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Downward Nominal Wage Rigidity in the Estonian Private Sector

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TABLE OF CONTENTS

LIST OF ORIGINAL PUBLICATIONS

I Monographs and chapters in monographs

1. **Järve, J.**, Veisson, T. (2003). Finantsjuhtimine. Tartu Ülikooli Kirjastus. 237 lk.

II Articles in international journals

1. Anspal, S., **Järve, J.** (2011, forthcoming). Downward nominal wage rigidity and Gender. LABOUR.

III Other research articles

Working papers

1. **Järve. J.** (2002). *Tööjõukulude mõju tööjõu nõudlusele Eesti tööstusettevõtetes*. *Poliitikaanalüüs Nr.1*, *Poliitikauuringute Keskus* PRAXIS. 16 p.
2. Philips, K., Arro, R., **Järve, J**., Eamets, R., Kallaste, E. (2001). Labour market flexibility and employment security: Estonia. Employment Paper 2001/25, Geneva: International Labour Office.

National journals, chapters of reports and research reports

1. **Järve, J.**, Jaakson, K. (2010). *Tööstress on juhitav*. *Eesti Töötervishoid.* Nr. 2, pp. 39–41.
2. **Järve, J.** (2008). *Töölepingu seadus – vana seadus on vana. Eesti Majanduse Teataja*, Nr. 4 (203).
3. **Järve, J.** (2007). *Töölepinguseadus ja halduskoormus. Eesti Majanduse Teataja,* Nr. 10 (197).
4. **Järve, J.**, Annus, T (2007). Building a system of early identification of skill needs in Estonia. Strietska-Ilina, Olga; Tessaring, Manfred (Eds.). Systems, institutional frameworks and processes for early identification of skill needs. Luxembourg: Office for Official Publications of the European Communities, pp. 92–101.

IV Conference publications

1. Seppo, I., **Järve, J.** (2010). Initial Results of Applying HSE Information Tool in Estonia. *Eesti Majandusteadlaste Seltsi aastakonverents*, Viljandi, 29.–30. January 2010.
2. **Järve, J.** (2002). *Kuidas tõsta tööturu paindlikkust? X teadus-ja koolituskonverentsi* "*Euroopa Liiduga liitumise mõju Eesti majanduspoliitikale*" *ettekanded-artiklid*. BERLIN VERLAG Arno Spitz, MATTIMAR OÜ, 99–107 p.

INTRODUCTION

Motivation for the research and scope of the thesis

The cyclical nature of economic development has been freshly visualised in the mind of every Estonian. In less than five years, there has been extraordinarily high economic growth followed by a staggeringly sharp fall in economic output and employment. Almost everybody has heard of the need to be more flexible and to adjust to new conditions in both the product and labour markets. The need to be flexible is unavoidable in many aspects of our everyday work life, but this does not mean that change comes without opposition. Our everyday income is certainly one such area where proposals for downward adjustments are not very likely to be met with understanding and acceptance.

Downward nominal wage rigidity (DNWR) is the tendency to avoid nominal wage cuts. This topic is important for several reasons. Firstly, European central banks see as their primary goal price stability. If workers resist nominal wage cuts, then in near-zero inflation environments a part of the real wage cuts that are needed for the normal functioning of the economy will not be enacted and this will lead to an increase in unemployment. Secondly, this problem is further aggravated by the fact that a large and increasing number of European countries have given up their independent monetary policies and are either members of the Euro area or have pegged their currency to the euro. In this setting wage flexibility is of paramount importance when dealing with idiosyncratic shocks. If there is downward rigidity in nominal wages, low and positive inflation 'could grease the wheels of the labour market' (Card & Hyslop, 1997).

DNWR is often analysed together with downward real wage rigidity (DRWR), which is a situation where wages are downwardly rigid in real terms. It is well known that most labour market outcomes for wage rigidity are linked to real wage rigidity, but there is a reason why the focus of this paper is on the existence of and reasons for downward nominal wage rigidity. This reason is that in certain circumstances, such as a low inflation environment, it is the DNWR that is the source of DRWR. Although there are several other explanations for DRWR, the following chapters of this thesis will show that DNWR is a quite widely spread phenomenon in Europe. To date, only a few papers have addressed this issue using Estonian data and so far there has been no attempt to address this issue with tools that allow for more comprehensible quantitative estimates of the extent of DNWR in Estonia.

As most of the quantitative estimations done in this thesis are based on data from the Estonian Tax and Customs Board on companies registered in the Commercial Register, there are some natural limitations to the scope of this thesis. Firstly, the private sector, which is the main focus throughout this thesis, is restricted to companies that are registered in the Commercial Register. This means that all other legal forms of economic activity, such as NGOs or the self-employed are excluded from the analysis. Secondly, the time period is limited to 2002–2009, and thirdly the data from the Estonian Tax and Customs Board doesn't include information on working hours. This means that although the

commonly accepted term 'wage rigidity' is used, it is actually total pay rigidity that is estimated (i.e. the average monthly total pay received from a particular employer). There is also, however, a non-technical reason for concentrating on total pay, because for labour market consequences it is not very relevant which components of total compensation are used to gain flexibility in labour costs in times when this is needed.

Obviously, as the information comes from the Estonian Tax and Customs Board, analysis is limited to pay received from legally sound employment relations.

Aims and objectives of the thesis

The aim of this thesis is to investigate the existence and size of DNWR, based on the example of Estonian private sector companies.

In order to achieve the aim of this thesis, the following research tasks will be fulfilled:

- An overview of the theoretical framework of downward nominal wage rigidity will be provided;
- An overview of the empirical findings from previously conducted studies on the size of and reasons for DNWR will be provided;
- The existence and size of DNWR in Estonian private sector companies will be identified;
- Differences in DNWR by worker and enterprise characteristics will be identified;
- The reaction of DNWR to the economic crisis (2008–2009) will be investigated.

Study of the theoretical framework and the empirical findings of previously conducted research have led to the following main hypotheses for this thesis:

- wages in the Estonian labour market are more flexible than those in Western Europe;
- there are differences in DNWR between industries;
- wages in large companies are nominally more downwardly rigid than those in smaller companies;
- younger workers have less DNWR than workers of prime age;
- there are differences in DNWR between men and women;
- the wages of low wage earners show more DNWR than the wages of higher wage earners;
- DNWR changes over the business cycle and a severe economic crisis reduces DNWR.

The thesis contributes to the literature in several aspects. The methods that use variation in the shape of wage change distribution for analysing DNWR are quite sensitive to the quality of data. Most of the research done in this field is based on earnings figures from survey data (like PSID in USA), which is known

to be plagued by measurement error (Akerlof *et al.* (1996)). This thesis uses registry data from Estonian Tax and Customs Board, the total pay figures of which are almost free of reporting error[1]. To author's knowledge this is the first time that kind of dataset is used for analysing DNWR in Eastern Europe.

Secondly, although differences in DNWR between employer and worker groups have been addressed by several authors (e.g. McLaughlin (2000)), usually less comprehensive methods have been used. This thesis intends to fill this gap.

Thirdly, some authors (e.g. Knoppik & Beissinger (2001), Behr & Pötter (2009)) have already indicated that DNWR does change over time. This thesis tests the dynamic properties of DNWR on Estonian registry data during economic boom as well as crisis and confirms the dynamic nature of DNWR.

Finally, a new method is proposed for analysing DNWR that does not make any assumptions about shape of the counter-factual wage changes distribution and is thus easily usable in situations like recent economic crisis.

Thesis structure

The thesis has six chapters in total. The first chapter provides the theoretical reasoning for the existence of downward nominal wage rigidity. The second part introduces the main findings from previous empirical studies on the existence of and reasons for DNWR. The third chapter describes the main dataset that was used in the empirical analysis of DNWR in the Estonian private sector. The data description has a prominent place in the thesis mainly because this is the first time the properties of this dataset have been described. The fourth part presents the results for the size of DNWR in the Estonian private sector in general and provides a limited comparison with findings from other countries. The fifth part investigates differences in DNWR by worker (age, gender, level of earnings) and employer characteristics (company size and economic activity). Chapter six presents the results for the adjustment of wages during the economic crisis (2009) in the light of findings on DNWR in Estonia.

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Firstly I would like to thank Professor Raul Eamets – my supervisor – for his insightful comments and suggestions and for keeping up my motivation during the long process of writing the thesis.

Special gratitude is due to the first round of opponents – Ott Toomet and Tairi Rõõm – whose criticisms and advice addressed several shortcomings in the initial version of the thesis. I would also like to thank Ana Lamo for finding the time to contribute to the defence of the thesis.

[1] The potential error stemming from the fact that there is no data on working hours will be discussed in chapter 3.

Last but not least, my thanks must go to my co-workers and friends in the Estonian Centre for Applied Research CentAR, especially Epp Kallaste and Sten Anspal, for reading and commenting on initial versions of the thesis as well as for the fruitful discussions, both theoretical and philosophical.

1. THEORETICAL FRAMEWORK FOR DOWNWARD NOMINAL WAGE RIGIDITY

1.1. Introduction

The aim of this chapter is to provide a theoretical framework for DNWR. As will be seen from the following sub-chapters, there is a peculiarity that should be explained before the description of these theories can be presented. Most of the theories operate with real wages, while this thesis explicitly addresses DNWR. Although real and nominal wages are two different indicators, there might be no reason to draw a very distinct line between these two types of rigidity when speaking of the reasons for wage rigidity. Indeed Agell & Bennmarker (2007) show that in a near-zero inflation environment it is difficult to distinguish between the forces that create real and nominal rigidity (Agell & Bennmarker, 2007, p. 350).

There are several theoretical explanations provided by a large number of authors. The following classification of theories is mostly based on Truman Bewley's book *Why Wages Don't Fall During a Recession* published in 2002. Some additions to the classification of theories have been made based on Campell *et al.* (1997) who propose a slightly different classification for theoretical models, though the list of theories remains roughly the same. However, it is important to keep in mind that most of the theories listed below do not explain 'perfect' downward nominal wage rigidity, meaning that the original models do not provide explanations for situations where wages do not decline at all. Several of the theories listed below require additional assumptions to be able to explain wage rigidity. It is fair to say, that below-listed theories are a broader source of ideas about possible reasons for wage rigidity and not so much a list of models developed with the purpose to explain DNWR.

The theories explaining wage rigidity can be classified into five broad groups, based on the source of wage rigidity:

- Labour supply theories;
- Worker bargaining theories;
- Theories based on market interaction;
- Theories attributing wage rigidity to the behaviour of firms;
- Rigidity resulting from regulations.

1.2. Labour supply theories

A good example of this theory is the work by Lucas and Rapping (1969) in which they claim that the non-frictional part of unemployment could be explained by wage expectations that are not consistent with the present market situation. In other words, there is always some kind of work to do, but the wage level offered to some job seekers does not exceed their reservation wage. As the labour supply decision represents a choice of how to divide time between

leisure and working, job seekers who receive job offers with a wage level lower than their reservation wage will decide to stay voluntarily unemployed. The reservation wage is the 'normal' real wage, or the expected real wage rate in the long run. The fluctuations in the presently offered wage around the normal wage explain the cyclical increases in unemployment (Lucas & Rapping, 1969, pp. 747–748).

According to Bewley (2002) wages are not flexible downwards in this model because a fall in wages will bring about a correction in the amount of labour supplied. As a result, wages seem to be sticky, because instead of accepting a lower wage people will choose unemployment. This, of course, will also lead to a decline in earnings, but this decline will not show up in wage statistics, because earnings while unemployed are classified as unemployment benefits and not as wages (Bewley, 2002, p. 398). This reasoning, however, is somewhat difficult to understand. The original work of Lucas and Rapping does not directly address DNWR. The main argument they use to explain fluctuation in employment is that accepting a wage cut usually means additional costs as the worker has to move to a new location or engage in a job search in the present location, and so a worker who has been laid off may choose unemployment instead and wait until the currently offered real wage exceeds the normal wage (Lucas & Rapping, 1969, p. 727). While this can apply to workers who have already been laid off, there seem to be no additional costs for someone who accepts the employer's offer of a wage cut. It seems that in order to explain DNWR some additional assumptions must be made, for example that the employee has sufficient financial resources to be able to take time off during a recession.

Another group of models that at least to some extent can be used to explain DWR are real business cycle (RBC) models. In RBC models unemployment is the result of people preferring leisure over work. Examples of RBC settings are Hansen (1985) and Kydland & Prescott (1982). Again, some additional assumptions are needed for these theories to be used as explanations for DWR.

In some models workers are assumed to have access to household production processes (e.g. Benhabib, Rogerson, & Wright (1991)). This will result in their being able to replace working in an open labour market with working in a household, and this induces stronger fluctuations into market activity (Benhabib, Rogerson, & Wright, 1991, pp. 1967–1968). If wages fall then employees take the opportunity to leave the labour market and engage in household production, thus introducing rigidity into wages.

1.3. Worker bargaining theories

1.3.1. The seniority rights model

Seniority rights models offer an explanation as to why unions would not be interested in employment levels and concentrate instead on wage demands. One possible explanation could be that the decisions inside a union are made by

senior members whose jobs are well protected through seniority privileges. Thus when it comes to lay-offs, those members of the union that are making the decision about wage demands are the last to be concerned.

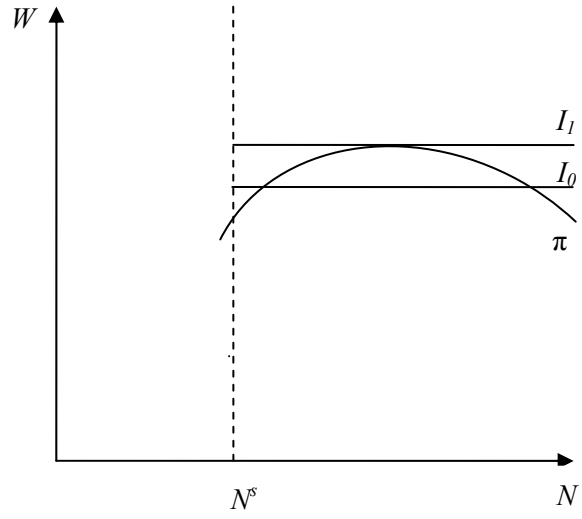

Figure 1. (Inferior) Efficient bargaining under lay-offs by seniority
Source: Oswald, 1985, p. 180

The situation described above is illustrated in
Figure 1. Employment level N^s is the position of the union decision maker on the labour market. If employment falls below N^s then this person will be dismissed. If employment is higher than N^s, then the union decision maker is indifferent about employment levels and is only interested in his or her own wage rate. This means that the union indifference curves (I_0, I_1) will be horizontal. It can be shown that efficient wage bargaining occurs where wage equals value of marginal employees output (π) (Oswald, 1985, p. 180).

If union decision makers behave in this manner, this can have quite clear implications. If the union decision maker is not interested in employment levels and the employer proposes a general wage cut or a reduction in employment, the union will not accept the wage cut and wages will be downwardly rigid. Grossman (1983) and Oswald (1985) are examples of seniority rights model.

1.3.2. The insider-outsider model

Piore (1973) argued that wage rigidity could be a result of a customary wage setting system which has its roots in customs prevailing inside the informal social groups present in a workplace. The customs and values prevailing

amongst these groups will be passed on to new workers during the training process. The effect of a customary wage setting system could be especially strong where the qualifications necessary for a job depend mostly on skills acquired inside the company. The customs that shape the workers understanding of just and moral wage setting oppose the competitive pressure from the interaction of demand and supply for the particular group of workers (Piore, 1973, p. 383).

The insider-outsider approach assumes labour turnover costs that can be exploited by the present workers of a company, referred to as 'insiders', as opposed to the unemployed, who are usually referred to as 'outsiders' and new workers who hold jobs that can lead to insider status and are referred to as 'entrants'.

Although there are several sources of labour turnover costs that make it unprofitable for companies to accept underbidding from outsiders, the reasoning most directly linked to the insider-outsider model is the claim that insiders can affect the productivity of entrants. More specifically, insiders can have individual or collective power to make the hiring of new workers costly for the business owner and thus make the hiring of under-bidders less profitable for the company (Lindbeck & Snower, 2002, p. 5). The ways an individual worker could affect the employer's decision are given as (Lindbeck & Snower, 1988, p. 173):

- Cooperation – cooperation between workers could be seen as a means of increasing productivity. The insiders can choose not to cooperate with entrants while still cooperating with other insiders. This leads to a situation where the marginal productivity of insiders is significantly higher than the productivity of entrants. In this way insiders can push their wages upward;
- Harassment – harassment makes working in a company less desirable for a worker and thus increases the reservation wage of new entrants. This reduces the number of entrants hired and has a positive effect on insiders' wages.

These reasons can lead to a situation where the owner is not interested in hiring new entrants and there is no effective underbidding of wages. In consequence wages do not adjust downwards sufficiently.

1.4. Theories based on market interaction

1.4.1. The market misperception approach

Bewley (2002) describes the market misperception theory in the context of rigidity of wages as follows. It is assumed that the workers' draw conclusions about the market wage rate based on their own wage. New information can be obtained by looking for a new job. However, it is easier to look for a new job when you are unemployed. If wages decline due to a reduction in the demand

for labour, workers are unaware that this is the same for other jobs too. They think that the market level of wages is higher than the new wage offered by the employer. Workers will not accept a wage cut and will be laid off in order to search for a new job. This leads to a rise in unemployment. Later, when they see that wages are lower or are increasing at a lower rate than they had assumed everywhere, they are willing to accept work with lower pay than they had previously expected and unemployment will decline (Bewley, 2002, p. 405).

In this kind of setting the wages appear to be rigid because instead of accepting lower wage rates people will leave their employment and the decline in their nominal wage cannot be observed. It is similar to the mechanism that causes wages to be rigid under the inter-temporal substitution theory described in chapter 1.2.

1.4.2. Keynes's Relative Wage Theory

According to classical theory, the labour market will clear if the marginal physical product of workers equals real wages and at the same time the marginal disutility of working instead of having leisure-time is also equal to the real wage (Keynes, 1936, p. 5). If prices increase then real wages should decline decreasing the labour supply and increasing demand for labour.

According to Keynes' General Theory of Employment, Interest and Money, the classical theory of employment does not match what can be seen in the real world – if prices increase, leading to a decline in real wages, then it does not necessarily mean that the labour supply will decline. In wage bargaining employees and trade unions are more concerned with nominal wages[2] and do not react to every fluctuation in real wages (Keynes, 1936, p. 13). Keynes argues that as wage adjustments are imperfect, any individual who agrees to a reduction in his or her nominal wage relative to others will suffer as a result a reduction in his or her relative real wage and this is something employees are not willing to accept. Thus, it is the relative wages or the distribution of wages between employees that the employees are interested in (Keynes, 1936, p. 12).

According to Keynes, wage rigidity comes from employees' unwillingness to accept wage declines because this would affect their relative real wage and purchasing power compared to those of other workers.

[2] Keynes uses term „money-wage".

1.5. Theories Attributing Wage Rigidity to Firms' Behaviour

1.5.1. The implicit contracts model

Implicit contracts refer to informal agreements between employer and employee. There can be several types of implicit contract. Bewley (2002) identifies two different settings:

- Implicit insurance contracts;
- Moral obligation implicit contracts.

In the implicit insurance contracts model, employers have better access to capital markets and thus have better opportunities for diversifying their risks. Employees, on the other hand, have lower knowledge and less access to risk management instruments. This means that employers can offer employees a form of insurance that would lessen the uncertainty in employees' incomes. So as Baily puts it: "… the firm is offering a joint product, employment plus an insurance or financial intermediation service" (Baily, 1974, p. 37).

This kind of insurance can have an interesting impact on wage dynamics, by smoothing fluctuations in wages. It is possible to show that under certain conditions, where firms are risk neutral and workers are risk averse and do not operate in stock markets, it is optimal for companies to use a pre-announced non-stochastic wage strategy (Baily, 1974, p. 38). In other words, even when there are adverse developments in the product market, companies have an incentive to keep real wages from declining. A similar model has also been composed by Azariadis (1975). Surveys of different settings in implicit contract models are provided by Stiglitz (1984) and Rosen (1985).

Bewley (2002) identifies a subclass of implicit contracts that he names "moral obligation implicit contracts". The difference from insurance contracts is in the formulation of the implicit agreement. The underlying idea of this setting is that both employers and employees are making investments when they enter into an employment relationship. For workers these investments are the time and money spent on the job search, training and so forth, while for a company, the hiring cost can be treated as investment, covering the time and money spent on finding candidates, the interviewing process, training costs and similar. After these investments have been made, both parties are in a position to demand a higher or lower wage accordingly because the decision to terminate the contract will affect the return from the contract partner's investment. This can be described as a hold-up problem. In order to overcome the problem, parties agree implicitly to a plan for future pay rates (Bewley, 2002, p. 412). Malcomson (1997) shows that under certain circumstances it might be reasonable for companies to use a fixed wage contract (Malcomson J. , 1997, p. 1953).

A framework involving the hold-up problem and wage rigidity is used by, for example, Hashimoto & Yu (1980).

1.5.2. Efficiency wage theories

The efficiency wage theory is based on the assumption that an employee's productivity is a function of his or her wage. If this is true, then employers may not be willing to lower wages even if there's an excess supply of labour, because this would lower employees' productivity and as a net result the labour costs could increase instead of falling. The efficiency wage theories do not necessarily provide reasons for 'full' downward wage rigidity, as lower unemployment will also lead to a decrease in the general wage level, for example through the shirking model or the labour turnover model. However, it does explain why wages do not adjust sufficiently in order to eliminate unemployment. Stiglitz (1984) gives five different explanations for efficiency wages[3].

The nutrition argument

This is the most basic form of efficiency wage model. At low levels of nutrition it would be logical to assume that workers nutrition depends on wage earned and at the same time workers productivity depends on nutrition. A decline in wages would lead to malnutrition and thus a reduction in productivity (Stiglitz, 1984, p. 43).

The nutrition argument was used among others by Stiglitz (1976) and could be considered a base theory of efficiency wages. However, in more developed countries a slightly different approach is needed, because there, malnutrition is usually not the main factor influencing labour productivity.

The adverse selection model

Weiss (1980) starts his article with a reference to a real life situation from 1975 when, after the Stanford Linear Accelerator Center had declared that it would lay off 10% of its workers, the workers proposed that they would be willing to accept a 10% wage drop in order to avoid the lay-offs. The company declined the offer, arguing that: "... if wages were cut, the best workers would quit." (Weiss, 1980, p. 526).

Adverse selection models assume that information about the characteristics of job seekers is imperfect. However, it is known that higher wages attract people with higher qualifications. Offering higher wages guarantees a better quality-mix of applicants (Stiglitz, 1984, p. 46). If a company is choosing the wage that minimises the cost of its efficiency units, and wages reflect the quality of a worker, then a worker waiting in a job queue cannot get the job by offering a lower wage than other applicants because this would also signal that the worker is of lower quality (Weiss, 1980, p. 527). The downward rigidity of wages enters into the model through the secondary labour market where the wages are assumed to be rigid.

See Weiss (1980) and Malcomson (1981) for examples of adverse selection models.

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[3] Stiglitz does not use the same headings to mark different models. However most of the headings used are common in efficiency wage literature.

The labour turnover model

The labour turnover model is based on the assumption that companies are averse to labour turnover costs. It assumes that low wages bring about high labour turnover. As long as workers are more risk averse than companies, companies have to bear at least some of these costs. This, however, lowers the net productivity of the workers. A company can reduce the costs associated with turnover by introducing wages that are higher than the market clearing level. For workers, this also makes leaving the company more costly (Stiglitz, 1984, p. 44).

Despite the fact that the arguments used in the turnover model have been tested in several survey-based approaches to DNWR, this model does not explain downward wage rigidity, since a rise in unemployment above the equilibrium level would also reduce turnover costs and bring about a fall in wages (Bewley, 2002, p. 413).

Examples of this kind of approach are provided by Phelps (1970) and Salop (1979).

The shirking model

The underlying assumption of shirking models is that the information about workers' actions is imperfect. Monitoring workers brings costs, contracts are rarely perfect and firms need a means of encouraging workers to give their best effort. This means that there has to be some kind of punishment if a worker shirks. If there is full employment, firing a worker would not be a reasonable punishment, because he or she would instantly find a new job with the same wage. For this reason, the company is willing to pay wages that are higher than those of other companies in order to bring about a loss in the worker's income, if he or she gets fired. If all firms are identical, then relative to each other wages will not increase, but a higher general wage level would lead to higher unemployment. As long as unemployment benefits are lower than wages, a worker's income will decline if he or she is fired, and this should motivate workers not to shirk. As in Stiglitz (1984) labour turnover model, wages can decrease if unemployment increases.

Examples of shirking theory are Calvo (1979) and Shapiro & Stigliz (1984).

Social models

Social models assume that wage rigidity may arise from social norms and principles of appropriate behaviour (Yellen, 1984, p. 204).

Probably the best known version of social models is the gifts exchange model composed by Akerlof (1982). The theory intends to provide an explanation for involuntary unemployment. It starts with an observation from Homans (1954) about some workers who are willing to provide significantly stronger effort than the company-prescribed norms would require (for example by exceeding the number of units produced that is prescribed as an obligatory daily norm), while the official company wage policy does not prescribe any performance related bonus for that.

He proposes a model where through interaction employees acquire sentiment for each other and for the company. As a result the utility of an employee can be increased through the exchange of 'gifts' with the employer. The gift from the employee is effort in excess of the minimum work standards set by the employer. The gift from the employer is the wage that is considered fair by the employee. The fair wage is determined amongst other things by the wage of other workers, as well as by the worker's wage in the previous periods (Akerlof G. A., 1982, p. 556). Wage rigidity is introduced by the last period's wages as well as by the relation with other workers' wages.

There is also the fair wage hypothesis presented by Akerlof & Yellen (1990). This proposes that workers have a conception of a wage level they consider to be fair and if the actual wage falls below this level they will reduce their work effort proportionately (Akerlof & Yellen, 1990, p. 255).

1.5.3. Stigma of unemployment

Layard & Bean (1989) are concerned with the persistence of unemployment. They propose that this is partly due to what they call the 'outsider mechanism'. Layard and Bean say that: "If the unemployed or 'outsiders' are demoralised or stigmatised by, for example, long spells of unemployment, the wage pressure at given unemployment will rise – because effective excess supply is reduced" (Layard & Bean, 1989, p. 376).

The 'stigma of unemployment' is a result of asymmetric information. The previous employer has significantly more information about a former employee than the one that is considering hiring him or her. This means that employers who are recruiting new workers have to use some kind of proxy information. The status of being unemployed or eagerness to switch jobs can serve as a proxy indicating that the person has not fulfilled the previous employer's expectations.

There are several reasons why employers could consider the unemployed inferior to the employed. First of all, the reason why the person became unemployed might be that the previous employer was forced to cut down the number of employed and decided to let the weakest members go. This suggests the unemployed could be inherently less skilled than the employed.

Although Bewley (2002) lists this theory under theories providing some explanations for downward wage rigidity, he himself points out that it is more concerned with a higher unemployment rate and explains why wages do not adjust sufficiently to eliminate unemployment. It does not, however, explain why wages do not fall.

There are several authors who have suggested some kind of stigmatising effect of unemployment. In addition to Layard & Bean (1989) examples can also be found from Greenwald (1986), Riordan & Staiger (1993), Lazear (1984) and Gibbons & Katz (1991).

1.5.4. Menu cost

Nominal rigidities do not necessarily have to be downward nominal rigidities. One form of rigidity is the so-called "menu costs". It might be that price changes create certain costs, for example from changing the price on a menu, and the price changes have to be large enough to make themselves worthwhile. The consequence is that even if a worker's marginal productivity does not exactly equal his real wage, changes in the nominal wage will only be enacted if they are big enough.

Menu costs have been analysed by, amongst others, Beissinger & Knoppik (2001) and Card & Hyslop (1997).

1.6. Rigidity as a result of legal regulations

According to **contract theory** the obstacles to downward wage adjustment lie in the contractual form of labour relations. Since the time of Roman law the underlying principle of private law is that agreements must be kept[4] (*pacta sunt servanda*), and as most labour contracts are of permanent nature, employers cannot change employees wages whenever they like – new wages have to be negotiated with employees. It is quite logical to assume that employees will resent wage cuts and thus previous agreements have to be honoured and wages will not be adjusted downwards, even if the employer wishes to do so.

In economic models this assumption usually means that some sort of wage stickiness is introduced into models by assuming that labour contracts are fixed for more than one period. As an example, Fischer (1977) constructs a rational expectations model with overlapping labour contracts where each contract is made for two periods. This setting is justified with transaction costs that are related to frequent price changes (Fischer, 1977, p. 194). A model with overlapping contracts was also presented by Taylor (1979).

In addition to private law, factors that can lead to wage rigidity include institutionalised social norms such as the minimum wage, or employment protection legislation. It could be argued that at least for certain groups of workers, legal restrictions on wages below a certain level could serve as a reason for wage stickiness. Employment protection legislation introduces additional costs for terminating an employment contract. This can also result in wage stickiness because even if an employee's marginal productivity is

[4] Sharp (1941) says that since the time of Roman law there have also been reservations in the enforcement of valid promises in modern legal systems (Sharp, 1941, p. 783). However, when considering the right of the employer to adjust wages downwards, these exceptions are usually of temporary nature and do not bring about a decline in hourly wages. For example, according to the Estonian Labour Contract Act §37, the employer has the right to reduce the pay of an employee for up to 3 months during a 12-month period, but the employee has the right to reduce his or her working hours proportionally to the wage cut. Also, the reasons for such a wage cut must be beyond the control of the employer, such as an economic recession.

temporarily lower than his wage, firing him would be more costly, so instead wages are frozen. An example of models which allow for the effects of EPL is Holden (2004).

1.7. Summary

Theories that have been considered to explain DWR address different aspects of this phenomenon. Firstly, there are theories that concentrate on explaining why there is unemployment. These theories do not necessarily provide an explanation that could justify the hypothesis of wages being rigid downwards. For example, if the benefit from the outside-employment option decreases in efficiency wage theories then this will also allow companies to lower wages, meaning that wage decreases are not impossible. Some of them do explain why wages do not adjust downwards enough that it would allow unemployment to disappear. However, there are also theories that explain why wages can be sticky downwards, for example reasons linked to legislation.

When testing for the causes of wage rigidity, these theories are usually not differentiated, so ideas from the models explaining the existence of unemployment are also considered to be theories of downward wage rigidity. This line will also be followed in this thesis. To summarise, the main reasons why employers do not cut wages are as follows:

- **They cannot** – wages are set in a work contract and cannot be altered unilaterally, or cutting them is prohibited by law because wages are at minimum levels (*contract theory*, *minimum wage regulation*). Furthermore, the costs that both employee and employer have borne in connection with job search and hiring respectively can put both parties in a situation where they can inflict costs on the other contract partner creating a hostage situation (*hold-up problem*);
- **It is costly** – changing wages is reasonable only if a worker's marginal product changes enough that it exceeds a certain threshold. Otherwise it is not reasonable (*menu costs*). It may be less costly for employers to enter into an implicit contract with employees that insures employees against fluctuations in wages (e.g. *implicit contract model*). Equally if employees do not accept wage decline and quit, this results in higher turnover, and this in turn is costly for companies (*labour turnover model*);
- **It affects workforce composition adversely** – if the size of wage claims is an indicator of workers' abilities that are not directly observable to employers, then lowering wages would mean attracting less qualified personnel and the first to quit because of wage cuts would also be the best qualified employees (*adverse selection theory*). Furthermore, new recruits might be less productive than their older colleagues for quite a long time, because senior workers might not be willing to cooperate with them if they are wage under-bidders (*insider-*

outsider theory). Equally, as employers do not have complete information, they may believe that people who have been unemployed are unemployed because they are less capable and thus do not dare to hire them, even if this would allow them to cut wage costs (*stigma of unemployment*);

- **It affects adversely workers' performance –** higher wages, compared to those of other companies or unemployment benefits, could make workers work more because they have more to lose from getting fired (*shirking theory*). Workers could also consider the relationship with the employer to be an emotional one where workers do favours to their employer by working slightly more and employers pay slightly more than the contract obliges them. Cutting a wage could be seen as treason and thus result in lower work morale and effort (*social models*). In the least developed countries the worker's performance could also be improved by higher wages because the market wage does not allow workers to buy sufficient food (*nutrition argument*).

From the employee's side:

- **Wages may seem to be rigid** – if employees are not willing to accept wage cuts, they choose to quit. This, however, does not bring about wage reduction because the wages of the employed will remain the same (*inter-temporal substitution theory*, *market misinterpretation approach*).
- **Employees are afraid of falling living standards** – employees compare their nominal wages with other employees and are strongly opposed to relative wage cuts because this influences their living standard as goods produced in other sectors become more expensive. Due to this, labour markets can adjust only by reducing the number of workers (*Keynes' relative wage theory*);
- **Unions do not allow wages to fall** – if there are deteriorating product market conditions, either wages or employment have to fall. If decisions inside a union are made by senior members whose jobs are well protected through seniority privileges, the union becomes more interested in preserving wages (*seniority rights model*).

2. EMPIRICAL EVIDENCE FOR DOWNWARD NOMINAL WAGE RIGIDITY

2.1. Introduction

Different approaches have been used for analysing downward nominal wage rigidity. A very broad classification could be the following (Beissinger & Knoppik, 2001, p. 386):

- Studies that explore company behaviour with respect to wage cuts by asking personnel managers, for example Bewley (2002), Campbell & Kamlani (1997), Agell & Lundborg (1995) and Blinder & Choi (1990). These studies suffer from the well-known problem that the responses of individuals in such surveys may not conform to their actual economic behaviour;
- Studies that test downward nominal wage rigidity using aggregate data, for example Akerlof *et al.* (1996) and Holden & Wulfsberg (2008). Beissinger & Knoppik (2001) show that the most important shortcoming of aggregate data is that it is not clear how the heterogeneity of firm-specific shocks, wage adjustments and downward nominal wage rigidity translate into the properties of aggregate time series (Beissinger & Knoppik, 2001, p. 386).
- Survey studies based on individual compensation micro-data; as this thesis is mostly based on that approach, the evidence from compensation micro-data will be discussed more thoroughly in the following chapter. The most important advantage of earnings micro-data is that it offers information on the whole earnings change distribution, which is an advantage when compared to approaches using aggregate data, and it reflects actual economic behaviour and not mere intent (Beissinger & Knoppik, 2001, p. 386).

Studies based on individual compensation micro-data can be divided into several subgroups, which will be further elaborated in following chapters)[5] (Beissinger & Knoppik, 2001, p. 391):

- The skewness-location approach;
- The symmetry approach;
- The histogram-location approach.

2.2. The basic concept

Let us start by recapping the intuition behind DNWR. DNWR means that people dislike nominal wage decreases. The employer, however, is mostly

[5] There are also some other approaches such as the earnings-function approach used by Altonji & Devereux (1999) and Fehr & Goette (1999). However, these approaches require quite detailed background data on the people whose wage changes are being analysed. For Estonia, this kind of data is not accessible.

concerned with real wages. Every now and then it happens that the employer has to cut real wages. If this occurs in an environment of high inflation, then it might well be that both parties achieve what they want as high inflation can accommodate both a decline in real wages and a small nominal wage increase, and if the money illusion exists, both employer and employee would be happy with the situation. As a result real wages will adjust without any significant obstacles. However, if real wages must be cut during times of low inflation, the real wage cut must also assume a decline in nominal wages. Employees will oppose the wage cut and real wages cannot adjust sufficiently. The size of DNWR depends on the degree of opposition of the employees to employer-side proposals for wage cuts. As this opposition changes with inflation, this mechanism can be used for assessing the extent of DNWR.

If wages are nominally rigid, the part of the change in real wages that requires nominal wage cuts will not be enacted. In order to use micro-data on wage changes for estimating nominal wage rigidities a distinction must be made between two distributions of wage changes, the observable or factual distribution and the hypothetical or counter-factual distribution of notional changes in wages that would apply if there were no rigidities. Nominal downward rigidity prevents the enforcement of all or at least a part of negative wage changes. This results in some proportion of the probability mass being shifted from the left side of the distribution to zero, showing higher shares of wage freezes (Beissinger & Knoppik, 2001, p. 388).

The rigidity function can have various forms. In order to illustrate the mechanism employed in analysing wage rigidity we may assume a simple form of rigidity, proportional downward rigidity. In this case a constant proportion $\rho(x) = \rho(0 < \rho < 1)$ of negative wage changes is not enacted because of rigidity. The functional relationship between the factual and counter-factual wage distribution functions is as follows (Beissinger & Knoppik, 2001, p. 389):

$$F_t(x_t) = \begin{cases} (1-\rho)G_t(x_t) & x_t < 0 \\ G_t(x_t) & x_t \geq 0 \end{cases} \quad (2\text{–}1)$$

where:

x_t-	actual changes of wages;
$F_t(x_t)$ -	factual distribution of wage changes;
$G_t(x_t)$ -	counter-factual distribution of wage changes;
ρ-	proportion of wage changes not enacted because of rigidity.

Downward nominal wage rigidity can be derived from changes in the location (usually the median) of the distribution. The basic mechanism is shown in Figure 2. Panels a) and b) illustrate the shift in factual distribution. This shift can for example be brought about by changes in inflation, or also in productivity, that result in a lower location for the counter-factual nominal wage earnings change distribution during times of low inflation and an

equivalently higher location in times of high inflation. The factual and counter-factual distributions do coincide above zero wage growth. Below zero wage growth, the dotted line denotes the counter-factual distribution while the solid line indicates the factual distribution.

The figure shows how changes in location influence the shape of factual distribution. With low location, a substantial proportion of the left side of the factual wage distribution is relocated to zero, while for high location this happens to a significantly lesser extent.

The change in the shape of factual distribution combined with changes in location are the main properties that are used for assessing the presence and in some cases the extent of downward nominal rigidity.

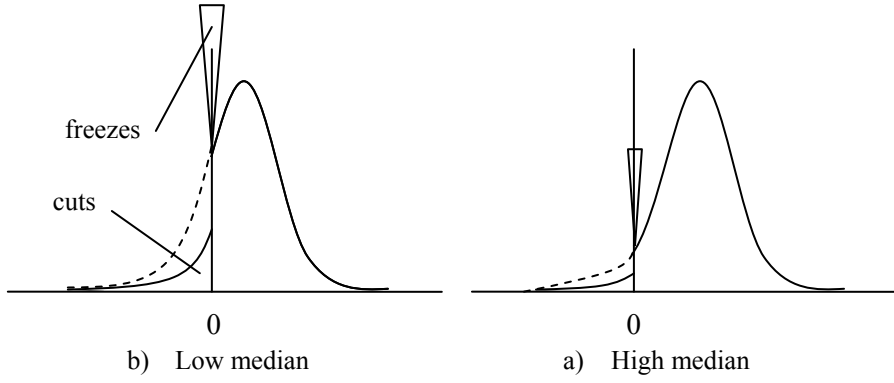


Figure 2. Counter-factual distributions and corresponding factual distributions
Source: Beissinger & Knoppik, 2001, p. 390, author's modifications

There are several ways of analysing the rigidity of wage earnings, starting from looking closely at wage distributions and searching for spikes at the location of zero wage growth and for evident thinning of the left tail of the distribution. Several parameters of the distribution, such as the skewness coefficient or mean-median difference, have also been used to describe wage change distributions. However, this kind of approach does not reveal much about the rigidity, because of the lack of reference; it might well be that wage change distributions are by nature positively skewed and this has nothing to do with downward nominal wage rigidity. McLaughlin (1999) proposes at least three reasons why this kind of positive skewness could exist (McLaughlin, 1999, p. 130):

- People can be averse to real wage cuts and this will induce a right skewness of factual nominal wage change distribution;
- Self-selection occurs, as the data used in the analysis of DNWR only includes accepted wage offers, as the offers that were not accepted resulted in resignations or lay-offs. As wage increases are more likely to be accepted than wage cuts, this will induce the skewness to the right;

- Pooling different symmetric distributions can generate spurious skewness, also to the right.

In addition to the reasons already listed, it should be kept in mind that wage cuts are limited to 100%, while there is no technical limit for wage increases, which can also be the reason for skewness to the right, even if there is no DNWR.

To summarise, more systematic approaches are needed for identifying DNWR. Beissinger & Knoppik have proposed three broader categories of non-parametric methods for assessing downward nominal wage rigidities. These are presented in the following sub-chapters.

2.3. The skewness-location approach

The skewness-location approach is based on the assumption that if the location of the counter-factual wage changes distribution changes, this will have an effect on the left side of factual distribution and change the skewness of the distribution. In other words, the factual distribution becomes positively skewed. A negative relationship between location and skewness is interpreted as a sign of DNWR. This method was proposed by McLaughlin (1994).

This approach has the following assumptions (Beissinger & Knoppik, 2001, pp. 391–393):

A1: Only the direct effects of nominal rigidity are taken into account. There are no indirect effects such as an impact on unemployment through higher levels of lay-offs resulting from wage rigidity. Indirect effects can only be addressed by specifically modelling wage formation and labour market flows. This adds additional demands to the data and increases the complexity of the analysis. (Beissinger & Knoppik, 2001, p. 391)

A2: The median of the counter-factual distribution is sufficiently high. The highest value of wage change that is affected by the nominal wage rigidity is smaller than the median of the counter-factual distribution. This means, in combination with assumption A1, that the means of factual and counter-factual distributions are equal and the analysis can concentrate on the left tail of the distribution alone. If the median and some part of right tail of the distribution are affected by rigidity, the median of the factual distribution cannot be used as a measure of location, though this can be corrected by using a higher percentile of the distribution instead of the median (Beissinger & Knoppik, 2001, p. 392).

A3: The shape of the counter-factual distribution is time invariant. The only difference between counter-factual distributions over different periods is in location, meaning that the shape of counter-factual distribution is, apart from location, time invariant. This assumption is relevant for all approaches, because all use the joint variation of location and shape over the years for estimating the rigidity. Assumption A3 may often not be precisely fulfilled, but the problems resulting from this violation can to some extent be corrected either by limiting the analysis to homogeneous groups (Beissinger & Knoppik, 2001, p. 392) or

by using standardised wage change distributions (Knoppik & Beissinger, 2009, p. 326).

A4. The extent (and type) of rigidity does not vary in time. Time invariance of the rigidity function is not an obvious assumption and there are several reasons for suggesting the opposite. Firstly, companies become eager to cut wages in situations when these cuts are justifiable, in order to avoid any impact on workers' moral, and usually this coincides with deteriorating market conditions. This implies that rigidity may change over the business cycle. Another reason for time-variant rigidity is variation in working hours, which also tends to depend on the business cycle (Beissinger & Knoppik, 2001, p. 393).

A5. Negative and linear skewness-location relationship. "There is a falling, approximately linear functional relationship between measures of skewness of the factual distribution and measures of location of the shifting underlying counter-factual distribution" (Beissinger & Knoppik, 2001, p. 399).

The most common measure of location is the median of factual distribution, which coincides with the median of counter-factual distribution if the median is sufficiently high and is not affected by DNWR. The original version of the skewness-location method also uses the rate of inflation instead of location. As inflation is not the only indicator that influences the location of counter-factual nominal wage change distribution, then as long as the factual distributions median is not affected by wage rigidity, the factual distributions median should be the superior choice for the counter-factual distributions location (Beissinger & Knoppik, 2001, p. 399).

The choice of measures of skewness is quite large. The following list is based on (Beissinger & Knoppik, 2001, pp. 395–397) and (McLaughlin, 2000, pp. 4-8). When appropriate, the list is complemented with criticism from other authors[6]:

1. Skewness coefficient – the ratio of the third central moment of the distribution to the cubed standard deviation. The most important shortcoming of the skewness coefficient is that it is sensitive to extreme observations (Lebow, Saks, & Wilson, 1999, p. 4).
2. Median-centred skewness coefficient – this is a modification of the skewness coefficient where the mean is replaced by the median. As the skewness coefficient is centred around the mean and is thus influenced by rigidity, this is an attempt to correct for this flaw by using a median

[6] The indicators are asymmetry indicators and thus could easily also be classified under the symmetry approach. However, as most of these indicators are seldom used separately in DNWR studies, they are introduced in the current thesis under the skewness-location approach and later some of these indicators (e.g. the LSW statistic) will additionally be used also under the symmetry approach. In the author's opinion this structure reflects best the way that these indicators are treated in the literature, usually in the context of the skewness-location approach.

that is assumed to be sufficiently high and not affected by rigidity (Beissinger & Knoppik, 2001, p. 399).

3. Difference between the mean and median of the distribution – this measure was used by McLaughlin (1999) in order to catch asymmetry with something that is less sensitive to outliers. As a criticism of this measure Lebow *et al.* (1999) point out that outliers still affect the mean of the distribution and the measure is not immune to the outlier problem (Lebow, Saks, & Wilson, 1999, p. 4);
4. The LSW statistic[7] – the difference between the cumulative frequencies of the distribution above twice the median and below zero was proposed by Lebow *et al.* (1995). As zero and twice the median are equidistant from the median then if there is symmetric distribution the value of the statistic will be zero. If there is downward nominal wage rigidity, meaning a shortage of observations on the left side of the distribution, then the statistic becomes positive, because the probability mass below zero will be smaller than that above twice the median. The LSW statistic can be calculated using the following equation (McLaughlin, 2000, p. 8):

$$T = [1 - F(2m)] - F(0) \quad (2–2)$$

where m is the median of the distribution and $F(x)$ is the cumulative distribution function of the nominal wage change distribution(Lebow, Saks, & Wilson, 2003, p. 3).

The most important benefits of this statistic are that it concentrates directly on downward nominal wage rigidity and, as it is a pure order statistic, it is insensitive to the extreme values in the far end of the right tail of wage change distribution.

The most important drawback of this statistic is that it assumes symmetry and in cases where this assumption is violated the results become unreliable;

5. Sign test – observations between the mean and the median are counted. The more positive observations there are, the more probable it is that the distribution is right-skewed. For comparability purposes, this measure is usually normalised by dividing it by its standard deviation.
6. Signed ranks statistic – observations are ranked by the absolute value of their deviation from the median. The ranks are multiplied by minus one if they deviate to the left of the median and totalled. If the total is positive, then the distribution is more likely to be skewed to the right (McLaughlin, 2000, p. 7).

[7] Beissinger & Knoppik use the term "thinness measure" (Beissinger & Knoppik, 2001, p. 397), the LSW statistic is the name proposed by the authors of the indicator.

7. Runs statistic – observations are ranked by the absolute value of their deviation from the median. A run occurs if two observations that are ranked next to each other come from the same side of the distribution. A new run begins if consecutive observations come from opposite sides of the distribution. If the distribution of x_i is symmetrical, the number of runs is expected to equal $1+N/2$ where N denotes the number of observations. The test statistic is calculated as follows (McLaughlin, 2000, p. 6):

$$T = 1 + \frac{N}{2} - \sum_{i=1}^{N} \Delta_i$$

(2–3)

where $\Delta_i = 1$ if there is a new run, otherwise $\Delta_i = 0$ and $\Delta_1 = 1$.

A drawback of the runs statistic is that it is sensitive to ties. Spikes in the distribution reduce the number of runs and strongly increase the runs statistic (McLaughlin, 2000, p. 6).

8. Signed gaps statistic – the observations (x_i) are sorted in ascending order and the difference between consecutive observations is calculated $y_i = x_{i+1} - x_i$. These differences are paired while the sign of each within-pair difference is tracked. The test statistic is calculated as follows (McLaughlin, 2000, p. 7):

$$T = \frac{-1}{2\sqrt{N}} \sum_{i=1}^{\frac{N-1}{2}} sign(y_i - y_{N-i})$$

(2–4)

If the distribution of x_i is symmetric then $T=0$ (McLaughlin, 2000, p. 7).

9. Triples statistic – a triple is a combination of any three consecutive observations. If the difference between the leftmost and centre observations is smaller than the difference between the rightmost and centre observations, then the triple $S_t = +1$. If it is the other way around then $S_t = -1$. The statistic is calculated as follows (McLaughlin, 2000, p. 7):

$$T = \frac{1}{N'} \sum_{t=1}^{N'} S_t$$

(2–5)

N' denotes the number of triples. If the statistic has a positive value, then it is a sign of skewness to the right (McLaughlin, 2000, p. 7).

The skewness location approach has been quite a popular method for analysing the downward rigidity of nominal wages. The results, however, have been mixed.

McLaughlin (1994) uses the USA Panel Study of Income Dynamics from 1970–1986, looking at the household heads who did not change job, information which can be obtained from job tenure data, year on year and reported a straight-time hourly wage or salary. He aggregates the data and seems to be ending up with a mix of hourly wage and salary growth. The skewness location approach used by McLaughlin is somewhat different from the approaches used by later authors, as he estimates a probit model that assesses the probability of wage cuts. As explanatory variables inflation, both expected and unexpected, and productivity growth were used. The results confirmed the existence of DNWR as the coefficient of inflation was negative and statistically significant (McLaughlin, 1994, pp. 403–406).

Card & Hyslop (1996) use the skewness location approach on the USA Current Population Survey (CPS) from 1979–1993. To measure skewness, they apply roughly the same construction as the LSW measure with what is called the 'sweep up' effect as detailed further in the symmetry approach chapter below. They concentrate on the hourly wage data of job stayers, defined as people who did not show changes in industry or occupation. They find strong negative correlations between the size of the sweep up effect and inflation (Card & Hyslop, 1996, p. 46).

McLaughlin (1999) reviews the topic and computes, among other things, correlations between the previously described skewness measures ((1), (3), (4) and (5)) and inflation, both expected and unexpected, using PSID data from 1971–1992. Employed household heads (from 1971) and spouses (from 1979) who reported a wage or salary and stayed employed in the same job, according to tenure, were included in the sample (McLaughlin, 1999).

The only significantly negative correlation was found between the LSW statistic and inflation, but, as the LSW statistic is based on the assumption of symmetrical wage distribution, and asymmetries near the median that should not be affected by downward rigidity reject this assumption, McLaughlin concludes that in general the expected negative correlation between the skewness and inflation is absent. However, there are differences in subgroups of workers. For union workers, all measures of skewness except the skewness coefficient are strongly negatively correlated with inflation, which leads him to the conclusion that union members' wages are nominally rigid downwards. This also applies for hourly workers, but the extent of nominal rigidity is considered lower than for union members.

McLaughlin (2000) uses the same data as in his 1999 paper but introduces four additional measures for skewness ((6)-(9)). The correlation between these indicators and wage growth median and expected inflation is calculated. No remarkable differences emerge from the introduction of these new measures. Union and hourly paid workers are still the most affected by downward nominal rigidity. However, a subgroup analysis with quite remarkable range is per-

formed and in addition to union and hourly paid workers, less educated and non-white employees' wages also show nominal rigidity (McLaughlin, 2000).

Beissinger & Knoppik (2001) use the German micro-data of *Institut für Arbeitsmarkt und Berufsforschung Beschäftigtenstichprobe* (IABS) from 1975–1995. They concentrate on male job stayers from West Germany aged 25–65 who held their job during two consecutive years full time and whose degree of training, profession, occupational status, marital status and number of children remain unchanged for two consecutive years. The sample does not include civil servants, the self-employed, unpaid family workers, highly skilled workers and employees who do not pay social security contributions because of their low level of earnings (Beissinger & Knoppik, 2001, pp. 399–402).

Beissinger & Knoppik regress the skewness measures listed above ((1), (2), (3), (4) and (5)) against the median of the wage distribution and the change in the unemployment rate, which is used in order to capture the potential time-variance of the rigidity. The coefficients of the medians for all skewness measures were statistically significant and negative. They conclude that the results support the hypothesis of nominal wage rigidity. It must be mentioned though, that the values of the coefficients were in most cases relatively small, with exception of the sign test and the LSW statistic.

Lebow, Saks, & Wilson (2003) look at the US micro-data from 1981–1999 which form the basis for the employment cost index (ECI) of the Bureau of Labour Statistics. These data have some interesting features. First of all, they characterise jobs, not individuals, so the figures for compensation are the average of everyone doing a given job. The economic sectors are limited to the private sector, excluding farms, households and the self employed (Lebow, Saks, & Wilson, 2003, pp. 13–18).

The data are particularly interesting because they distinguish between wage and salary base components and additional benefits, allowing downward nominal rigidity to be assessed with and without benefits. More specifically: "*Wages and salaries* [...] include straight-time hourly wage and salary costs, including commissions and *total compensation excluding legally-required benefits* which adds most benefit costs over which the firm has some discretion, including paid leave (vacation, holiday, and sick leave), supplemental pay (non-production bonuses, overtime, and shift differentials), health and life insurance, retirement and savings plans, and severance pay" (Lebow, Saks, & Wilson, 2003, p. 8).

