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The Notion of Money Illusion and Its Development in Economics

Master's thesis

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I declare on my honour that I wrote this master's thesis independently, and I used no other sources and aids than those indicated.

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Abstract

This thesis maps development of money illusion through the history of economic thought and analyzes relevance of the concept in these days. The story begins in 1928 with Irving Fisher, who saw money illusion as a failure to perceive changes in purchasing power of money. Different notion was developed by John Maynard Keynes when he proposed a non-homogeneous labor supply. In the 1970s, the success of rational expectations theory led to a dismissal of the original theories of money illusion and Tobin's critique revealed also an inconsistency of the Keynesian notion. Since then, money illusion lost its position in the mainstream economic science. The modern theories were, however, able to align money illusion with rational expectations and provided the phenomenon with a psychological framework. Money illusion became described as a tendency to think in nominal rather than real terms. While the concept was revived as a part of behavioral and New Keynesian economics, the question of its aggregate effects remains as the Keynes' inconsistency have not been resolved until these days.

Keywords:

Money Illusion, History of Economic Thought, Non-neutrality of Money, Inflation Expectations, Phillips curve

JEL classification:

B20, D84, E52

Abstrakt

Tato diplomová práce mapuje vývoj peněžních iluzí v historii ekonomického myšlení a analyzuje relevanci této myšlenky v současné době. Příběh začíná v roce 1928 Irvingem Fisherem, který popsal peněžní iluze jako neschopnost vnímat změny v kupní síle peněz. Odlišnou koncepci vyvinul John Maynard Keynes, když přišel s nehomogenní nabídkou práce. V 70. letech 20. století vedl úspěch teorie racionálních očekávání k zamítnutí původních teorií peněžních iluzí a Tobinova kritika navíc odhalila nekonzistenci Keynesova pojetí. Od té doby ztratily peněžní iluze místo v hlavním proudu ekonomie. Moderním teoriím se ale podařilo smířit peněžní iluze s racionální tvorbou očekávání a poskytnout tomuto fenoménu psychologický rámec. Peněžní iluze začaly být popisovány jako tendence uvažovat spíše v nominálním než reálném vyjádření. Zatímco se ale koncept podařilo oživit jako součást behaviorální a Nové Keynesovské ekonomie, otázka jeho agregátních efektů přetrvává, neboť Keynesovu nekonzistenci se dodnes nepodařilo vyřešit.

Klíčová slova:

Peněžní iluze, dějiny ekonomického myšlení, ne-neutralita peněz, inflační očekávání, Phillipsova křivka

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Pojetí peněžních iluzí a jeho vývoj v ekonomii

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Introduction

What is money illusion? This thesis tries to answer the question by mapping the development of its notion in economic science. This concept, mainly recognized as one of the explanations of money non-neutrality, underwent many transformations since its origination in the 1920s. However, in order to understand the modern theories of money illusion and its proposed effects, it is important to comprehend the history of the thought together with the problems it was facing through different stages of development.

The story begins with Irving Fisher (1928), who devoted a whole book to the phenomenon and started to call it money illusion. This book, filled with numerous examples of money illusion in human life, also came up with the first definition of the phenomenon. Fisher's somewhat narrow view described it as a failure to perceive changes in the value of money. As a result, Fisher demanded stability of monetary units to prevent adverse effects of money illusion. Although his theory was later described as naive, it offered a number of insights into human behavior, which were later developed by other authors and used to achieve a coherent theory based on psychological framework of money illusion.

A different concept of money illusion was developed in 1930s by John Maynard Keynes (1936). Money illusion, in his view, was present on the supply side of the labor market causing workers to stipulate for nominal rather than real wage. His theory of the non-homogeneity of labor supply did not result in the requirement of the stable money. On the contrary, Keynes interpreted it as an opportunity to raise the aggregate demand function and increase employment.

The inflation-unemployment trade-off in form of the Phillips curve became inseparably bound to money illusion. In his famous presidential address to the American Economic Association, Milton Friedman (1968) provided it with rationale using adaptive expectations hypothesis. According to Friedman, money illusion caused agents to evaluate the nominal wages at previous level of inflation and fail to perceive when it changes. An increase in monetary growth, which leads to a temporary discrepancy between the ex ante and ex post values, may then have a short-run impact on the level of employment. However, Friedman denied the long-run possibility to increase employment without the cost of accelerating inflation.

The era of recognition of money illusion ended in the 1970s, when rational expectations hypothesis was introduced and the concept of irrationality became perceived as incompatible with the maximization behavior of economic agents. It denied the role

of money illusion together with its aggregate effects. Other factors as informational frictions, long-term contracts or cost of price adjustment replaced it as the rationale for money non-neutrality. Moreover, Tobin's (1971) critique decomposed even the money illusion in Keynesian labor supply. He pointed out the inconsistency provided by the assumption that only one side of one market suffers from money illusion. The problem was that incorporating money illusion to other demand and supply functions destroyed Keynes' argument about its macroeconomic consequences.

As a result, money illusion disappeared from the economic literature for almost 20 years. It returned thanks to a survey from a field of behavioral economics by Shafir, Diamond and Tversky (1997). The authors revisited many aspects of money illusion previously mentioned by Fisher and incorporated them into their psychological framework. They redefined money illusion as a tendency to think in terms of nominal rather than real monetary values. Subsequently, the experiment by Fehr and Tyran (2001) revived the discussion about its aggregate effects by linking it with strategic uncertainty. The Keynesian conception of money illusion found its followers in the theory of near-rational agents by Akerlof et al. (2000), who tried to bring back the non-vertical long-run Phillips curve.

The renewed interest led to a number of improvements of the money illusion theory. The rational expectations theory was incorporated and inflation as the only source of irrational behavior was suppressed. The psychological framework shed some light on the causes for departures from perfect rationality. Moreover, employing the strategic complementarity allowed even small levels of individual money illusion to have large aggregate effects. All of this leads to a conclusion that money illusion, though it left the mainstream over the years, remains an active part of the economic thinking.

As a consequence, number of both theoretical and empirical works emerged recently, incorporating the money illusion concept and exploring its various effects, especially at individual markets. However, it is important to note that the inconsistency in the Keynesian labor supply has not been properly resolved yet and until then money illusion in the traditional view remains only an ad-hoc explanation of the non-vertical Phillips curve. The possible aggregate effects appear to stem rather from the strategic complementarity as proposed by Fehr and Tyran.

The remainder of this thesis is organized as follows: the first chapter provides a detailed understanding of the old-fashioned theories of money illusion. The second chapter discusses the dismissal of the concept from economic literature and introduces related competing theories. The revival of money illusion and the understanding of the recent works on this topic is provided by chapter three. The fourth chapter discusses success of the new theories when dealing with the previous problems of the money illusion concept and provides a closer look on the inflation expectations data from the Czech Republic. The last part concludes.

1. The Recognition

“We have standardized every other unit in commerce except the most important and universal unit of all, the unit of purchasing power.”

– Irving Fisher, 1913

This chapter first presents the view on the phenomenon of money illusion expressed by I. Fisher in the time of the first recognition of this concept. It also outlines some of the linkages between his theory and more recent works on that subject, which will be described more in depth in subsequent chapters of this thesis. Then, the definition of money illusion ascribed to W. Leontief is introduced. The presence of this concept in the work of J. M. Keynes is then discussed in the context with his definition. Finally, the origination of the relation known as the Phillips curve is presented, as it is an important part of the discussion concerning money illusion. The theoretical underpinning of the Phillips curve, which was delivered later by M. Friedman, is also discussed together with its implications.

1.1 Irving Fisher’s Money Illusion

The recognition of the phenomenon of money illusion dates back to Fisher and his book *Money Illusion* (1928). The aim of the book was to show the instability in buying power of monetary units. Although Fisher mentions number of articles and books dealing with the subject of unstable money before him, it is his book that can be accounted for the introduction of the term “money illusion” into economic science.

While Fisher’s book primarily brought attention to the existence of money illusion, it did not present a coherent theory relying on this phenomenon. It merely illustrated the frequent occurrence of money illusion by a number of observations from Fisher’s life and discussed its possible consequences. One exception is a short sequence that explained the business cycle as an indirect effect of money illusion. Subsequently, various elements of this book were elaborated by different authors and schools of economic thought. For those reasons, this section mainly focuses on Fisher’s influence as his major contribution to the theory of money illusion.

Money illusion was defined by Fisher (1928, p. 4) as “the failure to perceive that the dollar, or any other unit of money, expands or shrinks in value.” This somewhat narrow view on money illusion actually captures its substance quite well even in comparison with more recent definitions. For instance, according to Shafir, Diamond and Tversky (1997, p. 341), money illusion “refers to a tendency to think in terms of nominal rather than real monetary values.” In the core of both of these definitions lies the discrepancy between the nominal and real monetary units. Both also mention the inability of people to see through the veil of money. The early definition by Fisher, however, indicates that people may be fully unconscious of inflation and its effects on the purchasing power of money. That conjecture does not appear in the modern views of money illusion.

Fisher's emphasis on the changing purchasing power of American dollar, German mark and other currencies stemmed from its fluctuations caused by World War I. In his experience, people were more likely to perceive the changes in value of other currencies than in their own. In the case their money fell in value, they were inclined to think of it as if the value of other goods increased.

He argued that this problem was intensified in the United States by the presence of gold standard. Due to that, dollar appeared to be fixed while its buying power fluctuated. In fact, the fixation of dollar to gold stabilized it only in terms of weight, not in terms of buying power. Or as Fisher (1928, p. 18) put it: “It follows that our dollar could be used accurately for weighing sugar, but it cannot at present be used, with accuracy, for measuring value. This fact nevertheless is hidden from us by the Money Illusion.”

Fisher (1928, p. 73) also noticed that not only the distinction between nominal and real income is hidden by the money illusion, but people also fail to perceive the real interest rate concealed by its nominal representation. In times when the growth rate of price level exceeds the interest rate, it may even cause savers to lose part of their principal instead of being rewarded for their thrift. Although Fisher did not recognize possible reasons making savings rational even under those circumstances, he correctly brought attention to the fact that money illusion may concern also interest rate. Subsequently, more elaborate views on the confusion of real and nominal interest rate were developed. It was empirically tested in the stock market by Modigliani and Cohn (1979), who suggested that real cash flows are often mistakenly discounted at nominal rates. This study was then followed by another empirical work on that subject (Cohen, Polk, and Vuolteenaho 2005), where authors included also risky assets and further tested the original hypothesis. The idea that people may incorrectly follow the nominal interest rate when estimating real cost was even more recently tested in the housing market (Brunnermeier and Julliard 2008).

Another interesting observation of Fisher was that people tend to think they are making profit even when the gain is only illusory and they are actually experiencing a real loss. He illustrated that with an example of a German shop woman from the times when German mark had depreciated by more than ninety-eight per cent due to inflation. This woman sold him a shirt under its current price and she explained her action by saying that she had originally bought that shirt for less so she had still made

profit (Fisher 1928, pp. 6–9). Since the price she charged was not enough to replace the shirt under new price level, her profit was merely nominal and she experienced a loss in real terms. This particular way of assessing transaction was later thoroughly examined from the point of view of behavioral economics in the survey of Shafir, Diamond and Tversky (1997).

In contrast, Fisher explains, a man's real income is determined by two factors: the nominal amount of income and its purchasing power. The reason money changes in its purchasing power is the circulation of money in relation to the volume of goods. This is what Fisher (1928, p. 31) calls *relative* inflation and deflation – inflation and deflation related to the volume of trade in given period. In Fisher's (1928, p. 39) view it is because of money illusion that the money side of the market is assumed to be of minor importance although it usually varies greatly, especially compared to the variability of the goods side, and causes the value of money to fluctuate.

Fisher was convinced that people are unconscious of inflation and the changing value of money as a consequence of it, and because of that they make suboptimal decisions. As already mentioned, it was Fisher's goal to raise public awareness in that matter and in this respect, his objective was at least in part accomplished. Nowadays it is really hard to imagine people ignoring inflation whatsoever. Widespread calculations and use of various price indices also speak to the contrary. As a result, Fisher's concept of money illusion became obsolete. In Friedman's (1968) influential presidential address, delivered to the American Economic Association, a necessary revision of the early view on money illusion was provided. According to Friedman, people include expected inflation into their decision making process. Further refinement of the agent's account of inflation came with the introduction of the rational expectations hypothesis (Muth 1961; Lucas 1972).

The argument about the danger of changing purchasing power of money was presented by Fisher (1928, pp. 58–60) as threefold: 1) it affects every transaction, 2) monetary units are used for long-term contracts, and 3) the effects of that are concealed from people by the money illusion. The direct harm from inflation and deflation consists in the injustice when the wealth is redistributed from creditors to debtors, from bondholders to stockholders or the other way around. Long-term contracts promising to pay a certain sum of money in the future that neglect inflation or deflation lead to the redistribution if the purchasing power of money changes over the length of the contract. Fisher showed that apart from bonds also insurance contracts or salaries and wage contracts represent similar type of relationship.

A number of remedies of this direct harm caused by the unstable money is offered by Fisher, reaching from the use of forecasts of business conditions to diversified investment, e.g. in common stocks or foreign assets. The suggestion to “contract out” of the unstable money to a better currency starts with the possibility to employ another unit of measure, as for example corn, iron or a foreign currency, in which the long-term contracts are specified. But then the risk of instability is only transferred to another commodity or monetary unit. Therefore Fisher (1928, pp. 117–123) proposes contracts in multiple-commodity standards, i.e. index standards, as a protection from the chang-

ing purchasing power of money. He notes that the use of index standards can be traced back to the 18th century.

In later literature (e.g., Shafir, Diamond, and Tversky 1997; Akerlof and Shiller 2009), the structure of long-term contracts was brought to attention and particularly, the absence of perfect indexation in wage and debt contracts was examined more in depth. The inability or unwillingness to secure the real value of all long-term contracts were used by proponents of modern theory of money illusion to illustrate that there is a room for this concept in economic science even though people's account of inflation may be different than originally presented by Fisher.

Apart from the direct effects of unrecognized inflation or deflation, Fisher (1928, pp. 89–106) mentions also its indirect harm – the business fluctuations. According to him, at least part of the business cycle can be explained by the phenomenon of money illusion. The argument goes as follows: the rising price level stimulates business because while producers get higher prices for their goods, their costs initially don't grow at the same rate. Wage and rent contracts cause the expenses to lag behind receipts and profits to rise with the increasing price level. As a consequence, higher profits lead to the expansion of business. But producers may be misled by the money illusion and not realize that in the progress money decreases in value. Costs then seem to be lower than they actually are, because they were incurred sooner than the product were sold. Thus the profits are actually not as high as it seems and the expansion of business is excessive.

The result is that money illusion leads to an unduly expansion of business during inflation and to an unduly contraction of business during deflation. Fisher argued that these unnecessary fluctuations caused by unstable money harm the working men, cause discontent and mean a net loss to a society as a whole, not to mention again its more direct effects. In Fisher's (1928, p. 106) own words: "These evils of unstable money may be reduced to three: social injustice, social discontent and social inefficiency."

The money illusion in Fisher's view leads to redistribution of wealth and suboptimal allocation. Furthermore, business fluctuations are partly caused by fixed long-term contracts, in which inflation is not correctly considered, and then money illusion also intensifies the reactions of output that stem from the changes in price level. As the money illusion brings number of undesirable outcomes, Fisher's theory resulted in a straightforward requirement of a currency that is stable in its purchasing power.

There are many issues in Fisher's conception of money illusion that seem implausible in the light of current economic knowledge. For instance, his belief that people irrationally disregard all fluctuations in purchasing power of monetary units doesn't stand well in today's world. Even modern proponents of the money illusion concept, Akerlof and Shiller (2009, p. 46), describe Fisher's view as "remarkably naïve" and "in need of serious revision." That is why the idea of money illusion in its original form became an object of criticism from the standpoint of the adaptive expectations theory (i.e., Phelps 1967, Friedman 1968) and then was further revised with the help of the rational expectations theory (e.g., Lucas 1972).

On the other hand, Fisher's book indicated a number of aspects of money illusion that were later examined more closely by other authors. Some of his insights regarding

human behavior were later developed in the literature from the field of behavioral economics (e.g., Shafir, Diamond, and Tversky 1997) or New Keynesian economics (e.g., Akerlof and Shiller 2009). Another of his observations were gradually polished to achieve a more sophisticated and tangible theory that can be applied and empirically verified in specific markets, namely the stock market (e.g. Modigliani and Cohn 1979; Cohen, Polk, and Vuolteenaho 2005) or the housing market (Brunnermeier and Julliard 2008). Thus, although not entirely relevant as a whole in these days, Fisher's theory of money illusion offers some important features and its absolute dismissal might not be completely justified.

