The development of wage dispersion and wage rigidity in Finland

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Abstract

This paper examines the development of wage dispersion and wage rigidity in Finland. We find that while labour market institutions remained stable they allowed for wage dispersion to increase both within and between firms. Different from many other countries the within firms increase has dominated during the last decade. Second, using the methods developed in the International Wage Flexibility Project (IWFP), we find that micro-level real wage rigidity has remained as high as in the 1980's and 1990's but nominal rigidity rose after the financial crisis of the late 2000's. These rigidities together with low inflation have prevented real wage adjustment downwards particularly during the Great Recession. Finally, we find that the primary margin to adjust wage costs in firms is the adjustment of employment, rather than hourly wages, overtime or regular working hours, or turnover of employees. Furthermore, firm-level wages are very sticky in the face of firm-level employment shocks. Local wage cuts are delayed and muted when employment declines, compared to wage growth.

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1. Introduction

The purpose of this study is to examine a number of topics related to the development of wage dispersion and wage rigidity over time in the Finnish private sector. The Great Recession[1] has revitalized the interest on the extent of wage rigidities and their effect on the adjustment of the labour markets during the severe slump caused by the financial crisis of 2007-2008; see e.g. Elsby et al. (2016) and Blundell et al. (2014) for US and UK. The Finnish economy also faced a prolonged negative shock in the aftermath of the financial crisis. Labour market institutions are often subject to changes during such major downturns. However, the Finnish wage determination institutions remained unchanged and centralized in international comparison. This provides an interesting case to study the wage adjustment during a severe slump without concurrent institutional changes.

The first topic of this paper is to examine the development of wage dispersion as a general measure of wage flexibility. Is it stable, given the unchanged institutions, or have the existing institutions allowed for increasing wage dispersion similar to other countries. We find that existing labour market institutions have not prevented both within firm and between firm wage differences from increasing. However, the between-firms share of total variance stopped from increasing in the early 2000's. This is different from many other countries where the increase in between-firm wage differences have explained (a large share of) the increase in overall wage variation. The reasons for this difference are open, but it may be that job polarization and routine biased technological change can affect wages based on individual and job characteristics, even within centralized institutions, which curtail wage differences between firms. Another possibility is that the productivity dispersion between firms and monopoly power have diminished compared with 1990's, because of more foreign competition than before.

The second topic is the extent and change of wage rigidities over time. We first document the proportion of nominal and real wage freezes (zero changes) and negative changes in wages as well as the magnitude of wage cuts when they occur. These are indicators for downward nominal wage rigidity (DNWR) and downward real wage rigidity (DRWR). We also examine how many wage changes fall below a generally accepted (union bargained) wage change. However, such standard indicators for wage rigidities are affected by measurement error in individual wages. To correct for measurement error, we produce estimates for downward nominal and real wage rigidity using the

[1] The Great Recession refers to the general economic decline observed in many countries after the financial crisis of 2007-2008. The exact timing and severity of the crisis varied between countries. In the U.S. it lasted 19 months from December 2007 to June 2009. In the EU, including Finland, the recession started somewhat later, and lasted longer. There are no official declarations of start and end dates of recessions in Finland, so we do not attach any years to this term. It refers to the (prolonged) recession era after the financial crisis of 2007-2008.

parametric model developed in the International Wage Flexibility Project (IWFP); see Dickens at al. (2006). We thereby update these wage rigidity measures for Finland for the period 1995-2013 covering the Great Recession. Previously estimates have been available only for 1985-2000 from Böckerman et. al (2010), which covered the previous severe recession of the Finnish economy in the early 1990's. We are then able to examine the nature of wage rigidities over a 28 year period and compare the wage adjustment in Finland during two major recessions. Our main findings are that overall real wage cuts have contributed to the average wage adjustment during both recessions, but that micro-level real wage rigidity measures have remained high and nominal rigidity rose during the recent crisis. Nominal wage rigidity together with low inflation has prevented real wage adjustment downwards particularly during recessions. Our result is in contrast to Verdugo (2016) who found no evidence of downward nominal wage rigidity during the Great Recession in most countries in the sample of eight Eurozone countries (including Finland).

The third topic of this paper is to examine other possibilities that firms have in adjusting their labor costs when they face demand shocks. We do this by decomposing, as in Fuss (2009) and Deelen (2016), the changes in firm's total wage bill into changes in employment, changes in hours worked and hourly wages for job stayers, as well as the effects from the turnover of workers when incoming persons wages differ from outgoing persons wages. Our main finding is that the bulk of the downward adjustment of wage costs in firms experiencing negative shocks has occurred through cuts in employment. On average, there are no wage cuts even in firms experiencing declining sales. The average contribution of continuing workers' wage growth in these firms remains positive, being only 0.5%-points lower compared to firms with increasing sales. The entry-exit effects for hours and wages are small, so firms do not seem to use turnover strategically to cut the wage bill in the face of negative demand shocks. We also examine the adjustment of firm-level wages to firm-level negative shocks. Our regressions show that local (firm-level) wage setting is very sticky and slow to adjust, particularly downwards. These results are consistent with the high level of micro-level downward wage rigidity.

In section 2 below, we start with a brief overview of theories for wage rigidity. Some of them give reasons for why employers may actually prefer firing employees to wage cuts. We also review empirical evidence for these theories and recent literature on wage and employment adjustment during the Great Recession. Section 3 introduces our data and presents an overview of the development of wage dispersion in Finland. Sections 4 and 5 focus in detail on the development of descriptive and parametric measures for real and nominal wage rigidities correspondingly. In section 6 we examine what other possibilities firms have to adjust their wage bill besides wage cuts, and how wages respond to firm-level negative shocks. Section 7 concludes.