They use measures of asymmetry (skewness coefficient, mean-median difference, sign test, LSW statistic) and regress them against inflation / wage distribution median and unemployment to show that nominal wages and salaries as well as total compensation are downwardly rigid. The rigidity is smaller for the total compensation than it is for the base wage and salary. However, they do not find any evidence that employers are deliberately using benefits to offset the rigidity of base wages and salaries.

Dwyer & Kenneth (2000) use the Mercer Cullen Egan Dell (MCED) Survey, Australian data from 1987–1999. The MCED survey is an employer survey of

companies that are willing to participate in it. As a result there is data on the base salary and total salary for more than 450 different jobs, although the results are only calculated for base salary. The data characterise jobs, not individuals, as the main purpose of the dataset is to give employers some idea of current market prices for certain jobs (Dwyer & Kenneth, 2000, p. 16).

Dwyer & Kenneth find correlations between skewness indicators ((1), (2) and (4)) and inflation (headline, core and expectations). The results show strong negative correlations for all the indicators, concluding that there is evidence for downward negative rigidity. However, they also detect skewness around the median, indicating that at least some of the rigidity is caused by something other than downward nominal rigidity.

Kuroda & Yamamoto (2003) analyse wage rigidity using the Japanese Panel Survey of Consumers from 1994–1998. The sample is based on Japanese females residing nationwide. The survey population does not include males, but there still is some information on the husbands of those women who were married. Age groups are limited to female respondents who in 1993 were aged 24–34. The unemployed, those working in family businesses, the self employed, those who switched jobs and workers whose overtime working hours changed substantially from year to year are excluded (Kuroda & Yamamoto, 2003, pp. 24–25).

They present results for both men and women, and draw the conclusion that there is some evidence of DNWR in men's monthly wages. This, however, was not the case for yearly earnings; women's earnings also seemed not to suffer from downward nominal rigidity. That said, it must be kept in mind that during that period the inflation levels in Japan were very low, between –0.60 and 1.53. The authors point out that because of this the results may not be reliable for a high inflation environment.

Table 1 summarises the results. Most of the works reviewed in this chapter do provide some sort of support for the downward nominal rigidity of wages, but several of them do it with relatively strong reservations, limiting the phenomenon to specific subgroups. The evidence seems to be stronger for hourly workers and union members. When looking at the wage and salary components, then base pay is usually more rigid than benefits and the total payroll.

Table 1. Summary of results from the skewness-location approach

Article	Country	Survey type	Subjects	Obs	Time frame	Compensation type used in analysis	Results (detail)	Conclusion
McLaughlin (1994)	USA	Individual survey	Employed household heads, age 21–65, who reported wage or salary and stayed employed (based on tenure) in the same job; no self employed.	5000 per year (24879)	1976(70)–1986	**Hourly workers:** straight-time hourly wage; **Salaried worker:** salary (not converted to hourly wage) (seen to be pooled together and used for calculating average nominal wage growth)	**PROBIT estimates from nominal wage cuts regression (aggregated data):** Coefficients for anticipated inflation –8.85; unanticipated inflation –6.56 ; general inflation –8.7.	**Confirms** the existence of DNWR NB! Author draws different conclusion!
Card & Hyslop (1997)	USA	Individual survey	Job stayers (based on industry and occupation data), no minimum wage earners.	approx 25 000 per year	1979–1993 (CPS)	**Hourly workers:** hourly wages.	Regression coefficient of rigidity measure ("sweep up effect" (su)) and inflation: –0.81.	**Confirms** the existence of DNWR
McLaughlin (1999)	USA	Individual survey	Employed household heads (from 1971) and spouses (from 1979), who reported wage or salary and stayed employed (based on tenure) in the same job	34 633 in total	1971–1992	**Hourly workers:** straight time hourly wage; **Salaried worker:** salary	Correlation coefficients between skewness measures and **inflation / anticipated inflation** **For all workers**: Skewness coef: 0.3/0.23 Mean median diff: 0.07/–0.14 Sign test: 0.08/–0.08 LSW statistic: –0.33/–0.5 **For union members:** Skewness coef: 0.03/–0.14 Mean median diff: –0.55/–0.69 Sign test: –0.53/–0.66 LSW statistic:–0.6/ –0.68 **For hourly workers:** Skewness coef: 0.02/0.05 Mean median diff: –0.04/–0.37 Sign test: –0.1/–0.38 LSW statistic:–0.65/ –0.79	**In general, this paper does not confirm** DNWR, but for specific groups (union members, hourly workers), DNWR exists.

Article	Country	Survey type	Subjects	Obs	Time frame	Compensation type used in analysis	Results (detail)	Conclusion
McLaughlin (2000)	USA	Individual survey	Employed household heads (from 1971) and spouses (from 1979), aged 18–70, who reported wage or salary and stayed employed (based on tenure) in the same job, no self-employed	34 637 in total	1971–1992	**Hourly workers:** hourly wage; **Salaried worker:** salary	Correlation coefficients between skewness measures and **anticipated inflation / median (selected statistics and group)s:** **For all workers**: Skewness coef: 0.2/0.16 Mean median diff: –0.25/–0.11 Sign test: –0.18/–0.07 LSW statistic: –0.57/–0.42 **For union members:** Skewness coef: –0.15/–0.07 Mean median diff: –0.79/–0.68 Sign test: –0.74/–0.63 LSW statistic:–0.79/ –0.64 For **hourly workers:** Skewness coef: 0.00/–0.02 Mean median diff: –0.43/–0.17 Sign test: –0.42/–0.20 LSW statistic:–0.78/ –0.74	**In general there is no DNWR.** **Some evidence for:** union members, hourly workers, less educated and non-whites.

Article	Country	Survey type	Subjects	Obs	Time frame	Compensation type used in analysis	Results (detail)	Conclusion
Beissinger & Knoppik (2001)	Germany	Individual registry data	Job stayers (except women, unpaid family workers, highly skilled workers, civil servants, the self-employed, , and employees who do not pay social security contributions) in West-Germany aged 25–65 who maintained a job during two consecutive years full time and whose other characteristics remain unchanged.	487 507 observations for workers and 121 458 observations for salaried employees	1975–1995	**Gross earnings** including fringe benefits (no information on hours worked)	**Regression coefficients between location and skewness indicators:** **For workers:** Skewness coef: –0.06 Skewness coef (mod):–0.09 Mean median diff: –0.05 Sign test: –2.48 LSW statistic:–1.09 **For salaried employees:** Skewness coef: –0.08 Skewness coef (mod):–0.11 Mean median diff: –0.07 Sign test: –1.37 LSW statistic:–1.78	**Confirms DNWR**

Article	Country	Survey type	Subjects	Obs	Time frame	Compensation type used in analysis	Results (detail)	Conclusion
Lebow et al. (2003)	USA	Employer survey	Private non-farm sector of the economy (excluding households and the self-employed). Data characterise jobs, not individuals.	5000 per year	1981–1999	**Straight-time hourly wage and salary costs**, including commissions (does not distinguish between hourly wage and salary). **Total compensation** excluding legally-required benefits The data is calculated as the average of the workers working in this specific job.	**Wages and salaries:** LSW test's coefficient on: - median:–1.76; - inflation: –1.37. **Benefits**: LSW test's coefficient on: - median: 0.4 (statistically insignificant); - inflation: –0.25 (statistically insignificant). **Total compensation:** LSW test's coefficient on: - median: –1.45; - inflation: –1.37.	**Confirms DNWR**, overall compensation is less rigid than wages and salaries.
Dwyer & Kenneth (2000)	Australia	Employer survey	Data of 700 companies from MCED survey. More than 450 different jobs. The data of workers who did not change job between surveys. Data characterise jobs, not individuals.	80 000 all together	1987–1999	**Base pay** is as annual salary excluding allowances or additional payments. No data on hours worked.	Correlation coefficients between skewness measures and **headline inflation / core inflation / inflation expectations:** **Base pay:** Skewness coef: –0.69/–0.85/–0.84 Mean median diff: –0.50/–0.61/–0.59 LSW statistic:–0.60/ –0.65/–0.68	**Confirms DNWR**.

Article	Country	Survey type	Subjects	Obs	Time frame	Compensation type used in analysis	Results (detail)	Conclusion
Kuroda & Yamamoto (2003)	Japan	Individual survey	Japanese females residing nationwide and also husbands of those females in the sample who are married. Age group 24–34 Excluding: unemployed, those working in family businesses, the self-employed, job movers, and workers whose overtime hours changed.	1292 per year	1994–1998	Regular monthly salary, annual earnings and hourly earnings	**Regular monthly salary earners** (male), correlation of skewness measures with **inflation** / **lagged inflation**: Skewness coef: –0.048/–0.303 Mean median diff: 0.225/–0.523 Sign test: –0.123/–0.443 Sign rank statistic: –0.025/–0.379 LSW statistic:–0.23/ –0.062 **Annual earnings** (male), correlation of skewness measures with **inflation / lagged inflation**: Skewness coef: 0.185/–0.046 Mean median diff: 0.060/–0.137 Sign test: –0.037/–0.111 Sign rank statistic: 0.128/–0.202 LSW statistic: 0.053/ –0.139	**Some evidence of DNWR** (regular monthly salary of men)

The skewness-location approach also has several weaknesses, as it does not allow the direct quantification of the impact of nominal rigidity, and there are questions concerning the functional relationship between skewness measures and location (Beissinger & Knoppik, 2001, p. 402).

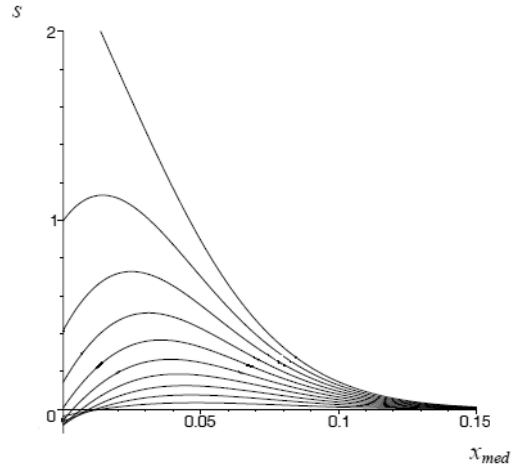


Figure 3. Skewness-location relationships of the skewness coefficient for different degrees of rigidity
Source: Knoppik, 2007, p. 13

In Figure 3 the relationship between changes in location (x_{med}) and values of skewness coefficient (s) is presented using a numeric example proposed by Knoppik (2007). The properties of the normally distributed counterfactual distribution are assumed to be the following: standard deviation 5% and median between 0%–10%[8]. Curvatures correspond to different levels for the rigidity coefficient (ρ) ranging from 0.1 up to 1 ($0 \leq \rho \leq 1$).

The simulation shows that depending on the range of medians for which observations are available, the regression coefficients of a simple linear regression of the skewness statistic against the median of the distribution (in other words the slope of the curvatures depicted in the figure) could take values with either sign, despite the fact that the simulation has been built up to include substantial downward nominal rigidity (Knoppik, 2007, p. 5). In other words, even if there is substantial DNWR, this does not necessarily mean that the correlation between skewness and location will be negative.

The behaviour of the skewness coefficient depicted in Figure 3 is substantially different from another skewness indicator, the mean-median difference (*mmd*). As can be seen from Figure 4 the mean-median difference has falling

[8] These properties are similar to those estimated in empirical studies of nominal rigidity.

skewness-location relationships, which indicates that for measuring rigidity the negative correlation between the mean-median difference and locations is in this respect more reliable.

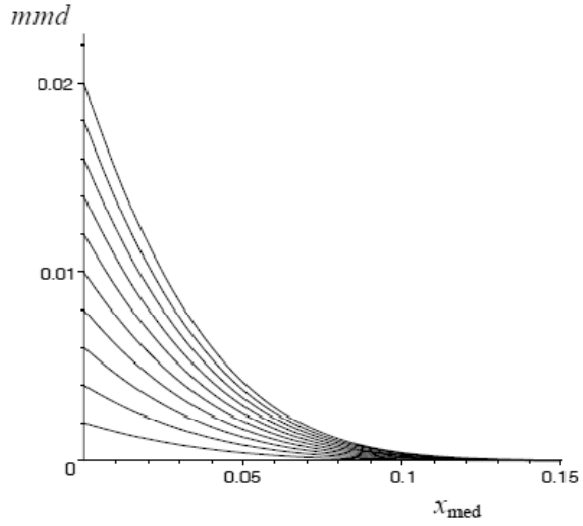


Figure 4. Skewness-location relationships of the mean-median difference for different degrees of rigidity.
Source: Knoppik, 2007, p. 13

These two figures explain why different skewness measures may produce different results.

The skewness coefficient is not the only skewness measure that can contribute to mixed results. Several authors have also used the LSW statistic as an indicator of skewness. The LSW statistic is especially interesting because it is the only skewness statistic that addresses downward nominal rigidity directly. However, it assumes symmetry of the counter-factual distribution and if the counter-factual distribution is skewed to the right, the rigidity estimates could be overestimated. This leads us to the next approach, the symmetry approach.

2.4. Symmetry approach

To get a quantitative estimate about the extent of downward nominal wage rigidity, then a counter-factual distribution has to be constructed. There are several ways of doing this. One way is to introduce one additional assumption:

A6: The counter-factual distribution of the wage change distribution is symmetric around its median (Beissinger & Knoppik, 2001, p. 392). If other assumptions are also fulfilled, then the right side of the wage change dis-

tribution can be used to derive the shape of the left side of the distribution. The basic idea behind the symmetry approach is that in a symmetric counter-factual, the right side of the factual distribution can be considered to be the mirror image of left side of counter-factual distribution. Thus it follows that if the probability mass on the left side of the factual is smaller than on the right side of the factual distribution, then this could be considered as a sign of nominal wage rigidity.

The idea was first introduced by Card & Hyslop (1997), who use real wage change distributions as the basis for their example. If the counter-factual probability density function of real wage changes is symmetrical and median centred, then it can be shown that (Card & Hyslop, 1997, p. 85):

$$su_t = \left(1 - F(2m_t + \pi_t^-)\right) - F(-\pi_t^-) \quad (2\text{–}6)$$

where su_t is the fraction of workers affected by downward nominal rigidity at period t, $F(x)$ is factual cumulative distributions function of real wage changes, m_t is the median, π_t is the rate of inflation at period t, and $-\pi_t^-$ and π_t^- exclude the mass point at $-\pi_t$ and π_t (Card & Hyslop, 1997, p. 85). The intuition behind this equation is that if distribution is symmetric then the share of observations below the inflation rate in the distribution of real wage growth should be equal to the share of observations above twice the median plus the inflation rate.

Equation (2–6) and (2–2) are versions of the symmetry approach based respectively on real and nominal wage change distributions. Thus the LSW statistic is also an application of the symmetry approach.

The discussion about the appropriateness of the symmetry approach has been quite intensive (e.g. McLaughlin (1999), McLaughlin (2000), Lebow *et al.* (2003)) and it has been used in several papers, mostly in the form of the LSW statistic.

Most of the papers dealing with downward nominal wage rigidity use several methods for assessing the existence and size of wage rigidities. In order to avoid duplication, the following sections will provide a more detailed description of the dataset only if this has not been done in previous chapters.

Card & Hyslop (1997) use the symmetry approach on the US Current Population Survey data from 1979–1993 and find that during the high inflation period (1979–1982) downward nominal wage rigidity affected 5.4%–7.3% of hourly rated non-job changers, depending on the year. The estimates for the low inflation period (1983–1993) were between 9.7% and 13.5% (Card & Hyslop, 1997, p. 93).

McLaughlin (2000) uses the data from the Panel Study of Income Dynamics (PSID) from 1971–1992. For all workers the share of people affected by nominal wage rigidity is 7.9% (McLaughlin, 2000, p. 18). Values for selected subgroups are listed in Table 2.

Table 2. Symmetry test statistics from Panel Study of Income Dynamics 1971–1992

Subgroup	LSW statistic
Overall	7.9%
Female	9.2%
Male	6.9%
Non-union	8.2%
Union	6.2%
Salaried	4.7%
Hourly	10.9%

Sectors	LSW statistic
Agriculture	10.9%
Mining	11.5%
Construction	9.9%
Metals	5.9%
Machinery	8.7%
Transportation Equipment	6.9%
Other Durables	7.5%
Food & Tobacco	4.2%
Textiles, Apparel, & Leather	9.7%
Paper, Printing, & Publishing	7.6%
Chemicals, Petroleum, & Rubber	6.9%
Transportation	6.9%
Communications & Utilities	7.8%
Wholesale Trade	4.3%
Retail Trade, Entertainment & Recreation	11.4%
Finance, Insurance, & Real Estate	6.6%
Business & Repair Services	7.7%
Personal Services	16.1%
Health Services	8.1%
Education	5.9%
Other Professional Services	8.5%
Public Administration	5.6%

Source: McLaughlin, 2000, pp. 18–20

However, it has to be kept in mind that several of the results were not consistent with other indicators of skewness, for example the result for union participation.

Beissinger & Knoppik (2001) use the German micro-data from *Institut für Arbeitsmarkt und Berufsforschung Beschäftigtenstichprobe* from 1975–1995. They calculate the LSW indicator and find that a symmetry approach for all workers shows that 4.8% of wage cuts could have been considered as not enacted because of nominal wage rigidity. When they differentiated between workers and salaried employees, the figures were 4.6% and 6.8% respectively (Beissinger & Knoppik, 2001, pp. 399–402).

Dwyer & Kenneth (2000) perform the same kind of exercise on Australian data for 1987–1999 and show that the LSW statistic is 15.75% (Dwyer & Kenneth, 2000, p. 12).

Kuroda & Yamamoto (2003) analyse Japanese data from 1993–1998 and find the LSW statistic's value to be 12% for men working full time, when calculated from a full time regular monthly salary. Annual earnings data yielded an LSW statistic of 11%. For women the figure was 7% for both monthly and yearly earnings. However, they did have at their disposal also the wages of part-time female workers and from their hourly wages they found a shortage of wage cuts of nearly 40% when compared with the equivalent part of the right side of wage distribution (Kuroda & Yamamoto, 2003, pp. 24-25).

Lebow, Saks & Wilson (2003) use data from the US Bureau of Labor Statistics' employment cost index from 1981–1999 and find that the LSW statistic is 13.2% (Lebow, Saks, & Wilson, 2003, p. 11). This is somewhat higher than the results obtained by Lebow in cooperation with other co-authors using the US PSID data from 1971–1988 and showing the LSW statistic for wage and salary earners to be 6.8% (Lebow, Stockton, & Wascher, 1995). Lebow, Saks & Wilson explain the difference primarily with different inflation regimes.

Iregui, Melo, & Ramírez (2009) use Colombian company level registry data filed by companies with the *Superintendencia de Sociedades* from 1999–2006. The sample covers 1517 companies for white collar workers and 781 for blue collar. The analysis concentrated on companies where employees had a permanent contract and during the period there was no interruption in the payment of wages. Government employees, the self-employed and people working in micro-companies were also excluded. As a measure of wages, the average wage across companies is used. They conclude that there is a 7.8% shortage of observations of below zero wage change for blue collar workers and a 7.5% shortage for white collar workers (Iregui, Melo, & Ramírez, 2009).

The assumption of the symmetric counter-factual has received quite heavy criticism, mainly because empirical work seems not to support the hypothesis of symmetry. One way to test this is to search for symmetry near the median. Assuming that observations above zero are not affected by downward nominal rigidity, meaning there are no menu costs, then the left side of the distribution from zero to median must be symmetric to the right side of the distribution from median to twice the median. If there are menu costs, this test has to be modified so as to exclude observations in the neighbourhood of zero.

Such tests have been performed by several authors (e.g. McLaughlin (1999) for PSID data, Beissinger & Knoppik (2000) for IABS data). If the underlying counter-factual distribution is skewed for reasons other than nominal wage rigidity, then the LSW statistic will overestimate the share of not-enacted wage cuts. Both the articles mentioned here found that the symmetry assumption is not fulfilled.

This leads us to the histogram-location approach, which can also give easily interpreted quantitative estimates of downward nominal wage rigidity and does not use the often criticised assumption of symmetry.

Table 3. Summary of results from the symmetry approach

Article	Country	Survey type	Subjects	Obs.	Time frame	Compensation type used in analysis	Results	Conclusion
Card & Hyslop (1997)	USA	Individual survey	Job stayers (based on industry and occupation data), no minimum wage earners.	ca 25 000 per year	1979–1993	Hourly workers: hourly wages.	Downward nominal wage rigidity affected between 6.2% and 13.85% of hourly rated job stayers	**Confirms the existence of DNWR**
McLaughlin (1999)	USA	Individual survey	Employed household heads (from 1971) and spouses (from 1979) who reported wage or salary and stayed employed (based on tenure) in the same job	34 633 in total	1971–1992	**Hourly workers:** straight time hourly wage; **Salaried worker:** salary	7.89% shortage of observations of below zero wage change (4.11% shortage when observations of zero wage change are excluded).	**Confirms the existence of DNWR**. However, the symmetry of the counter-factual is rejected. NB! Author draws different conclusion!
McLaughlin (2000)	USA	Individual survey	Employed household heads (from 1971) and spouses (from 1979) aged 18–70 who reported wage or salary and stayed employed (based on tenure) in the same job, no self-employed	34 637 in total	1971–1992	**Hourly workers:** straight time hourly wage; **Salaried worker:** salary	Overall 7.9% shortage of observations of below zero wage change.	**Confirms the existence of DNWR**. However, the symmetry of the counter-factual was rejected. NB! Author draws different conclusion!

Article	Country	Survey type	Subjects	Obs.	Time frame	Compensation type used in analysis	Results	Conclusion
Beissinger & Knoppik (2001)	Germany	Individual registry data	Job stayers (except women, unpaid family workers, highly skilled workers, civil servants, the self-employed, and employees who do not pay social security contributions) in West Germany aged 25–65 who maintained a job during two consecutive years full time and whose other characteristics remain unchanged.	487 507 observations for workers and 121 458 observations for salaried employees	1975–1995	**Gross earnings** including fringe benefits (no information on hours worked)	**For workers:** There is a 4.6% shortage of observations of below zero wage change **For salaried employees:** There is a 6.8% shortage of observations of below zero wage change **All employees:** There is a 4.84% shortage of observations of below zero wage change	**Confirms the existence of DNWR**.
Lebow et al. (2003)	USA	Employer survey	Private non-farm sector of the economy (excluding households and the self employed). Data characterizes jobs, not individuals.	5000 per year	1981–1999	**Straight-time hourly wage and salary costs**, including commissions (does not distinguish between hourly wage and salary). **Total compensation** excluding legally-required benefits The data are calculated as the average of the workers working in each specific job.	**Wages and salaries:** There is a 13.2% shortage of observations of below zero wage change **Benefits:** There is a 9.9% shortage of observations of below zero wage change **Total compensation:** There is a 8.9% shortage of observations of below zero wage change	**Confirms DNWR.** Overall compensation less rigid than wages and salaries.

Article	Country	Survey type	Subjects	Obs.	Time frame	Compensation type used in analysis	Results	Conclusion
Dwyer & Kenneth (2000)	Australia	Employer survey	Data from 700 companies for MCED survey. More than 450 different jobs. The data of workers who did not change job between surveys. Data characterise jobs, not individuals.	80 000 all together	1987–1999	**Base pay** is as annual salary excluding allowances or additional payments. No data on hours worked.	**Base pay:** There is a 15.5% shortage of observations of below zero wage change	**Confirms DNWR.** However, assumption of symmetry is violated.
Kuroda & Yamamoto (2003)	Japan	Individual survey	Japanese females residing nationwide and husbands of those females in the sample who are married. Age group 24–34 Excluding: the unemployed, those working in family businesses, the self-employed, job movers, and workers whose overtime hours changed.	1292 per year	1994–1998	Regular monthly salary, annual earnings and hourly earnings	**Regular monthly salary:** There is a 11% shortage of observations of below zero wage change: – men: 12% – women: 7% **Annual earnings:** – men: 11% – women: 7%	**Confirms DNWR.**

Article	Country	Survey type	Subjects	Obs.	Time frame	Compensation type used in analysis	Results	Conclusion
Iregui et al. (2009)	Colombia	Company level registry data	Firms that reported the payment of wages to workers with permanent contracts throughout the period Study excludes the self-employed, government employees, and small-scale companies. Data on company, not individual level.	1517 companies for white collar workers, 781 for blue collar	1999–2006	Companies' average wage by skill types and industry	**Blue collar:** There is a 7.8% shortage of observations of below zero wage change **White collar:** There is a 7.5% shortage of observations of below zero wage change	**Confirms DNWR.** Wages of blue collar workers are slightly more rigid than those of white collar workers

2.5. Histogram-location approach

The histogram-location approach originates from Kahn (1997), but is more systematically elaborated by Beissinger & Knoppik (2001). The following explanation of this methodology is mostly based on their work.

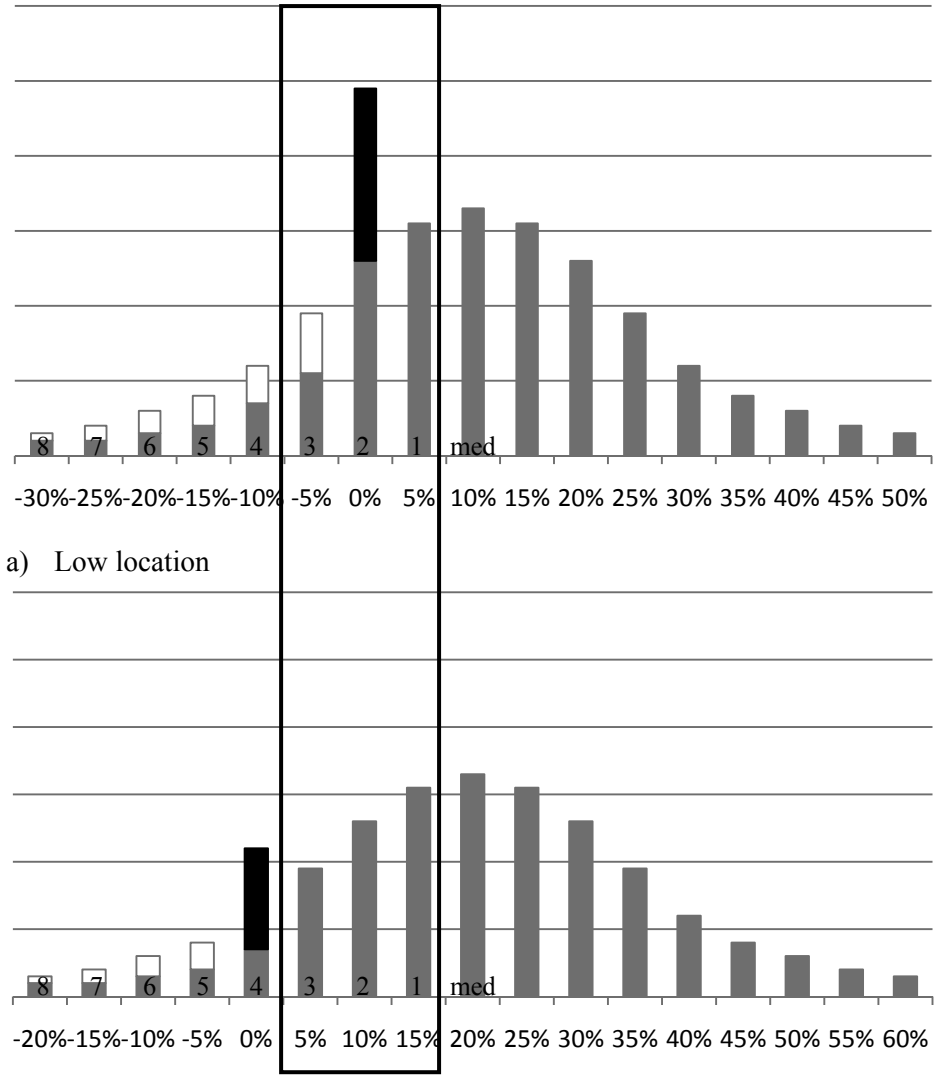


Figure 5. Factual median-centred histograms in times of high and low location
Source: Lebow, Saks, & Wilson, 1999, p. 7.

Kahn's idea was to model the whole distribution of both factual and counter-factual wage change distributions. She explains the bin heights of the factual median-centred nominal wage change distribution with two determinants, the median-centred counter-factual distribution and the rigidity function. Changes in location allow the variation in the height of the bins of factual distribution to be observed. This can be exploited for estimating the rigidity function.

The bins of histograms are numbered starting from the median to the left (see Figure 5). It is important to keep in mind that under these factual distributions there is also a counter-factual distribution that is identical in shape whatever the position of the location (the grey and white parts of the histogram bars in Figure 5).

The shape of the factual distribution can be described by the following equations (Beissinger & Knoppik, 2001, pp. 404-405):

$$PF_{r,t} = PC_r \quad for \qquad r > r_t^0 \tag{2–7}$$

$$PF_{r,t} = PC_r + RIG_{r,t} \quad for \qquad r \leq r_t^0 \tag{2-8}$$

where r is the number of the respective bin, r_t^0 denotes the bin containing zero wage growth, $PF_{r,t}$ denotes the proportion of observations in bin r of factual distribution at time t, and PC_r is the proportion of observations in bin r of the counter-factual distribution[9]. $RIG_{r,t}$ is the effect of downward nominal rigidity on bin r at time t (Beissinger & Knoppik, 2001, p. 405).

Let us look at bin no. 3 in Figure 5. If there is high location, this bin includes only positive wage growth observations and the height of the bin of the factual distribution equals the height of the bin in the counter-factual. However, if there is low location, this bin falls below the zero-bin and due to downward rigidity is shorter than the same bin in the counter-factual distribution (the share of observations "stolen" by DNWR is marked white).

We can then look at bin no. 2. If there is low inflation, this is a zero-bin, meaning that all the observations that are lacking from the bins to the left of the zero-bin due to downward rigidity are accumulated in the zero-bin, making it higher than bin no. 2 in the counter-factual distribution. Thus the component $RIG_{r,t}$ must catch both the thinning of the bins that are positioned to the left of the zero-bin and a pile-up effect at the zero-bin.

In order to go forward, certain assumptions must be made concerning the rigidity function. The original application of this methodology by Kahn (1997) uses the following assumption:

A7. The rigidity function has proportional form (Beissinger & Knoppik, 2001, p. 406):

[9] It should be kept in mind, that while *PF* changes over time, *PC* remains constant.

$$\rho(Z) = \rho Z \qquad for\ Z < 0$$

(2–9)

where ρ is the rigidity coefficient measuring the time-invariant proportion of wage cuts that have not been enacted.

The econometric model proposed by Kahn is as follows[10] (Beissinger & Knoppik, 2001, p. 407):

$$PF_{r,t} = PC_r - \rho PC_r DNEG_{r,t} + \left(\gamma + \rho \sum_{j=\mathrm{r_{min}}}^{r_{max}} PC_j DNEG_{j,t} \right) DO_{r,t} + \mu_{r,t}$$
$$for\ r = r_{min} \ldots r_{max}$$

(2–10)

In the econometric model (equation (2–10)) it is necessary to introduce a dummy variable indicating the status of the bin as negative (denoted with $DNEG_{r,t}$) or a zero-bin (denoted with $D0_{r,t}$). It is also reasonable to concentrate only on the range of bins that change their status (r_{min} and r_{max} denote respectively the lowest and highest bin number of the zero-bins over the years). A constant γ is introduced to catch the thinning effect of bins that are always negative and outside the range r_{min} ... r_{max}). ρ is the rigidity coefficient indicating the proportion of wage cuts that were not enacted and $\mu_{r,t}$ denotes the error term.

The regression is usually estimated as a system of equations, with one for each bin in the range of r_{min} ... r_{max}. In order to take the contemporaneous correlation between the error terms of different equations into account, Kahn (1997) used a seemingly unrelated regression as an estimation method.

Most of the applications of Kahn's idea have included some modification to the basic model. She herself used a specification that also takes into account the existence of menu costs. Her results were estimated on USA PSID data from 1970–1988, using the earnings figures of household heads who had not changed job for two consecutive years of the survey. The sample excludes non-heads of households, people who change employers during a year, and people with missing wage or salary data for those years. People who work only for themselves were also excluded. Kahn uses data on the hourly pay rates of workers and converts salaries into an hourly pay rate. As bin width, she uses 1%.

She shows that for wage earners, negative wage changes occur 47% less often than would be predicted by their distance from the median. According to this estimation and assuming average wage distribution, 9.4% of wage earners did not receive wage cuts because of DNWR. For salary earners the results were mixed and did not yield clear results. She suggests that the analysis might partly be influenced by the technical properties of PSID, namely that salaries are con-

[10] We will use the rewritten version of the model from Beissinger & Knoppik (2001), because their formulation of the model is easier to understand.

verted into hourly wages by correcting them with working hours. The flexibility could be the result of variation in working hours. Kahn tries to correct for this by estimating the results on the data of those salary earners whose working hours did not change. The results did not change qualitatively (Kahn, 1997, p. 1002).

Beissinger & Knoppik (2001) use German IABS data from 1975–1995 and make several modifications to Kahn's approach. First, they lose the time-invariance assumption of the rigidity function and let it depend on the change in the unemployment rate. They also use iterative weighted least squares as an estimation technique in order to correct for the heteroscedasticity[11] in error terms across equations. Their data lack information on hours worked. As bin width, they use 0.5%. The results show that the rigidity coefficient for the whole period is 21.6% for waged workers, indicating that 21.6% of wage cuts have not been enacted due to DNWR, and 31.2% for salaried workers (Beissinger & Knoppik, 2001, p. 410).

Lebow *et al.* (2003) use the US ECI data from 1981–1999 and analyse the downward nominal rigidity of different compensation measures (wages/salaries and total compensation without legally required benefits). Their data concern the wages for specific jobs rather than for individuals. Their results show that the rigidity coefficient for the overall wage was 52%. When differentiating between wages/salaries and benefits then benefits are less rigid (33%). The rigidity coefficient for overall compensation is 38% (Lebow, Saks, & Wilson, 2003, p. 18).

Castellanos *et al.* (2004) use the data of *Instituto Mexicano del Seguro Social*, registry data that exclude government employees, from 1986–2001. The data are on wages and benefits and are standardised so that wages are reduced to a daily wage. The data are gapped with 25 times the Mexico City minimum wage since 1995 and with 10 times the Mexico City minimum wage before 1995. The database excludes the self-employed, government employees and those employed informally and the analysis uses the data of job stayers. The bin width is 1% (with median location) and 4% (with 75th percentile as location). The rigidity coefficients using Kahn's original specification were 62% and 35% respectively (Castellanos, Garcia-Verdu, & Kaplan, 2004).

Iregui *et al.* (2009) use Colombian firm level registry data from 1999–2006. As a measure of wages, they use the average wage from across companies by skill type and industry. The bin width is 1%. They perform the Kahn test and show that for blue collar workers, 28.6% of wage cuts were not enacted, while for white collar workers this figure is only 17.5%. They conclude that the wages of blue collar workers are more rigid. (Iregui, Melo, & Ramírez, 2009)

There are also some cross-national applications of Kahn's method. Knoppik & Beissinger (2009) use European Community Household Panel data from 1994–2001. They focus on job stayers and use the information on the current

[11] This is because bin sizes at different distances from the median differ significantly (by more than ten times) (Beissinger & Knoppik, 2001, p. 407).

monthly net earnings reported in the questionnaire. They can also control for changes in hours worked and include in their sample only those workers whose hours did not change. The most interesting chapter of this dataset is the international comparability of the results. Beissinger & Knoppik (2009) also make some modifications to the methodology. A two-percent bin width is used in the estimation and the wage changes are standardised using the 60th percentile as location and the difference between the 80th and 60th percentiles as the measure of variance, in order to allow several countries to be included in one model, and dummies of each country are included, and they also estimate the closed form of the model (Knoppik & Beissinger, 2009, p. 327). The results are presented in Table 4.

Table 4. Estimated degrees of downward nominal wage rigidity of selected European countries

Country	Rigidity coefficient	t-value
Austria	0.45	(16.36)
Belgium	0.47	(13.47)
Denmark	0.35	(12.49)
Finland	0.46	(12.99)
France	0.23	(7.54)
Germany	0.28	(9.42)
Greece	0.43	(16.86)
Ireland	0.18	(7.03)
Italy	0.66	(22.38)
Portugal	0.41	(15.13)
Spain	0.07	(2.60)
UK	0.14	(5.32)
EU[12]	0.36	(25.17)

Source: Knoppik & Beissinger, 2009, p. 330

Behr & Pötter (2009) use also Kahn's histogram-location approach, although as a reference methodology for their generalised hyperbolic estimates. Their analysis is based on ECHP from 1994–2001. However, they do not concentrate only on job stayers but also include people who changed job and they calculate yearly earnings from hourly wages. Behr & Pötter use a bin width of 2%, but their measure of location is the median, and for standardisation they use the difference between the 90th and 50th percentiles as a measure of variance (Behr

[12] The EU estimate is based on 12 of the 15 older EU members (without Luxembourg, the Netherlands, and Sweden).

& Pötter, 2009, p. 169). The model seems to be slightly different from the version used by Knoppik & Beissinger (2009)[13]. Otherwise the differences between the methodologies are not very large. However, it seems from the estimates listed in Table 5 of the rigidity coefficients that the size of the co-efficients estimated by (Behr & Pötter, 2009) is significantly lower. This is probably because their sample is not restricted to job stayers.

Table 5. Estimated degrees of downward nominal wage rigidity for selected European countries from Behr & Pötter (2009)

Country	Rigidity coefficient
Belgium	0.190
Denmark	0.301
France	0.059
Germany	0.152
Greece	0.163
Ireland	0.063
Italy	0.304
Portugal	0.372
Spain	0.035
UK	0.056

Source: Behr & Pötter, 2009, p. 182

Kahn's approach is not free of criticism either. Card & Hyslop (1997) have pointed out that the dispersion of wage distribution might be correlated with inflation, meaning that the assumption of a time-invariant counter-factual distribution might not be fulfilled (Card & Hyslop, 1997, p. 17). However, Lebow *et al.* (2003) check the Bureau of Labor Statistics' Employment Cost Index data for variation differences during times of low and high inflation and find no significant differences (Lebow, Saks, & Wilson, 2003, p. 3).

Behr & Pötter (2009) suggest that Kahn's approach assumes the existence of a relatively long time series for observations. Thus it is difficult to estimate the effects of policy reform on DNWR, especially if the interest is in quick results. They also stress that although standardisation could be an effective way to correct for the time-variant variance of the distribution, "... after standardisation zero wage changes will no longer be located in the centre of the relevant bin" (Behr & Pötter, 2009, p. 170).

[13] They do not mention using the closed version of the model.

Table 6. Summary of results from symmetry approach

Article	Country	Survey type	Subjects	Obs.	Time frame	Compensation type used in analysis	Bin with	Results	Conclusion
Beissinger & Knoppik (2001)	Germany	Individual registry data	Job stayers (except women, unpaid family workers, highly skilled workers, civil servants, the self-employed, and employees who do not pay social security contributions) aged 25–65 who maintained a job during two consecutive years full time and whose other characteristics remain unchanged.	487 507 observations for waged workers and 121 458 observations for salaried employees	1975–1995	**Gross earnings** including fringe benefits (no information on hours worked, gross daily earnings are truncated to integer values)	0.5%	**Workers:** Kahn test: 8.97% of wage cuts were not enacted. **Salaried employees:** Kahn test: 17.2% of wage cuts were not enacted.	**Confirms DNWR.**
Beissinger & Knoppik (2001)	Germany	Individual registry data	Job stayers (except women, unpaid family workers, highly skilled workers, civil servants, the self-employed, and employees who do not pay social security contributions) aged 25–65 who maintained a job during two consecutive years full time and whose other characteristics remain unchanged.	487 507 observations for waged workers and 121 458 observations for salaried employees	1975–1995	**Gross earnings** including fringe benefits (no information on hours worked, gross daily earnings are truncated to integer values)	0.5%	**Salaried employees:** Rigidity coefficient: 22.37 Change in unemployment rate coefficient: –8.14	**Confirms DNWR**, for salaried employee's rigidity diminishes with growth of unemployment.

Article	Country	Survey type	Subjects	Obs.	Time frame	Compensation type used in analysis	Bin with	Results	Conclusion
Lebow et al. (2003)	USA	Employer survey	Private non-farm sector of the economy (excluding households and the self employed). Data characterise jobs, not individuals.	5000 per year	1981–1999	**Straight-time hourly wage and salary costs**, including commissions (does not distinguish between hourly wage and salary). **Total compensation** excluding legally-required benefits The data are calculated as the average of the workers working in this specific job.	1%	**Wages and salaries:** Kahn test: 52% of wage cuts were not enacted. **Benefits:** Kahn test: 33% of wage cuts were not enacted. **Total compensation:** Kahn test: 38% of wage cuts were not enacted.	**Confirms DNWR.** Overall compensation is less rigid than wages.

Article	Country	Survey type	Subjects	Obs.	Time frame	Compensation type used in analysis	Bin with	Results	Conclusion
Iregui et al. (2009)	Colombia	Company level registry data	Firms that reported the payment of wages to workers with permanent contracts throughout the period Study excludes the self-employed, government employees, and small-scale companies. Data on company, not individual level.	1517 companies for white collar workers, 781 for blue collar	1999–2006	Average wage across companies by skill type and industry	1%	**Blue collar:** Kahn test: 28.6% of wage cuts were not enacted. **White collar:** Kahn test: 17.5% of wage cuts were not enacted.	**Confirms DNWR.** Wages of blue collar workers are more rigid than those of white collar workers.
Kahn (1997)	USA	Individual survey	Household heads observed in the same job for two contiguous years of the survey. Excludes: the self-employed, job changers, non-heads of households and people with missing earnings data.		1970–1988	The analysis uses data on hourly pay rates of workers and converts salaries into an hourly pay rate	1%	**For wage earners:** Wage cuts occur 47 percent less often than would be predicted by their distance from the median. **For salary earners:** no DNWR	**Confirms DNWR.** The wages of workers are nominally downward rigid while wages of salary earners are not.

Article	Country	Survey type	Subjects	Obs.	Time frame	Compensation type used in analysis	Bin with	Results	Conclusion
Castellanos et al. (2004)	Mexico	Individual registry data	Excludes the self-employed, civil servants, the informally employed. Only job stayers are included in the analysis.	Random sample of 500,000 workers from each quarter	1985–2001	Wages plus benefits. Earnings reduced to daily wages. Wages are capped.	1%	All wage earners: 62% of wage cuts were not enacted due to nominal rigidity.	**Confirms DNWR.**
Knoppik & Beissinger (2009)	12 European Union "old" member states. Excludes: Luxemburg, Sweden, and the Netherlands.	Individual survey	Male employees between 21–65 years old, working in industry or services with permanent employment contract. Excludes job changers.	70 239 observations	1994–2001	Current monthly net wage and salary earnings.	2%	The rigidity coefficients were as follows: Austria 0.45 Belgium 0.47 Denmark 0.35 Finland 0.46 France 0.23 Germany 0.28 Greece 0.43 Ireland 0.18 Italy 0.66 Portugal 0.41 Spain 0.07 UK 0.14 EU 0.36	**Confirms DNWR.**

Article	Country	Survey type	Subjects	Obs.	Time frame	Compensation type used in analysis	Bin with	Results	Conclusion
Behr & Pötter (2009)	Germany, Denmark, Belgium, France, United Kingdom, Ireland, Italy, Greece, Spain and Portugal	Individual survey	All employees aged between 18 and 65, working at least 20 hours a week.	–	1995–2001	Wage changes are computed based on hourly wage rates.	2%	The rigidity coefficients were following: Belgium 0.190 Denmark 0.301 France 0.059 Germany 0.152 Greece 0.163 Ireland 0.063 Italy 0.304 Portugal 0.372 Spain 0.035 UK 0.056	**Confirms DNWR.**

2.6. Results from other quantitative methods for analysing downward nominal wage rigidity

The methods described in the previous chapter are those that have been used the most in analysing DNWR. There are also other approaches. These methods will not be applied in the empirical chapters of this thesis, but it is still reasonable to give a brief description of their methodologies and of their results.

Quite a lot of literature analyses the existence of menu costs. This appears in several settings done side by side with estimations of DNWR. Of the studies mentioned earlier, Card & Hyslop (1997), Kahn (1997) and Lebow *et al.* (2003) have all investigated the existence of menu costs too, by searching for an abnormally low concentration of observations near zero wage growth. They all confirm the existence of menu costs.

Holden & Wulfsberg (2008) use a slightly different method from Kahn (1997). They assume that the shape of wage change distribution does not change over the years, but in a slightly different manner from Kahn (1997). They find that the dispersion of wage change distribution and inflation are correlated, and thus the assumption of invariability in the way that Kahn used it (1997) is not valid. They derive the shape of the counter-factual distribution from the shape of the country-year samples with high wage growth by estimating the parameters of the distribution. In Holden & Wulfsberg (2008) the location and dispersion of the counter-factual distribution of industry wage growth is allowed to vary over regions and time, by imposing the same structural form of the distribution function in all country-year combinations. They test this method on a panel of industry-level data, using gross hourly wages as the measure of wages. The group under scrutiny are manual workers in the industrial sector of 19 OECD countries and the time period is 1973–1999. Holden & Wulfsberg find that for the whole sample, 25.9% of wage cuts were prevented by DNWR (Holden & Wulfsberg, 2008, pp. 4–7).

Altonji & Devereux (2000) build an econometric model that nests a flexible wage model, a downward rigidity model and a model that allows nominal wage cuts under certain circumstances. They use workers' characteristics, the unemployment rate and price levels in order to gain information on the wage changes as they should be if there were no nominal rigidities. The model also allows for potential measurement error in wage reports. Altonji & Devereux estimate their model on the US PSID data for hourly wages of non-job-changers from 1971–1992. They find that true wage changes as estimated from the model have significantly fewer wage cuts and more wage freezes than the reported wages in the PSID. They conclude that in models, perfect wage rigidity is a better approximation than perfect flexibility. However, the estimates of wage freezes range widely depending on the estimation methods and samples (Altonji & Devereux, 2000, p. 385). To summarise, the conclusions depend on the exact estimated model. Because of the estimated structure of the model, the identification power is weak and relies strongly on the normality assumptions. Evidence of a lack of identification is also given (Kramarz, 2001, p. 13).

Akerlof *et al.* (1996) conduct their own telephone survey in the summer of 1995. The survey was carried out in the Washington D.C. area. Amongst others, the following questions were asked of 409 individuals who had not changed employer or the circumstances of their job (Akerlof, Dickens, Perry, Gordon, & Mankiw, 1996, p. 11):

- "Excluding overtime, commissions and bonuses, has your base rate of pay changed since a year ago today?"
- "Did it increase or decrease?"
- "By how much?"

Only 2.7% of respondents reported a wage cut (5.8% of wage earners, 1.6% of salary earners). They conclude that wage cuts are uncommon (Akerlof, Dickens, Perry, Gordon, & Mankiw, 1996, p. 11). They also look at the PSID data and conclude that most of the downward wage change variability is the result of measurement error (Akerlof, Dickens, Perry, Gordon, & Mankiw, 1996, p. 15).

Smith (2000) uses the British Household Panel Study for 1991–1996. She looks at weekly earnings as a measure for wages and concentrates on job stayers who do not change the number of hours worked. Her analysis concludes that 9% of employees who remain in the same job from one year to the next experience wage freezes. However, she shows that most of this is connected to menu costs or measurement error. She suggests that there are only 1% of workers whose wages may be affected by DNWR. (Smith, 2000, pp. 193–194)

Nickell & Quintini (2003) assume that the probability of a nominal wage cut does depend on the median and the dispersion of the wage change distribution. Their approach does not assume symmetry of the wage change distribution and does allow for time-variance in the rigidity function. This method is applied on the UK New Earnings Survey data from 1976–1999. They conclude that the share of people whose nominal wages decline in year over year comparison is large, but: "... while there is a statistically significant distortion in the distribution of real wage changes caused by nominal rigidities around zero wage changes, the macroeconomic impact of this distortion is very modest." (Nickell & Quintini, 2003, p. 780).

Barwell & Schweitzer (2005) extend the work of Altonji & Devereux (2000) by introducing real rigidities into the model too. They analyse the extent of rigidities in Great Britain's New Earnings Survey Panel Dataset (NESPD) from the 1980s and 1990s. They estimate that slightly more than two in five workers belong to a regime of real rigidity. Only 15 % of workers are found to be affected by DNWR (Barwell & Schweitzer, 2005, p. 9).

Dessy (2002) uses ECHP data from 1994–1996. As a measure of wages, earnings received in the month of the interview were used. She looks at nominal wage changes and finds evidence of DNWR in all European countries. The wages of job stayers are more rigid than those of people who decided to move, but even for job changes zero wage growth can be found (Dessy, 2002, p. 1).

Behr & Pötter (2009) estimate the extent of downward nominal wage rigidity in ten European countries for 1995–2001 using ECHP data. They propose an estimation approach based on the generalised hyperbolic distribution.

Their analysis shows large differences in the estimates of the rigidity parameter, ranging from an average of about 4.1% for Spain up to 32.2% for Portugal (Behr & Pötter, 2009, p. 182). Behr & Pötter's method also allows the estimation of yearly fluctuations in the rigidity coefficient. Their results are depicted in Figure 6..

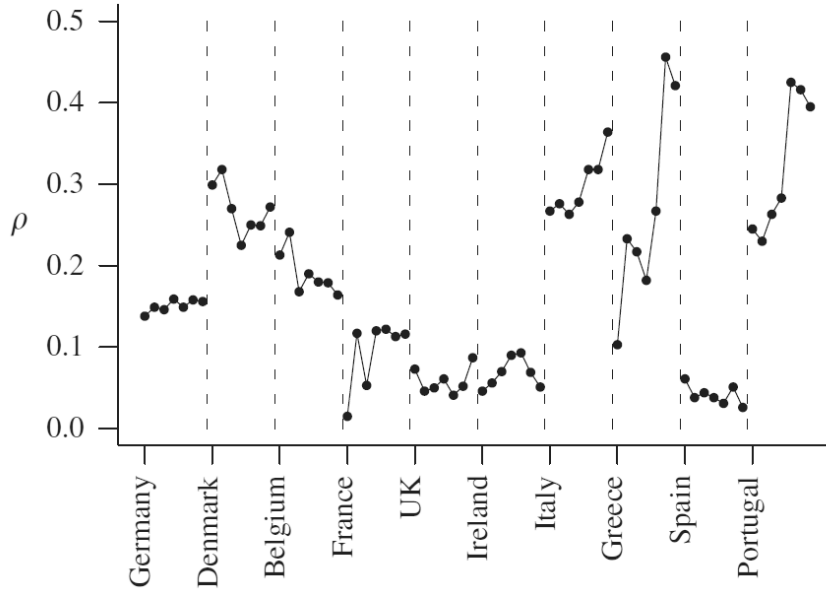


Figure 6. Estimated rigidity parameters, 1995–2001
Source: Behr & Pötter, 2009, p. 181

Babecký *et al.* (2010) analyse real and nominal wage rigidity in 15 EU countries[14]. The analysis was based on data collected through a company survey that was organised in the framework of the Wage Dynamics Network, a research project organised by the European System of Central Banks. The time frame for the survey was the end of 2007 and the beginning of 2008. Downward nominal wage rigidity was defined by the incidence of wage freezes (Babecký, Du Caju, Kosma, Lawless, Messina, & Rõõm, 2010, pp. 889–890).

[14] Austria, Belgium, the Czech Republic, Estonia, France, Greece, Hungary, Ireland, Italy, the Netherlands, Lithuania, Poland, Portugal, Slovenia and Spain.

The results were very interesting. Firstly, Estonia was a country with one of the highest shares of wage freezes that could be a sign of DNWR[15] (Babecký, Du Caju, Kosma, Lawless, Messina, & Rõõm, 2010, p. 892). Secondly, the results show that firms employing larger shares of high-skilled white-collar workers are more likely to be subject to downward wage rigidity, and labour intensive production technologies seem to be more related to DNWR. It also emerged that larger companies have more nominally downwardly rigid wages, and the same applies to the manufacturing sector when compared to services and the construction sector. In terms of the contractual settings, a larger share of permanent contracts has a positive effect on nominal wage rigidity, and so does the tenure of workers. Interestingly, the existence of union contracts does not influence nominal wage rigidity, although it does influence downward real wage rigidity (Babecký, Du Caju, Kosma, Lawless, Messina, & Rõõm, 2010, pp. 903–908).