1.2 Leontief's Definition of Money Illusion and J. M. Keynes

Thanks to devoting a whole book to it, Fisher's name became one of the most frequently mentioned in further literature on the phenomenon of money illusion. However, he was not the only one dealing with this concept and so other definitions also appear in subsequent texts. Particularly the definition of Leontief (1936) may be regarded as very popular. It is interesting to note that this definition comes from his comment to Keynes' monetary theory of unemployment, where Leontief just contrasts Keynes's view with the classical theory and actually doesn't use the term money illusion at all.

To show the difference between the classical scheme and *The General Theory of Interest, Employment and Money* (Keynes 1936), Leontief presents two fundamental assumptions of the classical orthodoxy. First of them is known as the *homogeneity postulate* and it goes as follows: "all supply and demand functions, with prices taken as independent variables and quantity as a dependent one, are homogeneous functions of the zero degree" (Leontief 1936, p. 193). The second assumption states the nonexistence of any kind of frictions and time-lag effects in an economic system.

The violation of the homogeneity postulate is then denoted as Leontief's definition of money illusion and appears as such in a number of works (e.g., Fehr and Tyran 2001; Brunnermeier and Julliard 2008 or Basak and Yan 2010). Let's look more closely at this mathematical definition and its implications.

A real valued function $f(x_1, \dots, x_n)$ is homogeneous of degree k if for all $k > 0$:

$$f(tx_1, \dots, tx_n) = t^k f(x_1, \dots, x_n).$$

If we suppose for instance the following demand function for commodity x_i :

$$x_i^* = f(p_1, \dots, p_n, m),$$

where (p_1, \dots, p_n) are nominal prices and m is nominal income, the property of homogeneity of degree zero implies that:

$$x_i^* = \left(\frac{1}{p}\right)^0 f(p_1, \dots, p_n, m) = f\left(\frac{p_1}{p}, \dots, \frac{p_n}{p}, \frac{m}{p}\right),$$

where p could be either general price level or a price of some other commodity. Thus, the homogeneity assumption in this case means that demand function for the good x_i depends strictly on real or relative prices and real income.

This is a special case of Leontief's broader view, in which not only demand but also supply functions were considered and the term price was defined universally to include not only commodity prices but also prices paid for services, i.e. money wages. However, implication of this narrower conception are in accordance with another definition of money illusion. Namely, Don Patinkin (1989, p. 22) wrote on money illusion: "An individual will be said to be suffering from such an illusion if his excess-demand functions for commodities [...] do not depend solely on relative prices and real wealth, inclusive of initial real balances."

Leontief's view is also more general than the previously presented definition by Fisher. Although they are not in conflict, Leontief said nothing about people's inability to perceive changes in the purchasing power of money. Under his definition, people may be able (even when suffering from money illusion) to determine inflation but they choose to make decisions based on nominal quantities for some reason. The broader applicability and universality of this definition means that in this view also another consequences of money illusion are plausible.

In fact, Leontief – instead of attempting to define money illusion – merely discusses whether Keynes' theory of unemployment contradicts the two aforementioned assumptions of classical scheme. The focus is drawn to the homogeneity postulate for two reasons. Firstly, the introduction of various lags and frictions is not specific to Keynes' theory, but appears also in modern classical works. Secondly and more importantly, the violation of the homogeneity assumption alone results in contradiction of the neutrality of money.

Breach of the homogeneity postulate – that is, the existence of money illusion – has according to Leontief (1936, pp. 194–195) consequence in existence of a monetary optimum, which can be determined for output of any commodity or employment of any factor of production. Since it is very unlikely that all of these optima coincide, a deviation from this optimum may be also computed for each commodity or service. The non-homogeneity condition also leads to the interest rate becoming a function of the quantity of money.

In Leontief's view, the assumption of non-homogeneity is crucial to Keynes' monetary theory of unemployment, however, the problem is that "he does not commit himself to a precise, clear-cut statement of this basic postulate" (1936, p. 195). Thus, Leontief outlines the possible presence of money illusion in Keynes' theory, although he also notices the absence of an explicit conflict with the assumptions of classical economics. The universality of the homogeneity postulate, allowing for money illusion to concern also supply behavior and defining price in its broad term to include also wages, is of special importance. It is because the closest we can get to identifying the presence of money illusion in Keynes' *General Theory* is while examining his notion of labor supply.

In his fundamental book, Keynes (1936) disputes the classical theory of unemployment, which is in his view embodied in Pigou's *Theory of Unemployment* (1933). Keynes

argues that in contradiction to classical theory, supply of labor is not solely a function of the real wage. Although – as Leontief remarks – he fails to directly attack the classical assumption of homogeneity, he chooses to reject another postulate of classical economics. Keynes (1936, pp. 5–22) opposes the claim that at a given level of unemployment, the marginal disutility of this volume of employment is equal to the utility of wage.

He supplemented this objection with the intuition that an increase in the cost of living (i.e., fall in the real wage) doesn't cause a withdrawal of labor supplied at a given nominal wage. As even more important objection he denoted the character of wage bargains. Keynes expressed his doubt about the existence of an instrument available to the labor force that could possibly ensure the real wages to be an accurate measure of the marginal disutility of the given amount of labor.

In contrast, Keynes claimed, workers react to changes in the nominal wage rather than real wage and they do not resist reduction in real wage at all unless it reaches an extreme level. The reason for that is the imperfect work mobility. Since wages do not tend to perfectly offset advantages among different occupations, a reduction of nominal wage means a decrease in the real wage relatively to others. A reduction in real wage, on the other hand, concerns all workers alike and keeps the relative real wage unchanged. The struggle over nominal wage is then de facto a struggle over relative real wage and its distribution over different subgroups.

The rejection of the real wage as a tool equilibrating the marginal disutility of labor with the utility of this wage leads to a possible emergence of involuntary unemployment which cannot occur under the assumptions of classical theory. Moreover, it meant some form of existence of money illusion in Keynes' theory of employment. However, the presence of money illusion in Fisher's conception cannot be found in *General Theory*. Keynes does not assume people disregard the fluctuations in purchasing power of money. On the contrary – in his view they choose to respond only to changes in the relative real wage, which coincide with the movements of money wage. Although the responses are not entirely intended, workers are in some way, unlike in Fisher's theory, aware of the distinction between the nominal and real wage. Keynes (1936, p. 14) illustrates the mechanism of labor supply reactions by following remark: “[I]t is fortunate that the workers, though unconsciously, are instinctively more reasonable economists than the classical school.”

While the presence of money illusion in Fisher's interpretation may be dismissed, the compatibility with definition of money illusion by Leontief is quite apparent. It was already mentioned that Leontief lacked a direct commitment of the non-homogeneity postulate in Keynes' theory, but Leontief (1936, p. 195) also wrote: “Mr. Keynes assumes that the supply function for labor is non-homogeneous.” And this assumption is crucial throughout his critique of classical theory of unemployment. The requirement of labor supply not being solely function of real wage is the cornerstone of Keynes' rejection of the real wage as a correct measure for the disutility of labor. And because of that it may be claimed Keynes' *General Theory* incorporates phenomenon of money illusion as defined by Leontief.

Aside from the *General Theory*, Akerlof and Shiller (2009, p. 42) mention the presence of money illusion also in one of the others Keynes' works: "Fisher is not alone, even among the great economists of the past century, in believing that people are vulnerable to such money illusion. Even our hero, John Maynard Keynes, explained income distribution for economies at full employment by assuming that workers fail to negotiate increases in wages to offset inflation." They refer to later Keynes' (1940) book titled *How to Pay for the War*.

In this book, Keynes proposes a solution, alternative to the inflationary method used in the World War I, to meet the financial demands of World War II in the United Kingdom. As a part of his line of reasoning, he also presents how the traditional inflationary method¹ works to extract the necessary amount of war finance in contrast with his method of *compulsory savings*. The model of inflation developed in this work, however, does not place that much reliance on money illusion in the labor market as often envisaged.

The main difference concerns the very specific circumstances under which the inflationary process is examined in contrast to e.g. the *General Theory*. In the *How to Pay for the War* Keynes (1940, pp. 62–63) outlines a numerical example where inflation of 20 per cent is needed to equate the demand with the supply after required war demands of investment and defense have been satisfied by the government. This volume of price increase is in that case necessary to close the inflationary gap. Whereas workers, according to Keynes, do not respond to changes in real wage due to minor rates of inflation, such an increase in prices may exceed the threshold limit under which the money illusion is operational. For instance, Trevithick (1975, p. 103) states that according to many Keynes' writings "a modest increase in prices of the order of 5–10% may be sufficiently small to prevent retaliatory wage demands." Since the numerical example in the *How to Pay for the War* discusses inflation much higher than that, there is no reason to presuppose the presence of money illusion in this text.

Indeed, the mechanism of voluntary savings is, according to Keynes, effective due to other reasons than money illusion, namely the time-lags in wage adjustment. As a response to a 20 per cent increase in prices, in Keynes' (1940, pp. 65–67) numerical example, workers press for a higher nominal wage and this pressure is, at least partially, successful since the nominal profits of firms rise and labor is scarce. Higher taxes on profit and income during war time also reduce the gains of resisting those demands. But the adjustment may take considerable time and this time-lag ensures the success of the inflationary method even when the adjustment of wages is proportional to inflation. The only condition is that prices increase at a higher rate than wages and thus the income is redistributed from workers to *profiteers*². Higher marginal propensity to save of this group together with the abnormal tax rates ensure that majority of the increased income ends up in the hands of the Treasury.

¹In this book, Keynes denotes the inflationary method unconventionally as the method of *voluntary savings* and to his solution refers as to the *compulsory savings* method, because it sets a portion of income that must be deferred and should be made available for consumption only after the war is over.

²Keynes' (1940, p. 64) term for the group of individuals claiming profit of trading and manufacturing companies.

Why was then the system of compulsory savings by deferred pay preferable according to Keynes? Trevithick (1975, pp. 111–112) argues that it was because the lag between wage and price changes dramatically shortened. And since this would be welcomed under the assumption of money illusion, he also rejects its presence in the theory lying behind *How to Pay for the War*. (Although he acknowledges a certain form of money illusion in other Keynes' works.) According to Trevithick, the higher speed of adjustment would only make the inflationary method more efficient tool for war financing, if the mechanism rested on imperfect negotiation of wage increase to offset inflation. In that case, the economy would converge even more rapidly to the equilibrium. However, Keynes rather saw a problem with the inflationary method when the time-lag shortened. In his view, the necessary annual rate of inflation to close the inflationary gap depends, apart from the initial size of the gap, also upon the speed of adjustment of wages to prices (Trevithick 1975, pp. 105–106). When the speed increases, higher inflation is necessary and the inflationary method leads to a greater national debt in terms of money and also to more extensive redistribution of wealth in the economy (Keynes 1940, p. 73). The undesirability of both of these effects constitutes then the Keynes' argument for the compulsory savings method.

Although Akerof and Shiller (2009, p. 42) refer to *How to Pay for the War* as a source of money illusion in Keynes' theory, it was shown he actually did not rely on this assumption while he advocated the method of compulsory savings as an alternative to the inflationary solution. He supposed the time-lag between price and wage adjustment ensures the functioning of the latter. Nevertheless, based on his other works, including the *General Theory*, he assumed some form of money illusion in the labor market. Within a certain range, the labor supply is a function of nominal wage rather than real wage in Keynes' theory. Despite the fact that this form of money illusion lacks the irrational factors intrinsic to the Fisherian conception, it fulfills the definition ascribed to Leontief.

The presence of money illusion in Keynes' theory means the real wage does not equilibrate the labor market and as a consequence, involuntary unemployment may emerge. This eventually led Keynes to the well-known conclusion of insufficient aggregate demand. His policy implication derived from the existence of money illusion was then very different from the one expressed by Fisher. While Fisher required stable currency to avoid undesired effects of fluctuating prices, Keynes was confident that, thanks to money illusion in the labor supply function, raising aggregate demand would boost employment. He believed that the higher price level would induce workers under money illusion to supply more labor and as consequence unemployment would diminish. Let's not forget that this relationship holds in Keynes' view only for inflation rates in a certain range.

The non-homogeneity of labor supply function proposed by Keynes can be depicted in the classical model of labor market, which is shown in Figure 1.1. Increase in price level from P_1 to P_2 decreases the real wage, but does not affect the nominal wage at first. When workers do not react to changes in price level, their labor supply function shifts from L_s to L'_s , as they supply the same amount of labor under the lower real wage.

New equilibrium emerges at the point where the labor demand crosses the shifted labor supply function. At this point (E'), employment and nominal wages are higher, but real wages are lower than in original equilibrium.

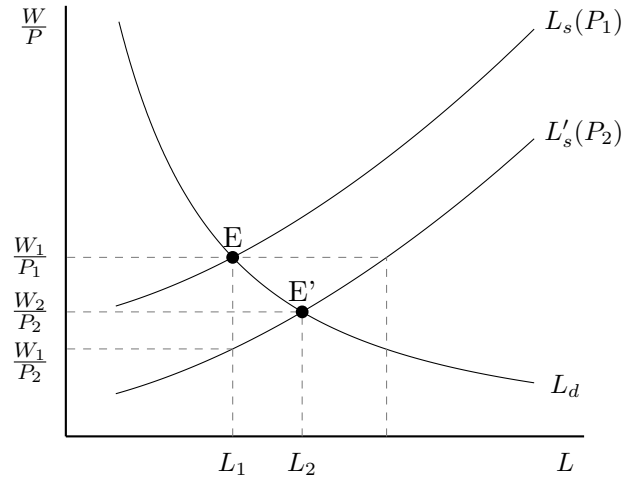


Figure 1.1: Keynes' labor supply function.

Source: Own elaboration based on Keynes (1936)

1.3 The Origins of the Phillips Curve

The relationship between money wages and unemployment became an object of analysis carried out by Phillips (1958), which eventually led to development of the so called *Phillips curve*. A lot of discussion have been devoted to the relationship firstly discovered by Phillips over the years and it is still a subject of theoretical and empirical research until these days. Since great deal of the discussion concerning the Phillips curve is closely related to money illusion, it is desirable to examine its origin at first.

In his 1958 article, Phillips proposed a negative and non-linear relationship between the rate of change of money wage rates and the level of unemployment in the United Kingdom. The central point of his analysis was to explain the annual rate of change of money wage rates, which were in his view dependent on two main factors.

Firstly, Phillips supposed that, when level of unemployment is low and the demand for labor high, employers bid up the money wage rapidly to attract the best workers from other occupations. On the other hand, under high unemployment and low demand for labor, the reluctance of workers to accept lower than the prevailing wage leads to slower decline of the wage rate. This was the source of non-linearity in the aforementioned negative relation. Phillips was, however, interested not only in the levels but he also examined the rates of change of variables. As the second factor, he denoted the rate of change of demand for labor, which was according to him associable with the rate of change of unemployment. He expected higher increases in money wage rates when

percentage unemployment decreased due to higher labor demand and lower increases in money wage rates when unemployment rose.

Phillips (1958, pp. 283–284) rejected changes in cost of living as another factor influencing the rate of change in money wage rates under the assumption of no rapid rise in import prices. He argued that the wage increases caused by the growth in the cost of living would have been given to workers in any case as a result of the competitive bidding for labor, provided that the growth in the import prices is moderate. (Meaning that the change in price level caused by an increase in import prices does not exceed the rate at which wage rates would rise as a result of the competitive bidding.)

As a result, Phillips (1958, p. 284) presented a hypothesis that “the rate of change of money wage rates in the United Kingdom can be explained by the level of unemployment and also by the rate of change of unemployment, except in or immediately after those years in which there was a very rapid rise in import prices” and confronted it with the data.

He came up with a hyperbolic curve, as shown in Figure 1.2, relating the annual growth rate in nominal wages to the level of unemployment. Based on the estimated relationship, Phillips predicted level of unemployment that was compatible with stable price level assuming a constant annual growth in productivity (point A). He also derived level of unemployment associable with constant wage rates (point B). The stability of the relationship relied on the assumption of the demand-pull nature of inflation stated in Phillips’ hypothesis.

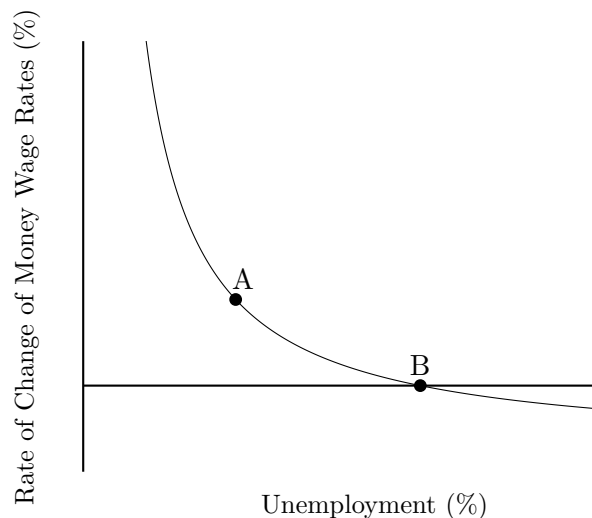


Figure 1.2: The original Phillips curve.

