Assessment of the euro area sustainability in the context of the optimum currency area criteria:

The Assessment of Salary Flexibility in Latvia

Salary flexibility is a crucial asymmetric shock-absorbing mechanism viewed in the setting of the optimum currency area criteria. Elastic salaries in Latvia, the recent Eurozone member, work as a tool not only facilitating the country's ability to maintain competitiveness, but also can serve as an example to a number of euro area members. Reaching the extent and significance of wage flexibility similar to the one in Latvia, the countries would facilitate both their own and the whole area's long-run sustainability.

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Abstract

The first part of this paper examines salary flexibility in Latvia using error correction model developed by Zasova and Meļihovs (2005). The study evaluates the extent of average gross salary elasticity to changes in productivity and deviations of job-seeker ratio from the structural level over the period of first quarter of 2002 until third quarter of 2013. The results show that real salaries possess a significant reaction to deviations from long run equilibrium and adjust to changes in productivity and unemployment both in long run and short term. The second part of the paper inspects salary dynamics particularly during the recession, using micro data on gross salaries of individual workers from State Social Insurance Agency of Latvia. Results indicate that females, higher paid individuals, mid-aged workers, employees in utilities, transportation and construction industries, and public sector workers had the most flexible salaries. The paper concludes that joining euro area Latvia is equipped with an effective asymmetric shock absorbing mechanism.

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1. Introduction

Only countries with high degree of similarity and integration should join a monetary union. Before adapting one currency the countries should already have high degree of labour [1] and capital [2] mobility between them, similar business cycles [3] and homogeneous preferences [4]. Without these four parameters, which describe the Optimum Currency Area (OCA), within the single currency region there would be considerable differences in unemployment rates and inflation rates, economies would not be able to effectively adjust to an asymmetric shock (Mundell, 1961).

Latvia joined European Union (EU) in 2004 and since then has been trying to meet the Maastricht criteria in order to join the Eurozone (EZ). The ease of trade (eliminated exchange rate risk, exchange rate related transaction costs, etc.) and even higher level of integration with other countries within the EZ would lead to faster economic development (Krugman & Venables, 1995).

However, joining a monetary union means giving up tools with which the country can adjust independently in case there is a shock to the economy. With flexible exchange rate one way the country adjusts is trough money market: the exchange rate appreciating or depreciating. Latvian lats have had a peg to the euro since 2005 and before that to the SDR since 1994 (Bank of Latvia, n.d.). Still, it had the option to devalue or revalue. In 2013 Latvia met the Maastricht criteria and adapted euro in 1st January of 2014. Since this date, the monetary policy is no longer a tool with which the country can adjust to external shocks. Hence, other tools have greater importance

According to Caporale, Ciferri, & Girardi (2011), in terms of meeting the most important OCA criteria, Latvia has done quite well. Since it joined the EU the capital mobility has been relatively high, partially due to EU free-trade promoting legislation (Skribans, 2010). Furthermore, business cycles for euro area and Latvia take a similar trend (Fadejeva & Meļihovs, 2008) as do the preferences, as Latvia has been actively participating in EU institutions and Parliament decisions (Ministry of Foreign Affairs of the Republic of Latvia, n.d.). Meanwhile, similarity of business cycles, capital mobility and homogeneous preferences are more important in a longer term.

One of the other possibilities for the economy to adjust over a short term in case of disequilibrium is trough flexible labour market, which can be characterised by low government restrictions; no powerful, stagnant labour unions; flexible employment laws,

easily adapting firms and flexible wages (Rodgers, 2007). Artha & de Haan (2011) show how labour market flexibility relates to impact of financial crisis on output. They confirm that more flexible labour market leads to smaller output loss.

In this paper we focus on the examination of salary flexibility, one of the main components of labour market flexibility, where salary represents the monthly remuneration of an employee. We determine the extent of average salary flexibility in Latvia during the period of first quarter of 2002 until third quarter of 2013. We also identify which age, gender and income groups and workers in which industries and entity types have experienced the sharpest decline in their monthly salary during the financial crisis of 2008/2009.

The first part of our research serves as an update of the existing flexibility assessment conducted by the Bank of Latvia (Zasova & Meļihovs, 2005). The study prolongs time-series analysed by the authors to include years of stable economic growth (2002-2004), boom (2005-2007), recession (2008-2010) and subsequent recovery and stabilizing. Therefore, the aim of our study is to investigate the extent of flexibility and adjustments to both latest spikes and declines in deviation of job-seeker ratio from the structural level and productivity.

The choice of flexibility determinants is justified – measures of the level of unemployment and productivity are the most commonly used factors in the literature for salary flexibility assessment (e.g., Montuenga *et al.*, 2003; Iara & Traistaru, 2004; Arpaia & Pichelmann, 2007).

Therefore, the central question that is going to be answered as a result of the study is: *"How flexible to changes in productivity and employment were the salaries in Latvia during the period of 2002-2013?"*

The second part of the research delivers a closer examination of the salary flexibility particularly in the period of 2008 - 2010. The goal of the analysis is to distinguish the potential differences in salary cuts among different age and income groups as well as between genders and employees in different industries and business entities during the financial crisis. As documented by the existing literature in Europe, elderly are expected to have lower wage rigidity (Du Caju, Fuss, & Wintr, 2012), which could be explained with the help of shirking model of Shapiro & Stiglitz (1984). Also, the extent of wage inelasticity is found to be lower for females by Ammermuller *et al.* (2010), which is contrary to their theory that women would rather quit or be laid-off instead of having a wage cut. Finally, there is evidence that wage stickiness decreases with the increase in earnings level. This is justified by the fact that

for those receiving higher income relatively larger proportion of earnings is constituted of bonuses and other extra income, which is proven to be a substitute for base wage cuts (Babecký *et al.*, 2012). Nevertheless, these findings, to the author's knowledge, have not been empirically tested in the Latvian context.

Hence, the sub-question of this study is: *"Salaries of which gender, age, income groups' and industry's employees possessed the most pronounced decline during the economic downturn in 2008/2009?"*

In addition to the sub-question, possible hints to differences in public and private sector changes are made by looking at the employer as a business entity.

The rest of the paper is structured as follows. Section 2 is an overview of existing empirical findings on labour market flexibility, and where Latvian labour market stands in terms of flexibility according to previous studies. It also provides a background on which groups in Latvia should be the ones affected by the recession the most. Section 3 follows with the methodology of our approach of estimating salary flexibility and comparing the salary elasticity for different demographic groups. Section 4 combines the outcome of estimations as well as provides the interpretation and discussion of the obtained results. Section 5 concludes and section 6 outlines the limitations of the study.

2. Literature review

2.1. The Western World

The issue of ability of wages to adjust to changes in the economy dates back at least to 1936. As argued by Keynes (1936), it is not always that a decrease in demand will lead to lower prices, given the supply is constant. During an economic downturn it is possible that although demand for labour decreases, wages do not shrink. That is, nominal wages are "sticky". Keynes stated that the stickiness, at least partially, is explained by decentralised union bargaining. Indeed, during the Great Depression in United Kingdom, where the negotiations were mostly done via decentralised trade unions, it was found that money wages remained adamantly rigid. On the other hand, Australia and New Zealand, where the system was more centralised, did experience considerable wage cuts after 1931 (Chapple & Savage, 1995).

More recently, different methodologies have been applied to study the labour market flexibility and in particular the nominal wage rigidity in various regions. Furthermore, many have compared either private to public wage, white-collar to blue-collar worker wage flexibility differences, or variation in flexibility of different pay schemes (e.g. bonus pay vs. fixed wages) (Dickens *et al.*, 2006; Khan, 1997; Lemieux, MacLeod and Parent, 2012).

International Wage Flexibility Project (IWFP) in 2006 analysed the wage flexibility level in 16 countries. Dickens *et al.* (2007) conclude that one of the causes for different wage rigidity levels is labour union bargaining power. IWFP also looks at wage change distributions, which are notably non-normal, asymmetrical and are clustered tightly around the median.

Empirical evidence from the United States shown by Khan (1997) suggests that in 70'ies and 80'ies 9.4% of wage earners would have experienced a nominal wage decline if downward wage "stickiness" was not present. Using histogram-location approach the author also compares rigidity differences for wage and salary earners and concludes that less frequent salary cuts are experienced by wage earners in the US. For example, within blue-collar workers 26.9% of salary earners experience negative pay changes compared to 10.4 % of wage earners. Meanwhile, the histogram-location approach has been known to ignore the variation of dispersion of wage changes through time. Lemieux, MacLeod and Parent (2012) using OLS regressions study differences in wage flexibility for different contractual arrangement workers in the US. They find that workers with bonus-pay contractual

arrangements experienced much bigger fluctuations in wages (also looking at wage decreases); however, they also had a higher probability to stay employed if there was a shock to the economy.

Fabiani & Rodriguez (2001) compare the US to European countries. They state that there exists a gap in terms of labour market flexibility and prove that it exists by building a structural VAR model of real wages, output and unemployment dynamics from 1960 to 1999. The US is proved to have a more flexible labour market than European countries. Furthermore, the gap between smaller European countries and the US is less significant. Another study comparing various countries around the world in terms of wage flexibility is done by Goubert and Omey (1996). They use "corrected" measure for disequilibrium in the labour market by estimating disequilibrium in labour demand and labour supply instead of using unemployment. Contradicting the abovementioned studies they conclude that the wage flexibility in the US is lower than in continental Europe and state that Germany has the highest wage flexibility according to their measures. Moreover, they conclude that employers overall have greater power in wage setting than employees.

2.2. Europe and the Euro Area

The relevance of wage flexibility examination in the context of European Union, and particularly Eurozone, is justified by Deroose, Langedijk and Roeger (2004). Similarly to the renowned theory of Optimum Currency Area by Robert Mundell (1961), the authors argue that flexible wages are one of the crucial mechanisms by which a country can smoothly adjust to disturbances of macroeconomic aggregates, thus reducing the volatility of output. In their dynamic model-based simulations authors find that an asymmetric exogenous demand shock lasting for 4 years with a size of 1% of GDP for a euro area country on average could result in much higher output gap (-7.5%) if wages and prices are downwardly rigid, compared if they are flexible (-4.5%). Moreover, as argued by the authors, the negative output gap effect could be more pronounced for small economies. A small economy is often more specialized, and thus the probability of being exposed to asymmetric shock is higher. Also, since it has limited weight in the union, the monetary stance at the aggregate level can move rather independently of the cyclical position of the country, potentially widening the output gap between the country and the currency area. A survey of European evidence on wage flexibility can shed light on the extent of existence of this adjustment mechanism, which is especially crucial for small economies in the European Monetary Union that Latvia has joined in 2014.

Considerable part of the existing body of literature reveals that the nominal and real gross wage flexibility in Europe and Eurozone varies across countries, and regardless of the time period studied and methodologies employed in general is found to be rather insufficient (Montuenga et al., 2003; Iara & Traistaru, 2004; Arpaia & Pichelmann, 2007). In their panel estimation of the negative elasticity of wages to changes of the level of unemployment, also known as the wage curve, Montuenga, Garcıa, & Fernandez (2003), for instance, find that the elasticity in Portugal is only -0.008. Namely, doubling the unemployment rate in the country would cause hourly wages to shrink by slight 0.8%. The wages of the other four European covered in the study: France, Italy, Spain and United Kingdom, however, are found to be much more elastic (-0.158, -0.076, -0.235 and -0.244 respectively). The estimates were obtained controlling for region and time fixed effects. The results let the authors challenge what they call the conventional 'empirical law of economics' stipulating a -0.10 wage elasticity to unemployment, irrespective of the period and country examined (Blanchflower & Oswald, 1995).