Dabušinskas & Rõõm (2011) make use of the data gathered during the European System of Central Banks project called the Wage Dynamics Network, and produce a separate report for Estonia, having also at their disposal the results of the last wave of the survey conducted in 2009. They look at the incidence of cuts in base wages during 2009 in order to assess the degree of DNWR and conclude, that the massive incidence of wage cuts during 2009 is an indicator of very low DNWR, in fact the lowest amongst the countries participating in the survey (Dabušinskas & Rõõm, 2011, p. 79). They also try to eliminate the magnitude of the economic crisis by looking only at the companies that suffered a strong or severe fall in demand. The picture remains the same – in Estonia the share of wage cuts was the highest amongst the countries participating in the survey (Dabušinskas & Rõõm, 2011, p. 58).

2.7. Reasons for downward nominal wage rigidity

2.7.1. Results from surveys

In analysing why wages are rigid downwards, surveys are tools that are used quite often. Usually an employer is asked for the reasons for keeping or not keeping wages rigid downwards. In the following section a selection of results from this kind of study is presented:

Blinder & Choi (1990) survey the personnel managers of 19 companies in New Jersey, Pennsylvania. The companies were selected using *Ward's Business Directory of U.S. Firms* and were selected in such a way that the sample would resemble the industrial structure of manufacturing in New Jersey, and also some service companies. Out of 37 companies that were initially contacted 19 were willing to participate (Blinder & Choi, 1990, pp. 1004–1005). The interviews

[15] The authors don't draw a direct conclusion about DNWR form the ranking of countries by wage freezes as the share of wage freezes in the labour market can be affected also by other factors like overall economic situation.

were, despite the fixed list of questions, in free form. In brief the results showed that:

- There is modest support for the implicit contract theory – slightly more than half of personnel managers agreed that it is plausible that workers and firms have an implicit agreement of income stability (Blinder & Choi, 1990, p. 1006).
- There is strong support for Keynes' relative wages theory, however, with answers suggesting that the relative wages are not important because of their purchasing power, but because they are a "sign of status" (Blinder & Choi, 1990, p. 1006).
- Of efficiency wage theories:
    - Adverse selection found almost no support – if a person asked for a higher wage in a job interview, then this was not considered as a sign of higher productivity (Blinder & Choi, 1990, p. 1007).
    - The shirking model found somewhat stronger support – despite the fact that almost none of the personnel managers found the wage to the most important factor influencing work performance, 13 out of 19 respondents agreed that a wage cut reduces effort. The main reason for this was the decline in morale that is caused by a wage cut (Blinder & Choi, 1990, p. 1007).
- The labour turnover model also found strong support – almost all respondents believed that wage reductions would increase resignations, however the size of this effect was considered to depend on the reasons why wages were reduced.
- The issue of "fairness" was considered quite important in assessing the reaction a wage cut would provoke in workers:
    - If a company were to reduce wages because the labour market situation allows it to do that, for example because of rising unemployment, most of the personnel managers suggested that workers would classify this as unfair (Blinder & Choi, 1990, p. 1009).
    - A real wage cut in the form of wages rising less than inflation was considered significantly more 'fair' than an actual reduction of nominal wages. This shows there is evidence of the money illusion (Blinder & Choi, 1990, p. 1009).
    - Concerning the effect of unfair conduct, almost all the personnel managers interviewed agreed that unfair policies would raise personnel turnover, reduce work effort and lower the quality of future job applicants (Blinder & Choi, 1990, p. 1009).

Campbell & Kamlani (1997) survey the compensation executives of 184 companies, most of them on the Business Week 1000 list. In their answers, respondents were asked to distinguish between highly skilled white collar, highly skilled blue collar and less skilled workers. The sample also allowed for distinction between company sizes, broad economic sectors and unionisation. Respondents were shown several statements that were based on the theories explaining wage rigidity, and were asked how important each statement is in influencing the decision to cut wages during a recession to the lowest level that still allows the hiring of a sufficient number of workers (Campbell & Kamlani, 1997, p. 765).

The results showed, that:

- The strongest support was given to the statement "If your firm were to cut wages, your most productive workers might leave, whereas if you lay off workers, you can lay off the least productive workers" indicating the relevance of adverse selection models when applied to resignations (Campbell & Kamlani, 1997, p. 765). In this respect the results differed from Blinder & Choi (1990) who could not find support for the adverse selection hypothesis. However, they tested adverse selection as being applied to hires while Campbell & Kamlani (1997) used it as applied to resignations.
- For white collar workers, firms seem to keep wages rigid because they are afraid that doing otherwise would increase the number of quits. This is important both because firms are concerned with the explicit costs associated with hiring and training new recruits and also with the loss to the firm of specific human capital (Campbell & Kamlani, 1997, p. 770).
- For white collar workers, respondents also supported the statement that wage cuts would decrease work effort (Campbell & Kamlani, 1997, p. 771).
- For less skilled and blue collar workers, strong support was given to the implicit contract theory and also to the decreased work effort as a result of a wage cut.
- Hiring and training costs associated with new recruits because of increased resignations also seem to be fairly important, though to a lesser extent than for white collar workers (Campbell & Kamlani, 1997, p. 771).
- Concerning different firm sizes, for large corporations the effect of potential loss of reputation resulting from wage cuts played a significantly more important role than it did for smaller firms. For smaller companies the loss of company-specific human capital was more important (Campbell & Kamlani, 1997, p. 772).

The other theories found less support. Thus it seems that the effect of wages on resignations explains better the rigidity for white collar workers while for blue collar workers the theories stressing the effort-lessening effect of wage cuts find more support.

Bewley (1998) interviewed nearly 300 businessman, business consultants, union leaders, and counsellors of unemployed people. The interviews were carried out in the north-eastern part of the USA during the recession in the beginning of the 1990s. He tried to find an answer to the question of why wages, even during a recession, decline only in a very few companies. He finds strong support for the morale theory. He did not find any confirmation for the idea that the unemployed cannot find work because their reservation wage is too high. Bewley concludes that his findings support only those theories that emphasise the role of morale (Bewley, 1998, p. 459).

Agell & Lundborg (2003) conduct a survey in 157 Swedish firms in 1998. They conclude that there are very few wage cuts and even the low-inflation environment has not changed the workers' resistance towards wage cuts. Their results do provide some support for efficiency wage theories as unemployment seems to increase the work effort (Agell & Lundborg, 2003, p. 28).

Franz & Pfeiffer (2006) surveyed 5157 German companies in the first half of 2000. These companies were selected randomly from 160,000. They got 801 responses. The approach they use is similar to that of Campbell & Kamlani (1997) and puts strong emphasis on investigating the reasons for rigidity between workers in different skill groups. Altogether nine different statements capturing several theoretical explanations of wage rigidity were presented to the heads of human resource development departments. The impact of firm and person-specific characteristics on the answers was analysed with ordered probit regressions models (Franz & Pfeiffer, 2006, pp. 259–260). Their results show that (Franz & Pfeiffer, 2006, p. 280):

- Union contracts – German companies agreed that wage rigidity is fostered by union contracts, especially for the less skilled;
- Specific human capital – with highly skilled workers the probability of losing specific human capital due to a wage reduction is a factor explaining DNWR;
- Negative signals to the community and the potential impact on new hires are considered to be important;
- The implicit contract theory is found to be a probable explanation for DNWR for less skilled workers;
- The negative influence on work and higher turnover costs are relevant factors causing DNRW for all skill groups.

Franz & Pfeiffer (2006) also look at the interaction of different cases of wage rigidity and conclude that implicit contracts and union contracts as explanations for wage rigidity are positively correlated, suggesting that union contracts reflect workers' desire for stable wages. Different types of efficiency wage theories are also quite strongly correlated, indicating that the additional contribution from efficiency wage theory as an explanation of DNWR is small. It also seems that labour union contracts cannot be considered as a substitute in explaining efficiency wage contracts or vice versa (Franz & Pfeiffer, 2006, p. 280).

Agell & Bennmarker (2007) look at public administration, unskilled services, manufacturing and skilled services in the Swedish economy. The survey was conducted in March 1999. They obtain 885 results with response rates varying from 46% (small unskilled services) to 94.8% (large public administration units) (Agell & Bennmarker, 2007, pp. 350–351). Agell & Bennmarker look at both real and nominal wage rigidity, although they admit that in a low inflation environment it is difficult to differentiate between the mechanisms creating nominal and real rigidities. The effect of background characteristics (firm size, unions, economic sector) is estimated with logit models.

Their results for nominal wage rigidity show that:

- There is evidence of the money illusion, derived from the well-known comparison of scenarios yielding similar real but different nominal outcomes, proposed by Kahneman *et al.* (1986). (Agell & Bennmarker, 2007, p. 362).
- There is support for Keynes' relative wages theory – employers believe that workers do care about how their wage relates to both external and internal wages. This is even more relevant in unionised and large corporations (Agell & Bennmarker, 2007, p. 362).

Concerning the models explaining real wage rigidity:

- Firms' willingness to hire unemployed people offering to work for a lower salary – there are not many companies that have actually encountered job seekers willing to work for less than is the usual norm in the company, but 89.6% of managers who had ever encountered such offers said that they always reject them (Agell & Bennmarker, 2007, p. 354).
- Efficiency wages – a majority of the managers believed that if the wages of other comparable companies increased while wages stayed the same in their own company, this would affect the work effort of workers, thus making shirking less costly in companies where wages are lower. This was especially the case for large companies where managers are less capable of assessing work effort than in smaller companies (Agell & Bennmarker, 2007, p. 355).
- They also confirmed the reciprocity argument of gift exchange models – in larger companies especially, the managers believed that if workers are not satisfied with their pay, they will reduce work effort (Agell & Bennmarker, 2007, p. 356).
- Turnover and unemployment benefits – managers also believed that dissatisfaction with pay would increase the turnover of workers and induce additional costs. At the lower end of the labour market, they also believed that higher unemployment benefits would reduce the effort of workers with low qualifications, such as those with only elementary education (Agell & Bennmarker, 2007, pp. 358–359).

- Bargaining power – many managers indicated that wage claims are related to the economic success of the company (Agell & Bennmarker, 2007, p. 360).

To summarise, Agell & Bennmarker find evidence of wage rigidity and confirm most of the hypotheses for the causes of wage rigidity proposed in the literature.

The reasons for wage rigidity have also been investigated for Estonia. Dabušinskas & Rõõm (2011) use the data gathered during the European System of Central Banks project called the Wage Dynamics Network, and produce a separate report for Estonia. They looked at the rigidity of wages of the newly hired; in this context, wage rigidity is the tendency of the wages of the newly employed not to deviate from those of workers who have already worked in the company for a longer time (Dabušinskas & Rõõm, 2011, p. 62). When the company managers were asked why they do not offer different wages to the newly hired, the most prominent reason was their concern about workers reducing their effort as a result of that kind of wage policy. When compared with other countries, the concerns about workers effort are considerably higher in Estonia (Dabušinskas & Rõõm, 2011, p. 68).

2.7.2. Impact of institutional characteristics and external factors

Several authors have tried to estimate the impact of different institutional characteristics on downward nominal wage rigidity.

Dessy (2005) analyses ECHP data from 1994–2001. She is interested in the impact of the following factors on the frequency of wage cuts and wage freezes (Dessy, 2005, p. 22):

- Employment protection legislation;
- Degree of centralisation (economy wide, sector or firm level) of collective bargaining;
- Collective bargaining coverage;
- Degree of coordination/cooperation of bargaining partners.

The results showed that an increase or decrease of one standard deviation from the average value of the employment protection legislation index leads to a 20 to 30-percent reduction in expected wage cut frequencies. So deviation from the average EPL index does increase wage rigidity. Second, the impact of centralisation on wage flexibility was not confirmed. Third, a one-standard-deviation increase from the average union coverage reduces expected cut frequencies by 10 points while bringing an increase of more than 30 points when it decreases by one standard deviation. Fourth, there is a hump-shaped relationship between the indicator of coordination and wage flexibility, but with the increasing portion of the curve predominating over the decreasing – an increase of one standard deviation leads to a rise of only two percent in expected cut frequencies, but on the other hand a decrease of one standard deviation implies

a reduction in the expected wage cut frequency of around 12 points (Dessy, 2005, pp. 32–34).

Dickens *et al.* (2007) analyse 31 different datasets from 12 countries[16]. The main data sources are employment registers, and household and employer surveys. They analyse the impact of a myriad of institutional variables on DNWR. However, only union density has a robust positive connection with downward nominal wage rigidity (Dickens, et al., 2007, pp. 210–213).

Holden & Wulfsberg (2008) use industry-level data of 19 OECD countries in the period 1973–1999. They find that higher union density induces stronger downward nominal wage rigidity. The same effect has stricter employment protection legislation. Nominal wage rigidity is negatively influenced by unemployment (Holden & Wulfsberg, 2008, pp. 30-32).

Babecký *et al.* (2010) analyse real and nominal wage rigidity in 15 EU countries[17]. The analysis is based on data collected through a company survey in the end of 2007 and in the beginning of 2008, and downward nominal wage rigidity was defined by the incidence of wage freezes (Babecký, Du Caju, Kosma, Lawless, Messina, & Rõõm, 2010, pp. 889–890). Labour market institutions also have an important effect on wage rigidity. Stricter employment protection legislation is associated with higher nominal wage rigidity while collective bargaining coverage is not (Babecký, Du Caju, Kosma, Lawless, Messina, & Rõõm, 2010, pp. 908–910).

2.8. Summary

The general conclusion is that wages are at least to some extent rigid. This result is quite robust to the methodology used for assessing DNWR. However, there are significant variations in the degree of DNWR for different worker groups. From quantitative estimation techniques using the properties of wage distributions (skewness-location, histogram-location and symmetry approach) there is stronger evidence of DNWR for blue collar workers than for white collar workers. From different compensation types the base pay is usually considered to be more rigid than benefits and the total payroll. Concerning salary earners and hourly wage earners the results seem to be mixed, with some studies showing no DNWR for salary earners (e.g. Kahn (1997)) and others indicating that the wages of salaried employees are more rigid than the wages of waged workers (e.g. Beissinger & Knoppik (2001)). There are also indications suggesting that the wages in smaller companies are less rigid than those in larger companies.

Nevertheless, it must be noted that with the exception of skill type and pay type, more comprehensive quantitative estimation techniques such as a histo-

[16] Austria, Belgium, Denmark, Finland, France, Germany, Italy, Norway, Portugal, Sweden, Switzerland, and the United Kingdom.

[17] Austria, Belgium, the Czech Republic, Estonia, France, Greece, Hungary, Ireland, Italy, the Netherlands, Lithuania, Poland, Portugal, Slovenia and Spain.

gram location approach have not been used in analysing DNWR amongst different worker groups.

The application of quantitative estimation methods (histogram location approach) also shows that there are significant differences between countries. For example Knoppik & Beissinger (2009) show that while the average rigidity coefficient for the EU is 36%, the country with the highest rigidity coefficient (Italy) has almost twice as high a rigidity coefficient (66%), while in Spain the size of the coefficient was only 7%.

Papers that lean mainly on the results of interviews have usually been designed to test different theories of wage rigidity. Of the long list of theories presented in the first part of this thesis, most seem to have found at least some sort of support. The following theories seem to have found slightly more support than others:

- Efficiency wage theories – probably the strongest support was given to labour turnover model (high skilled) and to the shirking model (less skilled) and theories suggesting some sort of morale component in the decision making of wage setting and effort provided by workers;
- Implicit contract theory – especially for less skilled workers.

In addition, the macro level analysis has confirmed that employment protection legislation and union coverage have a positive influence on DNWR.

For Estonia the DNWR estimates obtained so far are mixed. The results relying solely on the incidence of wage freezes indicate that DNWR is amongst the highest in Europe. If the incidence of wage cuts is examined during the recent economic crisis, a completely different picture emerges, indicating that DNWR is amongst the very lowest in Europe. The main reason for Estonian employers not to cut wages is that they are afraid that the worker will respond with lower productivity.

2.9. Research hypotheses of this thesis

After study of the theoretical framework and of the empirical findings from the earlier research, the main hypotheses of this thesis are as follows:

- wages in the Estonian labour market are more flexible than in Western Europe – this hypothesis is mainly related to the findings that strong employment protection legislation (e.g. Babecký *et al.* (2010)) and trade union coverage (e.g. Holden & Wulfsberg (2008)) can induce higher DNWR. As is seen later (see sub-chapter 4.1.1) the effective enforcement of employment protection legislation and trade union coverage are low in Estonia;
- there are differences in DNWR between industries – the hypothesis is raised from earlier empirical findings (e.g. Babecký *et al.* (2010)) showing that there are differences in DNWR between manufacturing and the services sector;

- wages in large companies are nominally more downwardly rigid than those in smaller companies – the hypothesis is again raised from the previous empirical findings (e.g. Babecký *et al.* (2010)) that show that larger companies have higher DNWR than smaller companies;
- younger workers have less DNWR than workers in their prime age – this hypothesis is mainly reached from the observation of younger people having higher unemployment rates and lower average wages, which could be an indication of lower bargaining power and thus lower DNWR;
- women have less DNWR than men – this hypothesis is related both to bargaining power and bargaining behaviour differences by gender in general. As there is a substantial gender wage gap, it should be expected that women's bargaining power is lower than that of men. In addition to this, several studies have shown that women are more risk averse than men, which should also influence bargaining behaviour and contribute to a lowering of DNWR (e.g. Croson & Gneezy (2009), Holt & Laury (2002));
- the wages of low wage earners show more DNWR than the wages of higher wage earners – this hypothesis is mainly linked to the theoretical proposition that labour market regulations could be one reason for DNWR. In this specific case, the institution of the minimum wage is considered to increase DNWR;
- DNWR changes over the business cycle and a severe economic crisis reduces DNWR – theoretical explanations of DNWR such as morale theory stress the concept of fairness as one important factor influencing wage setting processes. It is reasonable to believe that incidents like severe economic crises can temporarily alter the understanding of which wage setting practices are considered fair and which are not. Thus it would be interesting to test whether crises lead to a change in DNWR.

3. DATA

3.1. Data source and data availability

This thesis is mainly based on data from the Estonian Tax and Customs Board (ETCB). All companies registered in Estonia are required to file monthly declarations of income tax, social tax, compulsory funded pensions and unemployment insurance premiums to the Estonian Tax and Customs Board[18]. This declaration includes, among other things, the amount of social tax that will be paid for each person who receives remuneration for work done for the company. The design of the database allows all combinations of employer-employee relations to be seen on a monthly basis. Given that the social tax rate is 33% of the payroll, it is in general quite straightforward to calculate the wages and wage changes of all workers for whom the companies have paid legal taxes, by calculating annual averages of year-on-year monthly remuneration changes.

The dataset covers 2001–2009 and includes companies that are either registered in the Estonian Commercial Register or are listed as subsidiaries of foreign companies at the Estonian Tax and Customs Board. This excludes government institutions and non-profit sector organisations, which are listed in other registers. While most of the government sector is missing from the dataset as they are listed in other registers than the Commercial Register, some institutions that are implementing government policy are registered in the Commercial Register and are thus also present in this dataset. In order to keep the focus on the private sector, observations from the sectors of health and social work, education and public administration are not included in the analysis.

As the database seems not to include the whole population of private sector enterprises, it is important to describe it more specifically and present reference material in order to assess the actual coverage.

The dataset includes the following information:

- Economic sector of employer (EMTAK 2003[19] and EMTAK 2008[20]);
- Name of the register in which the company is registered in Estonia;
- Monthly number of workers for whom the employer has paid social security tax;
- Social security tax paid for each specific individual by each specific company on a monthly basis;
- Worker's gender;
- Worker's year of birth;

[18] *Tulu- ja sotsiaalmaksu, kohustusliku kogumispensioni makse ja töötuskindlustusmakse deklaratsioon.*

[19] The first four levels of EMTAK correspond to the NACE rev 1.1 classification for the years 2001–2007.

[20] The first four levels of EMTAK correspond to the NACE rev 2 classification for the years 2008–2009.

- Number of months in a year when the person has worked in the specific company with the company as the main employer.

The dataset allows employers to be linked with workers over the period 2001–2008 and separately for 2008–2009.

3.2. Descriptive characteristics of the dataset

As already mentioned, the dataset covers the years 2001–2009, which means that remuneration changes can be calculated for the years 2002–2009.

Before presenting the comparison between the ETCB dataset and the figures regularly published by Statistics Estonia, some clarifications are in order concerning who is a worker in the ETCB dataset. In the following tables everybody who received some kind of payment that was declared to the ETCB as a payment taxable with social security tax during at least one month in a year is considered to be a worker.

Table 7. Number of observations in the dataset

	Number of employee observations	
Year	**Dataset**	**ELFS[21]**
2001	448 218	382 391
2002	453 724	386 880
2003	465 461	386 225
2004	484 333	385 676
2005	508 137	403 733
2006	538 540	428 501
2007	558 426	434 591
2008	547 385	449 917
2009	458 805	394 597
TOTAL	4 463 029	

Source: Estonian Tax and Customs Board, Estonian Labour Force Survey, author's calculations

Table 7 presents the total numbers of observations. It appears that 2009 has slightly fewer observations than previous years. In one way this is in line with the onset of the economic crisis, but at the same time there seem to be some other forces working behind these figures. During the years of intensive economic and employment growth, the number of observations in the ETCB dataset in relation to Estonian Labour Force Survey (ELFS) increases. During

[21] Estonian Labour Force Survey, public administration, defence, compulsory social security, education, health and social work are excluded.

the years of lower employment growth (after the crisis of 2000 and in 2009) the ratio is lower. The drop in worker numbers also suggests that the principles of the last extract of data from the ETCB could have been slightly different from those used in previous years.

It is important to keep in mind that the figures listed here are not directly comparable with the statistics published by Statistics Estonia from company surveys or the Labour Force Survey, as Statistics Estonia collects their data through surveys, and applies certain methodical procedures in order to get an accurate picture of Estonian companies and the work force, while the current thesis uses raw registry data that have not been cleaned or modified for analytical purposes. Furthermore, the ETCB data are based on legally sound employment relationships, while the Labour Force Survey should also capture work in the black market. On other hand, the ETCB data pick up people even if they are employed for only a single day in a year, while the ELFS classifies people as employed if they themselves say that this is the case. It can be assumed that a person who has worked only very briefly would not classify him or herself as employed in the ELFS, so the employment figures in the ELFS should be lower than in the ETCB. This is probably the reason why the number of workers in ETCB exceeds the figures from ELFS.

From the preceding discussion it is not possible to be sure whether the ETCB really does cover the entire population. However, it is reasonable to assume that the coverage is very high.

Table 37 – Table **42** present worker observations by different characteristics. Considered by company size, the share of workers employed at micro and small enterprises (less than 50 workers) is slightly smaller in the ETCB database than in data from the ELFS. The main reason for this discrepancy is probably the method used for gathering the ELFS data. In the ELFS, the worker is asked either the size of the company (the number of workers) or of the establishment. It is conceivable that the worker is better informed of the size of the local establishment of the company than of the overall number of employees in the company as a whole. However, the number of workers from the ETCB dataset is the total number of workers in the company. The more remarkable differences by economic sector are the larger share of wholesale and retail workers and the lower share of manufacturing workers in the ETCB dataset. The share of workers in the real estate sector is also somewhat higher than in the ELFS data. However, it is difficult to find a systematic reason behind these differences.

Comparison by age group shows that the ETCB data include more observations from younger cohorts than from the middle one. The most plausible explanation is that as the data of Statistics Estonia are collected through the Estonian Labour Force Survey, younger cohorts are harder to find and are thus underrepresented.

Finally, in the ETCB data the share of women is slightly higher (especially in the first half of the decade) than in the ELFS.

3.3. Strengths and shortcomings of the dataset

Registry data can be considered superior to survey data mainly because of the lower level of reporting errors. Data filed with the Tax and Customs Board is a direct basis for later tax liabilities, which can be considered a strong incentive for accurate reporting. Beissinger & Knoppik (2001) refer to this kind of advantage while describing the *IAB-Beschäftigtenstichprobe* – a 1% random sample of German social security accounts. Similar references can be found in other studies using registry data (e.g. Castellanos *et al.* (2004)). Another, not less relevant, advantage of registry data is the size of the population of private enterprises.

Despite its advantages, the dataset also has some shortcomings. First, the data used in this analysis do not include any information on hours worked, meaning that changes in remuneration can also be a result of changes in working time.

Second, there are no data on the type of the employment contract. It could be argued that the nature of the contract, whether permanent or temporary for example, also reflects people's bargaining power on the labour market.

Third, in Estonia there is a minimum base for the social tax, which will be used as the basis for calculating the social tax liability if the remuneration falls below the minimum level. The levels of the minimum social tax base are listed in Table 8. If a person's monthly income falls below the minimum level, it is impossible to determine the actual level of remuneration on the basis of social tax payments, because social tax would be paid at the minimum level.

There is also the question of payments related to the termination of the employment contract. Following redundancy, the person laid off is entitled to severance payments and possibly to other additional payments such as compensation for postponed vacation related to the termination of contract. In a yearly comparison, this can distort the data on wage changes.

Discontinuities in the social tax payment data can also result if a person goes on a vacation that lasts for a whole month. The vacation payment must be paid out at the beginning of the vacation, which means that the month preceding the vacation will show an abnormally high level of remuneration, followed by a month where remuneration is missing.

Table 8. Minimum wage and calculation base for the minimum level of social tax applied to monthly wages in Estonia

Year	Minimum wage		Minimum social tax base	
	EEK	% of average wage	EEK	% of average wage
2001	1600	29%	700	13%
2002	1850	29%	700	11%
2003	2160	30%	700	10%
2004	2480	32%	700	10%
2005	2690	34%	700	9%
2006	3000	33%	1400	15%
2007	3600	32%	2000	18%
2008	4350	32%	2700	21%
2009	4350	35%	4350	35%

Source: Statistics Estonia, Estonian State Budget Acts 2001–2009, author's calculations

There are also no data on occupation, which means that changes in remuneration can be the result of promotions inside the company.

The dataset contains only a few variables describing the personal characteristics (age and gender) of the employee, which limits the econometric approaches that can be used for analysing data.

3.4. Amendments to the dataset

Fortunately, there are ways to correct most of these problems. The most important shortcoming that has to be addressed is the issue of severance pay. The accidental inclusion of severance payments could lead to most contract terminations being preceded by a year-on-year wage increase, as the total amount of severance pay is up to four months salary, which will certainly have an effect on someone's yearly wage income. In order to correct for this, all cases are excluded where a month with remuneration exceeding the preceding three months' average by at least 50% is followed by at least two months of missing remuneration data.

To neutralise the effect of vacations, months are excluded in which remuneration exceed the average of the previous three months by at least 50% and which are followed by one month of missing data.

The total pay figures that fall below the minimum social tax level are a puzzle, because there are certain groups on the labour market, such as those with two jobs, who are exempt from this requirement and for whom the figures represent their actual salary. It was decided not to exclude these figures. The result could be an overestimation of wage freezes in years where the minimum base of social tax did not change (years 2001–2005).

As for the absence of data on hours worked, there is also no way to correct for this. However, this is not necessarily a major shortcoming because it may be argued that the employer is mostly concerned with reducing labour costs in response to decreasing demand without having to lay people off and bear the cost of the notice period and severance payments. This is equally well achieved through reducing hours worked or hourly wages. It is, though, important to keep in mind that this dataset can only be used for analysing the downward nominal rigidity of changes in monthly / yearly payments to workers while it is not applicable for analysing the downward nominal rigidity of wage rate changes.

The lack of data on hours worked leads to another kind of problem. Even if the analysis is concentrated on total pay, an interesting type of measurement error emerges – the fluctuations in total pay for work can be the result of changes in working time that were induced not by the employer but by the activities of the employee. Some of these fluctuations are addressed by the filter mechanism proposed in the beginning of this sub-chapter, for example the fluctuation in pay resulting from the employee being on vacation for more than one month. However, there can be also other reasons for these fluctuations such as a short illness of a worker or his or her child that will not be picked up by these filters. Unfortunately, there is no credible mechanism for solving this problem. We could use techniques that correct for measurement errors (e.g. Gottschalk (2005)), however the end result would not be more satisfactory as the error correction mechanism would also eliminate some of the variability that comes from true downward nominal wage flexibility.

The lacking of data on occupations is also a problem that cannot be corrected. There is always the possibility that a change in a person's wage could be a result of either promotion or demotion.

The low number of personal characteristics clearly limits the usage of methods that require substantially richer information on workers socio-demographic characteristics when applied for analysing DNWR (e.g. Altonji & Devereux (2000)). Fortunately, as already described, there are several methods that can very well be applied to the data described above.

Last but not least, there are some technicalities that must be taken into account. There are some negative social tax amounts that are most probably the result of corrections, and for some people the total amount of social tax paid during the whole year was zero. While negative social tax payments have economic meaning they clearly distort social tax growth figures, sometimes showing up as wage cuts that are larger than 100%. The zero social tax figures are also problematic, though the number of both negative and zero yearly social tax observations is not large at around 0.2% of observations for 2001–2008. These observations will be excluded.

3.5. Calculation of wage growth figures

This thesis concentrates on ongoing work relationships. To this end each employer-worker relationship is assigned its own identifier. Next, potential anomalies are eliminated by using the procedures listed in the previous chapter. Then, for each employer-worker relationship monthly year-on-year wage growth figures are calculated. Finally, the average wage growth for each year is found as the weighted average of monthly wage growth rates. The monthly wage, with a lag of 12 months, for a given employer-worker relationship is used as the weight.

To summarise, the end result is yearly total pay growth for an ongoing employer-worker relationship that is purified of potential anomalies to the extent that is possible with the procedures described in the sub-chapter 3.4.

4. DOWNWARD NOMINAL WAGE RIGIDITY IN ESTONIA – AGGREGATE LEVEL

4.1. Institutional framework and wage setting systems influencing downward nominal wage rigidity in Estonia

4.1.1. Legislative framework and collective bargaining

Downward nominal wage rigidity can be affected by institutional context. In this short overview the focus is on the four main components that affect rigidity – employment protection, regulation of overtime work, unemployment insurance, and collective bargaining.

Employment protection legislation influences the costs associated with renegotiating wages. If there is a need to cut wage costs and the employee does not agree to a wage cut, then the only alternative to carrying on with the same wage is to lay the worker off and hire a new one with a lower wage. However, high severance costs can make this alternative quite unattractive. Strict EPL should thus increase DNWR. During the period 2002–2008, employment protection legislation in Estonia was quite strict. Eamets and Masso (2005) have estimated the EPL index, which measures the strictness of employment protection legislation in Estonia at 2.6, which is close to the EU average (Eamets & Masso, 2005, p. 75). To illustrate the strictness of the regulation, the severance pay for dismissals ranged from 2 to 4 months of pay, depending on tenure, and the notice period was from 2 to 4 months. Collective dismissals were subject to approval by the Labour Inspectorate and the Public Employment Service could request that they be postponed by up to one month. The average strictness of EPL in Europe can be considered quite rigid. However, the researchers also claimed that the enforcement of the legislation was not strict and actual flexibility in the labour market may have been underestimated by the EPL index (Eamets & Masso, 2005, p. 75).

Regulations regarding overtime work may also affect DNWR, by influencing the ability of firms to increase or reduce hours worked flexibly without incurring labour turnover costs. In Estonia, it is allowed to work overtime for up to 4 hours per day but not exceeding a total of 8 hours per week. Overtime must be compensated either with time off or with money, in the latter case at a rate not less than 1.5 times the hourly pay in regular hours (Working and Rest Time Act)[22]. The share of workers working overtime has ranged from 1% in 2005 to 5.5% in 2006[23].

Unemployment insurance may contribute to DNWR by reducing the cost of being unemployed. Estonian unemployment insurance benefits are available for those unemployed who were employed for at least 12 months during the 36 months prior to becoming unemployed. The period that unemployment benefit

[22] The Working and Rest Time Act (*Töö- ja puhkeaja seadus*) was abolished in the second half of 2009 with the Employment Contract Act.

[23] Source: Statistics Estonia.

can be received depends on insurance seniority and ranges from 180 to 360 days. Unemployment benefits in the first 100 days are worth 50% of the average monthly wage in the nine months prior to registration as unemployed, and 40% from the 101st to the 360th day. Those who have left employment voluntarily do not qualify for the benefit (Unemployment Insurance Act[24]).

Collective bargaining can be an important determinant of wage rigidity, as it increases workers' bargaining power compared to individual wage bargaining. In Estonia, 25% of all employees were covered by a collective agreement (EIRO, 2009). A great majority of these are company-level agreements, as sector-level collective agreements exist only in health care (5.5%), education (9.2%) and passenger transportation, which accounts for 2% of total employment. Union density is very low and has been decreasing. In 2008, only 6.2% of employees were union members, down from 12% in 2002[25].

To summarise, the legislative framework and the situation in collective labour relations do send mixed signals. On the one hand EPL legislation is more or less as strict as in the average EU country, but on the other hand its enforcement has not been very strict. Collective bargaining coverage and union participation are also relatively low. Thus, this could be expected to reduce the DNWR compared to the EU average.

4.1.2. Wage setting systems

The European System of Central Banks initiated a project in 2006 called the Wage Dynamics Network (WDN), which, among other things, aimed to identify the sources and features of wage and labour cost dynamics that are most relevant for monetary policy. As a part of this project a firm-level survey that also included valuable information on wage setting systems was conducted in most of the participating countries (Dabušinskas & Rõõm, 2011, p. 4). This section relies on Dabušinskas & Rõõm (2011), who have made an excellent summary of the results for Estonia.

In wage setting systems, there are three main indicators that can be monitored using the data collected during the project – the share of companies using performance related components (bonuses), the share of bonuses in total pay and the use of different base pay methods.

Concerning the use of performance related pay it seems that it is in general a widespread practice to pay bonuses. In the European Union, less than 70% of companies use performance related pay on average. In Estonia this percentage is much higher, reaching up to 80% (Dabušinskas & Rõõm, 2011, p. 18).

[24] *Töötuskindlustuse seadus*.
[25] Source: Statistics Estonia.

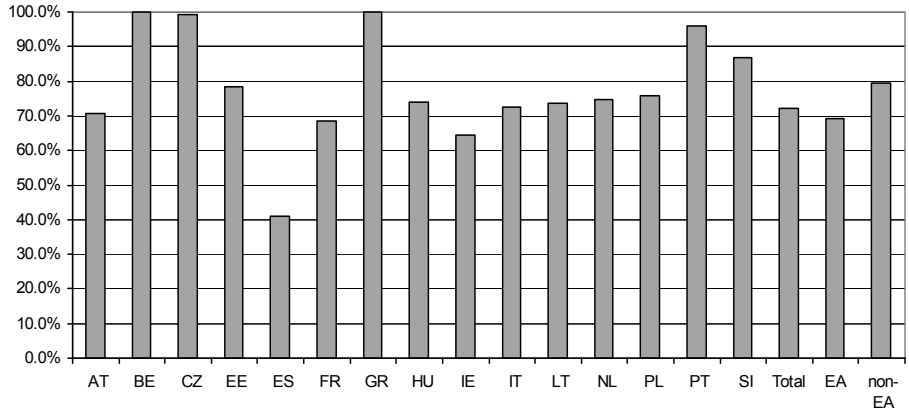


Figure 7. Share of firms paying bonuses, percent
Source: Dabušinskas & Rõõm, 2011, p. 18

The share of bonuses in total pay is not very large. In the European Union, the average share of bonuses in total pay is slightly lower than 10%. The Estonian figure is again higher, reaching 14% (Dabušinskas & Rõõm, 2011, p. 18). From these two figures we could say that in most companies there is a way of adjusting wages without the need to renegotiate the employment contract. Even if 14% is not a very large figure it should still allow for quite considerable flexibility in total pay without the contract being renegotiated.

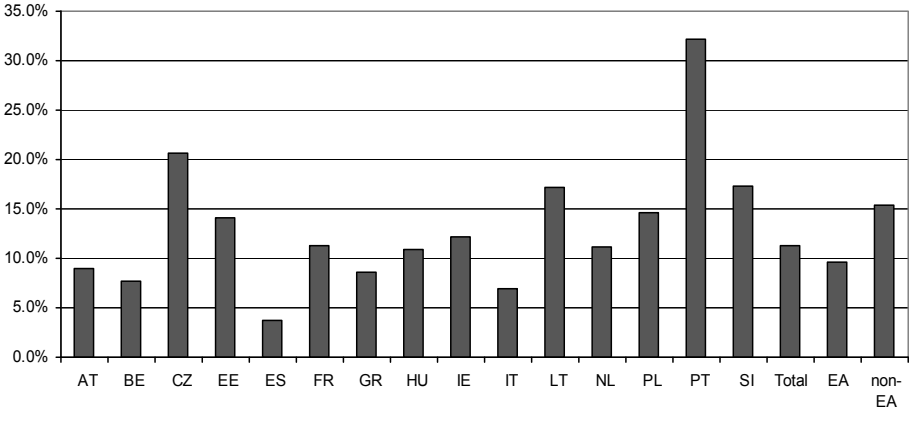


Figure 8. Share of bonuses in total pay, percent
Source: Dabušinskas & Rõõm, 2011, p. 18

Among different base pay mechanisms, the monthly base wage is probably the most rigid form of base pay from the total pay point of view. This is also the

most widespread form of base pay in the European Union where on average roughly 65% of companies use the monthly base wage. In Estonia the share of the monthly base wage is significantly lower at around 40%, hinting again that wages may be slightly more flexible than in the European Union on average (see Figure 9).

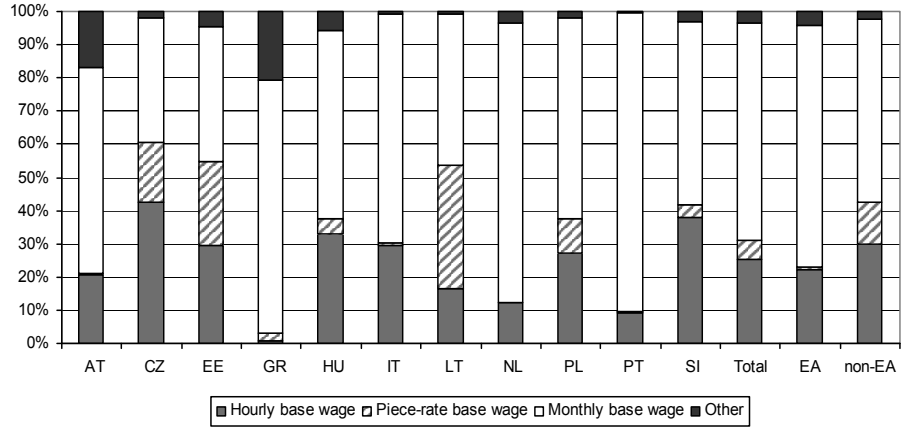


Figure 9. Remuneration methods
Source: Dabušinskas & Rõõm, 2011, p. 18

4.2. Descriptive evidence from wage change distributions

The usual practice when conducting an empirical analysis of downward nominal wage rigidity is to start with a visual examination of wage change distributions in order to get confirmation for:

a) Thinning of the left side of the distribution;
b) A spike at the interval point of zero wage changes;
c) A lack of observations in the immediate neighbourhood of the point of zero wage change location, if the aim is to identify menu costs.

In the following figures wage change distributions are depicted. Figure 10 and Figure 11 present wage change histograms calculated from social tax declared to the Estonian Tax and Customs Board for 2002–2009. Wage change figures are calculated using the method described in the sub-chapter 3.5. The bin step is one percentage point. Solid, dashed and tight-dotted vertical lines denote respectively median wage growth, minimum wage growth and growth of the minimum social tax base.

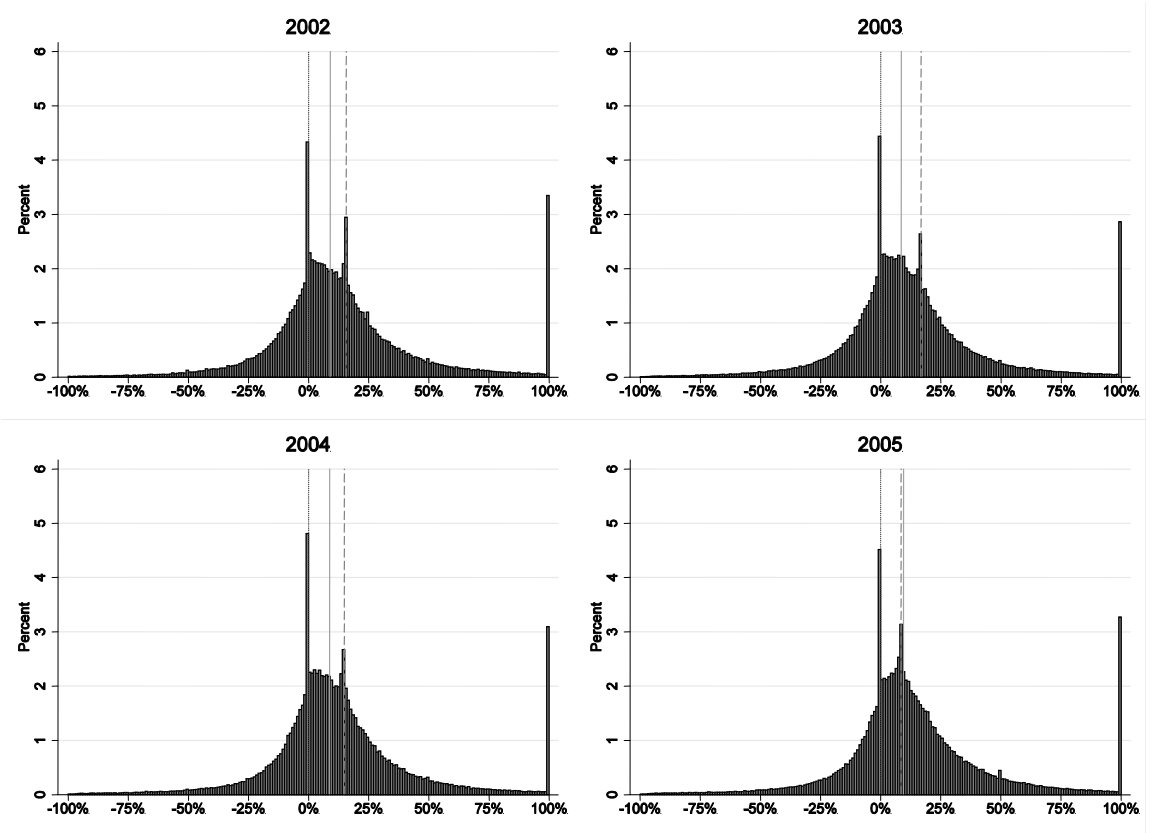


Figure 10. Wage change distributions 2002–2005
Source: Estonian Tax and Customs Board, author's calculations

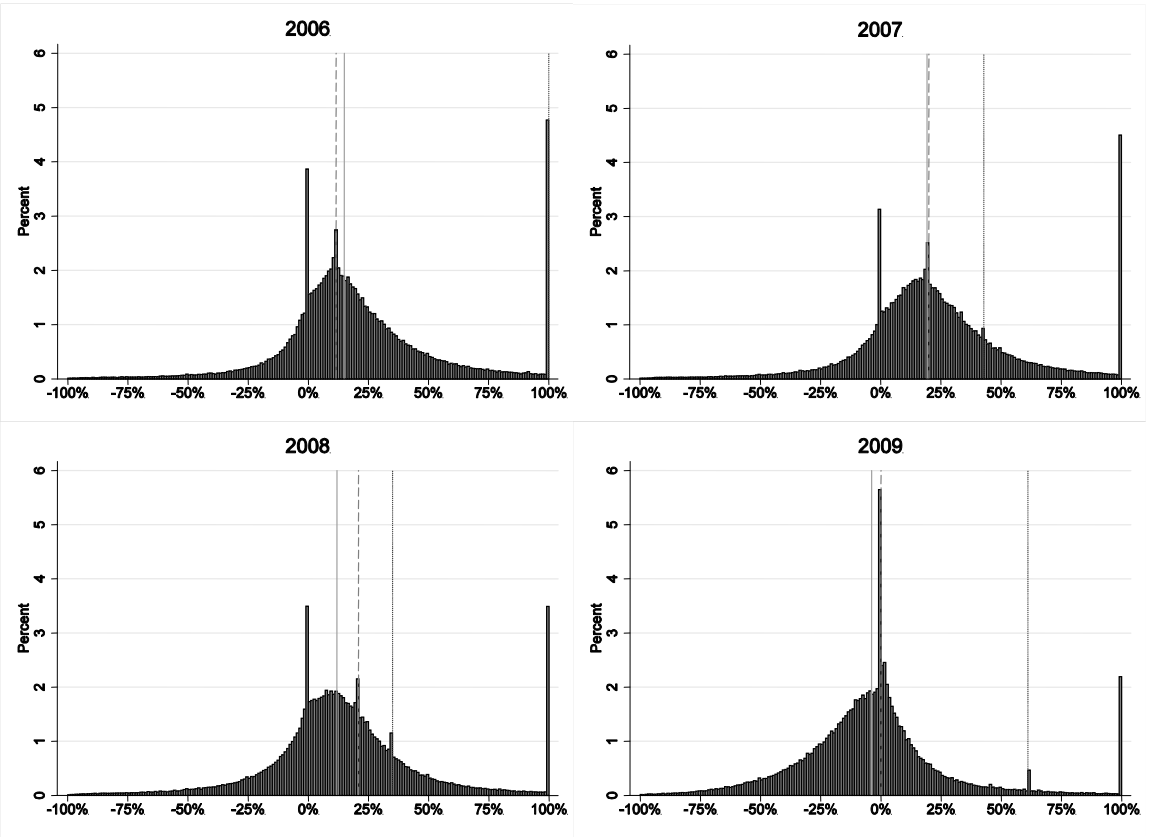


Figure 11. Wage change distributions 2006–2009
Source: Estonian Tax and Customs Board, author's calculations

At first glance it is clear that there is a spike at the histogram bar that includes zero wage change. The size of the spike varies between 3.5% and 5.7%. However, this is not the only spike that emerges from the figure. Two other spikes are at wage change locations that correspond to yearly growth of minimum wage and the minimum social tax base. These three different spikes are most evident for 2008. In 2008, the minimum wage rose by 20.8%, while the minimum social tax base rose by 35%. Figure 12 provides growth rates for the minimum wage and minimum social tax base for the whole period. As can be seen, these are in line with the alignment of spikes in other years as well.

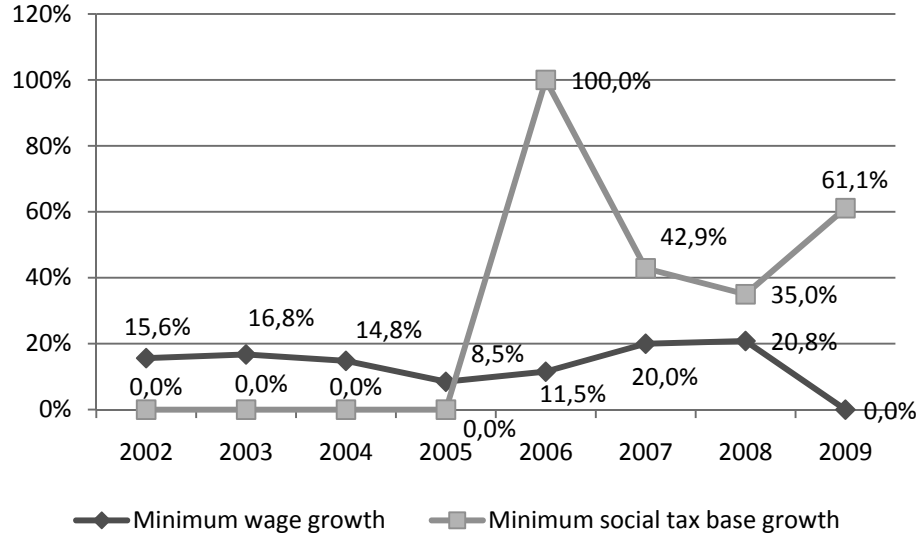


Figure 12. Minimum wage and minimum social tax base growth 2002–2009
Source: Estonian legal acts, author's calculations

The spike at the location of zero wage change could be an indicator of wage rigidity. We can also note that the left side of the distribution is slightly thinner than the right side, with the exception of 2009. Thus in total the visual inspection does seem to suggest downward nominal wage rigidity.

The panel depicting wage changes in 2009 deserves closer attention. With wage change distributions, skewness to the right is usually expected. However, in 2009 the distribution is skewed to the left. The main candidate for the cause of this anomaly is the economic crisis that caused a drop of around 15% in real GDP within three consecutive quarters (Figure 13). It would be natural to assume that as a result of this, workers compensations dropped as well.

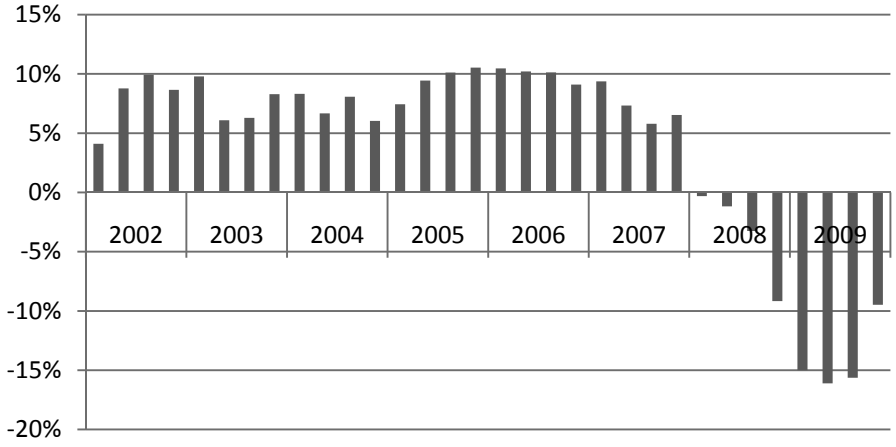


Figure 13. Estonian real GDP growth 2002–2009
Source: Statistics Estonia

This anomaly must also be kept in mind when more technical methods are applied, because it seems that there is no reason to assume the time-invariant counter-factual for the whole period of 2001–2009.

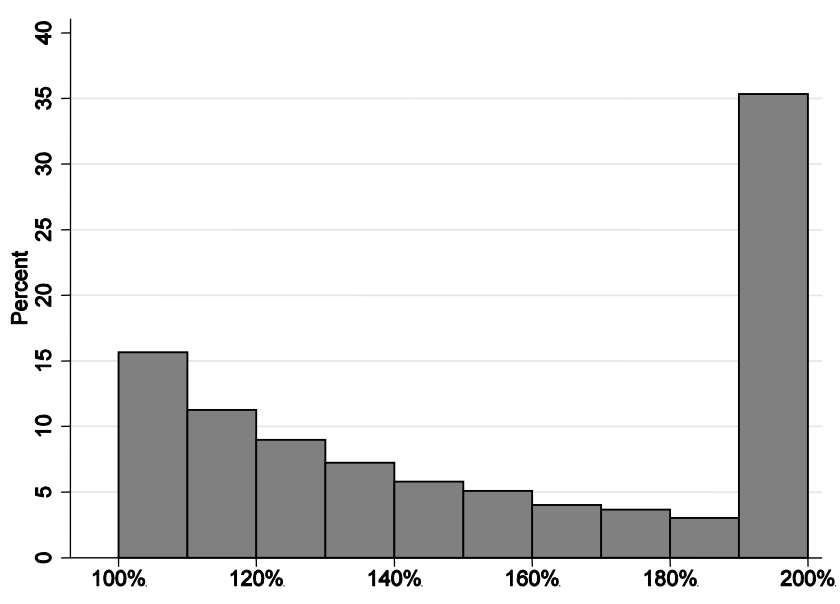


Figure 14. Wage change distribution for growth rates above 100%, 2002–2009
Source: Estonian Tax and Customs Board, author's calculations

There is also a spike at 100% wage growth, but this is artificial and includes all observations with 100% or higher wage growth rates. The share of this kind of observation ranges between 2.5% and 4.5%. This group also deserves a more detailed examination, as very high wage growth rates are not common. It would be interesting to see how these wage growth rates are distributed. As the dispersion of wage growth rates above 100% is relatively large, a 10% bin is used in Figure 14. It can be seen that more than 35% of these observations (slightly more than 1% of the whole sample) have wage growth higher than 200%, so the share of very high growth rates in the database is quite high. The first implication of this is that skewness estimators that are sensitive to extreme observations will probably yield unreliable results.