Source: Own elaboration based on Phillips (1958)

Shortly after publishing Phillips’ findings, a further study on the same subject was carried out by Lipsey (1960). His aim was to retest the hypothesis and develop a more elaborate theoretical model to enable an interpretation of the results. Although he found few points of disagreement with Phillips’ results, Lipsey (1960, pp. 11–12) consented

that “[t]here is a significant relation between the rate of change of money wage rates on the one hand and the level of unemployment and its rate of change on the other” and supplemented this view with a theoretical background.

Lipsey tried to explain the relation between growth of money wages and level of unemployment starting at the single labor market, which was then aggregated. He also theoretically underpinned the influence of the rate of change of unemployment and, in contrast to Phillips, attempted to quantify it. Furthermore, the threshold effect of the cost of living on living outlined by Phillips was criticized and a rethinking of the relation between the growth in money wages and the growth in price level was suggested. Lipsey’s (1960, p. 31) conclusion was that the findings of Phillips together with his theoretical model meant a contribution to the discussion of the causes of inflation, although it could not clearly decide between the cost-push or demand-pull hypothesis.

It wasn’t until the paper published by Samuelson and Solow (1960) that the Phillips curve became important for the economic theory. Authors firstly examined the relationship between the changes in money wage and the level of unemployment on the U.S. data. Although the relation did not show such a consistency as in the United Kingdom, they concluded that similar pattern was present also in the U.S. and that the lack of fit might be caused by shifts in the curve, possibly as a result of change in the trade union power.

Samuelson and Solow presented number of possible causes for inflation, reaching from demand-pull hypotheses by Fisher or Keynes to various cost-push theories. However, they do not commit to one or another and they merely discuss possible explanations of the inconsistency in the relationship in comparison with the U.K. Without proposing a clear theoretical background for the original *Phillips curve*, Samuelson and Solow (1960, p. 192) translate the relationship into a related diagram showing the dependency of the level of unemployment and the rate of inflation (Figure 1.3).

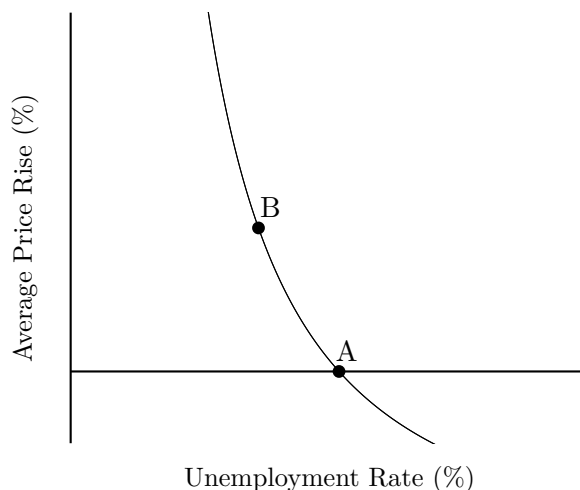


Figure 1.3: The modified Phillips curve for the U.S.

Source: Samuelson and Solow (1960)

The possibility of such a modification was actually already proposed by Phillips when he attempted to quantify the level of unemployment consistent with stable price level. Samuelson and Solow also relied on the assumption of constant annual growth in productivity to calculate the unemployment rate that should be consistent with stable price level based on the estimated relationship (point A). In other words, they supposed price stability as long as the annual growth in nominal wages is exactly the same as the annual growth in productivity. Furthermore, Samuelson and Solow (1960, p. 192) estimated what rise in price index would be necessary “[i]n order to achieve the nonperfectionist’s goal of high enough output to give us no more than 3 per cent unemployment” under the same assumptions (point B).

Samuelson and Solow (1960, pp. 193–194) warned about the short-run nature of the presented relationship and gave reasons for possible shifts in the American Phillips curve in both directions. Although they merely expressed the wish to implement some institutional changes to reduce the level of unemployment necessary for keeping the prices stable, the possibility of an exploitable trade-off between inflation and unemployment was implied by the graphical representation of the modified Phillips curve in their article.³ It seemed that authorities are able to select from a menu of inflation-unemployment policy choices.

1.4 Milton Friedman’s Presidential Address

At the beginning of the previous section it was stated that Phillips curve is closely related to the phenomenon of money illusion. However, we have seen that this relationship wasn’t properly described by Phillips or Samuelson and Solow on theoretical grounds. Although Lipsey (1960, pp. 12–23) offered a model explaining the observable relation, it did not become an integral part of economic science. The theoretical underpinning, which includes the influence of money illusion, was brought into economic science by Milton Friedman, almost 10 years after the origination of the Phillips curve. Ironically, it was a part of Friedman’s (1968) presidential address delivered to the American Economic Association, in which he warned about the instability of the relationship embodied in the Phillips curve.

In this speech, Friedman – besides of accentuating the power of money – also unusually emphasized the incapacities of monetary policy. He stated that monetary policy is unable to peg interest rates and unemployment for more than very limited periods. This thesis focuses on the second issue. His discussion about the trade-off between inflation and unemployment explains the mechanism allowing to move along the Phillips curve in the short run and the impossibility to use it in longer periods.

Friedman (1968, pp. 9–11) agreed that when a price level is stable, monetary expansion can temporarily bring the unemployment under its *natural* level. By the term *natural level of unemployment* he meant the unemployment rate that is consistent with the labor market being equilibrated by the real wage. The mechanism proposed is as

³Forder (2010) provided a detailed treatise focusing on the extensive impact and misinterpretation of Samuelson and Solow’s article.

follows: when authorities increase the monetary growth, interest rate temporarily decreases, spending is stimulated and income starts to rise. Since prices are expected to be stable and wage contracts are set for some time in the future, we can observe an initial growth in output and decrease of unemployment.

The decrease of unemployment is a result of the fact that prices of factors of production respond slower than prices of products. As the prices unexpectedly increase, the *ex post* real wages decrease to employers and simultaneously the *ex ante* real wages increase to workers. Although Friedman also does not use the term money illusion in his work, the concept is present in this explanation. Money illusion is what induces the increase in the labor supply. While workers evaluate the nominal wages at previous price level, they are unable to determine the real quantities right away and fail to perceive the change in purchasing power of money. Although they make the decisions based on the real wage, the discrepancy between its *ex ante* and *ex post* values prevents the labor supply of being homogeneous of zero degree.

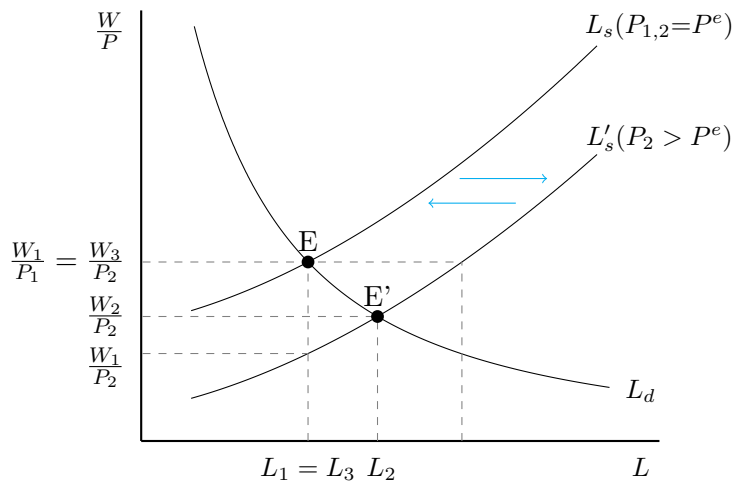


Figure 1.4: Friedman's labor supply function.

Source: Own elaboration based on Friedman (1968)

This non-homogeneity of labor supply could be depicted in the graph of labor market very similarly as the Keynesian labor supply was represented. Friedman's view is shown in Figure 1.4. The supply function shifts again in the same direction when price level rises from P_1 to P_2 , although the reason is different. In Friedman's view it is the incorrect anticipation of the price level, i.e. the curve L'_s is connected with price level higher than expected ($P_2 > P^e$). The shift results in lower unemployment and increased nominal wages. On the other hand, monetary contraction would lead to an opposite shift causing unemployment to increase. Thus, the consequence of the non-homogeneity is a Phillips curve relation between unemployment and inflation, which in Friedman's view disappears as soon as workers update their expectations. Because of that, labor supply returns to its previous position (L_s) where $P_2 = P^e$. As a result, nominal wages further increase until their rise is proportional to the inflation and the real wage and

employment return to their previous levels. Therefore, L_s is homogeneous of degree zero in the long run.

In Friedman's theory, money illusion are present both in the Fisherian and the Keynesian conception, but with serious differences. Friedman's notion supposed workers eventually notice the fall in ex post real wage, when prices of the goods they buy increase and as a result they adjust their expectation and demand higher nominal wage. As opposed to Fisher, Friedman believed workers are rational in the long run, i.e. that they are able to update their expectations and take the actual inflation into account. Since the new price level is incorporated in the expectations, the decrease of unemployment is only temporary and both the real wage and unemployment tend to return to its natural level in the long run.

The difference from Keynesian view of money illusion is obvious, because in Friedman's view the workers react to changes in the real wage. The non-homogeneity is caused due to the discrepancy in its ex ante and ex post values, not by the tendency to rather stipulate for the relative real wage. Paradoxically, the workers are less rational in Friedman's theory, because (when prices are rather stable) they tend to make decisions based on previous experience and they don't include new information as they come. This element of irrationality is missing in Keynes' conception of money illusion. In Keynes' view people are – though unconsciously – able to react to changes in the real wage, but they choose not to do so.

On the other hand, there is one important common feature in both Keynes' and Friedman' view. They both assume money illusion not to be operational when changes in the price level are excessive. It has been already stated that Keynes believed the labor supply is a function of nominal wage only when the inflation does not exceed some threshold limit. The same intuition can be found in Friedman's presidential address. Although the story is different, Friedman also pointed out that by him proposed mechanism breaks down when prices are not stable and, as a result, people are incapable of creating expectations based on previous state. In his case it means that the trade-off incorporated in the Phillips curve does not hold even in the short run. In Friedman's (1968, p. 9) own words: "For periods or countries for which the rate of change of prices varies considerably, the Phillips Curve will not be well defined."

Conversely, "for any period for which the average rate of change of prices, and hence the anticipated rate, has been relatively stable" Friedman (1968, p. 9) agrees with a reasonably stable Phillips curve, because nominal and real wages move together. Friedman therefore criticized Phillips for disregarding the difference between nominal and real wage, i.e. for assuming money illusion, which in his view dissolves in the long run as workers adjust their expectations. As a result, Friedman agreed with the Phillips curve as a stable relationship only after restatement of the analysis in terms of the rate of change of anticipated real wages.

One possible representation of this restated relationship is depicted in Figure 1.5. When the labor market is in its equilibrium, real wages grow at some rate depending on technological progress and other forces. Let's assume that these factors follow their long run trends and so are perfectly anticipated. Then, anticipated real wages grow at

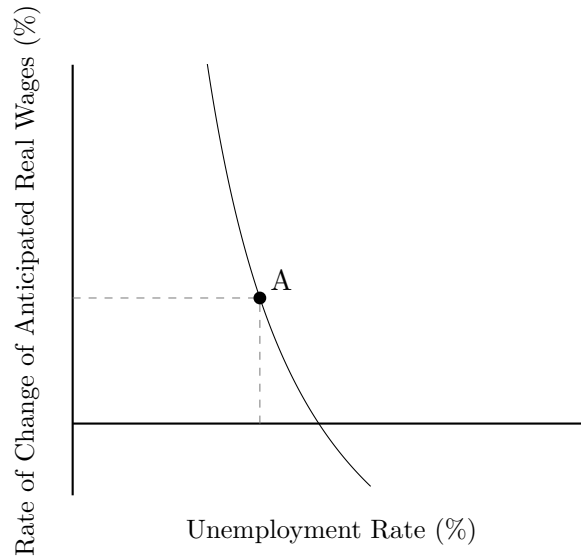


Figure 1.5: Friedman's restatement of the Phillips curve.

Source: Own elaboration based on Friedman (1968)

the same rate and the economy is for example at the point A on the restated Phillips curve. In case of an excess demand for labor (i.e, when the equilibrium changes), there is upward pressure on (expected) wages and unemployment decreases. Conversely, the excess supply of labor causes the (expected) wages to decrease and unemployment grows. As a result, the restated Phillips curve is downward sloping. In the situation, where anticipated wages coincide with their ex post values, points on the curve present the possible equilibria on the labor market, i.e. all situations when unemployment is on its natural level, and also the path to it. When anticipation are not in accordance with reality, the relationship still holds (although the labor market is not in its long run equilibrium), because workers' behavior follows the anticipated real wage. This relationship, though it is stable, is not directly observable.

For this reason, Friedman also discussed the behavior of the observable Phillips curve with the growth rate of prices on vertical axis. He concluded that as the increased monetary growth gets incorporated in worker's expectations, Phillips curve tend to shift upwards. This concept became later known as the *expectations-augmented Phillips curve*.⁴ The level of the curve is then determined by the average rate of price change – the higher is the average inflation, the higher inflationary expectations and the higher the level of the curve tends to be. Then, in order to keep the unemployment under the natural rate, still higher monetary growth is necessary. As Friedman (1968, p. 11) himself stated it: “A rising rate of inflation may reduce unemployment, a high rate will not.” Thus there is a temporary trade-off between inflation and unemployment in

⁴The concept is also associated with the article of Phelps (1967) but since he does not relied on the money illusion, it is not discussed in detail at this point.

Friedman's view, but the permanent trade-off does not exist and the attempts of using it lead to ever increasing rate of inflation.

The expectations-augmented Phillips curve is depicted in Figure 1.6. Suppose the economy is at the point $[u^*; 0]$, i.e. the unemployment is at its natural level (u^*) and since there is zero inflation, people expect stable price level ($\pi^e = 0$). When the authorities try to decrease unemployment to $u' < u^*$, they need to increase the rate of inflation to π_1 . Temporarily, this policy may be successful, but eventually the inflation rate π_1 will get incorporated in the expectations and the Phillips curve will shift from $PC_1(\pi^e = 0)$ to $PC_2(\pi^e = \pi_1)$. To return unemployment to u' , even higher rate of inflation (π_2) is necessary and ultimately, the curve will shift again. This may continue several times – as the expectations about inflation get updated, the unemployment rate always returns to its natural level. In the long run, the Phillips curve is vertical line through the natural rate of unemployment ($LRPC$) and the strive to peg unemployment at a lower rate leads to a spiraling inflation.⁵

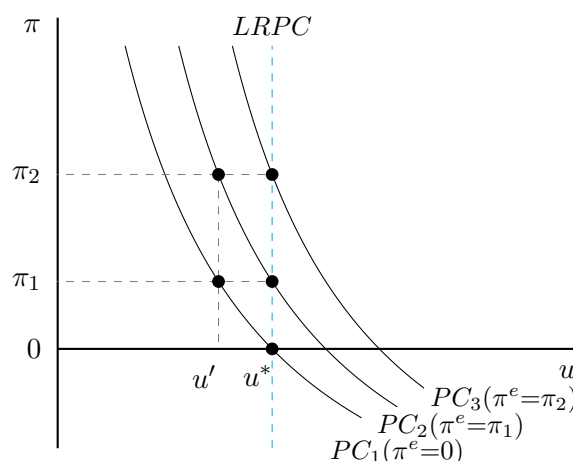


Figure 1.6: Expectations-augmented Phillips curve.

Source: Own elaboration based on Friedman (1968)

Friedman's explanation of the Phillips curve in terms of money illusion brings then some implications for the monetary policy. The main lesson is that monetary authorities may peg nominal quantities, but they are unable to peg real quantities. Therefore the monetary policy should be conducted in a way it does not cause economic disturbances itself. Rather it should behave in a stable and predictable manner, so that agents in the economy may create anticipation that are largely consistent with reality.

In particular, Friedman proposed (1968, p. 11) the adoption of a steady and known rate of monetary growth that would on average ensure stable price level. The fixed rate of growth in the quantity of money would produce moderate inflation or deflation, depending on other forces affecting the economy, but it would also create favorable con-

⁵The natural rate of unemployment is therefore sometimes called *non-accelerating inflation rate of unemployment* (NAIRU).

ditions for economic growth. This policy implication is similar to Fisher's requirement of stable currency. However, since Friedman's view (in contrast to Fisher) allows for anticipation of inflation, the quantity of currency may grow by a stable pace to prevent depressing the economy.