Similar result of what the authors call insufficient nominal and real wage flexibility is documented by Arpaia & Pichelmann (2007). In their study covering 12 euro-area countries in the period of 1980-2005 the authors find a 0.3% real wage downward adjustment following a 1 percentage point increase in unemployment. Additionally, the study estimates the response of real wages to changes in productivity, and adjustment of nominal wages to increase in inflation. The results show that 40% of changes in productivity are passed into real wages in the next year while about 50% of inflation in the previous period is reflected in nominal wage increase. The extent of adjustment, however, varies significantly across the EZ members with most upwardly rigid wages being in Austria, France and Greece while downward stickiness is present in all sample countries except Germany, Spain, Ireland and Finland.

The inelasticity of nominal wages in France was later confirmed by Le Bihan, Montornès, & Heckel (2012). Covering the period included in the aforementioned study, 1998-2005, the authors affirm quarterly wage stickiness using a different methodology of type two Tobit models. Similarly to aforementioned study, the elasticity of nominal wage to changes in inflation and regional unemployment is examined. The study documents that 32% of hourly base wages increase on a quarterly basis while only 6% of them decrease. The average period during which a wage is not changed, also known as spell, is found to be 2.0

quarters. What is more, the authors indicate that the wage adjustments are mostly harmonized within while staggered across firms.

Interestingly, the findings of Maza & Moral-Arce (2009) on real wage rigidity in Spain are opposite to the results of Arpaia & Pichelmann (2007). Analysing 17 Spanish regions in the period of 1985-1999 the authors conclude that earnings are sticky and do not respond to increase in national unemployment growth and productivity, which is measured as gross value added per employee. However, proceeding with the main contribution of the paper of estimating the interaction effect between unemployment and productivity on wages, authors do find signs of flexibility for the Spanish wages. Namely, the authors employ bi-dimensional nonparametric term regression, with help of which they discover that the regional unemployment has a significant negative effect on real wages – but only when the productivity growth in the region is high. Also they observe that wages do increase after a growth in productivity, nevertheless, only when unemployment growth is negative.

The extent of the adjustment mechanism in developing countries like Bulgaria, Hungary, Poland and Romania was scoped by Iara & Traistaru (2004), who assessed the elasticity of wages to local unemployment rates. The results indicate that only in Bulgaria wages were approximately as flexible as the 'empirical law of economics' would predict. The elasticity coefficient for the country was estimated to be -0.12. The average monthly earnings of Poland, Hungary and Romania were found to be significantly less flexible: adjustment coefficient ranging from -0.04 in Poland to statistically indifferent from zero in Romania. In addition to the frequently used estimates, the authors also explored the dynamic relationship between earnings and unemployment using Generalized Methods of Moments estimation. This enabled them to discover that while in Bulgaria the wage adjustment took place contemporaneously, in Poland it happened with a one year and in Hungary with two year delay. Importantly, in both static and dynamic models the authors control for regional and time fixed effects, which empirically have proven to help to avoid underestimation of the wage – unemployment relationship (Pannenberg & Schwarze, 1998).

The relatively high degree of nominal and real wage stickiness in the majority of European countries has raised an interest on possible explanations for the findings. Determinants of wage inflexibility and justifications for the elasticity divergence across Europe have been explored in the literature, though to a smaller extent (Babecký et al. 2012, 2010; Holden, 2004).

Firstly, as argued by Babecký *et al.* (2012), decrease in base wage is not the sole way how can a European firm adjust its labour costs during an economic downturn. Using data from a unique survey conducted over 2007-2008 covering firms from 12 EU countries, including Lithuania and Estonia, the authors document that around 10% of employees in European firms have experienced a freeze in their base wage in the recent past: an evidence of nominal wage stickiness. More interestingly, however, it is found that 58% of firms have used at least one of the six alternative adjustment mechanisms: reduction/elimination of bonus payments; cuts in non-pay benefits; changes in shift assignments/premia; freezes or slowdowns of promotion filling rate; recruitment at a lower wage compared to ones that received those who left voluntarily as well as encouragement of early retirement so that the high wage employees could be replaced by entrants requiring lower wage. What is more, the authors observe that the alternative adjustments are used as a substitute for reduction in base wage. Firms experiencing wage stickiness are more likely to use the alternative labour cost reduction strategies. Therefore, as stated by the authors, firms working in more competitive environment and enterprises facing high degree of labour union involvement in the process of wage setting, will employ the alternative cost reduction mechanisms more extensively.

The role of institutional labour market characteristics in wage flexibility determination in Europe was investigated in another study conducted by the authors (Babecký *et al.*, 2010). Using data from a survey of a same scope and applying bivariate Probit regressions, it is found that real wage rigidity is positively linked with collective bargaining coverage. The authors argue that unions facilitate acquiring of information about inflation expectations and help to maintain the real income level of the employees. In addition, it is confirmed that countries in which firing is more costly because of employment protection legislation possess higher nominal wage rigidity. As explained by Holden (2004), protection provisions help employees to resist wage cut demands by weakening the effect of lay-off threats. In his analysis Holden confirms that high coverage of collective agreements and strong employment protection legislation are related to larger nominal wage rigidity even in a low inflation environment. Moreover, he argues that the labour market participants contribute to the nominal wage stickiness. By finding the wage cuts unfair, employees facilitate the existence of the unions and thus protection of their earnings.

Importantly, as revealed by Du Caju (2010) in his investigation on most important reasons for avoiding base wage cuts in Europe (based on the aforementioned studies conducted by Babecký *et al.*, 2012 and 2010), the collective bargaining and labour

regulations are twice as important determinants in the Eurozone than in non-Euro area members. Also it is found that across all the 14 countries under examination the two most essential causes for refraining base wage decrease are beliefs that it would cause a reduction of morale or effort, and increase in the probability of the most productive workers leaving the company.

Furthermore, couple of researchers have investigated the divergence of the level of wage flexibility in Europe across demographic groups and various characteristics of an employee (Ammermuller *et al.*, 2010; Du Caju *et al.*, 2012). The possible motives for the found diversity has been put forward and analysed as well (Shapiro & Stiglitz, 1984; Du Caju *et al.*, 2012).

Contrary to the findings of Montuenga, Garcıa, & Fernandez (2003), the study of Ammermuller, Lucifora, Origo, & Zwick (2010) finds no statistically significant link between unemployment rates and wages in Italy. What is more, the study did not confirm the existence of the relation even after disaggregating the sample by the gender, years of education, experience and tenure. Nevertheless, the results of the study are in accordance with Arpaia & Pichelmann (2007) who document the presence of wage flexibility in Germany. The extent of wage elasticity found (-0.06), however, is lower than the 'empirical law' would suggest. Additionally, earnings in Germany are found to be more elastic to changes in unemployment for females and lesser educated workers. The gender difference is not in line with the evidence that female labour participation reacts stronger to the business cycle (Morrison, Papps, & Poot, 2006). Namely, the theory Ammermuller *et al.* (2010) propose that instead of wage cut they leave/are laid off is not confirmed. Moreover, the authors test the hypothesis that wages at the upper part of distribution are more elastic. In essence, it is argued that during a downturn firms fire the workers who are less costly to replace (low-wage and low-skilled workers) while decrease the earnings of the employees with higher turnover costs (high-salary workers). However, the authors find weak support for the hypothesis.

Real wage stickiness divergence across income groups are inspected also in the work of Du Caju, Fuss, & Wintr (2012). Firstly, the authors document that overall real wages in Belgium over the period of 1990-2002 have been strongly rigid. Nominal wage stickiness, in turn, is absent, which is explained by the wage indexation in the country- since 1994 the development wages in the country have been adapted to consumer price index, i.e., inflation.

Further, in line with the hypothesis of Ammermuller *et al.* (2010) they find evidence that wage stickiness decrease with the increase in earnings level. This is justified by the fact that for those receiving higher income relatively larger proportion of earnings is constituted of bonuses and other extra income, which is proven to be a substitute for base wage cuts (Babecký *et al.*, 2012). Moreover, it is found that rigidity of wages is declining as employees are becoming older. This finding is reasoned with the help of shirking model of Shapiro & Stiglitz (1984). Namely, a cut in wage makes the costs of a job loss lower, thus causing more workers to shirk. For the elderly, however, the cost of a workplace loss is relatively high, since it is much harder for them to get a new job. Therefore, theoretically they would bear even high levels of wage decreases without changing their work performance, which managers could exploit.

Considerably less studies covering European countries have investigated wage rigidities and earnings changes specifically during times of structural changes Yamaguchi (2008) and economic crises (Vandekerckhove *et al.*, 2012; Heinz & Rusinova; 2011) - times in which wage distributions might be extremely volatile.

The study of Yamaguchi (2008) relaxes the common assumption present in the wage curve estimation literature of the wage-change distribution being stable over time and elasticity being uniform with respect to unemployment. As argued by the author, the assumption does not hold during turbulent times of economic transition. For instance, in a country experiencing a structural shock, elasticity might become less pronounced since the unemployment has risen to very high levels. Applying the nonparametric wage curve estimation to Poland in the period of 1995-2002 and controlling for age, gender, education, marital status and firm ownership, he estimates that an elasticity of -0.064, smaller flexibility than the one that the 'empirical law of economics' would predict. What is more, the prediction of less flexibility at high levels of unemployment is confirmed. The estimated wage curve is steeper when the unemployment is lower. Also, the author argues that in case of Poland, two different wage curves can be distinguished, a finding in accordance to the assumption that salary distributions change over time.

Economic downturns having a negative impact on real wage flexibility was also confirmed by Heinz & Rusinova (2011). Studying a panel of 19 EU countries, authors discover that when the unemployment rate exceeds its natural level (in which there is an equilibrium in the labour market, and there is no inflationary pressure), the strong negative

response of wages to unemployment tends to vanish. The finding is explained with the concept of hysteresis effect. Namely, periods of high rates of unemployment can have an adverse effect on people's human capital and willingness to participate in the labour market. Thus, it may boost the bargaining power of those remaining employed to resist a salary cut. In essence, persistent unemployment decreases the competition in the labour market, so granting the insiders a higher power of salary setting.

Lastly, the impact of the economic and financial crisis on wages of different demographic groups in Europe was explored by Vandekerckhove *et al.* (2012). They conclude that although the crisis had more effects on employment than impact on wages, there was observable trend of wage freezes in 2008-2010. The groups that experienced wage cuts are younger, low-paid and low-skilled workers, which as mentioned by the authors, have also experienced freeze in their career developments. In the context of these findings, a closer examination should be conducted in Latvia, since it was one of the hardest hit countries in the period of 2008-2009.

2.3. Latvia

Labour market in Latvia has not been studied to such extent as other ES countries and the US. Furthermore, the results of the studies that research labour market flexibility and especially wage flexibility in Latvia show mixed results.

On one hand there are studies (discussed below) that conclude that wages are quite flexible in Latvia and can be seen as a tool for adjusting to economic shocks when there are no other options (e.g. depreciation, devaluation or fiscal stimulus) to regain competitiveness.

A study by Eamets (2004) compares worker flows in Baltic countries after the Russian crisis. He concludes that labour markets were quite flexible in Baltic States and predicts that they would become more rigid due to convergence to other EU countries. Zasova and Meļihovs (2005) study the case of Latvia during 1990-2004. The authors look at the Latvian labour market from various perspectives. Tax burden was about the same as in the rest of the EU; however, minimum wage, which in 2004 was one of the lowest in EU and was earned by a large proportion of employees, raised concerns about labour market flexibility. Meanwhile, labour protection laws promoted flexibility of labour market and union bargaining power was quite low. Furthermore, they determine the degree of wage flexibility during the period of 1996-2004 by constructing structural VAR model and error correction model. They conclude that wages in Latvia are quite flexible to changes in

supply of labour and productivity and comparing to other countries they are very flexible in the short run (during the first quarter after labour supply shock wages decrease by 0.03% relative to 0.003% in Portugal, which according to their estimates has the second most flexible wages).

Another study discusses the labour market elasticity until 2010 and hints to the flexibility during the financial crisis. Calculating real wage flexibility indices the author compares wage flexibility between Baltic States and selected OECD member countries. The results indicate that Latvia has the most flexible labour market among these countries. The author suggests that this can be explained by the fact that the degree of compliance with the law in Latvia is lower, allowing for higher degree of flexibility (Zasova, 2012).

