equities, he would suffer from substantial loss for more than a decade. As a result, arbitrage activity is prevented in this sense. In this sense, strategic complementarity in vein of Fehr and Tyran (2001) might intensify undervaluation of stock prices in case of high inflation despite the fact that majority of investors is rational.

Even empirical evidence confirms the possibility that the market tends to exhibit money illusion of Modigliani-Cohn type. Cohen, Polk and Vuelteenaho (2005), Brunnermeier and Julliard (2008), Engsted and Pedersen (2016), and Campbell and Vuelteenaho (2004) confirm a negative relationship between price-dividend ratio and inflation based on backward-looking inflation expectations. It is interesting to note that Modigliani-Cohn hypothesis is limited only to the presence of money illusion in the stock market. However, Bassak and Yan (2010) provide a proof that money illusion seems to be relevant also in bond market. By bringing back the Fisher's relation mentioned in the beginning (Fisher, 1930; Thaler, 1997) stating that nominal interest rate moves one-for-one with expected inflation, it is inconsistent with the aforementioned Modigliani-Cohn negative relationship. In other words, the expected nominal rates of return of assets expressed as a sum of the expected inflation and the ex-ante real return should provide a sufficient hedge against inflation, which implies a positive relationship between stock returns and inflation. Thus, investors are thereby compensated for the loss in purchasing power due to inflation (Gavriilidis & Kgari, 2016). Unfortunately, this is not the case. It has already been mentioned that

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conventional Fisher equation might not represent a good description of reality, which supports again our hypothesis that it is money illusion that is responsible for a rather imperfect working of this conventional equation in reality. Furthermore, it is worthy to note that some studies such as Boudoukh and Richardson (1993) and King and Watson (1997) are consistent with the expected direction of Fisher´s effect in the long run, which suggests that investors will in the longer horizon find out their deception and uncover veil of nominal values. There is a vast amount of other literature on Fisher´s effect which will not be elaborated for the sake of clarity and accuracy of the paper such as Yeh and Chi (2009), Lintner (1975), Gultekin (1983), Schwert (1977), and Svedsater, Gamble and Garling (2007).

Some studies attempt to find alternative explanation for the imperfect working of Fisher equation such as risk premium (Cohn & Lesard, 1980). Risk premium might be a potential factor responsible for negative relationship between capitalization rates and inflation, since inflation affects the value of equity, because it affects the risk premium. Naturally, question arises why profits should be riskier with a steady six percent inflation than with a steady two percent inflation (Modigliani & Cohn, 1979). Moreover, risk premium hypothesis seems to be identical to money illusion hypothesis because changes in inflation change equity values as they also change the risk premium. As a result, the only difference between these two hypotheses is that in the case of money illusion, investors will start to see through the veil of nominal values and inflation will no longer depress market values. In addition, proxy effect might play a negative role in the relationship between inflation and the price of stocks (Brunnermeier & Julliard, 2008). In other words, inflation serves as proxies for some unidentified real macroeconomic variable which drives fundamental stock values. In this particular case, high inflation or high inflation expectations are a bad signal about future economic development. Logically, higher inflation is associated with riskier environment or higher risk aversion, generating a risk premium, which is correlated with inflation. In other words, inflation and or inflation expectations is a proxy for risk aversion (Fama, 1981).

The negative relationship between stock returns and inflation is attributed to the tax effect and high effective corporate tax rate on corporate income (Feldstein, 1980; Cohn & Lesard, 1980). Chen, Lung, and Wang (2009) propose apart from money illusion an alternative hypothesis called the resale hypothesis. They empirically prove that both money illusion and resale hypothesis are relevant explanation in explaining the level of stock mispricing. However, the resale hypothesis appears to have better explanatory power in case of high or volatile price level.

Geske and Roll (1983) tackle the issue of reverse-causality. In their view, the interaction of the fiscal and monetary policy is responsible and

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changes in stock prices once future economic activity is anticipated are highly correlated with government revenues. Once economic activity declines followed by government deficit, monetary policy will try to balance the budget by expanding the monetary base followed by inflation. This leads to a negative relationship between stock returns and inflation.