It has been stated that Friedman's theory includes the phenomenon of money illusion, which causes an increase in output and reduction in unemployment when monetary growth increases and, as a result, excess demand for labor emerges. Although this trade-off between inflation and unemployment was denied in the long run, the element of irrationality is present for a limited time period. However, in following years economic science dealt with the topic of rationality in more detail. The outcome of subsequent period was the *revolution of rational expectations*. Nonetheless, even after its success, the discussion about the role of Phillips curve and money illusion did not quite end. For instance, recent models of near-rational behavior (e.g., Akerlof et al. 2000), relying on the presence of a form of money illusion, tried to revive the concept of a long-run trade-off between inflation and unemployment. Development of the view on money non-neutrality and the evolution of money illusion theory will be content of the next chapters.

2. Competing Theories

“An economic theorist can, of course, commit no greater crime than to assume money illusion.”

– James Tobin, 1972

The concept of money illusion as an explanation of non-neutrality of money is concerned with a serious difficulty, because the implied irrationality contradicts the basic assumption of economics – the maximizing behavior of agents. To deal with this issue, several other theories have been offered to explain nominal inertia without disrupting the requirement of rationality. This chapter begins with Hayek’s explanation of money non-neutrality, in which the problem of irrationality is tackled by a change of relative prices during monetary contraction or expansion. Next, Tobin’s attempt to reconcile Keynesian labor supply function with rationality is presented. Then the revolution of rational expectations and the informational frictions theory of nominal inertia by Lucas follows as the defining moment of perceiving money illusion in economics. Finally, the long-term contracts explanation of Stanley Fischer is discussed together with its linkages to the theory of money illusion.

2.1 The Monetary Framework by F. A. Hayek

One of the first explanations of money non-neutrality that did not implied irrationality was given by Hayek (2013) in his essay *The Monetary Framework*, originally published in 1960 as a part of *Constitution of Liberty*. In this text, Hayek explains why even solely monetary changes influence the real economy and emphasizes the importance of a stable monetary system. However, Hayek’s theory is very different from the concept of money illusion. In his view, changes in the amount of money must *always* influence relative prices.¹ As a consequence, agents’ reaction to changes in monetary quantities is fully rational.

¹The ideas from *Constitution of Liberty* are derived mainly from Hayek’s fundamental works that originated in the 1930s. For instance, Hayek (1935, p. 28) already expressed this thought in *Prices and Production*. However, in order not to get too far from the main subject of this thesis, only the formulation of this theory as described in *Constitution of Liberty* is discussed here.

In the text, Hayek (2013, p. 452) stressed the uniqueness of money in being the only commodity that is always circulating instead of being consumed. Although he saw changes in the supply or demand of money as self-reversing, the path to the temporary equilibrium meant serious consequences for the whole economic system. The reason for that was the disruption in particular supply and demand functions caused by the process money is being handed over. Hayek (2013, p. 452) offers an example of monetary expansion. The additional money is initially spent on a service or commodity creating new demand for it and altering the relative prices for all goods and services. Those who next received the additional money spend it on other things and the disruptions are spreading through the whole economy. This train of effects is reversed only when the quantity of money ceases to increase. Exactly the same mechanism applies to the reduction of money supply.

Hayek (2013, p. 453) commented on that as follows: “Each change of this sort will give rise to a succession of changes in demand which do not correspond to a change in the underlying real factors and which will therefore cause changes in prices and production which upset the equilibrium between demand and supply.” Though this may resemble the consequences of money illusion, Hayek managed to avoid using this concept or any other occurrence resting on irrational behavior. His explanation is based on the change in relative prices, which is caused by the additional money being spent in different periods of time.

Even distributing the money perfectly evenly to all people at the same time would not prevent the movements in relative prices, because not everyone has the same propensity to consume. Therefore even in this scenario, additional money have disruptive effects, because they increase the demand for the good or services being purchased first and by that initiate the chain of effects. As it has already been said, these effects influence the real economy until they are reversed.

The change of relative prices in the course of action is very important, because it denies the possibility for agents to be deceived by the veil of money. By reacting to changes in relative prices, there is no reason for breaching the homogeneity postulate or the assumption of rationality. Thus, Hayek's theory may be denoted as one of the first alternative to money illusion as an explanation of the short-run non-neutrality of money.²

2.2 Tobin's Critique of Keynesian Labor Supply Function

Previous chapter of this thesis discussed in detail money illusion in Keynes' labor supply function. The effect of a change in money wage rates on aggregate output and unemployment in Keynes' view was also discussed in Tobin's essay from 1950s, which

²Since Fisher (1928) clearly stated that money illusion is a phenomenon that may concern all prices, including the interest rate, we might be inclined to find it in one of others Hayek's works. The confusion between money rate of interest and natural rate of interest is a central part of Hayek's (1933) business cycle theory in *The Monetary Theory and Trade Cycle*. However, for similar reasons as mentioned above, neither this problem contains any of the defining characteristics of money illusion.

was again with some alteration published in a compilation *Essays in Economics* (1971). Although Tobin (1971, p. 1) agreed that changes in money wages and prices may have real effects on the economy, he also found it hard to believe that human behavior suffers from indefinite persistence of irrationality as the property of money illusion indicates. Though, previous chapter demonstrated that the Keynesian notion of money illusion does not depend necessarily on the factor of irrationality, in contrast to money illusion in e.g. Fisher's or Friedman's view.

Nevertheless, Tobin (1971, pp. 15–16) argued that Keynesian thesis that involuntary unemployment emerges as a consequence of money illusion in the labor supply function and the character of wage bargain, is damaged by a number of assumptions of the Keynesian model, which clash with each other. Among the main weaknesses Tobin mentioned following: 1) the assumption that labor is the only variable factor of production, 2) the presence of money illusion in the supply function for labor itself and 3) the assumption that money illusion is not present in other supply and demand functions.

When Tobin (1971, pp. 16–17) attacked Keynes' assumption of labor as the only variable factor, he also added that the continuity of the model may be preserved as long as another assumption is accepted. This necessary requirement states that all variable factors other than labor are fully employed and their prices are fully flexible. Then the relationship between money wage and employment proposed by Keynes is still holds, even after more factors are assumed to be variable. The reason is following. Even if substitution between labor and other factors is allowed, their full employment and flexible prices will discourage it. Any attempt to substitute labor when the money wage increases will result only in bidding up the prices of other factors and the possibility of substitution vanishes. And reversely, lowering of the money wage will only lower the prices of other factors to keep them fully employed.

The second problem concerns the presence of money illusion in labor supply function itself. In the previous chapter it was presented that the property of non-homogeneity of supply and demand functions is regarded as money illusion in Leontief's view. It was also discussed in detail that money illusion in this form is present in Keynes' interpretation of labor supply function. Tobin (1971, pp. 18–19) gave several reasons to reconcile such behavior on the part of labor with the assumption of rationality, which the non-homogeneity property seemingly contradicts.

First, he mentioned Keynes' argument about stipulating money wage in order to maintain the relative real wage constant among occupations as a result of imperfect mobility of labor. This motive was already outlined in section 1.2. As the second reason, Tobin denoted fixation of worker's obligations in terms of money. Since debts, taxes and other long-term obligations tend to be specified nominally, their burden increase after the wage cut even after all current prices fell proportionally.

Third reason concerns inelastic price expectations. If a certain (*normal*) price level is expected to prevail in the future, regardless of current level of prices, it is rational to increase the supply of labor as a response to increasing money wage even when price level rises. Under these circumstances, the increase in labor supply is desirable as it increases the money income and consequentially also the money savings. Since workers

expect the price level to return to its *normal* level, the expected value of real income rises with the increasing value of current money income. Conversely, workers are reluctant to accept a wage cut even when prices are falling, partly because of the uncertainty whether wages will return to their previous level, but also because the return of prices to their *normal* level will reduce the real wealth.

Fourth, and also the last reason is, according to Tobin (1971, p. 19), pure money illusion – in other words, the genuine ignorance of the course of prices. Based on the consciousness of the cost of living, Tobin did not regard the last ground to be very significant.

However, on the whole he found the basis for the non-homogeneity in Keynesian labor supply convincing. What troubled him was the absence of similar logic in other supply and demand functions. Tobin (1971, pp. 19–22) draw attention to the fact that workers are supposed to behave as free of the money illusion in all other markets.

When labor supply suffers from money illusion, the supply of the other factors should be expected to have the same property. The money illusion affecting sellers of other factors would, though, cause their prices to be rigid (as wages are expected to be), thus it would contradict the additional assumption offered by Tobin to allow for multiple variable factors of production. And as a result, Tobin (1971, p. 20) claimed, money wage rate to be “an independent determinant of the volume of employment.”

When this argument is taken even further, it is also unclear why agents are deceived by money illusion while supplying labor, but they behave completely *rational* when they enter the market as consumers. Tobin (1971, p. 21) was confident that arguments constituting the non-homogeneity property of labor supply are relevant also for consumer theory, where workers act on the demand side of the market. From the logic of the money illusion in labor supply, the whole body of consumers would also have to be influenced by it.

It was demonstrated earlier that Fisher was a proponent of such an omnipresence of money illusion in human behavior. According to him, regardless on which part of whatever market, people may be deceived by money illusion and various consequences emerge. Although his view on money illusion suffered from many flaws and he did not aspire to form a coherent theory, Fisher was consistent. On the other hand, Keynes based his theory of involuntary unemployment on the assumption of non-homogeneous labor supply. His explanation relied on the proposition that workers stipulate for the relative real wage, but when Tobin further analyzed this property of labor supply while assuming rationality, he failed to find a persuasive reasons for money illusion not to affect all the supply and demand functions in the economic system. This conclusion underlines that Keynes was not in fact consistent in his theory, but instead introduced merely an ad-hoc explanation of money illusion.

The problem is that money illusion in consumption function operates in opposite direction than in labor market. When prices fall and price expectations are inelastic, present consumption substitutes for future consumption, because people expect prices to return to their *normal* level, and vice versa. Even without inelastic price expectations, real consumption demand increases when prices decline as the real value of accumulated

savings rises. This behavior that is – according to Tobin (1971, p. 22) – consistent and rational, appears to be the consequence of a money illusion when “current prices and incomes are taken as the sole variables to consumption decisions.” The restatement of Keynes’ real consumption expenditure as a direct function of real income and also an inverse function of nominal income leads to a different relationship between money wages and output than Keynes proposed. In this case, cut in money wage decreases prices and money incomes, real demand for consumption goods increases and as a result, output and employment increases.

Since aforementioned assumptions of Keynes’ theory are in contradiction, Tobin disregards it as convincing solution to the money wage problem. However, in the original essay, Tobin (1952b) did not to offer an alternative reason why the inverse relationship between money wages and unemployment is observable after dismissal of the money illusion property.

In another essay (Tobin 1952a), which was also published after revisions in *Essays in Economics*, alternative rationale for Keynesian labor supply is offered. Tobin (1971, p. 93) derives it from the *Pigou effect*. The reason why labor supply increases when money wage rises (even though real wage remains constant) is that the higher price level makes household poorer in wealth. As a result, they can afford less leisure and supply more labor.

Yet another brief attempt of explaining the non-neutrality of money in the absence of money illusion was offered by Tobin (1971, pp. 1–2). He stated that real consequences of a uniform change in all current prices stem from the disproportional change in other determinant variables. As those variables Tobin meant for instance assets, debts or future prices. Since it may take some time before these factors adjust to the new level of prices, there is no need to rely on money illusion in explaining the changes in labor supply, consumption and other real behavior.

Although, the alternative explanations of nominal inertia offered by Tobin are very brief and unpersuasive, he managed to decompose Keynes’ theory of labor supply. He showed that thanks to imperfect factor mobility and other reasons, rationality-based explanations are feasible. The problem, however, lies in the inconsistency incorporated in Keynes’ theory. This attack against Keynes’ non-homogeneous labor supply was the first step to the rejection of money illusion concept. The second step was the erosion of money illusion in Fisherian notion and in the theory of adaptive expectations that was caused by the revolution of rational expectations.

2.3 Robert Lucas, Jr.: Imperfect Information

The relationship between money wage and employment, embodied in Phillips curve, was examined by another influential economist – Robert Lucas, Jr. His view on inflation-output trade-off changed the notion of money illusion and became widely accepted. Lucas was convinced that there is no long run dependence and that there is no reason to base the short run trade-off on irrational behavior. However, before Lucas initiated the

revolution of rational expectations, he also relied on the concept of adaptive expectations, which was presented as a part of Friedman's theory in previous chapter.

In their joint paper, Lucas and Rapping (1969) construct and test a model of an American labor market. Similarly to Tobin, they use the adaptive expectations hypothesis and try to reconcile money illusion in the labor supply function with the rationality assumption. The authors also assume form of money illusion defined as labor supply not being homogeneous of degree zero in current prices and money wages. They emphasize that money illusion does not stem from irrationality or ignorance about the price level.

Instead, the authors (Lucas and Rapping 1969, p. 732) claim that: “*money illusion* results not from a myopic concentration on money values but from our assumption that the suppliers of labor are adaptive on the level of prices, expecting a return to normal price levels regardless of current prices, and from the empirical fact that the nominal interest rate does not change in proportion to the actual rate of inflation.”

Authors base that assertion first on Hicks' model of inter-temporal choice. In part, the money illusion is present, because the decision about the supply of labor is regarded as a multi-period decision problem. The intuition comes from Hicks (1946), who draws the wage stickiness from the confusion about transitory and permanent changes in prices. When agents expect that fluctuations of price level are only temporary, they may be reluctant to bargain for different wages. As soon as the parties of a wage bargain realize the change of price level is permanent, they adjust their expectations.

This explanation, however, does not explain the asymmetry in homogeneity of labor supply and demand. It is the asymmetry that was already criticized by Tobin to appear in Keynes' work: while he attacked the homogeneity property of labor supply, he did not challenge the view that demand for labor is derived from its marginal productivity. Lucas and Rapping also did not contest the homogeneity of labor demand.

Apart from Hicks' inter-temporal theory, their model builds also on the Tobin's (1952b) assumption of inelastic price expectations. This precondition provided rationale for the relationship between money wage and unemployment: labor supply increases when prices rise together with wages, because workers expect prices to return to their *normal* level. As a result, the expected value of real wage is increased and (since the nominal interest rate doesn't change proportionally) so does the expected real interest rate.

In contrast to Tobin, Lucas and Rapping were not trying to provide necessary consistency and rationality to agents in Keynes' theory. They were merely restating the hypothesis of adaptive price expectations and reconciling the presence of money illusion in labor supply with rational behavior. After rehabilitating the non-homogeneity of labor supply from the view of rationality, Lucas and Rapping (1969, p. 732) reach similar conclusion about Phillips curve as Friedman: it holds only as a short-run relationship and it is highly unstable in long run because the Phillips curve shifts for example due to changes in inflation rates and productivity.

In his revolutionary text, however, Lucas (1972) succeeded in excluding the concept of money illusion from his theory altogether. He replaced the hypothesis of adaptive expectations with a more satisfactory concept of rational expectations, which “permits

a treatment of the relation of information to expectations” (Lucas 1972, p. 104). The expectations are formed with the use of all available information and agents behave optimally according to their objectives and expectations. Lucas (1972) suppressed the factor of irrationality (in the form of money illusion) and the presence of a Phillips curve relationship is explained solely by informational frictions.

Lucas maintained the classical view of long run neutrality of money. The short run non-neutrality of money, resulting in general to a Phillips curve relationship, is caused by a mechanism that may be briefly explained as follows. Fluctuations of agents between number of markets, modeled as a partly stochastic process, results in movements of relative prices. Changes in nominal price level are, on the other hand, caused by changes in the quantity of money. The information concerning changes in states of both real and monetary economy is then transmitted to agents through prices. However, they are able to use only the price information from their own market. Such an informational friction forces “agents to hedge on whether a particular price movement results from a relative demand shift or a nominal (monetary) one” (Lucas 1972, p. 103). And this kind of *hedging behavior* causes that even monetary changes have real consequences as the agents are unable to distinguish them from real demand shifts in the short run.

Lucas (1972, p. 116–119) also showed that even in the model of economy constructed intentionally without any usable trade-off between inflation and real output, the convincing econometric evidence for such a trade-off emerges – similarly as in the real world. His political consideration then leads to the claim that a steady and known rate of monetary growth, in other words a *k-percent rule* as proposed by Friedman (1968), leads to a Pareto-optimal competitive allocation between markets.