On the other hand some researchers argue that labour market in Latvia has not been as flexible as in other countries. Babecký (2007) studies aggregate wage flexibility in new EU member countries and uses indices of labour market rigidity constructed by Botero *et al.* (2004). Comparing to other eastern European countries and Austria, Greece, Portugal, UK and US, labour market has not been flexible in Latvia (0.72 on a scale from 0 to 1, where absolutely rigid market receives 1 and completely flexible - 0) during 1995-2004. According to his measures labour market has been more rigid only in Portugal (0.81) and Slovenia (0.74). However, the author determines the labour market flexibility by looking at regulation of labour, which might show misleading results due to possibilities to circumvent the law (Krasnopjorovs, 2013; Zasova, 2012).

Another mechanism relevant for Latvia through which labour market can adjust is the relationship between public and private sector wages. In the recent financial crisis, Latvia chose to devalue internally. Wages were cut in the public sector hoping that that would also reduce wages in private sector, overall decreasing unit labour costs, which in turn would decrease prices and increase the comparative competitiveness of Latvia.

A study estimating the correlation level between public sector and private sector wages in largest EU countries, US and others, shows that the correlation is positive and strong (0.71 for EU, significant at 5% level) over a business cycle. And as the authors state this can be explained by the fact that the main drivers for wages are productivity and inflation (Lamo, Pérez, & Schuknecht, 2013). Another study by Lamo, Perez and Fuentes (2013) tries to hint on the direction of the relationship. They use Granger causality tests in 15 OECD countries. Their estimations show that in most observations private sector wages cause public

sector wages. And the biggest impact comes from index of globalisation. Another way of explanation comes from the fact that private sector wages are one of the main drivers of inflation, which in turn drive both public and private sector wages.

Particularly in Latvia, Blanchard *et al.* (2013) analyse the internal devaluation during the financial crisis (2008-2009). Authors argue that after the government's downward push on public wages, private sector wages did not decrease as much, but overall the unit labour costs decreased which can be explained by increased productivity. This implies that while the wages overall decreased, the productivity was rising, thus implying a negative relationship between these variables during the recession. According to theory this relationship should be positive, as increase in productivity should lead to higher wages. Furthermore, since wages in private sector did not react as much, the authors argue that in Latvia most inflexible salary groups are most likely found in the private sector.

A closer examination of the salary adjustment processes in the private sector during the recession in Latvia is carried by Vanags, Zasova and Semjonovs (2014). Using a unique dataset including monthly salary payments received by individuals in Latvia, the authors inspect the extent of salary reductions as well as presence of other adjustment mechanisms observable in the longitudinal individual-level data. The findings confirm the claim of Blanchard *et al.* (2013) that wage adjustments in private sector were rather moderate. What is more, the authors discover that a crucial adjustment mechanism of labour cost reduction was hiring at a lower rate. Salaries of employees that were not employed at the respective employer in the previous year (new matches) were found to be by 30% lower than those of incumbents. Salaries of those that were not employed at all in the previous year of the study were found to be lower even by 40%. This confirms the existence of one of the alternative adjustment mechanisms mentioned by Babecký *et al.* (2012), namely, recruitment at a lower wage.

Overall, during the recession the real average gross wage in Latvia fell by 13% compared to the peak before the economic downturn and the number of employed persons decreased by more than 240 thousands (Bičevska, 2012). Hence, it would be relevant to look at different groups of employees to determine which groups experienced the biggest impact on wages. Unemployment rates hint to one group that encountered large decline in wages and layoffs. Youth unemployment rate was almost two times higher than the average in 2011 when 28.2% of job seekers younger than 24 could not find a work place (Bičevska, 2012), which is in line with the evidence that youth unemployment is found to be more cycle

sensitive (Hoynes, Miller, & Schaller, 2012). Masso and Krillo (2011) argue that not only youth but also males and non-native population have suffered in Latvia the most. Furthermore, using Probit model the authors show that especially workers in construction and workers with low levels of education had highest probabilities of wage cuts in the Baltics.

3. Methodology

3.1. Econometric Model Assessing Salary Flexibility

To provide a quantitative answer to the central research question of the study, we employ an econometric model developed by Zasova and Meļihovs (2005), expressed in the equations (1) and (2):

$$(1) \qquad \ln(RS_t) = \beta_0 + \beta_1 \ln(UGAP_t) + \beta_2 \ln(PROD_t) + \beta_3 dummy + \varepsilon_t$$

$$(2) \qquad \Delta \ln(RS_t) = \gamma * \varepsilon_{t-1} + \alpha_0 + \alpha_1 \Delta \ln(UGAP_t) + \alpha_2 \Delta \ln(PROD_t) + e_t$$

The dependent variable RS_t is the real average gross salary in quarter *t*, which is obtained by deflating the average nominal salary in the economy with the consumer price index. The measure includes base wage and bonuses, as well as other irregular income. *UGAP*, for the purposes of the study let us call it unemployment gap, reflects the deviation of the job-seeker ratio in the economically active population (*JSR*) from its structural level (*NAWRU*) (3):

$$(3) \qquad UGAP_t = \frac{JSR_t}{NAWRU_t}$$

To be able to compare (at least to a certain extent) the real salary elasticity to changes in unemployment in Latvia with other EU and EZ countries as well as the 'empirical law of economics', we also calculate an alternative unemployment gap measure. Instead of calculating it as a ratio between JSR and NAWRU, we set it as a difference between the measures (4), which is also commonly done in theory (Estrella & Mishkin, 1999):

$$(4) \qquad UGAPalt_t = JSR_t - NAWRU_t$$

Non-accelerating wage inflation rate of unemployment (*NAWRU*) indicates the unemployment rate at which growth of wages is constant. Following the authors, we estimate the measure by the method of Elmeskov (1993) shown in equation (5):

$$(5) \qquad NAWRU_t = u_t - \frac{\Delta u_t}{\Delta^3 w_t} \Delta^2 w_t$$

u_t denoting the actual unemployment rate (the job-seeker ratio) and w_t the average gross nominal wage in the economy at quarter *t*.

The *PROD* measure (equation 1) proxies the productivity of the economy, and is calculated as real gross value added per employed person at the respective quarter. Unlike Zasova and Meļihovs (2005), we use gross value added instead of GDP per employed person as a proxy for productivity since gross value added reflects the result of the use of factors of production, and does not include subsidies and taxes, which are a part of GDP. Such proxy for productivity is also used by Maza & Moral-Arce (2009). Additionally, to separate the effects of the economic and financial crisis, and possible hysteresis effect, during which the wage elasticity is expected to become less pronounced (Yamaguchi, 2008; Heinz & Rusinova, 2011), we create a dummy variable that takes value „1" in the period starting from third quarter of 2008 until the end of 2010, and „0" otherwise. The period was chosen based on the seasonally adjusted real GDP level and job seeker ratio in the country. In the third quarter of 2008, a trend reversal took place, during which real GDP started to shrink rapidly while unemployment began skyrocketing[1]. Both of the measures started to return to their pre-crisis level only in first quarter of 2011.

The equation (1) in the model represents a long-run relation, and can be thought of as an equilibrium relationship between wages and unemployment gap, and productivity. Supplemented with the short-run relationship represented in equation (2), we get an error correction model, which indicates the rate at which the system tries to correct the deviations from the long-term equilibrium. More specifically, if there is a deviation from the equilibrium reflected in the equation (1) in quarter *t-1*, denoted here as ε_{t-1}, wages in quarter *t* will adjust by $100*|\gamma|$ percent to maintain the long-term equilibrium. The expected sign of γ, therefore, is negative (wage growth decreases if there is a positive deviation while increases in case there is a negative deviation).

The coefficient β_1 reflects the elasticity of the real average wage to the long –term absolute changes in the unemployment gap. It is expected that in case of job-seeker ratio being higher than the structural level, a downward pressure on wages is created since there is an excess supply of labour force and the employers can decrease the price, namely, salary. In this case natural logarithm of the measure is positive, thus a negative *beta* is expected. The opposite case of excess demand of labour will force the employers to increase wages, thus a positive effect is anticipated. The logarithm of the measure in this case will be negative, so to

[1] In the third quarter of 2008 a trend reversal from the previous growth took place. Real GDP decreased from 5.8 to 5.4 billion euro while unemployment increased from 6.6% to 7.4%, in 2010 reaching a peak of 21.3%.

the *beta* is expected to be negative as well. Similarly, a negative sign is expected for the coefficient α_1. It shows the elasticity of real wage growth to the short term changes in the speed at which the unemployment gap is changing.

The coefficients β_2 and α_2 show similar adjustments to changes in productivity. In case the productivity increases by 1%, in long-run the gross average real wage is expected to change by β_2%. Additionally, in case the growth of productivity increases by 1%, the salary growth is anticipated to change by α_2%. Both of the coefficients are expected to be positive, since higher productivity should reflected higher added value for the employer, thus he would be willing to accept higher labour costs.

Furthermore, since the wages are expected to be less elastic to changes in unemployment in times of economic downturn when the job-seeker ratio has reached very high levels (Yamaguchi, 2008; Heinz & Rusinova, 2011) , it is expected that the coefficient before dummy will be significantly positive. This would indicate that, *ceteris paribus*, wages possessed a less pronounced decline during the period from first quarter of 2008 until second quarter of 2012.

For the purpose of the econometric analysis we assume a one-way causality. Namely, given the much lower than EU-average bargaining power of trade unions in Latvia as well as considerably lower share of wages that were set in collective manner (Zasova, 2012), it is the unemployment that determines wages, not vice versa. More specifically, in Latvia primarily employers are the ones setting the wages, given the level of unemployment in the economy (Fabiani & Rodriequez-Palenzuela, 2001). Nevertheless, we run a Granger causality test between the unemployment gap and real wages measures to provide a statistical confirmation for this assumption. It is expected that the changes in unemployment gap will be a good predictor of the changes in average real wage in the economy, and not the other way around.

In order to avoid a spurious regression, we test the stationarity of the time-series data. We perform the Augmented Dickey-Fuller (ADF) test both on the time series of wages, unemployment gap and productivity levels as well as their changes. We chose the optimal lag length for the test based on the significance of the individual coefficients for the lagged values. Since the time series are found to be integrated of the same order, we test whether there is a common stochastic trend, i.e., whether the variables are co-integrated. For the purposes of the co-integration analysis, we perform the Engle-Granger Augmented Dickey

Fuller two stage test procedure. In essence, in the first stage of the test a co-integration coefficient and the error term are found, while in the second the stationarity of the obtained error term is tested. If the error term does not contain a unit root, the variables are co-integrated and can be included into regression without transformation into differences.

Finally, the model is estimated using OLS with Newey-West standard errors. The standard errors are thus adjusted for heteroskedasticity and autocorrelation in residual, issues which could potentially arise in our data-series. The autocorrelation is examined up to 3 lags, a truncation parameter suggested by a rule of thumb and is calculated according to formula $0.75T^{1/3}$, where T – number of periods in the series (Stock & Watson, 2003).

We prefer using the particular model since it allows direct comparison of the magnitude and significance of the obtained estimates with the ones calculated for the period of 1996Q2 to 2004Q2 (Zasova & Meļihovs, 2005). Besides, the model lets us to control for the effects of the recession, which given the relatively short time series (2012Q1 to 2013Q3) might affect the results. Lastly, the model enables estimation of real salary long-run trend, and short run adjustments to deviations from it, without a substantial loss of degrees of freedom.

3.2. Method of Assessing Salary Dynamics Heterogeneity during the Economic Downturn

To answer the sub-question about differences in wage dynamics for different demographical groups, we conduct a descriptive analysis using a unique individual level dataset provided by State Social Insurance Agency of Latvia. We look at how large and if significant changes in salaries were experienced by gender, different age groups, different income groups, by workers in different industries and employees working in various types of business entities. We divide the sample into 6 age groups: up to 24 year-olds, 25-34, 35-44, 45-54, 55-64 and more than 64 years old people. Based on income, the sample is divided into deciles. To do this, we sort the total sample from smallest to largest and 10% of the lowest salaries represent the 1st decile, top 10% represent the 10th decile. Furthermore, we group the sample by industries according to Campbell's (1996) classification. See Appendix 1 for details on Campbell's classification and business entity types.

