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## A literature study on price stickiness from a microeconomic perspective

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Tamara Lazić, Bakk. rer. soc. oec.

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| Ort, Datum | Tamara Lazić |

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## List of Abbreviations

B-AIDS.....Behavioural Almost Ideal Demand System
BLS.....Bureau of Labour Statistics
CPI .....Consumer price index
COICOP ..... Classification of Individual Consumption According to Purpose
DC ..... Demand curve
EC ..... European Commission
ECB ..... European Central Bank
IPN ..... Inflation Persistence Network
PPI.....Producer price index
RFM..... Recency, frequency and monetary value

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# 1. Introduction

For most of the people the meaning of the term “price stickiness” is unknown and sounds very abstract. Surprisingly, similar stands for many business administration students and, according to literature some managers. This is very unusual since the phenomenon of price stickiness can be observed in every industry and almost every product. In general, under this term we understand the situation in which prices of goods and services do not immediately adjust to changes in cost or demand (cost or demand shocks). Such occurrence is considered to be an inefficiency of the market mechanism, which leads to markets not being at their full employment. There is an extensive literature that deals with this topic; however, there is no unique, general consensus on the level of price stickiness, causes behind it and its relevance for the economy as a whole.

The aim of this paper is to provide an insight into current empirical findings on this topic, and serve as an introduction for more thorough research. As stated in the title, I will review papers that analyze microeconomic aspect of the problem and will focus on most relevant and recent researches. This paper starts with the theoretical introduction to price stickiness and its relevance for macroeconomic modelling and monetary policy. Second part focuses on the practical validity of the existing theories of causes of price stickiness, whereas the third part examines results of empirical studies on frequency and scope of price stickiness. Finally some general statements and conclusions about price behaviour will be presented.

# 2. Price stickiness or price rigidity?

Before I start with more detailed explanation of the topic, I would like to address the issue between terms *stickiness and rigidity.* According to Dhyne, under stickiness it is considered that prices adapt to cost or demand change with delay, and that adaptations are not frequent. On the other hand, prices are rigid if the instantaneous adaptation of price is not proportional to change in costs or demand. In his paper, he claims that for the purposes of finding optimal monetary policy it is rigidity that counts. More specifically, it is *intrinsic rigidity* that matters. Prices are intrinsically rigid when they don't adapt at all, or adapt just partially to change in costs or demand. Extrinsic rigidity is a state in which prices do not change because there is no change in costs or demand. Influence of government's policies is different in these two cases. Intrinsic rigidity can be decreased by policies that effect obstacles which firms face when changing prices (e.g. additional costs).[1]

Nevertheless, in this paper terms price stickiness and price rigidity will be used as synonyms. Reasons for such simplification are to be found in observed studies. None of the available studies does actually differ between these terms, so it would be impossible to make any conclusion about, for example, intrinsic rigidity of prices. It is also plausible to believe that methods used to measure stickiness as an aggregate measure of price persistence might not be appropriate for rigidity measurement.

[1] Dhyne et al.(2009)

# 3. Why is price stickiness an issue?

The theory of sticky prices is mostly connected to Keynes's philosophy and his theory that governmental activist policy is necessary for proper functioning of the economy. As one of the most argued issues between advocates of classical economist thought and Keynesian supporters, lays the disagreement on how markets clear.

Classical economists (including Say, Smith, Ricardo etc.) held the belief that market economy automatically gravitates towards full employment. Under full employment we understand the state o the market where only voluntary unemployment exists and in which possible increase in demand would not be followed by an increase in supplied output. Their predictions were based on Say's Law which assumed that as long as people accepted wages that did not exceed the value of their productivity, there will be firms who want to hire such workers. Based on the Say's idea that "supply creates its own demand"[2], the demand and supply will end up at the equilibrium. The issue of people saving money, i.e. not spending total income, was explained by the idea that that money would be borrowed by firms for investments.

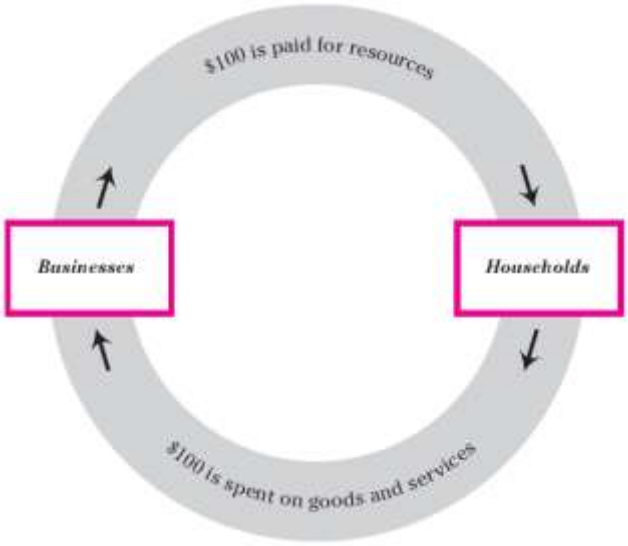


Figure 1 Say's Law – Supply creates its own demand[3]

[2] Kates (2005)

[3] Rohlf (1996), 3

Classical economists explained that all money saved would be borrowed due to interest rates. Interest rates regulate the amount of money people want to spend and firms want to invest, so at the equilibrium interest rate, all money saved would be borrowed by firms and invested. Even the question what happens when people don't deposit their savings in banks was explained by classical economist as an issue not relevant for the disturbance of the system, since price and wage adjustment would balance for the decrease in spending.

On the other hand, Keynes argued that the process was functioning in reverse, that the demand initiated the output which will be supplied. In his opinion, the firm's decision on production output depends on expected level of spending. He also claimed that the interest rate is not the most important factor for people deciding how much to save, it is the income level. Therefore, an increase in income available might not lead only to increase in consumption but also to increase in saving. What Keynes advocated was that there is a possibility of market being in equilibrium, but not being at full employment, but rather at "unemployment equilibrium". This situation arises precisely as a consequence of non-adjusted prices. Generally speaking, firms oppose to decrease of price; they would rather decrease the output, while workers oppose to decrease of the wage.[4]

Under the theory of clearing markets it is assumed that prices of goods and services move towards market equilibrium. This assumption lays in the basis of most of economic models. However, continuously clearing markets, meaning that prices adjust instantaneously to any changes in cost or demand, are not very realistic. Despite the fact that such models define prices (and wages) as flexible, in reality they are rather sticky. Most of the prices are fixed for certain period of time, ranging from few days up to even few years. Still, this does not invalidate the reliability of existing economic models, since the argument of flexible prices stands if we observe the markets in the long run.[5]

[4] Rohlf (1996), 2
[5] Mankiw (2003), 14-15

The importance of inflexible prices is most significant in the issue of short-run trade off between inflation and unemployment. This trade off is, according to prevailing scientific opinion, due to the fact that some prices adjust to new market conditions with delay. For instance, if we consider the situation in which government decides to reduce its spending, i.e. reduce the supply of money, in the long – run this will lead to a decrease in overall price level. Nonetheless, in the short – run, due to price stickiness, some prices will still be at higher level and at the same time such measure will decrease total spending of people. Correspondingly, this will lead to decrease in output and lower sales which causes firms to lay off workers. So until prices are adjusted and set at the lower level, reduction in money quantity leads to an increase in unemployment.[6]

Because one of the main tasks of the government is to make sure the inflation level is as low as possibly, as well as unemployment, we can see how conflicting this situation is. The conclusion that stems from it is that the duration of a price, i.e. the level of price stickiness, will be crucial for decision makers when choosing the right monetary policy. This is because the effects of such policy will strongly depend on the speed with which prices will adapt to newly occurred circumstances.

Until the Great depression, the beliefs of classical economists on self-clearing markets were universally accepted. Even such downturn, of which they were well aware, was regarded as an inevitable phase of a business cycle.[7] Classical economists believed that no government intervention is necessary and it's only purpose is to ensure the functioning of the free market. They assume the flexibility of prices and wages in the short run, as well as in the long run. On the other side Keynes suggested that in fact prices are not flexible in the short run, therefore the monetary policy will have effects on the output in the short run.[8]

[6] Mankiw (2006), 12
[7] Laidler (1992)
[8] Roubini and Backus (1998)

It is not possible to say that either of conflicting theories is more right than the other. Classical economists successfully argue how the economy works at its “full employment”, whereas Keynesian theory focuses on the phase in which markets exhibit some inefficiency. Classical economists support the idea that markets clear by themselves, without any need for government intervention.

The idea of sticky prices is not solely to be attributed to Keynesian economists. Predeceasing researches by other economists also contain the notion of prices not changing instantaneously. The most significant contribution from Keynes was that he directed the focus of the research from supply to demand side of the economy.[9]

However Keynesians, as well as New Keynesian economists, attribute the effect on macro level to prices stickiness in micro surrounding. New Classical economists claim that the microeconomic evidence, found in numerous researches which are more thoroughly presented in the second part of this paper, is not sufficient to adopt as relevant on macro level.

[9] Laidler (1992)

# 4. Literature overview

There is a considerable amount of literature that deals with the issue of price stickiness. Here we have to distinguish between wage and price stickiness in the narrow sense, since the "price" can also refer to price of labour. This paper analyzes literature which examines price stickiness of goods and services only. This narrowing of the research topic makes it easier to conduct such analysis since the stickiness in general is capacious problematic and requires extensive mathematical and macroeconomic knowledge. Furthermore the choice of the literature has been limited to empirical studies only, due to its current relevance and closeness to subjects of industrial organization. Such studies are a basis for successful economical modelling and decision making regarding monetary policies. Appendix 1 contains a detailed overview of few most important studies on price stickiness, methods used and results. Only models and theories that can explain these empirical findings are relevant for the economic theory.

In general, empirical studies can be divided into two main groups. In the first one are the studies that examine the validity of existing theories of price stickiness. Such studies, mostly by conducting interviews with decision makers, try to extract the reason behind firms' decision not to change prices simultaneously to changes in cost or demand. This methodology will be further discussed in the second part of this chapter. In the second group, there are studies that examine the frequency and scope of price stickiness. The aim of these researches is to discover how sticky prices actually are, capture the differences and possibly project the similarities that could be applied to whole markets.

The issue that arose during the analysis of this topic is the inconsistency of results between studies, as well as differences between empirical microeconomic results and hypothesis included in macroeconomic models. Naturally, there are a number of studies that deal with theoretical modelling of price setting and price behaviour; however such studies are not the topic of this paper but are still relevant as they can indirectly test the validity of certain assumptions on price behaviour.

Following is the presentation of used research methods, their applications, advantages and disadvantages. It is not possible to say that one is better than the other, since they are in most cases used to examine, i.e. measure, different variables.

The methods used in price stickiness researches are:

- Surveys
- CPI and PPI analysis
- Scanner and online data analysis
- Experiments

## 4.1. Surveys

Surveys (questionnaires) are predominantly used, as previously stated, in order to examine the reasoning of price – setters and what influences their decision making process. The first time this method was used in examining prices stickiness is in a study by Alan Blinder (1998), after which a series of similar studies has been conducted in different countries and industries.

Alan S. Blinder has, with the help of his colleagues, Ellie Canetti, David Lebow and Jeremy Rudd, conducted a study in order to "assess the validity of theories of price stickiness by asking actual decision makers".[10] This research paper has made a groundbreaking step in the research of price stickiness because it introduced completely new method in investigating the phenomenon of price stickiness. So instead of using time-series econometrics, they have conducted almost 200 interviews with company executives from northern part of United states. Blinder argues that such method is much more appropriate since some variables that are considered to effect price rigidity are not observable (for example implicit contracts between seller and buyer). The goal of this study was to capture the trends in executive's reasoning which will provide better general understanding for price stickiness. In these interviews, 12 hypotheses (theories)

[10] Blinder et al. (1998)

have been tested by asking the decision makers about their validity.[11] These 12 hypothesis have been in the centre of interest in all succeeding surveys and results have been consistent in most cases, at least when it comes to most important theories. Furthermore, his most important results will be discussed in this paper more thoroughly.