The rational expectations theory became the most accepted concept of expectation formation until today, because Lucas’ model combines sophisticated formal representation with convincing and intuitive outcomes. Lucas achieved to dismiss the money illusion as an explanation of the non-neutrality of money and replaced it by the theory of imperfect information. As a result, the rational expectation revolution led to a change in the notion of money illusion. It became perceived as an unnecessary concept that contradicts the rationality of agents and their ability to form optimal decisions under constraints – the fundamental assumption of mainstream economics. The opening quote to this chapter by Tobin (1972) thus perfectly illustrates the change in perception of money illusion at the end of the 20th century.

2.4 Stanley Fischer’s Long-Term Contracts

Among those who accepted Lucas’ hypothesis of rational expectations belongs also Stanley Fischer, who offered yet another explanation of money non-neutrality. In his paper advocating the role of monetary policy, Fischer (1977) builds a model on rational expectations, but the source of nominal inertia is not based on informational frictions. It stems from the existence of overlapping labor contracts, which create a short-run stickiness in the model. Since the contracts are renegotiated less frequently than the authority is able to execute monetary policy, Fischer advocated its ability to influence

the short-run output. Traditionally, the monetary policy may not affect output in the long run.

Fischer's model does not require accelerating inflation, as advanced by Friedman (1968), nor *fooling* the agents by creating gap between actual and expected price level (Lucas 1973), for the monetary policy to be effective.³ Fischer (1977, p. 191) derives the role of the monetary policy from the assumption that "economic agents contract in nominal terms for periods longer than the time it takes the monetary authority to react to changing economic circumstances" and from two kinds of random disturbances, to which the economy is subjected: real supply disturbances and nominal demand disturbances.

Both of these assumptions are crucial for Fischer's defense of activist monetary policy. Fischer (1977, p. 195–197) further assumes that monetary authority follows a rule to accommodate disturbances that is publicly known and that wage contracts set the nominal wage to maintain constant real wage. However, Fischer also adds that altering any of these two additional assumptions about monetary rule or wage setting objective would not seriously change the outcomes of the model.

In the first scenario, wage contracts are made only for one period and the current shocks can be identified neither by public nor by the monetary authority. As a result, monetary policy is unable to offset them and money is neutral. In the second scenario, on the other hand, wage contracts are negotiated for two periods. Consequently, "there is time for the monetary authority to react to new information about recent economic disturbances" (1977, p. 199) whereas those in the second year of their contract are unable to respond. Even indexing the wage contracts in its common form does not preclude monetary policy to affect the output according to Fischer (1977, p. 201). For this to happen, the indexation would have to account for both price level and profit sharing, which is not usual in practice.

Fischer (1977, p. 200), however, warns about too frequent use of the monetary policy. Since the effectiveness is ensured by affecting the real wage of those in the second year of their labor contract, too activist policy may lead to a change in the structure of contracts in the economy. This is a conclusion already reached by Lucas (1976).

Furthermore, Fischer (1977, p. 194) admits that his paper does not include proper microeconomic foundation for the existence of long-term contracts. He only mentions that minimization of real wage variance and the reduction of cost stemming from frequent negotiations about wage and terms of the contract belong to the reasons leading to their emergence. He states that his argument is therefore mainly derived from "the revealed preference of economic agents for long-term contracts" (Fischer 1977, p. 202).

By relying on the existence of long-term contracts, Fischer builds an argument for activist monetary policy, even when the expectations are formed rationally and the monetary rule is both publicly known and fully anticipated. When the wage contracts are fixed, a gap between actual and expected wage contracts emerges as the result of authority's reaction to the disturbance occurring during the time of the contract.

³Note that even accelerating inflation is not sufficient when agents form rational expectations.

The authority may therefore choose between the stabilization of price level and the stabilization of output.

Although Fischer offers competing explanation for money non-neutrality to Lucas' theory based on incomplete information, the same cannot be stated about the theory of money illusion without a brief discussion. Admittedly, Fischer (1977, p. 195) accepts the assumption that agent set the nominal wage with the real wage in mind, but he also emphasizes the possibility to replace it with another assumption without affecting the important results of his model. The main feature that brings Fischer close to money illusion is exactly the agents' preference for long-term contracting in nominal terms.

This cornerstone of Stanley Fischer's theory is interlinked with the idea of money illusion from the very beginning. It was already discussed in section 1.1 that Irving Fisher (1928) pointed out the manifestation of money illusion in long term wage contracts that, without a good reason, do not take inflation into account. Contracting in nominal terms in the environment with changing purchasing power of money is an indication of money illusion according to Akerlof and Shiller (2009) as well. Akerlof and Shiller (2009, p. 47–48) emphasize that according to data of Canadian union contracts from 1976–2000, only 19% of the wage contracts had cost-of-living adjustment. And even among those 19%, the indexation provided much less than one-to-one inflation adjustment. Although they admit it is possible to avoid money illusion even without indexation, i.e. by adjusting the wage for expected inflation when the contract is made, it seems to them very unlikely in the light of such evidence. Also Shafir, Diamond and Tversky (1997) approach the lack of indexation as an indication of money illusion and include long-term contracting behavior in their survey.

Aside from the fact that the non-indexed contracts incorporate the element of irrationality, nominally specified wage contracts also cause the labor supply not to be homogeneous of zero degree in the periods of time between the renegotiations of the contract. Thus Fischer's theory is prone to a presence of money illusion in either Fisherian or even Keynesian tradition.

The difference between proponents of money illusion and Fischer is following: Though perfect indexation to price level is unlikely to occur, its implementation would deny the presence of money illusion. However, even the presence of perfect indexation that accounts for inflation in one-for-one manner would not destroy Fischer's argument about the money non-neutrality. In other words, his argument does not depend on agents being subjected to money illusion. And because Fischer does not offer a microeconomic basis for emergence of long-term contract, it is unclear, whether his explanation of contracting in nominal terms would presume money illusion, as it is usual for other authors (e.g., Fisher 1928, Shafir, Diamond, and Tversky 1997 or Akerlof and Shiller 2009).

In conclusion, Fischer's theory of long-term contracts as an explanation of money non-neutrality contains factors often discussed together with the concept of money illusion. Between those belongs especially the agents' tendency to contract in nominal terms as an element of irrationality and the non-homogeneity of labor supply (or even other supply and demand functions) in short-term. But since Fischer's theory is not decomposed by precluding money illusion and it does not offer microeconomic foundation explaining

the emergence of the long-term contracts by money illusion, it ought to be regarded as a competing theory.

2.5 Denial of Money Illusion in the 1970s and 1980s

The aim of this chapter was to put into context the changed notion of money illusion in the 1970s and 1980s. The efforts to avoid breaching the postulate of rationality started with the critic of Keynesian concept of money illusion by Tobin, who showed the inconsistency of non-homogeneous labor supply function. It then culminated with the revolution of rational expectations, which lead to the rejection of money illusion as assumed by the adaptive expectations hypothesis.

Except from Lucas' explanation of money non-neutrality by incomplete information, many other theories emerged to replace the unsatisfactory rationale offered by money illusion. This chapter presented the early theory of Hayek and also Fischer's explanation, which already builds on the rational expectation formation, because those two are particularly relevant to the money illusion discussion. However, it is important to note that many other theories emerged to theoretically underpin the nominal inertia, for instance the very well-known cost of price adjustment hypothesis by Mankiw (1985).

As a result, the money illusion concept vanished from the economic literature in the 1970s and 1980s. The article by Modigliani and Cohn (1979) represents a rare exception. In this paper, authors examine the hypothesis that stock market investors discount real cash flows with nominal discount rates, i.e. they suffer from a form of money illusion. This thesis discusses their article in section 3.3, together with other empirical works on related topic from the 2000s (e.g., Cohen, Polk, and Vuolteenaho 2005, or Brunnermeier and Julliard 2008).

Despite all of that, the phenomenon of money illusion was revisited again in the 1990s from the viewpoint of behavioral economics and found its way back into scientific literature. Later, it also appears in the work of several authors belonging to New Keynesian economics. Next chapter discusses the revival of money illusion due to these two schools of economic thought and due to the empirical works mentioned earlier.

3. | The Revival of Money Illusion

“In fact, I am persuadable – indeed, pretty much persuaded – that money illusion is a fact of life.”

– Alan S. Blinder, 2000

This chapter introduces several ways how the phenomenon of money illusion returned into economics during past two decades. In 1990s, results of the extensive survey by Shafir, Diamond, and Tversky (1997) indicated that money illusion plays a role in human decision-making process. This work provided the concept of money illusion with a psychological background and returned it into economic discussion. Later, money illusion appears also in the work of New Keynesian economists, who mainly focused on its aggregate effects. First, this thesis presents the experiment by Fehr and Tyran (2001), who link money illusion with strategic complementarity. Then, the model with near-rational agents by Akerlof et al. (2000) is discussed together with their restatement of the long-run Phillips curve. The last part of this chapter introduces some of the recent empirical and theoretical works pointing to money illusion effects on asset prices.

3.1 Psychological Account of Money Illusion

After the dismissal of money illusion in the conception of Keynes and Friedman in the 1970s and 1980s, Shafir, Diamond and Tversky (1997) come with their survey titled “Money Illusion”, which more than anything else takes us back to Fisher (1928) and his account of this phenomenon. These three behavioral economists follow Fisher’s tradition for instance by the omnipresence attributed to money illusion in their work or by the acceptance of irrationality in human behavior. The authors, although mentioning the consequences of money illusion in form of *stickiness* of wages and prices, focus on the psychology that underlies it and leave the macroeconomic implications to others.

The main step forward from Fisher’s theory is the detailed explanation of the emergence of money illusion in human perception. Shafir, Diamond and Tversky (1997, p. 342) do not assume people to be unaware of inflation and instead they propose “a psychological account of money illusion based on the presence of multiple representations.”

The authors describe two representations of economic transaction. The nominal representation, which is simpler and more salient, is often sufficient for the short-run, because price level tend to stay constant. On the other hand, the real values of transactions is captured only by the representation in real terms. Although people are aware of the difference between representations, they show a bias towards nominal terms, as money is a more natural unit for them. As a consequence, the evaluation of transaction is usually a mixture of both assessments and from that, money illusion emerges. In other words, Shafir, Diamond and Tversky (1997, p. 366) define money illusion as “a bias in the assessment of the real value of transaction, induced by their nominal representation.”

Similarly to Fisher, Shafir, Diamond and Tversky (1997) discuss money illusion in numerous areas of human life and show its manifestation on the survey results. Despite the use of surveys, which has obvious limitations, persuasive evidence of money illusion is presented in this paper. Authors achieve that by combining carefully constructed survey questions presented to a large groups of people with a clearly explained underlying theory.

The presence of money illusion is discussed and illustrated for instance in the settings of long-term contracts. Shafir, Diamond and Tversky (1997) draw attention to lack of indexed contracts in the practice and also to that fact that such contract are only slowly introduced when inflation rises, but they tend to disappear after the price increase slows down. This leads them to an interesting conclusion that money illusion is not eliminated in time by learning. On the other hand, authors emphasize that indexed contracts may be perceived as riskier to a nominally risk-averse agent, since the final amount is likely to change in nominal terms. This conclusion is also confirmed with the experimental evidence.

Furthermore, Shafir, Diamond and Tversky (1997, p. 361–363) present the prevalence of money illusion in accounting. They point out that money illusion may be found not only in mental accounting of individual agents, but also across the variety of traditional accounting methods and standards. The authors mention methods like FIFO and LIFO, relying on historic prices, as well as the U.S. tax laws, which do not take proper account of inflation.

Authors of the survey also emphasize that changing value of money is not necessary for money illusion to emerge – there only has to be a change in relative prices. Shafir, Diamond and Tversky (1997, p. 347) illustrate it on the example of someone selling a house in noninflationary times with the intention of buying another one. If the prices of real estate fell down relative to other prices, a person may be inclined to anchor on the historical price of the house and may be reluctant to accept a lower price even if aware of the true value of houses at that time.

In this case, the true value is the real representation and the historical price is a nominal anchor. According to author’s theory, the reaction is determined by both. They state that assuming real value constant, the reaction will be determined by the nominal anchor and the change in current prices – and since the loss aversion occurs relative to a *nominal* reference point, such anchoring represents just another case of money illusion.

This point of view is very important because, according to previous literature on money illusion (e.g., Fisher 1928 or Friedman 1968), the elimination of inflation would be sufficient to restore rational behavior. Shafir, Diamond and Tversky (1997, p. 367) reject this postulate and they believe that systematic departures from rational behavior go beyond reactions to inflation. They show on their survey results that money illusion is interconnected with other phenomena like loss aversion, fairness concerns, underweighting of opportunity cost and undue influence of sunk cost.

In this framework, which is very different from the classical models with rational agents, Shafir, Diamond and Tversky (1997) raise the question, whether different rates of inflation may have normative consequences for the economy. This proposition is derived from the survey results, because decisions concerning housing and work seem particularly influenced by the money illusion. In addition to that, authors also notice a strong tendency of people to derive their work satisfaction from nominally expressed income, which further supports their argument.

Since Shafir, Diamond and Tversky (1997) recognize that agents base their work decisions on nominal rather than real terms, they arrive at the conclusion of non-homogeneous labor supply. They admit this finding is nothing new and acknowledge the similarity of their money illusion conception with the Keynesian theory of labor market. Authors supplement their view with evidence from the survey, however, they avoid the discussion about macroeconomic consequences. Although they presume traditional effects of money illusion in form of nominal inertia, they make only a general conclusion that labor market and housing market equilibrium are (partially) determined by the current rate of inflation.

However, because the authors do not spend much time going through the specific effects of the money illusion at the aggregate level, they also do not resolve the Keynes' inconsistency problem. As Tobin (1971) pointed out, the problem of Keynesian labor supply is that money illusion is assumed only for one part of the market. As soon as both sides of the market are assumed to be deceived by the veil of money, which would be more logical, the outcomes of the model change significantly.

Authors furthermore discuss the impact of inflation on financial investment decisions, which is mainly adopted from an unpublished study by Thaler and Tversky (1996). In this experiment, two groups of subjects carried out investment decisions – one of them did it in inflationary environment and the other one dealt with zero inflation. In accordance with money illusion, the inflationary settings had serious impact on the allocation of subject' portfolios. Since the increasing price level hid some of the real losses, the investments of subjects from the inflation conditions were much more oriented towards riskier assets. The mean allocation of risky funds was 71.5 percent in the group dealing with inflation in contrast to 42.3 per cent of the no-inflation group. The confusion between nominal and real gains, which was already discussed by Fisher (1928), is according to Shafir, Diamond and Tversky (1997) another indication that choice of inflation target may have substantial normative consequences.

From the illustrated omnipresence and importance of money illusion emerges authors' desire to incorporate this concept into formal economic models. They wish so in accor-

dance with the presupposition that even small departures from optimality at individual level may result in significant changes in the economic equilibrium. Although Shafir, Diamond and Tversky (1997, pp. 368–370) do not specify expected outcomes of such models, they offer an illustration of the money illusion incorporated to the labor supply function. Authors chose to extend the model of efficiency wages from Solow (1979) and, apart from real wage concerns determining the supply of effort, additional concern about nominal wage increases is introduced. The result is a model with interaction between real and nominal rigidities.

However, the assumption of the model that continuous relationship exists between cost of raising wages and the workers' effort seems implausible, because Shafir, Diamond and Tversky (1997, p. 371–372) recognize resistance to wage cuts. The reluctance to accept wage cuts by workers may in turn result in a more compressed wage schedule of firms in order to avoid them. Both of these effects lead to further implications for allocation of workers and the aggregate level of employment. Authors therefore propose to model money illusion both on the part of the workers and the firm – this time, however, without a practical illustration.

To sum up, the paper of Shafir, Diamond and Tversky (1997) demonstrates that money illusion is widespread among economic agents. In contrast to the works from the 1970s and 1980s, they embrace the lack of rationality in human behavior and discuss also number of other concepts that often accompany money illusion. The authors' main contribution consists in the psychological framework of money illusion they offer. Their theory builds on the Fisherian account of money illusion and resolves some of its limitations. For instance, the authors did not rely on the changing purchasing power of money in order to explain irrational behavior.

Since authors mainly discuss modeling of money illusion in the labor market, the comparison with Keynes' notion is also desirable. Unlike Keynes, Shafir, Diamond and Tversky propose incorporating money illusion to both labor supply and demand. Despite the fact that they do not deal with the outcomes of such models, their work is a milestone in the history of the money illusion. That is because they achieved to return the term of money illusion into economic discussion. It is important to note, though, that this renewed interest in money illusion does not reflect the opinion of mainstream economic science as it did in the time of its recognition.