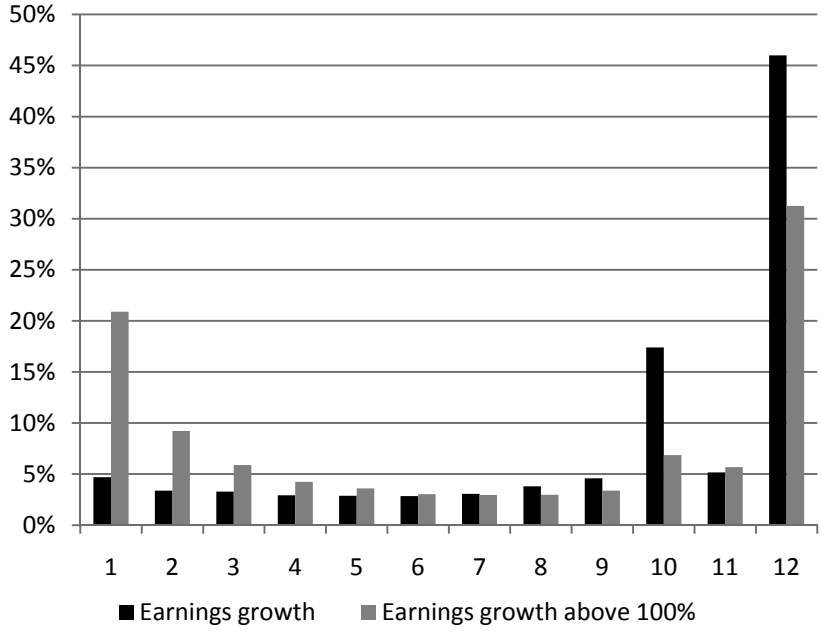


Figure 15. Number of months used in the calculation of wage changes for total sample and for growth rates above 100%, 2002–2009.
Source: Estonian Tax and Customs Board, author's calculations

Are these observations information that should be included in the further analysis or not? It could be that such high wage growth figures are the result of some kind of anomaly in the data generation procedure.

Figure 15 shows the number of monthly observations that were available for calculating the yearly wage changes for the whole sample and for growth rates exceeding 100%. Indeed, for higher wage growth rates the share of one, two and three-month-based growth observations is significantly higher. Monthly earnings are probably more volatile than the average yearly wage. However, there has to be a substantial reason for excluding these observations, like the

reason for excluding high earnings of the month exceeding the ending of work contract as they include severance payments. There is no theoretical reason to consider these observations as not suitable for analysis.

4.3. Symmetry approach

Next, let us look at symmetry statistics to get quantitative estimates for the skewness of the distribution. At first three different statistics are chosen: *skewness coefficient* is the most common choice, but it has problems as the test statistic in strongly influenced by extreme observations. The *difference between mean and median* is also widely used, and is somewhat less influenced by extreme observations. The *Wilcoxon signed ranks test* is selected as a test that is not influenced by mean (see section 2.3 for methodology description).

Table 9. Symmetry indicators of wage change distribution, whole sample[26]

Year	Skewness coefficient	s.d.	Mean-median difference	s.d.	Signed rank statistic (mld)	Prob
2002	419.33	0.0042	0.10	0.006	28.27	0.0000
2003	129.75	0.0042	0.08	0.002	30.05	0.0000
2004	135.06	0.0041	0.09	0.002	32.75	0.0000
2005	62.17	0.0041	0.10	0.002	32.75	0.0000
2006	43.95	0.0040	0.12	0.002	34.35	0.0000
2007	86.37	0.0039	0.10	0.002	38.21	0.0000
2008	85.94	0.0039	0.08	0.002	37.14	0.0000
2009	191.88	0.0041	0.05	0.003	30.92	0.0000
2002–2009	429.09	0.0014	0.09	0.001	2095.00	0.0000
2002–2008	459.93	0.0015	0.10	0.001	1617.30	0.0000

Source: Estonian Tax and Customs Board, author's calculations

Table 9 shows the results of the symmetry tests. For the skewness coefficient and mean-median difference, the standard deviation of the statistic is listed as a reference for assessing the significance of the indicator. For the signed rank

[26] The standard deviations for skewness coefficient and mean-median difference are calculated based on (McLaughlin, 2000, pp. 4-5). For skewness coefficient standard deviation is calculated with normality of the distribution assumed. This increases the probability of false positives. Other tests serve as a control for this. The Z- statistic values are calculated using the Stata signed rank test.

statistic, the figures listed in the table are the difference of the summed ranks of the right and left tails of the distribution. The probability value is the probability testing the H_0 that the right and left tails of the wage change distribution are drawn from the population with the same distribution.

The tests have been performed for each year in the sample, and for the whole period. All three tests confirm that distributions are not symmetric and this applies for the whole period from 2002–2009. This is somewhat contradictory to visual inspection, as 2009 seems to be skewed more to the left than to the right.

There are some additional issues that can influence the results of these statistics. It is well known that the skewness coefficient is sensitive to extreme observations, so it would be interesting to see how the test results behave if these observations are excluded. The following table presents the test results for the sample where wage growth above 100% is excluded.

Table 10. Symmetry indicators of wage change distribution, wage change below 100%

Year	Skewness coefficient	s.d.	Mean-median difference	s.d.	Signed rank statistic (mld)	Prob
2002	0.12	0.0043	0.02	0.000	26.45	0.0000
2003	0.06	0.0042	0.01	0.000	28.39	0.0000
2004	0.04	0.0042	0.02	0.000	30.68	0.0000
2005	0.01	0.0041	0.02	0.000	30.68	0.0000
2006	0.00	0.0041	0.03	0.000	31.33	0.0000
2007	–0.25	0.0040	0.01	0.000	34.93	0.0000
2008	–0.19	0.0040	0.00	0.000	34.65	0.0000
2009	0.28	0.0042	–0.01	0.000	29.62	0.0000

Source: Estonian Tax and Customs Board, author's calculations

Excluding the extreme observations does indeed influence the value of the test statistics. The values of the skewness coefficients are relatively small and for some years even indicate skewness to the right (2007 and 2008). The mean and median difference also shows only a very small skewness to the right. Interestingly, this is the only statistic that confirms the skewness to the left of the wage change distribution in 2009. The signed ranks test still indicates skewness to the right. It can be said that exclusion of extreme observations influences the values of the skewness coefficient the most. The other statistics are more robust to the observations in the far left of the distribution. Nevertheless, both the mean-median difference and the signed rank statistic still confirm at least a slight skew to the right.

The other phenomenon that can influence the results of the previously listed statistics is the spike in wage change distribution that can be observed at the

locations of the minimum wage and the minimum social tax base growth. As the minimum social tax base has throughout the period been below or equal to the minimum wage, it is easy to eliminate the effect of these spikes by excluding observations of wage changes that remain below the minimum wage.

Table 11. Symmetry indicators of wage change distribution, minimum wage excluded

Year	Skewness coefficient	s.d.	Mean-median difference	s.d.	Signed rank statistic (mld)	Prob
2002	11.93	0.0045	0.05	0.001	21.29	0.0000
2003	7.21	0.0044	0.04	0.001	23.76	0.0000
2004	298.45	0.0044	0.05	0.002	24.00	0.0000
2005	10.87	0.0044	0.04	0.001	24.00	0.0000
2006	42.90	0.0043	0.07	0.001	26.49	0.0000
2007	23.50	0.0042	0.04	0.001	29.19	0.0000
2008	4.79	0.0042	0.03	0.001	29.01	0.0000
2009	8.47	0.0044	0.00	0.001	23.83	0.0000

Source: Estonian Tax and Customs Board, author's calculations

The results in Table 11 show that although the exclusion of these observations does reduce skewness to the right, it is not the reason for the skewness to the right. This means that at this stage it can be concluded that even if extreme observations or the effect of the minimum wage and the minimum social tax base growth are eliminated, the wage change distributions still remain at least slightly skewed to the right.

Table 12. LSW statistic values for 2002–2009

Year	LSW statistic (whole sample)	s.d[27].	LSW statistic (minimum wage excluded)	s.d.	LSW statistic (below 100% wage growth)	s.d.
2002	3.47%	0.0013	4.64%	0.0015	2.98%	0.0014
2003	3.72%	0.0013	4.03%	0.0014	4.15%	0.0014
2004	4.26%	0.0013	4.05%	0.0014	3.63%	0.0013
2005	7.19%	0.0013	5.84%	0.0014	5.90%	0.0013
2006	9.02%	0.0011	7.93%	0.0012	7.54%	0.0012
2007	6.12%	0.0010	5.59%	0.0011	3.93%	0.0010
2008	3.39%	0.0012	3.14%	0.0013	2.56%	0.0012
2009	–0.53%	0.0018	–1.10%	0.0020	–0.65%	0.0018
2002–2008	5.39%	0.0004	–	–	4.28%	0.0004
2002–2009	4.26%	0.0005	–	–	3.64%	0.0005

Source: Estonian Tax and Customs Board, author's calculations

The skewness indicators discussed so far do not allow for easily interpretable quantitative estimates of the size of DNWR. This problem can be solved by assuming symmetry of the counter-factual wage change distribution and calculating the LSW indicator (the method is described in the sub-chapter 2.3). The idea behind the indicator is simple: the proportion of observations below zero-wage-growth should be the same as the proportion of the distribution above twice the median, assuming that the distribution is symmetric and there is no rigidity. If there is downward nominal rigidity, then the proportion of observations above twice the median should be higher. Table12 presents the LSW statistics for the period 2002–2009. As can be seen, during most of the years there is an evident shortage of observations below zero. This result remains valid if extreme observations or wages below the minimum wage are also excluded. The only exception is 2009, where the shortage of below-zero observations turns into a surplus. The reasons for this have already been discussed in the previous chapter and are associated with the culmination of the economic crisis.

Before continuing, it is important to decide which indicators will be used as indicators of DNWR, whether the cropped or the non-cropped sample. As the

[27] Standard deviation of the LSW statistic was calculated according to (McLaughlin, 2000, p. 8).

symmetry approach is not very sensitive to extreme observations and the effect of minimum wage growth is seldom if at all excluded in the studies that have so far been carried out, it seems reasonable to stay with the results of the unrestricted sample.

These results seem to confirm the presence of modest DNWR. However, the symmetry of the factual distribution has not so far been tested. The importance of the symmetry assumption is illustrated by Figure 16. If the distribution of wage changes is right-skewed, then in a high inflation environment the test would pick up a shortage of below-zero observations and thus report downward nominal rigidity, although the lack of observations is actually the result of a skewed counter-factual distribution.

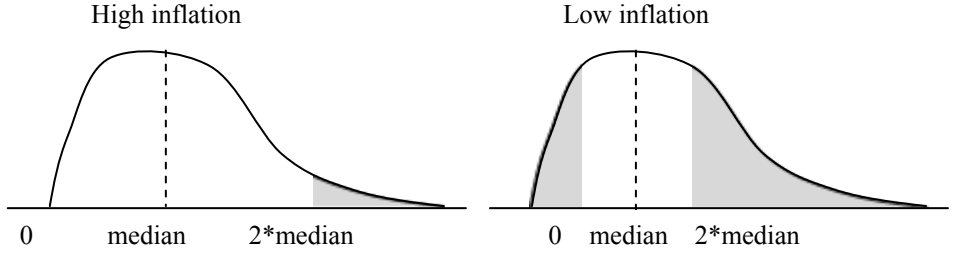


Figure 16. The impact of asymmetry of the counter-factual distribution on the LSW statistic
Source: Lebow, Saks, & Wilson, 2003, p. 4

So it is imperative to test for the symmetry of the counter-factual distribution. This is a difficult task, as it cannot be observed directly. McLaughlin (1999) looks at the symmetry near the median in order to assess the symmetry of the counter-factual distribution. The part of the wage change distribution that is above zero and below the median should not be influenced by downward nominal rigidity[28], thus if this part of distribution is symmetrical to its counterpart in the right side of the distribution, this could serve as a sign that the counter-factual distribution is symmetric (McLaughlin, 1999, p. 126).

As results near the median are not plagued by extreme observations, the skewness coefficient will be used as a measure of symmetry. During the period 2002–2008, the median of wage change rates varies between 8.5% and 19.3%. In 2009, the median growth rate is –3.6%.

[28] Assuming that there are no menu costs or spillovers of nominal wage rigidity to the upper part of the distribution.

Table 13. Skewness near median

Year	Number of observations	Median	Skewness coefficient (near median)	s.d.
2002	116972	9.04%	0.0197	0.0072
2003	126246	8.51%	0.0750	0.0069
2004	128669	8.71%	0.0322	0.0068
2005	130199	9.47%	0.1255	0.0068
2006	117502	14.93%	0.1732	0.0071
2007	116738	19.26%	0.0711	0.0072
2008	117926	11.90%	0.0545	0.0071
2009	126892	–3.91%	–0.2982	0.0069

Source: Estonian Tax and Customs Board, author's calculations

Table 13 suggests that the counter-factual distribution is slightly skewed to the right, except in 2009, where the wage changes are skewed to the left. Despite the relatively low values of the skewness coefficient it is still not possible to say that the counter-factual distribution is symmetric. What could the theoretical reasons for the right skew of the wage change distribution be? There are several possible explanations (McLaughlin, 1999, p. 130):

- People can be averse to real wage cuts and this will induce a right skewness of factual nominal wage change distribution;
- Self-selection occurs, as the data used in the analysis of DNWR include only accepted wage offers, as the offers that were not accepted resulted in resignations or lay-offs. As wage increases are more likely to be accepted than wage cuts, this will induce the skewness to the right;
- Pooling different symmetric distributions can generate spurious skewness, also to the right.

In addition to these reasons it should be kept in mind that wage cuts are limited to 100%, while there is no technical limit for wage increases, which can also be a reason for skewness to the right even if there is no DNWR.

In all, there are several conclusions from this sub-chapter:

a) The symmetry approach supports the existence of DNWR especially during the years 2002–2008 and to a very modest extent also during the period 2002–2009;
b) However, the symmetry approach is not the best suited method for analysing wage rigidity in Estonia, as the right skewness of the counter-factual distribution is likely to introduce upward bias to the estimates;
c) The shape of the counter-factual wage change distribution in 2009 is substantially different from those of the rest of the period. This again confirms the doubts that the assumption of time-invariance of the counter-factual distribution is not correct for the year 2009;

d) The skewness around the median in 2005–2006 is also slightly higher than in the rest of the period. This might suggest that standardisation might be necessary when methods assuming time-invariance of the counter-factual distribution are applied.

4.4. Skewness-location approach

The main idea behind the skewness-location approach is to test whether skewness becomes smaller as the wage growth at the location increases. So far several symmetry indicators have been calculated, and the most logical next step would be to see how they correlate with the location of wage distribution. The location must not be exposed to DNWR, so as the median wage change in 2009 was negative, a higher percentile has to be chosen. The following setting uses the 65th percentile.

Table 14. Correlation between location and symmetry indicators

	65th percentile			
	Whole sample		**Wage change below 100%**	
	2002–2009	**2002–2008**	**2002–2009**	**2002–2008**
Skewness coefficient	–0.3858	–0.4480	–0.8642***	–0.7745**
Mean-median difference	0.8071**	0.5273	0.6210	–0.2780
Signed rank statistic (mld)	0.6492*	0.7918**	0.5176	0.7097*
LSW statistic	0.7991**	0.5343	0.7035*	0.2165

*10% significance level; **5% significance level; *** 1% significance level
Source: Estonian Tax and Customs Board, author's calculations

The correlations presented in Table 14 give mixed results. The only indicator showing negative relationships between symmetry and 65th percentile for the whole sample is the skewness coefficient, although the value of the correlations coefficient is statistically insignificant. As already discussed above, this statistic is influenced by extreme observations and there is a relatively large share of extremely high wage growth figures in our sample. If the same correlation is calculated for earnings changes that do not exceed earnings growth of 100%, the result is the same – there is a strong negative correlation between the 65th percentile and the skewness coefficient, however, the coefficients are also statistically significant.

The mean and median difference shows mixed results – calculations based on the whole sample show strong positive correlations between the median and the mean-median difference. It should, though, be kept in mind that if the anomalous 2009 is excluded and only the sample of wage growths below 100%

is considered, the correlation is with the expected sign. The other two indicators show positive correlation between the 65th percentile and the skewness indicator. In interpreting these results, it must be kept in mind that despite their statistical significance these figures are only found from nine yearly observations, and so the results from this approach as a whole cannot be considered very reliable.

This sub-chapter concludes with the following notes. First of all, the correlation analysis in this specific case is quite uninformative. The time span 2002–2009 includes only eight yearly observations, which leaves the results unreliable even though they are in some cases statistically significant. It is, however, interesting that most of the skewness indicators are positively related to the right-shifts of the location, indicating that higher median wage levels create a stronger skewness in the wage change distribution. As the influence of downward nominal rigidity should in theory decline as the location shifts to the right, then maybe it is the right side of the distribution that is affected by the change in location? This is important, because time-invariance of the counter-factual distribution is an important precondition for the histogram-location approach.

Is it possible that despite these results there is some kind of rigidity in the Estonian wage change distribution? This cannot be excluded. All measures of skewness are more or less unsuitable for analysing the downward nominal rigidity of wages. The skewness coefficient is influenced by extreme observations and looks at the whole distribution, so it does not deal specifically with the nominal downward rigidity that affects most the part of the distribution that lies below zero, although both with and without extreme observations, this is the only indicator in the correlation matrix suggesting the existence of rigidity. The same problem of attention to the whole distribution also plagues the signed ranks statistic. The mean-median difference looks only at the mean-median difference and does not look at the left side of the distribution at all. The only statistic that deals specifically with downward nominal wage rigidity is the LSW statistic, but as the near-median part of the distribution is skewed, there is no reason to believe that the whole distribution is symmetric. It should also be kept in mind, that most of this analysis is based on eight yearly observations of the skewness indicators and median. As the number of observations is small, it is still possible that nominal wages are rigid.

The results of this chapter are the following:

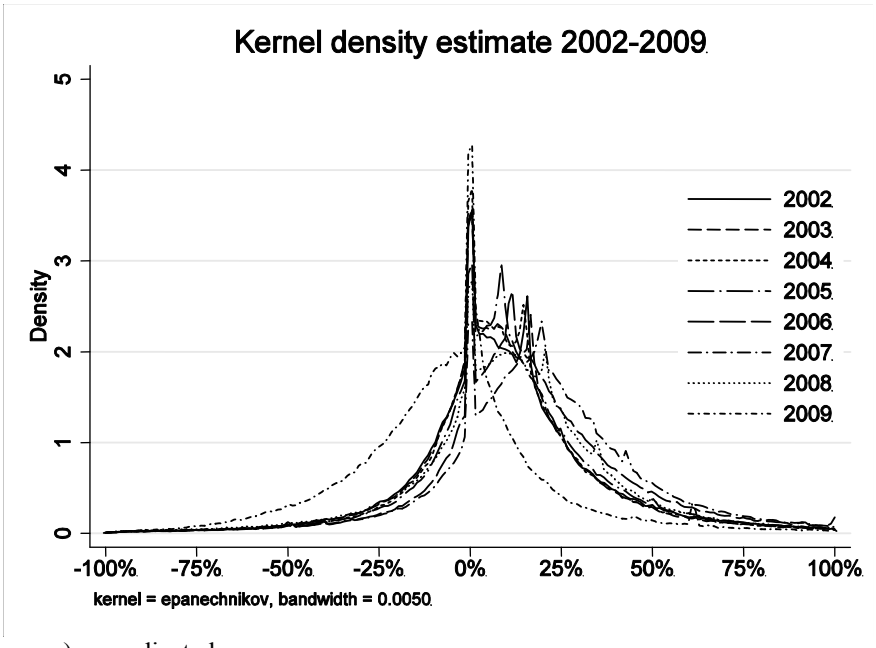
- Estonian aggregate level data give mixed results on the negative relationship between location and skewness, suggesting that there is no clear evidence of downward nominal wage rigidity;
- Some skewness indicators tend to increase as location shifts to the right. This might suggest potential problems with time-invariance of the counter-factual distribution as DNWR might also be influencing the right side of wage distribution;

- However, most of the indicators used in this analysis have shortcomings and there are too few observations, rendering the analysis rather weak, so the results are not conclusive.

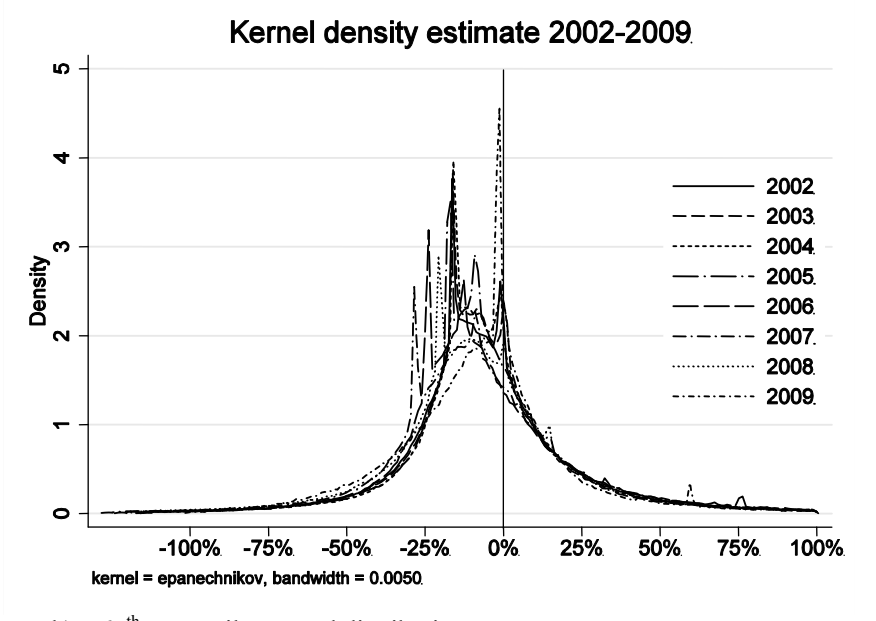
4.5. Histogram-location approach

The histogram-location approach has several advantages over the methods used in the previous sub-chapter. First of all, it models the whole left side of the distribution, allowing for easily interpretable estimation of DNWR. Second, as it does not assume symmetry of the earnings change distribution, it is better suited for the Estonian data, making it superior to the LSW statistic. However, there are some doubts as to whether the counter-factual distribution is actually time-invariant. A way to test this is to put the distributions on the same picture to get a visual confirmation of the variance or non-variance. Figure 17 depicts kernel density estimates of earnings changes for the period 2002–2009. Panel a) depicts distributions with unadjusted location, while in panel b) distributions are listed as 65^{th} percentile–centred. It can be seen that 2009 is clearly different from the other years. However, in panel b) the part of the wage distribution that is located above the 65^{th} percentile shows relatively little variation, so at first glance there should be no obvious obstacles to using the assumption of time-invariance of the counter-factual distribution, except for 2009. However, when a more formal test is conducted (a two sample Kolmogorov-Smirnov test for equality of wage change distributions above the 65^{th} percentile) the differences between the years become more evident, and the equality of distributions is rejected for all combinations of years (see Appendix 2).

To summarise, from the previously conducted tests, there is no reason to believe that the shape of the counter-factual distribution changes significantly over time. However, just to be on the safe side, earnings changes will be standardised.



a) unadjusted



b) 65th percentile centred distribution

Figure 17. Kernel density estimates of wage change distributions for the years 2002–2009, normal and 65th percentile-centred
Source: Estonian Tax and Customs Board, author's calculations

In order to apply the histogram-location approach, location-centred histograms must be constructed. To get location centred standardised histograms the following transformation will be made (Knoppik & Beissinger, 2009, p. 326):

$$\Delta w^s = \frac{\Delta w - l}{v} \quad (4\text{–}1)$$

where Δw^s is standardised wage growth, Δw is non-standardised wage growth, l is location and v is a measure of variance of the wage change. In analysis of DNWR, the location and the measure of variance must not be influenced by DNWR. This can be achieved if a sufficiently high location is chosen. In this case, the median earnings change in 2009 was –3.9%, so locations should be more than 3.9 percentage points higher than the median. The 65th percentile is used as a measure of location. Concerning variance, Knoppik & Beissinger (2009) use the difference between the 80th percentile and the location. (Knoppik & Beissinger, 2009, p. 326) Estonian wage change distribution is more dispersed and as a more compressed distribution makes the estimation easier because a lower number of histogram bins have to be included in the sample, the following analysis uses the difference between the 95th percentile and the location as its measure of variance.

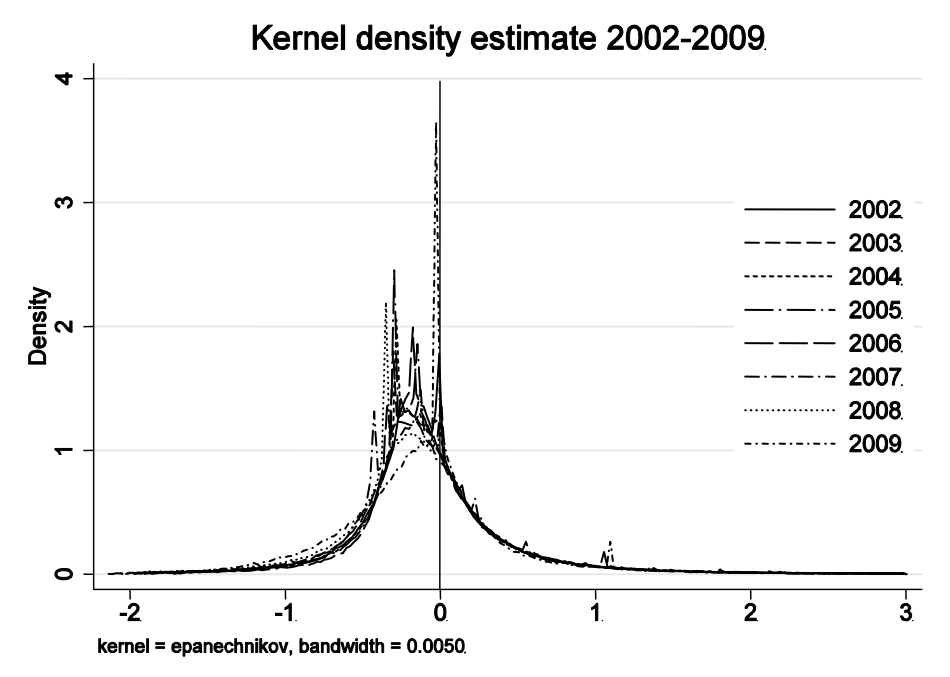


Figure 18. Kernel density estimates of wage change distributions for 2002–2009, standardised, 65th percentile centred.
Source: Estonian Tax and Customs Board, author's calculations

Figure 18 depicts kernel density estimates for wage changes that have been standardised using the previously proposed measure of variance. The right side of the distribution (above zero) shows relatively low variation over the years, but more formal tests (a two sample Kolmogorov-Smirnov test for equality of distributions) again reject the hypothesis of the equality of all yearly combinations of distributions above the location. On one hand, this means that the rigidity coefficient from the histogram-location approach could be biased but on the other hand this is expected, as the number of observations for each year is several hundreds of thousands of observations. This means, that distributions have to be literally identical in order for the test to confirm this. Figure 18 shows that the distributions above the location are almost identical, so it seems to be reasonably safe to conclude that the histogram-location approach will not yield biased results.

In addition to this, it can be seen that 2009 is even after standardisation significantly different from the other years. It seems reasonable to exclude the year 2009 from the analysis when applying the histogram-location approach. As for the other years, the differences in the shape of the distribution near the peak are the result of administrative measures, increases in the minimum wage and the minimum social tax base. These measures in effect steal observations both from the zero bin and from the whole region lying to the left of those peaks, thus affecting the degree of rigidity. Here the effect of these changes will be ignored as it is quite difficult to interpret the results after integrating them in one model, but later separate rigidity coefficients will be estimated for wages below and above the minimum wage in order to eliminate the effect of minimum wage growth on DNWR.

Another problem that has to be addressed concerns the shortage of yearly observations. If 2009 is excluded, then the dataset includes wage increases from only seven years (2002–2008). This would not be problematic if the yearly median wage change figures were not very volatile, but as already discussed above, this is not the case, and the Estonian labour market has been relatively turbulent throughout the whole decade. On the other hand, for each year, there is a very large number of wage growth observations. It is possible to increase the number of observations by looking at subgroups of workers or companies. For example, if companies are divided into four different size groups, then instead of seven yearly observations there will be four times seven or 28 observations. In the following sections, yearly observations will be divided into six age groups[29], yielding altogether 42 observations. This will allow different settings to be used for estimating rigidity coefficients.

A final remark concerning the data is that as 2009 will be dropped and later on the analysis will also be conducted for several employer and employee groups, different measures of standardisation can be used. The figures of the

[29] Less than 25 years old, 35–34 years old, 35–44 years old, 45–54 years old, 55–64 years old, older than 65.

location as well as for variance will be reported in the beginning of each sub-chapter.

The model used is that proposed by Knoppik & Beissinger (2009), a closed version of the model proposed by Kahn (1997). The original model by Kahn (1997) treats the pile up coefficient γ as non-constrained (see equation (2–10)). However, the part of the left side of distribution, which is not modelled in equation (2–10), must be equal to $F(q) - \sum_{j=1}^{r_{max}} PC_j$, where PC_j is the j^{th} bin of counter-factual distribution (counted from the location), r_{max} is the last bin estimated in the equation and *F(q)* is the value of the cumulative distribution function at location q[30]. So, the share of the counter-factual distribution that is transferred to the zero bin (γ) should be equal to $\rho(F(q) - \sum_{j=1}^{r_{max}} PC_j)$ (Knoppik & Beissinger, 2009, p. 327). The resulting equation system is (Knoppik & Beissinger, 2009, p. 327):

$$PF_{r,t} = PC_r - \rho PC_r DNEG_{r,t} + \left(\rho \left(F(q) - \sum_{j=1}^{r_{max}} PC_j \right) + \rho \sum_{j=1}^{r_{max}} PC_j DNEG_{j,t} \right) DO_{r,t} + \mu_{r,t} \quad for\ r = 1 \dots r^{max}$$

(4–2)

where r is the number of the bin counting to the left from the location, $PF_{r,t}$ denotes the proportion of observations in bin r of the factual distribution at time t and $PC_{r,t}$ is the proportion of observations in bin r of the counter-factual distribution at time t. $DNEG_{r,t}$ and $D0_{r,t}$ are dummy variables taking the value 1 if the bin at time t contains negative or zero wage changes. *F(q)* is the value of the cumulative distribution function at location q and r_{max} indicates the highest bin number of the zero-bins over the years. $\mu_{r,t}$ is the error term. The coefficient ρ is the share of wage cuts that could not be enacted due to downward nominal rigidity (Knoppik & Beissinger, 2009, p. 327).

Several methods have been used for estimating the equation system (4–2). Kahn (2007) estimated it as a seemingly unrelated regression with cross-equation constraints. A seemingly unrelated regression does allow for contemporaneous correlation between error terms of different equations, but there are several problems with this approach. Firstly, by allowing contemporaneous correlation between error terms, the seemingly unrelated regression violates the assumption of a time-invariant counter-factual. Secondly, for small samples a SUR can lead to unstable results (Beissinger & Knoppik, 2001, p. 407). Because of this a simpler specification will be used. Two logical options would be OLS or WLS. As the bin sizes of the bins near median and those further out in the left side of the distribution differ substantially, we could suspect

[30] For example median.

heteroskedasticity across equations (Beissinger & Knoppik, 2001, p. 407), so WLS is probably the best choice.

The equation system (4–2) was estimated by weighted least squares and the results are listed in the following tables (see Table 15). The histogram is constructed using a 1% histogram bin width. For the period 2002–2008, there are 42 observations (7 years, 6 age groups per year). Altogether 29 parameters must be estimated, 28 counter-factual distribution histogram bins and the rigidity parameter. Statistics that are usually descriptive for different equations (like R^2, RMSE) and the estimated bin sizes for the counter-factual distribution are not listed in the results. The same practice is followed here.

The estimate of the rigidity coefficient is statistically significant. The rigidity coefficient calculated from standardised data is 9.3%, meaning that when the counter-factual wage change distribution is compared with the factual, then 9.3% of wage cuts have not been enacted due to wage rigidity.

Table 15. Rigidity coefficients from WLS estimates of the equation system (4–2), whole of Estonia, standardised data (45–95), bin width 1%, years 2002–2008

	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
ρ	9.3%	0.0015	63.3742	0.0000

Source: Estonian Tax and Customs Board, author's calculations

In the literature dealing with DNWR, there is usually sufficient information for the results to be estimated using yearly observations for the whole country. As described earlier this is not the case here. In order to generate more observations, the sample was divided into six age groups. It could be argued that this procedure may alter the results, and so a robustness check of the parameters obtained is in order. In the following chapter the rigidity coefficients for different employer and employee groups are estimated. From the data generated for these estimations it is also possible to make pooled estimations for the whole of Estonia. In addition to differences in subgroups a different bin size is also used (2%). The results are listed in Table 16.

The estimates obtained from the different datasets vary between 8.1% and 11.1%. As a percentage of the smallest value of the coefficient, the difference between these two estimates is quite large. However, if this is compared with the rigidity coefficients listed in Table 18, then it is clear that between-country variance is significantly higher and the fluctuation in the value of the rigidity coefficient does not hinder us from getting an idea of the flexibility or rigidity of wages in international comparison.

Table 16. Rigidity coefficients from WLS estimates of the equation system (4–2), whole of Estonia, various datasets and bin widths, years 2002–2008

Basis for constructing subgroups in the dataset	Measure of variation[31]	Number of obs.	Bin size	Coeff.	Standard error	t-Statistic	Prob.
Gender	35–95	14	2%	10.1%	0.0029	35.3038	0.0000
Number of workers in company	40–95	28	2%	8.7%	0.0054	16.2237	0.0000
Age	45–95	42	2%	10.7%	0.0025	42.8669	0.0000
Age	45–95	42	1%	9.3%	0.0015	63.3742	0.0000
Wage	40–95	35	2%	8.1%	0.0027	29.6679	0.0000
Economic sector	65–95	112	2%	11.1%	0.0019	58.7858	0.0000

Source: Estonian Tax and Customs Board, author's calculations

How does this compare to other results in the literature? Beissinger & Knoppik (2001) also use registry data and do not have information on working hours. They are able to distinguish between salaried employees and waged workers and find that rigidity coefficients for the period 1975–1995 are 8.9% and 17.3% for the two groups respectively (Beissinger & Knoppik, 2001, p. 409). However, they use a bin size of 0.5% instead of one, and also a more flexible form of equation (4–2)[32]. In order to allow for a more precise comparison the coefficients are re-estimated using the same model specification. Unfortunately there are not enough observations for estimation of this model with 0.5% bin width, so 1% is used. The estimation results are listed in Table 17.

[31] The measure of variation used in standardising the data indicates the upper and lower percentiles that are used for calculating the measure of variation. The lower value also indicates the location that is used in constructing the location-centred histograms that are the basis of the histogram-location approach. Different locations are a pragmatic consideration, as this allows a reduction in the number of equations that have to be estimated.

[32] The actual form they used was following (Beissinger & Knoppik, 2001, p. 407): $PF_{r,t} = PC_r - \rho PC_r DNEG_{r,t} + \left(\gamma + \rho \sum_{r_{min}}^{r_{max}} PC_j DNEG_{j,t}\right) DO_{r,t} + \mu_{r,t}$ the difference lies mostly in the un-constrained coefficient γ. The same authors have later in their 2009 paper indicated that leaving this parameter un-constrained could lead to inconsistent results. However, in order to keep the results as comparable as possible, the same form is used in this estimation.

Table 17. Rigidity coefficients from WLS estimates of the equation system (2–10), whole of Estonia, various datasets and bin widths, years 2002–2008

Basis for constructing subgroups in the dataset	Measure of variation[33]	Number of obs.	Bin size	Coeff.	Standard error	t-statistic	Prob.
Gender	35–95	14	2%	6.9%	0.0125	5.5331	0.0000
Number of workers in company	40–95	28	2%	14.2%	0.0175	8.1158	0.0000
Age	40–95	42	2%	5.9%	0.0083	7.0570	0.0000
Age	45–95	42	1%	6.6%	0.0050	13.2025	0.0000
Earnings	40–95	35	2%	5.6%	0.0114	4.9177	0.0000
Economic sector	65–95	371	2%	10.7%	0.0038	27.9184	0.0000

Source: Estonian Tax and Customs Board, author's calculations

As suspected, the results are significantly more volatile varying between 5.3% and 14.6%. It seems reasonable to stick with the estimates obtained from model (4–2). Taken all together, the estimated rigidity coefficients suggest that wage rigidity in Estonia is lower than it is in Germany.

Concerning comparisons with other countries, unfortunately very few estimations have been done based on registry data. A rather far-fetched comparison can be obtained by using the results of Knoppik & Beissinger (2009), who estimate rigidity coefficients for the European Union including Germany from ECHP data from 1994–2001. These estimates also include rigidity coefficients for Germany, and as can be seen from Table 18, Germany ranks significantly below European average. This means it would be reasonable to assume that the Estonian wage rigidity coefficients are also below the European average.

[33] The measure of variation used in standardising the data indicates the upper and lower percentiles that are used for calculating the measure of variation. The lower value also indicates the location that is used in constructing the location-centred histograms that are the basis of the histogram-location approach. Different locations are a pragmatic consideration, as this allows a reduction in the number of equations that have to be estimated.

Table 18. Estimated degrees of downward nominal wage rigidity for selected European countries

Country	Rigidity coefficient
Italy	66%
Belgium	47%
Finland	46%
Austria	45%
Greece	43%
Portugal	41%
EU[34]	36%
Denmark	35%
Germany	28%
France	23%
Ireland	18%
UK	14%
Spain	7%

Source: Knoppik & Beissinger, 2009, p. 330

There are, of course, problems with this kind of approach. First of all, total wage and wages are two different indicators. A flexible total wage could be the result of flexibility in wages, or also in working hours. Moreover, the whole reason for using registry rather than survey data is to improve the quality of information on wage growth. Rankings composed using survey data are still plagued with measurement error. In addition to the problems with data sources already mentioned, it must be remembered that the time periods used in Beissinger & Knoppik (2001) (years 1975–1995), Knoppik & Beissinger (2009) (years 1994–2001) and the current analysis (years 2002–2008) are different. If rigidity coefficients are not constant over time, then the results are difficult to compare even between Beissinger & Knoppik (2001) and the current analysis. In fact Beissinger & Knoppik show that this is precisely the case for Germany where wage rigidity increases as unemployment decreases and vice versa (Beissinger & Knoppik, 2001, p. 409), so it would be interesting to estimate the results while controlling for changes in unemployment.

[34] The EU estimate is based on 12 of the 15 old EU countries (without Luxembourg, the Netherlands, and Sweden).

4.6. Histogram-location approach with dynamic rigidity

In order to introduce variability over time to the rigidity coefficient, the DNWR is assumed to be related to the unemployment rate. A modified version of the equation system proposed by Beissinger & Knoppik (2001) that will also take into account the constraint on the additional pile up coefficient is ($\gamma = \rho(F(q) - \sum_{j=1}^{r_{max}} PC_j)$ is following:

$$PF_{r,t} = PC_r - (\rho + \rho^{\Delta U}\Delta U_t)\, PC_r DNEG_{r,t} + (\rho + \rho^{\Delta U}\Delta U_t)\left(F(q) - \sum_{j=1}^{r_{max}} PC_j + \sum_{j=1}^{r_{max}} PC_j DNEG_{j,t}\right) DO_{r,t} + \mu_{r,t} \quad (4\text{–}3)$$

where in addition to the previously defined coefficients and variables, ΔU_t denotes the yearly change in unemployment and $\rho^{\Delta U}$ captures the effect of the change in unemployment on the rigidity coefficient. The actual coefficient for each year can be obtained from the following equation:

$$\rho_t = \rho + \rho^{\Delta U}\Delta U_t \quad (4\text{–}4)$$

where ρ_t is the rigidity coefficient at year t, ΔU_t is the unemployment rate and $\rho^{\Delta U}$ is the coefficient that captures the impact of the change in the unemployment rate on the rigidity coefficient. The equation system (4–3) will be estimated as weighted least squares. For simplicity the following results are calculated using the dataset with six age groups and a 1% bin width.

Table 19. Rigidity coefficients from WLS estimates of the equation system (4–3), whole of Estonia, standardised data (45–95), bin width 1%, years 2002–2008

	Coefficient	Std. Error	t-Statistic	Prob.
ρ	8.7%	0.0019	46.0167	0.0000
$\rho^{\Delta U}$	–0.00684	0.0012	–5.6299	0.0000

Source: Estonian Tax and Customs Board, author's calculations

The regression results show that coefficient $\rho^{\Delta U}$ has the expected sign, as an increase in the unemployment rate should reduce the rigidity coefficient as the bargaining power of workers diminishes with deteriorating labour market conditions. The coefficient is also statistically significant, indicating that rigidity does indeed change with changes in unemployment rate. By using the equation (4-4) and estimation results listed in Table 19, the values of the rigidity

coefficient can be constructed for the Estonian private sector. These values are depicted in the following figure.

The rigidity coefficient changes over time, taking values from 8.1% to 10.2%. The rigidity coefficient shows a slight downward-sloping trend. Model (4–3) assumes that the rigidity coefficient depends on the change in the unemployment rate, not on the level of the unemployment rate. The intuition is that it is the change in labour market conditions that influences wage bargaining behaviour, not the actual level of these conditions. This, of course, is arguable, because for example a decline in unemployment when there is a very high unemployment rate does not necessarily lead to bolder wage bargaining behaviour from the workers' side.

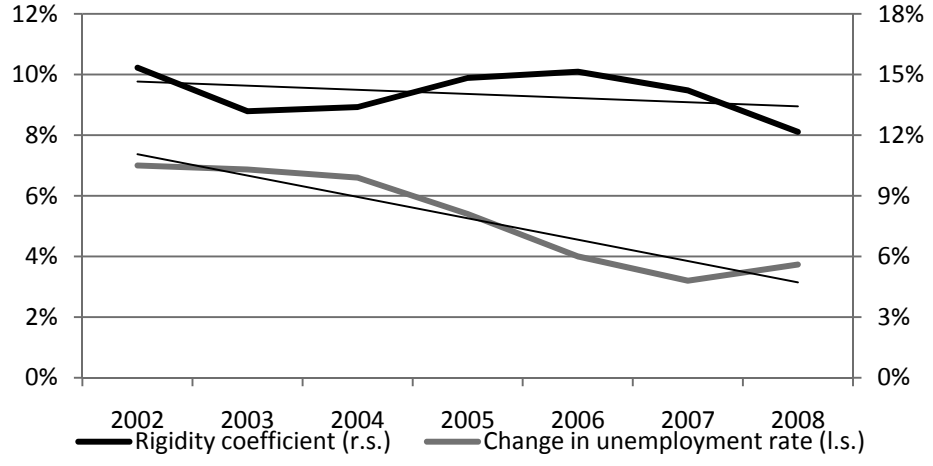


Figure 19. Rigidity coefficient and unemployment rate for Estonian wage data 2002–2008, based on Table 19.
Source: Estonian Tax and Customs Board, Statistics Estonia, author's calculations

Figure 19 shows that while unemployment declined from 11% to 7%, the rigidity coefficient actually decreased. If the efficiency wage theory has explanatory power for wage rigidity, the results should be the other way around – declining unemployment reduces the costs of being laid off as it is easier to find work and thus should lead to higher DNWR. It would be interesting to estimate the same model by adding the unemployment level as a factor influencing the rigidity coefficient. The equation system including the level of unemployment rate is:

$$PF_{r,t} = PC_r - (\rho+\rho^{\Delta U}\Delta U_t+\rho^U U_t)\, PC_r DNEG_{r,t} + \left(\rho+\rho^{\Delta U}\Delta U_t+\rho^U U_t\right)\left(F(q) - \sum_{j=1}^{r_{max}} PC_j + \sum_{j=1}^{r_{max}} PC_j DNEG_{j,t} \right) DO_{r,t} + \mu_{r,t}$$

(4–5)

Table 20. Rigidity coefficients from WLS estimates of the equation system (4–5), whole of Estonia, standardised data (45–95), bin width 1%, years 2002–2008

	Coefficient	Std. Error	t-Statistic	Prob.
ρ	12.5%	0.0051	24.5477	0.0000
$\rho^{\Delta U}$	–0.0084	0.0013	–6.3183	0.0000
ρ^{U}	–0.0045	0.0006	–6.9470	0.0000

Source: Estonian Tax and Customs Board, author's calculations

The regression coefficients ρ^U and $\rho^{\Delta U}$ are both statistically significant (at the 5% significance level) and have the expected signs. The level of unemployment influences the rigidity coefficient negatively, meaning that a higher unemployment rate means lower rigidity and a lower rate means higher rigidity. The dynamics of the rigidity coefficient is presented in Figure 20. The total effect of the unemployment rate and its change is intuitively more appealing than in the previous setting.

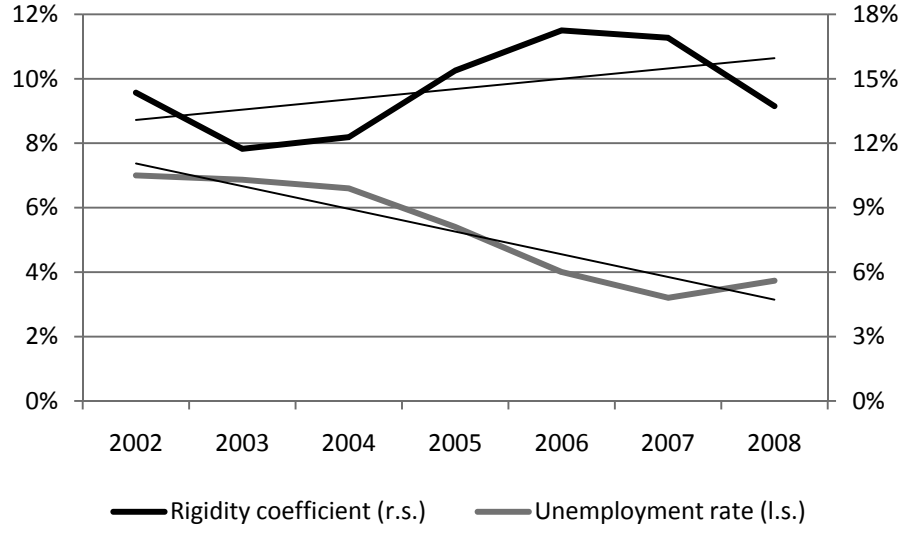


Figure 20. Rigidity coefficient and the unemployment rate for Estonian wage data 2002–2008, based on Table 20.
Source: Estonian Tax and Customs Board, Statistics Estonia author's calculations

Beissinger & Knoppik (2001) also estimate a model including the change in the unemployment rate, and in order to maintain comparability this form will be estimated on Estonian data as well, using the 0.5% bin width (Beissinger & Knoppik, 2001, p. 407):

$$PF_{r,t} = PC_r - \left(\rho + \rho^{\Delta U} U_t\right) PC_r DNEG_{r,t} + \left(\gamma + \left(\rho + \rho^{\Delta U} U_t\right) \sum_{j=1}^{r_{max}} PC_j DNEG_{j,t}\right) DO_{r,t} + \mu_{r,t} \; r = 1 \ldots r^{max}$$

(4–6)

Table 21. Rigidity coefficients from WLS estimates of the equation system (4–6), whole of Estonia, standardised data (45–95), bin width 1%, years 2002–2008

	Coefficient	Std. Error	t-Statistic	Prob.
ρ	5.4%	0.0056	9.7568	0.0000
$\rho^{\Delta U}$	–0.0104	0.0025	–4.2251	0.0000
γ	0.0176	0.0006	31.7186	0.0000

Source: Estonian Tax and Customs Board, author's calculations

Coefficient $\rho^{\Delta U}$ is statistically significant and has the expected sign. If changes in unemployment are taken into account, then the rigidity coefficient for workers in Germany for the whole period of 1975–1995 was roughly 10% and for salaried employees it was 20% (Beissinger & Knoppik, 2001, p. 408). In Estonia where the average change in the yearly unemployment rate was 1 percentage point during 2002–2008, the overall earning rigidity coefficient was 6.5%. If the rigidity coefficient is allowed to change over time, then in either case the Estonian wage show less downward nominal rigidity than the wage in Germany.

4.7. Discussion and conclusions

Three different approaches were used to analyse the existence and size of DNWR (the skewness-location approach, the histogram-location approach and the symmetry approach) during 2002–2008, using data from the Estonian Tax and Customs Board.

The results from the skewness-location approach were mixed. There should be a negative correlation between the skewness of the wage change distribution and the changes in location or inflation. Some asymmetry indicators of the wage change distribution, such as the skewness coefficient, confirmed the existence of DNWR, while others like the mean-median difference and the ordered ranks statistics yielded a positive correlation with the skewness of the distribution. However, both the symmetry approach, and the histogram-location

approach did confirm a shortage of observations on the left side of the distribution. The next question was the size of DNWR. The symmetry approach indicated that the share of wage cuts that were not enacted due to DNWR varies between 7.9% and 3.1% depending on the year. Different specifications using a histogram-location approach have shown that slightly less than 10% of nominal wage cuts have not been enacted due to rigidity for the whole period of 2002–2008. Although the material for international comparison is not very good, because registry data on wages has been rarely used for estimating DNWR, some suggestions can also be obtained about the downward rigidity of Estonian wages in the international context. First of all, Estonian wages in 2002–2008 were less rigid than German wages from the period 1975–1995. A further test was performed to see whether rigidity changes over time and it confirmed that the rigidity coefficient depends to a statistically significant degree on both the level of unemployment and the change in the unemployment rate. A fall in both of these indicators leads to a rise in wage rigidity, but including the unemployment rate as an additional variable yields intuitively more comprehensible results, as specifications that include only the change in unemployment result in DNWR declining slightly with unemployment, at least with the Estonian data. In comparison with Germany, the evidence of lower wage rigidity in Estonia becomes even more evident if the rigidity coefficient is allowed to change over time; this is also the preferred measure for international comparison, as including the change in unemployment allows changes in business cycle to be controlled for.

Which method should be preferred for drawing conclusions about DNWR? The differences in the results are mostly related to the fact that these methods use different parts of the distribution for estimating the existence and size of the DNWR. The skewness-location approach uses the whole distribution to draw conclusions about the behaviour of the asymmetry of the distribution. If fluctuations in asymmetry correlate negatively with location, then this is considered a sign of DNWR. The symmetry approach uses the parts of the distribution that lay below zero and above twice the median and derives the existence and the size of the DNWR from the difference between the shares of observations located in these specific parts of the distribution. The histogram-location approach uses the part of the distribution that lies below the highest yearly median in the sample.

One of the problems of both the skewness-location and the symmetry approach is the far right tail of the distribution. Extreme observations influence both skewness indicators and the size of observations lying above twice the median, though there are of course less sensitive indicators to extreme observations that have also been used in this thesis. If these observations are excluded then there is a reasonable concern that DNWR is underestimated. If they are included, then at least some of them are clearly anomalously high wage growth figures. One of the benefits of the histogram-location approach is that there is no need to deal with these issues. Furthermore, the assumption of symmetry in the symmetry approach is challenged by both theoretical explana-

tions and empirical findings from the literature (e.g. McLaughlin (1999)). The histogram-location approach does not prescribe the shape of the counter-factual wage change distribution. The data used in this thesis have additional shortcomings linked with the shortage of yearly observations, as there are only seven yearly observations and this makes it difficult to use methods that rely on calculating correlation coefficients. As previously mentioned, the results of the skewness-location approach do not yield results that can be easily interpreted for the size of DNWR. This is not a problem in the histogram-location approach or the symmetry approach.

The most important assumption made by the histogram-location approach concerns the inter-temporal invariability of the shape of the counter-factual wage change distribution. This is a strong assumption and does not hold for situations like severe economic crises. However, during periods of more stable economic development the empirical work, as done in this paper, tends to support this assumption.

In the light of this discussion the histogram-location approach is the preferred method for analysing DNWR and the following chapter will also be based on this method.

The next part of the discussion concerns the wage indicator used in this thesis. The results presented in the previous sub-chapter are calculated from total compensation. What can be said about the rigidity of wages? The flexibility in total compensation can be obtained by adjusting either hourly wages or hours worked. Despite the fact that total compensation and hourly wages are quite different indicators, in the Estonian case the differences in downward nominal rigidity between these two indicators might not be that large. Part-time work is not very common in Estonia, and the share of full time workers has been stable over time (during 2002–2008 the share of part time workers varied between 7.2% and 8.5%[35]). This could indicate that most of the information on wages is based on workers working full time and having relatively low variation in working hours. It could be tempting to make comparisons based on working hours, but there is no reliable source for that kind of comparison. Overtime is usually not accounted for in Estonian companies and estimates obtained from the Labour Force Survey concerning working time are not considered very reliable.