Originally, the researches intended to use free-form interviews due to differences in industries in which randomly selected companies were acting. On one hand, such approach might have potentially offered a deeper insight into specific decision making reasoning when setting prices. Furthermore, discussing unnecessary questions and theories could be avoided.

However, standardized interviews have their advantages as well, especially when it comes to deriving general conclusions. The issue of objectivity is also resolved, since it would not be reasonable to expect that two interviewers would conduct an interview identically. Standardized interviews allow the work of more interviewers and are more feasible. Transition from free-form to standardized interviews has also allowed the increase of the sample size. Researchers have conducted face-to-face interviews, which ensured higher probability of executed interviews and that the questionnaire is answered by the person for whom it was intended. Some new studies however used questionnaires which are sent to respective companies and, although their samples are bigger, they face the problem of lower response rate, as well as the insecurity on who actually answered the questionnaire.[12]

Since there was a possibility that some of the managers would not be familiar with the theories it was necessary to be able to interpret certain questions and make sure that they were understood properly. This is one of the main problems with this method, which makes critics question the reliability of results. On one side, interviewers have to make sure the interviewee has understood the theory an on the other, he has to be able to capture the real meaning in interviewee's response. In the aforementioned study, respondents did not have the possibility to circle one

[11] Downward and Lee (1998)
[12] Blinder et al. (1998), 48-50

of the answers for the corresponding theory (e.g. from totally unimportant to very important). They were supposed to explain in their own words how important they thought respective theory was and then the answers are coded by interviewers.

In addition, surveys are also used to examine the perceived price stickiness of firm's products or services. Here, interviewees were supposed to say how often, on average, they change their prices and how much. These results tent to be inconsistent with results obtained from other researches. Blinder also raises the question of what results of this study actually tell us, since it is a known fact that often people don't do what they say and vice versa. In this case, he recommends that researchers assign more weight to observed actions.

## 4.2. CPI and PPI

Consumer and producer price indices are used to measure the frequency of price change and, stemming from it, the average duration of certain price. According to American Bureau of Labour Statistics (BLS) the consumer price index measures "average change over time in the prices paid by urban consumers for a market basket of consumer goods and services." All goods, purchased for consumption, are analyzed, and they are divided into 8 major groups: food and beverages, housing, apparel, transportation, medical care, recreation, education and communication and other goods and services. Both consumer prices in USA and in Europe are classified based on COICOP classification (system of UN), which simplifies the comparison of obtained data. However, since most of raw data are not available to researchers, not all categories can be analyzed and compared.[13]

The prices are obtained by collectors who observe "on – the – shelf" prices of respective products. The CPI data are characterized by so called "discontinuity", which means that in case a product is no longer available, it will be replaced with its closest substitute. Surveys that used CPI as an indicator of price stickiness gained results that exhibit high level of heterogeneity not only between goods

[13]Dhyne et al. (2009)

categories but also within the product groups. Most of the studies analyze the stickiness on an aggregate level, without going deep into detailed interpretation of level of stickiness, which can be a disadvantage of such research.[14]

When it comes to studies that analyze producer price index, results did not differ significantly, although they exhibit slightly higher frequency of price change. PPI, unlike CPI, measures change in price on the side of producers. This index does not include imported goods, which can be meaningful when we observe the price level stickiness on a country level. It also includes a significant amount of goods which are not included in calculation of CPI, such as producer's equipment. Also the prices obtained from producers actually represent the revenue producer of the good receives (sales and excise taxes not included). Furthermore, the method of obtaining the information is somewhat different, since national statistics offices obtain prices from producers (not "on – the – shelf" prices).[15]

Finally, the disadvantage of use of indices to measure level of price stickiness is also that datasets available across countries might differ not only in their compositions, but also in time periods making it difficult to conduct a reliable comparison.

## 4.3. Scanner and online data

Relatively new methods of collecting data on prices and their behaviour are collecting and analysis of scanner data, usually obtained by retailers and online data, also called scraped data. Scanner data allow detailed analysis of price changes for a wide range of products on a very particular level. With the introduction of customer loyalty cards is has become possible not only to track the price change, but also the customer behaviour and reactions to different prices and price setting practices. This aspect has showed as very efficient in proving the thesis that firms change their prices rarely due to fear of customer antagonism.

[14] Bureau of Labour Statistics
[15] Bureau of Labour Statistics

Information obtained by the retailers is usually weekly data, but results for only few countries are available. Next to the consumer behaviour issue, maybe the biggest advantage of such research method is the availability of information on quantities bough by individual customers.

Capturing daily online prices, so called web scrapping method, has become new focus for price stickiness researches for multiple reasons. First of all, retailers use online shops to either sell their goods or advertise prices for customers that shop offline. This has made a significant number of prices, for almost all goods sold also through regular channels, available to researchers. Rather simple scripts can be programmed, which will retrieve the prices from websites in a regular time spans for a determined goods. General advantages of such method are daily observation of prices, which is not possible for CPI/PPI researches and possibility to observe prices for more countries. Furthermore, since the script analyzes all posted prices on a webpage it can also get data for close substitutes and cross compare price changes. Some disadvantages include the limited range of products that can be analyzed and, unlike scanner data, do not provide data on quantities sold. Despite some advantages, the number of studies analyzing online data is limited, due to non - existence of historical data. Another issue is that information is spread over a large number of different websites.[16]

## 4.4. Experiments

There are no many researches that used experiments in order to study price stickiness in consumer markets. What can be investigated with such experiments is how buyers perceive price changes and what are they reactions. This usually means which level and direction of price change antagonizes customers more or less. Most known experimental study on price stickiness is one conducted by Renner and Tyran[17] which has proven the existence and importance of customer relationships for the pervasiveness of sticky prices. These and similar studies will be presented in the next chapters of this paper.

[16] Cavallo (2012)
[17] Renner and Tyran (2003)

# 5. Theory and practice

The underlying theories on causes of price stickiness are still not investigated enough and most of them are still regarded as assumptions, since there is a lack of empirical evidence to support their significance. What available literature shows is not that some of these theories are completely irrelevant or wrong, but the contribution of those inefficiencies is not strong enough to cause considerably rigid prices as observed in real life. Another problem is the possibility of testing some aspects of pricing strategy, because they might be either unobservable or immeasurable or it is not in the interest of the decision makers to tell the truth about their practices. Following overview of the most important theories of price stickiness relies heavily on literature analysis of Blinder et al. (1998) and is the only detailed presentation and analysis of this topic available (Table 1). It has also been a basis for all succeeding studies of both theoretical and empirical investigation of price behaviour.

1. Coordination failure
2. Cost – based pricing with lags
3. Non – price competition
4. Implicit contracts
5. Explicit (nominal) contracting
6. Menu costs
7. Procyclical elasticity of demand
8. Pricing points
9. Constant marginal cost
10. Inventories
11. Hierarchy
12. Price as a quality signal

Table 1 Theory rating results[18]

[18] Blinder et al. (1998), 110

Table 2 represents the results of a number of survey studies conducted in a similar way, which have tested the validity of theories chosen by Blinder. The second column shows average grades for respective theories based on already mentioned scale (totally unimportant-1 to very important-4) in studies conducted in European countries. The average grade for entire Euro area can be then compared to results of studies from United States (Blinder et al. 2008), Sweden (Apel et al. 2005), United Kingdom (Hall, Walsh and Yates 1997) and Canada (Amirault et al. 2004). In the last column, numbers represent the ranking of the theory in the research.

| | BE | DE | ES | FR | IT | LU | NL | AT | PT | EURO AREA | US | SW | UK | CA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Implicit contracts | 2.5 | | 2.6 | 2.2 | | 2.7 | 2.7 | 3.0 | 3.1 | **2.7** | 4 | 1 | 5 | 2 |
| Explicit contracts | 2.4 | 2.4 | 2.3 | 2.7 | 2.6 | 2.8 | 2.5 | 3.0 | 2.6 | **2.6** | 5 | 3 | 1 | 3 |
| Cost-based pricing | 2.4 | | | 2.5 | | 2.7 | | 2.6 | 2.7 | **2.6** | 2 | 2 | 2 | 1 |
| Co-ordination failure | 2.2 | 2.2 | 2.4 | 3.0 | 2.6 | 2.1 | 2.2 | 2.3 | 2.8 | **2.4** | 1 | 4 | 3 | 5 |
| Judging quality by price | 1.9 | | 1.8 | | | 2.2 | 2.4 | 1.9 | 2.3 | **2.1** | 12 | | 10 | |
| Temporary shocks | 1.8 | 1.9 | 1.8 | 2.1 | 2.0 | 1.7 | 2.4 | 1.5 | 2.5 | **2.0** | | | | |
| Change non-price factors | 1.7 | | 1.3 | | | 1.9 | 1.9 | 1.7 | | **1.7** | 3 | | 8 | 4 |
| Menu costs | 1.5 | 1.4 | 1.4 | 1.4 | 1.6 | 1.8 | 1.7 | 1.5 | 1.9 | **1.6** | 6 | 11 | 11 | 10 |
| Costly information | 1.6 | | 1.3 | | | 1.8 | | 1.6 | 1.7 | **1.6** | | 13 | | 10 |
| Pricing thresholds | 1.7 | | 1.5 | 1.6 | 1.4 | 1.8 | 1.8 | 1.3 | 1.8 | **1.6** | 8 | 7 | 4 | |

Table 2 Survey results – international comparison[19]

Blinder categorizes the theories into five groups based on the sources of price stickiness. In the first group are theories based on the nature of costs, starting with the theory in which prices do not change since the firm's *marginal costs* do not change. The reasoning behind is that the firm's marginal cost curve is even over different levels of output, i.e. there will not be any change in firms marginal costs if it decides to produce a different output, which is on the flat part of the MC curve (Figure 1). If we assume that such firms uses mark up pricing strategy, then it is logical that rigid costs will lead to rigid prices.

[19] Fabiani (2005)

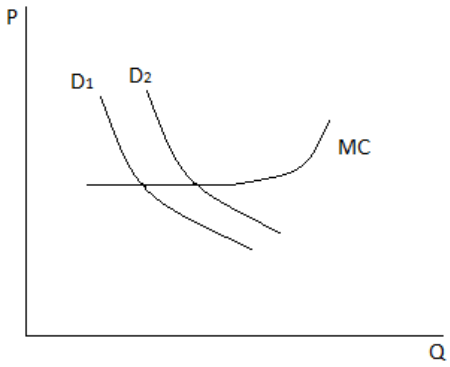


Figure 2 Partially flat demand curve [20]

Assumed is that those companies will not change their prices since the marginal costs do not change and they use a constant pricing mark up. But this also implies that the moment the marginal cost change they will react by changing prices. So this theory alone does not provide the explanation for sticky prices, but in contrast requires the influence of additional factors. I will not deal with this theory in detail, since the results of the Blinder's study show that for almost 80% of the companies it turned out to be irrelevant as a potential cause of price stickiness. In addition, it has rarely been a part of other studies and in cases it has been investigated, the results were not deviating from previous findings.

The next theory is the theory of *cost-based pricing with lags,* which considers the time lags in price adjustments in separate production stages as a cause of large price adjustment delays on aggregate level. It also includes previously mentioned importance of marginal cost, but attributes the delay in adjustment to complex production cycle. It is also obvious that such theory does not hold for services, since services are characterized by very short production chain, usually containing only one person as the service provider. Empirical findings on validity of this theory will be presented in next part of this chapter.

Similar will be done with the theory of *price adjustment costs.* It suggests that price do not change because it is costly for companies to do so. These costs can be either physical, such as printing menus with prices (also known as *menu cost theory*) or costs connected with time and labour necessary for the adjustment of

[20] Author's illustration

prices. The observed results have rated this theory as very relevant therefore it will be analysed by looking into more researches.