The change in salary is expressed as the percentage change from previous period. Statistical significance of the wage changes between different groups is measured by Welch approximated two sample t-tests, which allow for the variances of the two samples to differ

(Sawilowsky, 2002). The test statistic (6) for unequal variances test and modified degrees of freedom (7) are calculated as follows:

$$(6) \qquad t = \frac{\mu_1 - \mu_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} \qquad (7) \qquad v = \frac{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)^2}{\frac{\left(\frac{s_1^2}{n_1}\right)^2}{n_1 - 1} + \frac{\left(\frac{s_2^2}{n_2}\right)^2}{n_2 - 1}}$$

(Ruxton, 2006), where μ are the mean values of the two samples, s stands for standard deviations and n for sample size.

3.3. Data

3.3.1. Data for Econometric Model

Data necessary for the econometric analysis of the real average wage flexibility are gathered from Central Statistical Bureau (CSP) of Latvia. The quarterly data are available for the period starting from first quarter of 2002 until third quarter of 2013[2], and include: average gross nominal salary, job-seeker ratio, real GDP, gross value added, and the number of employed persons. The data on CPI are available only on a monthly basis, thus we calculate the quarterly amount as an average between the three months. For instance, CPI in quarter one is calculated as an average between CPI in January, February and March. For gross value added and real GDP series we do not obtain the seasonally adjusted figure, since we conduct the seasonal adjustment by ourselves. Following Zasova and Meļihovs (2005), the adjustment is done for salary and productivity (calculated both from gross value added and from real GDP) series using X-12 Arima methodology. The outcome of nonparametric and moving seasonality tests indeed indicated seasonality at a one percent level for these two data series.

Concerning non-accelerating wage inflation rate of unemployment (NAWRU), the obtained figures are rather volatile, so similarly to Zasova and Meļihovs (2005) we perform a Hodrick-Prescott filter to separate the cyclical component of the series (Appendix 2). NAWRU is a figure reflecting a long run structural equilibrium in the labour market (Vanags, Paalzow, Ketels, & Cunska, 2012)**,** and it is not expected to have jumps and drops of up to 4% per quarter. Rather it is anticipated to be changing gradually since alterations of it require structural changes, which are highly unlikely to be attained in a short term. The Hodrick-

[2] For some of the variables the available-time series is even longer, but the time span is chosen according to the shortest available dataseries

Prescott filter smoothes the obtained time-series, so that they reflect fluctuations that occur over a somewhat longer period.

We chose the filter's smoothing parameter λ to be equal to 1600, a value suggested for quarterly time-series (Ravn & Uhlig, 2002). Within the filtering procedure, we also obtain NAWRU forecasts for year 2014 and 2015. This helps to estimate the cyclicality of the series more precisely. For the purposes of the forecast, we use the unemployment and wage growth predictions of European Commission (2013). Since the Commission's forecasts are made on an annual basis, we linearly – interpolate the predicted unemployment and wage growth. Namely, we assume that unemployment will shrink by and wages will grow at such constant rate per quarter, so that on an annual basis it will coincide with the figures anticipated by the Commission[3].

As a result, the obtained NAWRU rate is very similar to NAWRU estimate provided by European Commission (D'Auria, et al., 2010). Additionally, up to 2007 it is also very close to the equilibrium unemployment rate calculated by Zasova (2012) (Appendix 3). After 2007, however, our estimated rate follows a trend of gradual increase and by the end of 2010 reaches levels akin to the ones provided by the Commission. Arguably, the equilibrium unemployment rate did experience an increase in value during the period in question, since the spikes of unemployment after 2008 were not only cyclical (Vanags, Paalzow, Ketels, & Cunska, 2012). Namely, it is likely that at least a part of the pre-crisis employment volumes are not expected to be reached again in the short-run. Therefore, one could argue that the gradual increase of NAWRU indeed is reasonable.

3.3.2. Data for Salary Dynamics Heterogeneity Assessment

The second dataset consists of monthly gross salary for all individuals employed in Latvia during the period of October 2007 to December 2010. Data are provided by State Social Insurance Agency (SSIA) of Latvia. Gross salary represents the total earned, including bonuses, from which social tax is calculated. Each individual is also characterised by gender, age, employers ID and the type of business entity of the firm. The dataset consists of 54'442'842 observations.

Industry variable is added by gathering SIC 3 industry classification codes from Odin database for companies that were employers in 2007 and converting SIC 3 codes to industry

[3] The job-seeker ratio (JSR) is forecasted to be 10.3% in 2014 and 9% in 2015. This implies a JSR reduction of 0.17% per quarter in 2014 while a 0.42% reduction in 2015. Wages growth is anticipated to be 5% in 2014 and 4.6% in 2015, suggesting a 1.22% and 1.13% quarterly growth in respective years.

groups as defined by Campbell (1996). This classification allows classifying most of the companies into only 12 major groups (see Appendix 1), which allows us to readily compare results between industries.

We limit the dataset to individuals that have been earning at least minimum salary, which has been steadily increasing from 120 LVL in 2007 to 180 LVL in 2010 (Labklājības ministrija, n.d.). Afterwards, we transform the data to quarterly basis by taking the average salaries, so that the results between the two parts of this study can be compared. After these modifications the sample consists of 10'206'256 observations.

On average 7.76 % individuals earn minimum salary, from which 47% are females and 53% are males. Meanwhile, if we look at the total sample the proportion of females and males is reverse, since 52% of observations are female representatives and only 48% are males. Industry variable is available for a bit more than half of the total pool of observations in each quarter.

4. Results

Let us begin the section with providing econometric evidence on the real gross salary flexibility in the economy. Before we present the main results, let us describe and interpret the outcome of causality, stationarity and co-integration analysis we conduct on the given time series. The analysis can let us argue that the results are not biased, and the model's regression is not spurious.

4.1. Causality Test

The outcome of the Granger causality tests is in line with our assumption that it is the unemployment that affects wages, and not vice versa (Appendix 4). Zero hypothesis of changes in unemployment gap not Granger causing changes in real wages is rejected at 5% significance level, while the hypothesis of non-existence of the causality in the opposite direction is not rejected. The optimal lag length for the test is chosen based on minimization of Akaike information criterion, and the tests are performed on equally long time-series to ensure the consistency of information criterion calculation.

The test result reflects the still generally insignificant role that trade unions play in the wage setting process in Latvia. A trade union can change the unemployment-salary causality direction (as well as facilitate the rigidity of salaries) by limiting the labour supply of a certain profession or for a given industry, in case an employer sets an unfavourable working condition of lower than expected remuneration. Trade union power can be especially pronounced for occupations requiring expensive training, for labour force with high replacement costs. *Ceteris paribus,* it is more likely that in this setting an employer will comply with the requirements set by the union, compared to the case where the labour force can be easily found and replaced (Zasova, 2012). Therefore, in the presence of solid union power, it might be the case that the salary is determined by the union, and the employer must choose the corresponding level of employment. When the union power is low, employers can decide on the level of salary based on the unemployment in the economy[4], so the causality goes in the aforementioned direction.

Trade unions are indeed found to be weak in the wage setting process in Latvia. Zasova (2012) documents that trade union density as well as the proportion of wages set in a

[4] For example, if the unemployment is high (considerably higher than the equilibrium unemployment), the employer can offer generally lower salary. Given that the bargaining power of an employee in this setting is rather low, it is likely that he or she will have to accept it.

collective manner in Latvia are one of the lowest in Europe. Only around 16% of the employees in Latvia are members of trade union while the collective bargaining coverage is only[5] 20% (Vitols, 2010). Moreover, as argued by Krasnopjorovs (2013), the unions are almost non-existent in the private sector.

As for causality between productivity and salary, the conventional relationship is assumed: changes in productivity lead to changes in real salary. It is highly unlikely that an employer will manipulate one's pay-rate (e.g., raise it in case one is slacking off just to make him more productive) to adjust the productivity, at least not in a general case.

4.2. Unit Root and Co-integration Tests

Performing the Augmented Dickey Fuller unit root test, we find that the real salary, productivity and unemployment gap time series are integrated of order one (Appendix 5). Namely, while the data are found to be non-stationary on the levels, the hypothesis that the first differences contain a unit root is rejected. We implement two test specifications, examining whether series contain neither stochastic, nor deterministic trend.

Interestingly, we find that none of the series are shown to have a deterministic trend, although they do tend to have a trend of a gradual increase until the middle of 2008. This might be explained by the structural break around 2009-2010, which was caused by the economic crisis, and might affect the trend-test significance.

Since the series are integrated of the same order, we proceed with the co-integration test. Using Engle-Granger Augmented Dickey Fuller test procedure, we check the stationarity of the residual from the long-run relation model (1). Importantly, although the computation procedure of the test statistic in the co-integration test is equal to unit root test, the critical values are not. Therefore, instead of relying on the unit root test result, we obtain the critical values according to the procedure suggested by MacKinnon (2010). Examining the deterministic trend of the residual, we find that it is convincingly insignificant, so we obtain the critical value using the specification without a time trend. The critical value for 4 variables and 42 observations at 5% significance level is found to be larger than the test

[5] For comparison, the measures for the Scandinavian countries are around 80% and 90%, respectively.

statistic, thus the series are co-integrated[6]. Based on the results, we can proceed with our econometric model, since the OLS estimator is consistent and the results are not spurious.

4.3. Flexibility of Average Gross Real Salary

From the econometric model we find following equations describing salary setting mechanism in Latvia:

$$(1)\underset{\text{t-statistic}}{\ln(RS_t)} = \underset{140.37}{4.299} - \underset{-15.15}{0.244}\ln(UGAP_t) + \underset{38.12}{1.011}\ln(PROD_t) + \underset{6.71}{0.140}dummy + \varepsilon_t$$

$$(2)\underset{\text{t-statistic}}{\Delta\ln(RS_t)} = \underset{-2.34}{-0.272}\varepsilon_{t-1} + \underset{1.99}{0.007} - \underset{-5.12}{0.090}\Delta\ln(UGAP_t) + \underset{2.74}{0.427}\Delta\ln(PROD_t) + e_t$$

The long-term relationship expressed in equation (1) shows that if the long-run absolute deviation of the job-seeker ratio from the equilibrium level decreases by 1%, real salaries change by 0.244%. More precisely, if the job-seeker ratio is higher than in the long-term equilibrium, *ceteris paribus* salaries decrease by 0.244% on average. If the job-seeker ratio is lower than in the structural equilibrium, *ceteris paribus* salaries increase by 0.244% on average. That is, while the job-seeker ratio is below its equilibrium level, there is a positive pressure on the salary level. However, when the job-seeker ratio exceeds the structural level, a negative pressure on the salaries in the economy is created. Concerning the productivity of labour, model indicates an almost one to one relationship in the long-run: productivity increasing by 1% over the long-run leads to a 1.011% growth in real salaries on average.

Equivalently to all other coefficients in the long-term regression, the estimate for dummy is significant at 1% level. Being positive, it suggests that during the period starting from third quarter of 2008 until the end of 2010, salaries were higher than in other periods of the study. More precisely, in the time of economic crisis and surging unemployment, real salaries did possess a less pronounced decline than in other periods – at a given level of productivity and unemployment gap, real average salary in the economy experienced on average a 0.140% smaller decrease.