It is possible at least to some extent to compare these results with other inquiries into DNWR conducted on the Estonian data. Babecký *et al.* (2010) conducted interviews in 15 European countries, including Estonia. The questionnaire allowed analysis of the remuneration strategies in companies. Among other questions, interviewees were asked: "*Over the last five years, has the base wage of some employees in your firm ever been frozen?"*. If companies answered

[35] Source: Estonian Labour Force Survey.

positively, this was considered as evidence of downward nominal wage rigidity (Babecký, Du Caju, Kosma, Lawless, Messina, & Rõõm, 2010, p. 6).

Table 22. Incidence of wage freezes and indexation mechanisms

Country	Wage freezes	Indexation
Austria	0.13	0.10
Belgium	0.12	0.98
Czech Republic	0.27	0.12
Estonia	0.22	0.04
Spain	0.02	0.55
France	0.07	0.10
Greece	0.13	0.20
Hungary	0.06	0.11
Ireland	0.09	0.10
Italy	0.04	0.02
Lithuania	0.20	0.11
Netherlands	0.23	N/A
Poland	0.10	0.07
Portugal	0.15	0.09
Slovenia	0.03	0.24
Total	0.10	0.17
Euro area	0.09	0.20
Non-euro area	0.13	0.09

Source: Babecký, Du Caju, Kosma, Lawless, Messina, & Rõõm, 2010, p. 97

The results showed that 22% of Estonian companies froze wages during the last five years (see Table 22). The authors do not use the share of companies exercising wage cuts as a means for ranking countries according to DNWR, as the share of companies experiencing wage freezes can be influenced by differences in the labour market situation. Nevertheless, the figures presented by Babecký *et al.* (2010) are very interesting, especially because the share of companies experiencing wage freezes is one of the highest in the country of which the labour market is under scrutiny in this thesis, namely Estonia. Is there a conflict with the results obtained from this chapter? Not necessarily.

Firstly, as has already been mentioned different labour market conditions can influence the share of companies who freeze wages. The data that was the basis for analysis in Babecký *et al.* (2010) was gathered during the second half of 2007 and the first quarter of 2008. In the second half of 2008 Estonia was already witnessing declining GDP. It is possible that several companies already faced difficulties in the beginning of the year and that this also influenced their answers to the questions about wage freezes.

Secondly, while Babecký *et al.* (2010) ask companies about the base wage, this thesis is mainly concerned with the total wage. It may well be that downwards flexibility of wages is the result of extensive use of performance-

based pay components. Dabušinskas *et al.* (2010) show that this could very well the case, as in Estonia nearly 80% of companies use bonus pay and the share of bonus pay in total remuneration is 14% (Dabušinskas & Rõõm, 2011, p. 18). This should leave plenty of room for the necessary reductions in total remuneration, while base pay is kept constant.

Thirdly, differences in the results can also be attributed to the nature of the data, as registry data picks up all the changes in remuneration. This also includes changes that are not the result of the employer's deliberate policy of using austerity measures in order to enhance the company's performance. Although it is almost free of reporting errors, it still has shortcomings as there is no information on the employer's intention. A reduction of 1–2% in a yearly wage may be the result of a short illness and not of the employer's decision to cut wages. The main question, however, is: if the employer needs to cut a worker's salary, can he or she do so? Distributions for total pay growth, the indicator that is used in this thesis as proxy for wage growth, do not give a very clear answer to this question. Babecký *et al.* (2010) ask the employer "*Over the last five years, has the base wage of some employees in your firm ever been frozen?"* and they get a more generalised assessment. The employer is probably more inclined to answer "yes", if there was a deliberate wage freeze, so in contrast to registry data, the answers to this question could carry more information on the intention of employer.

Finally, there also remains the question of whether a wage freeze is the result of a non-enacted wage cut or is it in fact a non-enacted wage rise? This cannot be entirely dismissed. It is easy to imagine that if a worker does not explicitly ask for a pay rise then not all employers are going to propose it to their workers. This is the reason why the share of wage freezes is not necessarily a good indication of DNWR in wage distributions as it is the difference between the factual and counter-factual distributions that reveals the information on DNWR.

Dabušinskas & Rõõm (2011) investigate specifically the rigidity of wages in Estonia. They look at the incidence of cuts in base wages during 2009 in order to assess the degree of DNWR. The results produced by Dabušinskas & Rõõm (2011) are quite in line with the results from this chapter. They show that there was a massive incidence of wage cuts during 2009, significantly higher than in any other country participating in the survey. They also show that the reason for this is not the severity of economic crisis. If companies in more or less equally severe conditions from different countries were compared, the share of wage cuts was still the highest (Dabušinskas & Rõõm, 2011, p. 58).

To summarise, it seems that as far as the downward nominal rigidity of total pay is concerned, there is relatively strong support for the hypothesis that DNWR in Estonia is amongst the lowest in the European Union.

5. DOWNWARD NOMINAL WAGE RIGIDITY IN ESTONIA – DIFFERENCES BY WORKER AND EMPLOYER GROUPS

5.1. Introduction

Different groups in the labour market can have different levels of DNWR. This may be a result of, for example, differences in bargaining power, risk awareness or group specific background conditions. As well as varying between employee groups, DNWR can also differ for employer groups. In the following sections the analysis will look at whether DNWR differs by:

- Gender;
- Age group;
- Wage level;
- Size of the company;
- Economic sector.

Before we turn to the estimation results, some methodical issues must be clarified. For some of these groups the separate estimation of equations is quite burdensome as there are 18 different economic sectors, which means that correspondingly 18 different equation systems must be estimated. Instead of this, a rewritten version of the model proposed by Knoppik & Beissinger (2009) will be used (Knoppik & Beissinger, 2009, pp. 325, 327):

$$PF_{rgt} = PC_r\left(1 - \left(\sum_g \rho_g DG_{rgt}\right) DNEG_{rgt}\right) + \left(\sum_g \rho_g DG_{rgt}\right)\left(F(q) - \sum_{j=1}^{r_{max}} PC_j + \sum_{j=1}^{r_{max}} PC_j DNEG_{jgt}\right) D0_{rit} + \mu_{rgt}$$

$$for\ r = 1 \dots r_{max}$$

(5–1)

where r is the number of the respective bin, g is the category identifier (e.g. gender, age group, economic sector), PF_{rgt} denotes the proportion of observations in bin r of the factual distribution at time t for the particular category g and PC_r is the proportion of observations in the counter-factual distribution. As can be seen, the method assumes that the counter-factual distribution is invariant not only over time, but also over different categories

(e.g. age groups). $DNEG_{rgt}$ and $D0_{rgt}$ are dummy variables that take the value 1 if the bin at time t for category g includes either negative or zero wage changes. DG_{rgt} is a dummy variable for category g that allows the separate rigidity coefficient for this category to be estimated. $F(q)$ is the value of the cumulative distribution function at location q and r_{max} indicates the highest bin number of the zero-bins over the years. μ_{rgt} is the error term. The coefficient ρ_i is the share of wage cuts that could not be enacted due to downward nominal rigidity (Knoppik & Beissinger, 2009, pp. 325, 327). This method is used by Knoppik & Beissinger (2009) in order to assess the rigidity coefficients for different countries.

In order to allow the rigidity to vary over time, variables ΔU and U are included in the same manner as in equations (4–3) and (4–5), yielding the following equations:

$$PF_{rgt} = PC_r\left(1 - \left(\sum_g DG_{rgt}\left(\rho_i + \rho_{\Delta U_i}\Delta U_t\right)\right)DNEG_{rgt}\right) + \left(\sum_g DG_{rgt}\left(\rho_i + \rho_{\Delta U_i}\Delta U_t\right)\right)\left(F(q) - \sum_{j=1}^{r_{max}} PC_j + \sum_{j=1}^{r_{max}} PC_j DNEG_{jgt}\right)D0_{rgt} + \mu_{rgt} \quad for\ r = 1 \dots r_{max}$$

(5–2)

$$PF_{rgt} = PC_r\left(1 - \left(\sum_g DG_{rgt}\left(\rho_i + \rho_{\Delta U_i}\Delta U_t + \rho_{U_i}U_t\right)\right)DNEG_{rgt}\right) + \left(\sum_g DG_{rgt}\left(\rho_i + \rho_{\Delta U_i}\Delta U_t + \rho_{U_i}U_t\right)\right)\left(F(q) - \sum_{j=1}^{r_{max}} PC_j + \sum_{j=1}^{r_{max}} PC_j DNEG_{jgt}\right)D0_{rgt} + \mu_{rgt} \quad for\ r = 1 \dots r_{max}$$

(5–3)

The data that are used as basis for the following calculations are standardised (location and variance measures will be specified in the sub-chapters). As the variation of median wage growth for some groups is high, a 2% bin width will be used in order to reduce the number of bins that have to be estimated.

5.2. Downward nominal wage rigidity and gender

The gender aspect of downward nominal rigidity has received little attention. Nevertheless, there are reasons to believe that men and women behave differently when faced with a proposed cut in wages. For example, Agell & Bennmarker (2007) find from a survey of Swedish firms that managers in companies with a large share of female workers are less inclined to believe that workers who feel underpaid respond by reducing effort than are managers in male-dominated firms (Agell & Bennmarker, 2007, p. 366). The reasons for this could be linked with the more risk adverse behaviour of women compared with men (e.g. Croson & Gneezy (2009), Holt & Laury (2002)).

When looking at pooled distributions of the yearly personalised social tax changes from 2002–2008, it seems that wage freezes are more common for men than for women (see Figure 21). This could be taken as the first sign of greater rigidity in the men's wage. However, it is important to keep in mind that the spike at zero is not a very useful tool for identifying rigidities if there is no comparison through a counter-factual distribution. Another interesting observation is that secondary spikes are missing. The explanation for this is a technical one – as the minimum wage and the minimum base of social tax grow at different rates in different years, pooling of the histograms serves as a smoothing mechanism.

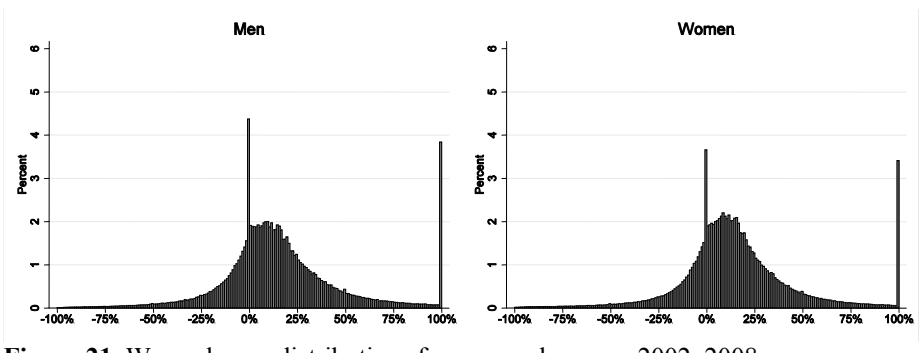


Figure 21. Wage change distributions for men and women 2002–2008
Source: Estonian Tax and Customs Board, author's calculations

In constructing the histogram bins that serve as the basis for the later analysis, the 35th percentile was used as the location of the distribution, while for the standardisation of wage growth figures the difference between the 95th and 35th percentiles of the wage change distribution was used[36]. The bin width was 2%-

[36] The use of different measures of location for employer and employee subgroups which can be seen in the following sub-chapters is motivated by the attempt to include in the analysis as few histogram bins as possible. The lower the location, the fewer the number of bins that must be estimated. However, the location must be sufficiently high to not be affected by DNWR itself, so it must always be above zero wage growth.

points. Altogether three different estimations were performed with equation systems (5–1), (5–2) and (5–3). First, the model (5–1) was estimated. This specification does not allow the rigidity coefficient to vary over time, and the results are presented in Table 23.

The table shows that all the coefficients are statistically significant and 11.5% of the wage cuts were censored for men, while the same estimate for women was only 9.1%. This indicates that there is a difference between the DNWRs of men and women. According to the Wald test for the equality of rigidity coefficients (See Appendix 3), this difference is also statistically significant.

Table 23. Rigidity coefficients from WLS estimates of equation system (5–1), by gender

Gender	Coefficient	Std. Error	t-Statistic	Prob.
Woman	9.1%	0.0035	25.6154	0.0000
Man	11.5%	0.0039	29.5869	0.0000

Source: Estonian Tax and Customs Board, author's calculations

Now we can turn to the model that allows a test of whether the business cycle has an influence on rigidity coefficients. As an indicator of the economic climate the change in the annual unemployment rate is used at first. If worsening labour market conditions do make workers less resistant to pay cuts, then $\rho_{\Delta U}$ should be statistically significant and have a negative sign.

Table 24. Time-varying rigidity coefficients from the WLS estimates of equation system (5–2), by gender

Gender		Coefficient	Std. Error	t-Statistic	Prob.
Woman	ρ	7.9%	0.0053	15.0815	0.0000
	$\rho_{\Delta U}$	–0.8%	0.0034	–2.4378	0.0165
Man	ρ	10.5%	0.0060	17.6501	0.0000
	$\rho_{\Delta U}$	–0.8%	0.0037	–2.2702	0.0253

Source: Estonian Tax and Customs Board, author's calculations

All the coefficients listed in the table are statistically significant at the 5% significance level, meaning that for both men and women DNWR is influenced by the labour market situation[37] (see Figure 22). However, as was already

[37] This result is relatively sensitive to the estimation method. Anspal & Järve (forthcoming) used on the same data the SUR estimator and found that for men the

mentioned in the previous chapter, the specification of model (5–2) tends to give results that are not intuitively appealing, as despite the decreasing unemployment the wage rigidity also seems to decline. The same problem is evident also from the Figure 22. The next logical step is to obtain the estimates from model (5–3) as well.

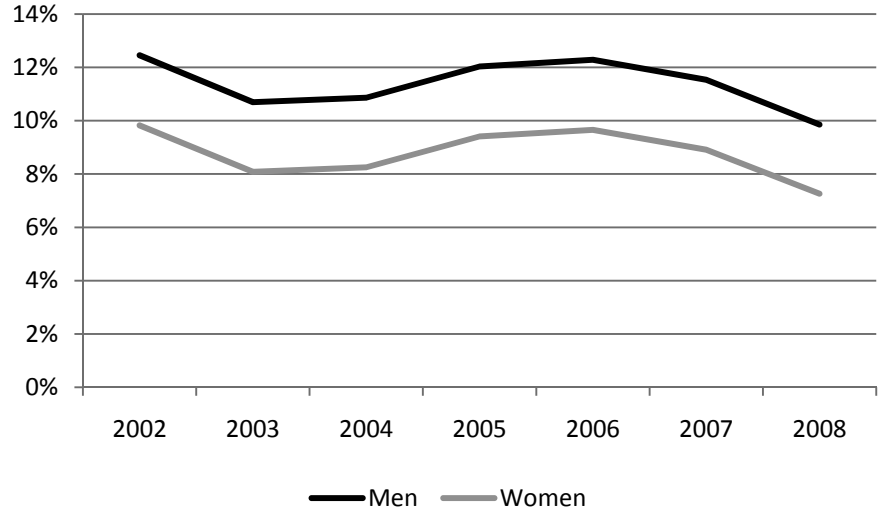


Figure 22. Rigidity coefficients for men and women (model (5–2))
Source: Estonian Tax and Customs Board, author's calculations

Table 25. Time-varying rigidity coefficients from the WLS estimates of equation system (5–3), by gender

Gender		Coefficient	Std. Error	t-Statistic	Prob.
Women	ρ	10.2%	0.0119	8.5800	0.0000
	$\rho_{\Delta U}$	–1.0%	0.0031	–3.2763	0.0015
	ρ_{U}	–0.3%	0.0016	–2.1103	0.0374
Men	ρ	14.9%	0.0136	10.8939	0.0000
	$\rho_{\Delta U}$	–1.1%	0.0038	–2.9205	0.0043
	ρ_{U}	–0.6%	0.0018	–3.3813	0.0010

Source: Estonian Tax and Customs Board, author's calculations

Again all coefficients are statistically significant at the 5% level of confidence. There are several conclusions from this sub-chapter. Firstly, men's wages are

cyclical component of DNWR (coefficient $\rho_{\Delta U}$) was insignificant while for women this was not the case. Here weighted least squares estimator is preferred, as it gives more stable results on small samples (Beissinger & Knoppik, 2001, pp. 407-408).

more downwardly rigid than women's wages. Secondly, the DNWR of men is more volatile over the business cycle than that of women.

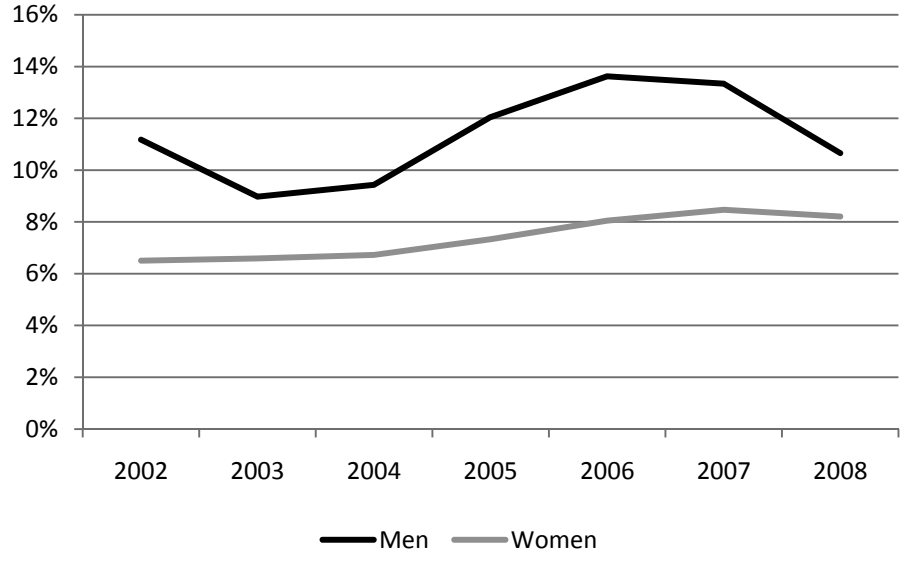


Figure 23. Rigidity coefficients for men and women (model (5–3))
Source: Estonian Tax and Customs Board, author's calculations

5.3. Downward nominal wage rigidity and age

A person's age could have an impact on his or her bargaining behaviour, and thus influence the DNWR. For example, younger people tend to have higher unemployment rates so that in 2009 the unemployment rate in Estonia among 15–24 year olds was 27.5% while it was 13% for the 25–49 age group 25–49)[38]. Difficulties in finding a job can make people behave less demandingly in wage negotiations.

A quick look at the histograms of the pooled wage change data for 2002–2008 highlights two interesting points. Firstly, judging by the number of zero wage growth observations in the wage distribution, then the group of those older than 65 years show significantly higher rigidity than workers younger than 65. Secondly, the share of higher than 100% wage growth is significantly higher for younger workers (under 24 years old) than for older age groups. The share of wage freezes is also the lowest for them. These findings will be addressed later in this chapter. In the following section the same models as in the previous sub-chapter will be estimated (5–1), (5–2) and (5–3). In order to keep the results as comparable as possible with other employee and employer groups, a 2% bin width will be used. The 45th percentile serves as the location and in

[38] Source: Statistics Estonia.

standardising the data difference between the 95th and 45th percentiles is the measure of variance.

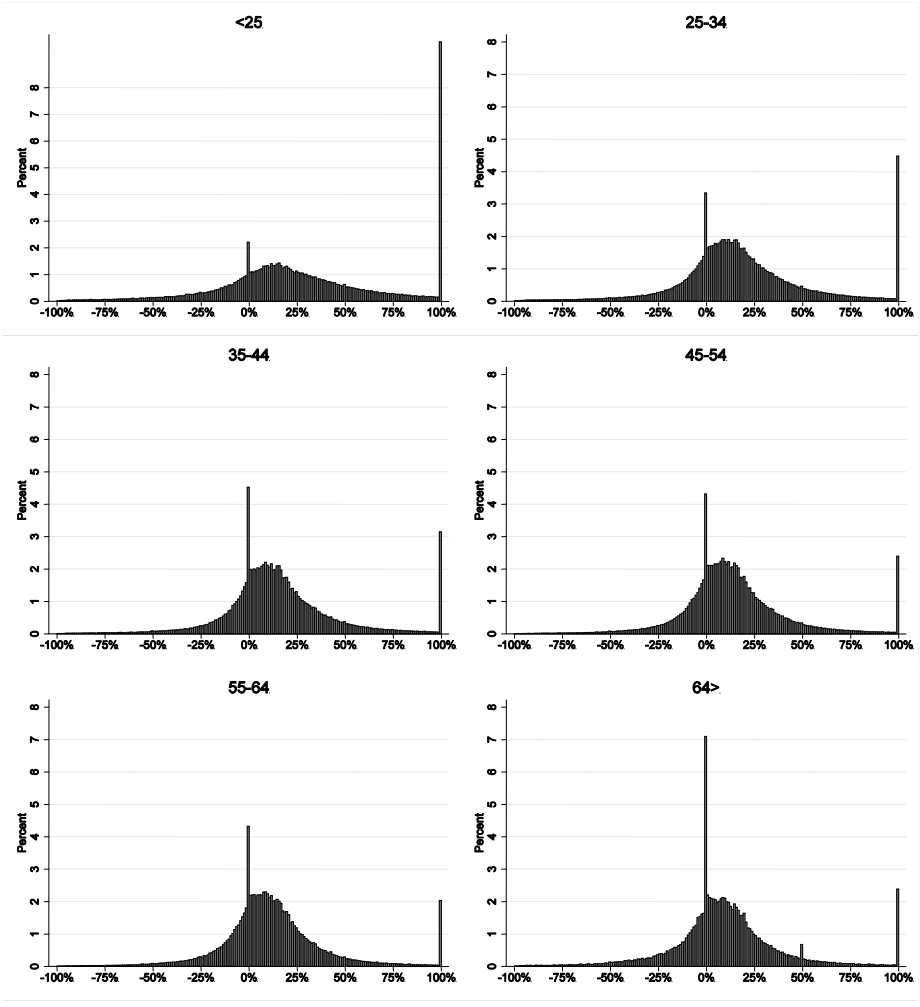


Figure 24. Wage change distributions, by age group 2002–2008
Source: Estonian Tax and Customs Board, author's calculations

The first glance at the Table 26 shows that there are clear differences between age groups[39] and the relationship seems to be hump-shaped. People in their prime working age of 35–55 tend to have more rigid wages than younger people (<24) and also people who do not have long before retirement (55–64). These figures seem to be quite closely in line with over-the-life-cycle wage figures,

[39] These differences (with an exception of differences between groups 25–34 and 55–64) are also statistically significant at 5% significance level (see Appendix 3).

which could also be treated as an indication of a person's bargaining power in wage negotiations (see Figure 25). Pseudo-cohort wage profiles also explain the high share of over 100% wage growth figures, as from 15–30 the wages seem to rise very steeply[40]

Table 26. Rigidity coefficients from the WLS estimates of equation system (5–2), by age group

Age group	Coefficient	Std. Error	t-Statistic	Prob.
<24	5.9%	0.0048	12.2781	0.0000
25–34	8.0%	0.0036	22.1815	0.0000
35–44	11.4%	0.0040	28.3019	0.0000
45–54	9.8%	0.0047	20.9804	0.0000
55–64	8.3%	0.0043	19.2700	0.0000
>65	15.2%	0.0053	28.6623	0.0000

Source: Estonian Tax and Customs Board, author's calculations

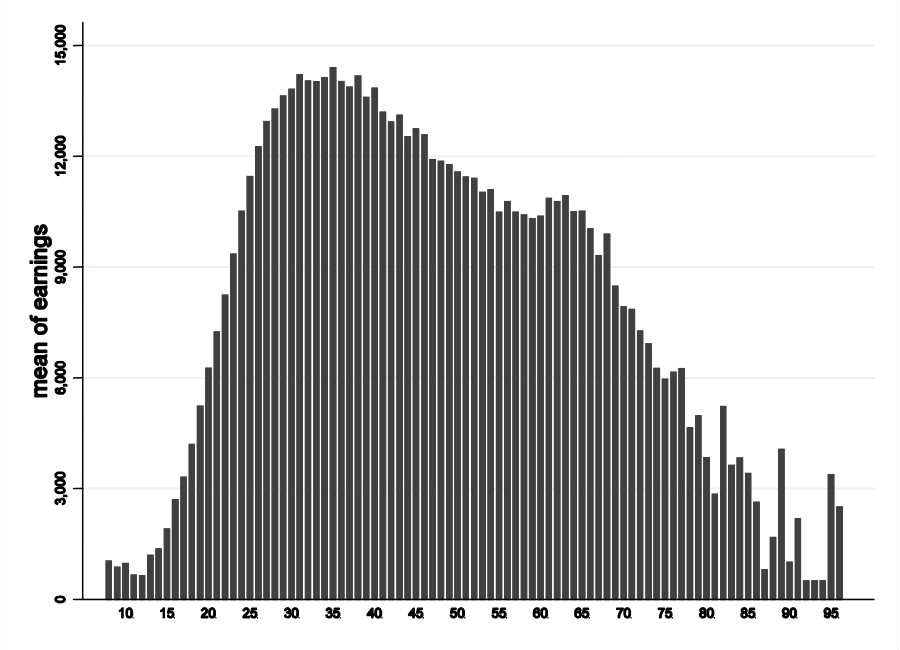


Figure 25. Pseudo-cohort over-the-life-cycle wage profile calculated as average mean wage for age group, year 2009 (EEK)
Source: Estonian Tax and Customs Board, author's calculations

[40] One reason for this could be that the share of part-time workers amongst 15–24 year olds is more than twice as high as amongst 25–49 year olds (Source: Statistics Estonia). High earnings growth figures can thus be partly a result of switches from part time to full time work.

However, older cohorts seem to be the ones with the most rigid wage, with more than 15% of wage cuts being prevented by DNWR. What could be the reason for this? As retired people do have an alternative income from their pension, they might be more rigid in wage negotiations. The most probable reason, however, is employment protection legislation. The costs associated with laying off a person with more than 10 years of experience during the period 2002–2008 consisted of a four-month notice period and severance payment of four average monthly wages. This is twice as high as for people with less than five years of experience, so threats of a wage cut or the sack if the worker does not agree are less convincing for workers with higher seniority than for people with shorter seniority. Among older workers, the share of more experienced workers is larger than in younger age groups.

Another point is the issue of selectivity. It could be that the personal characteristics of the workers who decide to continue working after retirement age are different, for example they have more qualifications or better wage bargaining behaviour. If this is the case, it is more difficult for the employer to get them to agree to a wage cut.

Table 27. Time-varying rigidity coefficients from the WLS estimates of equation system (5–2), by age group

Age group		Coefficient	Std. Error	t-Statistic	Prob.
<24	ρ	5.6%	0.0067	8.3214	0.0000
	$\rho_{\Delta U}$	–0.2%	0.0041	–0.5014	0.6163
25–34	ρ	7.2%	0.0053	13.6147	0.0000
	$\rho_{\Delta U}$	–0.7%	0.0038	–1.8699	0.0620
35–44	ρ	10.6%	0.0048	22.0639	0.0000
	$\rho_{\Delta U}$	–0.7%	0.0031	–2.2562	0.0244
45–54	ρ	9.2%	0.0059	15.6844	0.0000
	$\rho_{\Delta U}$	–0.6%	0.0037	–1.5306	0.1264
55–64	ρ	7.3%	0.0048	15.0375	0.0000
	$\rho_{\Delta U}$	–1.4%	0.0034	–4.0867	0.0001
>65	ρ	12.9%	0.0060	21.5165	0.0000
	$\rho_{\Delta U}$	–2.9%	0.0042	–6.9416	0.0000

Source: Estonian Tax and Customs Board, author's calculations

Introducing time variability to the rigidity coefficients gives quite interesting results. Not all age groups are equally sensitive to changes in labour market conditions – at the 5% significance level the rigidity of wages of those under 34 or aged 45–54 does not depend on changes in the unemployment rate. However, for other age groups too, the fluctuations brought about by changes in the unemployment rate are not large. The only exception is the group of those over 65, which shows significantly higher volatility.

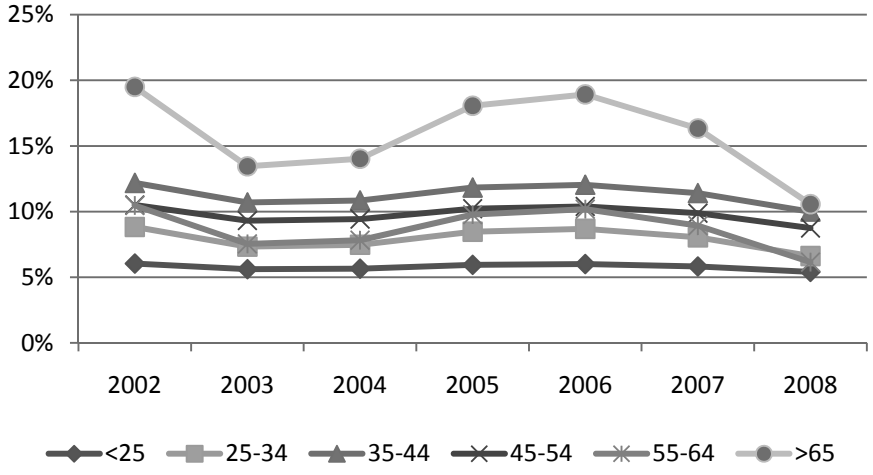


Figure 26. Rigidity coefficients, by age group (model (5–2))
Source: Estonian Tax and Customs Board, author's calculations

Table 28. Time-varying rigidity coefficients from the WLS estimates of equation system (5–3), by age group

Age group		Coefficient	Std. Error	t-Statistic	Prob.
<25	ρ	3.9%	0.0127	3.1155	0.0019
	$\rho_{\Delta U}$	–0.2%	0.0031	–0.6467	0.5181
	ρ_{U}	0.2%	0.0015	1.5459	0.1227
25–34	ρ	7.5%	0.0114	6.5673	0.0000
	$\rho_{\Delta U}$	–0.3%	0.0036	–0.8895	0.3741
	ρ_{U}	0.0%	0.0014	0.2406	0.8100
35–44	ρ	13.2%	0.0118	11.2065	0.0000
	$\rho_{\Delta U}$	–0.6%	0.0031	–1.8304	0.0677
	ρ_{U}	–0.3%	0.0015	–2.0961	0.0365
45–54	ρ	15.2%	0.0145	10.5377	0.0000
	$\rho_{\Delta U}$	–0.7%	0.0036	–2.0485	0.0410
	ρ_{U}	–0.7%	0.0017	–4.2592	0.0000
55–64	ρ	11.9%	0.0143	8.3786	0.0000
	$\rho_{\Delta U}$	–1.6%	0.0035	–4.5527	0.0000
	ρ_{U}	–0.6%	0.0018	–3.2859	0.0011
>64	ρ	29.4%	0.0158	18.6097	0.0000
	$\rho_{\Delta U}$	–3.0%	0.0041	–7.3944	0.0000
	ρ_{U}	–2.0%	0.0019	–10.6819	0.0000

Source: Estonian Tax and Customs Board, author's calculations

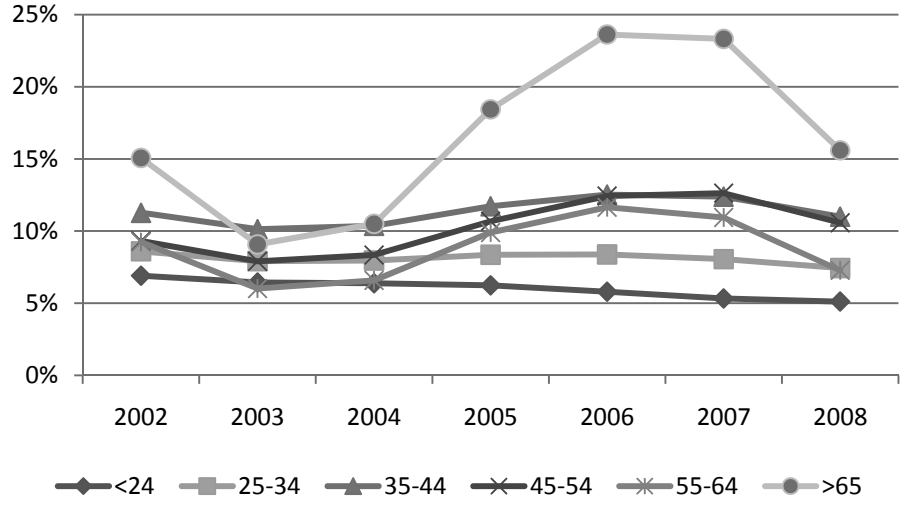


Figure 27. Rigidity coefficients for different age groups 2002–2008 (model (5–3))
Source: Estonian Tax and Customs Board, author's calculations

Model specification (5–3) does not change the picture significantly. The wages of the older people (65 and older) become even more volatile and are clearly increasing over the years of declining unemployment. However, when the labour market showed the first signs of crisis in 2008 the rigidity coefficient declined significantly, undermining the hypothesis that high rigidity coefficients for older people are the result of employers' preference for laying off older people instead of cutting their wages.

Another reason for higher wage rigidity in the age group of 65 and older could be that their wages are anyway lower than those of the age groups that form the majority of the labour market. It might thus be difficult to cut older workers' wages and still keep them motivated to work, especially when they are already entitled to a pension. However, if the overall labour market situation gets worse, nobody has immunity against wage cuts and so wage rigidity will decline, even while it remains higher than for other age groups.

5.4. Downward nominal wage rigidity and the level of the wage

The level of the wage could be a sign of a person's bargaining power and thereby also influence the DNWR. On the other hand, at very low wage levels there is no room for decline as the legislative environment does not allow this, for example because of regulations prescribing the level of the minimum wage. This means the size of the wage can have both positive and negative effects on DNWR.

Wage earners are divided into five groups:

- Last year's wage less than 50% of the average wage;
- Last year's wage between 50% and 100% of the average wage;
- Last year's wage between 100% and 150% of the average wage;
- Last year's wage between 150% and 200% of the average wage;
- Last year's wage more than 200% of the average wage.

Wage growth histograms show that remarkable differences are evident only for people earning less than half the average wage. For them the share of wage freezes is slightly higher, but the share of observations of above 100% wage growth is more noticeable. It should be kept in mind with the low wage figures for people less than 24 years old that these higher growth rates may at least partly be caused by rapid earning increases during the first years of a professional career, and from a switch from part time to full time work.

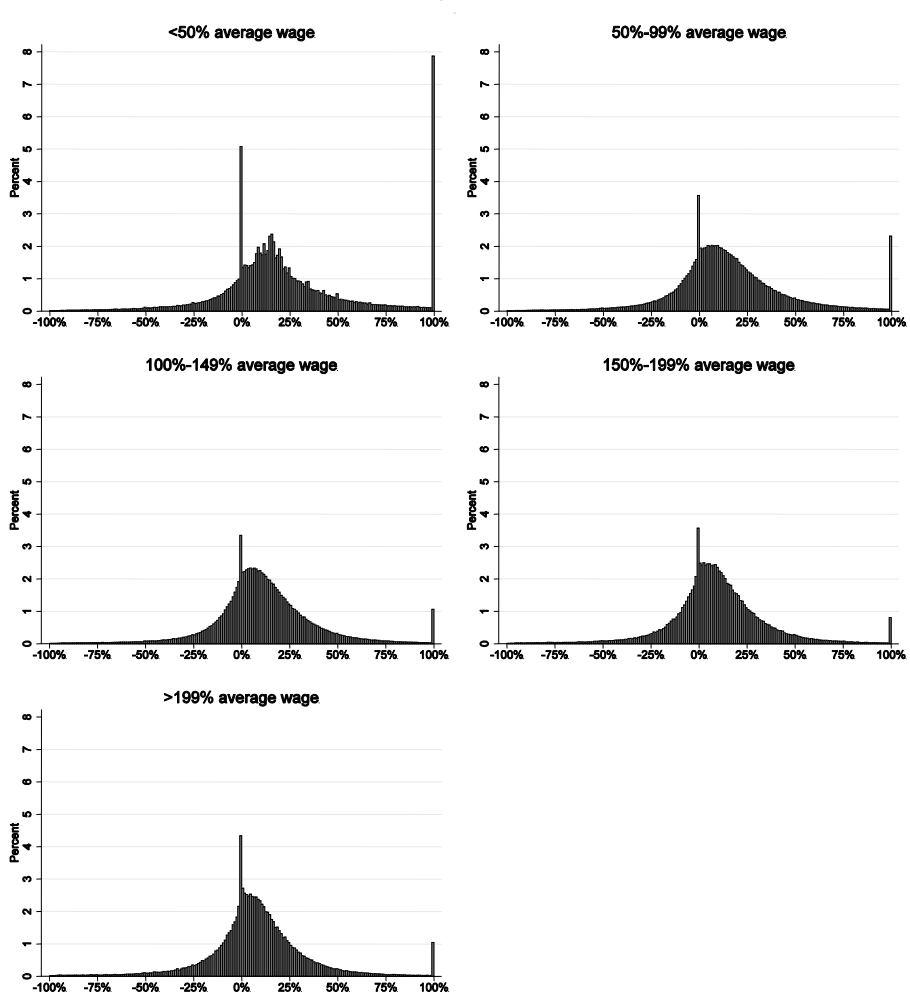


Figure 28. Wage change distributions, by level of wage group
Source: Estonian Tax and Customs Board, author's calculations

As in previous sub-chapters, models (5–1), (5–2) and (5–3) will be estimated. The location is the 40th percentile and the variance measure for standardisations is the difference between the 95th and 40th percentiles. The results are listed in the following tables.

Table 29. Rigidity coefficients from the WLS estimates of equation system (5–1), by wage group

Wage	Coefficient	Std. Error	t-Statistic	Prob.
<0.5 average wage	17.4%	0.0052	33.1542	0.0000
0.5–1 average wage	8.0%	0.0047	16.9246	0.0000
1–1.5 average wage	5.9%	0.0051	11.7626	0.0000
1.5–2 average wage	5.7%	0.0052	10.9146	0.0000
>2 average wage	7.7%	0.0057	13.3817	0.0000

Source: Estonian Tax and Customs Board, author's calculations

Table 30. Time-varying rigidity coefficients from the WLS estimates of equation system (5–2), by wage group

Wage		Coefficient	Std. Error	t-Statistic	Prob.
<0.5 average wage	ρ	16.4%	0.0068	24.2278	0.0000
	$\rho_{\Delta U}$	–0.9%	0.0046	–2.0060	0.0455
0.5–1 average wage	ρ	7.2%	0.0068	10.5870	0.0000
	$\rho_{\Delta U}$	–0.7%	0.0045	–1.6532	0.0990
1–1.5 average wage	ρ	5.0%	0.0076	6.5665	0.0000
	$\rho_{\Delta U}$	–0.9%	0.0048	–1.8368	0.0669
1.5–2 average wage	ρ	4.8%	0.0087	5.5630	0.0000
	$\rho_{\Delta U}$	–0.8%	0.0058	–1.3191	0.1878
>2 average wage	ρ	7.4%	0.0099	7.4983	0.0000
	$\rho_{\Delta U}$	–0.2%	0.0066	–0.3308	0.7409

Source: Estonian Tax and Customs Board, author's calculations

Model specification (5–1) yields coefficients that are statistically significant. Major differences are evident between the group that earns less than half the average wage and the rest. For low wages, 17.4% of wage cuts did not occur because of DNWR, while for the rest of the wage groups this coefficient varies between 8% and 5.7%[41]. Interestingly, though, model (5–2) shows that low

[41] Concerning the statistical significance of the differences between wage groups, the differences in rigidity between workers who earned 1–1.5 times the average wage and

wage earners are also the only group showing variance in DNWR that is conditional on the labour market situation. For all other wage groups, $\rho_{\Delta U}$ is statistically not significant. Another interesting result is that the statistical significance deteriorates with an increase in wages. For example, for wage groups earning between 0.5 and 1.5 times the average wage, although the coefficient of a change in the unemployment rate is statistically not significant at the 5% significance level, it is significant at the 10% level. This is not the case for wage groups earning above 1.5 times the average wage, where the probability values increase substantially.

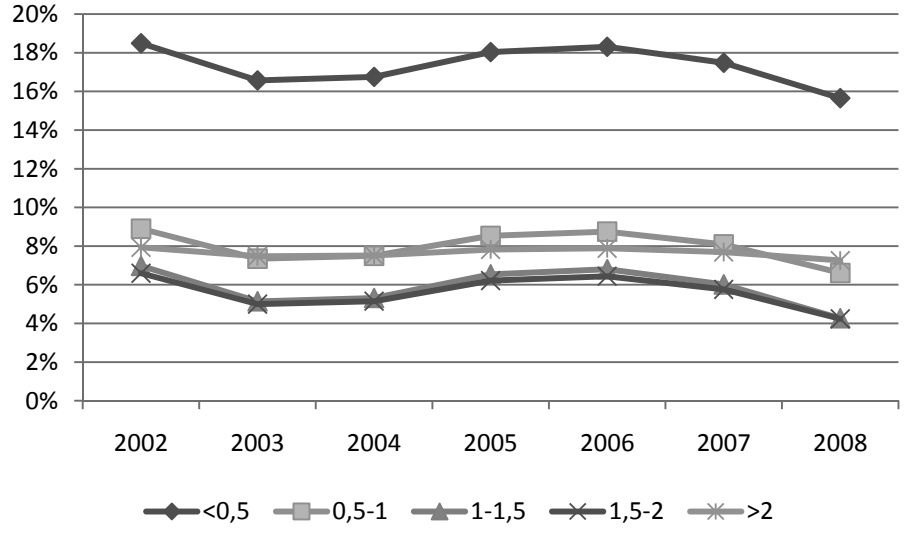


Figure 29. Rigidity coefficients for different wage groups 2002–2008 (model (5–2))
Source: Estonian Tax and Customs Board, author's calculations

Model specification (5–3) tests the importance of adding the unemployment rate to the previously estimated model. The results confirm that the DNWR of workers earning a wage above 1.5 times the average wage does not depend on labour market conditions. Otherwise, this specification does not add anything to the results already listed.

1.5–2 times the average wage were statistically insignificant. The same applies to the groups earning 0.5–1 and above 2 times the average wage (see Appendix 3).

Table 31. Time-varying rigidity coefficients from the WLS estimates of equation system (5–2), by wage group

Wage		Coefficient	Std. Error	t-Statistic	Prob.
<0.5 average wage	ρ	16.9%	0.0179	9.4205	0.0000
	$\rho_{\Delta U}$	–1.0%	0.0046	–2.0887	0.0373
	ρ_{U}	–0.1%	0.0022	–0.2508	0.8021
0.5–1 average wage	ρ	11.9%	0.0158	7.5400	0.0000
	$\rho_{\Delta U}$	–0.8%	0.0042	–1.8916	0.0592
	ρ_{U}	–0.7%	0.0021	–3.2221	0.0014
1–1.5 average wage	ρ	10.7%	0.0174	6.1483	0.0000
	$\rho_{\Delta U}$	–0.9%	0.0046	–1.9046	0.0575
	ρ_{U}	–0.8%	0.0023	–3.4692	0.0006
1.5–2 average wage	ρ	5.9%	0.0185	3.1707	0.0016
	$\rho_{\Delta U}$	–0.7%	0.0057	–1.2694	0.2050
	ρ_{U}	–0.1%	0.0023	–0.5942	0.5527
>2 average wage	ρ	6.6%	0.0211	3.1201	0.0019
	$\rho_{\Delta U}$	–0.2%	0.0066	–0.3609	0.7183
	ρ_{U}	0.1%	0.0026	0.4509	0.6523

Source: Estonian Tax and Customs Board, author's calculations

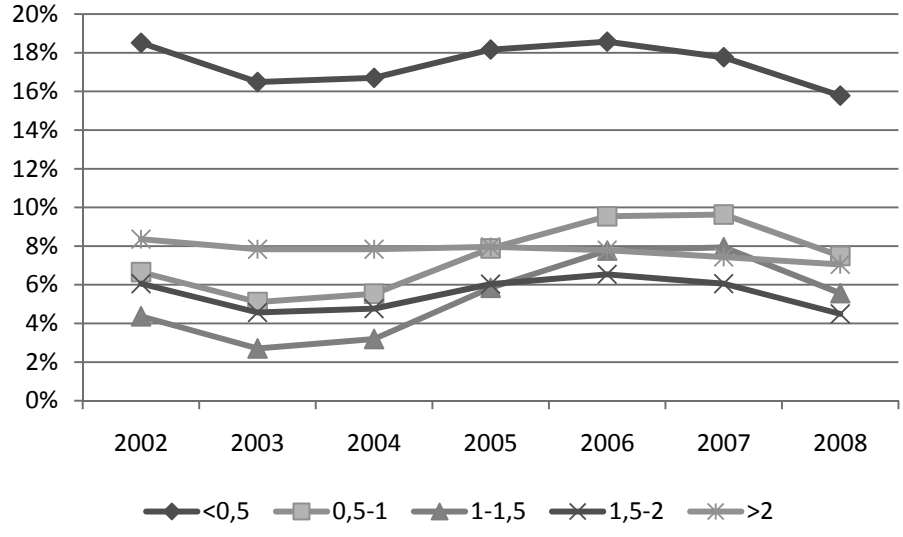


Figure 30. Rigidity coefficients for different wage groups 2002–2008 (model (5–3))
Source: Estonian Tax and Customs Board, author's calculations

In general it can be concluded that the wages of low wage earners are significantly more downwardly rigid than those of other groups. Furthermore, for wages below 1.5 times the average wage there is the relationship between labour market conditions and DNWR, either with the unemployment rate or a change in the unemployment rate. Wages above 1.5 times the average wage are not influenced by conditions in the labour market at least if they are measured with the unemployment rate or a change in the unemployment rate.

These results are somewhat surprising, as the bargaining power of high wage earners should be significantly higher than that of those earning lower wages. On the other hand, with higher wages the share of performance related pay can also be higher, leaving more room for wage flexibility. However, low wages below 50% of the average wage can hardly incorporate a significant share of performance related pay, because they are against the lower bound of legally allowed wage levels. The minimum wage has for most of the period been 30–35% of the average wage, which could have censored significant income reductions in this wage group (see Figure 31).

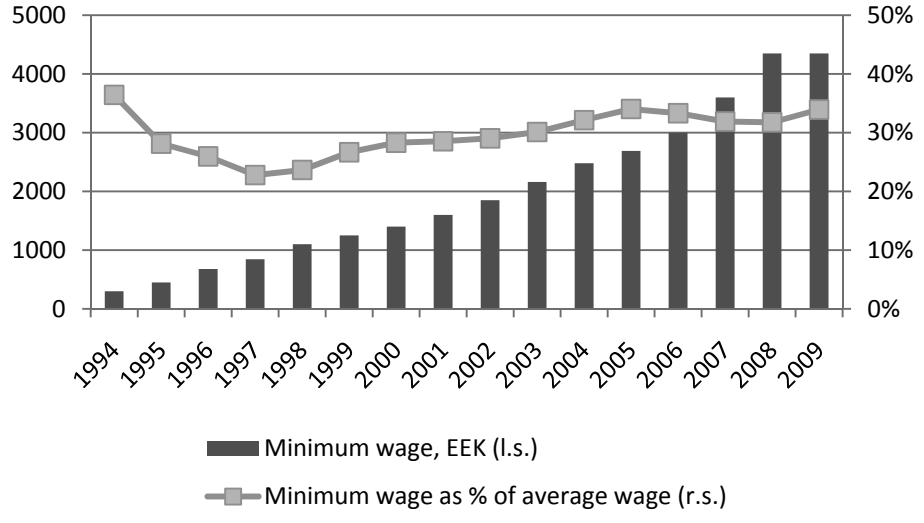


Figure 31. Minimum wage in Estonia 1994–2009
Source: Statistics Estonia, legal acts, author's calculations

The impact of minimum wage on DNWR of low wage earners deserves further scrutiny. It is important to keep in mind that for those, who earn only minimum wage, an increase in minimum wage results in spike at the location of minimum wage growth and not at the location of zero wage growth. At least for those people, the minimum wage cannot be the source of DNWR as for all years in the sample (2002–2008) minimum wage growth has been above zero. Model specifications that have been used so far have ignored the rigidity coming from

minimum wage increases[42]. However, when analysing minimum wage earners the old model specification can leave a false impression of nominal wage flexibility, because there will be no pile-up at zero wage growth and thus no DNWR. In order to address these issues additional wage earner sub-groups as well as new model type will be used.

The group of people earning below 50% of average wage will be further divided into five sub-groups:

- Las years wage lower than 95% of last year's minimum wage;
- Las years wage equal to last year's minimum wage +/–5%;
- Las years wage between 105% of last year's minimum wage and 95% of current years minimum wage;
- Las years wage equal to current year's minimum wage +/–5%;
- Las years wage between 105% of current year's minimum wage and 50% of average wage.

The model that will be used in the following section was proposed by Castellanos *et al*. (2004). It is a modification of Kahn (1997) model, incorporating rigidities stemming from minimum wage increases (Castellanos, Garcia-Verdu, & Kaplan, 2004, p. 523). A closed version of this model (derived in spirit of Knoppik & Beissinger (2009)) would be following:

$$PF_{rgt} = PC_r - PC_r\left(\sum_g \rho_g DG_{rgt}\right) DNEG_{rgt} + \left(\sum_g \rho_g DG_{rgt}\right)\left(F(q) - \sum_{j=1}^{r_{max}} PC_j + \sum_{j=1}^{r_{max}} PC_j DNEG_{jgt}\right) D0_{rit}$$

$$-PC_r\left(\sum_g \rho_g^{MW} \; DG_{rgt}\right) DMWLOW_{rgt} + \left(\sum_g \rho_g^{MW} DG_{rgt}\right)\left(F(q) - \sum_{j=1}^{r_{max}} PC_j + \sum_{j=1}^{r_{max}} PC_j DMWLOW_{jgt}\right) DMW_{rit} + \mu_{rgt}$$

[42] Ignoring the rigidity stemming from direct increases in minimum wage is motivated by the fact that the focus of this analysis is on DNWR not all possible types of rigidity (e.g. menu cost or upward rigidity of wages).

$$for\ r = 1 \dots r_{max}$$

(5–4)

where in addition to previously defined variables and coefficients ρ_g^{MW} indicates rigidity that stems from minimum wage increases, $DMWLOW_{rgt}$ is a dummy variable that takes value *1* if histogram locates below the minimum wage and DMW_{rit} is another dummy variable that takes value *1* if histogram bin includes the growth of minimum wage.

The intuition behind the model is the same as behind Kahn (1997), however instead of one rigidity coefficient there are two (one for histogram bins below zero wage growth and other for histogram bins below minimum wage growth), also there are two different pile-up location (zero wage growth and minimum wage growth). In other words – in addition to persons who do not like wage cuts there are also workers who resist wage increases below minimum wage growth (or whose wages cannot be increased with lower rate because of the law). It could be imagined that for workers with different wage levels one or the other source of rigidity is more dominant.

Table 32. Rigidity coefficients from the WLS estimates of equation system (5–4), for wage group below 50% average wage

Wage group		Coefficient	Std. Error	t-Statistic	Prob.
Total pay lower than 95% of last year's MW	ρ	0.2127	0.0094	22.7070	0.0000
	ρ_{MW}	0.0995	0.0100	9.9576	0.0000
Total pay equal to last year's MW+/–5%	ρ	0.0437	0.0110	3.9937	0.0001
	ρ_{MW}	0.3351	0.0102	32.9656	0.0000
Total pay between 105% of last year's MW and 95% of current year's MW	ρ	0.0425	0.0133	3.1852	0.0015
	ρ_{MW}	0.0048	0.0092	0.5219	0.6019
Total pay equal to current year's MW+/–5%	ρ	0.1241	0.0173	7.1764	0.0000
	ρ_{MW}	–0.0176	0.0094	–1.8688	0.0620
Total pay between 105% of current year's MW and 50% of average wage	ρ	0.2348	0.0184	12.7308	0.0000
	ρ_{MW}	–0.0208	0.0088	–2.3701	0.0180

Source: Estonian Tax and Customs Board, author's calculations

The results are listed in Table 32[43]. It seems that DNWR is the highest for persons whose wage in the last year was below minimum wage (ca 21%) as

[43] 65th percentile was used as location, data was standardised by using the difference between 95th and 65th percentile.

well as for group earning above current year's minimum wage (ca 23%). The wage of last year's minimum wage earnest shows, as expected, very low DNWR (only 4.2% of wage cuts were not enacted because of DNWR), however more than 33% of wage changes below minimum wage growth were converted into wage increases at the rate of minimum wage growth. Minimum wage increases affected also people earning less than minimum wage (ca10% of wage growth figures below minimum wage growth were converted into wage rise a rate of minimum wage growth). For other groups, the impact of minimum wage increases was either statistically insignificant or even negative (also the size of the coefficient is modest).