Theory of *inventories* as reason for price stickiness comes from the premise that it is costly to change the level of output; therefore firms use inventories to avoid changing prices. The concept is following; in case of a demand increase companies can satisfy it from existing excess inventory without having to affect the price or produced quantity. Similarly, when the demand decreases, by withholding products in the inventories, they will cause increase in demand without being forced to lower the price. It is not expected that companies that have inventories have sticky prices, but that the companies that have low cost of changing inventory levels will tend to have stickier prices. So they rather choose to vary the inventory than price of the good. Naturally, this theory cannot be applied to service businesses, since they are unstorable. General findings do not support the validity of this theory, which can on hand be the consequence of the fact that many decision makers did not understand it and rated it as unimportant. Furthermore, the results show that even if they use this method in order to balance the demand it happens only in case that they perceive shocks as temporary.[21]

Second group of the theories in Blinder's research are those which are based on the nature of demand. Starting with *procyclical elasticity of demand*, which assumes that firms face two kinds of customers, who will exhibit different demand elasticities (we could divide them into loyal and not loyal customers) it is argued that in economical downturn loyals will stick with the company. Since their demand is considered to be less elastic, firms will avoid changing prices.

Further theories include the assumption that firms might react to cost or demand shocks by changing features other than price (*non-price competition*), which includes the changes in product quality, quality of service, delivery etc. In most of the researches this theory has proved to be rather justified and probably its main result is that it actually proves that when thinking about market clearing mechanisms and price rigidity, the focus should not solely be on the frequency and

[21] Blinder et al. (1998), 22

amount of price change. In order to gain an extensive insight into issue of price stickiness and to be able to fully understand its persistence, it would be necessary to conduct a deep analytical research that would capture all ways in which firms react to changes in inputs or environment in which they are doing their business.

Another theory that stems from characteristics of demand is a *pricing points theory*, which essentially names the psychological effect of some prices as a cause of rigid prices. Prices like €14.99 or €49.99 are standard at almost all retailers and are a common practice in many industries. There is an extensive literature that deals with effect of such pricing strategy, where findings show that such prices on average increase sales by 24%.[22]

Theories that focus on contracts as a source of stickiness include both *explicit* and *implicit contracts*. Under explicit contracts it is assumed that the existence of such (nominal) contracts, which contain fix nominal prices, is a significant source of stickiness. Since contracts are prevailing in many industries, not only theoretical but also empirical evidence support this idea and turn out to be one of the most recognized causes. Implicit contracts, however, stand for an unexpressed agreement between the parties (seller and buyer) by which they feel obligated not to break some expected conditions of interaction. Findings on these theories will be fully discussed in the following chapter.

Market interactions could also influence the price setting behaviour and researches detected the phenomenon of *kinked demand curve* and *coordination failure.* Both these theories include the absence of information on what competitor's actions will be. According to these theories, customers react more to price increases than to price decreases, which also assumes some general upward price rigidity. In addition, firms will not dare to decrease prices due to a fear of possible price war. Coordination failure theory explains that exactly because of such situations, markets will be stuck in a dominated equilibrium. This happens due to absence of a coordination mechanism that would provide information, for instance, to all producers in a market. This theory has had most

[22] Poundstone (2010)

recognition in Blinder's study, and provides a plausible explanation for sticky prices and will be analyzed in the next chapter based on more similar studies. However it is not possible to measure its relevance any way other than by conducting interviews with decision makers which is a quite important disadvantage.

The last theory which will be introduced in this part is the practice of using *price as a quality signal*. Signalling, as a solution for adverse selection problem, is a known topic. In this case, it also causes price to remain unchanged even if market conditions change. However, in most relevant surveys it rates very low and almost always at the last place by importance to decision makers. This theory also confirms the problems which are encountered when studying this subject, because some of them are impossible to measure and the only way to investigate them is by conducting surveys.

Following sections analyze empirical results for most relevant theories including theories of explicit and implicit contracts, cost – based pricing with lags, coordination failure and adjustment costs.

## 5.1. Explicit (nominal) contracts

One of the first studies that investigated the connection between the existence of contracts and prices stickiness is one conducted by Carlton (1986). Before we present the most important findings it is necessary to raise the issue of existence of nominal contracts at all. Since this paper investigates the nominal price stickiness it is plausible to come to conclusion that this occurs precisely due to existence of nominal contracts. In practice people seem to ignore the real value of money, or more accurately the nominal value is the one that matters, i.e. customers suffer from *money illusion*. Therefore, the company that indexes its prices for inflation will not be considered as fair, but such actions will be perceived as using customers to increase the profit.[23]

[23] Carlton (1986)

In his study Carlton investigates the level of price stickiness in the transaction process between sellers and buyers, by analyzing Stigler-Kindahl data set. This data set is comprised of actual prices for transactions of a variety of products, obtained from the respective buyers (B2B transactions). The transactions are categorized into three main categories according to the duration of respective contract: monthly, quarter monthly and yearly contracts. It is important to accentuate that the existence of a contract does not imply that prices or other aspects of the agreement cannot be changed. This is one of the central problems in macroeconomic modelling, because different outcomes will occur if it is assumed that firms are able to change prices or if they are fixed for a certain period of time. Researches show that inclusion of fixed – price contracts leads to longer duration of effects of monetary shocks, i.e. to different optimal monetary policy.[24]

| Product | Type of contract | Avg. Duration of price stickiness (months) | Average absolute price change (%) | Length of association (months) |
|---|---|---|---|---|
| Steel | A | 18,1 | 3,3 | 61 |
| | QM | 17,4 | 4,2 | 119 |
| | M | 9,4 | 2,5 | 105 |
| Petroleum | A | 10,3 | 5,3 | 73 |
| | QM | 4,1 | 5,4 | 88 |
| | M | 2,5 | 2,9 | 94 |

Table 3 Price stickiness and contract duration[25]

Table 3 represents just a small sample of Carlton's findings. As previously mentioned by categorizing transactions (contract) according to their length and examining its influence on level of price stickiness he has obtained some significant, but at the same time conflicting results. If explicit contract do actually influence the persistence of price stickiness then the associations which are regulated by longer contracts will exhibit more stickiness, i.e. less often change in price. In order to prove it, Carlton tested following hypothesis:

[24] Parker (2010), 8
[25] Carlton (1986)

a) If there exists a correlation (positive) between length of contract and the duration of price stickiness
b) If there exists a negative correlation between size of price adjustment and the duration of price stickiness
c) If there exists a negative correlation between length of contract and the size of price adjustment

As observable from previous figure, transactions comparable to yearly contracts exhibit the highest level of price stickiness. However, these results also show that partners with monthly contracts (no obligation to renewal or any further engagement) are those that continue to exist for the longer periods. Furthermore, in case of steel industry, we can see that this relation is not directly proportional since quarter monthly contracts tend to be renewed much longer. One explanation could be that due to long association, a certain level of trust exists between the parties, therefore often changes of price will not be considered as aggressive behaviour, but as a action caused by increase in input or other variables. Therefore, the results reject the first hypothesis, showing that although some relation between length of association and stickiness exists, it is rather a negative correlation. Results for the size of price change are also ambiguous, since stickiest contracts do not necessarily exhibit highest average price change. The reasoning behind such expectations is that firms wait with price adaptation until, for instance, cost of raw material become significantly higher.[26]

On the other hand, firms that often change their prices, tend to do it even for slight change in cost or demand. Similar stands for duration of association and size of adjustment. Although not always positively correlated, trend can be suggested that parties that are involved for longer periods of time face higher number of small price changes. To sum up, parties that are not in a longer association are likely to use fixed price contracts before a certain level of trust is established, which can be a reason for high level of stickiness in prices.[27]

[26] Carlton (1986)
[27] Carlton (1986)

Another approach to test this theory is conducting surveys with decision makers, as done by Blinder. Since his estimation show that almost one quarter of the private economy is under nominal (fix – priced) contracts, it would be reasonable that managers recognize this practice as responsible for price stickiness. However, the results have not been very supporting. When confronted with this theory, almost 50 % of the interviewees marked it as "totally unimportant". Researchers assumptions was that many firms do not actually have contracts with their business partners, so they decided to include firms that responded like this and focus on other three groups.[28]

| Code | Response | Percentage of firms |
|---|---|---|
| 2 | Of minor importance | 26,3% |
| 3 | Moderately important | 26,9% |
| 4 | Very important | 46,8% |

Table 4 Importance of nominal contracts[29]

Distribution of the remaining answers is presented in Table 4. As we can see, if we consider companies among which majority has contracts with their buyers/sellers the importance of implicit contracts is more obvious. The conclusion that can be made is that the theory of implicit contracts can be applied only to those companies (industries) that have a considerable number of contracts with their buyers. This means that for such industries the existence of explicit (nominal, fixed – price) contracts might be one of the most relevant causes for price stickiness.[30]

[28] Blinder et al.(1998)
[29] Blinder et al.(1998)
[30] Blinder et al.(1998)

## 5.2. Implicit contracts

The theoretical background for this topic originates in work of Arthur Okun, who made the distinction between auction and customer markets. As a main difference he accentuates the absence of price tags in auction markets, which makes sellers price takers. However, most of the transactions are conducted under conditions in which sellers post a price and buyers accept it or search further. Since search and evaluation process is time and money consuming for the buyers, i.e. they face some cost; they will usually give up the strategy of searching for the best offer. Rather, they decide to settle for some given price, as long as they perceive this price as outweighing the benefits of further search. [31]

In general, the author differs between repeat and once-in-a-lifetime customers. Repeat customers make a so called “quit-or-stick” decision, and since they are more valuable to companies, the pricing policy should be set so that it attract exactly this group. Such customers have information about price and quality form previous purchases and as the offer satisfies their criteria, they will not go on a search for a better one. What company can do is convince the customer to continuity of firm’s pricing policy and by doing so, discourage them from shopping elsewhere. Essentially, this represents the unofficial agreement between sellers and buyers, the first will keep their prices while the latter will not switch to other parties. And the result is that prices will vary less and repeat purchases will be more often. [32]

According to his theory, two characteristics of the price changes emerge from this constellation. First, prices will react much faster to changes in cost than to changes in demand. This is due to customer’s perception of those changes. In case that production, labour or some other cost change customer perceive the change in price as justified and in that case would not consider other offers. However, if the adaptation of the price is a reaction to shift in demand, this is not clear for most of the customers, and they feel used and consider firm’s actions as

[31] Okun (1982)
[32] Okun (1982)

unfair. Second, customers do not mind prices changes downwards; it only affects them if prices increase. This is the case since any decrease in prices is still inside customer's willingness to pay, so customers' consumption might only increase.[33]

First results on this theory are presented by Blinder, and are characterized by the typical attributes of all price stickiness theories, namely inconsistency and heterogeneity. This issue will be discussed in the last part of this paper, since it is a common outcome and prevents from making generally valid conclusions.Among companies in aforementioned survey, more than a third does not believe to have implicit contracts with their customers. This significantly affects the result of the study regarding respective theory, so it might be reasonable to observe the results, excluding the "totally unimportant" answers.

Table 5 represents partial table with answers from the interviewees on relevance of implicit contracts.

| Code | Response | Manufacturing | Trade | Services |
|---|---|---|---|---|
| 1 | Totally unimportant | 29,7% | 36,1% | **44,2%** |
| 2 | Of minor importance | 10,9% | 19,4% | 5,8% |
| 3 | Moderately important | 28,3% | 12,5% | 24,0% |
| 4 | Very important | 31,2% | 31,9% | 26,0% |

Table 5 Importance of implicit contracts[34]

Clearly, manager's opinion on the theory of implicit contracts is equally divided, making it hard to draw a clear conclusion on its relevance for price stickiness issue. What can be concluded is that results do not completely support the theory. Although it was expected that industry that is characterized by higher number of implicit contracts, such as service industry, will show more recognition for this theory, it is not the case in this particular study.[35]

[33] Okun (1982)
[34] Blinder et al. (1998)
[35] Blinder et al. (1998)

Naturally, the composition of the sample can always be questioned and might be a good explanation for diverse outcomes across studies. In order to gain a better insight, results of another two studies will be presented, shredding a new light on how implicit contracts might be responsible for price rigidity.