Cohn and Lessard (1980) control for the risk premium analysis reveals that money illusion clearly dominates not only risk premium factor but also a tax effect. Cohen, Polk, and Vuolteenaho (2005) present advanced tests which detach money illusion from investor´s attitudes towards risk. Findings suggest that expected inflation does not proxy for future output movements or for the higher risk aversion but instead strengthen the relevance of money illusion. In contrast, Schmeling and Schrimpf (2008) consider money illusion and the proxy hypothesis as competing hypotheses rather than joint hypotheses but still achieve similar results compatible with money illusion. Chen, Lung, and Wang (2009) confirm the significance of money illusion and also strong case for resale hypothesis in case of high or volatile price level.

In general, available literature suggests that money illusion is a prevailing phenomenon and overweighs clearly alternative effects.

Modigliani-Cohn hypothesis (1979) suggests that even knowledgeable investors found it surprising that the appropriate capitalization rate may become negative with sufficiently high inflation. If this view is accepted, it cannot be ruled out that apart from investors, lending institutions and business managers are also affected. In turn, the presence of money illusion has significant implications for firm´s behavior and resulting profits. Furthermore, it appears that money illusion is highly probable in case of price level fluctuations, which is in line with the results of Cohn and Lessard (1980) and Cohen, Polk and Vuolteenaho (2005), whereas undervaluation will be noted by investors in case of stable price level.

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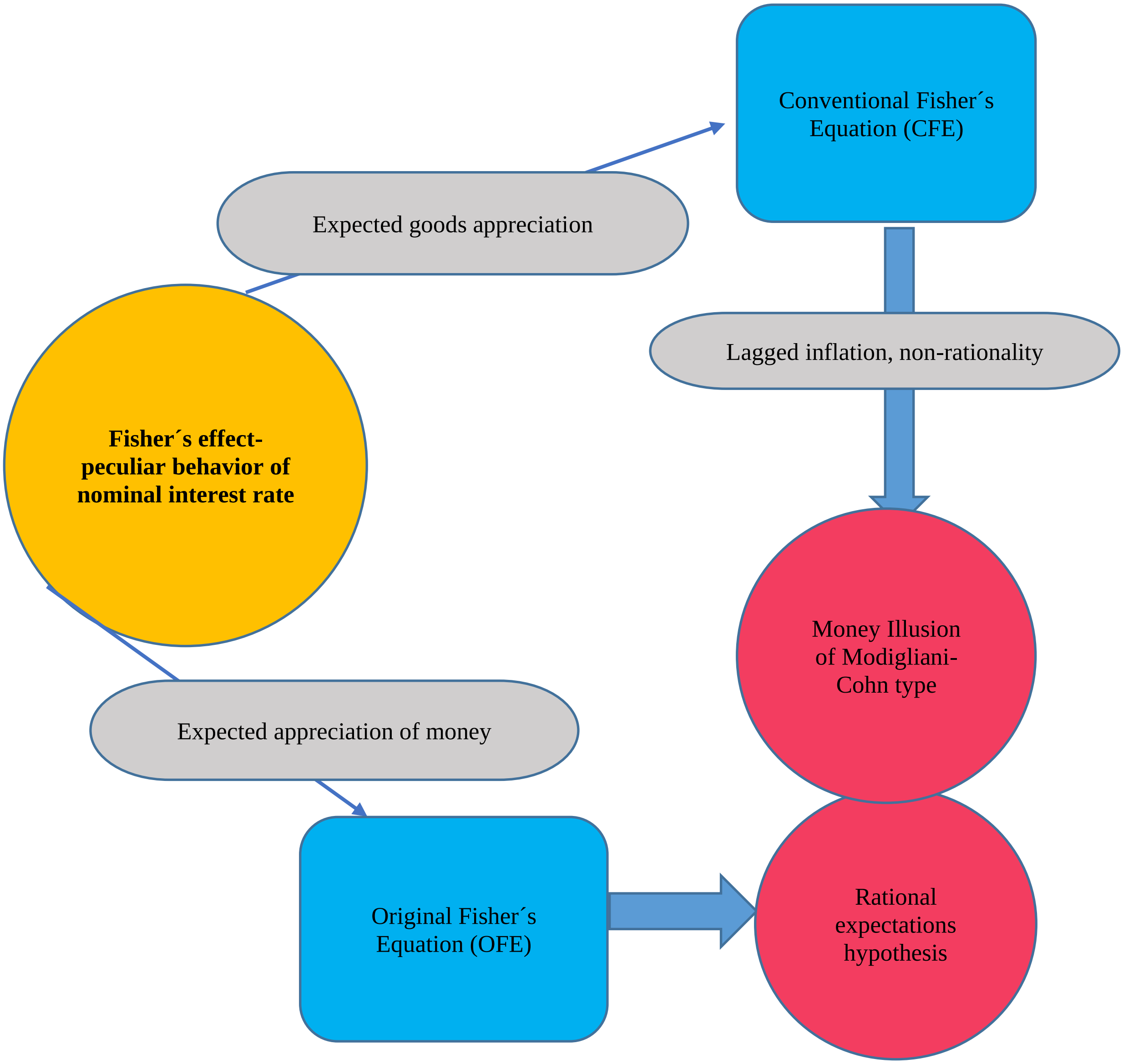