In general it can be concluded that wages of workers earning below 50% of the average wage are significantly more rigid than wages of workers with higher earnings. For persons with very low earnings (minimum wage and below minimum wage) the increases in minimum wage are an important additional source of nominal wage rigidity.

5.5. Downward nominal wage rigidity and company size

Wages can behave differently in smaller and larger companies. There can be several reasons for this, for example in larger companies the wage setting system is usually more formalised and follows a more clearly defined personnel policy, while in small, and especially micro, companies the wage setting system is less formal. This could result in lower DNWR for smaller companies. On the other hand the bargaining power of the employer might be stronger in larger companies so they can be more effective in enforcing the necessary wage cuts.
Wage growth histograms show that companies with 50 and more workers behave almost identically. For smaller companies the share of wage freezes is higher, especially for micro enterprises, those with less than 10 workers.

Models (5–1), (5–2) and (5–3) were estimated using standardised data. The location is the 40^{th} percentile and the variance measure for the standardisations is the difference between the 95^{th} and 40^{th} percentiles. The results are listed in the following tables.

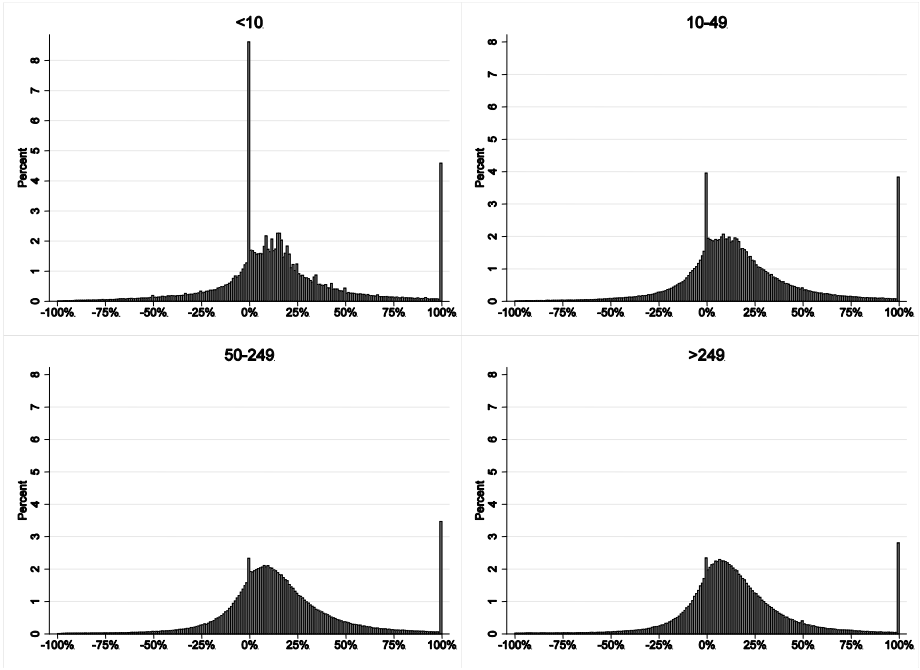


Figure 32. Personalised social tax change distributions, by company size 2002–2008
Source: Estonian Tax and Customs Board, author's calculations

The coefficients of model (5–1) are all statistically significant. There is a clear and negative relationship between company size and DNWR, and the larger the company the less rigid are the wages[44]. Even more remarkable is the difference between companies employing less than 10 workers, where 25.6% of wage cuts were not enacted, and other company size groups, where rigidity coefficients ranged from 9.9% for companies employing 10–49 workers to 2.7% for companies employing more than 500 workers.

Table 33. Rigidity coefficients from the WLS estimates of equation system (5–1), by company size group

Number of workers	Coefficient	Std. Error	t-Statistic	Prob.
<10	25.6%	0.0043	59.6391	0.0000
10–49	9.9%	0.0033	30.0226	0.0000
50–249	2.9%	0.0037	7.8855	0.0000
>250	2.7%	0.0040	6.6794	0.0000

Source: Estonian Tax and Customs Board, author's calculations

[44] These differences are also statistically significant with the only exceptions being the two largest size groups (see Appendix 3).

Table 34. Time-varying rigidity coefficients from the WLS estimates of equation system (5–2), by company size group

Number of workers		Coefficient	Std. Error	t-Statistic	Prob.
<10	ρ	24.2%	0.0061	39.3023	0.0000
	$\rho_{\Delta U}$	–1.1%	0.0040	–2.6830	0.0077
10–49	ρ	8.3%	0.0046	18.1105	0.0000
	$\rho_{\Delta U}$	–1.2%	0.0030	–3.9999	0.0001
50–249	ρ	2.3%	0.0047	4.8553	0.0000
	$\rho_{\Delta U}$	–0.6%	0.0032	–1.7667	0.0782
>250	ρ	1.5%	0.0054	2.8101	0.0053
	$\rho_{\Delta U}$	–1.1%	0.0036	–3.0929	0.0022

Source: Estonian Tax and Customs Board, author's calculations

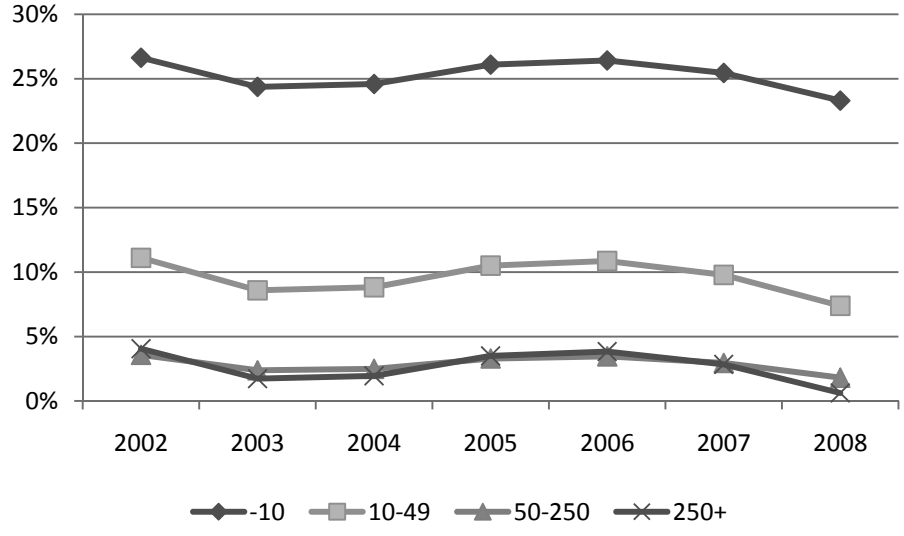


Figure 33. Rigidity coefficients for different company sizes 2002–2008 (model (5–2))
Source: Estonian Tax and Customs Board, author's calculations

In model (5–2) the change in the unemployment rate is used for to add in the changes in the business cycle. The coefficients have the expected signs and are statistically significant, except for companies with 50–249 workers where the variance of the coefficient for change in unemployment is slightly above the 5% significance threshold. Although it seems that labour market conditions do influence DNWR, the fluctuations are not very large for any groups. Also, there seems to be no clear trend over the years, despite the fact that unemployment declined from 2002 to 2008 significantly.

Table 35. Time-varying rigidity coefficients from the WLS estimates of equation system (5–3), by company size group

Number of workers		Coefficient	Std. Error	t-Statistic	Prob.
<10	ρ	23.8%	0.0144	16.5383	0.0000
	$\rho_{\Delta U}$	–1.3%	0.0039	–3.2460	0.0013
	ρ_{U}	0.0%	0.0018	0.0402	0.9679
10–49	ρ	7.8%	0.0118	6.5831	0.0000
	$\rho_{\Delta U}$	–1.2%	0.0030	–4.0622	0.0001
	ρ_{U}	0.1%	0.0016	0.4282	0.6688
50–249	ρ	1.7%	0.0120	1.4123	0.1589
	$\rho_{\Delta U}$	–0.6%	0.0031	–1.8787	0.0612
	ρ_{U}	0.1%	0.0016	0.4454	0.6564
>250	ρ	6.8%	0.0116	5.8616	0.0000
	$\rho_{\Delta U}$	–1.3%	0.0032	–4.1937	0.0000
	ρ_{U}	–0.7%	0.0015	–4.7108	0.0000

Source: Estonian Tax and Customs Board, author's calculations

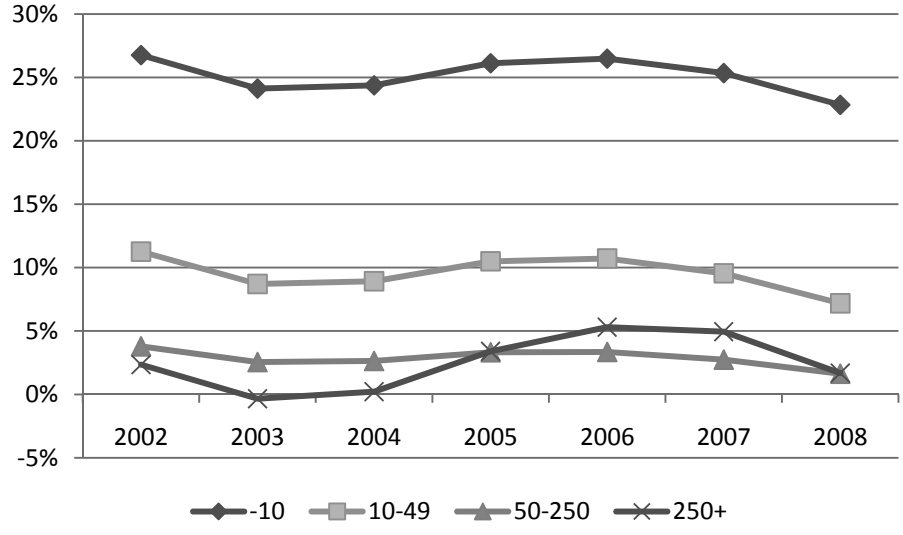


Figure 34. Rigidity coefficients for different company sizes 2002–2008 (model (5–3))
Source: Estonian Tax and Customs Board, author's calculations

Model (5–3) shows that the unemployment rate does not help to explain the fluctuations in DNWR as the coefficient of level of unemployment is statistically insignificant for all company size groups except companies employing

over 250 workers. For large companies with 250+ workers the coefficient is significant, but for the year 2003 it yields a slightly negative DNWR coefficient, which is not consistent with the theoretical framework.

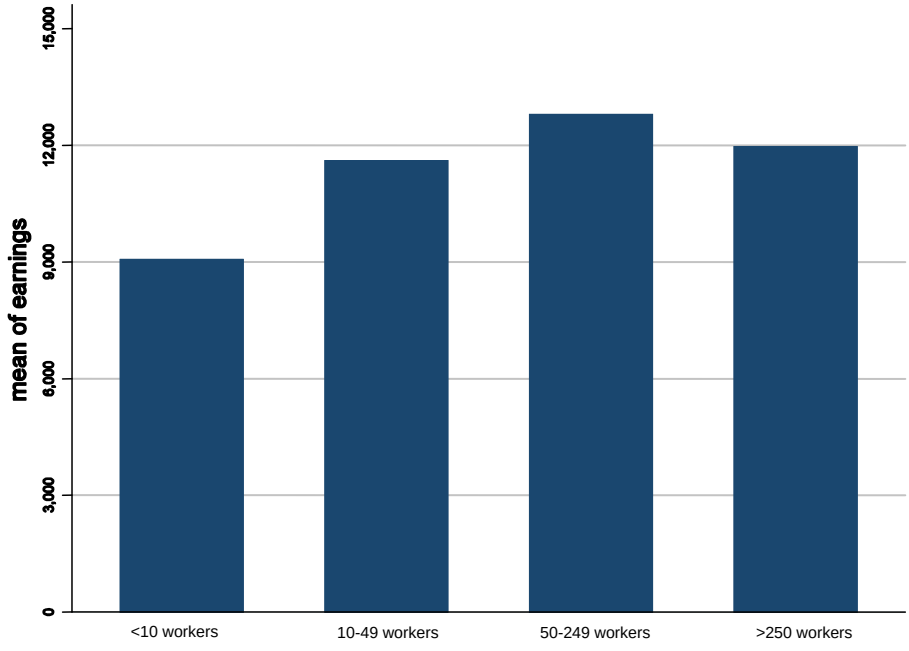


Figure 35. Average wage by company size 2008
Source: Estonian Tax and Customs Board, author's calculations

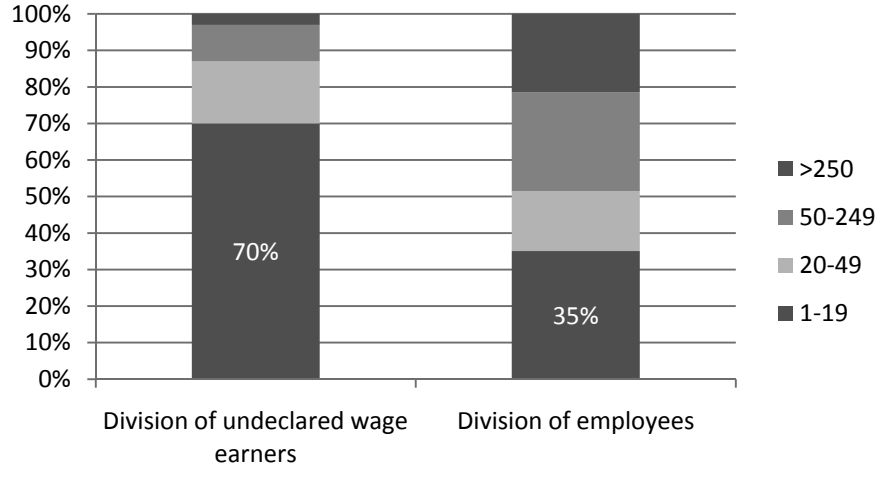


Figure 36. Distribution of undeclared wage earners by company size, 2008
Source: Statistics Estonia, (Ahermaa, 2009)*, author's calculations*

It must be admitted, that it is quite surprising to see that wages in micro companies are significantly more rigid than those in larger companies. One reason could be that in small and micro companies the practice of paying undeclared wages is more common than in larger companies. The result is that the declared wages that are reported to the Estonian Tax and Customs Board are smaller and probably less volatile, as flexibility is obtained by varying the undeclared part of the salary. This hypothesis is partly confirmed by the figures listed above (Figure 35 and Figure 36), which show that wages are indeed lower in micro companies than in other employer size groups, because while only 35% of workers work in companies with less than 20 workers, roughly 70% of those who answered in the Survey on the Undeclared Economy 2008 that they had received at least part of their wage as undeclared worked in companies that had less than 20 workers (Ahermaa, 2009, p. 22). Unfortunately the company size groups used in the Survey on the Undeclared Economy 2008 do not allow for observation of the incidence of undeclared pay in companies with less than 10 workers, but there is no reason to believe that micro companies are more law-abiding than companies with 10–19 workers.

5.6. Downward nominal wage rigidity and economic sector

Economic sectors are influenced by different factors that shape the wage conditions of workers. For example, some sectors are more export oriented while others provide goods and services on local markets; some sectors are more unionised, while others are union free. DNWR depends on the economic environment and at any given time different sectors can have completely different economic environments, depending on the conditions in the market in which they operate. It would thus be interesting to test the differences in wage rigidity by economic sector. As there are 19 different economic sectors (the first level of NACE 2.2) only the static rigidity coefficients will be calculated. The results are listed Figure 37, and exact coefficient values and standard deviations are listed in Appendix 4. All coefficients are statistically significant.

A look at the figure shows that services sectors seem to be more rigid than average, while manufacturing enjoys less rigid wages. At first glance sectors known to have high union participation rates, such as education and transport, also seem to have higher DNWR. There are, however, exceptions. The health care sector is also unionised but is located in the lower end of the figure. The same applies to electricity, gas and water supply, sectors that are less rigid than average, but at the same time more unionised than average. Thus unionisation does not seem to play a significant role in explaining DNWR over the period 2002–2008.

A general conclusion seems to be that the domestic market oriented sectors that benefited the most from high economic growth are also the ones with

higher wage rigidity while export sectors that were more strongly affected by international competition show more flexible wages.

Figure 37. Rigidity coefficients 2002–2008 (NACE 2.2), by economic sector (model (5–1))
Source: Estonian Tax and Customs Board, author's calculations

5.7. Discussion and conclusions

The method used in previous sub-chapters allows the size of rigidity coefficient to be estimated for different subgroups in the labour market. The main conclusions are that:

- There are remarkable differences in DNWR between employer and employee subgroups;
- DNWR is higher than average in micro enterprises with less than 10 workers, and also in the services sector and more generally in sectors that are oriented to the domestic market. As concerns employee groups, wages are more rigid for the low waged earning less than 50%

of the average wage, and also for older workers aged 65 and over and for workers in their prime of 35–44. There is also a gender aspect as men's wages are more rigid than women's;

- DNWR is below the average in medium and large companies with more than 50 workers, and also in the manufacturing sector. From employee groups, women and young workers under 25 years old tend to have lower DNWR. So do workers who earn between the average wage and two times the average wage;
- DNWR changes over time and usually has a negative relationship with the unemployment rate or changes in the unemployment rate. However, this is not the case for all employer and employee groups. This is especially so for older workers (65 years and older) and for those earning between 50% and 100% of the average wage;
- DNWR seems to be unrelated to changes in labour market conditions for younger workers under 24, and for people earning more than twice the Estonian average wage.

Concerning the relation between DNWR and gender, Agell & Bennmarker (2007) conduct a survey amongst Swedish company managers and show that in firms with a large share of female workers, managers consider it less probable that workers who feel underpaid will respond by reducing effort. The lower probability of such retaliation for a wage cut can be associated with risk aversion, as deciding to reject the employer's proposal for a wage cut involves a certain degree of risk of being laid off. Several authors have shown that women are more risk averse (e.g. Croson & Gneezy (2009), Jianakoplos *et al.* (1998)).

Differences in DNWR by age group show that people entering the labour market have lower rigidity than those who are in their prime working age of 35–44 years. On the other hand, after the prime age DNWR starts to decline. The most obvious explanation for the hump shape in DNWR is individual bargaining power. New entrants to the labour market are less able to dictate their working conditions than those who have gained sufficient company-specific human capital and general labour market experience. Concerning the declining DNWR for the age groups 45–64 it has to be kept in mind that Estonia regained its independence only twenty years ago. The change from a planned to a market economy made a lot of previously gained human capital obsolete. As a result people who entered the labour market in the early years of independence having gained their education in the new education system are today more competitive than those who gained their professional education during soviet times. This is also reflected in the steep decline of wages after the age 35 (see Figure 25). The only piece that does not fit in the puzzle is the high DNWR among the over–64s. The most plausible explanation is employment protection legislation; before the individual labour legislation reform that came into force in the second half of 2009, the costs associated with firing people with more than 10 years of experience included a notice period of four months topped up with a severance payment of four months of the average wage. The lay-off costs

for people with less than five years of experience were half as much (Labour Contract Act). The share of people with more than 10 years of experience is higher among those aged over 64 than among younger people.

The differences in DNWR between wage groups are quite intuitive, as wages below 50% of the average wage are already close to the legal minimum monthly wage. Any attempts to lower wages below this level are prohibited by law. Anyway, a significant reduction in pay below the minimum wage, even disregarding its illegality, will probably result in workers quitting their jobs, as anything below the minimum wage hardly provides the means for a decent standard of living and the support that can be received from social security system in the form of unemployment insurance for being laid off and subsistence allowance (especially for larger households with single wage earner) will motivate these people to withdraw from the labour market. So instead of wage cuts we see quits, and wages seem to be more nominally downward rigid. It must also be noted, that for persons earning wage lower than minimum wage nominal rigidity emerges in two different forms – one indicating aversion against wage cuts and other against wage increases lower than minimum wage growth.

The connection between DNWR and company size group yields intriguing results, indicating that wages in smaller companies are significantly more rigid than wages in large companies. This is contradictory to the results presented by Babecký *et al.* (2010), who reach exactly the opposite conclusion. Efficiency wages have so far been used for explaining differences in DNWR between small and large companies as large companies have more resources to develop pay systems and also have more need for pay systems, as the effort of each worker cannot be observed directly by the head of the organisation. This might be the reason why efficiency wages could be more widely used by larger companies (Babecký, Du Caju, Kosma, Lawless, Messina, & Rõõm, 2010, p. 95). However, there are also reasons to believe that wages that are reported to the ETCB are indeed less nominally rigid downwards than those of larger companies, due to the existence of undeclared wages. There is evidence that paying (partly) undeclared wages is significantly more wide-spread in small than in large companies (Ahermaa, 2009, p. 22). It is thus quite plausible that legal wages in smaller companies are nominally rigid downwards, while actual wages are not.

Results on DNWR by economic sector are puzzling. In our analysis the wages in manufacturing sectors show less nominal downward rigidity than those in the services sector or construction. This contradicts the results obtained by Babecký *et al.* (2010). Lower DNWR in manufacturing could be explained by exposure to international competition. During 2002–2008 Estonia experienced steady economic growth that was fuelled by the rapid growth of domestic demand. While export-oriented sectors had to remain competitive in the international market, domestic market oriented sectors were operating under more favourable conditions. This might also have influenced the DNWR.

All these results raise the question of whether there is a common reason for higher DNWR behind the employee groups or company types, and thus a regression analysis would be in order. Unfortunately, it is difficult to perform that kind of analysis, because the number of subgroups also determines the number of observations in the regression analysis. For example, if we would like to analyse the reasons for DNWR by economic sector, then at present there are DNWR coefficients for 16 different sectors, meaning that there are also only 16 observations that can be used in regression analysis – this is too few.

It is also difficult to find a good indicator for DNWR at the micro level. For example if wage freezes are used as proxy for DNWR, then the results of a simple regression analysis with the incidence of wage freezes on one side and a specific employer or employee group on the other side do not replicate the results previously obtained from the approach used by earlier in this thesis. The same applies if instead of freezes the probability of wage cuts is used. The reason for this is the lack of comparison with a counter-factual distribution.

6. IMPACT OF ECONOMIC CRISIS ON DOWNWARD NOMINAL WAGE RIGIDITY IN ESTONIA

6.1. Introduction

The period of 2002–2008 can mostly be described as years of rapid economic growth and falling unemployment. The cycle started to turn in 2008 but, although economic growth was negative throughout the year, unemployment continued to decline until the second half of 2008. The year 2009 was the severest as throughout the first three quarters GDP declined by more than 15% and unemployment grew to 15% in the last quarter of 2009.

Theoretical explanations attribute DNWR to several different causes. Some of these are closely linked to the general labour market situation, so for example if a company pays efficiency wages and the reason for doing so is to increase the opportunity cost of leaving the company, increasing unemployment should influence efficiency wages negatively; deteriorating labour market conditions should also influence workers' bargaining power if the rigidity is stemming from the activities of unions.

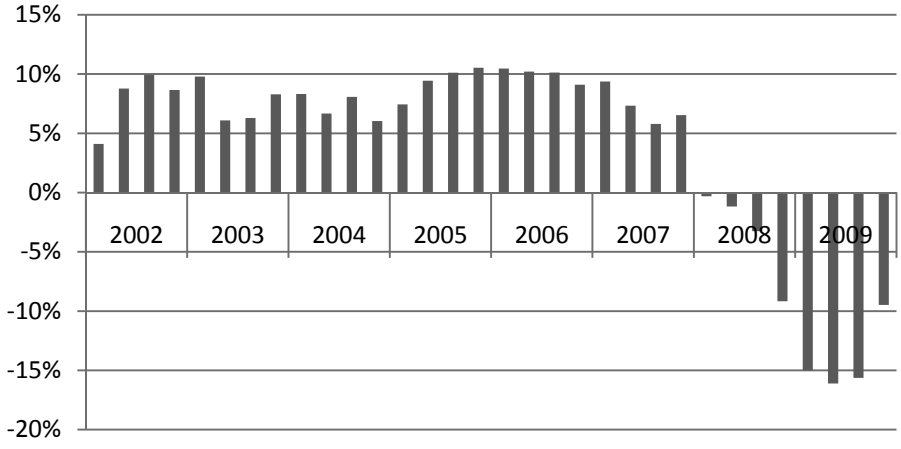


Figure 38. Estonian real GDP growth 2002–2009
Source: Statistics Estonia

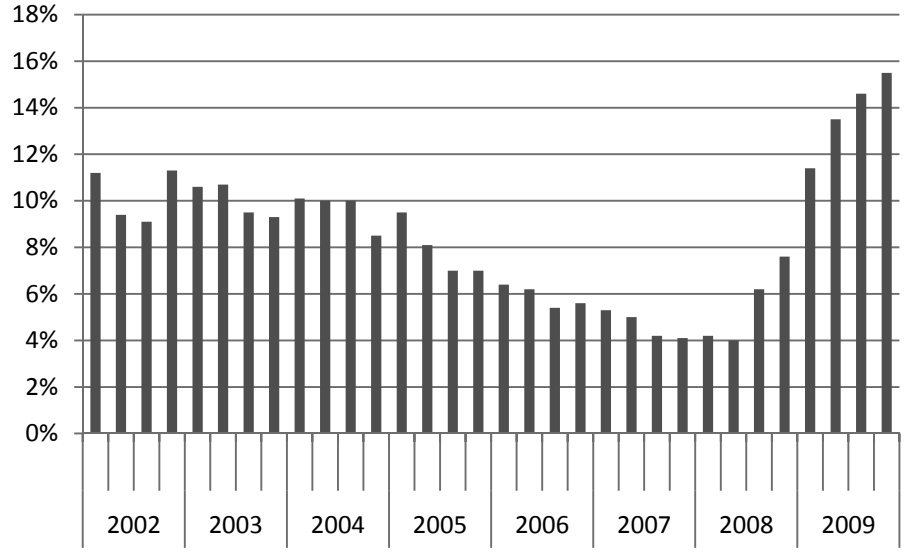


Figure 39. Unemployment rate 2002–2009
Source: Statistics Estonia

The aim of this chapter is to investigate the impact of the economic crisis on DNWR, looking at the events that took place in the Estonian labour market during 2008–2009. The impact of the business cycle on DNWR has already been analysed in previous chapters, where it was shown that downward nominal wage rigidity is influenced by the unemployment level as well as by changes in the unemployment rate. There are, however, problems with extending the histogram-location approach to the years of the severe crisis that hit Estonia at the end of the last decade. The histogram-location approach assumes that the shape of the counter-factual wage changes distribution is constant over time. As the shape of the wage change distribution of 2009[45] is significantly different from the distributions of wage changes for 2002–2008 (see Figure 40)[46], the assumption of a time-invariant counter-factual would be incorrect and it would be implausible to assume that such large differences could be corrected with standardisation. The histogram-location approach would produce incorrect results and in order to investigate the impact of the crisis on DNWR another method must be applied.

[45] 2009 is denoted by the dotted line located significantly to the left of the rest of the years depicted in Figure 40. The most significant difference from a visual inspection is a strong skewness to the left.
[46] This is also confirmed by the Kolmogorov-Smirnov test (see Appendix 2).

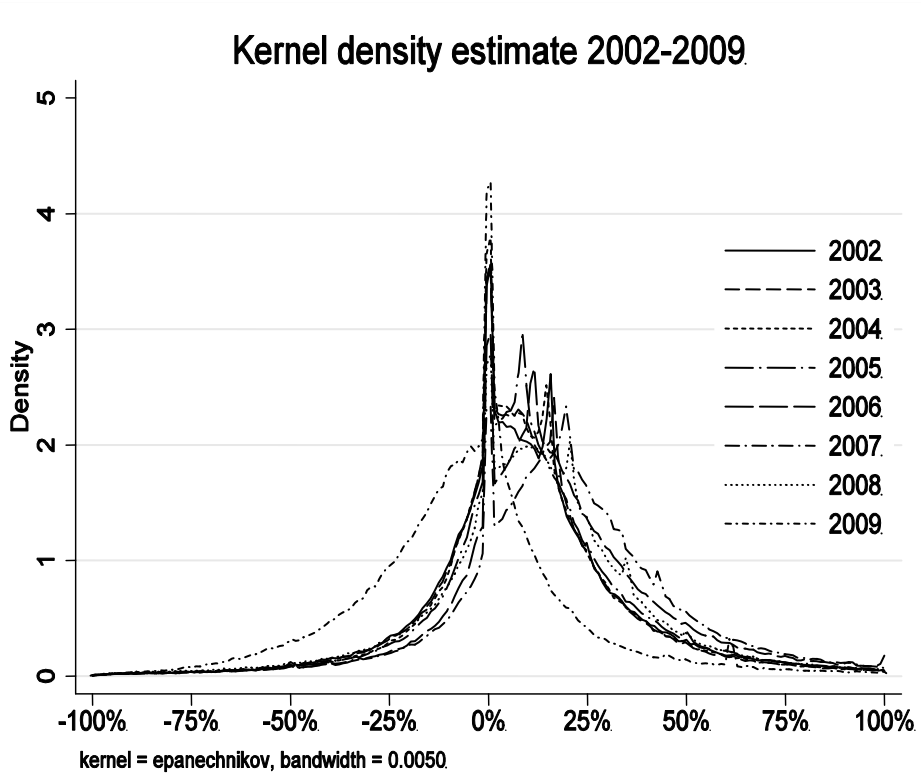


Figure 40. Kernel density estimates of wage growth distributions for the years 2002–2009
Source: Estonian Tax and Customs Board, author's calculations

In order to understand the influence of the economic crisis on DNWR, the following approach is used:

- The data from national accounts and labour market statistics are analysed in order to see how employment, working hours, wages and share of labour cost in GDP have changed during the quarters of economic crisis;
- Proxy measures for DNWR are used to assess the change in DNWR between 2002–2008 and 2009;
- Using proxy measures for DNWR the impact of the economic crisis on DNWR by employer and employee groups is analysed.

6.2. General evidence of downward nominal wage rigidity in national accounts and labour market statistics

Labour costs can adjust to shocks in demand through three different channels: a reduction in the number of people employed, a reduction in working hours, and cuts in wages. All these channels were also at work during the recent crisis in Estonia. Average wages fell in 2009 by slightly less than 5% (see Figure 41).

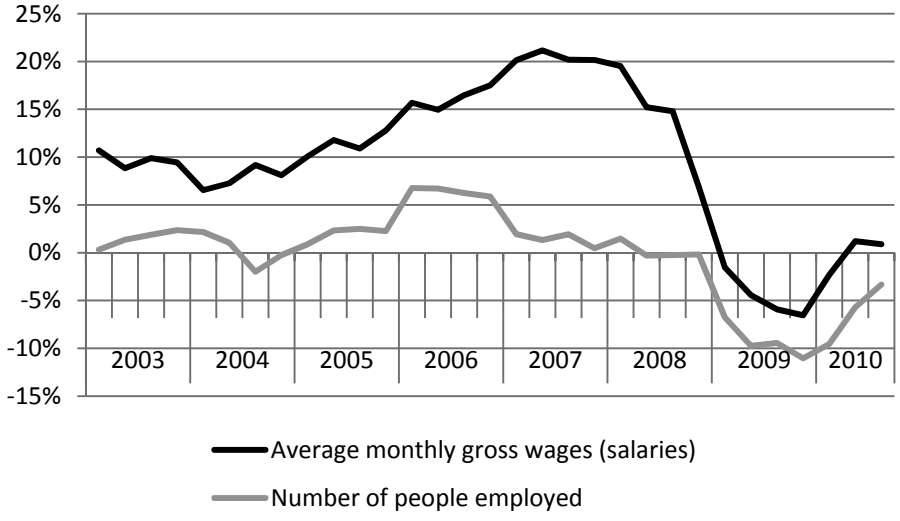


Figure 41. Year-on-year growth of average monthly salaries and number of employed
Source: Statistics Estonia

This picture is reinforced by an international comparison of average wage dynamics during the present crisis. Unfortunately the information available through *Eurostat* on average wages is not recent enough to allow analysis of the events of 2009, so Figure 42 is based on an OECD database[47] that has been updated with information on Estonian, Latvian and Lithuanian average gross wages from their statistical offices. All wages are in national currencies and current prices. Despite the fact that real GDP for several countries had already started to decline in 2008, the effect on wages mostly emerged in 2009. This is the reason why the change in real GDP is calculated for the period 2007/2009, while the change in nominal wages is calculated for 2008/2009.

The slope of the diagonal line in the third quarter of Figure 42 indicates Estonian nominal wage elasticity to real GDP. In comparison with countries where real GDP declined then there are only two examples where nominal wages responded more strongly to real GDP decline than they did in Estonia, and those are Lithuania and Belgium. For most of the countries struggling with

[47] Source: http://stats.oecd.org/Index.aspx

contracting real GDP, the nominal wage to real GDP elasticity was negative, meaning that the decline in real GDP led to modest nominal wage increases.

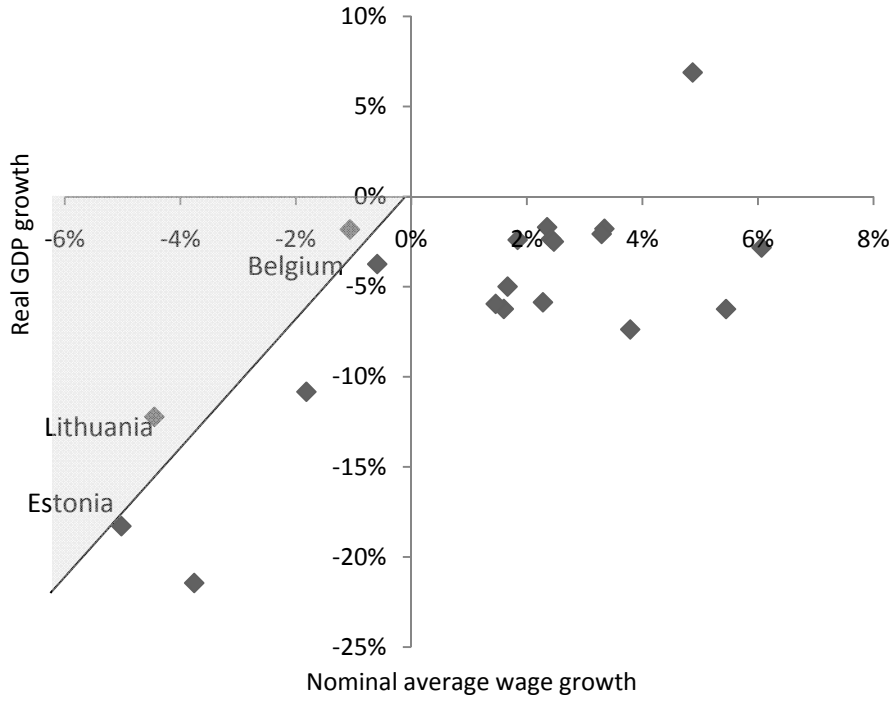


Figure 42. Average gross nominal wage growth (2008/2009) and real GDP growth (2007/2009) in selected OECD countries[48], Latvia and Lithuania
Source: Eurostat, OECD database, Statistics Estonia, Statistics Latvia, Statistics Lithuania, author's calculations

On the other hand, the main channel of adjustment was employment, which fell in 2009 on average by nearly 10% (see Figure 41).The average number hours worked also declined, by 3.5% in 2009[49]. In all, the adjustments in the total working hours dropped significantly more than average wages did.

As the reduction in employment was so severe, it could be argued that this indicates downward wage rigidity – if wages had been flexible enough, the decline in employment would not have been so extensive. The reduction in the number of people employed was the second largest amongst the 27 members of

[48] Information on average yearly wages was available for Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Luxembourg, Netherlands, Poland, Portugal, Spain, Sweden, the United Kingdom.
[49] Estonian Labour Force Survey 2009, author's calculations. A word of caution is probably in order, as the Labour Force Survey figures on hours worked are usually not considered to be very reliable.

European Union. The slope of the diagonal line in Figure 43 indicates Estonian employment elasticity to real GDP. Countries located in the grey triangle above the line have higher employment to real GDP elasticity than Estonia when experiencing a fall in GDP. There were only seven countries, Hungary, Ireland, Latvia, Lithuania, Portugal, Spain, and Romania, where employment responded to a GDP fall more intensively than it did in Estonia.

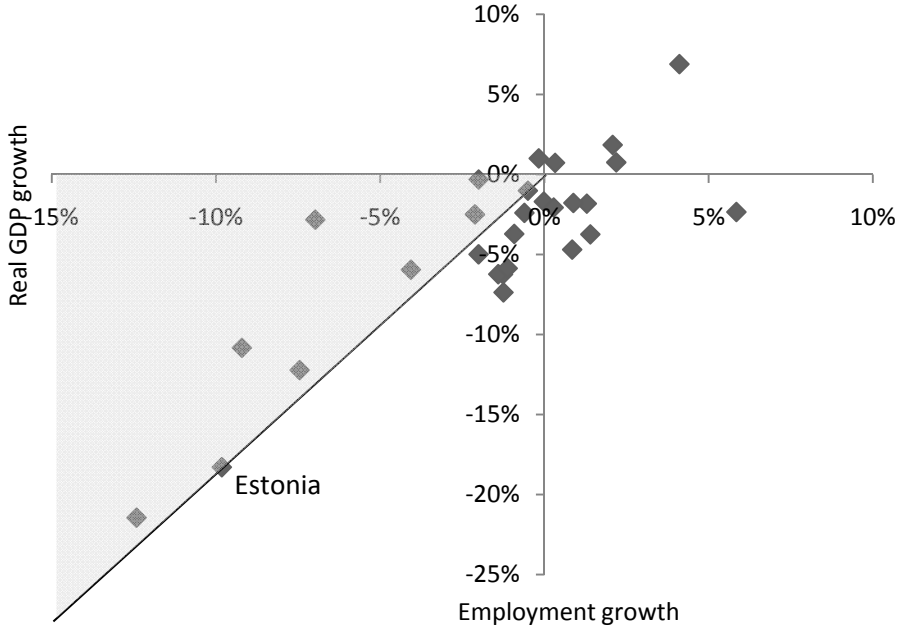


Figure 43. Employment and GDP growth in Europe, 2007–2009
Source: Eurostat, author's calculations

Another statistic that to some extent should reflect wage rigidity is the dynamics of the labour share in GDP. It could be argued that if wages were perfectly flexible, then during an economic crisis the labour share in GDP would remain more or less stable as the decline in value added would translate into a reduction in labour costs.

Figure 44 shows that for Estonia, this was not the case. The share of labour costs in GDP rose considerably from an average of 45% to nearly 54% of GDP in the first quarter of 2009. At the same time the share of operating surplus and mixed income also declined significantly. The proportions of labour costs and operating surplus started to converge to their previous levels only in the second quarter of 2009, indicating that there was something that delayed the adjustment process considerably.

Figure 44. GDP by income approach, share of selected components in total GDP
Source: Statistics Estonia

It is also interesting that these developments did not start immediately before the crisis, but had already begun in 2007. This means that at least part of this was caused by the demand for labour during the peak year of the boom in 2007. Nevertheless, the share of labour costs rose throughout the whole of 2008, even though real GDP went through a significant contraction.

Of course, there are other reasons why even with flexible wages a severe decline in employment can happen. One of these reasons can be rapid structural changes; as the crisis hit the construction sector significantly harder than it hit other sectors there was a surplus of labour with skills that were not immediately usable in other sectors. Even if the wages in construction had adjusted more, there was just no need for the total capacity of construction services – the number of people employed in construction fell from 82 thousand (in 2007) to 48 thousand (in 2010).

In general, it seems that despite our earlier findings which showed Estonia as a country with relatively flexible wages and average nominal wage decline in 2009, the crisis led to a severe across-the-board reduction in the number of people employed, and even when the size of the decline in real GDP is taken into account, the reduction in employment was a significant one.

This raises the question of DNWR during the crisis. The calculations of DNWR presented in the previous chapter come from the period of economic boom. Is it possible, that during the crisis the wages were more rigid than our previous findings suggested? In the following chapter the micro-data of wage changes during 2008/2009 will be analysed in order to understand the magnitude of wage cuts during the crisis.

6.3. Downward nominal wage rigidity during the crisis – aggregate level

In order to get a first impression of the reaction of wages to the recent economic crisis a very simple set of statistics will be used: the share of wage cuts and wage freezes in the total number of wage changes. Before we can look at the results, certain methodical issues have to be clarified. Registry data, although it reflects very accurately the actual change in total wages, does not tell much about the employer's intentions behind cutting wages. So if the registry data shows a small wage cut, it is difficult to believe that this wage cut is a result of a determined action to cut workers' wages by exactly this amount (say 0.3%). It is far more plausible that such small changes are the result of some technical issues, for example a worker being absent for half a day for personal reasons. The same applies also to wage increases. On the other hand, it is very difficult to draw a clear line between 'probably random' wage cuts and wage reductions that were the result of employer-side austerity measures.

In the histogram-location approach a 1% or 2% histogram bin is usually used, which also means that wage changes that fall into the range +/–0.5% around zero (or +/–1% respectively) are considered to be wage freezes and changes that fall to the left of this range are wage cuts.

In Figure 45 wage freezes and wage cuts are depicted for period 2002–2009. The wage changes data is prepared according to the same methodology that was described in chapter 3.5. The different lines on the figure designate the different ranges for wage changes that will still be considered as a wage freeze. Most of the empirical work done in this thesis uses a 2% bin width. For this range, the share of wage freezes varies between 4.3% (the lowest value (2007)) and 8.1% (the highest value (2009)). While economic growth left the share of wage freezes more or less constant, during the economic crisis the share of wage freezes almost doubled. Next we can look at the wage cuts using the same range (+/–1%). It is evident that the share of wage cuts shows significantly higher variation than the share of wage freezes. During solid economic growth the share of wage cuts dropped from 26.7% to 15.8% in 2007. However, in 2009 the share of wage cuts increased to as high as 55.1% which is 3.5 times more than in 2007.

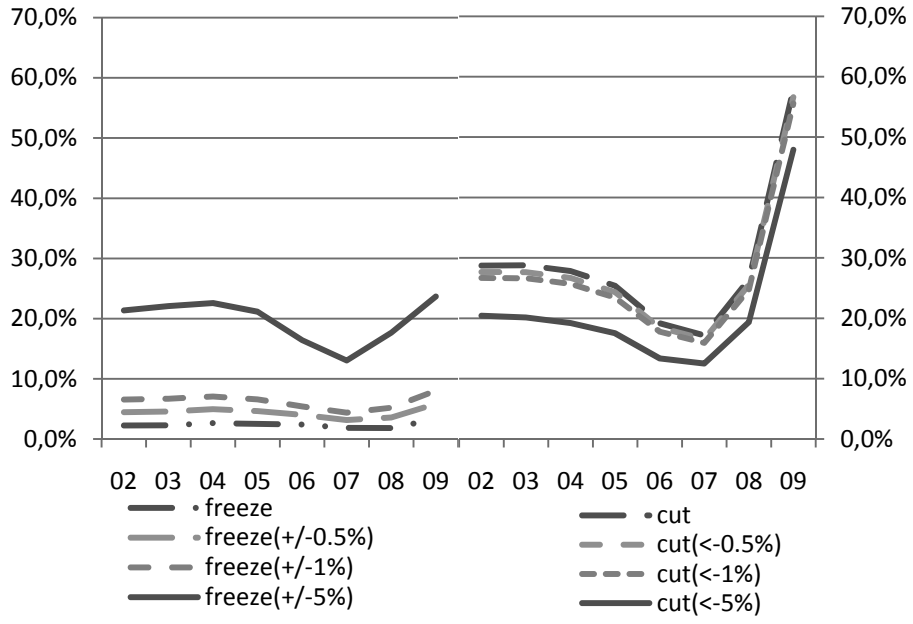


Figure 45. Wage freezes and wage cuts
Source: Estonian Tax and Customs Board, author's calculations

What happens with higher wage cuts? Figure 45 also provides information on the dynamics of wage cuts of more than 5%. It is clear that they follow the same pattern. In 2009 47% of observations in wage change distribution were wage cuts of more than 5%, which is 3.8 times more than in 2007.

The first conclusion from the wage change distributions is that the share of wage freezes and of wage cuts increased substantially during the period 2007–2009. However, the increase in wage cuts was significantly higher than the increase in wage freezes and the extent of the share of wage cuts indicates that this was a very wide-spread practice.

It is difficult to put wage freezes and cuts separately on the same picture with DNWR – it would be easier to interpret only one indicator. The rigidity coefficient used in the histogram-location approach estimated the share of wage cuts that did not happen and were instead converted into wage freezes. The maximum number of wage cuts that can theoretically be converted into wage freezes cannot exceed the number of observations in the zero bin of the distribution. Thus, the maximum possible value of the rigidity coefficient can be obtained by dividing the share of wage freezes by the combined share of wage freezes and wage cuts in the wage changes distribution:

$$\rho_{max} = \frac{\int_{-u}^{u} f(x)dx}{\int_{-\infty}^{u} f(x)dx}$$

(6–1)

where ρ_{max} is the maximum share of wage cuts that were not enforced due to DNWR, *f(x)* is the probability density function of wage changes, and *u* and *-u* are respectively the upper and lower bounds of the range of wage changes that are still considered to be wage freezes.

Unlike the 'real' DNWR coefficient, the maximum size of the DNWR can easily be observed from the wage changes distribution. If there are changes in ρ_{max} over the business cycle then this could be an indication of the dynamics of DNWR as well. Table 36 lists wage freezes and wage cuts and the theoretical maximum values of DNWR for the different ranges used for defining wage freezes.

In the sub-chapter 4.5 DNWR was analysed on the Estonian aggregate level with 1% as the histogram bin width. If we concentrate on the columns using +/– 0.5% as the range for defining wage freezes we can see that the size of maximum DNWR declined from its highest value of 17.8% in 2006 to 9.4% in 2009. This is a significant reduction. For the period 2002–2008 the DNWR coefficient estimated with the histogram location approach was 9.3%. Unless all zero wage growth observations in 2009 were the result of wage rigidity (i.e. redistributed from the left side of the distribution to the zero location), it can be said that DNWR has declined during the crisis. The ratio of actual DNWR to the maximum DNWR coefficient for the period 2002–2008 was around 53%. If the same proportions also prevailed for 2009, then the actual DNWR for 2009 would be 4.9%.

It is also interesting that the indicator of maximum DNWR reaches its peak in 2006, while the peak of the economic boom was achieved only in 2007. It seems that the maximum DNWR indicator has certain leading indicator properties over mean wage growth, which reacts more slowly to economic downturns (see Figure 46).

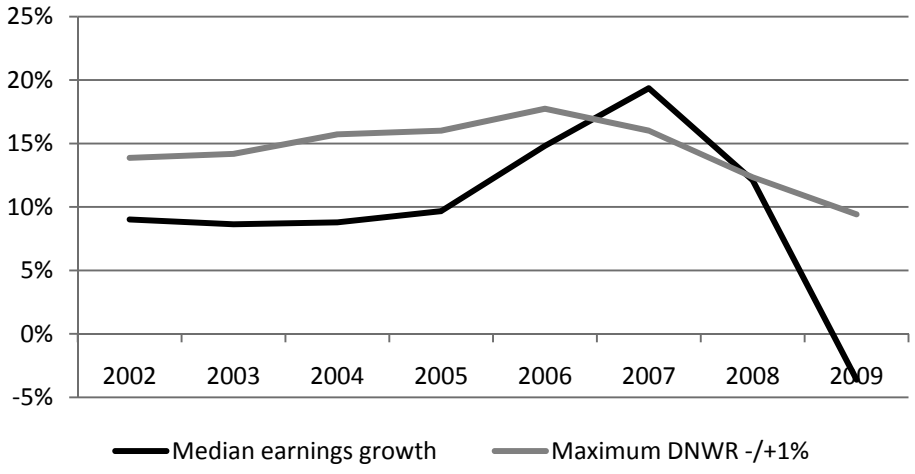


Figure 46. Dynamics of median wage growth and the maximum DNWR indicator
Source: Estonian Tax and Customs Board, author's calculations

Table 36. Incidence of wage freezes, wage cuts and maximum DNWR in Estonia 2002–2009

	Wage freezes					Wage cuts					Maximum DNWR			
	+/– 0%	+/– 0.5%	+/– 1%	+/– 5%		+/– 0%	+/– 0.5%	+/– 1%	+/– 5%		+/– 0%	+/– 0.5%	+/– 1%	+/– 5%
2002	2.3%	4.5%	6.6%	21.4%		28.7%	27.7%	26.7%	20.4%		7.3%	13.9%	19.7%	51.1%
2003	2.3%	4.6%	6.7%	22.1%		28.8%	27.6%	26.6%	20.1%		7.3%	14.2%	20.1%	52.3%
2004	2.7%	5.0%	7.1%	22.6%		27.8%	26.7%	25.7%	19.2%		8.7%	15.7%	21.6%	54.0%
2005	2.5%	4.7%	6.6%	21.2%		25.4%	24.3%	23.4%	17.5%		9.0%	16.1%	22.0%	54.7%
2006	2.4%	4.0%	5.4%	16.4%		19.2%	18.4%	17.8%	13.4%		11.2%	17.8%	23.4%	55.2%
2007	1.9%	3.2%	4.4%	13.0%		17.2%	16.5%	15.9%	12.5%		9.8%	16.0%	21.6%	51.1%
2008	1.8%	3.6%	5.2%	17.7%		26.4%	25.5%	24.8%	19.4%		6.5%	12.3%	17.4%	47.7%
2009	3.3%	5.8%	8.1%	23.7%		57.8%	56.6%	55.6%	47.9%		5.4%	9.4%	12.7%	33.1%
2002–2008	2.3%	4.2%	6.0%	19.1%		24.6%	23.7%	22.8%	17.4%		8.4%	15.0%	20.7%	52.3%

Source: Estonian Tax and Customs Board, author's calculations

From the maximum DNWR coefficients, the main conclusions do not depend on the range that is used in defining wage freezes, as the economic crisis brought about a significant decline in the maximum possible values of DNWR and this applies to all definitions of wage freezes.

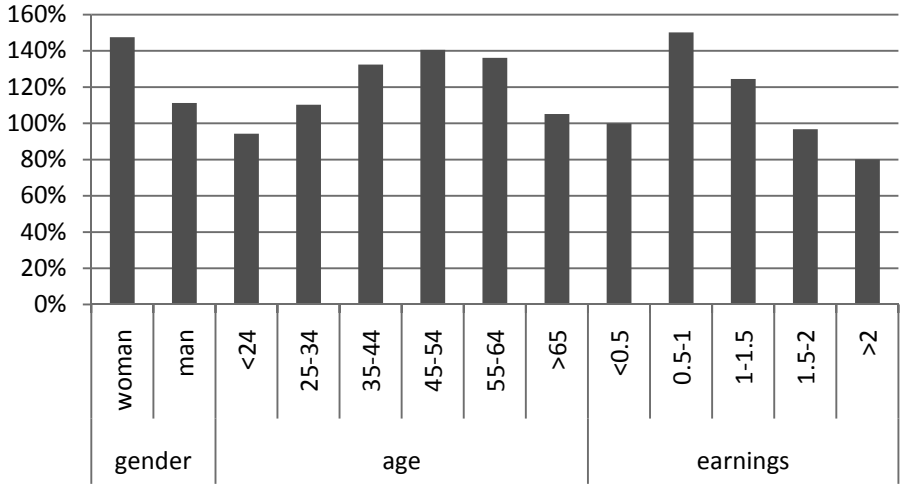
To summarise, there is no exact measure of DNWR that could be applied for analysing this phenomenon during severe economic crises. However, when relying on second best alternatives such as looking at the share of wage cuts and

wage freezes in the wage change distribution and a new indicator, the maximum DNWR indicator, the picture is quite clear. The economic crisis led to a significant increase in wage cuts and a sizeable reduction in the maximum DNWR indicator. The theoretical maximum of wage cuts that were transformed into zero wage changes was 9.4%, although this would mean that all observations of wage freezes are in fact non-enacted wage cuts. From the previous estimates of DNWR coefficients and the maximum rigidity indicator there is reason to believe that the actual DNWR coefficient for 2009 is significantly smaller. This also means that when comparing 2009 with the period 2002–2008 there was a decline in the DNWR coefficient.