A study on connection between implicit contracts and sticky prices, conducted by Verhelst and Van den Poel, unlike Blinder's uses analytical approach.[36] They have analyzed scanner data, obtained from a customer loyalty cards by an unspecified European retailer. By segmenting customers and analyzing demand elasticity, they have showed that repeat customers are more sensitive to price change, i.e. have more elastic demand curve, which could be why companies do not change prices as often.

In order to categorize the respective customers, researchers have used the RFM method, in which customer clusters are created based on the *recency* of the last purchase, *frequency* of purchases (how often has the customers made a purchase) and average *monetary value* of purchase. Since the aim was to obtain two extreme groups (loyal and non-loyal customers) they have omitted the recency attributes of the customer. Why these two groups are so important for the analysis is logical, if prices increase in case of high demand, companies risk losing loyal customers. On the other hand, if they decrease prices in case of lower demand only customers who search for a bargain will be attracted, and when prices rise again they will be the first to leave.

In this study, two aspects of demand have been examined, namely demand elasticity and the curvature of the demand curve. Demand elasticity of loyal customers should arise as less elastic (their value the continuity of offer more) and the curvature of demand as higher. Behind the idea of curvature of the demand curve stands the reasoning that at higher price levels changes in price will be punished more by loyal customers, because they have information on reference (previous) prices. In contrast, at lower price levels (under loyals' willingness to pay) non-loyal customers will be the one to consider switching or increasing their

[36] Verhelst and Van den Poel (2012)

consumption first. Therefore, the expected result was that loyals' demand curve will be more concave than the demand curve of non-loyal customers. [37] Graphical representation can be seen in Figure 2.

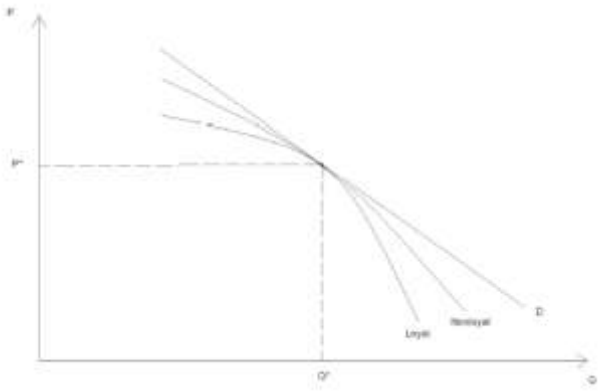

Figure 3 Demand curve for loyal and non-loyal customer segments[38]

As previously stated, the assumptions were that loyal customers will have less elastic demand curve and that it will be more concave. Results of the analysis have confirmed these expectations. Table 6 represents the results of the B-AIDS algorithm for specific product groups, mostly food and hygiene products. Price elasticity of loyal consumer does indeed prove to be slightly less elastic. This result, however, is observed on an aggregate level while there are significant differences among product groups. Authors explain this by stating that loyal customer tend to adapt their quantities when prices change, rather than switch to another seller.

| Product Category | Loyals | Non-loyals | Product Category | Loyals | Non-loyals |
|---|---|---|---|---|---|
| Baking flour | 0.94 | 0.97 | Mineral Water | 2.08 | 1.91 |
| Chips | 1.53 | 1.38 | Nappies | 2.54 | 3.69 |
| Coke | 2.41 | 1.38 | Plasters | 0.75 | 0.04 |
| Detergent | 0.18 | 0.84 | Potatoes | 0.79 | 1.17 |
| Emmental | 2.21 | 4.64 | Smoked Salmon | 3.32 | 4.46 |
| Floorcloth | 4.58 | 4.42 | Sugar | 0.92 | 0.67 |
| Fruit Juice | 0.50 | 0.81 | Toilet paper | 2.89 | 2.96 |
| Lemonade | 1.35 | 1.21 | Tuna | 1.50 | 1.68 |
| Margarine | 1.50 | 2.28 | Whiskey | 2.41 | 2.56 |
| Mayonnaise | 1.04 | 0.14 | Wine | 2.11 | 5.81 |
| | | | MEDIAN | 1.52 | 1.68 |

Table 6 Price elasticity of demand[39]

[37] Verhelst and Van den Poel (2012)
[38] Verhelst and Van den Poel (2012)

The difference in curvature of demand of loyal and non-loyal customers is more obvious. As observable in Table 7, this study proves that loyal customers will react stronger to increase in prices (antagonise against the sellers) than non-loyal customers. On the other hand, they will not be as drawn to decreased prices as non-loyals will, i.e. they will probably stick to their previous buying behaviour.

| Product Category | Loyals | Non-loyals | Product Category | Loyals | Non-loyals |
|---|---|---|---|---|---|
| Baking flour | 4.78 | 1.64 | Mineral Water | 3.22 | -0.32 |
| Chips | 5.48 | 1.73 | Nappies | 8.44 | 6.83 |
| Coke | 5.53 | 2.04 | Plasters | 2.91 | -2.08 |
| Detergent | -4.62 | -3.04 | Potatoes | 0.33 | 0.12 |
| Emmental | 6.29 | 4.49 | Smoked Salmon | 1.41 | 2.22 |
| Floorcloth | 7.64 | 6.48 | Sugar | 7.98 | 1.23 |
| Fruit Juice | 0.79 | 0.33 | Toilet paper | 3.42 | 3.77 |
| Lemonade | 3.09 | -0.40 | Tuna | 4.29 | 3.60 |
| Margarine | 6.77 | 4.65 | Whiskey | 8.47 | 5.80 |
| Mayonnaise | 6.57 | 4.11 | Wine | 5.38 | 6.52 |
| | | | MEDIAN | 5.08 | 2.13 |

Table 7 Curvature of demand[40]

One of the most recent and relevant studies that examines customer's valuation of implicit contracts is one on consumer antagonism, conducted by Anderson and Simester.[41] Similar as the previous study, the demand characteristics for a retailer are analyzed. In this case, researchers conducted an experiment with a publishing retailer, who has regularly engaged in intertemporal price discrimination. The aim of the study was to examine how customers react to price changes of different scope. The hypothesis that was to be proved was that customers that saw sale prices, which were significantly lower than the price they have previously paid for the product, tend to antagonize against the company and decrease their orders in the future. This proves, in contrast to Okun's theory, that downward price adjustments can also be unsatisfactory for the consumers.

In their experiment, researchers sent two types of catalogues with sale sections to firm's customers. These customers have previously bought at least one of company's products in the last 6 months. The only difference between two types of catalogues was the scope of price reduction (deep discount and shallow discount).

[39] Verhelst and Van den Poel (2012)
[40] Verhelst and Van den Poel (2012)
[41] Anderson and Simester (2010)

By observing sales before and after the catalogue was sent, it was possible to capture the effect that price change had on consumers.

It was expected that the post-test demand of the customers under deep discount will be lower than of those under shallow discount. The results of the analysis are presented in Table 8, and as long as the sales are compared on an aggregate level, distinguishing only between sales under deep and shallow discount, there are no significant differences in buyer's behaviour after the test catalogue has been mailed. However, when focusing on customers that have made a purchase in the last three months prior to test catalogue was sent, the situation is much clearer. Recent customers react more firmly to lowered prices, namely total revenue from the customer's under deep discount as well as number of orders in lower than in the shallow discount group. This shows that customers, who saw higher decrease in prices, antagonise against the company, presumably because they feel cheated and perceive previous prices (reference prices) as overvalued. [42]

| | Complete Sample | | Recent Customers | |
|---|---|---|---|---|
| | Shallow discount | Deep discount | Shallow discount | Deep discount |
| Revenue and orders per customer | | | | |
| Revenue ($) | 159.28 | 157.16 | 506.02 | 415.31 |
| | (2.19) | (3.06) | (23.70) | (30.91) |
| Orders: all post-test orders | 1.05 | 1.04 | 3.27 | 2.78 |
| | (0.01) | (0.02) | (0.13) | (0.18) |
| Orders: from the Test Catalog itself | 0.022 | 0.036 | 0.10 | 0.12 |
| | (0.001) | (0.002) | (0.01) | (0.02) |
| Orders: from other catalogs | 1.03 | 1.00 | 3.17 | 2.66 |
| | (0.01) | (0.02) | (0.13) | (0.17) |
| % of customers with at least 1 post-test order | 35.4 | 35.0 | 72.9 | 66.0 |
| | (0.3) | (0.4) | (1.5) | (2.2) |
| Number of customers | 36,815 | 18,232 | 933 | 459 |
| Composition of orders | | | | |
| Average item price ($) | 101.49 | 101.14 | 97.61 | 97.82 |
| | (0.51) | (0.74) | (1.98) | (2.87) |
| Average number of items per order | 1.57 | 1.60 | 1.66 | 1.64 |
| | (0.01) | (0.01) | (0.06) | (0.06) |

Table 8 Comparison between complete sample and recent customers[43]

Why recent customers are more important is obvious; when compared with whole sample we can see that total revenue, number of orders and frequency of purchases is the multiple of the average values of the whole sample. Recent, i.e.

[42] Anderson and Simester (2010)
[43] Anderson and Simester (2010)

repeat customers are most important for the company and the price setting policy should be created in a way that attracts precisely them.

Furthermore, what can be concluded from this initial observation is that sales from the test catalogues are higher under deep discount. This also supports results of Verhelst and Van den Poel, confirming that very low prices in the short run do attract customers looking for a bargain. In contrast, in the longer run such move will be antagonized by the repeat customers so it is not in company's interest to conduct price adjustments as often as expected by macroeconomists. It also provides empirical proof for the significance of downward price adjustment; since the general belief is that companies do not hesitate to lower their prices and that prices tend to be sticky mostly upwards.

Apart from confirming the predictions about customer's reaction to downward price adjustment, this study has obtained few other interesting results. It is shown that customers react differently to different price levels (by segmenting them according to previously paid price for a product on sale in a test catalogue), and that the highest level of antagonism can be expected in high segment, i.e. among the customers who have previously paid highest price for the test item. What strikes is that it seems that they would be willing to except small changes in price. Having that in mind, it might be concluded that often changing prices could be accepted by customers in case they were justified (e.g. by increase in cost) and of a smaller scope.

Overall, it seems that implicit contracts should be much more relevant for the pricing strategy than recognized by managers in existing studies. Customers appreciate the relationship with the seller and expect some level of fairness, which means that, in case the company is not perceived as fair, they will not hesitate to punish it and either decrease their consumption or completely switch the seller.

## 5.3. Cost-based pricing with lags

It is a wide spread and a common practice that prices are set based on costs (production costs, administrative costs, R&D costs etc). But what is important for the price stickiness is that many products go through several production stages and in a more complex production chain short lags of price change in each stage will cumulatively contribute to rather sticky price of a product. On the other side, what seems as an almost instantaneous change of price as a reaction to shock at the individual level, is a "late" reaction on an aggregate level. So more complicated production chain would cause slower price adaptations. A model that explains this flow was presented by Olivier Blanchard[44] and although it does not present explicitly input-output relation, it uses stages of production to model the change lags. The process contains *n* stages, where 0 represents raw materials and *n* the final product. [45] For each stage *i,* with *y* - log output and c – unimportant scale term:

$$y_{it} = y_{i-1,t} + c_i$$

In his model, prices stay unchanged for two periods, more precisely, half of the prices change in even and the other half in uneven periods. So the pricing relationship looks as follows:

$$p_{it} = 0.5 * p_{i-1,t-1} + 0.5 * E_t[p_{i-1,t+1}]$$

In the previous equation, *p* stands for log price and E for rational expectations. Here it is assumed that stage *i* producer which sets his price in *t*, changes it in *t+2* and the one that sets it in *t-1*, changes it again in *t+1.* The first input, i.e. labour, is not produced but is supplied as a function of relative price of the input (*e* – disturbance term):

$$y_{0t} = b(p_{0t} - p_{nt}) + e_t$$

[44] Blanchard (1983)
[45] Blinder et al. (1998)

Nominal demand for the final good is formulated as follows:

$$y_{nt} = m_{,t} - p_{nt}$$

Blanchard's model shows that macroeconomic, or aggregate, price lag depends on the microeconomic, or the price lag of intermediate product (firms in this model).