In short -run, reflected by equation (2), we find real salary growth being also significantly elastic to changes in unemployment gap and productivity. If the speed at which the job-seeker ratio is deviating from the equilibrium level is raising by 1%, growth of real

[6] Additional *hint* that time series are co-integrated can be provided by the significance of the lagged error term in model (2). In case a valid error correction mechanism exists, and the lagged residual is significant, this might suggest that series are indeed co-integrated (Granger & Engle, 1987).

salaries decreases (increases) by 0.090% if the job-seeker-ratio is higher (lower) than the equilibrium level. This indicates that wages are elastic not only to long-term deviations of structural unemployment, but also to short-term fluctuations of the cyclical unemployment. As for productivity, we find that when the rate at which the labour force becomes more productive increases by 1%, real salaries are growing by 0.427% faster. It implies that while employers do adjust salaries for given productivity in short-run, it takes a longer time horizon for all the productivity changes to be reflected in real salary. That is, one can earn twice as much if working twice as productive only over the long-run, which could be explained by the fact that it takes time for the employer to realize the goods or services that were produced more productively.

Finally, we find that salaries do respond to deviations from the long-term trend in a short-run. If average gross real salary in Latvia is not equal to its long-term equilibrium level, the disequilibrium will be reduced by 27.2% within a one quarter. Being significant at 5% level, the coefficient before the lagged error term also serves as an indicator that the series used in the model are co-integrated.

4.4. The Extent of Flexibility of Average Gross Real Salary in Latvia

Comparing the outcome with the results available in the existing literature, we find that real wage elasticity to changes in unemployment is arguably higher than on average in Europe and Euro-zone. Being significantly elastic not only in long-run, but also in short term, we can conclude that salaries in Latvia are a more effective shock-absorbing mechanism than, for instance, in Spain (Maza & Moral-Arce, 2009), Romania, Poland and Hungary (Iara & Traistaru, 2004) as well as Italy (Ammermuller, Lucifora, Origo, & Zwick, 2010). In these countries either no significant wage-unemployment relationship was found, or it took place with at least one year delay.

A direct comparison to the ‘empirical law of economics’ cannot be made due to differences in methodology as well as since our unemployment measure is not simply the job-seeker ratio (JSR) but rather is expressed in terms of deviation from NAWRU. However, our alternative unemployment gap measure gives an approximate understanding of the extent of flexibility. Difference between JSR and NAWRU increasing by 1% is associated with a 2.23% decrease in real average gross salary if the JSR is above the structural level (Appendix

7, Column 3). Arguably[7], it is considerably higher elasticity than the 'empirical law of economics' (Blanchflower & Oswald, 1995) would suggest. However, the series in the specification are on the margin of co-integration (test statistic being slightly smaller than critical value at 10% level), thus exact figures should be interpreted with caution.

The high and significant elasticity to changes in unemployment can be explained by the low trade union density as well as the small proportion of wages set in a collective manner. Being insignificant in wage setting mechanism, trade unions in Latvia do not impede the salary adjustments during the economic cycles. Real wage stickiness is indeed found to be positively related to the collective bargaining coverage (Babecký *et al.*, 2010) and the employment protection legislation (Holden, 2004). Concerning the employment protection, while being rather rigid de jure, it is actually found to be rather weak and elastic in practice (Krasnopjorovs, 2013).

Real salaries are also significantly elastic to changes in productivity. Moreover, in long-run an almost perfect one-to-one relationship exists just like in the simplest models of economics theory books. Namely, if the productivity, for instance, doubles, then the employer in long-term gets twice as high revenue and profits, from which a constant part is paid in salaries. Thus, the real salaries become twice as high as well. What is more, the effect on wages is high and significant also in short-term. In a study covering 12 euro-area countries in the period 1980-2005 Arpaia & Pichelmann (2007) find that 40% of changes in productivity are passed into real wages in the next year. We find that changes in growth of productivity are passed into a similar wage growth increase within a one quarter, indicating a faster changing salary mechanism.

Productivity is also found to become more significant factor affecting salaries than compared to period of 1996-2004. In contrast to study of Zasova & Meļihovs, (2005), not only we get a slightly higher coefficient for the long-term relationship, but we also find a statistically significant effect on the short run (Appendix 7). The finding at least partially can be explained by the raising number of employees receiving variable remuneration. While bonuses, premiums and other non-constant remuneration in 2005 were paid approximately to 39% of the labour force (RS Group, 2006), according to the most recent Fontes salary report,

[7] Since NAWRU and JSR generally tend to move in the same direction, an increase in UGAPalt of 1% means that JSR has most likely increased by more than 1%. Nevertheless, given that NAWRU is not volatile, it also means that JSR has not increased by much more than 1%. Therefore, if being above the structural level, JSR increases by moderately more than 1%, wages tend to decreases by 2.23%

the number has reached 51% in 2013 (Delfi.lv, 2013). Being almost perfectly related to employees' performance, the variable part of salary ensures a better and faster adjustment of average salaries to the level of productivity.

In the period starting from third quarter of 2008 until the end of 2010, however, average gross real salary did experience a period of rigidity. Namely, for a given level of productivity and surging unemployment, it was by statistically significant 0.140% higher. We can outline three possible reasons, for this finding. First, it might be the case that the average salary in the economy cannot fully reflect the adjustment dynamics of the labour market during turbulent times. It is possible that in the period of 2008-2010 a lot of interns and other considerably lower-paid workers got fired, thus simply leaving the pool from which the average salary is calculated and pushing it up (Krasnopjorovs, 2011a). Second, it is also possible that dummy variable reflects the gap between the productivity and wages that was created due to the booming economy in 2005-2006, and which closed only in 2010 (Krasnopjorovs, 2011b). During the time-span for a given level of the productivity, salaries were higher than in other periods. Finally, it could be true that during the economic crisis a pronounced *hysteresis effect* took place. Due to spiking unemployment, considerably high proportion of the labour force lost their competitiveness in the labour market, so increasing the bargaining power of those remaining employed and thus putting an upward pressure on salaries.

4.5. Flexibility of Average Salary for Various Sets of Individuals

Given the statistically significantly higher salary level during the crisis, we proceed with a closer examination of the earnings of various individuals. Unlike the total average, it can help us to draw more precise conclusions on the extent of downward adjustments that took place in the reviewed period.

4.5.1. Salary Dynamics by Income

Looking at average salaries during the period for each income level (Income decile 10 for highest paid individuals and 1 for lowest paid), not surprisingly, the distribution of these deciles is squeezed down in direction of minimum salary leaving no room for flexibility in salaries of lowest income groups (see Appendix 8, Chart A). Meanwhile, the salaries of top paid individuals fluctuate from a little over twelve hundred LVL (1'707 EUR) to almost fifteen hundred LVL (2'134 EUR) per month.

Data in Appendix 8, Chart B have been modified to take people characterising the top income decile, middle income decile and bottom income decile in last quarter of 2007 as a base groups, so that salaries of those specific sets individuals can be monitored over periods. The number observations for these three groups drop by 48%, 69% and 89% respectively, which already hints to the fact that bottom decile had to suffer the most from lay-offs during recession. Meanwhile, average salaries show a more interesting picture. Mean pay of bottom decile has experienced a small steady increase over the periods, in line with increase in minimum wage. However, the group that represented top decile in last quarter of 2007 suffered quite large and statistically significant 25% drop in its average salary, while if we looked at total sample the average salary for top decile even grew during the crisis due to lowest paid individuals being laid off and hence decreasing the number of observations in each decile.

As argued by Babecký *et al.* (2012) on of the reasons that the salaries of higher paid workers are more flexible is that a bigger proportion of their income constitutes from bonuses which are easier to cut during bad times. Moreover, bottom decile represents employees earning salaries close to the minimum level reduction of which is protected by legislation. Also, these employees are most likely low-skilled workers that are easy to replace in case the downturn is perceived to be temporary. Hence, for the bottom decile a dismissal might be preferred over a salary cut.

To sum up, most rigid income groups are found in bottom deciles, while salaries of higher paid individuals are quite flexible, which supports the results shown by Ammermuller *et al.* (2010), Vandekerckhove *et al.* (2012) and Zasova and Meļihovs (2005).

4.5.2. Salary Dynamics by Gender

The average percentage change of salary from one quarter to the next for men and women over the period from last quarter of 2007 to last quarter of 2010 is shown in Appendix 9, Chart A. The results show that the trend is similar for both groups; until 2009 the income grows at falling pace and from the last quarter of 2008 to first in 2009 the change is already negative. While after this decline of -2.5%[8] for females and -0.5% for males the average salary again starts growing for both groups, females experienced another drop in their income while men did not. Comparing these changes in incomes by Welch approximated t-

[8] Percentage changes in average salary are statistically different from zero at 5% level for both men and women in all quarters.

tests allow us to reject the null hypothesis that the changes in incomes are equal for both men and women, except for second quarter of 2009 and first quarter of 2010, were the null hypothesis cannot be rejected.

Meanwhile, these changes do not capture layoffs. Hence, we look at the number of employed people (see Appendix 9, Chart B) and it has decreased for both groups from around 500 thousand to 300 thousand. More interestingly, the gap between the number of employed females and males has widened, implying, that more women have retained their jobs than men, which is contrary to existing theory put forward by Morrison, Papps, & Poot (2006) and in line with evidence provided by Ammermuller *et al.* (2010).

Looking from salary flexibility perspective, we can conclude that females suffered grater salary cuts while fewer lay-offs; hence, salary flexibility is grater for them. The fact that males were more likely to be laid off or leave than receive a salary cut during that period is linked to the proportion of male workers that receive minimum salary leaving no room for salary cuts. As mentioned above 7.76% of employees on average earned minimum pay and 53% of them were males. Also, it can be explained by the fact that during the recession male-dominated sectors like construction were affected more severely, thus requiring lay-offs. Another explanation for females having their salary lowered instead of a dismissal is that women are arguably more stable employees than men. Ammermuller *et al.* (2010) argues that women might leave jobs more frequently if their husband changes employment place to different geographical region. Meanwhile, in Latvia the probability that the new workplace will be more than one hour away is significantly smaller than in Italy or Germany. However, the probability of accepting a job abroad still holds, and in this case the argument of Ammermuller *et al.* (2010) might be true.

4.5.3. Salary Dynamics by Age Group

Shapiro & Stiglitz (1984) explain how older employees might experience higher salary flexibility due to fear of not being able to find a different job because of old age. Data on employed individuals in Latvia grouped by age, show a similar result (see Appendix 10, Chart A and C). However, the spike in salaries for elderly can be explained by amendments to the law that took place in July of 2009 and were lifted by the judgment of Constitutional Court on 21.12.2009 (Latvijas Vēstnesis, 2009). During the period the amendments were in place, elderly people that were working while receiving a pension, would receive only 30% of their pension. Hence, from second to third quarter in 2009 the number of individuals

working over the age of 64 fell by almost 50% (Chart B in Appendix 10), thus increasing the average salary of the group by almost 100 LVL (141 EUR). Furthermore, not only least paid pensioners left their jobs, but also the ones that kept their jobs started to earn more, hence the spike in Chart C[9] (Appendix 10).

Other age groups all experienced quite similar trend[10]. Younger workers suffered lay-offs (see Appendix 10, Chart B); meanwhile, mid-aged people experienced sharper salary cuts. Hence, salary flexibility is higher for mid-aged workers, which are not so easy to fire due to their valuable experience and are more eager to keep their jobs due to higher need for independent financial stability.

4.5.4. Salary Dynamics by Industry

The industry a person chooses to work in also plays quite substantial role in that person's salary flexibility. Appendix 11, Chart A depicts the situation for four different cases: utilities, finance and real estate, transportation and construction industry, which is of a great interest due to the housing bubble before the crisis hit. The rest of the industries show a similar, yet more narrowly fluctuating trend.

One on the interesting cases is the utility industry where the number of employees fell by only 16% from the last quarter in 2007 to first quarter in 2010 (see Chart B in the Appendix 11), which is the lowest among all twelve industries. Meanwhile, in second quarter of 2009 their income on average increased by 24.72%[11] raising the average monthly salary by 87 LVL (124 EUR) (see Chart C).

Another case are people in construction industry who suffered the longest period of salary decline and biggest labour supply reduction (47% from the last quarter in 2007 to first quarter in 2010). Meanwhile, people who worked in finance and real estate industry were able to keep their salaries at a certain level and did not experience rough shocks in their incomes or massive lay-offs. And individuals in transportation sector faced a decrease in first quarter of 2009, then an increase in their salaries of 9.4%, then again decrease, then increase and lastly a quite substantial decrease of 3.36% in last quarter of 2010.