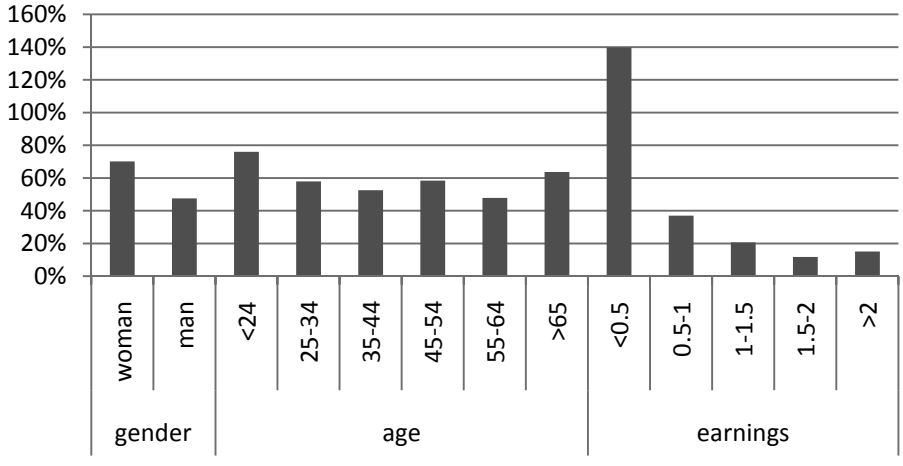
6.4. Downward nominal wage rigidity during the crisis – differences in worker and employer groups

6.4.1. Differences by gender, age and wage groups

In order to see what changes the economic crisis has caused in DNWR by different employer and employee groups, the main focus is on the dynamics of the indicator of maximum DNWR in 2009 (i.e. wage changes in 2009 compared to the average of 2002–2008). It is assumed that the dynamics of the maximum DNWR also reflect the changes in actual DNWR. However, in order to set the scene, differences in the dynamics of wage cuts and earnings freezes will also be discussed. In the following discussion, wage freezes are defined as wage changes that fall in the range of –1% to 1%. Wage cuts are defined as wage changes that fall below –1%. Figure 47 depicts the change in the share of both wage cuts and wage freezes in 2009 compared to the average of 2002–2008 for different employee groups. The groups are formulated according to gender, age (six different groups), wage (five different groups according to their relations to the average wage), company size and economic sector. Firstly, for all employee groups the share of wage cuts increased substantially. The same applies for wage freezes, although to a significantly lesser extent.



a) wage cuts



b) wage freezes

Figure 47. Change in the share of wage cuts and wage freeze observations in the earning change distribution 2008/ 2009, by employee group
Source: Estonian Tax and Customs Board, author's calculations

There are, however, certain differences among the employee groups. Firstly the share of wage cuts increased significantly more for women, than for men. This is in accordance with the findings listed in the previous chapter indicating that women's wages are less downwardly rigid. The picture, however, gets a bit blurred as we look at wage freezes – interestingly, in the women's wage distribution the change in the share of wage freezes also increased significantly more than for men, by 70% compared to 48%. What conclusion should be made about DNWR in a situation where both wage cuts as well as wage freezes

increase? Maybe some light can be shed on this matter by looking at the maximum DNWR indicator (see Figure 48). It shows that the maximum possible DNWR of wages decreased significantly for both men and women and there are no big differences in the size of the change. So despite the fact that the economic crisis caused more wage cuts for women than for men, the DNWR decreased for both groups more or less by the same amount.

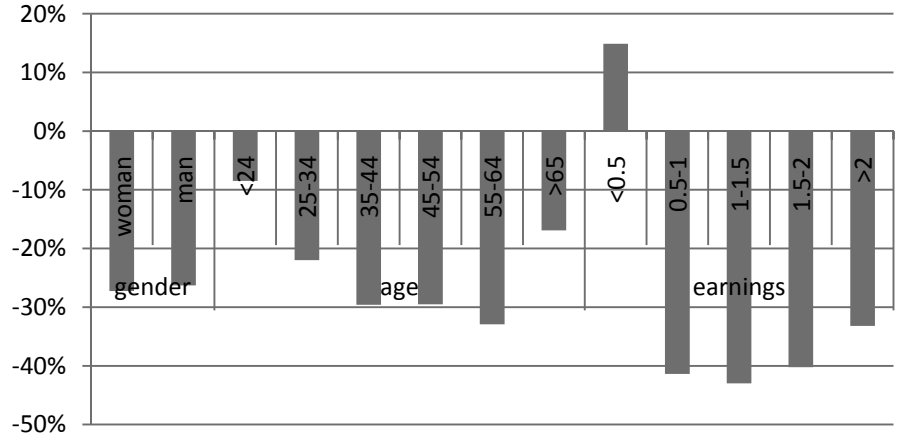


Figure 48. Change in the size of the maximum DNWR indicator 2008/2009, by employee group
Source: Estonian Tax and Customs Board, author's calculations

For age groups, there seems to be no significant connection between the DNWR coefficients estimated for the years 2002–2008 and the change in the share of wage cuts during 2008/2009. With the exception of workers who are more than 65 years old, higher DNWR coefficients during 2002–2008 somehow result also in a higher change in the share of wage cuts and a lower change in share of wage freezes in 2008/2009. The maximum DNWR indicator shows that DNWR decreased in 2009 significantly more for age groups between 25–64 years, while for younger and older workers the decrease in DNWR was significantly lower. In this light, the coefficients of DNWR calculated before the crisis seem not to be a very good predictor of wage behaviour during the crisis. The lower change in the share of wage cuts and the higher change in the share of wage freezes during the crisis can be explained by the lower level of wages of these groups, which makes it difficult for employers to cut their wages (see Figure 49). The wages of workers in their prime are significantly higher and thus there is more room for cutting without seriously affecting workers' standard of living. It is worth recalling that in the previous chapter the size of the wage was suggested to indicate the market power of an employee and served as explanation for the higher DNWR of the age groups between 25–64 years when compared to younger workers less than 25 years old.

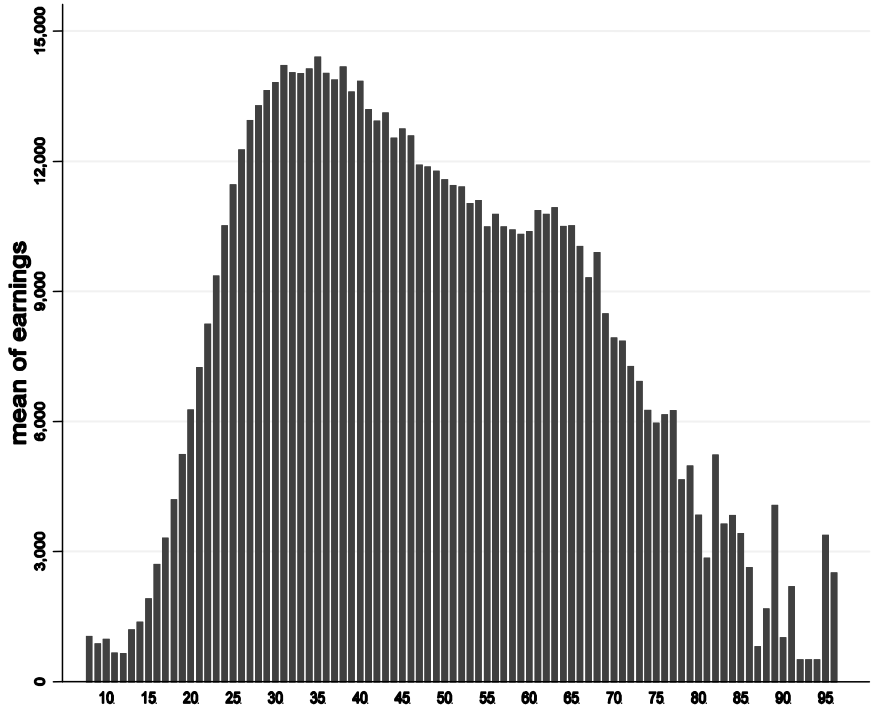


Figure 49. Pseudo-cohort over-the-life-cycle wage profile calculated as average mean wage for age group, year 2009 (EEK)
Source: Estonian Tax and Customs Board, author's calculations

These two explanations are not necessarily contradictory. In Estonia wages are mostly bargained individually[50]. During good times people at their prime exercise their bargaining power individually in order to get better pay conditions and are also in quite a good position for avoiding wage cuts. This, however, is not the case for people who have just entered the labour market and are less than 25 years old, as their individual bargaining power is quite weak. As a result, in times of solid economic growth the wages of people in the age group 25–64 seem more downwardly rigid than those of their younger colleagues.

However, the situation is different if large scale wage cuts are needed in order to keep a company alive, i.e. during a severe economic crisis. There is anecdotal evidence that this kind of large wage cuts were approached in a more collective manner and reductions did not occur for groups earning very low salaries, as an expression of solidarity, or they were significantly smaller.

The main reason, though, is probably firing behaviour – companies were probably more eager to fire people who were not of crucial importance to the company. As younger workers have had less time to gain company-specific human

[50] 25% of all employees were covered by a collective agreement (EIRO, 2009).

capital, they were first candidates to be laid off as an austerity measure. Firings do not show up in wage distributions as wage cuts. For older workers the smaller incidence of wage cuts is in accordance with the higher DNWR estimates from the period 2002–2008. To summarise, during an economic crisis, the maximum DNWR estimates decreased the most for the age groups between 35–64.

In terms of different wage groups, the share of wage cuts increased the most for groups earning between 0.5 and 1.5 times the average monthly wage. For other wage groups the increase in the share of wage cuts was less evident, and it was the smallest for people earning more than two times the Estonian average wage. Wage freezes paint a significantly different picture as by far the largest growth in wage freezes was for workers earning less than 50% of the average wage, which is probably linked with a large share of the wages in this group being close to the minimum wage. For other groups the increase in earning freezes was significantly smaller. As a result, the maximum DNWR indicator increased significantly for low wage earners while for other wage groups this indicator decreased. This picture is in accordance with the reasoning used for describing the changes in maximum DNWR by age group. A small wage of less than 0.5 times the average wage already showed significantly higher rigidity than other wage groups during 2002–2008. The crisis amplified these differences. Interestingly though, the increase in wage cuts was highest for earning groups whose wage remained between 0.5–1.5 times the average wage. This suggests that bargaining power is still reflected in wage level and people who enjoy significantly higher than average wages are more immune to wage cuts.

6.4.2. Differences by company size and economic sector

When looking at different company sizes, then there is a quite clear tendency that the larger the company the more the economic crisis has increased the share of wage cuts. With an exemption for large companies of more than 250 workers, the opposite is true for the share of wage freezes. As a result, the maximum DNWR indicator increases with company size. It should also be noted that there is a significant difference between small companies (less than 10 workers) where the maximum DNWR increases only marginally and large companies where wages become significantly more downwardly flexible.

The growing share of wage cuts in company size fits well with DNWR coefficients estimated using data from 2002–2008. Smaller companies had significantly higher DNWR coefficients than large companies and this also explains the lower growth in wage cuts and the higher growth in wage freezes. As already discussed in previous chapters, the incidence of illegal wages is significantly more widely spread in smaller companies and thus it is only natural to assume the lower DNWR in the legal wage. There is no reason to assume that companies became more law-abiding during the crisis.

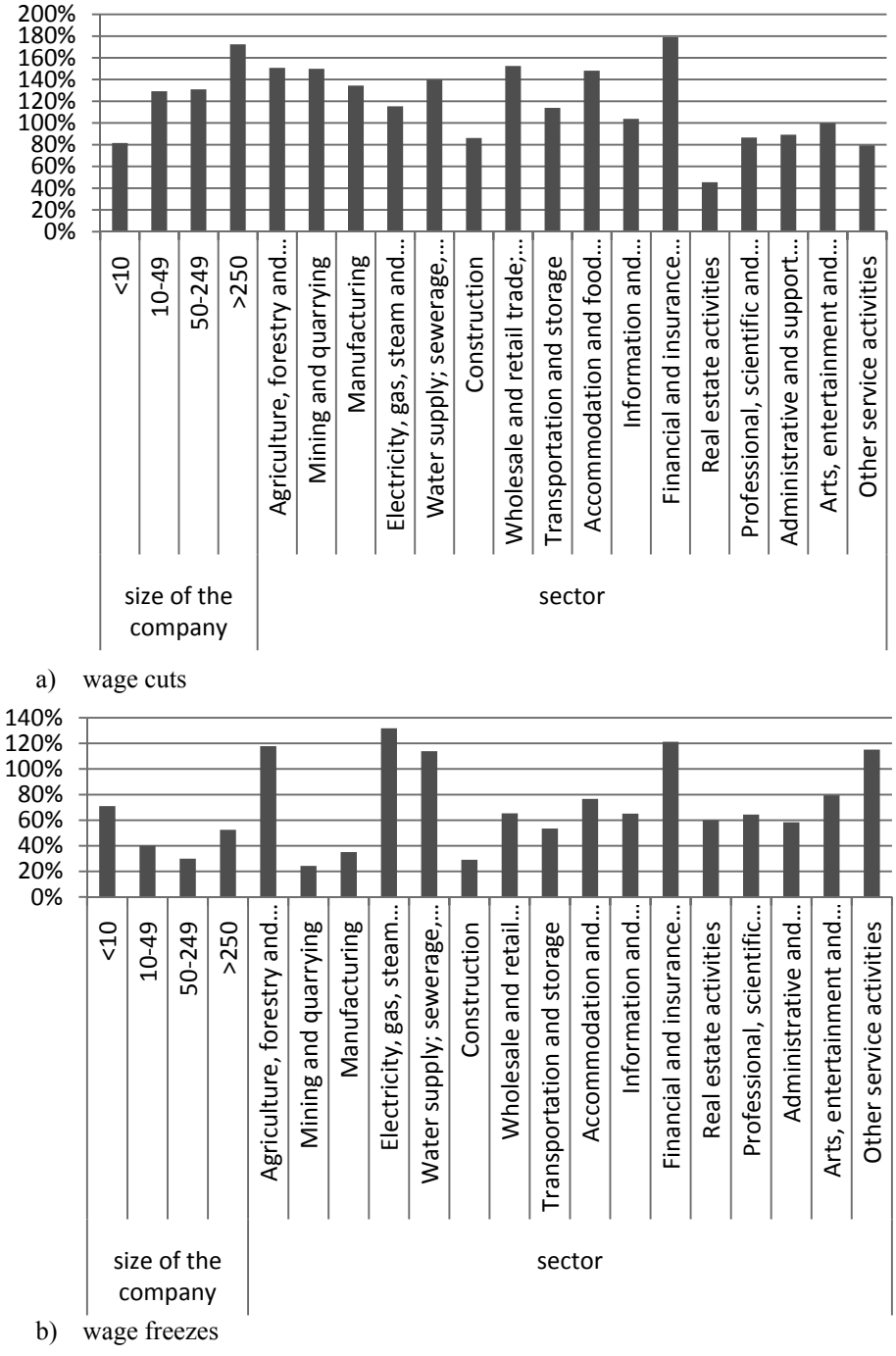


Figure 50. Change in share of wage cuts and freeze observations in the earning change distribution 2008/2009, by employee group
Source: Estonian Tax and Customs Board, author's calculations

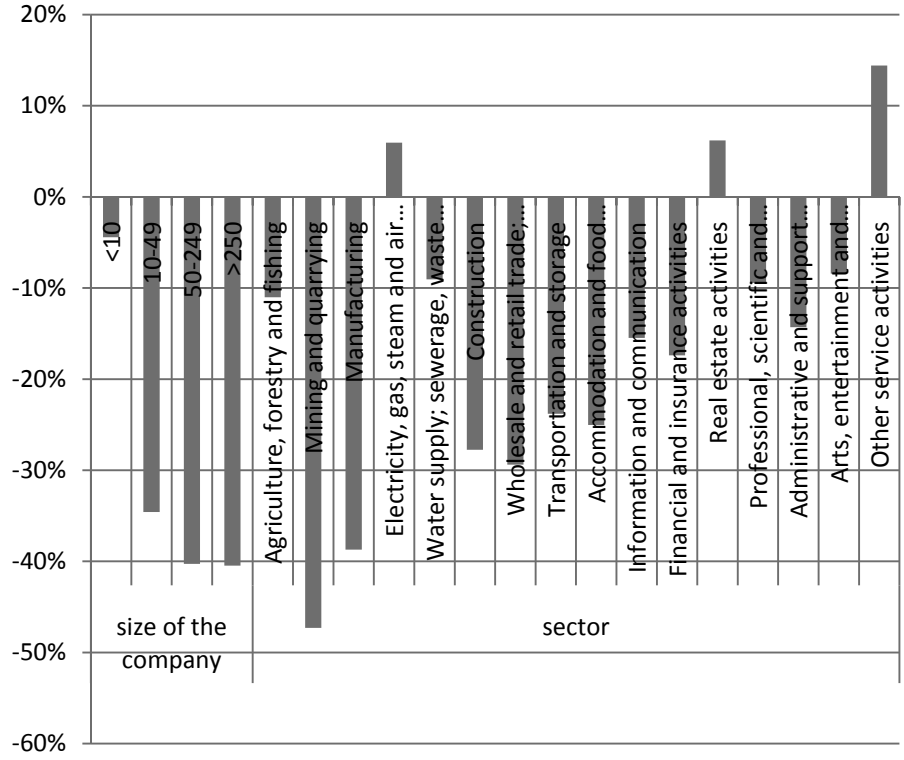


Figure 51. Change in the size of the maximum DNWR indicator 2008/2009, by employer group
Source: Estonian Tax and Customs Board, author's calculations

By economic sector the maximum DNWR indicator shows that although manufacturing already had one of the lowest rigidity coefficients for the period 2002–2008, there is a further significant reduction in the size of the maximum DNWR estimator in 2008/2009. Although there are several exceptions, it also seems that the decline in DNWR was lower for the services sector than it was for manufacturing. There were also several sectors where DNWR even increased (electricity, gas, steam and air conditioning supply, real estate, and other service activities).

6.5. Discussion and conclusions

This chapter presented several interesting findings from the year 2009. Firstly, average wage developments show that in 2009 Estonian wages were amongst the most flexible in the OECD countries. Furthermore, when the severity of GDP reduction is taken into account, then there were only two countries where the GDP elasticity of the average wage was higher than in Estonia. These findings

were also supported by micro-data, as in 2009 the incidence of wage cuts more than doubled. Despite the fact that the share of wage freezes also increased, which could be interpreted as a sign of rigidity, the maximum possible size of the DNWR coefficient (measured as the share of wage freezes in the total number of non-positive wage changes) decreased substantially in 2009. The first conclusion from these findings is that there is no reason to expect DNWR to be constant in time and the predictive power of pre-crisis estimates of DNWR over the actual events during the crisis may not be very high.

The idea of dynamic wage rigidity is most certainly not new and has been proposed also by several authors (e.g. Behr & Pötter (2009), Beissinger & Knoppik (2000)). In this respect this thesis confirms their findings. The findings of this thesis also coincide with Dabušinskas & Rõõm (2011), who used the WDN survey results for Estonia to show that the share of workers who experienced wage cuts increased in 2009 from 14% to 30% when compared to the previous survey conducted in 2007/2008 (Dabušinskas & Rõõm, 2011, p. 55). However, there are also differences in our results and these concern the incidence of wage freezes. According to the WDN survey, the share of workers that have experienced wage freezes rose from 9.6% to 56.9%. This increase, as well as the size of the share of wage freezes, is remarkable. From the Estonian Tax and Customs Board (ETCB) data the share of wage freezes in 2009 was estimated to be 8.1% if wage freezes are defined as wage changes falling between –1% and 1%. Of course the size of wage freezes depends on the range used to define a wage freeze. If the range +/- 5% was used as a definition of a wage freeze then the share of freezes in the ETCB data would be 28% in 2009. However, when compared to 2008 when the share of freezes as 18% for +/–5% range, the increase that was caused by the crisis is significantly smaller.

One reason for these differences is that Dabušinskas & Rõõm (2011) look at the dynamics of base pay while the ETCB provides information on wages. It has been shown that the total wage is nominally less downwardly rigid than base pay (Lebow, Saks, & Wilson, 2003, p. 18), which could also explain the higher share of wage freezes in Dabušinskas & Rõõm (2011). However, even with the higher share of wage freezes, the results concerning the dynamics of DNWR remain the same. Dabušinskas & Rõõm (2011) do not use the maximum DNWR indicator, but if they had, it would have shown significant reduction in maximum DNWR, meaning the crisis increased the downward flexibility of wages[51].

The results for different employer and employee groups are also interesting. Firstly the maximum DNWR indicator shows that the economic crisis affected men and women similarly as DNWR decreased substantially for both groups. More puzzling were the results by age group where it seemed that DNWR

[51] Dabušinskas & Rõõm (2011) actually do not stress the dynamics of wage rigidity. They conclude that Estonian base wages show remarkable flexibility compared to wages in the other countries participating in the survey. As the main reasons, the institutional environment, the depth of the crisis and the currency board system are proposed, while it is shown that the depth of the crisis was not the most important factor explaining downward flexibility (Dabušinskas & Rõõm, 2011, p. 54).

decreased the most for the earning groups (25–35, 35–44, 45–54) that should enjoy higher market power than younger and older workers. This can be explained by the fact that during the crisis younger workers were the first to be fired. In fact, the number of people employed in the age group 15–24 decreased in 2009 by 24%, while in the age group 25–49 the number employed decreased only by 9%[52]. Exits into unemployment reduce the observed wage cuts and so the wage seems more rigid. The wage of older workers was also significantly more rigid during the period 2002–2008 and although the maximum DNWR coefficient decreased during 2009, this happened to a lesser extent than for people in their prime working age. Again, employment protection legislation that makes firing workers with high seniority more costly is the most probable reason for these results. A counterargument to this explanation would point out that the new Labour Contract Act reduced firing costs across the board significantly, but the act only came into force in the second half of 2009. Employment already fell significantly in the first half of the year and even after the reform the notice periods for longer and shorter seniorities remained different[53].

The data was also analysed for different wage groups and the results showed that the only group for which the maximum DNWR indicator increased was people earning less than 50% of the average wage. For all other groups, the crisis brought about a decline in wage rigidity. As half of the average wage (6132 EEK) is quite close to the national minimum wage (4350 EEK), the different dynamics of DNWR are probably explained by institutional boundaries for additional wage cuts for the share of workers in the group of low wage earners that earn wages close or equal to the minimum wage.

Results by company size show that there were differences between micro companies with less than 10 workers where the maximum DNWR indicator decreased marginally during the crisis, and the rest of the size groups, where DNWR decreased substantially. As wages also turned out to be more rigid during the period 2002–2008 one explanation could be the relatively higher use of illegal pay in micro companies (Ahermaa, 2009, p. 22) which probably did not change, or may even have increased during 2009. In the different economic sectors, the crisis reduced the DNWR in manufacturing significantly more than in the services sector.

The results do not allow much to be said about the connection between employment and DNWR. It is interesting though, that despite the apparent downward flexibility of nominal wages, the correction in employment was very strong, even when the severity of the crisis is taken into account. The relationship between DNWR and employment in Estonia is an interesting topic that should be further analysed.

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[52] Source: Statistics Estonia.

[53] According to new Labour Contract Act workers with more than 10 years of experience must be notified of being laid off 3 months in advance, for workers with less than 5 years of seniority the notice period is 1 month. The severance payment paid by the employer is the same for all seniorities (Labour Contract Act).

CONCLUSIONS

Downward nominal wage rigidity (DNWR) is the tendency to avoid nominal wage cuts. The aim of this thesis was to investigate the existence of DNWR in the Estonian private sector. The main hypotheses of the thesis were:

- wages in the Estonian labour market are more flexible than those in Western Europe;
- there are differences in DNWR between industries;
- wages in large companies are nominally more downwardly rigid than those in smaller companies;
- younger workers have less DNWR than workers of prime age;
- there are differences in DNWR between men and women;
- the wages of low wage earners show more DNWR than the wages of higher wage earners;
- DNWR changes over the business cycle and a severe economic crisis reduces DNWR.

Conclusions from the literature show that in general wages are at least to some extent nominally rigid downwards. This result is quite robust to the methodology used for assessing DNWR. There are, however, significant differences between countries. For example Knoppik & Beissinger (2009) show that while the average rigidity coefficient for the EU is 36%, the country with the highest rigidity coefficient (Italy) has a rigidity coefficient that is almost twice as high[54] (66%). In Spain, which is at the opposite end of the ranking, the size of the rigidity coefficient was only 7%.

There are significant variations in the degree of DNWR among different worker groups. From quantitative estimation techniques (skewness-location, histogram-location and the symmetry approach) there is stronger evidence of DNWR for blue collar workers than for white collar workers. Among different compensation types base pay is usually considered to be more rigid than benefits or the total pay package. The results concerning salary earners and hourly wage earners seem to be mixed with some studies showing no DNWR for salary earners (e.g. Kahn (1997)) and others indicating that the wages of salaried employees are more rigid than the wages of workers (e.g. Beissinger & Knoppik (2001)). However, with the exceptions of skill type and pay type, more robust quantitative estimation techniques such as the histogram-location approach have not been used in analysing DNWR amongst different worker groups. This is one of the research gaps that will be filled by this thesis.

Most of the theories for the reasons for DNWR seem to have found at least some kind of support. Nevertheless, efficiency wage theories probably enjoy the strongest support, especially the labour turnover model for the highly skilled and the shirking model for the less skilled. Theories suggesting some sort of

[54] The rigidity coefficient shows the proportion of wage cuts that were not enacted due to DNWR.

moral component in the decision making of wage setting and effort provided by workers are also more in touch with reality. In addition to these theories, macro level analysis has confirmed that employment protection legislation and union coverage have a positive influence on DNWR, so stricter employment protection legislation is a factor.

For Estonia the DNWR estimates obtained so far indicate that Estonian wages are relatively flexible downwards. For example, Dabušinskas & Rõõm (2011) conclude that during the economic crisis in 2008–2009 Estonian nominal base wages showed remarkable flexibility. The most prominent reason given for Estonians for not cutting wages is that they are afraid that workers will respond by lowering their productivity.

Most of the quantitative estimations done in this thesis are based on Estonian Tax and Customs Board data from the years 2002–2009. More specifically, the focus is on the companies that are registered in the Commercial Register and the term "wage" in the empirical part of this thesis denotes the average monthly *wage* received from a particular employer. As the information comes from the Estonian Tax and Customs Board, the analysis is obviously limited to pay received from legally sound employment relations

The novelty of this work lies in the quality of the database, as the registry data is not prone to reporting error, and its application to a wider range of different employer and employee groups using more comprehensive estimation techniques (a modified Kahn test). It is also new because wage histogram based approaches have not so far been used in Estonia.

The results of the empirical work are presented in the same sequence as in the hypotheses listed earlier. The analysis confirms the hypothesis that wages in the Estonian labour market were more flexible than in Western European countries during the period 2002–2008. As most of the analysis based on wage change distributions uses survey data (e.g. ECHP) it was not easy to find a basis for direct comparison with results calculated on registry data. Fortunately, there are results for Germany based on registry data, a similar type of data to the Estonian Tax and Customs Board data. The comparison of Estonian and German DNWR coefficients showed that wages in Estonia are less rigid than those in Germany. As Germany ranked among the countries with below European average DNWR in cross-country analysis based on ECHP data, this allows the conclusion that Estonian wages are nominally less rigid downwards than the European average.

There are also remarkable differences in DNWR between employer and employee subgroups. Manufacturing seems to enjoy lower DNWR than the services sector. Although the dataset at hand did not include sufficient information for analysis of the reasons for these differences, openness to foreign competition could be the reason for lower DNWR in the manufacturing sector.

The hypothesis of smaller companies having lower DNWR did not find support, and in fact wages in micro companies exhibited significantly higher DNWR than those in larger companies. Although it is quite plausible that larger

companies have more strongly regulated remuneration policies which could also lead to higher DNWR, this seems not to be the case in Estonia, at least from the evidence of the distributions of legal wage changes. The reasons for this should be sought in the higher incidence of illegal pay amongst micro and small companies, suggesting that flexibility in wages can also be reached through variation in pay components that are not visible to the Tax and Customs Board.

The relationship between age and DNWR is more complex than was proposed in the initial hypothesis. The wages of young workers less than 25 years old are indeed less downwardly rigid than the wages of people in the age groups 25–64. The main reason for this is probably the lower bargaining power of workers who have just entered the labour market. However, as an interesting discovery the wages of those over 64 years old are even more rigid than the wages of younger workers. There can be several reasons for this, mostly linked to the regulatory framework – after reaching retirement age a person has the right to receive a pension, and this alternative income can affect people's bargaining behaviour. The most important role, however, is probably played by employment protection legislation during 2002–2008, which made firing people with more than 10 years of seniority significantly more expensive than firing their colleagues with less company-specific experience. As new wages cannot be set unilaterally by the employer, older workers are probably less inclined to agree to a wage cut.

The results of the analysis confirm the hypothesis that the DNWR of men's wages is higher than that of women's wages. The difference between men's and women's risk preferences could be the explanation for this phenomenon. It is also confirmed that low wage earners earning less than 50% of the average wage exhibit higher DNWR than other wage groups. Institutions like the minimum wage are the most probable reason for this.

Concerning the dynamic properties of DNWR, the analysis shows that DNWR changes over time and usually has a negative relationship with the unemployment rate and /or changes in the unemployment rate. However, this is not the case for all employer and employee groups. The relation between labour market conditions and DNWR is especially evident for older workers (over 64 years old), and also for people earning between 50% and 100% of the average wage. DNWR seems to be unrelated to changes in labour market conditions for younger workers under 24 years old or for people earning more than twice the Estonian average wage. An economic crisis of the magnitude that hit Estonia in 2009 is expected to influence the behaviour of companies and people, and this includes behaviour in wage negotiations. A new indicator, the maximum DNWR indicator, was used to analyse the changes in DNWR during the crisis. It was evident that for almost all groups there was a significant reduction in DNWR. The only exceptions were the low wage earners earning below 0.5 times the average wage and some sub-sectors of the services sector.

Despite the fact that DNWR has been quite a popular topic, there are still issues that should be investigated further. This thesis is mainly concerned with the size and dynamics of DNWR. However, it remains still to be investigated

what impact DNWR has on other variables like changes in employment or the duration of unemployment, especially when the changing extent of this phenomenon is taken into account. It would also to be interesting to analyse the impact of DNWR on the recovery from the blow of the economic crisis. Despite the work already done on the reasons for DNWR, rigidity by different employee groups could be investigated further.

Last but not least, the methods and data used in this study are subject to several limitations that have to be kept in mind when using the results. Firstly, this paper is about the downward nominal rigidity of wages measured as total pay. The excess flexibility when compared to other studies investigating the rigidity of base pay could be the result of changes in working hours. However, for Estonia the share of part time workers has been quite low and so has the variation of working hours, according to information from the Estonian Labour Market Survey. Secondly, despite wide coverage of the population of private enterprise workers on a yearly basis, the time series is still short at eight years, not allowing estimation of the dynamics of DNWR over several business cycles. Thirdly, there are differences between the results of DNWR obtained from registry data and those from survey data. As a majority of the research done so far in this field relies on survey data while this thesis relies on registry data, the international comparison of the results could still be methodically improved. The most important aspects concern the intention behind the observation of wage freezes and small wage increases / declines. It is highly probable that the registry data reflects most accurately the actual yearly and monthly payments to each employee. This, however, means that if a person happens to miss some days of work for personal reasons this shows up as wage decrease and if there are more working days in a month then earnings seem to increase. Changes that are the result of this kind of fluctuation do not say much about DNWR, as there was no employer-side intention for the wage cuts. This problem is probably not very big as the massive decreases in wages by employers during the crisis are also reflected in the ETCB dataset. Nevertheless, when compared to survey based results, there is probably a downward bias in the estimates from the registry data.

REFERNCES

1. Agell, J., & Bennmarker, H. (2007). Wage incentives and wage rigidity: A representative view from within. Labour Economics (14), 347–369.
2. Agell, J., & Lundborg, P. (2003). Survey Evidence on Wage Rigidity and Unemployment: Sweden in the 1990s*. Scandinavian Journal of Economics, 105 (1), 15–29.
3. Agell, J., & Lundborg, P. (1995). Theories of Pay and Unemployment: Survey Evidence from Swedish Manufacturing Firms. Scandinavian Journal of Economics, 97, 295–307.
4. Ahermaa, E. (2009). Varimajandus Eestis 2008. Eesti Konjunktuuriinstituut, 27.
5. Ahermaa, E. (2008). Varimajandus Eestis 2007. Eesti Konjunktuuriinstituut, 36.
6. Akerlof, G. A. (1982). Labor Contracts as Partial Gift Exchange. The Quarterly Journal of Economics (4), 543–569.
7. Akerlof, G. A., & Yellen, J. L. (1990). The Fair Wage-Effort Hypothesis and Unemployment. The Quarterly Journal of Economics, 105 (2), 255–283.
8. Akerlof, G. A., Dickens, W. T., Perry, G. L., Gordon, R. J., & Mankiw, G. N. (1996). The Macroeconomics of Low Inflation. Brookings Papers on Economic Activity (1), 1–76.
9. Altonji, J. G., & Devereux, P. J. (2000). The Extent and Consequences of Downward Nominal Wage Rigidity. Research in Labor Economics, 19, 383–431.
10. Anspal, S., & Järve, J. (2011, forthcoming). Downward nominal wage rigidity and Gender. LABOUR.
11. Azariadis, C. (1975). Implicit Contracts and Underemployment Equilibria. The Journal of Political Economy, 83 (6), 1183–1202.
12. Babecký, J., Du Caju, P., Kosma, T., Lawless, M., Messina, J., & Rõõm, T. (2010). Downward Nominal and Real Wage Rigidity: Survey Evidence from European Firms. Scandinavian Journal of Economics, 112 (4), 884–910.
13. Baily, M. N. (1974). Wages and Employment under Uncertain Demand. The Review of Economic Studies, 41 (1), 37–50.
14. Barwell, R. D., & Schweitzer, M. E. (2005). The Incidence of Nominal and Real Wage Rigidities in Great Britain: 1978–1998. Working Paper, Federal Reserve Bank of Cleveland.
15. Behr, A., & Pötter, U. (2009). Downward Wage Rigidity in Europe: A New Flexible Parametric Approach and Empirical Results. German Economic Review, 11 (2), 169–187.
16. Beissinger, T., & Knoppik, C. (2001). Downward Nominal Rigidity in West German Earnings, 1975–95. German Economic Review, 2 (4), 385–417.
17. Beissinger, T., & Knoppik, C. (2000). Downward Nominal Rigidity in West-German Earnings 1975–1995. University of Regensburg Discussion Paper (344), 32.
18. Benhabib, J., Rogerson, R., & Wright, R. (1991). Homework in Macroeconomics: Household Production and Aggregate Fluctuations. The Journal of Political Economy, 99 (6), 1166–1187.
19. Bewley, T. F. (1998). Why not cut pay? European Economic Review, 42 (2–5), 259–490.
20. Bewley, T. F. (2002). Why Wages Don't Fall During a Recession. Harvard University Press.

21. Blinder, A. S., & Choi, D. H. (1990). A Shred of Evidence on Theories of Wage Stickiness. The Quarterly Journal of Economics, 105 (4), 1003–1015.
22. Bound, J., Brown, C., Duncan, G. J., & Rodgers, W. L. (1994). Evidence on the Validity of Cross-Sectional and Longitudinal Labor Market Data. Journal of Labor Economics, 12 (3), 345–368.
23. Calvo, G. (1979). Quasi-Walrasian Theories of Unemployment. The American Economic Review, 69 (2), 102–107.
24. Campbell, C. M., & Kamlani, K. S. (1997). The Reasons for Wage Rigidity: Evidence From a Survey of Firms. The Quarterly Journal of Economics, 112 (3), 759–789.
25. Card, D., & Hyslop, D. (1996). Does Inflation "Grease the Wheels of the Labour Market"? Working Paper 5538, National Bureau of Economic Research.
26. Card, D., & Hyslop, D. (1997). Does Inflation "Grease the Wheels of the Labour Market"? In C. D. Romer, & D. H. Romer, Reducing Inflation - Motivation and Strategy (pp. 71–123).
27. Castellanos, S. G., Garcia-Verdu, R., & Kaplan, D. S. (2004). Nominal wage rigidities in Mexico: evidence from social security records. Journal of Development Economics (75), 507–533.
28. Croson, R., & Gneezy, U. (2009). Gender Differences in Preferences. Journal of Economic Literature, 47 (2), 1–27.
29. Dabušinskas, A., & Rõõm, T. (2011). Survey evidence on wage and price setting in Estonia. unpublished .
30. Dessy, O. (2005). Nominal Wage Rigidity in Europe: Estimates and Institutional Causes. Working Paper, 65.
31. Dessy, O. (2002). Nominal wage rigidity in the European Countries: evidence from the Europanel. CREST-INSEE.
32. Dickens, W. T., Goette, L., Groshen, E. L., Holden, S., Messina, J., Schweitzer, M. E., et al. (2007). How Wages Change: Micro Evidence from the International Wage Flexibility Project. The Journal of Economic Perspectives, 21 (2), 195–214.
33. Dwyer, J., & Kenneth, L. (2000). Nominal wage Rigidity in Australia. Research Discussion Paper, 33.
34. Eamets, R., & Masso, J. (2005). The Paradox of the Baltic States: Labour Market Flexibility but Protected Workers? European Journal of Industrial Relations, 11 (1), 71–90.
35. EIRO. (2009). Estonia: Industrial Relations Profile. European Industrial Relations Observatory .
36. Fehr, E., & Goette, L. (2005). Robustness and real consequences of nominal wage rigidity. Journal of Monetary Economics, 52 (4), 779–804.
37. Fischer, S. (1977). Long-Term Contracts, Rational Expectations, and the Optimal Money Supply Rule. The Journal of Political Economy, 85 (1), 191–205.
38. Franz, W., & Pfeiffer, F. (2006). Reasons for Wage Rigidity in Germany. LABOUR, 20 (2), 255–284.
39. Gibbons, R., & Katz, L. F. (1991). Layoffs and Lemons. Journal of Labor Economics, 9 (4), 351–380.
40. Gottschalk, P. (2005). Downward Nominal-Wage Flexibility: Real or Measurement Error? The Review of Economics and Statistics, 87 (3), 556–568.
41. Greenwald, B. C. (1986). Adverse Selection in the Labour Market. The Review of Economic Studies, 53 (3), 325–347.
42. Grossman, G. M. (1983). Union Wages, Temporary Layoffs, and Seniority. The American Economic Review, 73 (3), 277–90.

43. Hansen, G. D. (1985). Indivisible Labor and the Business Cycle. Journal of Monetary Economics (16), 309–327.
44. Hashimoto, M., & Yu, B. T. (1980). Specific Capital, Employment Contracts, and Wage Rigidity. The Bell Journal of Economics, 11 (2), 536–549.
45. Holden, S. (2004). The Costs of Price Stability: Downward Nominal Wage Rigidity in Europe. Economica, 71, 183–208.
46. Holden, S., & Wulfsberg, F. (2008). Downward Nominal Wage Rigidity in the OECD. The B.E. Journal of Macroeconomics, 8 (1), 50.
47. Holt, C. A., & Laury, S. K. (2002). Risk Aversion and Incentive Effects. American Economic Review, 92 (5), 1644–1655.
48. Homans, G.C (1954). The Cash Posters - American Sociological Review, XIX, 724–33., through Akerlof, G.A. (1982) Labor Contracts as Partial Gift Exchange – The Quarterly Journal of Economics, 97(4), 543–569.
49. Iregui, A. M., Melo, L. A., & Ramírez, M. T. (2009). Are wages rigid in Colombia?: Empirical evidence based on a sample of wages at the firm level. Borradores de Economia, I (571), 31.
50. Jianakoplos, N. A., & Bernasek, A. (1998). Are Women More Risk Averse? Economic Inquiry, 36, 620–630.
51. Kahn, S. (1997). Evidence of Nominal Wage Stickiness from Microdata. The American Economic Review, 87 (5), 993–1008.
52. Kahneman, D., Knetsch, J. L., & Thaler, R. (1986). Fairness as a constraint on profit seeking: entitlements in the market. American Economic Review (76), 728–741.
53. Kaufman, B. E. (2002). Models of Union Wage Determination: What Have We Learned Since Dunlop and Ross? Industrial Relations, 41 (1), 110–158.
54. Keynes, J. M. (1936). The General Theory of Employment, Interest and Money (2006 edition). Palgrave Macmillan.
55. Knoppik, C. (2007). Skewness and Location of Distributions of Wage Change Rates in the Presence of Downward Nominal Wage Rigidity. University of Regensburg Discussion Paper (420), 17.
56. Knoppik, C., & Beissinger, T. (2009). Downward nominal wage rigidity in Europe: an analysis of European micro data from the ECHP 1994–2001. Empirical Economics, 36 (2), 321–338.
57. Kramarz, F. (2001). Rigid Wages: What Have we Learnt from Microeconometric Studies? CREST-INSEE and CEPR.
58. Kuroda, S., & Yamamoto, I. (2003). Are Japanese Nominal Wages Downwardly Rigid? (Part I): Examinations of Nominal Wage Change Distributions. Monetary and Economic Studies, 1–30.
59. Kydland, F. E., & Prescott, E. C. (1982). Time to Build and Aggregate Fluctuations. Econometrica, 50 (6), 1345–1370.
60. Lazear, E. P. (1984). Raids and Offer-Matching. NBER Working Paper Series, 1419, 41.
61. Layard, R., & Bean, C. (1989). Why Does Unemployment Persist? Scandinavian Journal of Economics, 91 (2), 371–396.
62. Lebow, D. E., Saks, R. E., & Wilson, B. A. (1999). Downward Nominal Wage Rigidity: Evidence from the Employment Cost Index. Working Paper, 38.
63. Lebow, D. E., Saks, R. E., & Wilson, B. A. (2003). Downward Nominal Wage Rigidity: Evidence from the Employment Cost Index. Advances in Macroeconomics, 3 (1), 1–30.

64. Lebow, D., Stockton, D., & Wascher, W. (1995). Inflation, Nominal Wage Rigidity, and the Efficiency of Labor Markets. Finance and Economics Discussion Series, 94 (45).
65. Lindbeck, A., & Snower, D. J. (1988). Cooperation, Harassment, and Involuntary Unemployment: An Insider-Outsider Approach. The American Economic Review, 87 (1), 167–188.
66. Lindbeck, A., & Snower, D. J. (2002). Insider-Outsider Theory: A Survey. IZA Discussion Paper Series, 534, 55.
67. Lucas, R. E., & Rapping, L. A. (1969). Real Wages, Employment, and Inflation. The Journal of Political Economy, 77 (5), 721–754.
68. Malcomson, J. (1997). Contracts, Hold-Up, and Labor Markets. Journal of Economic Literature, 35 (4), 1916–1957.
69. Malcomson, J. M. (1981). Unemployment and the Efficiency Wage Hypothesis. The Economic Journal, 91 (364), 848–866.
70. McLaughlin, K. J. (1999, May/June). Are Nominal Wage Changes Skewed Away From Wage Cuts? Review, 117–132.
71. McLaughlin, K. J. (2000). Asymmetric Wage Changes and Downward Nominal Wage Rigidity. mimeo, 44.
72. McLaughlin, K. J. (1994). Rigid wages? Journal of Monetary Economics (34), 383–414.
73. Nickell, S., & Quintini, G. (2003). Nominal Wage Rigidity and the Rate of Inflation. The Economic Journal, 113, 762–781.
74. Oswald, A. J. (1985). The Economic Theory of Trade Unions: An Introductory Survey. Scandinavian Journal of Economics, 87 (2), 160–193.
75. Phelps, E. S. (1970). Micro-economic Foundations of Employment and Inflation Theory. New York: Norton.
76. Piore, M. J. (1973). Fragments of a "Sociological" Theory of Wages. The American Economic Review, 63 (2), 377–384.
77. Riordan, M. H., & Staiger, R. W. (1993). Sectoral Shocks and Structural Unemployment. International Economic Review, 34 (3), 611–629.
78. Rosen, S. (1985). Implicit Contracts: A Survey. Journal of Economic Literature, 23 (3), 1144–1175.
79. Salop, S. C. (1979). A Model of the Natural Rate of Unemployment. The American Economic Review, 69 (1), 117–125.
80. Shapiro, & Stiglitz, J. E. (1984). Equilibrium Unemployment as a Worker Discipline Device. The American Economic Review, 74 (3), 433–444.
81. Sharp, M. P. (1941). Pacta Sunt Servanda. Columbia Law Review, 41 (5), 783–798.
82. Smith, J. C. (2000). Nominal Wage Rigidity in the United Kingdom. The Economic Journal, 110, C176-C195.
83. Stiglitz, J. E. (1976). The Efficiency Wage Hypothesis, Surplus Labour, and the Distribution of Income in L.D.C.s. Oxford Economic Papers, 28 (2), 185–207.
84. Stiglitz, J. E. (1984). Theories of Wage Rigidity. NBER Working paper, 1442, 91.
85. Taylor, J. B. (1979). Staggered Wage Setting in a Macro Model. The American Economic Review, 64 (2), 108–113.
86. Töö- ja puhkeaja seadus – 24.01.2001(RT I 2001, 17, 78), abolished with 1.07.2009 (RT I 2009, 5, 35).
87. Töölepingu seadus – 17.12.2008 (RT I 2009, 5, 35) 01.07.2009, last reduction 18.06.2009 (RT I 2009, 36, 234) 1.07.2009. [https://www.riigiteataja.ee/ert/act.jsp? id=13198023]. 22.07.2009.

88. Töötuskindlustuse seadus – 13.06.2001 (RT I 2001, 59, 359) 01.01.2002, reduction 17.12.2008 (RT I 2009, 11, 67) 14.02.2009.
89. Weiss, A. (1980). Job Queues and Layoffs in Labor Markets with Flexible Wages. The Journal of Political Economy, 88 (3), 526–538.
90. Yellen, J. L. (1984). Efficiency Wage Models of Unemployment. The American Economic Review, 74 (2), 200–205

APPENDICES

Appendix 1. Description of Tax and Customs Board Data

Table 37. Comparison of the number of workers in the dataset with the number of workers reported by Statistics Estonia, by average number of workers in the company

	0–9		10–49		50–199		200+	
	Dataset	Statistics Estonia*	Dataset	Statistics Estonia*	Dataset	Statistics Estonia*	Dataset	Statistics Estonia*
2001	18.2%	22.1%	29.3%	41.1%	24.5%	23.4%	28.1%	13.5%
2002	18.8%	21.4%	30.0%	43.5%	24.9%	22.0%	26.3%	13.1%
2003	19.5%	20.7%	29.8%	43.7%	25.1%	21.4%	25.7%	14.3%
2004	19.7%	21.3%	29.3%	43.5%	25.4%	21.0%	25.6%	14.2%
2005	19.4%	20.0%	29.4%	43.4%	25.1%	23.2%	26.0%	13.4%
2006	20.1%	18.4%	29.6%	39.9%	24.7%	24.9%	25.6%	16.8%
2007	20.9%	17.8%	29.1%	40.9%	24.3%	25.0%	25.7%	16.3%
2008	21.6%	17.2%	28.8%	41.9%	23.9%	26.6%	25.7%	14.4%
2009	27.2%	19.6%	27.0%	41.8%	22.1%	23.6%	23.8%	15.0%

Source: Statistics Estonia, Tax and Customs Board

* Estonian Labour Force Survey, public administration, defence, compulsory social security, education, health and social work are excluded.

Table 38. Comparison of the number of workers in the dataset with the number of workers reported by Statistics Estonia, by sector

NACE 1.1	2001		2002		2003		2004		2005		2006	
	Dataset	Statistics Estonia*	Dataset	Statistics Estonia*	Dataset	Statistics Estonia*	Dataset	Statistics Estonia*	Dataset	Statistics Estonia*	Dataset	Statistics Estonia*
A	4.7%	6.2%	4.6%	5.9%	4.4%	5.6%	4.3%	4.8%	4.2%	5.0%	4.0%	5.3%
B	0.3%	0.4%	0.3%	0.4%	0.3%	0.4%	0.2%	0.5%	0.2%	0.3%	0.2%	0.3%
C	1.8%	1.7%	1.5%	1.6%	1.5%	1.6%	1.5%	2.1%	1.4%	1.5%	1.2%	1.3%
D	34.1%	34.1%	33.4%	32.1%	32.6%	33.5%	31.3%	34.8%	29.4%	32.7%	28.3%	30.9%
E	2.7%	3.1%	2.3%	2.7%	2.1%	2.7%	2.0%	3.1%	1.8%	3.0%	1.7%	2.9%
F	8.1%	9.1%	8.3%	9.0%	8.4%	9.4%	8.3%	10.3%	8.5%	10.5%	10.1%	12.5%
G	21.1%	18.5%	21.7%	19.7%	22.8%	18.0%	24.4%	18.0%	26.0%	17.9%	24.6%	18.2%
H	3.9%	3.2%	4.0%	3.2%	3.9%	3.7%	3.9%	3.5%	3.9%	4.7%	4.6%	4.4%
I	11.7%	13.0%	11.5%	13.1%	11.2%	13.4%	11.0%	12.4%	10.5%	12.8%	10.1%	13.3%
J	1.7%	1.8%	1.8%	2.1%	2.0%	2.0%	2.1%	1.9%	2.2%	1.7%	2.0%	1.6%
K	9.9%	8.8%	10.5%	10.3%	10.8%	9.7%	11.0%	8.6%	11.8%	10.1%	13.1%	9.4%

Source: Statistics Estonia, Tax and Customs Board

* Estonian Labour Force Survey, public administration, defence, compulsory social security, education, health and social work are excluded.

Table 39. Comparison of the number of workers in the dataset with the number of workers reported by Statistics Estonia, by sector (continued)

NACE 1.1	2007		2008		2009	
	Dataset	Statistics Estonia*	Dataset	Statistics Estonia*	Dataset	Statistics Estonia*
A	3.5%	4.4%	3.5%	3.6%	3.4%	4.6%
B	0.2%	0.3%	0.2%	0.2%	0.1%	0.2%
C	1.2%	1.3%	1.2%	1.4%	1.4%	1.6%
D	28.6%	30.1%	27.4%	30.0%	25.6%	28.7%
E	1.6%	2.1%	1.5%	1.8%	1.5%	2.1%
F	12.3%	15.8%	11.7%	16.1%	11.8%	13.1%
G	22.0%	17.8%	23.1%	19.0%	21.8%	19.0%
H	4.8%	4.4%	4.9%	4.7%	5.4%	4.5%
I	10.0%	12.3%	9.9%	11.3%	10.9%	12.6%
J	2.1%	2.1%	2.1%	2.2%	2.4%	2.9%
K	13.8%	9.5%	14.6%	9.7%	15.8%	10.7%

Source: Statistics Estonia, Tax and Customs Board

* Estonian Labour Force Survey, public administration, defence, compulsory social security, education, health and social work are excluded.

Table 40. Comparison of the number of workers in the dataset with the number of workers reported by Statistics Estonia, by age group

	2001		2002		2003		2004		2005	
	Database	Statistics Estonia*	Database	Statistics Estonia*	Database	Statistics Estonia*	Database	Statistics Estonia*	Database	Statistics Estonia*
–24	13.7%	13.2%	14.0%	11.5%	14.6%	11.8%	15.6%	11.0%	16.7%	11.4%
25–49	60.7%	62.2%	60.7%	63.1%	59.9%	63.2%	58.7%	62.8%	57.5%	62.3%
50–74	25.6%	24.7%	25.3%	25.4%	25.5%	25.0%	25.7%	26.2%	25.8%	26.3%

Source: Statistics Estonia, Tax and Customs Board

* Estonian Labour Force Survey, public administration, defence, compulsory social security, education, health and social work are excluded.

Table 41. Comparison of the number of workers in the dataset with the number of workers reported by Statistics Estonia, by age group (continued)

	2006		2007		2008		2009	
	Database	Statistics Estonia*	Database	Statistics Estonia*	Database	Statistics Estonia*	Database	Statistics Estonia*
–24	18.0%	12.3%	18.5%	13.5%	17.2%	13.5%	13.1%	11.7%
25–49	56.2%	61.6%	55.4%	60.3%	55.8%	60.4%	58.2%	60.9%
50–74	25.8%	26.1%	26.1%	26.2%	27.0%	26.0%	28.7%	27.4%

Source: Statistics Estonia, Tax and Customs Board

* Estonian Labour Force Survey, public administration, defence, compulsory social security, education, health and social work are excluded.

Table 42. Comparison of the number of workers in the dataset with the number of workers reported by Statistics Estonia, by gender

	Female		Male	
	Dataset	Statistics Estonia*	Dataset	Statistics Estonia*
2001	45.3%	42.9%	54.7%	57.1%
2002	45.3%	42.6%	54.7%	57.4%
2003	45.4%	42.9%	54.6%	57.1%
2004	45.7%	43.7%	54.3%	56.3%
2005	45.5%	44.2%	54.5%	55.8%
2006	45.4%	43.2%	54.6%	56.8%
2007	45.5%	43.1%	54.5%	56.9%
2008	45.7%	42.9%	54.3%	57.1%
2009	46.0%	44.4%	54.0%	55.6%

Source: Statistics Estonia, Tax and Customs Board

* Estonian Labour Force Survey, public administration, defence, compulsory social security, education, health and social work are excluded.