The cost-based theory with lags, as presented by Blanchard is very plausible for explaining the behaviour of prices of goods, since most of them go through more production stages. However the theory has some defects, starting with the fact that usually services are considered to be stickier than products, despite not having a multi-stage production process. Secondly, it might happen that the demand shock affects the final good first, so it would be expected that the raw material price changes with most delay. This is, of course, very hard to test and almost even impossible to isolate as the only cause of change. Furthermore, if the lag between stages is short, then it would require extremely complex production chains to cause price stickiness of a year or longer. This is also something that was examined in Blinder's research.[46]

Surveys show relatively good acceptance of this theory among managers, with ratings approximately around 2.6 (4 being "very important") not only for USA, but also for most of the studies conducted in Europe[47] as a part of the IPN. Since a certain percentage of company officials interviewed in such surveys are from the service sector, it might have had a significant influence on such ratings. Namely, since service companies usually rate such theory as unimportant, it is probable that average rating in other industries is even higher.

However, another finding emerged as surprising, which deals with companies' actions when anticipating cost or demand shocks. Basically, in case some system shocks occur, or are about to occur, in many cases companies can predict thee rise in price of intermediate good. That it is why it is expected that they will raise the prices prior to actual change. But, at least according to Blinder's results, this is

[46] Blinder et al. (1998)
[47] Fabiani (2005)

not the case. Companies tend to delay or cancel the price adaptation, due to already mentioned customer antagonism.

| | Reason | Number of responses (121) |
|---|---|---|
| 1 | We worry that competing prices won't raise they prices | 32 |
| 2 | It would antagonize or cause difficulty for our customers | 31 |
| 3 | Once costs rise, we can raise our prices promptly | 18 |
| 4 | We lack confidence in our forecasts | 10 |

Table 9 Why firms don't raise prices when anticipating cost increase[48]

Table 9 present results that uncover that firms pay much more attention to what the consequences of price change would be and how they would influence customers' behaviour. However, companies also believe that they are able to react promptly to any change in costs; therefore there is no reason to pre-adapt the prices (which could potentially neutralise the effects of pricing lags). It is also interesting that as the main reason, competitor's actions are stated, which is a good confirmation of the coordination failure theory, which will be discussed in the next sub-chapter.

Similar study, which examines the price stickiness levels and characteristics in a Canadian market, confirms most of Blinder's results. Amirault and Kwan use the survey method to find out if price stickiness levels in Canada exhibit same persistence as in rest of the world (mainly comparing to USA studies) and come across similar results, particularly on acceptance of pricing lags theory. Nevertheless, an interesting result is, that in this study, around 40% of interviewees actually claim to change their prices when anticipating change in cost.[49] This once again, leads us to the issue of inconsistency among survey results for respective theory. For such phenomenon there is still no clear explanation, which indirectly accentuates the lack of deep understanding of price stickiness.

[48] Blinder et al. (1998)
[49] Amirault and Kwan (2006)

Another topic of discussion is the difference in influence of price adapting lags concerning the nature of price change, i.e. are the companies dealing with downward or upward cost change. In the recent research on price stickiness due to adjustment lags in Portuguese market, different stickiness characteristics were found for different sources of stickiness.[50]

| | Cost shocks | | Demand shocks | |
|---|---|---|---|---|
| Price adjustment lag | Positive | Negative | Positive | Negative |
| 1 - less than one week | 4.7 | 3.5 | 2.8 | 4.8 |
| 2 - from one week to one month | 16.8 | 15.2 | 12.2 | 16.8 |
| 3 - from 1 month to 3 months | 25.0 | 25.7 | 19.3 | 23.4 |
| 4 - from 3 to 6 months | 17.6 | 15.0 | 13.4 | 13.7 |
| 5 - from 6 months to one year | 26.3 | 21.2 | 17.7 | 14.0 |
| 6 - the price remained unchanged | 9.6 | 19.5 | 34.7 | 27.4 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 |

Table 10 Distribution of the price responses (cost vs. demand shocks)[51]

As can be seen in Table 10, results show that firms react more rapidly to cost shocks than to demand shocks. That is very clear if we compare the number of firms that do not change their prices at all (6-the price remained unchanged) and we can see that such practice is not very common when facing cost shocks (9.6% and 19.5%). On other hand, demand shocks do not cause prompt price adaptation in both cases (34.7% and 27.4). It is evident that firms react more to positive cost shocks (increase in price) than negative, the opposite stands for demand shocks.
When it comes to the amount of price change, there are no much deviations between upward and downward stickiness. What seems to be true for the cost-based theory with lags, according to this research, is that it's importance and validity varies widely across companies, industries and markets. It is also important in which environment company operates, what is its pricing strategy etc. The composition of the company's costs is also relevant factor, since it is logical to expect that company with high variable cost will be more influenced by their change and vice versa. Researchers also find that the one company's proneness to adapting or keeping prices does not have much to do with the share of business

[50] Dias et al. (2012)
[51] Dias et al. (2012)

under contracts, which directly disapproves the theory of explicit contracts as possible source of persistent price stickiness.[52]

## 5.4. Coordination failure

The starting point for the theory of coordination failure as a source of price stickiness is an argument of the existence of more equilibria in the market. This theory implies that the economy can settle at some equilibria which is suboptimal and none of the participants dares to be the first to be the first mover. It is due to their beliefs about the action and reaction of each other that they are stuck at the equilibrium from which all can deviate and all become better off. At the same time there is no authority that could mediate between participants. In general, since there is a number of theories and evidence on causes of stickiness, there could also be a number of opportunities that would lead to a coordination failure.[53]

In this case the optimal output level (price) depends on the activity of the competitors. Therefore, reaction function of one firm is dependent on the given activity of the other participants which eventually lead to n "underemployment equilibrium".[54]

For instance, we consider a product market that is currently at some equilibrium price and output and due to some externality demand increases. In that case, the new equilibrium could be at a higher price and that is what firms are expected to react on. However, none of the firms dares to raise prices first; since they cannot be assured that their competitors will do the same, so they might end up with lower market share and lower profit. Same reasoning is valid in case of price decrease, which could cause firms to undercut each other end at the end finish at even worse equilibrium.

[52] Dias et al.(2012)
[53] Romer (1996), 294-297
[54] Ball and Romer (1991)

This theory is almost impossible to test empirically, since it would require very detailed observation of the market and due to sensitivity of the information it would be almost impossible to obtain all relevant data from companies. Available literature, therefore, examines this topic only by interviewing managers or by conducting experiments. Experiments, however, cannot depict the real relevance of the theory in the microeconomic environment.

According to Blinder, this is the theory which most firms recognize as a potential cause for rigid prices, especially firms in trade industry where competitor's pricing is very important. Around 55% of the interviewees stated that they do not change prices do to fear of losing market share to low-price competition. Though, things are different when it comes to downward price adjustment.

| Response | All firms | Firms for which theory is important |
|---|---|---|
| Rarely or never | 61,3% | 53,8% |
| Sometimes | 13,8% | 16,5% |
| Usually/always | 24,8% | 29,7% |

Table 11 Do companies delay downward price adjustment[55]

When asked if they delay price decreases (which occur to decrease in cost or demand) because they do not want to be the first who cuts the prices, over 60% of managers answered negatively (Table 11). Such result supports the prevailing opinion that prices are more flexible downwards and contradicts some previously presented findings on consumer antagonism. To conclude, although rated high in studies (ranks between 1st and 5th place in all major studies) it seems that coordination failure theory is more valid in explaining upward than downward price stickiness.[56]

[55] Blinder et al. (1998)
[56] Blinder et al. (1998)

## 5.5. Price adjustment costs

The theory of price adjustment costs, also known as menu cost theory, is one of the most common theories of sources of price stickiness used in macroeconomic modelling. At the same time, it is one of the theories that is not recognized and marked as significant by decision makers. I have decided to analyze findings on this theory because theory and practice seem to be in conflict and there is no general stand on if this is a best way to model sources of sticky prices or is the reason for models not being successful at fully duplicating real state on the markets.

It is also called the menu cost theory, because it stems from a simple idea that when changing prices, firms also face costs of printing menus to advertise their new prices. But what we understand under these costs are not only physical prices, such as menus or placing a price tag on every product etc. In the literature it is often distinguished between information cost and menu cost. Nonetheless, empirical research shows that these two terms might be more connected than it is popular opinion. What is often discussed is that menu costs cannot be high enough to cause persistently sticky prices on an aggregate level, which is confirmed by most of the conducted surveys. Even decision makers, who should know the sources of all their costs, do not consider this to be a valid explanation for the delay or complete dismissal of price adjustment. According to recent researches in European area, managers strongly dismiss the menu costs as a source of price stickiness, which might also be one of the reasons for very few empirical papers that deal with this issue in a way other than conducting interviews.[57]

One possible explanation for the inconsistent results might be the formulation of the meaning of menu cost. While most of the studies concentrate mainly of physical costs, especially in surveys when explaining the theory to managers, latest researches emphasize the significance of costs of finding information, assessing them and making a decision on adapting or keeping current prices.

[57] Fabiani (2005)

Recently empirical literature starts to define price adjustment costs as a combination of physical costs, managerial costs and customer costs. Under physical costs, previously mentioned menu printing, price tagging and offer delivering costs are understood. Such costs are dependent on size of the price change, number of products for which price is changed and are also influenced by legislative regulations. Managerial costs consider time and labour costs necessary for observation of competition and environment in which company acts, evaluation and decision making process. As the last part of such process, customer's costs occur, which stand for all the necessary work connected with proper communication and negotiation on new arrangements with respective customers.

In Blinder's study, which in general can be a representative of almost all survey studies, menu cost theory ranks among the last. Majority of interviewees claim not only that these costs are not as relevant as expected, but most of them claim that they don't even face such costs, which is surprising. Furthermore, it seems that firm's prefer to change quantities when facing a change in demand than changing prices due to involved costs.[58] Such statements are contradictory and should be a topic of additional research, since it looks like in many surveys the wrong question has been asked, or that even managers themselves are not completely aware of some costly processes taking place in their business.

In order to show differences between research methods, and also to stress how uncovered and possibly important adjustment costs are two quantitative studies will be presented in the following section. These studies have used a relatively innovative approach to measuring adjustment costs and have delivered results that confirm the assumptions of macroeconomist.

First study actually does not include managerial and customer's costs into analysis, but still manage to deliver results challenge prevailing suspicion about validity of the theory. Five American retail chains have been examined, using store level data, and researchers have succeeded not only in calculating menu costs but also proving that they do present a barrier to more frequent price adjustment.

[58] Blinder et al. (1998)

| Menu cost component | Chain A | Chain B | Chain C | Chain D | Average of chains A–D | Chain E (item pricing law) |
|---|---|---|---|---|---|---|
| Labor cost of price changes | 61,414 | 53,149 | 40,027 | 53,748 | 52,084 (49.2%) | 52,944 |
| Labor cost of sign changes[a] | 16,411 | 22,183 | 22,183 | 27,955 | 22,183 (20.9%) | 22,183 |
| Costs of printing and delivering price tags | 4,110 | 10,018 | 3,048 | 6,879 | 6,014 (5.7%) | 7,644 |
| Mistake costs[b] | 19,135 | 20,593 | 20,692 | 20,140 | 20,140 (19.0%) | 20,799 |
| In-store supervision costs[c] | 4,241 | 6,692 | 5,466 | 5,466 | 5,466 (5.2%) | 5,466 |
| **Total annual menu cost per store** | **105,311** | **112,635** | **91,416** | **114,188** | **105,887 (100%)** | **109,036** |

Table 12 Estimates of the Annual Menu Costs Per Store for Each Chain[59]

Table 12 shows the results on scope of menu costs, which appear to be much higher than anticipated by most of the decision makers. On average, for a research period of 2 years (1991-1992) average annual menu cost amount 105,887 U.S. dollars, comprising 0,7% of chain's revenue on average. It is also obvious that researchers have covered wide range of physical costs, cited in the first column. It is interesting, however, that highest fraction comes from labour costs and precisely these costs are rarely included in theory definition in survey studies. Furthermore, the chain that is under the item pricing law exhibits slightly higher costs than average chain not subjected to the same law. Despite the high costs, in this study, researchers face relatively high frequency of price change, which can be attributed to attributes of the retail business, which is in a very competitive and dynamic business environment.[60] Additional explanation is that the marginal benefit might be exceeding the menu costs. Further contribution of this research concerns with the confirmation of menu costs as an obstacle preventing the companies from more regular price adjustment.