3.2 New Keynesian Economics

The following section presents works belonging to New Keynesian economics that reopened the topic of money illusion and examined mainly its macroeconomic consequences. First, this thesis presents experiment by Fehr and Tyran, who believe money illusion was prematurely dismissed as an explanation of nominal inertia. They derive substantial effects from small level of individual level irrationality, which is amplified by a coordination problem. Next, new long-run Phillips curve by Akerlof, Dickens and Perry is discussed. Their model with near-rational agents offers an alternative to

commonly accepted concept of the natural rate of unemployment and relies on money illusion.

3.2.1 Money Illusion and Strategic Complementarity

Whereas Shafir, Diamond and Tversky (1997) believed that small amount of individual level money illusion would have large consequences for the whole economy, there is a line of criticism that objects this point of view. The money illusion may also cancel out at the aggregate level and in that case proving human tendency to think in nominal terms is not enough to make it responsible for nominal inertia with macroeconomic consequences.

To examine whether in fact money illusion may be maintained as the explanation of the non-neutrality of money, Fehr and Tyran (2001) carried out experiment with a price-setting game. Its crucial assumption is the settings of strategic complementarity. Under this condition, it is beneficial for the players to set their prices in line with others and therefore choose sticky prices if they expect others are reluctant to change price. The results of this experiment showed that indeed even a small amount of individual level money illusion may cause considerable aggregate effects in the form of nominal inertia. Moreover, authors came to the conclusion that such effects are quite asymmetrical. The sluggish nominal price adjustment may be observed in the case of a fully anticipated negative shock, however, after a positive shock prices return to equilibrium relatively quickly.

Fehr and Tyran (2001, p. 1239) claim that the dismissal of money illusion as a potential candidate of the non-neutrality of money was premature, but they do not wish to contest the potential relevance of other explanations. In their setting, informational frictions, staggered contracts and the cost of adjustment are absent.

Similarly to Fisher, authors of this article distinguish direct and indirect effects of money illusion. The direct effects consist in individual optimization mistakes, i.e. losses resulting from taking nominal payoffs as a proxy to real payoffs. These effects are put aside a little bit in the experiment. The indirect effects, on the other hand, arise from expectations that other agents suffer from money illusion. In case of the strategic complementarity it is profitable not to fully adjust to equilibrium if others also do not fully adjust. Therefore, expecting other agents to be prone to money illusion leads to a so-called *snowball effect* (Fehr and Tyran 2001, p. 1241) that causes substantial nominal inertia, even when individual level irrationality is low.

However, these outcomes are conditioned on the settings of strategic complementarity. In the environment of strategic substitutability, there are incentives for agents to partially compensate for the suboptimal behavior of those suffering from money illusion. Under strategic substitutability it is beneficial for players of the price-setting game to change their price in opposite direction than others. Then, even when players assume their opponents have money illusion and do not fully adjust to equilibrium, the economy gets to a new post-shock equilibrium at a relatively high pace.

In order to isolate the effect of money illusion, Fehr and Tyran (2001) examine the behavior of identical firms in a pricing game before and after exogenous and fully ex-

pected monetary shock. They decided to rely on the laboratory settings to ensure all the necessary conditions that are rarely possible when using field data. As a result, their experiment takes form of a simultaneous n -player game under strategic complementarity with unique equilibrium and it is divided in the pre-shock and post-shock phase. The player set their prices in each of $2T$ periods of the game and the interaction takes place anonymously via computer terminals, where pay-off matrices are also displayed.

The most important part of the experiment is the division into four treatment conditions, which differ along two dimensions. Along the first dimension it is determined whether pay-offs are displayed in real or nominal terms. The second dimension concerns the subjects' opponents, which can be either humans or preprogrammed computerized players. Based on the framing and on whom the subjects face, games in following conditions are observed: real treatment with computerized opponents, nominal treatment with computerized opponents, real treatment with human opponents and nominal treatment with human opponents.

Comparison of the speed of adjustment to equilibrium after an anticipated shock then yields the separated direct and indirect effects of money illusion or other possible irrationalities. However, before start of the experiment subjects had to solve series of computational problems, which consisted in calculating real payoff from the nominal payoff. This training exercise served to eliminate the possibility that subjects are at all unable to deflate nominal values. As such, it may have led to decreasing of subjects' money illusion at the individual level – and it was partially authors' aim, since they were mainly interested in the indirect effects of money illusion.

Figure 3.1 shows the evolution of average price through the experiment in all the treatment conditions. The speed of adjustment from old equilibrium (in which the average price equals 18) to new equilibrium ($\bar{P}^* = 6$) determines the nominal inertia. Since the case of real treatment with computerized opponents show very rapid and precise adjustment to the new equilibrium, Fehr and Tyran (2001) exclude other forms of individual level irrationality other than money illusion. The setting with nominal framing and computerized opponents reveals nominal inertia caused solely by individual level money illusion. The results show a small amount of money illusion at the individual level. As compared with the real framing, where all subjects instantaneously adjust their prices to the new equilibrium value, in the nominal framing only 80 per cent do so (Fehr and Tyran 2001, p. 1249). As a result small income losses emerge in the period after shock.

In the real framing with human opponents, individual level irrationalities other than money illusion may also play a role. Apart from that, players face more complicated coordination problem that may slow down the adjustment to equilibrium after shock. In this settings, Fehr and Tyran (2001, p. 1252) initially observed considerable nominal inertia. However, after a few periods prices get quite close to the new equilibrium and this effect appears rather low. Since authors rejected presence of other irrationalities, the real income losses in these treatment conditions are in full ascribed to the coordination problem. In the first periods losses due to disequilibrium reach to 52 per cent, but they are quite quickly reduced to less than 10 per cent. Fehr and Tyran (2001, p. 1252) also

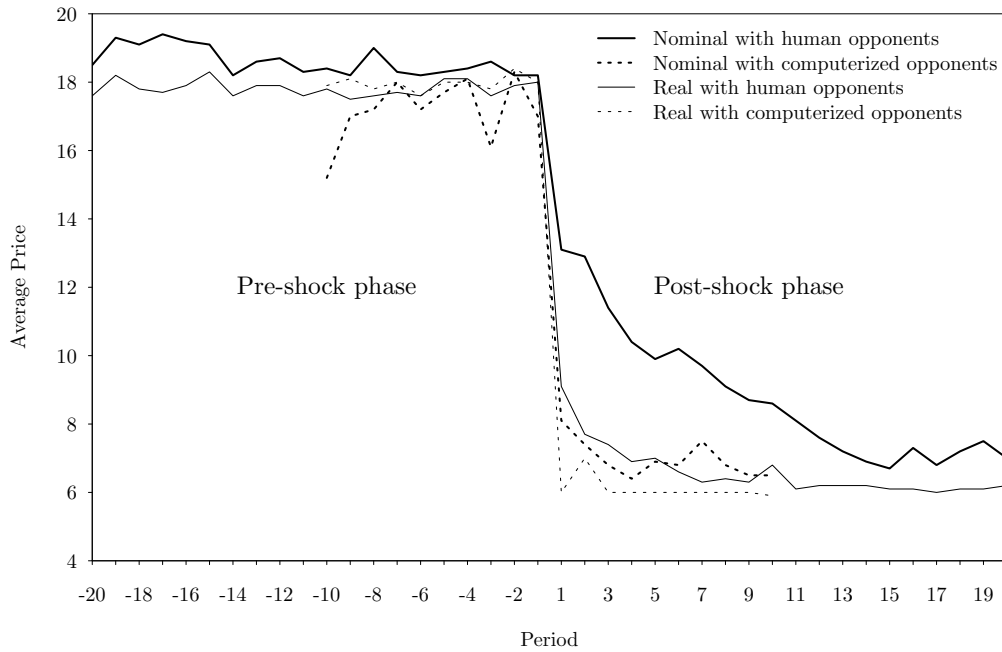


Figure 3.1: The Experiment Results: Evolution of Average Prices

Source: Fehr and Tyran (2001)

monitor decrease in players' confidence after the shock and present it as supplementary evidence of the coordination problem explanation.

Finally, authors examine the adjustment to equilibrium in the treatment conditions of nominal framing with human opponents. In these settings the coordination problem appears together with individual level money illusion. In other words, both direct and indirect effects of money illusion are combined and may cause nominal inertia. Fehr and Tyran (2001, p. 1253) observe large and long-lasting effects when nominal frame is introduced in the setting with human opponents. Significantly slower adjustment to equilibrium is visible also from Figure 3.1. The increased price stickiness caused by the anticipated negative monetary shock is associated with serious real income losses as well: it is 65 per cent in the first period and the decrease is rather slow.

The comparison with other treatment conditions indicates that even a relatively small amount of individual level money illusion may cause large indirect effects. Fehr and Tyran (2001, p. 1254) believe that the large indirect effects are caused by the existence of subject who employ a simple rule of thumb and use nominal payoffs as a proxy for real payoffs. These subjects are then reluctant to cut prices after negative nominal shock and it induces others to keep higher prices too. Authors show that apart from inflexible prices, sticky expectations are also observable, which further supports their hypothesis.

To see whether it is really the case, authors test also effects of a positive monetary shock. Since the adjustment to higher prices after a positive monetary shock means also higher nominal payoff, they expect much faster adjustment to the new equilibrium than in the case of negative shock. Their experiment results show indeed an asymmetric reaction. Whereas money illusion in the case of a negative shock causes a downward rigidity of prices, it does not cause a reluctance to adjust the prices upwards. Fehr and Tyran (2001) point out that their rationale is also confirmed by field evidence of asymmetric reactions to a monetary shock reported in several works (e.g., Cover 1992).

This asymmetry is reminiscent of the Keynesian conception of money illusion. Fehr and Tyran (2001, p. 1239) however limit their analysis to a pricing game and state that their results cannot be directly related to downward wage rigidity. They also only examine a particular form of money illusion, in which subject use nominal payoffs as a proxy for real payoffs. In contrast to Keynes, they offer a detailed theoretical foundation for their claim and, thanks to the assumption of strategic complementarity, avoid the inconsistency criticized by Tobin. Fehr and Tyran are focused on the indirect effects of money illusion and the direct effects are suppressed in order to show the amplification of individual level irrationality on the aggregate level. Nevertheless, some amount of individual money illusion is not denied by their work.

The strategic complementarity is a crucial assumption according to Fehr and Tyran (2001) when money illusion ought to be considered as the cause (or one of the causes) of nominal inertia. Although authors partially adopt the psychological account of individual money illusion elaborated by Shafir, Diamond, and Tversky (1997), an innovative approach to deal with its aggregate effects is presented in the article. In their view, they stem mainly from the agents' expectations about others and from the coordination problem. This is what distinguishes the experiment of Fehr and Tyran (2001) from previous theories of money illusion.

The experiment of Fehr and Tyran (2001) became an influential piece of work and as a result it also became frequently cited and retested by other authors. For instance, Petersen and Winn (2012) modify the original experiment and argue that the lower speed of adjustment is caused rather by increased cognitive load in the nominal framing and observe only limited effect of money illusion.¹ The experiment was also extended by Chytilová and Chytil (2014), who test whether economically educated individuals may be able to pierce the veil of money and as a result dampen the macroeconomic consequences of money illusion. They conclude that effects of money illusion are present and amplified even in the economy with well-educated individuals. Other recent works, e.g. Basak and Yan (2010) or Brunnermeier and Julliard (2008), emphasize Fehr and Tyran's contribution to the revival of money illusion concept.

¹In their response to this article, Fehr and Tyran (2014, p. 1063) defend their original results and interpretation as follows: "[Petersen and Winn] use an exceedingly narrow and psychologically implausible definition of money illusion that is not in line with the definition of money illusion as a behavioral consequence of the veil of money that economists have traditionally been using." Fehr and Tyran are confident that with proper interpretation even the experiment of Petersen and Winn supports their original hypothesis.

3.2.2 Near-Rationality and the New Long-Run Phillips Curve

The concept of near-rationality follows the Keynesian tradition, which disputes perfectly rational and maximizing behavior of agents and adds psychological perspective into economics. It is based on the presumption that agents may follow rules of thumb, be inclined to irrationalities or consider various other psychological and sociological factors. The survey of Shafir, Diamond, and Tversky (1997), which has been already discussed, linked such behavior to money illusion. However, it did not answer the question of its consequences at the macroeconomic level.

The article by Akerlof and Yellen (1987) proposed to include such near-rational behavior into economic models to better capture events of the real world. Eventually, Akerlof et al. (2000) came up with a model that translates near-rational wage and price setting into a new long-run Phillips curve. The main idea of the model is following: since full rationality involves subjective and objective costs and it may require overcoming some perception threshold or behavioral inertia, non-rational behavior may be preferable as long as the cost of resulting sub-optimality are lower. Then, for modest levels of inflation, Phillips curve relationship exists even in the long run. However, if inflation increases, the costs of being less than perfectly rational increase as well and consequently all people switch to fully rational behavior. From some point, the long run Phillips curve becomes vertical.

Akerlof et al. (2000) start with the critique of Friedman's presidential address. Authors disagree with the idea of natural rate of unemployment and its empirical counterpart, NAIRU. Their main argument is that "low and stable rates of inflation have coexisted with a wide range of unemployment rates" and that, even under rational expectations, stabilizing monetary policy is feasible due to small amounts of price and wage stickiness (Akerlof et al. 2000, pp. 1–2).

Authors are confident that individuals tend to base their decisions on simplified models rather than acting perfectly rationally at all times. They base it on the premise that losses due to near-rationality may be small, while being fully rational brings additional cost. Akerlof et al. (2000) offer three main reasons why they expect agent to treat changes in price level differently than usually appears in economic models. First, inflation may be entirely ignored as long as it is low and therefore does not reach a threshold of salience to be perceived. Second, even when inflation is accounted for, less than complete projection of anticipated rise in prices is made. The third important departure from perfect rationality stems from the way inflation is perceived by workers. Akerlof et al. (2000, p. 8) believe job satisfaction may be enhanced by nominal wage increases even if they fail to fully reflect inflation, as long as real wages are not considerably eroded. That means that firms face different efficiency wage constraint at low and high level of inflation.

If that is the case, increasing inflation to a modest value enables lower levels of unemployment to be sustained. The consequence of these departures from rationality is then consistently lower level of prices and wages relative to nominal aggregate demand than it would be under zero inflation. From that Akerlof et al. (2000, p. 4) derive a restatement of the long-run Phillips curve.

In the paper, simple formal model taking account of the behavioral aspects described above is introduced. In this model, firms pay efficiency wage to minimize labor cost of production. The morale of workers is determined by perceived opportunities outside the firm, i.e. by the level of unemployment and their reference wage.² Firms set prices and wages one period ahead, in which anticipated inflation is incorporated through the reference wages of their workers. There are fully rational firms and near-rational firms that differ in the extent in which they account for inflation – they may incorporate it in full, underweight it or totally ignore it. The wage differs for the types of firms, but the differences do not cumulate and they are small in case of moderate inflation. Akerlof et. al (2000, p. 14) show that firms' losses from being near-rational are small at levels of inflation levels near zero. These losses are ignored until they reach a given threshold and firms switch to fully rational behavior.

As a result of this model, Akerlof et. al (2000, pp. 15–16) derive short-run and long-run Phillips curve. The short-run Phillips curve is similar to the usual inflation-augmented Phillips curve, where a fraction of expected inflation is ignored. This fraction is determined by the ratio of near-rational firms and by the extent in which inflation is being disregarded.

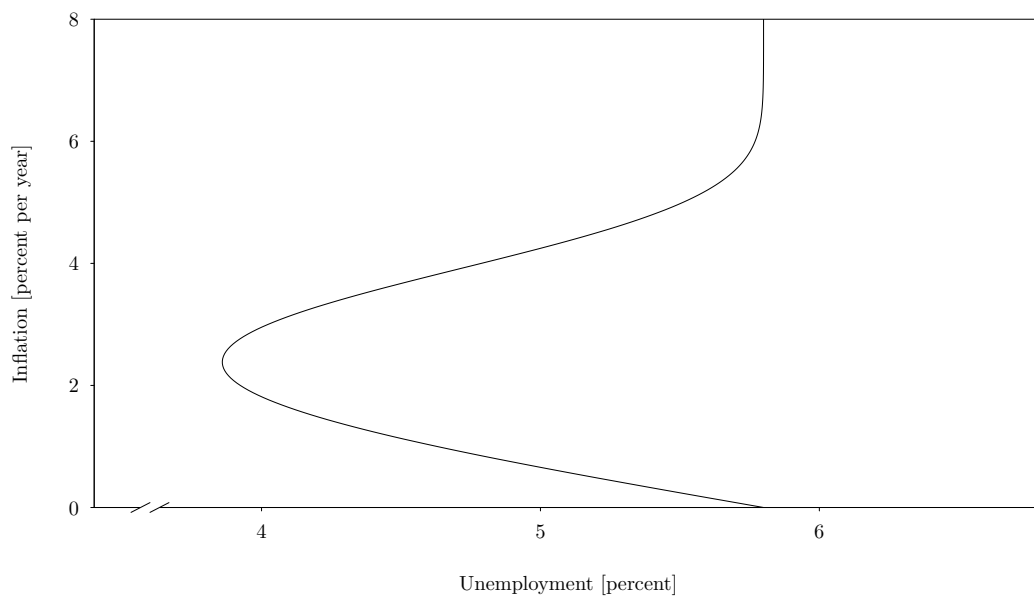


Figure 3.2: The Long-Run Phillips Curve with Near-Rationality

Source: Akerlof et al. (2000)

The derived long-run Phillips curve is depicted in Figure 3.2. It has inward bowed shape at low levels of inflation. At zero inflation, unemployment is at its natural rate and

²The reference wage gives workers perception of the wages of other workers outside their firm (Akerlof et al. 2000, p. 11).

at high rate of inflation it is vertical, since at some point all firms adopt fully rational behavior due to the increasing cost of near-rationality. At the vertical part of this long-run Phillips curve, the unemployment is again at its natural rate. However, at inflation greater than zero the unemployment is below its natural rate and the natural rate is its asymptote as inflation rises. Akerlof et. al (2000, pp. 15–16) stress that this shape of LRPC is caused by inflation being underweighted, not by being underestimated.