Figure 1. Fisher´s Effect and Modigliani-Cohn Hypothesis
Source: Author´s own contribution, inspired by Rhodes (2008) and Modigliani-Cohn (1979)

Conclusion

The main aim of this paper was to evaluate the relevance of Fisher equation in the context of resurrected concept of money illusion, which is extensively applied in the financial market literature.

Firstly, it was discussed that Fisher equation which relates nominal interest rate to the real interest rate is rather an imperfect description of the real world. In particular, the real interest rate is more of a variable than

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nominal interest rate, which is lagging because of the inability of nominally-blinded individuals to adjust nominal interest rate towards changes in price level. This raises questions about the relevance of Fisher equation which might be partially flawed.

As a result, the discussion in the second section was devoted to more thorough analysis of original Fisher equation and modern conventional form of Fisher equation which might not be considered as substitutes but rather competing phenomena. Paradoxically, conventional Fisher equation might provide a biased estimate of the relationship between nominal and real interest rate in times of uncertainty about future prices, and it is incompatible with rational expectations hypothesis. This is due to incorporation of goods inflation instead of expected money appreciation.

Finally, Fisher equation is applied within Modigliani and Cohn hypothesis where investors are unable to free themselves from certain forms of money illusion and tend to price equities in a way that fails to reflect their real economic value. In particular, investors in times of inflation discount real stock cash flows at a rate which parallels the nominal interest rate rather than the real interest rate. Instead of considering real returns, they consider the nominal return on bonds. Investors fail to correct reported accounting profits for the gain of stockholders accruing from depreciation in the real value of nominal corporate liabilities. In particular, the elaboration of money illusion effects in the literature appears to be inconsistent with the expected direction of Fisher's effect, but it is logical due to the illusory nature of nominal interest rate and the prevailing money illusion. Moreover, it shows that conventional form of Fisher equation might be puzzling in financial market and might provide biased estimate of the relationship between nominal and real asset yields in an environment of rational expectations characterized by uncertainty about future prices (Rhodes, 2008; Benniga & Protopapadakis, 1983; Blejer & Eden, 1979). As it has already been mentioned above, the conventional form is valid and close to the original equation only if the size of bias is reasonably small, which is a risky assumption in the real world characterized by imperfections.

This paper also accounted for studies whose results are in line with expected working of Fisher equation and whose findings are not inconsistent with money illusion. The study emphasized that undervaluation of stock prices in case of high inflation might be intensified through the channel of strategic complementarity, despite the fact that majority of investors is rational. However, the existence of money illusion where valuation of an asset by agent is inversely related to the overall level of inflation in the economy is hard to swallow in light of efficient market hypothesis.

As a result, various alternative effects were discussed in line with rational concept which might be responsible for this development in financial

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markets. Proxy affects, where inflation proxies for risk aversion, the resale hypothesis or the tax-effect hypothesis and others. Based on the investigation of available research, it was found that more or less studies successfully isolate these effects and finds the role of money illusion to be non-negligible.

In conclusion, it is worthy to emphasize that the relevance of this topic is undisputable despite the fact that money illusion is presumed to be nonexistent based on rational expectations theory. Instead, this represented a challenge to provide the reader with relevant arguments based on behavioral economics which provides resurrection to Modigliani-Cohn hypothesis and conventional Fisher´s effect described by money illusion.

Additionally, it is extremely difficult if not impossible to gather data which would entail the concept of money illusion in financial markets. Also, many empirical studies, which work with the real data, fail to isolate this effect due to the presence of other effects such as resale hypothesis and tax effect.

As a result, one of the suggestions for our future research is the evaluation of Modigliani-Cohn hypothesis in experimental settings directly in the laboratory. Hence, this would enable us to gather these special data, isolate the effect of money illusion, and thereby provide evidence about the illusory nature of Fisher´s effect in financial markets.

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