[59] Levy et al. (1997)
[60] Levy et al. (1997)

| | Chain A | Chain B | Chain C | Chain D | Average of chains A–D | Chain E (item pricing law) |
|---|---|---|---|---|---|---|
| General pricing strategy[a] | HL | HL | EDLP | EDLP | | HL |
| **Number of price changes per store per week** | **4,278** | **4,316** | **3,846** | **3,223** | **3,916** | **1,578** |
| **% of products for which prices change in an average week[b]** | **17.11** | **17.26** | **15.38** | **12.89** | **15.66** | **6.31** |

Table 13 Price change activity[61]

When comparing the percentage of products and total number of price changes (Table 13) we can see that chain subjected to item pricing law exhibits less frequent price adjustment (for less products). This means that actually higher effort necessary for price adjustment (labour, tagging etc.) leads to firm's delaying price adaptation. What also strikes as surprising is that, in case of other for chains, out of products for which costs change (e.g. wholesale price) for only 70%-80% prices do actually get adjusted. This also confirms the influence of costs of changing prices on the final decision on pricing, ceteris paribus.[62]

The limitation of this study is a very specific and narrow industry (part of an industry) that has been analyzed. Although operating in a B2C environment and assuming the high significance of item pricing, even in surveys trade shows specific results.

In order to examine the complete scope of price adjustment costs and their impact on pricing behaviour, i will present another study that actually includes managerial and customer's costs in its analysis and provides deeper understanding for the complexity of this theory and importance of correctly set boundaries when it comes what is included in the research of this issue.

Zbaracki's study is significant because it examines the scope of adjustment costs in a detailed and quite innovative way. Usually it is very difficult to obtain all information on costs, because most of them are confidential and almost none of the companies want to risk their exposure. However, researchers have managed

[61] Levy et al. (1997)
[62] Levy et al. (1997)

to find such company and literally follow its every step in the price adjustment process. Not only did the researchers have full access to all invoices, memos and sheets, they were also present in all meetings which had anything to do with pricing. The idea was to discover all processes and steps necessary for a final change in product price. What they did was to calculate the cost of every man hour spent on this issue, including meetings, travels, research time etc and include them to physical costs.

Such detailed analysis also presents a disadvantage of this research method and the study itself, since it is not possible to make conclusions on an industry based on the results obtained from one company. But it is possible to gain some new insight into characteristics of price adjustment costs and potentially obtain new ideas on the issue itself.

This comprehensive analysis delivered some surprising results, namely that managerial costs are 20 times higher, and customer's costs 6 times higher than sole physical costs of price adjustment.[63]

| | Physical Cost (Menu Cost) | Managerial Cost | Customer Cost | Total Cost |
|---|---|---|---|---|
| Annual cost ($) | $43,380 | $280,150 | $892,915 | $1,216,445 |
| Annual cost as a percentage of the total cost (%) | 3.57 | 23.03 | 73.40 | 100 |
| Cost/revenues (%) | 0.04 | 0.28 | 0.89 | 1.22 |
| Cost/operating expenses (%) | 0.22 | 1.39 | 4.44 | 6.05 |
| Cost/gross margin (%) | 0.14 | 0.93 | 2.97 | 4.05 |
| Cost/net margin (%) | 0.71 | 4.61 | 14.70 | 20.03 |
| Cost per product carried ($) | $5.42 | $35.02 | $111.61 | $152.06 |
| Cost per price change ($) | $0.80–$4.34 | $5.19–$28.05 | $16.53–$89.29 | $22.52–$121.64 |

Table 14 Absolute and relative measures of costs of changing prices[64]

It is also striking that total adjustment cost (in this study for year 1997) amount around $1.2 Million, presenting around 1.22% of the total revenues (Table 14). Such costs definitely cannot be ignored or even considered not high enough to represent an obstacle to frequent price adjustment. This thesis is confirmed by the information that this particular company, on average, changes its prices once a year. The causes for this are at the same time costly price adaptation as well time consuming process of information gathering, evaluation and decision making.

[63] Zbaracki et al.(2004)
[64] Zbaracki et al.(2004)

Another significant finding is the dependence of adjustment costs on the size of the change. Naturally, big changes involve more people and more time necessary for the final decision. That also implies that convincing customers and negotiating will take more efforts and will cause higher total costs. Moreover, the issue of customer antagonism arises in this study as well. Even the slightest change in price, no matter in which direction, draws the attention to prices in general. It is possible that customers will face price adjustment costs of their own, or will have to deal with their own customers. Anyway, this represents another aspect of price rigidity regarding adjustment costs. Not only is there a hesitance inside a firm in a face of occurring costs , but also a possibility to hold the old prices in order to keep the customers satisfied.[65]

Quantitative studies point to disadvantages of surveys, especially when it comes to definition of specific theory and inconsistencies between results obtained by interviews and observed data. Issue with this theory might also be considered when analysing other theories and examining their validity. They also provide important findings on actual size of these costs, which in case of surveys is only based on assumptions and managers' subjective assessment.

[65] Zbaracki et al. (2004)

## 5.6. Facts on theories of price stickiness

In general, it has been shown that there is no unique theory that is applicable for all companies, not even for separate industries. Companies use different pricing strategies, face different level of competition and legislative regulation. Results also vary depending on the research method, sample and time period which is observed. It seems, however, that behind most of the sticky periods, stands a "fear" of antagonizing customers. When asked explicitly, why prices do not change more often, most of the managers will blame it on the angst of customers' negative reaction and decrease in purchases. Presented studies also show that this reaction is to be expected in case of both, increase and decrease of nominal prices. Quantitatively, only menu cost theory (price adjustment costs) was confirmed as responsible for persistently sticky prices, since observed costs represent a considerable amount of company's revenues and might be a plausible justification for the high level of stickiness (change of price not more than once a year).

Here, the question of distinguishing between stickiness and rigidity can be raised again. For instance, menu cost theory is a good candidate for explaining intrinsic rigidity, since it prevents companies from adapting price fully to observed shock. On the other hand, theory of constant marginal cost can be an example for extrinsically rigid prices, since the observed shock does not change the optimal price level for the company. This could be one of the reasons why in different industries obtained results differ strongly.

# 6. Measuring price stickiness

It is generally considered that level of price stickiness directly influences the non-neutrality of money, i.e. impact of the monetary policy. In addition to testing theories, a significant number of authors deal with measuring the level of prices stickiness. Method used in almost all researches is similar, time series data on price level are observed for a specific industry or country, obtained mostly from institutions measuring national CPI and PPI. Since such institutions possess extensive data on prices, including analysis over the years, it makes it very convenient in observing not only recent but also historical changes in price behaviour. Despite the fact that almost most surveys use similar data, which enables cross-country analysis, and standardized measuring methods, the scientific literature is characterized by high level of discrepancy between levels of price stickiness. This happens not only in cross-country comparisons, but also in studies that research price stickiness in same countries and industries, but on a different sample or in a different time period.

The last section of this paragraph will try to provide some insight into the issue of price stickiness over the years. However, first the formal definition of levels of price stickiness and its measuring technique will be presented.

## 6.1. Frequency and scope of price change

How frequent prices change, over some set period of time, is the easiest and most used method of analyzing sticky prices. Due to its simple application, and possibility of evaluating a large amount of data, especially with the development of the IT, it has provided us with understandable and comparable characteristic of price changes. This method, however, has its disadvantages. Firstly, the frequency of price change depends heavily on frequency of cost and demand shocks. For instance, the introduction of Euro in number of European countries has caused a price switch that otherwise would not happen. A change in prices during the time before and after the introduction of Euro can be seen in Figure 3.

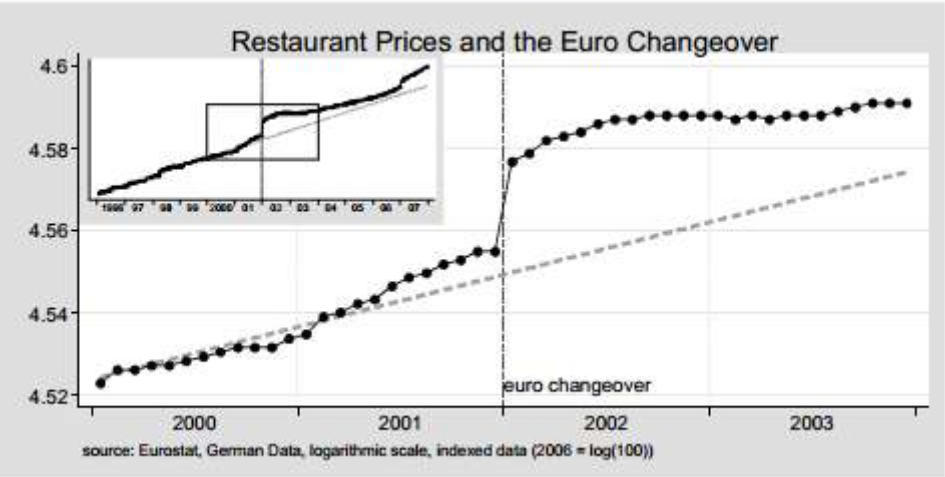


Figure 4 Euro chanageover and prices[66]

In addition, the number of price changes is also a firm specific variable, since it depends mainly on company's organization, price setting policy and market in which it is operating. Such arguments can, on one hand be explanation for differences in observed price behaviour; however it is not possible to measure the extent to which study results are biased by these characteristics.

Figure 4 shows general formulas with which researches calculate the frequency of price changes (*F*) and average (weighted) time for which price remains unchanged (duration, *T*).

$$F_j = \frac{1}{T}\sum_{t=1}^{T} I_{j,t} \quad \forall j = 1, ..., J$$

$$T_j = -\frac{1}{\ln(1 - F_j)} \quad \forall j = 1, ..., J$$

$$T = \frac{1}{J}\sum_{j=1}^{J} T_j \quad \text{and} \quad T^W = \sum_{j=1}^{J} w_j T_j$$

Figure 5 General formulas for frequency and duration of price stickiness[67]

[66] Eife (2008)
[67] Morande et al. (2008)

Variable I is a binary variable, having value of 1 when prices in previous and current period differ, and value 0 when they are the same. That way any change between two periods is captured. In order to obtain the frequency value, total number of changes is divided by the number of periods. In the second line there is a formula for calculation of price duration, for which given frequency is needed. In this case, data on prices are continuous (can be changed at any given time), otherwise formula would also include counter with values for possible limitations on change of prices (for monthly changes-12, every six months-2 etc.). In order to obtain most correct average duration, based on the composition of the CPI and PPI, weighted average duration is calculated by using weights of total consumption of single products in the consumer basket.[68]

As a part of a IPN network, a series of studies on price stickiness in Euro area have been conducted. By analyzing prices of over 10,000 companies, comprehensive data on pricing practices have been examined. Since they have been conducted under the same framework, it is possible to compare some main findings. Table 15 contains an overview of study results for 10 European countries.

| CPI Studies | Country | Sample | Frequency (%) | Duration (months) |
|---|---|---|---|---|
| Baumgartner et al. (2005) | Austria | 1996 – 2003 | **15,1** | **6,11** |
| Aucremanne and Dhyne (2004) | Belgium | 1989 – 2001 | **16,9** | **5,40** |
| Vilmunen and Laakkonen (2005) | Finland | 1997 – 2003 | **16,5** | **5,55** |
| Baudry et al. (2007) | France | 1994 – 2003 | **18,9** | **4,77** |
| Hoffmann and Kurz-Kim (2006) | Germany | 1998 – 2004 | **11,3** | **8,34** |
| Gabriel and Reiff (2008) | Hungary | 2001 – 2007 | **15,1** | **6,11** |
| Fabiani et al.(2006) | Italy | 1996 – 2003 | **10,0** | **9,49** |
| Wulfsberg (2009) | Norway | 1975 – 2004 | **21,3** | **4,17** |
| Alvarez and Hernando (2006) | Spain | 1993 – 2001 | **15,0** | **6,15** |
| Coricelli and Horvath (2006) | Slovakia | 1997 – 2001 | **34,0** | **2,41** |
| | | Median | **15,8** | **5,81** |

Table 15 Comparison of frequencies and price duration in Euro area[69]

[68] Morande et al. (2006)
[69] Author's illustration

We can see that the average frequency for given studies amounts 15.8%, which means that in the give time period this is the number of prices that have been changed. Translated into duration of a certain price, we see that on average prices last little under 6 months. Therefore we can say that, on average, companies in Europe change their prices twice a year. What is also noticeable is that deviations are present, meaning especially the results of the study conducted in Slovakia, which are inconsistent with the European average. Some of this can be attributed to inflation and as researchers note, market conditions, but there is no detailed analysis on such phenomenon.