[9] Percentage changes in average salaries are statistically different from zero for all age groups in all quarters.
[10] Welch approximated two-sample T-tests show that over the periods all income groups experienced different changes in salaries from the rest of the sample, except for one period for each group (two for group „Aged 25-34") where the change was not statistically different.
[11] Statistically significantly different from the rest of the industries as measured by Welch approximated two-sample T-tests. In 5 cases percentage change in salaries was not statistically different from zero; the average percentage change in these changes is -0.1%.

In line with findings of Masso and Krillo (2011) we conclude that workers in construction were one of the groups that experienced quite harsh labour market conditions. The biggest fluctuations in terms of salaries were faced by workers in utilities, transportation and construction, while finance and retail sector, petroleum, leisure, basic and workers in other industries did not experience such drastic changes. The highest labour supply changes happened in construction (reduction of 47%), leisure (43%), capital goods (35%) and consumer durables industry (33%).

4.5.5. Salary Dynamics by Entity Type

In 2009 Latvian government pushed down wages in the public sector in order to devalue internally. While our data do not allow us to compare the changes in salaries in public sector to private sector directly, we can hint to some results by looking at the business types of employers. In Latvia 96% of companies are limited liability companies (SIA – 59%), joint stock companies (AS – 13%) or budgetary entities (BUDZ – 24%). A small fraction of all companies are state enterprises (VU) and foreign entities (ARV).

While joint stock and limited liability companies can be a part of both public and private sector, budgetary institutions and state enterprises are typically public sector representatives. Average changes of salaries and average salaries of employees working in selected types of business entities are depicted in Appendix 12, Chart A and B respectively. The pay of an average worker in state enterprises and budgetary institutions dropped significantly during 2009[12], while the income of other entity type employees was on an increasing trend or stable. Hence, during the financial crisis, salaries were forced to change in the public sector by the government, while the effect on private sector is unclear. The downward adjustments in the private sector indeed are found to be moderate, which as discovered by Vanags, Zasova & Semjonovs (2014) were partially stemming from new hires at a lower rate. The increase in salaries in foreign entities[13] and almost no change in limited

[12] Average percentage change in salary in state enterprises in third quarter of 2008 and last quarter of 2009, and in joint stock companies in first quarter of 2009 is not statistically different from zero at 5% level. Average percentage changes in salary in other entity types discussed are statistially different from zero at 5% level.

[13] An upward pressure on the foreign-owned entity salaries during the recession was put by the unusually high redundancy payments made in 2009. Furthermore, starting from January 1st 2009 the upper limit on social contributions was lifted (Likumi.lv, 2008). As our data show the official average quarterly salary from which the social contributions are calculated, while the total gross salary for considerable proportion of individuals working in foreign entities exceeded the annual limit of 29 600 LVL or 42 117 EUR before the ceiling was lifted, the amendments might also account for the rapid increase in salaries of foreign enterprise workers from the last quarter of 2008 to the first quarter of 2009. Thus, generally, we cannot conclude whether salaries in foreign owned entities indeed possessed an increase.

liability and Joint Stock Company employees' salaries might hint to shadow economy that grew during the crisis, since the compliance with the law is relatively lower in Latvia than in western countries (Zasova, 2012).

5. Conclusions

This paper has served as an update of the salary flexibility assessment conducted in a study of Bank of Latvia (Zasova & Meļihovs, 2005). Applying the methodology on the latest publically available data-series and its various specifications, it gauges whether salaries in Latvia have been an effective shock absorbing mechanism up to the time just before entry in the Eurozone. Once joining a Monetary Union, an essential criterion for a country is to have a flexible labour market, and particularly flexible salaries, so that it can adjust to an asymmetric shock in short-run. The paper has estimated the extent of the salary flexibility and thus has made implications on the degree of fulfilment of this criterion. Additionally, it has examined a unique individual-level salary dataset provided by State Social Insurance Agency and scoped the salary dynamics heterogeneity among gender, income deciles, age groups, industries and entity types during the economic downturn. Containing data on each officially employed worker in Latvia, the dataset allows testing for statistical significance of the salary reductions among each of the aforementioned individual groups, which according to our knowledge has not been inspected before.

Our main findings are following. The error correction model results stipulate that real salary response to deviations from the long-run equilibrium is statistically significant and takes place at sound speed. During the business cycle of 2002-2013 real salaries have also adjusted to alterations in productivity and unemployment. Besides, productivity and unemployment are significant determinants of real salaries not only in long-term, but also over a short-term. The results are similar to the ones obtained by Zasova & Meļihovs (2005) covering the period of 1996-2004, apart our finding that productivity significantly affects real salaries also in short term. Overall, these results imply that salaries in Latvia are a shock-absorbing mechanism.

Real average gross salary according to model, however, is found to be less flexible during the recent economic downturn. Since the total average figure might be inflated by the fact that those receiving less were dismissed, we carry a closer examination on the salary dynamics using the State Social Insurance Agency micro-data. Indeed, investigating salary dynamics of a base group of fourth quarter of 2007, we find that earners at the bottom decile suffer considerably more dismissals than those at the middle or top deciles. The employees at the top decile, in turn, experience significantly higher salary reductions. As for gender, we find that salaries for female workers were reduced by a statistically significantly larger

amount than for men. Given that the demand for female labour force did drop less than for men, it suggests that salaries of female labour force were more flexible. Similarly, we find that salaries were more elastic for mid-aged workers; employees in utilities, transport and construction industries as well as in budgetary entities and state enterprises. Importantly, salaries of all the aforementioned groups were reduced by a statistically significant amount during the course of the economic crisis.

The persistently high real salary flexibility can be justified by generally insignificant role that trade unions play in the salary setting process in Latvia, especially in the private sector. The elasticity is also facilitated by the low collective bargaining coverage and de facto elastic employment protection legislation. The increasing importance of productivity as a real salary short-run determinant can be explained by the raising number of employees receiving variable remuneration, for example, premiums. The variability of bonuses and premiums might also account for the significantly higher salary reductions for employees at the top income decile, arguably for which the proportion of variable income is higher. Salary flexibility being less flexible and unemployment spikes larger for male labour force might be justified by the higher proportion of men receiving minimum salary as well as by the fact that the crisis affected male-dominated sectors more severely, thus requiring multiple lay-offs. In terms of age, our finding of salaries being less elastic for younger workers is in line with the argument that at a younger age one is more likely subject to a lay-off rather than salary cut in times of an economic downturn due to less experience and generally lower pay rate. Finally, the significantly larger salary cuts in budgetary entities and state enterprises reflect the austerity measures conducted in the public sector.

Our findings stipulate that joining Eurozone Latvia is equipped with an effective asymmetric shock-absorbing mechanism. To maintain the salary flexibility, it is suggested to facilitate further increase of usage of variable remuneration in one's pay, so linking salary to productivity and providing employers an unregulated alternative for base wage cuts. An effective downward adjustment in times of spiking unemployment might be hindered by trade unions. Therefore, their role in wage setting mechanism in Latvia should not be overemphasized as well.

6. Limitations

6.1. Adjustments in the Shadow Economy

While examining officially available salary data, the analysis is limited by non-inclusion of undeclared wages. As a result of the spikes in unemployment, it is possible that salaries were reduced in the shadow economy and thus the official data stipulate more moderate adjustments than de facto took place. Alternatively, declared salaries were cut while the undeclared pay level remained constant, so overestimating the extent of the elasticity. The first alternative is arguably more likely since it is considerably easier for the employer to change the unregulated part of remuneration over which the employee has no right for bargaining power.

The magnitude of difference between the actual adjustment and the one observable from the available data depends both on the size of the shadow economy and the size of adjustments made in the shadow economy. Concerning the former, according to a study by Putniņš and Sauka (2013), during the recession in Latvia the share of envelope wages in private sector increased to 35.5% in 2010 and declined to 26.5% in 2012. The proportion of unreported employees according to the study was 14.6% in 2009 and 2010. A study by Hazans (2012) measures the share of unreported employees in the total economy and arrives at a lower proportion – the peak of 3.6% - 5.1% being reached in the second quarter of 2009.

Concerning the size of adjustments conducted in the grey economy, it is a subject for further studies. Some light on the topic is shed by Vanags *et al.* (2014) using a unique survey in this year's *Shadow Economy Index for Baltic Countries* study. Asking the respondents by how much official and unofficial salary was changed during the recession, the authors find that from 2008 to 2009 relatively bigger proportion of official salaries (39.3% compared to 26%) were decreased (see Appendix 13), while from 2009 to 2010 envelope wages declined in 18.7% of the cases while official in only 10.6%. Given the considerable reductions in the shadow economy, one can argue that the total salary adjustment was significant. Therefore, the conclusion that salaries in Latvia are flexible and are an effective shock absorbing mechanism prevails.

6.2. Hourly Wage Rate Flexibility in the Micro Data

While being able to conclude about the total monthly salary elasticity, in the second part of our analysis we cannot distinguish the extent of the flexibility stemming solely from adjustments in the hourly wage rate. Namely, a part of the change in salaries might simply reflect changes in the amount of labour hours. Thus, for instance, a drop for salaries of mid-aged workers might be in to some extent attributed to the fact that a proportion of them started to work part-time. Since the essence of the adjustment to an asymmetric shock lies behind the ability to regain competitiveness by producing the same amount at a lower cost, the results of the second part of the analysis should not be interpreted in the context of salaries of each particular group serving as an effective shock-absorbing mechanism. The average gross monthly salary available in the Central Statistical Bureau of Latvia is calculated in full-time units, i.e., taking into account the labour hours each of the individual works and thus reflecting the changes in hourly rate (Central Statistical Bureau of Latvia, 2014). Therefore, the conclusions stemming from the error correction model hold.

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Appendices

Appendix 1.

Industry classification according to Campbell (1996).

Abbreviation	Industry
BAS	Basic
CAP	Capital goods
CDR	Consumer durables
CNS	Construction
FRE	Finance/real estate
FTB	Food/tobacco
LSR	Leisure
SVS	Services
TEX	Textiles/trade
TRN	Transportation
UTI	Utilities
PET	Petroleum

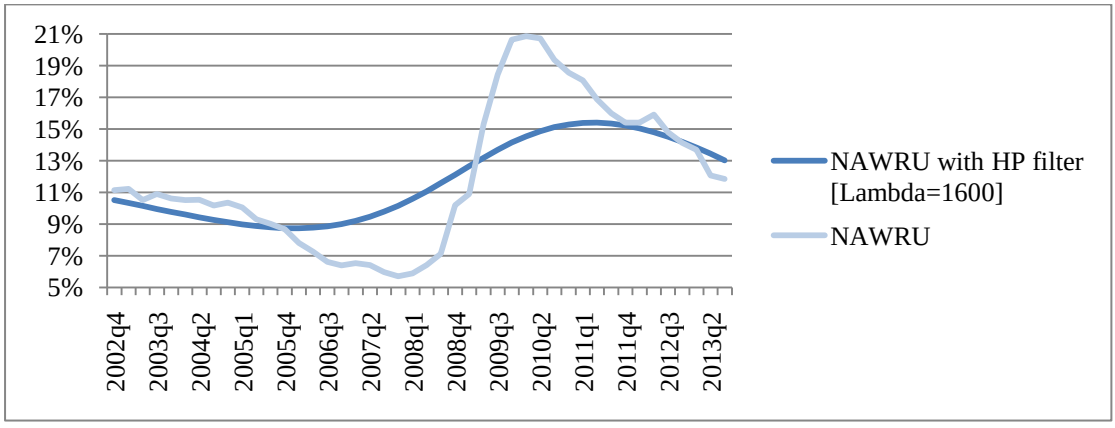
Source: Campbell, 1996.

Company type description.