Authors supplement their theory by related empirical evidence. They present the estimation of traditional Phillips curve with time-varying parameters³ motivated by the analysis of Brainard and Perry (2000). Their results agree with the previous research and state that the coefficient of the lagged inflation highly varies while intercept and the coefficient of inverse unemployment rate are rather stable. Akerlof et. al (2000) interpret the variation in response to inflation as a change of pattern in price and wage setting behavior during the times of lower and negligible inflation.

Then authors investigate whether the coefficient of expected inflation is lower in extended periods of modest inflation and increases in times of more serious levels of inflation. Their results are supportive of the presented hypothesis. Finally, authors attempt to estimate the parameters of their long-run Phillips curve in order to provide recommendations for economic policy. They reach the conclusion that macroeconomic policy should aim for the rate of inflation between 1.5 and 4 per cent (Akerlof et al. 2000, p. 39).

Akerlof et al. discuss the theory of natural rate of unemployment (Friedman 1968) as a special case of their general model and enrich it by psychological framework of irrationality. The implied money illusion is based on the old-fashioned conception by Fisher (1928), but it is far more elaborated. Unlike Fisher, agents' money illusion is not that omnipresent and limitless. While simplified thinking – i.e. thinking in nominal terms – is natural and preferred, it disappears as soon as the cost of being deceived by money illusion outweigh the cost of being fully rational. However, these small levels of individual irrationalities lead to important macroeconomic effects.

The similarity with the theoretical background of Shafir, Diamond, and Tversky (1997) is noticeable. There are psychological roots in both works discussing the bias towards nominal representation, which is more simple and salient. Also, it was mentioned that according to Shafir, Diamond, and Tversky (1997) money illusion is not eliminated in time by learning. The construction of new long-run Phillips curve by Akerlof et al. (2000) based on money illusion indicates the same belief.

Furthermore, the relict of Keynesian labor supply is present in Akerlof et al. (2000), since authors make the assumption that relative wage to other workers determines the supply of labor. Keynes' argument of non-homogeneous labor supply was based on the imperfect mobility of labor, which caused that relative real wage moved together with the nominal wage. For the workers, who react to changes in the relative real wage, it seems that their labor supply is determined by the nominal wage. However, the exact mechanism was not explained by Keynes (1936). According to him, workers

³The previous work in the NAIRU framework allowed only for the intercept to vary (Akerlof et al. 2000, pp. 19–20).

just instinctively behave in this manner without even realizing the complexity of the problem they were solving.

Akerlof et al. (2000) incorporate the same assumption by using the efficiency wage approach. However, the non-homogeneity of labor supply is given by the psychological aspects of the workers. Authors follow the logic of Shafir, Diamond, and Tversky (1997) and state that small changes in inflation are ignored since workers react only to salient changes that incur non-negligible cost. Authors provide both detailed theoretical explanation and formalization of this phenomenon. Though, they are unable to avoid the Keynesian inconsistency: when workers suffer from money illusion when supplying labor, they ought to exhibit this decision-making pattern also in other markets. The problem is that when non-homogeneity is imposed on some other supply and demand functions, money illusion begins to operate in the opposite direction. That makes it unable to explain the inflation-unemployment trade-off implied by the non-vertical Phillips curve.

To sum up, Akerlof et al. (2000) try to resurrect the hypothesis of long-run trade off between inflation and unemployment. Their theory incorporates rich background from previous literature on money illusion and provides it with rigorous model. The rational expectation hypothesis is accepted, however, agents' desire for simplified world perception is the cause of underweighting inflation even under this assumption. Moreover, authors present very thorough and convincing empirical evidence to support their hypothesis. The cast of doubt over the coherency of their theory emerges due to Keynes' inconsistency problem, which is not properly addressed. Nevertheless, authors offered interesting hypothesis and their paper polished the theory and modeling of how agents are prone to money illusion at different levels of inflation, by including the cost-benefit analysis of rational behavior.

3.3 Recent Research on Money Illusion and Asset Prices

The refinement of theoretical underpinnings of money illusion led to a number of recent works on this topic. For instance, Cohen, Polk, and Vuolteenaho (2005) decided to retest the Modigliani-Cohn hypothesis from the 1970s. In the original paper, Modigliani and Cohn (1979) explored the possibility that stock market investor discount real cash flows at nominal discount rates, which makes them suffer from a particular form of money illusion.

Modigliani and Cohn (1979) further proposed that while stock market investors are prone to this type of error, it does not concern bond market investors. That is caused by the difficulty of estimating long-term future growth rates of cash flows. Since nominal bonds have constant cash flows in nominal terms, its growth rate estimation is not difficult for an investor operating in a nominal mental frame. The estimation of long-term expected growth of cash flow for stocks is much more complicated. If the investor assumes that earnings and dividend growth are constant in nominal terms and, in fact, they are constant in real terms, inflation plays a role in her valuation of the stock. In times of high inflation, the equilibrium price of stocks would be undervalued and it will

be overvalued when inflation is low. The results of their analysis confirm that investors indeed commit such type of error, i.e. the money illusion is present in the stock market.

Cohen, Polk, and Vuolteenaho (2005) came with an enhancement to separate the money illusion effect from the impact of investors' attitude towards risk. While previous research has focused on the aggregate time-series predictions, they develop and test cross-sectional predictions of the Modigliani-Cohn hypothesis. Authors simultaneously examine the pricing of Treasury bills, safe stocks and risky stocks to separate the effects of money illusion and changing attitudes toward risk. Their results indicate that stock market investors are prone to money illusion regardless of their exposure to systematic risk.

They also come to the conclusion that high inflation causes investors to undervalue the stock market and low or negative inflation to overvalue it because investors erroneously assume long-term earnings and dividend growth to be constant in nominal rather than real terms. Cohen, Polk, and Vuolteenaho (2005, p. 643) also add that correction through arbitrage by rational individuals is very improbable, as it "requires long holding periods for the arbitrage positions along with significant exposure to volatility." However, it is important to note that the analysis is hindered by one critical assumption. Since the authors assume that investor use Sharpe-Litner capital assets pricing model (CAPM) for the risk evaluation, their results may have also been caused by the incorrect model of risk.

Later, the presence of money illusion was examined by Brunnermeier and Julliard (2008) in the housing market. This market is according to authors particularly well-suited for examining the effects of money illusion, since frictions are very common (e.g. short-sale constraints) and make possible mispricings difficult to remedy by arbitrage. Their work also identifies the form of money illusion when nominal and real interest rates are confused by agents. In particular, they state that simple comparison of monthly rent and monthly mortgage payments lead to underestimation of real future mortgage cost when inflation is low. This mechanism may run up housing prices when inflation declines and vice versa.

To isolate this effect, Brunnermeier and Julliard (2008) control for other factors of price changes in housing market and they do that in two steps. First, they calculate the price-rent ratio to capture the movements that affect rents and housing prices symmetrically. Then they take into account also rational channels through which inflation influences the price-rent ratio. One of them is, for instance, the *proxy effect* – since high inflation is a bad signal of future economic conditions, it may decrease housing prices even with illusion-free agents. After taking account of these channels, authors are left with the mispricing component of the price-rent ratio.

Brunnermeier and Julliard (2008) found that large share of variation in the mispricing component of the price-rent ratio is explained by the variation in inflation. This is consistent with the findings of Cohen, Polk, and Vuolteenaho (2005), who also conclude that under money illusion, subjective asset prices are inversely related to the level of inflation in the economy. Authors investigate whether this link may not be caused rather by market frictions. However, their extensive series of tests suggests that it is

not the case. Brunnermeier and Julliard (2008, p. 173) therefore interpret their findings as a supportive evidence for the money illusion hypothesis and present it as additional argument in favor of price stability.

On these empirical works react, for example, Basak and Yan (2010, p. 915), who “attempt to directly embed money illusion into an investor’s decision making and valuation framework.” They try to provide investment behavior under money illusion with a rigorous formal model and determine its impact on equilibrium asset prices in an inflationary economy. In order to do that, they generalize the Modigliani-Cohn hypothesis. In their conception, agent discount future real pay-offs with a mixture of real and nominal interest rates. The *money illusion parameter* is added to reflect the degree of bias towards the nominal rates, which may reach from perfectly rational to only discounting with nominal rates as originally proposed by Cohn-Modigliani.

Similarly to New Keynesian economists, Basak and Yan (2010) propose that small individual level of irrationality (associated with only negligible utility costs) generates substantial aggregate effects. At the partial-equilibrium level, they identify that *ceteris paribus* real consumption of a money-illusioned investor is decreasing in price level. In the general-equilibrium setting, authors focus on the asset prices. Their conclusion is that higher expected inflation decreases stock and bond⁴ prices, which is consistent with the empirical studies mentioned above. Furthermore, the basic model is extended by incorporating heterogeneous agents, i.e. agents with different degrees of money illusion.

3.4 The New Era of Money Illusion

Although money illusion may not be considered a part of mainstream economic theory after its dismissal in the 1970s, noticeable change in the perception occurred in the last 20 years. After a coherent psychological background was developed, this phenomenon was rediscovered and money illusion returned to economic literature. Its proponents managed to incorporate the rational expectation hypothesis to revive the money illusion concept in the post-Lucas period.

Since the late 1990s, money illusion received more rigorous framework. It was either highly influenced by the old-fashioned theories, as for instance in Shafir, Diamond, and Tversky (1997), or incorporated innovative elements like strategic uncertainty in the case of Fehr and Tyran (2001) and near-rational model by Akerlof et al. (2000). However, it is important to note that not even the New Keynesian concept of near-rationality managed to avoid the inconsistency problem. When applied as revised rationale for non-vertical Phillips curve, the money illusion remains an ad-hoc solution of the unemployment-inflation trade-off, because agents are only selectively assumed to be deceived by it. On the other hand, the theory of Fehr and Tyran (2001) managed to find a way around it as they transfer the cause of money illusion’s macroeconomic effects to strategic complementarity.

⁴Note that in contrast to Modigliani and Cohn (1979) and Cohen, Polk, and Vuolteenaho (2005), authors managed to address also the bond prices in their model.

Consequently, a number of empirical and theoretical works were devoted to the phenomenon of money illusion in the last few years. These recent articles examined mainly its possible effects in individual markets and some of them were outlined by this thesis. The outcomes from the stock market and the housing market serve as a good example of the impact money illusion may have on prices at the partial equilibrium level. In light of this research, the concept of money illusion seems not yet ready to be put to rest after all.

4. | Inflation Expectations in the Czech Republic

The aim of this chapter is to supplement the historical development of money illusion with a look on current data of inflation expectations. Although recent works were able to incorporate the rational expectations hypothesis, original theories of money illusion relied on the systematic difference between expected and actual inflation. Therefore, an exploration of the relationship between these two variables may offer a useful insight into the evolution of money illusion. In order to fully understand the modern theories, it is important to recognize the problems of the previous approaches, which they ought to resolve. On that account, this thesis confronts the data of actual inflation with the survey of expected inflation by the Czech National Bank and discusses the resulting implications for the money illusion theories.

4.1 CNB's Survey on Inflation Expectation

The Czech National Bank (2014) performs a survey on inflation expectation since May 1999. The participants are asked about the annual consumer price inflation index they expect at the 12-month horizon.¹ At first, the survey was carried only among financial analysts in order to reflect the inflation expectations in the financial market. This part is performed on a monthly basis, and over time the group of financial analyst gradually increased its size from 10 to 15. In June 1999, the survey was extended also to businesses and households. The survey of producers' inflation expectations is on quarterly basis and covers 118 managers of major businesses from all sectors of the economy. Finally, consumers' expectations were derived from a quarterly measurement of randomly selected sample of 600 households, but this part of survey ended in March 2007. The CNB publishes mean value of expected inflation for each group of respondents, which is trimmed from 5 per cent of highest and 5 per cent lowest values since March 2003.

In order to estimate the relationship between the expected and actual inflation, two hypotheses were explored for each survey group. Firstly, the systematic difference between the actual inflation and its mean expected value at the expectation horizon is tested. It is performed by a simple paired *t*-test with the alternative hypothesis that expected values are on average lower than actual. This is done to get the idea of how

¹The CNB also surveys the inflation expectation at the 3-year horizon, but these are not examined in the text, mainly because of the small sample size.

are agents aware of inflation and therefore how they are they able to include it in their decision making. It serves the purpose to reminisce Fisher's (1928) theory that people systematically ignore inflation, which was later dismissed as implausible. The thesis test a weaker hypothesis, in which people only underestimate inflation and discusses the results in light of current theories of money illusion.

The second hypothesis concerns adaptive expectations theory, which lies in the core of Friedman's (1968) conception of money illusion. Positive correlation between the inflation expectations and the last known value of inflation is tested. In case of inelastic expectations, the inflation expectations are assumed to be derived from the previous values of inflation. The results are also discussed in the context of current views.

4.2 The Results

Figure 4.1 shows the inflation expectations by survey groups. The actual inflation is represented by the black line and the expected inflation is depicted using the colored line segments. The value of the actual inflation is connected with the expected inflation in the 12-month horizon with a blue line segment when the expected inflation is higher than actual and by red line segment when disinflation is expected. More traditional look on the data is offered by Figure 4.2. In this graph the actual inflation is again depicted by a black line and the blue line connects the expected inflation in the 12-month horizon. This graph represents the accuracy of inflation expectations. In both figures, panel a) shows the expectations of financial markets, panel b) depicts the expectations of producers, and the consumers' expectations are in panel c).

In Figure 4.1 a general pattern is shown that respondents usually expected increase in inflation in the 12-month horizon with the exception of periods when actual inflation reaches its local maximum. The slope of the line segments indicates the expected change in the level of inflation. It is visible from the graph that it is usually steeper in the case of households than for business managers and financial analysts – i.e., the consumers expect the price level to be more volatile. The visualization in Figure 4.2 suggests that neither group of respondents is able to hit the actual values very precisely, however, the expectations show rather upward than downward bias.

This conclusion is also confirmed by results of the paired *t*-tests. The alternative hypothesis that expected inflation is on average lower than the actual value in the expectations horizon was tested. The results for all groups were following: the null hypothesis that on average expectations are not lower than actual inflation could not be denied with $p > 0.99$. Table 4.1 summarizes the detailed results for each group.

According the Fisher's theory of money illusion, it would be expected that agents at least underestimate inflation if not totally ignore it. Rejection of the early view of money illusion seems therefore consistent with the presented data, since it rather indicates that people are conscious of the fluctuating value of money.