If we further expand geographically, and compare obtained results, some evident differences arise. As it can be seen in next table, studies conducted in USA, Japan and some South American countries show significantly higher frequency of price change, i.e. longer duration of a set price.

| CPI Studies | Country | Sample | Frequency (%) | Duration (months) |
|---|---|---|---|---|
| Bils and Klenow (2004) | USA | 1995 – 1997 | **26,1** | **3,31** |
| Klenow and Kryvtsov (2008) | | 1988 – 2005 | **29,9** | **2,81** |
| Nakamura and Steinsson (2008a) | | 1988 – 2005 | **21,1** | **4,22** |
| Saita et al. (2006) | Japan | 1999 – 2003 | **23,1** | **3,81** |
| Baros et al. (2009) | Brazil | 1996 – 2008 | **37,2** | **2,15** |
| Gagnon (2009) | Mexico | 1994 – 2004 | **29,4** | **2,87** |
| Medina et al. (2007) | Chile | 1999 – 2005 | **46,1** | **1,62** |

Table 16 Comparison of frequencies and price duration – world[70]

South American countries exhibit highest frequency of changing prices, followed by US where prices tend to be more flexible than in Europe. Causes for such differences might be found in characteristics of markets themselves and inflation levels. In general, American markets are characterized by smaller number of bigger firms, which presumably have more financial resources and human capital

[70] Author's illustration

at their disposal that can deal with observation, assessment and possible adaptation of prices. Such market structure could potentially lead to some significant discrepancies in results.

What confirms this theory is the fact that internet prices are changed more frequently in Euro area than in USA: This can be due to more extensive regulations in European retail business (which can be compared to online stores).This also questions the overall estimation of consumer's reaction to prices, i.e. general frequency of price change, since the percentage of trade conducted online is constantly on the rise. In addition, it has been shown that internet price changes mostly vary in the range of 0% to 1%, whereas in retail stores they tend to be less often but higher in amount (more than ±5%).[71] Such differences might be attributed to reduced transaction costs as well as price adjustment costs (menu costs), which were discussed in the last chapter.

Collective analysis of price stickiness in Europe can be found in a paper published by a group of researchers, members of Directorate-General for Economic and Financial Affairs of the EC.[72] In their analysis of existing studies, they conclude that frequency of price change varies significantly across different product categories, from 5,6% for services till 74% for energy products). Similar to findings of existing studies on amount of price change, their results show that price changes are significant (8-10% on average). Price increases are slightly higher than price decreases, however, there are no important differences in how often they change. This points out to equal level of upward and downward price stickiness. Probably the most important finding of this analysis is the fact that prices depend heavily on composition of costs. Namely, products that are labour intensive will tend to have more rigid prices, due to connection to wage rigidity. The opposite stands for products and services involving significant amount of energy, which is characterized by low stickiness and therefore influences these products in a same way, causing very flexible prices.

[71] Lünnemann and Wintr (2006)
[72] Dhyne et al. (2009)

What strikes is that, similar to theories of causes of price stickiness, different research methods deliver inconsistent results. So measured price stickiness does not only differ among industries, due to market characteristics, cost composition of products or sample differences. We come to a conclusion that the formulation of questions, more general, the method used in observation is crucial for results of the study. Klenow and Malin show that previously presented studies on frequency of price change and duration of a set price deliver contradictory results when decision managers are asked about those issues.

**Number of Price Changes per year (%) in Survey Data**

| Country | Paper | <1 | 1 | 2-3 | ≥4 | Median | Mean (in months) |
|---|---|---|---|---|---|---|---|
| Austria | Kwapil *et al.* (2005) | 24 | 51 | 15 | 11 | 1 | 12.7 |
| Belgium | Aucremanne and Druant (2005) | 18 | 55 | 18 | 8 | 1 | 11.9 |
| Canada | Amirault *et al.* (2006) | 8 | 27 | 23 | 44 | 2-3 | 6.8 |
| Estonia | Dabusinskas and Randveer (2006) | 14 | 43 | 25 | 18 | 1 | 10.0 |
| Euro Area | Fabiani *et al.* (2005) | 27 | 39 | 20 | 14 | 1 | 12.3 |
| France | Loupias and Ricart (2004) | 21 | 46 | 24 | 9 | 1 | 11.8 |
| Germany | Stahl (2005) | 44 | 14 | 21 | 21 | 1 | 13.5 |
| Italy | Fabiani *et al.* (2007) | 20 | 50 | 19 | 11 | 1 | 11.9 |
| Japan | Nakagawa *et al.* (2000) | 23 | 52 | 11 | 14 | 1 | 12.5 |
| Luxembourg | Lunnemann and Matha (2006) | 15 | 31 | 27 | 27 | 2-3 | 9.0 |
| Mexico | Castanon *et al.* (2008) | - | - | - | - | - | 5.7 |
| Netherlands | Hoeberichts and Stokman (2006) | 10 | 60 | 19 | 11 | 1 | 10.7 |
| Portugal | Martins (2005) | 24 | 51 | 14 | 12 | 1 | 12.7 |
| Romania | Copaciu *et al.* (2007) | - | - | - | - | - | 4.1 |
| Spain | Álvarez and Hernando (2007a) | 14 | 57 | 15 | 14 | 1 | 11.1 |
| Sweden | Apel, Friberg and Hallsten (2005) | 29 | 43 | 6 | 20 | 1 | 12.7 |
| Turkey | Sahinoz and Saracoglu (2008) | - | - | - | - | - | 3.0 |
| United Kingdom | Hall, Walsh and Yates (2000) | 6 | 37 | 44 | 14 | 2-3 | 8.2 |
| United States | Blinder *et al.* (1998) | 10 | 39 | 29 | 22 | 1 | 8.8 |

Table 17 Number of price changes per year (%) – survey data[73]

Based on this method, prices actually rarely change more than once a year on average, which is not consistent with previous findings, stating that even in the areas characterized by high level of stickiness (Europe) prices change at least two time a year. Such problems are still not tackled, because there does not seem to be any logical mistake in problem formulation. However, it is questionable if surveys are actually reliable and appropriate method of measuring price change frequency, since they tend to underestimate the observed levels and decision makers do not seem to be bothered enough with this issue.

[73] Klenow and Malin (2010)

## 6.2. Causes of discrepancies

In order to try to explain existing inconsistencies (heterogeneities) in results on frequency of price change Alvarez and Hernando have analyzed previously mentioned studies conducted under IPN in Euro area. They focus on correlation between the price stickiness and level of competition in a market (industry, country), basing their findings on research from manufacturing and service industry.

A disadvantage of this study is that it does not consider analytical measures of intensity of competition, but rather relies on intensity of competition perceived by company executives.

Findings point out that companies operating in a lower competition environment tend to use markup pricing strategies, while those operating in an environment with high intensity competition rely on competitors' prices when setting their own.[74]

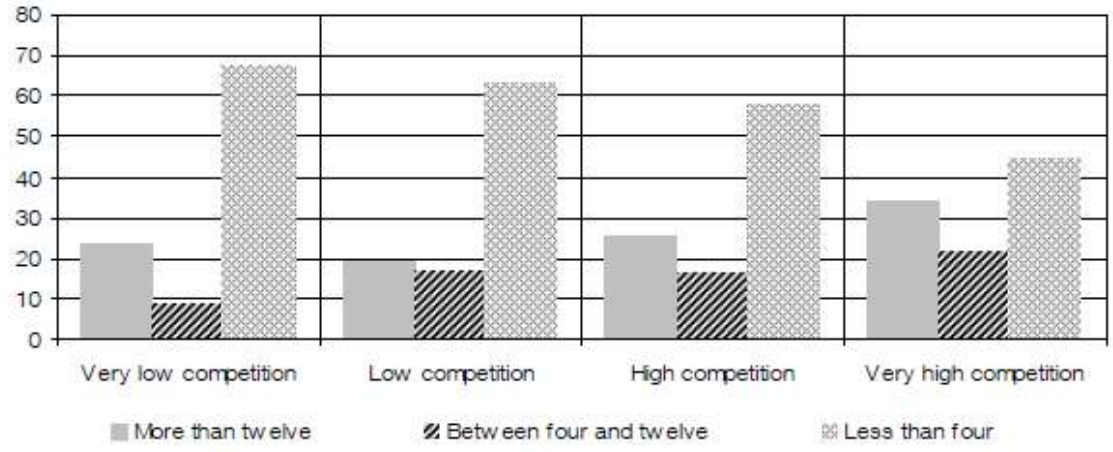


Figure 6 Frequency of price reviews by degree of perceived competition[75]

It is clear from Figure 5 that more intensive competition "forces" companies to review and possibly change their prices more often. It is plausible to assume that some cost/demand shock that might otherwise be ignored, become important because competitors act on them and adapt their prices.

[74] Alvarez and Hernando (2006)
[75] Alvarez and Hernando (2006)

Therefore, some of the inconsistency between studies and inside studies can be attributed to different *competition levels* which firms are facing. Furthermore, researches confirm the significance of cost composition, highlighting the influence of share of labour in production or provision of product or service.

It has to be mentioned that wage and price stickiness are strongly connected and some share of level of price stickiness can be attributed to *labour costs*. Labour is traded under explicit (nominal) contracts, and their effects have previously been discussed. Since such contracts tend to be very sticky, hey automatically influence products in which production they are included. Lastly, a possible explanation could be the *product market regulation*, since countries with more strict regulations tend to have slightly rigid prices, but these results are once again based on subjective perception of product market regulations, which does not completely validate such results. [76]

## 6.3. Upward and downward stickiness

Another ambivalent characteristic of price changes has been visible in all presented studies. Depending on the method used to conduct the research, followed by different time frames and samples, different results were obtained. Most of the studies claim that there are no significant differences between upward and downward movement of prices. However if we analyze existing findings more thoroughly we will notice that those studies that do register some deviation, tend to find that prices adapt less frequently when it comes to cost increase, i.e. prices are stickier upwards. Best explanation for such behaviour is found in researches dealing with theory of coordination failure, where most of the firms delay price increases, but don not waste time to decrease prices and capture higher market share (see sub-chapter 4.4).

[76] Alvarez and Hernando (2006)

## 6.4. State-dependent vs. time-dependent

The question if companies review and change their prices in regular time spans or only when there is a present cost or demand shock, remains very relevant for the macroeconomic studies. That it one of the crucial characteristics of models, since the most important attribute of such models is the assumption how and when firms review and change their prices. Again, depending on the study, results do not show a clear prevalence of certain strategy; however slight advantage is given to time-dependent models. This can be explained by following two arguments. Firstly, if we consider theory of menu costs, it is costly for companies to react to every change in cost/demand. It also does not have to mean that every observed change is significant enough to adjust existing prices. Secondly, consumer antagonism proved to be important variable when reviewing prices, ´so it could lead to the situation in which companies would rather sacrifice a share of their margin than risk decrease in sales, i.e. loss of customer share.