Appendix 2. Results of the two-sample Kolmogorov-Smirnov test for equality of distribution functions (non-standardised wage growth)

Year	compared to year	D	P-value	Corrected
2002	2003	0.7159	0.000	0.000
2002	2004	0.7112	0.000	0.000
2002	2005	0.6841	0.000	0.000
2002	2006	0.5825	0.000	0.000
2002	2007	0.5081	0.000	0.000
2002	2008	0.6340	0.000	0.000
2002	2009	0.8607	0.000	0.000
2003	2004	0.6967	0.000	0.000
2003	2005	0.6689	0.000	0.000
2003	2006	0.5654	0.000	0.000
2003	2007	0.4864	0.000	0.000
2003	2008	0.6169	0.000	0.000
2003	2009	0.8546	0.000	0.000
2004	2005	0.6722	0.000	0.000
2004	2006	0.5693	0.000	0.000
2004	2007	0.4909	0.000	0.000
2004	2008	0.6208	0.000	0.000
2004	2009	0.8559	0.000	0.000
2005	2006	0.6001	0.000	0.000
2005	2007	0.5320	0.000	0.000
2005	2008	0.6540	0.000	0.000
2005	2009	0.8666	0.000	0.000
2006	2007	0.6489	0.000	0.000
2006	2008	0.7550	0.000	0.000
2006	2009	0.8983	0.000	0.000
2007	2008	0.7926	0.000	0.000
2007	2009	0.9100	0.000	0.000
2008	2009	0.8813	0.000	0.000

Source: Estonian Tax and Customs Board, author's calculations

Appendix 3. Wald test for equality of rigidity coefficients

Characteristic	Group	Comparison group	Chi-square test statistic	Prob.
Gender	Men	Women	23.1001	0.0000
Age	<24	25–34	13.6121	0.0002
		35–44	81.1624	0.0000
		45–54	35.6421	0.0000
		55–64	14.5577	0.0001
		>65	172.4524	0.0000
	25–34	35–44	39.3211	0.0000
		45–54	8.8964	0.0029
		55–64	0.1846	0.6675
		>65	123.3528	0.0000
	35–44	45–54	6.9940	0.0082
		55–64	28.5161	0.0000
		>65	32.1938	0.0000
	45–54	55–64	5.7200	0.0168
		>65	58.6111	0.0000
	55–64	>65	101.7675	0.0000
Wage	<0.5 average wage	0.5–1 average wage	182.9915	0.0000
		1–1.5 average wage	252.8603	0.0000
		1.5–2 average wage	250.1844	0.0000
		>2 average wage	155.6777	0.0000
	0.5–1 average wage	1–1.5 average wage	9.0718	0.0026
		1.5–2 average wage	10.7763	0.0010
		>2 average wage	0.1922	0.6611
	1–1.5 average wage	1.5–2 average wage	0.1059	0.7448
		>2 average wage	5.1674	0.0230
	1.5–2 average wage	>2 average wage	6.4811	0.0109
Company size	<10	10–49	866.6921	0.0000
		50–249	1654.5570	0.0000
		>250	1529.2130	0.0000
	10–49	50–249	208.1950	0.0000
		>250	189.6613	0.0000
	50–249	>250	0.1085	0.7418

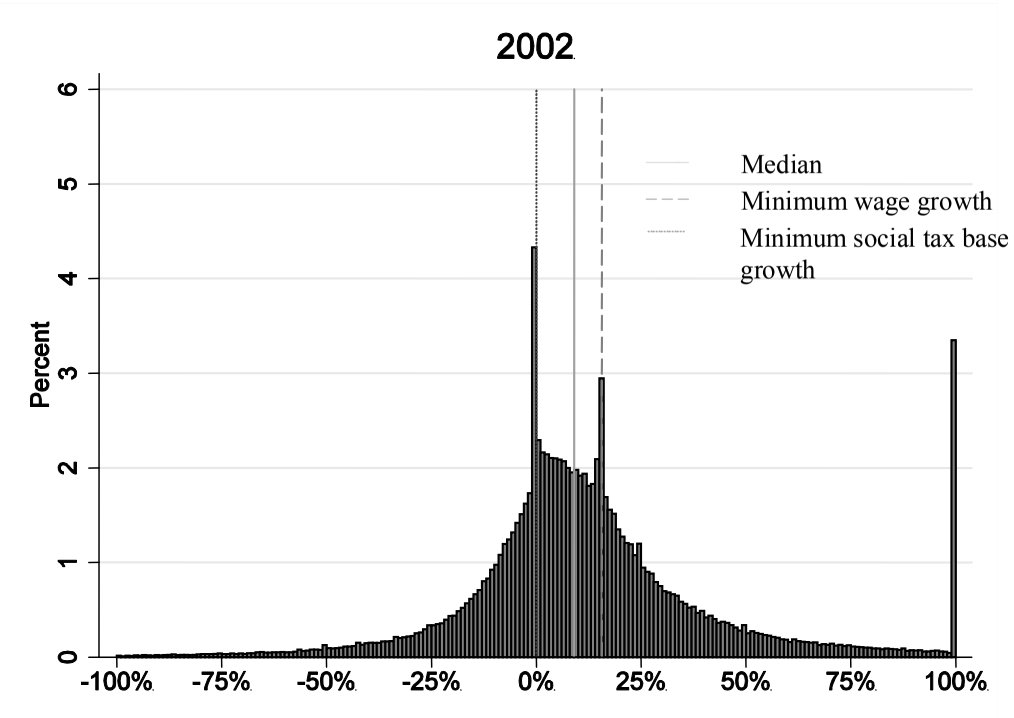
Source: Estonian Tax and Customs Board, author's calculations

Appendix 4. Rigidity coefficients 2002–2008, by economic sector (model (5–1)

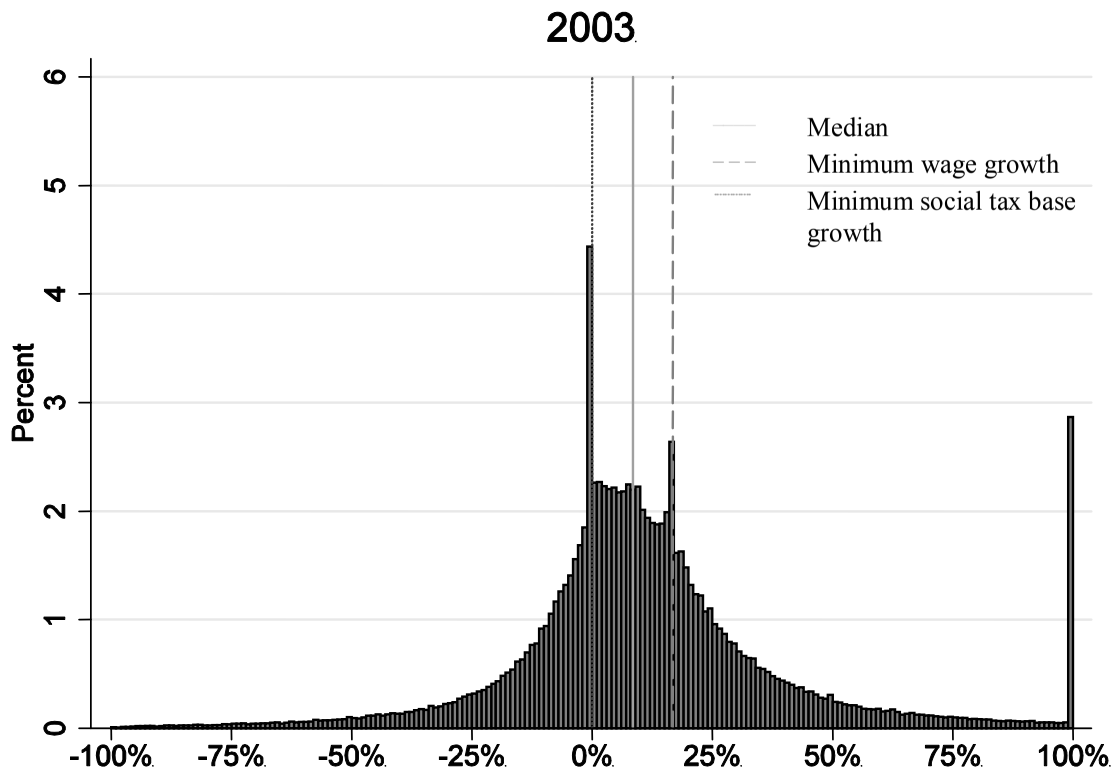
Economic sector (NACE 2.2)	Coefficient	Std. Error	t-Statistic	Prob.
Agriculture, forestry and fishing	9.2%	0.005068	18.08323	0.0000
Mining and quarrying	4.3%	0.006479	6.632348	0.0000
Manufacturing	4.3%	0.004671	9.249710	0.0000
Electricity, gas, steam and air conditioning supply	6.7%	0.005542	12.12488	0.0000
Water supply; sewerage, waste management and remediation activities	6.1%	0.005106	11.86275	0.0000
Construction	9.1%	0.004733	19.23841	0.0000
Wholesale and retail trade; Repair of motor vehicles and motorcycles	14.1%	0.004775	29.48855	0.0000
Transportation and storage	11.5%	0.004659	24.67219	0.0000
Accommodation and food service activities	9.9%	0.004569	21.66434	0.0000
Information and communication	12.1%	0.004735	25.57881	0.0000
Financial and insurance activities	9.2%	0.005098	18.00961	0.0000
Real estate activities	26.3%	0.005230	50.32822	0.0000
Professional, scientific and technical activities	16.3%	0.004347	37.52524	0.0000
Administrative and support service activities	8.3%	0.004539	18.31471	0.0000
Arts, entertainment and recreation	10.9%	0.004540	24.03219	0.0000
Other service activities	14.7%	0.004765	30.78893	0.0000

Source: Estonian Tax and Customs Board, author's calculations

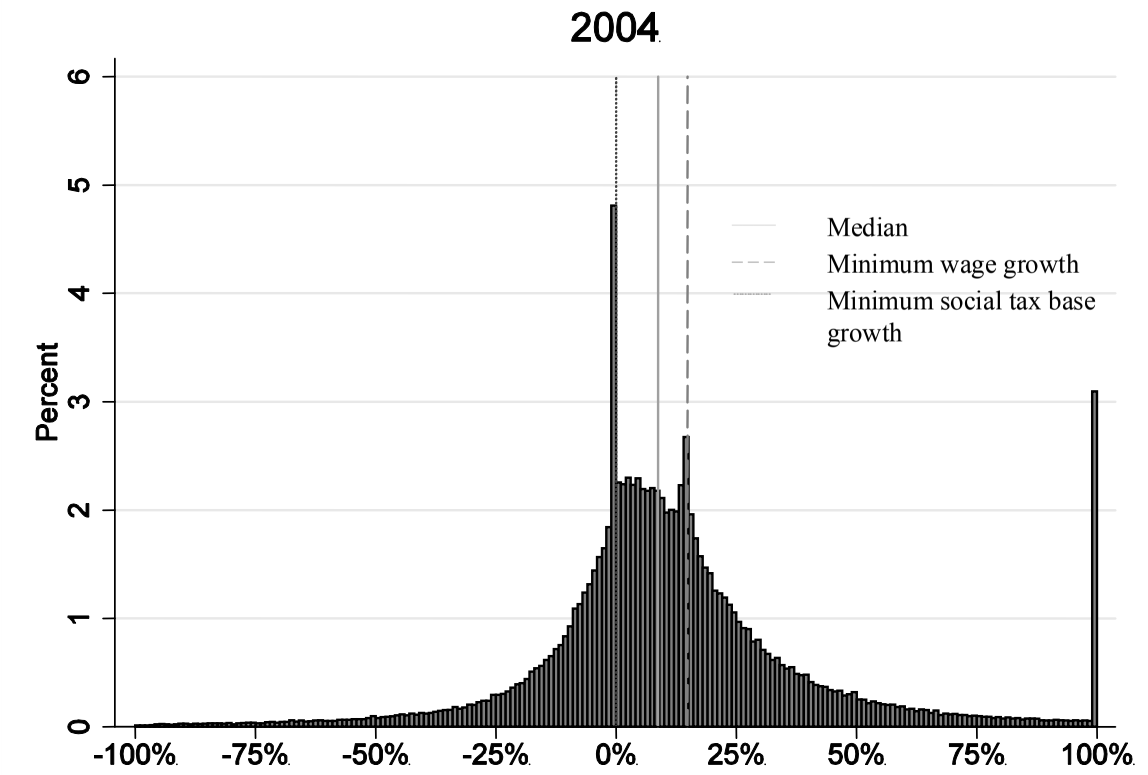
Appendix 5. Wage change distributions



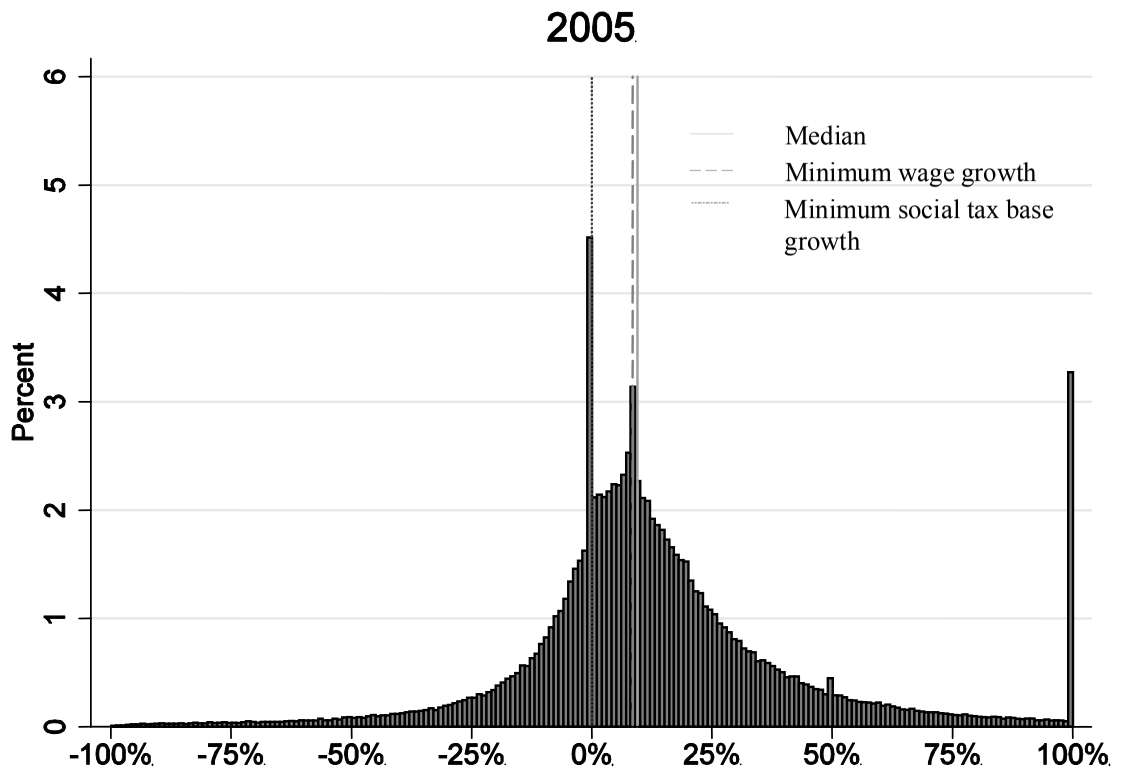
Source: Estonian Tax and Customs Board, author's calculations



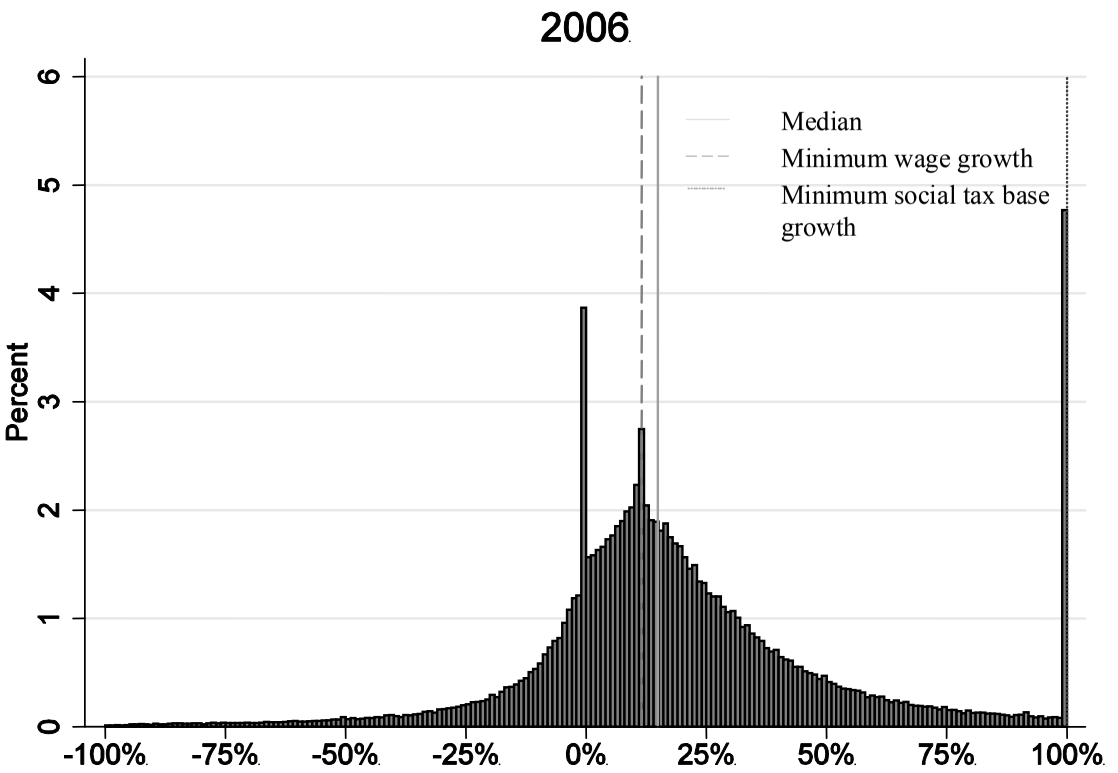
Source: Estonian Tax and Customs Board, author's calculations



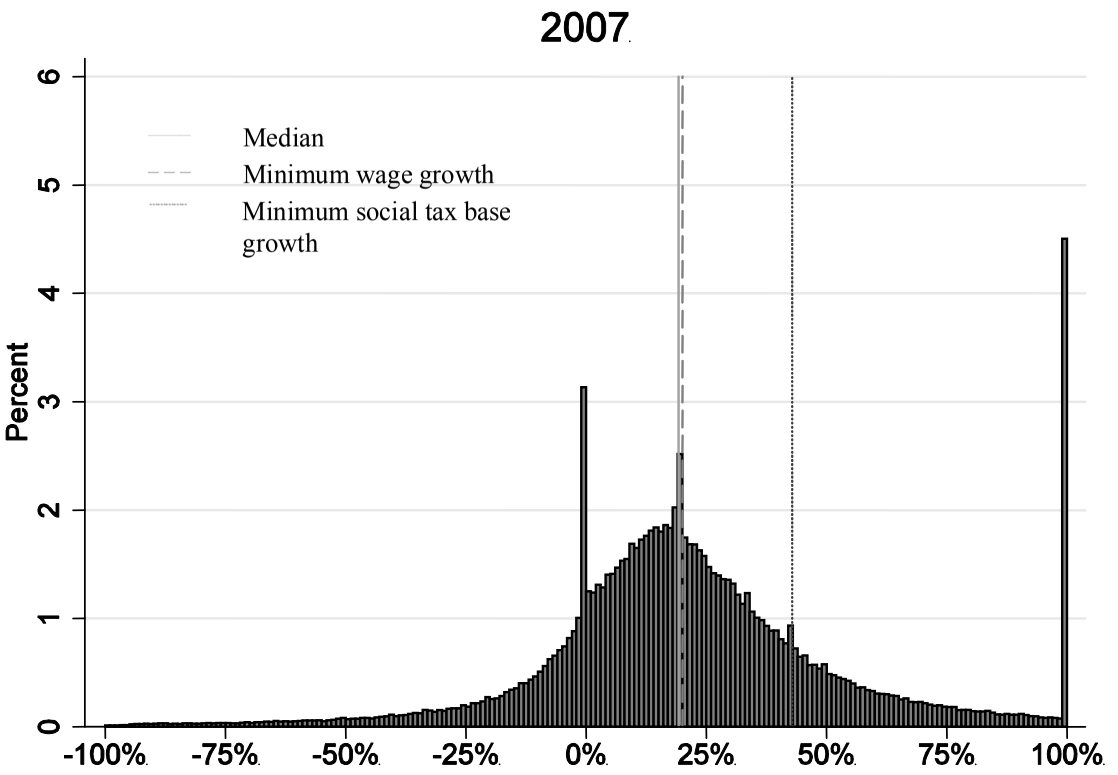
Source: Estonian Tax and Customs Board, author's calculations



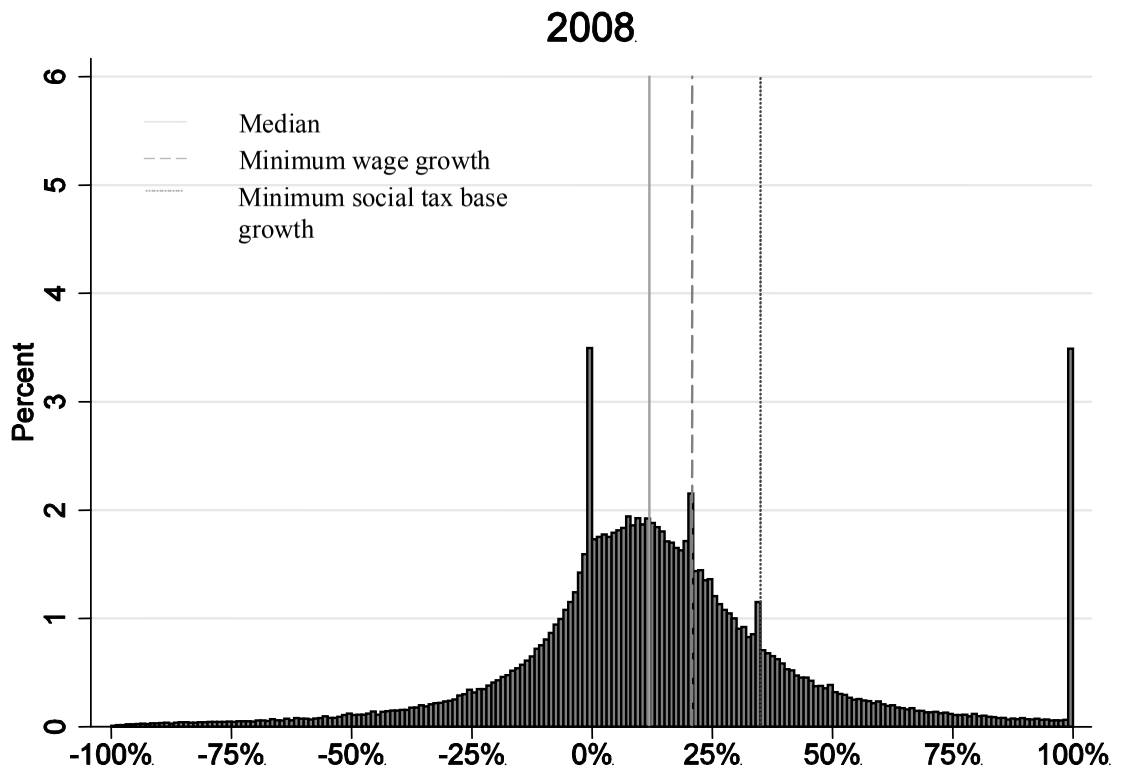
Source: Estonian Tax and Customs Board, author's calculations



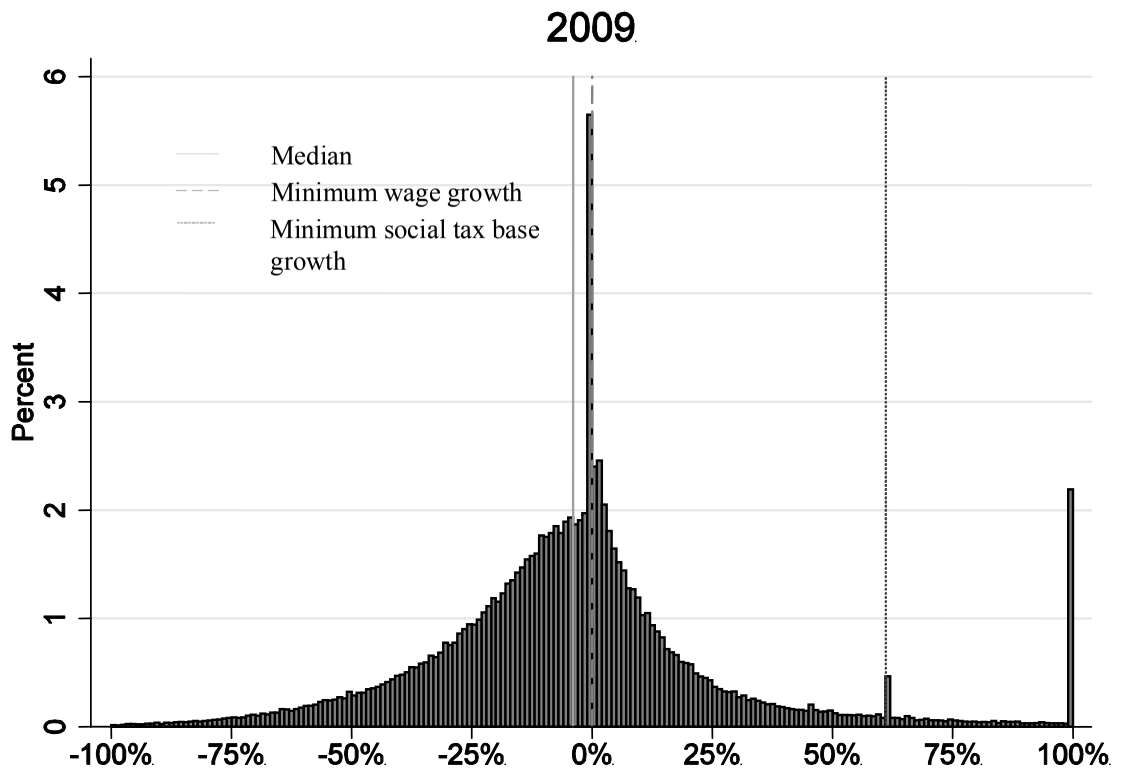
Source: Estonian Tax and Customs Board, author's calculations



Source: Estonian Tax and Customs Board, author's calculations



Source: Estonian Tax and Customs Board, author's calculations



Source: Estonian Tax and Customs Board, author's calculations

SUMMARY IN ESTONIAN – KOKKUVÕTE

Nominaalpalkade allapoole jäikus Eesti erasektoris

Töö aktuaalsus

Viimased viis aastat on olnud heaks näiteks majanduse tsüklilisest arengust. Tööandjad on saanud omal käel tunda nii nõudluse kiiret kasvu kui sellele järgnenud sise- ja välisnõudluse järsku langust, mis tõi paratamatult kaasa ka nõudluse vähenemise tootmisressursside (sh tööjõu) järele. Töötajate jaoks tähendas eeltoodu aga seda, et seni kiirelt kasvanud palk ja hõivevõimalused asendusid üha suurema tõenäosusega jääda töötuks ning tööandja poolsete ettepanekutega leppida kokku uutes tasumäärades – kohati oluliselt madalamal tasemel kui hetkel kehtivas töölepingus kokkulepitud. Töötajate valmidus selliseid ettepanekuid vastu võtta (ja tööandja valmidus neid teha) määravadki olulisel määral selle, kas nominaalpalgad on allapoole jäigad või mitte.

Nominaalpalkade allapoole jäikus tähendab seda, et tööturul püütakse hoiduda nominaalpalkade alandamisest. See teema on oluline mitmel põhjusel. Esiteks – Euroopa keskpankade tegevuse olulisimaks eesmärgiks on inflatsiooni ohjeldamine. Juhul kui nominaalpalgad on allapoole jäigad, siis võib madala inflatsiooni tingimustes tekkida olukord, kus tööandjal ei ole võimalik reaalpalkasid langetada ning see võib kaasa tuua tööpuuduse kasvu. Teiseks – antud teema on oluline ka seetõttu, et suur osa Euroopa keskpankadest on loobunud iseseisvast rahapoliitikast ning kas liitunud euroalaga või sidunud oma valuuta euroga. Olukorras, kus rahapoliitikat ei ole võimalik kasutada majanduse juhtimiseks, on palkade paindlikkusel väga oluline roll majanduse kohanemisel valuutapiirkonna siseste asümmeetriliste šokkidega. Card & Hyslop (1997) on öelnud, et juhul kui nominaalpalgad on allapoole jäigad, siis võib madal inflatsioon töötada kui „määre tööturu masinavärgis". Selleks et teada, kas mõningane inflatsiooni on vajalik, tuleb esmalt selgusele jõuda, kas nominaalpalgad on allapoole jäigad või mitte.

Uuringu eesmärk ja ülesanded

Käesoleva töö eesmärgiks on uurida nominaalpalkade allapoole jäikuse olemasolu Eesti erasektori näitel. Selle eesmärgi täitmiseks püstitati järgmised uurimisülesanded:

- anda ülevaade nominaalpalkade allapoole jäikust selgitavast teoreetilisest raamistikust;
- anda ülevaade nominaalpalkade allapoole jäikuse olemasolu, suurust ja põhjuseid uurivatest empiirilistest uuringutest;
- analüüsida nominaalpalkade allapoole jäikuse olemasolu Eesti erasektori ettevõtetes;
- analüüsida erinevusi nominaalpalkade allapoole jäikuses töötajate ja tööandjate gruppide lõikes;

- analüüsida 2008–2009 aasta majanduskriisi mõju nominaalpalkade allapoole jäikusele.

Metoodika ja motivatsioon

Käesoleva uuring põhineb andmestikul, mis võimaldab väga täpselt jälgida inimeste kogupalkade muutumist ajas. Palgajaotuse tihedusfunktsiooni parameetrite analüüsimisel põhinevaid uuringuid on hea kvaliteediga andmestikel (nagu käesolevas töös kasutatud registriandmed) tehtud kogu maailmas väga vähe ning Ida-Euroopa riikide kohta on see autorile teadaolevalt esimene sellist laadi uuring. Samas on just detailsed ja täpsed andmed palkade paindlikkuse hindamisel väga olulised, sest eelnevalt on mitmed autorid viidanud sellele, et palkade jäikus on pigem kunstlik fenomen, mis tuleneb mõõtmisvigadest (nt Smith (2000)). Käesolevas töös leitud hinnangud nominaalpalkade jäikusele põhinevad Eesti Maksu- ja Tolliameti tulu- ja sotsiaalmaksu deklaratsioonides deklareeritud sotsiaalmaksu andmetel aastatest 2001–2008. Andmed võimaldavad leida töötaja ja tööandja vahelise lepingulise suhte alusel töötajale makstud ametliku kuise töötasu suuruse. Kuna töö põhiliseks fookuseks on nominaalpalkade allapoole jäikus, siis konstrueeritakse eelpool kirjeldatud andmete põhjal iga tööandja-töötaja suhte jaoks aastased palkade muutuse näitajad.

Nominaalpalkade allapoole jäikust hinnatakse uurimise empiirilises osas kolmel erineval meetodil – asümmeetria-ankurpunkti meetod (*skewness location approach*) (vt McLaughlin (1994)), sümmeetria meetod (*symmetry approach*) (vt Card & Hyslop (1997)) ja histogramm-ankurpunkti meetod (*histogram-location approach*) (vt Kahn (1997)). Nominaalpalkade allapoole jäikuse dünaamilisust on käsitletud vähestes töödes (nt Beissinger & Knoppik (2001), Behr & Pötter (2009)). Käesolevas töös kasutada olevate andmete baasil on võimalik hinnata palkade jäikust ka majanduskriisi tingimustes. Metoodilise täiendusena pakub töö autor välja uue indikaatori (maksimaalne nominaalpalkade allapoole jäikuse indikaator) nominaalpalkade allapoole jäikuse dünaamika hindamiseks kriisiperioodil. Lisaks hinnatakse palkade jäikust erinevate töötajate ja tööandjate gruppide lõikes. Gruppide hinnangud põhinevad histogramm-ankurpunkt meetodil. Tegemist on meetodiga, mis võimaldab saada kergesti interpreteeritavaid hinnanguid nominaalpalkade allapoole jäikuse kohta ning teeb suhteliselt vähe eelduseid nominaalpalkade jaotusfunktsiooni kuju kohta.

Uuring koosneb kuuest sisupeatükist. Esimeses peatükis antakse ülevaade nominaalpalkade allapoole jäikuse teoreetilistest põhjendustest. Peatüki ülesandeks on anda teoreetiline põhjendus nominaalpalkade allapoole jäikusele.

Teises peatükis tuuakse ära seni teostatud empiiriliste uuringute tulemused. Ülevaates keskendutakse peamiselt uuringutele, mille koostamisel on kasutatud eelpool nimetatud kolme nominaalpalkade allapoole jäikuse analüüsimeetodit. Seejärel antakse põgus ülevaade ka teiste meetodite alusel läbi viidud uuringutest ning uuringutest, mis testivad empiiriliselt erinevaid palkade jäikuse põhjuseid.

Kolmandas peatükis kirjeldatakse uurimuses kasutatavat andmestikku, samuti selgitatakse andmestiku peamisi eeliseid ja puuduseid. Peatüki viimased kaks alapeatükki lahkavad metoodikat, mida kasutatakse puuduste kõrvaldamiseks, ning palgakasvude arvutamiseks kasutatud lähenemist.

Uuringu neljandas peatükis hinnatakse nominaalpalkade jäikust Eesti kui terviku näitel. Kasutatakse eelmainitud kolme meetodit ning lõppjäreldused tehakse neist meetoditest sobivaima põhjal (eelistatakse histogramm-ankurpunkti meetodit, kuna see ei sea piiranguid palkade jaotusfunktsiooni kujule (konkreetsel aastal) ning tulemused on selgelt interpreteeritavad). Tulemused asetatakse rahvusvahelisse konteksti, võrreldes käesoleva uuringu tulemusi varasemate empiiriliste uuringutega.

Uuringu viiendas peatükis analüüsitakse, kas töötajate ja tööandjate gruppide lõikes on nominaalpalkade allapoole jäikuses olulisi erinevusi. Analüüsi läbiviimisel tuginetakse eelmises peatükis eelistatud meetodina valitud histogramm-ankurpunkti meetodile, töötajaid vaadeldakse eraldi soo, vanuse ja palgagruppide lõikes. Tööandjaid analüüsitakse majandussektori ja ettevõtte suurusgruppide lõikes.

Viimases peatükis uuritakse, millist mõju avaldas nominaalpalkade allapoole jäikusele 2008–2009 aasta majanduskriis. Majanduskriisi tingimustes ei ole võimalik kasutada histogramm-ankurpunkti meetodit, kuna kõik selle eeldused ei ole kriisi tõttu kiiresti muutuvas majanduses täidetud. Palkade jäikuse analüüsimiseks kriisi olukorras kasutatakse autori poolt välja pakutud maksimaalse nominaalpalkade jäikuse indikaatorit.

Töö lõppeb kokkuvõttega, milles antakse lühike ülevaade uuringu sisust ja tulemustest.

Teoreetiline ja empiiriline taust, hüpoteesid

Nominaalpalkade allapoole jäikuse all mõistetakse olukorda, kus hoidutakse nominaalpalkade langetamisest. Nominaalpalkade allapoole jäikust käsitlevas kirjanduses on välja pakutud erinevaid teooriaid, mis aitavad seda selgitada. Mitte kõik nendest teooriatest ei ole loodud selleks, et kirjeldada olukordi, kus palgad ei lange. Näiteks enamiku efektiivsuspalkade maksmise mehhanismide puhul (nt töökohustustest kõrvalehiilimise teooria) sõltub palgatase tööturul valitsevast olukorrast, mis tähendab, et majandusolude halvenemine peaks võimaldama ka palkadel langeda. Empiirilistes uuringutes siiski testitakse selliseid mehhanisme (nt küsitakse tippjuhtidelt, kas nad ei langeta palkasid selle pärast, et kardavad tööjõukäibe kasvu (nt Blinder & Choi (1990)). Kokkuvõtlikult – palkade allapoole jäikuse alane empiiriline kirjandus on pigem kasutanud eelpool kirjeldatud mudeleid ideede allikana, et tuletada võimalikke põhjuseid selgitamaks palkade allapoole jäikust. Sageli ei tähenda see sugugi seda, et konkreetse idee allikaks olnud mudel välistaks palkade allapoole liikumise.

Valdav osa palkade allapoole jäikust kirjeldavatest teooriatest tegeleb reaalpalkade, mitte nominaalpalkadega. Nominaalpalkade allapoole jäikust

uurinud teadlased (nt Agell & Bennmarker (2007)) leiavad siiski, et nendel teooriatel on ka nominaalpalkade jäikuse kirjeldamisel oluline roll, sest väga madala inflatsiooni tingimustes määravad nominaal- ja reaalpalkade käitumist sarnased protsessid ning olukordades, kus nominaalpalkade allapoole paindlikkus muutub oluliseks (nt majanduskriisid), on nullilähedane inflatsioon küllaltki tavaline nähtus.

Lühidalt kokkuvõttes võiks palkade allapoole jäikuse teoreetilised põhjused jagada kahte suuremasse gruppi – esmalt need, mis selgitavad, miks tööandjad ei langeta palkasid ja teiseks need, mis selgitavad, miks töötajad ei ole nõus palkade langetamisega. Miks tööandjad ei langeta palkasid või teevad seda viitajaga? Põhjused on järgmised:

- **Tööandja ei saa palkasid langetada** – kehtiv õiguslik raamistik ei võimalda palkasid ühepoolselt muuta (*pacta sunt servanda* printsiip) või need on piisavalt madalal, et seadus ei luba neid langetada (*miinimumpalgast tulenev jäikus*);
- **Palkade langetamine on tööandjale kulukas** – väike ajutine langus töötaja tootlikkuses ei tekita nii suuri kulusid, et selle pärast tasuks palkasid muuta, kuna ka palga muutmisega kaasnevad kulud (nn *menüü muutmise kulud*). Tööandja jaoks võib olla vähem kulukas tasu langetamisest kindlustada töötaja palgakõikumise vastu (*psühholoogilise kokkuleppe teooria*). Tööandjapoolsed jõulised ettepanekud palkade langetamiseks võivad lõppeda töötajate vabatahtliku lahkumisega, mis tähendab tööandja jaoks suuremaid tööjõu käibekulusid (*tööjõu käibega kaasnevate kulude teooria*);
- **Palkade langetamine mõjutab negatiivselt tööjõu kompositsiooni** – palkade langetamise tagajärjel lahkuvad eeskätt just kõige kvalifitseeritumad töötajad (*ebasoodsa valiku teooriad*). Samuti võib lahkunud töötajate uutega asendamine osutuda keerulisemaks, kuna ettevõttes töötavad töötajad võivad suruda uustulnukate tootlikkuse madalamaks näiteks läbi selle, et keelduvad nendega koostööd tegemast (*sees- ja väljasolijate teooria*);
- **Palkade langetamine mõjutab negatiivselt töötajate tootlikkust** – kõrgem palk paneb töötajad rohkem pingutama, kuna töö kaotamise korral on neil seetõttu ka rohkem kaotada (*töö tegemisest kõrvale hiilimise teooria*). Töötajad võivad palkade langetamist tõlgendada ka „reetmisena" ning sellest tulenevalt oma tööpanust langetada (*moraalse kaalutluse teooria*).

Töötajate käitumisest tulenevad põhjendused on järgmised:

- **Palgad ainult näivad jäigad** – palga langetamisega mitte nõus olevad töötajad lahkuvad töölt. Tööandja jaoks tähendab see seda, et tööjõukulud ikkagi vähenevad, kuid kui vaadelda palkade dünaamikat ühe töösuhte sees, siis sellest palkade langetamine välja ei paista (nt *tööturuinfo valesti tõlgendamise teooria*);

- **Töötajad kardavad elatustaseme langust** – töötajad kardavad, et kui nad aktsepteerivad palgalangust, siis tähendab see seda, et nende suhteline palk (palk võrreldes nt teistes sektorites töötavate töötajatega) väheneb ning see toob kaasa elatustaseme languse (*Keynes'i suhtelise palga teooria*);
- **Ametiühingud ei võimalda palkasid langetada** – kui ametiühingus langetavad otsuseid inimesed, kes on ise koondamise eest hästi kaitstud, siis ei ole nende huvides tööhõive maksimeerimine, vaid võimalikult kõrge palk (*staažiga kaasnevate õiguste teooria*).

Siiani teostatud empiirilised uuringud valdavalt kinnitavad hüpoteesi, et nominaalpalgad on vähemal või suuremal määral allapoole jäigad, kusjuures riikide lõikes on nominaalpalkade jäikuses olulisi erinevusi (nt. Knoppik & Beissinger (2009)). Huvitava nähtusena on välja toodud, et palkade jäikus sõltub ka majandustsüklist (täpsemalt muutusest tööpuuduse määras) (vt Beissinger & Knoppik (2001)).

Erinevate töötasu tüüpide lõikes on järeldatud, et põhipalgad on jäigemad kui kogupalk või tulemustasu komponendid (nt Lebow *et al*. (2003)). Töötajate gruppidest on põhjalikumalt uuritud valge- ja sinikraede palkade jäikust ning jõutud järeldusele, et sinikraede palgad on jäigemad (nt Iregui *et al.* (2009)). Tunni- ja kuupalga saajate palkade jäikuse analüüsimisel on erinevad autorid jõudnud erinevatele tulemustele. Lisaks töötajate gruppidele on nominaalpalkade allapoole jäikust analüüsitud ettevõttegruppide lõikes ning tõdetud, et suurettevõtetes on palgad väikeettevõtetest jäigemad (Babecký *et al.* (2010)). Kokkuvõtlikult võib öelda, et mõningate üksikute eranditega on nominaalpalkade allapoole jäikuse hindamiseks autori hinnangul üht sobivaimat[55], histogramm-ankurpunkti meetodit, kasutatud suhteliselt väheste töötajate ja tööandjate gruppide uurimiseks.

Oluline on märkida, et palkade jäikust on analüüsitud ka Eestis. Dabušinskas & Rõõm (2011) analüüsisid palkade kohanemist kriisi tingimustes ning jõudsid järeldusele, et Eestis viidi 2009. aastal teiste riikidega võrreldes läbi märkimisväärsel hulgal palgalangetamisi. See järeldus jääb püsima ka siis, kui vaadata rahvusvahelise võrdluses aluseks olevates riikides vaid neid ettevõtteid, kus nõudlus ettevõtte toodangu järele oluliselt vähenes. Eeltoodu viitab sellele, et Eesti nominaalpalgad on allapoole paindlikud.

Lisaks eelnevalt loetletud empiirilistele tulemustele on mõningad täiendavad grupid, kelle palkade allapoole jäikust pole varem põhjalikult uuritud, kuid kelle osas võib teooria põhjal eeldada, et esinevad erinevused. Autori teada ei ole histogram-ankurpunkti meetodit rakendatud palkade jäikuse uurimiseks ei vanusegruppide, erinevate sissetulekutasemete ega soogruppide lõikes. Sellele vaatamata on põhjust eeldada, et nende gruppide lõikes võiks nominaalpalkade jäikuses olla olulisi erinevusi. Näiteks on mitmed autorid näidanud, et naiste ja

[55] Kõige sobivamat meetoditest, mis püüavad tõmmata järeldusi palkade jaotusfunktsiooni kuju muutustest.

meeste käitumine läbirääkimistel on erinev ning mehed on oluliselt riskialtimad kui naised (nt Croson & Gneezy (2009), Holt & Laury (2002)). Palgaläbirääkimised sisaldavad alati teatavat riskikomponenti – kui tööandja teeb töötajale pakkumise palga langetamiseks, siis riskib töötaja sellega, et juhul kui ettevõte hakkab inimesi koondama (ja olukorras, kus on vaja palkasid langetada, on koondamiste toimumise tõenäosus küllaltki suur), siis koondab tööandja kõigepealt need töötajad, kes ei olnud palga läbirääkimistel koostööaltid. Seega võiks eeldada, et vähem riskialtid töötajad nõustuvad kergemini palgakärbetega.

Mõningaid erinevusi on põhjust eeldada ka vanusegruppide lõikes. Tööpuudus on noorte (nooremad kui 25 eluaastat) seas oluliselt kõrgem kui keskealiste inimeste hulgas. See tähendab, et koondamise korral on neil keerulisem tööd leida. Lisaks eeltoodule on keskealised töötajad omandanud rohkem ettevõttespetsiifilist inimkapitali ning võivad seetõttu olla ettevõttele väärtuslikumad töötajad. Seega võiks oletada, et noored töötajad on palgaläbirääkimistel keerulisemas olukorras keskealistest, sest nendest on tööandjal kergem loobuda ning neil on ka keerulisem leida uut töökohta. Noorte palgad võiksid olla seetõttu allapoole paindlikumad kui keskealistel inimestel.

Sissetulekutasemeti peaks kõige selgemalt eristuma need töötajad, kelle palk on ligilähedane miinimumpalgale – nende palk peaks olema allapoole jäik, kuna Töölepinguseadus ei luba täiskohaga töötajale maksta alla miinimumpalga.

Teoreetilisele ja empiirilisele kirjandusele tuginevalt püstitati käesolevas töös empiirilisele hindamisele järgmised hüpoteesid:

Hüpotees 1. Nominaalpalgad Eestis on allapoole paindlikumad kui nominaalpalgad Lääne-Euroopa riikides

Hüpotees 2. Nominaalpalkade allapoole jäikus on erinevates tööstusharudes erinev;

Hüpotees 3. Nominaalpalgad on suurettevõtetes allapoole jäigemad kui väikeettevõtetes;

Hüpotees 4. Noorte töötajate nominaalpalgad on allapoole paindlikumad kui keskealiste töötajate palgad;

Hüpotees 5. Nominaalpalkade allapoole jäikus on sooti erinev;

Hüpotees 6. Madalamat palka teenivate töötajate nominaalpalgad on allapoole vähem paindlikud kui keskmist ja kõrgemat palka teenivate töötajate palgad;

Hüpotees 7. Nominaalpalkade jäikus sõltub majandustsüklist ning majanduskriis mõjub nominaalpalkade jäikust vähendavalt.

Tulemused

Hüpoteeside kehtivuse või ümberlükatuse paremaks mõistmiseks on analüüsi tulemused esitatud hüpoteeside lõikes.

Hüpotees 1. Nominaalpalgad Eestis on allapoole paindlikumad kui nominaalpalgad Lääne-Euroopa riikides.

Hüpotees leidis kinnitust. Perioodil 2002–2008 jäi toimumata veidi vähem kui 10% palgalangetamisest, mis oleks võinud toimuda, kui palgad oleksid täielikud allapoole paindlikud. Selle hinnangu rahvusvaheliseks võrdlemiseks tuleb leida uuringuid, mis kasutavad nominaalpalkade jäikuse hindamiseks sarnaseid andmeid (registriandmeid). Selliste andmete kasutamine uuringutes on nende vähese kättesaadavuse tõttu haruldane. Üks sarnase metoodika ja andmestikuga uuring on viidud läbi Saksamaal (Beissinger & Knoppik (2001)) ning võrdlus selle uuringu tulemustega näitab, et Eesti nominaalpalgad on allapoole paindlikumad kui Saksamaal. Rahvusvahelise konteksti loomiseks oleks oluline võrrelda Saksamaa nominaalpalkade jäikust teiste riikide omaga, mida on võimalik teha Euroopa Leibkonna Paneeluuringu andmetel läbi viidud rahvusvahelise nominaalpalkade jäikuse uuringu abil (Knoppik & Beissinger (2009)). Selle tulemused näitavad, et Saksamaa nominaalpalgad on Lääne-Euroopa riikide hulgas ühed paindlikematest.

Hüpotees 2. Nominaalpalkade allapoole jäikus on erinevates tööstusharudes erinev.

Hüpotees leidis kinnitust. Nominaalpalkade jäikus on tööstusharuti erinev ning teenustesektori palgad on allapoole oluliselt jäigemad kui töötleva tööstuse palgad. Sellised erinevuse põhjuseks võib olla töötleva tööstuse suurem avatus rahvusvahelisele konkurentsile.

Hüpotees 3. Nominaalpalgad on suurettevõtetes allapoole jäigemad kui väikeettevõtetes.

Hüpotees ei leidnud kinnitust. Vaatamata sellele, et seniteostatud uuringud on välja toonud, et väikeettevõtetes on nominaalpalgad oluliselt allapoole paindlikumad kui suurettevõtetes, andis käesoleva uuringu empiiriline osa hoopis vastupidise tulemuse. Tulemuste erinevuse peamiseks põhjuseks on tõenäoliselt see, et käesolev uuring tugineb ametlikult deklareeritud palkadele. Samal ajal on teada, et väikeettevõtetes on ümbriku-

palkade kasutamine oluliselt rohkem levinud kui suurettevõtetes (Ahermaa (2009)). Eeltoodust võib järeldada, et väikeettevõtete jaoks vajalik nominaalpalkade allapoole paindlikkus saavutatakse sagedamini palkade mitteametliku osa kahandamise arvelt, samal ajal kui ametlik palk on seatud piisavalt madalaks selleks, et ka raskematel aegadel ei oleks vajadust seda alandada.

Hüpotees 4. Noorte töötajate nominaalpalgad on allapoole paindlikumad kui keskealiste töötajate palgad.

Hüpotees leidis kinnitust. Alla 25-aastaste töötajate palgad olid oluliselt paindlikumad kui keskealiste töötajate palgad. Huvitava täiendusena selgus, et üle 65-aastaste töötajate nominaalpalgad on allapoole isegi jäigemad kui keskealiste töötajate omad. Selle põhjuseks on Eestis tõenäoliselt see, et pensionieelaste töötajate hulgas on rohkem töötajaid, kellel on pikaajaline tööstaaž ja sellest tulenevalt kõrgem koondamishüvitis (kehtis kuni 2009. aasta II pooleni). Samuti on põhjust eeldada, et vanemaealiste puhul toimib ka selektsiooniefekt.

Hüpotees 5. Nominaalpalkade allapoole jäikus on sooti erinev

Hüpotees leidis kinnitust. Naiste nominaalpalgad olid allapoole paindlikumad kui meestel. Eeldatavaks põhjuseks on erinev riskialtisus palgaläbirääkimistel.

Hüpotees 6. Madalamat palka teenivate töötajate nominaalpalgad on allapoole vähem paindlikud kui keskmist ja kõrgemat palka teenivate töötajate palgad.

Hüpotees leidis kinnitust. Madalamat palka (alla 50% keskmisest palgast) teenivate töötajate palk oli nominaalselt allapoole oluliselt jäigem kui kõrgemat palka teenivatelt töötajatel. Põhjuseks on eeldatavalt see, et selles palgagrupis on küllaltki suur miinimumpalga lähedast palga teenivate inimeste osakaal.

Hüpotees 7. Nominaalpalkade jäikus sõltub majandustsüklist ning majanduskriis mõjub nominaalpalkade jäikust vähendavalt.

Hüpotees leidis kinnitust. Nominaalpalkade jäikuse koefitsiendi väärtus sõltus statistiliselt oluliselt nii tööpuuduse määrast kui tööpuuduse määra muutusest. Maksimaalse nominaalpalkade jäikuse indikaator näitas, et nominaalpalkade allapoole jäikus jätkas alanemist ka majanduskriisi ajal (2009. aastal).

Soovitused edasisteks uuringuteks

Nominaalpalkade allapoole jäikuseanalüüsimisel on mitmeid aspekte, mis vajavad täiendavat tähelepanu. Käesolev töö keskendus eeskätt nominaalpalkade allapoole jäikuse suuruse ja dünaamika hindamisele. Oluline oleks uurida täiendavalt, millist mõju omab palkade allapoole jäikus teistele makromajanduslikele näitajatele nagu tööhõive või tööpuudus. See teema on eriti huvitav, pidades silmas palkade jäikuse dünaamilist iseloomu. Huvitav oleks uurida ka nominaalpalkade allapoole jäikuse mõju majanduse taastumisvõimele pärast majanduskriisi. Täiendavat analüüsimist vajaks kindlasti ka nominaalpalkade allapoole jäikuse põhjused erinevate töötajate ja tööandjate gruppide lõikes.

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