Abbreviation	Full company type description	Latvian description
AS	Joint Stock Company	Akciju sabiedrība
ARV	Foreign Entity	Ārvalstu uzņ., ārvalstu uzņ. fil.
BUDZ	Budgetary Entity	Budžeta iestāde
SIA	Limited Liability Company	Sabiedrība ar ierobežotu atbildību
VU	State Enterprise	Valsts uzņēmums

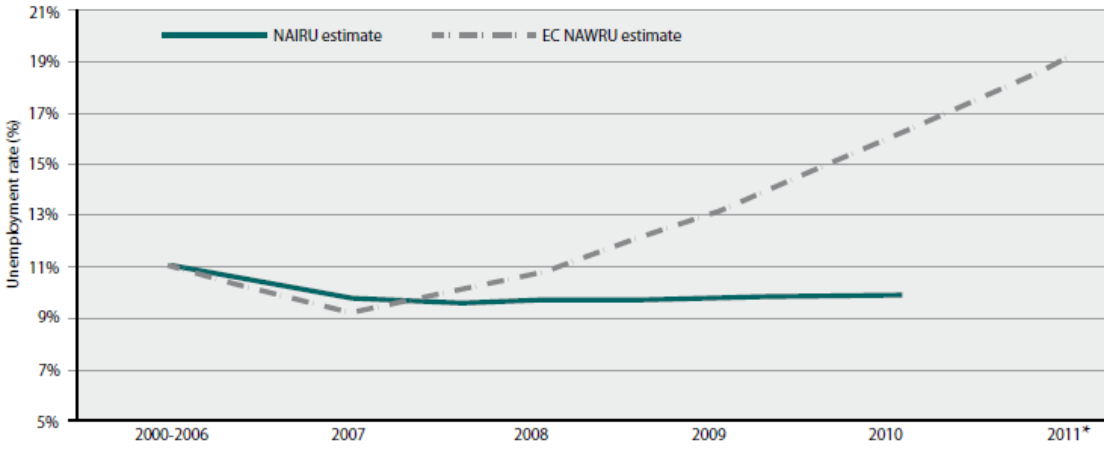
Source: Created by the authors.

Appendix 2. NAWRU Estimate



Source: Created by the authors using data from Central Statistical Bureau of Latvia.

Appendix 3. Comparison of Equilibrium Unemployment Estimates of Zasova (2012) and European Commission (D'Auria, et al., 2010)



* forecast

Source: Latvian Competitiveness Report (2012)

Appendix 4.Granger causality test results. One period lag.

Null Hypothesis	Observations	Chi^2 Statistic	Probability
$\Delta \ln(UGAP)$ does not Granger cause $\Delta \ln(RS)$	39	5.8468	0.016
$\Delta \ln(RS)$ does not Granger cause $\Delta \ln(UGAP)$	39	.90344	0.342

Source: Created by the authors.

Appendix 5. (Augmented) Dickey Fuller Stationarity Test Results.

Augmented Dickey Fuller Test with null hypothesis that $\ln(RS)$ has a unit root

With a constant, no trend, and 1 period lag			
		Tau- Statistic	MacKinnon P-value
Test statistic		-1.701	0.4304
Critical values	1% level	-3.614	
	5% level	-2.944	
	10% level	-2.606	

With a constant, trend, and 1 period lag			
		Tau - Statistic	MacKinnon P-value
Test statistic		-1.323	0.8822
Critical values	1% level	-4.196	
	5% level	-3.520	
	10% level	-3.192	
Trend Significance	P-value: 0.636		

Dickey Fuller Test with null hypothesis that $\Delta \ln(RS)$ has a unit root

With a constant, no trend, and 0 period lag			
		Statistic	MacKinnon P-value
Test statistic		-3.273	0.0161
Critical values	1% level	-3.614	
	5% level	-2.944	
	10% level	-2.606	

With a constant, trend, and 0 period lag			
		Statistic	MacKinnon P-value
Test statistic		-3.574	0.0423
Critical values	1% level	-4.196	
	5% level	-3.520	
	10% level	-3.192	
Trend Significance	P-value:0.261		

Augmented Dickey Fuller Test with null hypothesis that $\ln(PROD)$ [calculated using gross value added] has a unit root

With a constant, no trend, and 2 period lag			
		Statistic	MacKinnon P-value
Test statistic		-1.875	0.3440
Critical values	1% level	-3.621	
	5% level	-2.947	
	10% level	-2.607	

With a constant, trend, and 2 period lag			
		Statistic	MacKinnon P-value
Test statistic		-1.701	0.7504
Critical values	1% level	-4.205	
	5% level	-3.524	
	10% level	-3.194	
Trend Significance	P-value: 0.244		

Augmented Dickey Fuller Test with null hypothesis that $\Delta\ln(\mathbf{PROD})$ [calculated using gross value added] has a unit root

With a constant, no trend, and 2 period lag			
		Statistic	MacKinnon P-value
Test statistic		-6.502	0.0000
Critical values	1% level	-3.614	
	5% level	-2.944	
	10% level	-2.606	

With a constant, trend, and 2 period lag			
		Statistic	MacKinnon P-value
Test statistic		-6.634	0.0000
Critical values	1% level	-4.196	
	5% level	-3.520	
	10% level	-3.192	
Trend Significance	P-value: 0.244		

Augmented Dickey Fuller Test with null hypothesis that $\ln(\mathbf{PROD})$ [calculated using real GDP] has a unit root

With a constant, no trend, and 2 period lag			
		Statistic	MacKinnon P-value
Test statistic		-1.849	0.3564
Critical values	1% level	-3.621	
	5% level	-2.947	
	10% level	-2.607	

With a constant, trend, and 2 period lag			
		Statistic	MacKinnon P-value
Test statistic		-1.918	0.6455
Critical values	1% level	-4.205	
	5% level	-3.524	
	10% level	-3.194	
Trend Significance	P-value: 0.244		

Augmented Dickey Fuller Test with null hypothesis that $\Delta\ln(\mathbf{PROD})$ [calculated using real GDP] has a unit root

With a constant, no trend, and 2 period lag			
		Statistic	MacKinnon P-value
Test statistic		-6.286	0.0000
Critical values	1% level	-3.614	
	5% level	-2.944	
	10% level	-2.606	

With a constant, trend, and 2 period lag			
		Statistic	MacKinnon P-value
Test statistic		-6.368	0.0000
Critical values	1% level	-4.196	
	5% level	-3.520	
	10% level	-3.192	
Trend Significance	P-value: 0.315		

Augmented Dickey Fuller Test with null hypothesis that $\ln(\mathbf{UGAP})$ has a unit root

With a constant, no trend, and 4 period lag			
		Tau- Statistic	MacKinnon P-value
Test statistic		-2.157	0.2221
Critical values	1% level	-3.655	
	5% level	-2.961	
	10% level	-2.613	

With a constant, trend, and 4 period lag			
		Tau - Statistic	MacKinnon P-value
Test statistic		-2.271	0.4503
Critical values	1% level	-4.251	
	5% level	-3.544	
	10% level	-3.206	
Trend Significance	P-value: 0.372		

Dickey Fuller Test with null hypothesis that $\Delta\ln(\mathbf{UGAP})$ has a unit root

With a constant, no trend, and 0 period lag			
		Statistic	MacKinnon P-value
Test statistic		-3.814	0.0028
Critical values	1% level	-3.634	
	5% level	-2.952	
	10% level	-2.610	

With a constant, trend, and 0 period lag			
		Statistic	MacKinnon P-value
Test statistic		-3.765	0.0184
Critical values	1% level	-4.224	
	5% level	-3.532	
	10% level	-3.199	
Trend Significance	P-value: 0.944		

Source: Created by the authors.

Appendix 6. Engle-Granger Augmented Dickey Fuller Cointegration Test.

With a constant, one period lag. Number of observations: 42; Number of variables: 4		
Trend Significance	P-value: 0.898	
		Statistic
Test statistic (no trend)		-4.450
Critical values*	1% level	-5.096
	5% level	-4.370
	10% level	-4.012

*Critical values calculated using procedure suggested by MacKinnon (2010)

Source: Created by the authors.

Appendix 7. Error correction mechanism regression models.

	(1) Ln(RS)	(2) ΔLn(RS)	(3) Ln(RS)	(4) ΔLn(RS)	(5) Ln(RS)	(6) ΔLn(RS)
Ln(UGAP)	-0.244*** (-15.15)				-0.199*** (-11.35)	
Ln(PROD)	1.011*** (38.12)		1.039*** (28.28)			
Dummy	0.140*** (6.71)		0.157*** (6.83)		0.144*** (6.38)	
Lagged error (1)		-0.272* (-2.34)				
ΔLn(UGAP)		-0.0904*** (-5.12)				-0.0749*** (-5.45)
ΔLn(PROD)		0.427** (2.74)		0.417* (2.66)		
UGAPalt			-0.0223*** (-7.25)			
Lagged eror (3)				-0.144 (-1.55)		
ΔUGAPalt				-0.00892** (-3.33)		
Ln(PRODrgdp)					1.075*** (33.05)	
Lagged error (5)						-0.272* (-2.60)
ΔLn(PRODrgdp)						0.423** (2.99)
Constant	4.299*** (140.37)	0.00675 (1.99)	4.276*** (108.85)	0.00685 (1.77)	3.714*** (70.78)	0.00703* (2.04)
N	**44**	**43**	**44**	**43**	**44**	**43**

t statistics in parentheses * p<0.05, **p<0.01, *** p<0.001

OLS regression with Newey-West HAC standard errors. UGAPalt is the alternative unemployment gap measure calculated as a difference between job-seeker-ratio and NAWRU. PRODrgdp is an alternative productivity measure calculated as real GDP per employed person. For lagged error terms the brackets indicate from which model the lagged residual is obtained.

Zasova and Meļihovs (2005) for quarterly data from 1996Q2 to 2004Q2 find the following relationship:

$$(1)\underset{\text{t-statistic}}{\ln(RS_t)} = \underset{-12.242}{-1.963} - \underset{-5.594}{0.231}\ln(UGAP_t) + \underset{43.513}{0.980}\ln(PROD_t) + \underset{4.843}{0.034}dummy + \varepsilon_t$$

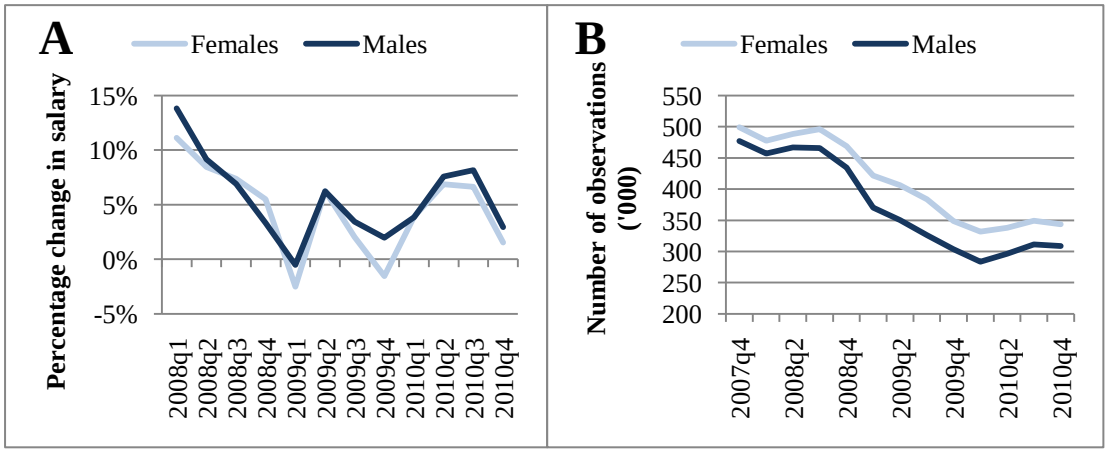
$$(2)\underset{\text{t-statistic}}{\Delta\ln(RS_t)} = \underset{-2.191}{-0.367}\varepsilon_{t-1} + \underset{2.761}{0.012} - \underset{-2.180}{0.088}\Delta\ln(UGAP_t) + \underset{0.615}{0.155}\Delta\ln(PROD_t) + e_t$$

Source: Created by the authors.