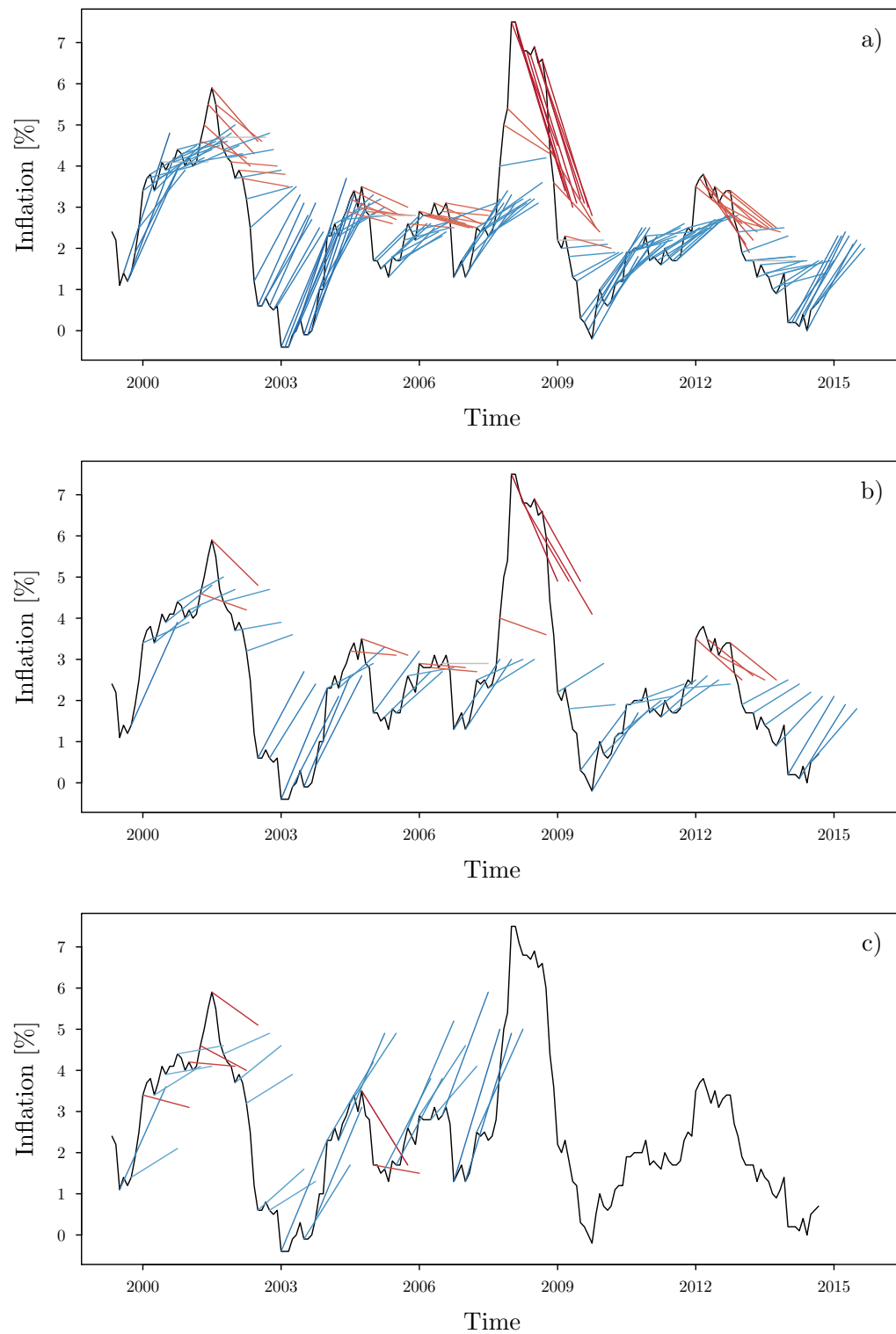


Figure 4.1: The Inflation Expectations in the Czech Republic by Survey Groups
Source: CNB (2014)

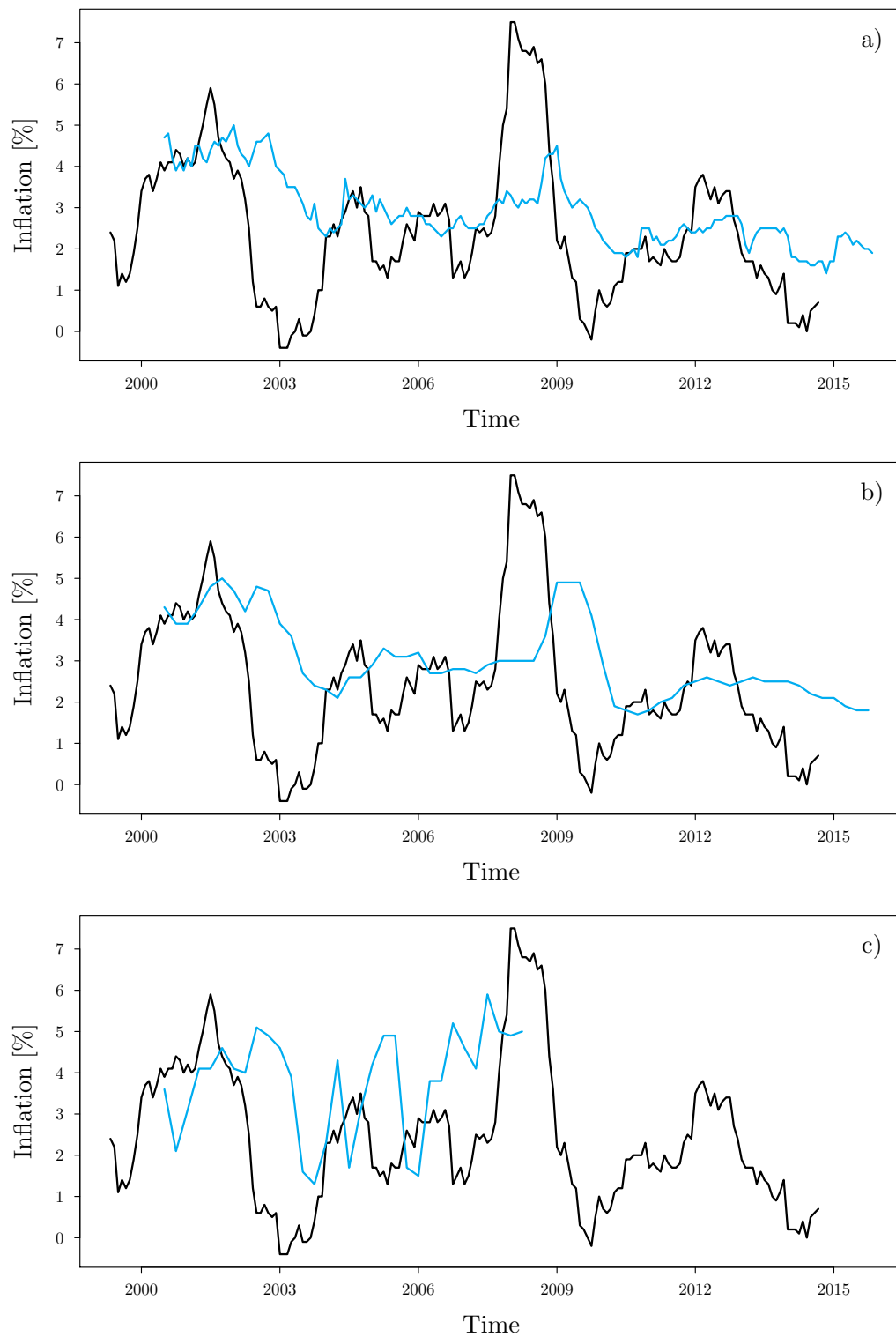


Figure 4.2: The Actual Inflation and Expected Inflation at the Expectation Horizon
Source: CNB (2014)

Table 4.1: Results of the Paired T-Tests

| | Financial Markets | Producers | Households |
|----------------------------|-------------------|-----------|------------|
| t statistic | 4.608 | 2.633 | 2.690 |
| p value | 0.999 | 0.995 | 0.994 |
| Average CPI | 2.420 | 2.433 | 2.766 |
| Average Expected Inflation | 2.997 | 3.109 | 3.813 |
| N (pairs) | 171 | 57 | 32 |

Note: $H_1 : \mu^e - \mu < 0$
 $H_0 : \text{non } H_1$

However, modern theories should not be harmed by presented evidence. The previous chapters showed that modern behavioral theories do not rely on people to underestimate inflation. According to them, the bias towards nominal representation leads them to disregard the real value of transaction even when they are able to compute it precisely. Such preference towards nominal representation is originally presented in Shafir, Diamond, and Tversky (1997). Subsequently, Akerlof et al. (2000) supplemented the argument with the cost-benefit analysis. Since full rationality is costly to agents, nominal perception of transactions may be beneficial when inflation and consequential losses from imperfect rationality are low. The experiment of Fehr and Tyran (2001) is also set in the modern psychological framework of money illusion. Moreover, their theory requires only small levels of individual irrationality since the aggregate effects are based on the assumption of strategic complementarity.

In conclusion, modern theories of money illusion avoid the assumption that changing value of money is underestimated by agents, which seems incompatible with the presented data on inflation expectations from the Czech Republic. The effects of money illusion are derived from different assumptions that seem much more plausible. The new framework is mainly focused on psychological factors determining the perception of financial transactions by agents or strategic settings of their interaction.

Figure 4.3 offers a look on the data from a different perspective. The black line represents again the actual values of inflation. The blue line, however, depicts the lagged inflation expectations to match the last published value of actual inflation. This graphs should help to assess whether inelastic expectations may be observed. If agents form adaptive expectations and they believe that previous level of inflation will sustain, large proximity of the two lines should be observed.

Just from looking at the data, it is visible that major peaks and drops in previous inflation are reflected in the inflation expectations. The differences seem much lower than in the case of comparing the actual values with the expected inflation at the expectation horizon. Quite large proximity between the actual and expected inflation is visible in the panel c) until March 2003. However, it does not seem to be caused by

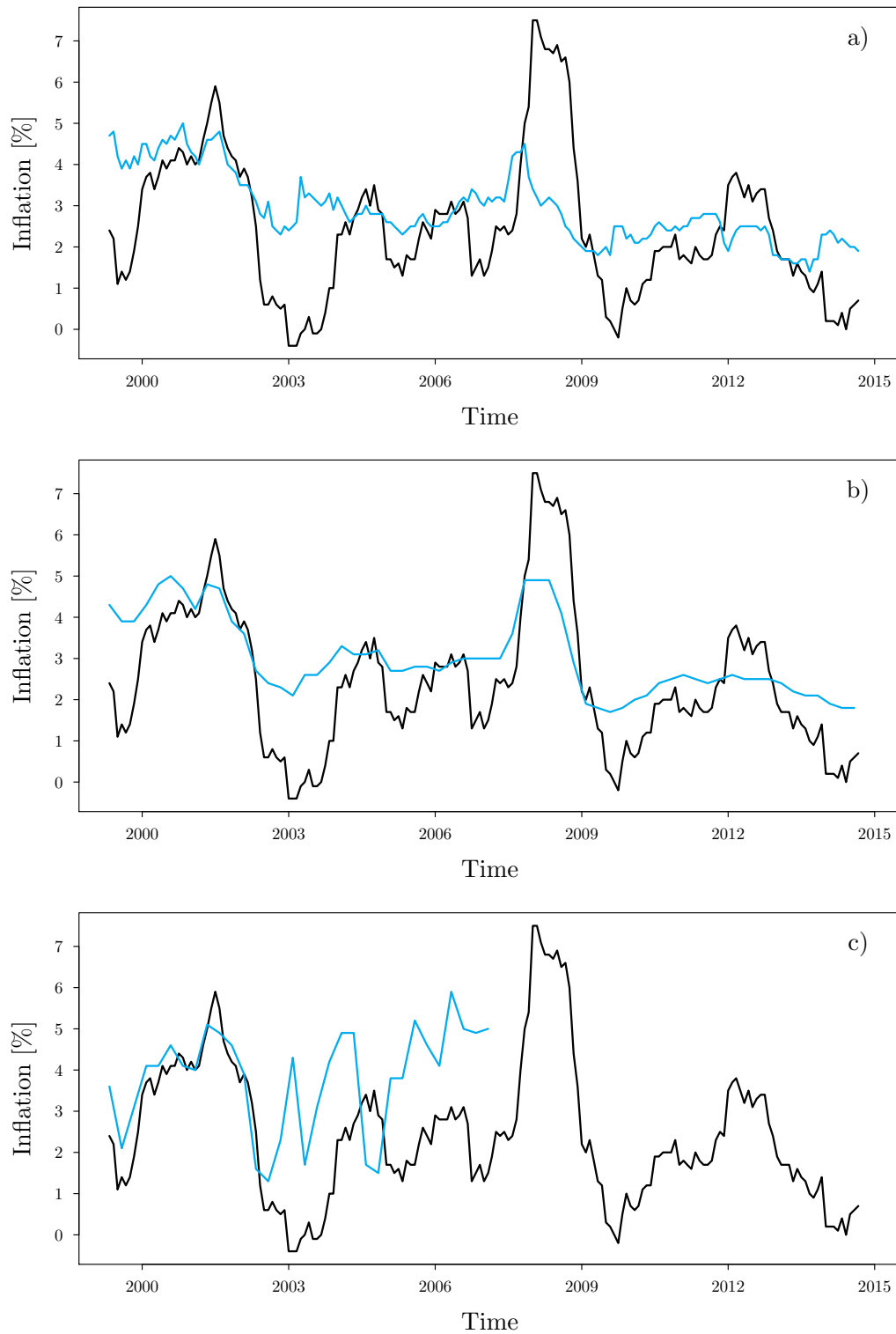


Figure 4.3: The Actual Inflation and Lagged Expected Inflation
Source: CNB (2014)

inelastic expectation formation, since CNB provided the respondents from households with the last known value of inflation before asking them about their expectations about inflation in 1 year. When the survey design changed in 2003, households were no longer provided with this information and since then the inflation expectation show little determination by the previous values of actual inflation.

To determine the role of adaptive expectations, an alternative hypothesis that last known value of inflation is positively correlated with the expected value was tested. For all groups, the null hypothesis that expectations are on average not positively correlated with last known value of inflation could not be dismissed at 0.10 significance level.² In other words, the data do not suggest significant positive correlation between last known and expected inflation. More detailed test results are offered in Table 4.2.

Table 4.2: Results of the Correlation Coefficient Test

| | Financial Markets | Producers | Households |
|-------------------------|-------------------|-----------|------------|
| t statistic | −3.424 | −1.214 | 0.997 |
| p value | 0.999 | 0.861 | 0.174 |
| Correlation Coefficient | −0.245 | −0.155 | 0.179 |
| N | 185 | 62 | 32 |

Note: $H_1 : \rho > 0$
 $H_0 : \text{non } H_1$

The statistical tests therefore contradict also the adaptive expectations hypothesis, which was the basis of money illusion in Friedman’s view. The inelastic price expectations do not seem to be the reason why agents are deceived by money illusion. The dismissal of the money illusion concept in 1970s was a result of the incompatibility with the rational expectations hypothesis. However, the previous chapter showed that modern theories of money illusion were able to incorporate rational expectation formation and avoided also this problem of the early views. Moreover, the possible influence of the current values of inflation on inflation expectation is – according to the modern views on money illusion – rather considered as a result of nominal framing. Current value is perceived as nominal anchor that influences agents’ expectations, who are able to form their expectations rationally. This is nicely illustrated by the change in methodology in the case of consumers’ expectations survey. After respondents were no longer provided with the information of last known inflation, their expectation show little dependence on those values.

²Positive correlation coefficient appeared only in the case of households, but it was statistically insignificant. However, the ex-post power of the test for significance level 0.10 was only 0.373 and so the result might have been caused by a limited sample size.

Conclusion

The theory of money illusion underwent serious modifications over time and the mainstream view on this phenomenon changed as well. The old-fashioned theories by Fisher and Friedman were rejected due to the revolution of rational expectations and Tobin's critique decomposed also money illusion in Keynesian labor supply. Admittedly, money illusion lost its place in the mainstream economic theory in the 1970s and has not been able to regain it until today.

However, revised theories of money illusion emerge since the 1990s. They incorporated the rational expectation formation and began to focus on the psychological aspects of human behavior. Tendency to think in nominal terms replaced the inability to determine changing value of money as source of the irrationality. This shift enabled to create coherent theories that avoid previous faulty assumptions. New views on money illusion do not rely on underestimation of inflation when explaining the phenomenon and rather link the assessment of transactions to their framing.

The new theories managed to address some of the problems of the original concepts and found its place in the economic thinking, mainly as a part of New Keynesian economics and behavioral economics. They base the human preference for nominal representation on its saliency and simplicity. Proponents of the near-rationality concept argue that full rationality entails cost for the agent while the errors from acting under money illusion may be negligible and they introduce cost-benefit analysis of rational behavior. Moreover, based on another New Keynesian model, only a small amount of individual level irrationality is required for money illusion to cause nominal inertia in the presence of strategic complementarity.

In past few years, numerous theoretical and empirical works building on the new conception have been published and further progress have been made. The current research focuses mainly on the effects that money illusion may have on a partial equilibrium level. However, the Keynesian inconsistency pointed out by Tobin have not been resolved until these days. When money illusion is assumed to affect the labor supply function, its presence in other supply and demand functions seem only logical and without addressing this issue, money illusion itself may not be regarded as a satisfactory explanation of the non-neutrality of money at the aggregate level. To fully understand the macroeconomic consequences of money illusion, further research is necessary in order to resolve the inconsistency problem. Acceptance of additional assumptions, as for instance strategic complementarity, may be regarded as the first step in that direction.

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