State-dependant pricing seems to be relevant when a previous pricing decision has had negative effect on sales. For instance, when previous increase in prices has affected demand to shrink. In such case, companies would decide to review their prices once again and not stick to their schedule.[77]

[77] Stahl (2005)

## 6.5. Facts on price stickiness level

The discrepancies between studies are still a puzzle for everyone who researches this topic. It is very difficult to draw conclusions that apply to whole markets and impossible for the whole economy. While surveys show that firms change prices once a year, on average, observed data imply higher level of price change frequencies. Even countries with relatively sticky prices, such as most of European countries, exhibit in reality more flexible prices than assumed, with price duration no longer than 6 months. It is clear, however, that recent researches obtain results which imply higher frequency of price change than those conducted in 80‘s and early 90’s. It is assumed that such development is due to development of the markets, industry concentration and technological changes in consumption.

Furthermore, existing microeconomic literature does not provide a clear and unique answer on stickiness on a country level, which is not helpful when it comes to business cycle modelling and determination of optimal monetary policy. Exactly this has been the assignment of microeconomic research, which points out to necessity of different or just modified approach to this subject. There are still a lot of questions to be investigated, since after nearly three decades since the first macroeconomic study of sticky prices[78] we do not know for sure how sticky prices are, what are the most important causes as well as if and how they influence the monetary policy effects.

[78] Cecchetti (1986)

# 7. Conclusion

Considering all the deviations and disparities which emerge in presented researches it is not possible to give clear conclusion on why and how sticky prices are. However, it is possible to grasp some characteristics of price stickiness that might be helpful in understanding this issue and its complexity.

Presented theories do not offer unique, globally applicable solution on what stops companies from adapting prices more frequently, but they are successful in explaining stickiness in individual industries and markets. It is evident that deeper understanding for this phenomenon could be obtained by taking into consideration newly presented definition of stickiness and rigidity. It is plausible to expect that future research will focus more on intrinsic rigidity of prices and maybe be able to better capture causes of such rigidity. That will also mean that government's policies will be more effective in dealing with this issue.

When it comes to frequency of price change and duration of set prices, story does not change significantly. Surveys mostly fins that firms change their prices once a year, while observed data show frequencies of minimum two times a year, and the majority fitting into span between 2 and 6 changes per year. What seems to effect how often firms change prices is competition intensity, forcing companies to review more often than when the perceived level of competition is low. Such findings can be questioned, since most of the studies measure perceived and not real level of stickiness. On the other hand, it seems plausible that managers will react to state perceived by them, which justifies existing results.

As shown in studies, what also affects firms' price setting policy is the cost composition. Higher share of labour costs, decreases frequency of price changes, especially downward price changes. In contrast, share of costs caused by energy consumption increases frequency of price change, so prices increases are very often in such companies.

Furthermore, more recent studies (CPI, PPI, scanner and online data) usually show more frequent price changes, which could be a consequence of different market characteristics. Consolidation in retailing business, for instance, has led to a situation in which there are only few, but very strong, competitors. Since big companies have more resources at their disposal, it is clear that they can adapt prices more often to the current state of the economy.

The question if firms use state-depending vs. time-depending pricing strategies does not provide clear results, since companies tend to combine these strategies. There is a slight prevalence in favour of time-depending models, because price reviewing and adaptation is not only money, but also time consuming. Therefore, unplanned and spontaneous changes are not easy to conduct. Still, if the shock is significant enough, i.e. utility of changing prices is higher than utility of holding them at the same level, companies will not hesitate to react (especially to decrease the prices). This leads us to subject of upward and downward stickiness, and the results show that there indeed are some differences in stickiness level in two different directions. Due to managers' recognition of customer antagonism problem, upward movements are usually less often, but when they do happen the increase is higher (higher percentage of previous price). It is a general occurrence that firms that adapt prices frequently do so for quite small increases/decreases. On the other hand, firms that delay price adaptation, and usually review prices more often than they change them, use bigger price changes.

Existing studies on price stickiness are quite similar, and although they have now covered wide range of product groups, industries and countries only few have made significant progress in clarifying some aspects of this issue. Future studies should focus on finding new research methods, as well as defining which aspect of price behaviour is to be investigated. That way, maybe, the focus will be on the rigidity aspect relevant for policy makers and could possibly solve some of the inconsistency issues.

# 8. Literature

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# 9. Appendices

## 9.1. Appendix A - Studies overview (partial)

| Author(s) | Country | Data | Key findings |
|---|---|---|---|
| Fabiani et al. (2006) | Italy | CPI from ISTAT<br>1996 – 2003<br>Monthly data<br>Observed by surveyors in stores | Prices remain unchanged for 10 months, on average<br>Stickiness more persistent in non-energy industrial goods and service, less in energy products<br>More frequent upward, than downward price change<br>Stickiness depends on company size (small stores vs. big retailers) |
| Baumgartner et al. (2005) | Austria | CPI from Statistics Austria<br>1996 – 2003<br>Products with high frequency of price change overrepresented (author's remark) | Prices stay unchanged for 10 – 14 months on average<br>Heterogeneity exists over sectors and products<br>Slightly emphasized downward stickiness<br>Price spell correlates positively with probability of price change |
| Hofmann and Kurz-Kim (2006) | Germany | CPI form German Federal Statistical Office<br>1998 – 2003<br>Results not affected by the transition to Euro | Only 10% of prices change on month<br>Differences in frequency across different goods<br>Prices with stable PPI change less often (importance of market conditions)<br>Input price shock are very important in price setting<br>Results might be biased by temporary sales<br>No difference between upward and downward stickiness<br>Service prices more rigid than goods prices<br>Evident seasonality in price changes |

| Author(s) | Country | Data | Key findings |
|---|---|---|---|
| Alvarez, Dhyne, Hoeberichts, Kwapil, Bihan, Lünnemann, Martins, Sabbatini, Stahl, Vermeulen and Vilmunen (2006) | Euro Area – Summary<br><br>*CPI studies conducted in*: Austria, Belgium, Finland, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain.<br><br>*PPI studies from*: Belgium, Germany, Italy, Portugal and Spain.<br><br>*Surveys:* Austria, Belgium, France, Germany, Italy, Luxembourg, the Netherlands, Portugal and Spain. | Data collected by National statistic Institutes of respective countries.<br><br>Unlike previous micro studies, cover a wide range of manufacturing and product prices. | Prices in the euro area stickier than in US (compared with Bils and Klenow 2004 for the US).<br><br>There is strong evidence of heterogeneity and asymmetry in price setting behaviour.<br><br>Downward rigidity is slightly persistent than upward price rigidity.<br><br>Firms identify theories of implicit and explicit contracts and coordination failure as most important causes for price rigidity. Menu and information cost theories are less relevant. |
| Bunn and Ellis (2010) | UK | Two studies, one on CPI (including additional database on supermarket prices) and the other on PPI change over the years. | 26% of producer prices change, on average, each month.<br><br>Distribution of producer price changes is wide, although there is a significant number of small changesProbability of price change is no constant over time.<br><br>Market heterogeneity in consumer prices. Existing models do not replicate the real behaviour of UK consumer prices. |

| Author(s) | Country | Data | Key findings |
|---|---|---|---|
| Bils and Klenow (2004) | USA | BLS data for CPI from 1995 – 1997 | Results imply to more frequent price changes.<br><br>For over half of goods and service prices remained unchanged for 4.3 months or less.<br><br>Time-dependent models proved to be overestimating price persistency in reality. |
| Klenow and Malin (2010) | USA | Provide a detailed report on CPI change from 1988-2009<br>Goods categorization change somewhat in 1998, so after that some goods had to be omitted. | Prices change at least one a year.<br>Sales are important factor of price flexibility.<br><br>Reference prices stickier than regular prices.<br>Evident heterogeneity across goods.<br><br>Scope of price change is rather large, but small changes happen as well.<br><br>Frequency and size are not increasing in the age of price. |
| Blinder et al. (1998) | USA | Conducted surveys with 200 managers in USA (mostly from Northeast), whose companies had a turnover of at least $10 Mio. | 80% of the firms change their prices less than 4 times a year.<br><br>Most important reason, customers' antagonism.<br><br>Price changes mostly occurred as a consequence of state-dependent reviews.<br><br>Firm's size is positively correlated with price changes.<br><br>Menu cost theory is not confirmed by the decision makers. |

| Author(s) | Country | Data | Key findings |
|---|---|---|---|
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| Morande and Tejada (2008) | South America (Brazil, Chile, Colombia and Mexico ) | CPI data from national statistic institutions.<br>Data from 1998-2006 (not exactly same time frame from each country) | Higher nominal rigidity in Colombia and Chile (change every 3 months), whereas in Brazil and Mexico prices change more often (approximately every 1.5 months).<br><br>Less processed goods have more flexible prices.<br><br>In all countries, heterogeneity issues arise.<br><br>Results correspond better to state-dependent modelling. |

## 9.2. Appendix B - Abstracts

### Abstract in Englisch

Price stickiness is characterised as market inefficiency, where prices do not adjust instantaneously to changes in costs or demand. This phenomenon has been a subject of dispute among economists for almost a century, ever since John Keynes marked it as a main cause of money non-neutrality. That is why there are a large number of studies, which examine sticky prices on microeconomic and macroeconomic level. This paper investigates existing literature on price stickiness from a microeconomic aspect, presenting main results and deficiencies. It deals with theories that try to explain causes of price stickiness and their empirical validity. Furthermore, it presents observed levels of price stickiness obtained in recent empirical studies. Such information provide a solid starting point for anyone who intends to investigate this topic in detail.

### Abstract in Deutsch

Als Preisrigidität (Preissturheit) wird eine Art Marktineffizienz bezeichnet, wobei die Kosten- oder Nachfrageshocks zu keinen Veränderungen der Preisen führen. Dieses Phänomen gilt seit fast einem Jahrhundert als strittiger Punkt unter Ökonomen, seitdem es von John Keynes als Hauptgrund für Nicht-Neutralität des Geldes bezeichnet wurde. Infolgedessen existiert eine große Anzahl von Studien die sich mit der Preisrigidität aus makro- und mikroökonomischer Sicht beschäftigen. Gegenstand dieser Arbeit ist die Analyse der bestehenden Literatur aus mikroökonomischer Sicht, wobei die Hauptergebnisse und Unvollständigkeiten präsentiert werden. Diese Arbeit befasst sich mit aktuellen Theorien über Ursachen von Preisrigidität und mit ihrer empirischen Gültigkeit. Desweiteren werden die Befunde der Studien, welche die Preisänderungshäufigkeit untersuchen, präsentiert und verglichen. Diese Daten bieten eine solide Basis für alle, die sich mit diesem Thema tiefer beschäftigen wollen.

# 9.3. Appendix C – Curriculum Vitae

## Tamara Lazić, Bakk. rer. soc. oec.

### Personal Information

Date of Birth: 07.06.1988
Place of Birth: Banjaluka
Citizenship: Bosnia and Herzegovina

### Education

since 2012 Master in Business Administration University of Vienna
Majors: Transportation Logistics and Industrial Management

2008-2012 Bachelor in Business Administration, University of Vienna
Major: Management (Production-, Supply Chain-, and Marketing Management)

2003-2007 Gymansium, Banjaluka

### Work experience

07/08 2011 Wiener Fernwärme
Summer internship in the department of "Wärmemessung"

02/03 2007 Tropic Group (Retail), Banjaluka
Working student in the department of Human Ressources

### Language Skills

Serbo-Croatian (mother tongue)
English (fluent, FCE and CAE certificates)
German (fluent, C1 certificate)

### Computer Skills

MS-Office: Excel, PowerPoint, Word (very good)
SAP APO, Fico Xpress MP, Java, HTML, Eviews (basic)