Appendix 8. Average salary of all observations (A), average salary of individuals employed in 2007 as base group (B) by income deciles.

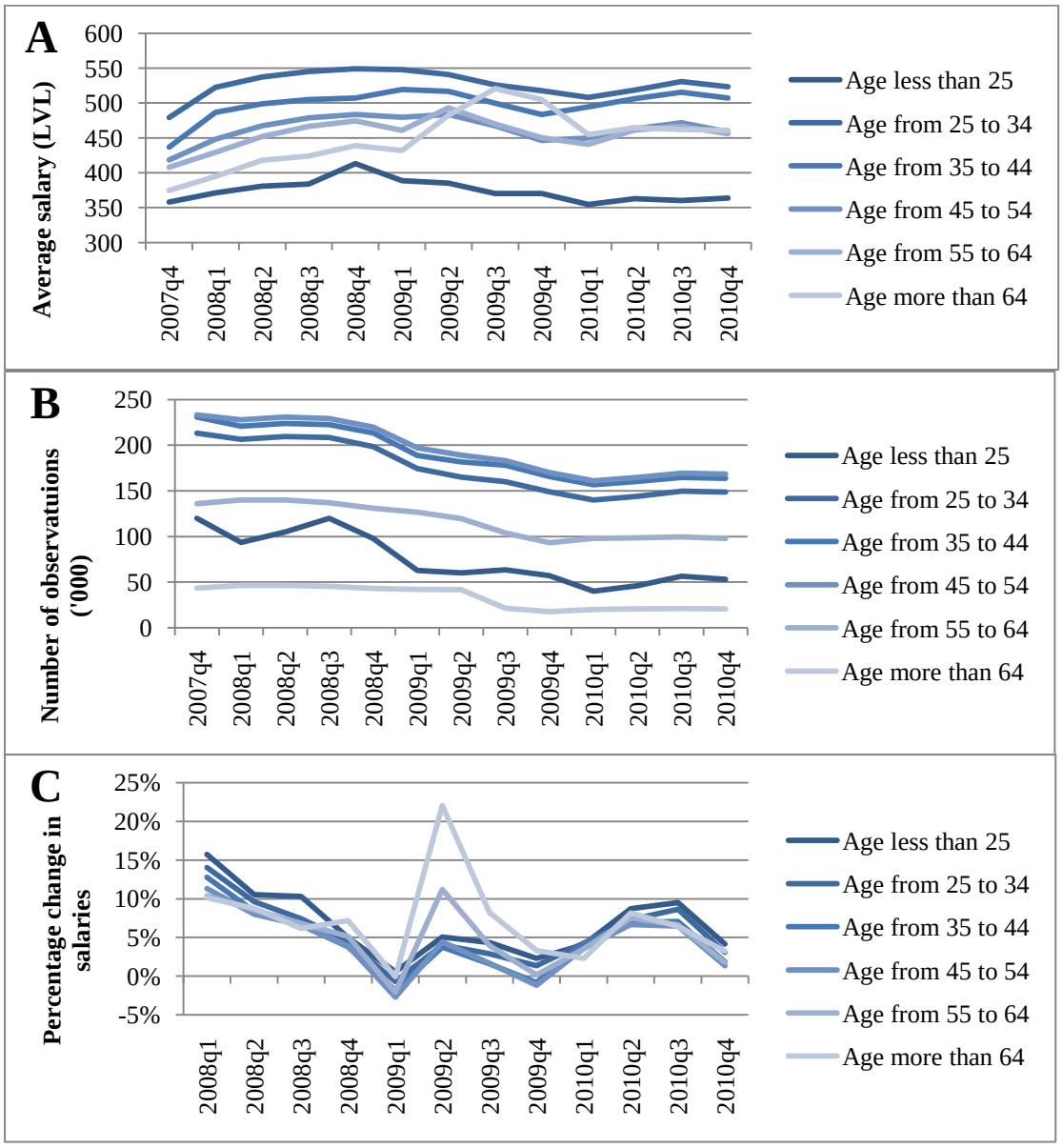
Source: Created by the authors using data from SSIA.

Appendix 9. Average percentage change in salaries (A) and number of observations (B) by gender.



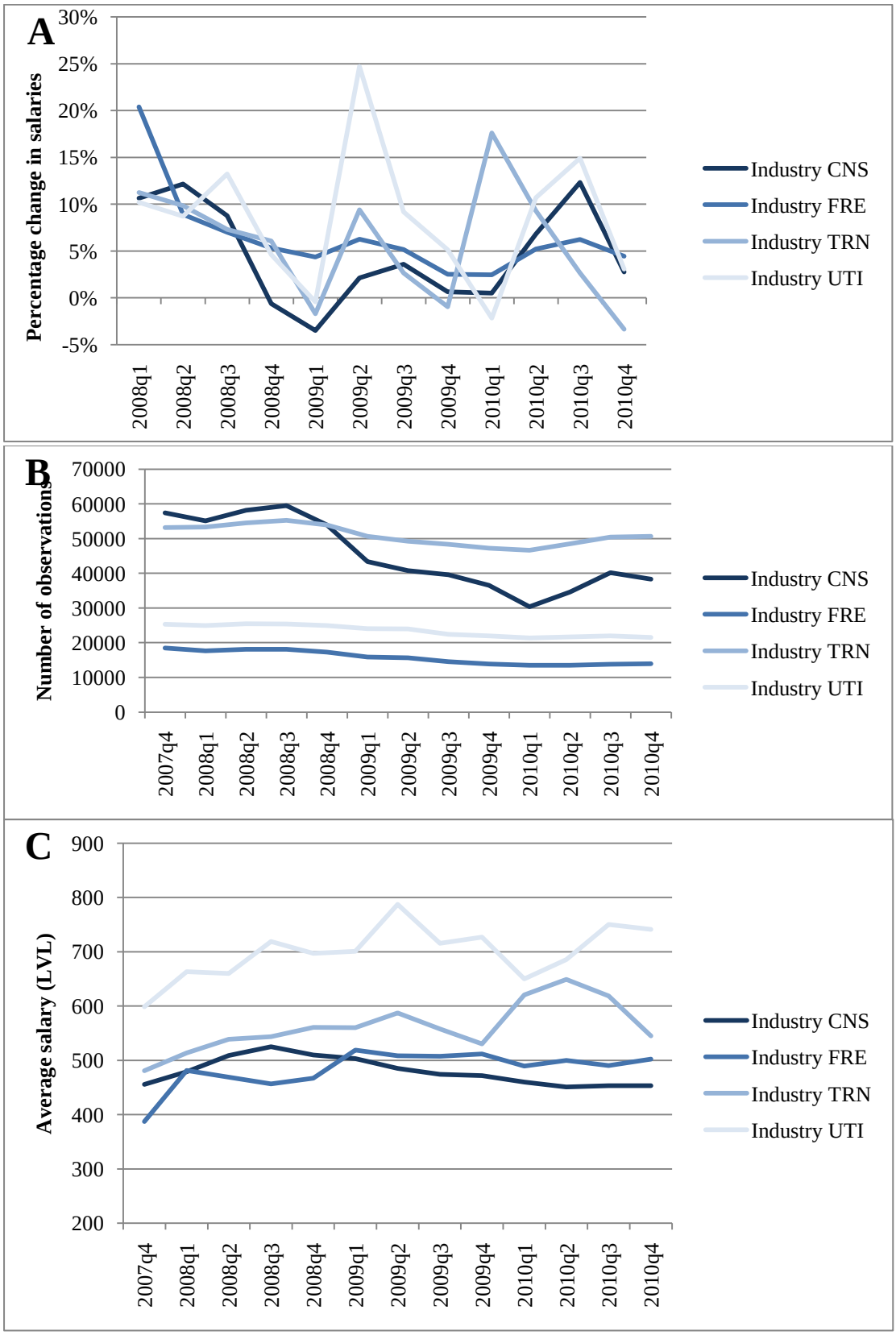
Source: Created by the authors using data from SSIA.

Appendix 10. Average salaries (A), number of observations (B) and average percentage change in salaries (C) by age groups.



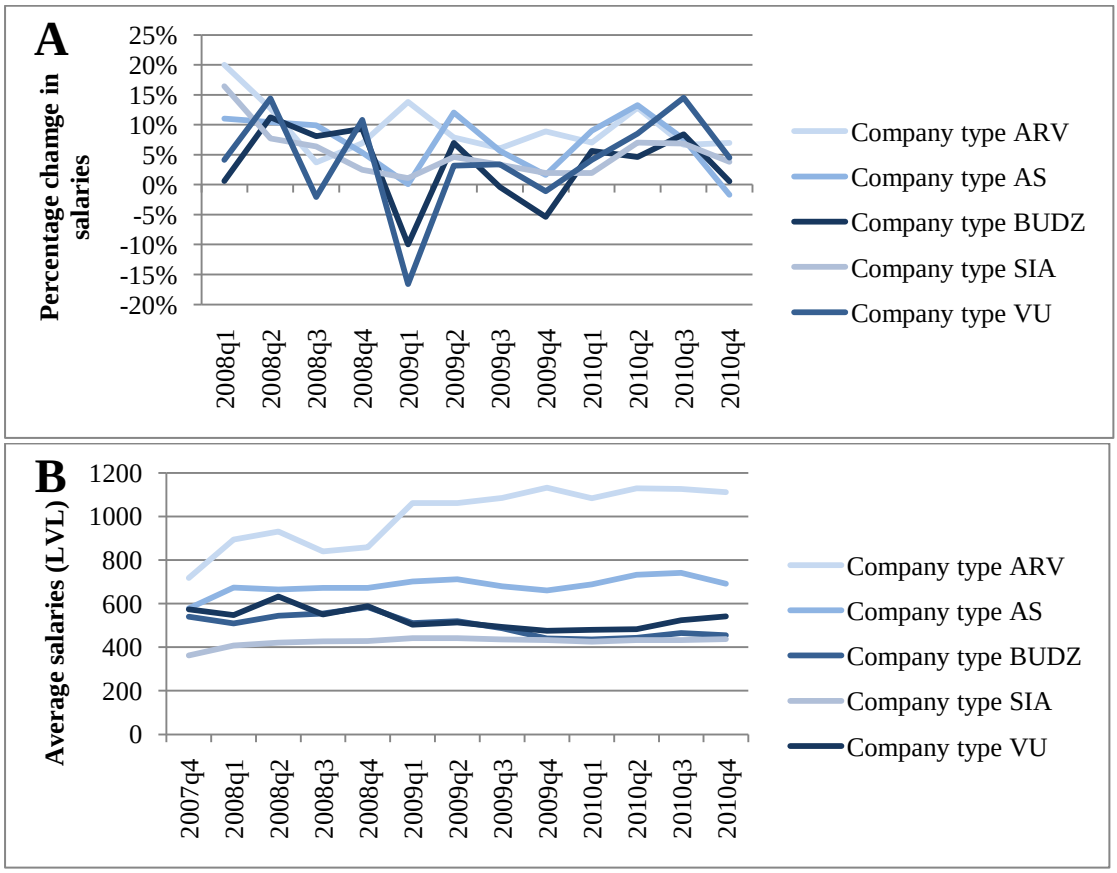
Source: Created by the authors using data from SSIA.

Appendix 11. Average percentage change in salaries (A), number of observations (B) and average salaries (C) by industry.



Source: Created by the authors using data from SSIA.

Appendix 12. Average percentage change in salaries (A) and average salaries (B) by selected employers' business entity types.



Source: Created by the authors using data from SSIA.

Appendix 13. Official and envelope wage change direction.

	2008-9		2009-10	
	Official	Envelope	Official	Envelope
Up	16.3%	17.3%	22.0%	5.0%
Down	39.3%	26.0%	10.6%	18.7%
Unchanged	44.4%	56.7%	67.3%	76.3%

Source: Vanags *et al.* (2014)