2. Theories and previous evidence for wage rigidity

Several theories are consistent with the empirical observation that *real wages* are not adjusted downwards in the presence on unemployment (see e.g. Campbell and Kamlani (1997), Bewley (1999), Agell and Bennmarker (2007) or Hirsch and Zwick (2015) for more detailed presentation and original references for the theories). In unionized labour markets, like in Finland, rent sharing drives wages up due to union bargaining power. During downturns, unions may resist real wage cuts if they give more weight to employed insiders than to unemployed outsiders. In non-unionized markets, implicit contract theory and different versions of efficiency wage theory imply real wage rigidity. According to implicit contract theory, the firm provides it's employees a kind of insurance against income variation by paying a stable wage in return to a lower average wage level.

In efficiency wage models firms find it in their own interest to pay higher wages, creating equilibrium unemployment, because higher wages increase firm's productivity for a variety of reasons. In the adverse selection / turnover model, higher wage raises the average productivity of the applicants, when hiring; and in downturns, the firm prefers firing to wage cuts, because cuts would induce the most productive workers to leave the firm. The same effect is predicted by the fair-wage / gift-exchange model, which builds on the idea that worker's productivity depends of the ratio of the current wage to the wage considered fair by the worker. A wage cut reduces this ratio and therefore the productivity of employees, making the wage cut unprofitable since the current wage is profit maximizing. In the shirking version, wage cuts induce more shirking and thereby lower productivity.

In the insider-outsider theory, incumbents are able to resist wage cuts and replacement of insiders with lower paid outsiders because of firing, hiring and training costs. Employment protection legislation is likely to increase the insider powers by raising the firing costs. Finally, Elsby (2009) has argued that firms may avoid wage increases in order to avoid costly wage cuts in the future. This reduces the effect of wage rigidity on the average wage growth and therefore its employment consequences.

In addition to downward real wage rigidity (DRWR), there may be downward *nominal* wage rigidity (DNWR). With non-negative inflation, nominal wage cuts imply real wage cuts, so all reasons above to resist real wage cuts hold for nominal wage cuts. In addition, there are specific explanations for nominal wage rigidity. First, workers may suffer from money illusion, so they would resist nominal cuts with zero inflation, whereas they would accept real wage cuts of the same size produced by a nominal rise being lower than inflation. Second, Keynes argued that workers are concerned about their wages relative to others. Then they resist nominal wage cuts, if they are not assured that wages

for all others are cut in a coordinated manner. Centralized wage setting may actually increase possibilities for such coordination.

Following the seminal survey evidence by Bewley (1999), Agell and Bennmarker (2007) presented more recently survey evidence for Sweden from a representative survey of human resource managers covering more firms, sectors and firm size categories than previous survey studies. They report that only a minority of firms (13.5%) encountered offers by outsiders to undercut pay or other working conditions. More importantly, majority of employers (89.6%) rejected such offers, main reasons being that it would create internal conflicts or that wage cuts would greatly impair productivity. This evidence supports efficiency wage theories as an explanation for real wage rigidity. However, Agell and Bennmarker (2007) also find that theories of wage rigidity are not mutually exclusive. They find for example that efficiency wage mechanisms complement worker bargaining power, and thereby reinforce the ability of incumbent workers to push for higher real wages. Thus, efficiency wage effects are relevant also in unionized markets, like Finland

In addition to survey evidence there is a large literature using either aggregate wage indices, industry data, or individual level data to study the extent of wage rigidities. For example, Bils (1985) and Solon et al. (1995) showed that the adjustment of average wage indices is affected by changes in the composition of work force over the cycle. Therefore, recent studies have mainly used individual level data, because they allow for controlling of the compositional changes when evaluating wage rigidities. Kahn (1997), Smith (2000) and Dickens et al. (2007) all used histograms of individuals' wage changes to examine the prevalence of downward nominal and real wage rigidities for USA, UK, and 16 industrialized countries (including USA and UK) respectively. A common finding is that downward nominal wage rigidity characterizes wage adjustment in all countries, but to varying extent. Furthermore, Dickens at al. (2007) found an inverse relationship between nominal and real rigidity; countries with high nominal rigidity tend to have on average low real rigidity and vice versa.

The extent of wage rigidity depends on the cyclical status and labour market institutions and therefore it may change over time. Using industry level data Holden and Wulfsberg (2007) found that the fraction of wage cuts prevented due to nominal rigidity had fallen from 61 percent in the 1970s to 16 percent in the late 1990s. They report that nominal rigidity is more prevalent when unemployment is low and union density or employment protection legislation is high. However, based on micro-data Dickens et al. (2007) report that only greater union density, of a number of labor market characteristics studied, had a robust positive relationship with downward real wage rigidity in the countries of their sample.

Recently the Great Recession has revived the interest on the extent of (real) wage flexibility, whether it has changed due to the severity of the downturn. Elsby et al. (2016) compared the wage adjustment during the Great Recession with previous downturns both in the United States and in the Great Britain. They found, consistent with previous studies using microdata, that composition adjusted real wages are pro-cyclical. However, the cyclicality has changed over time, and in a different manner in the US and Great Britain. Whereas the real wages were affected very negatively by the Great Recession in Great Britain, the downward adjustment of men's real wages in the United States was milder than in the previous recessions of the early 1980's and 1990's. Elsby et al. (2016) find this difference puzzling, because both countries experienced similar reductions in inflation and unionization. Similarly, Fallick et al. (2016) found no evidence that the high degree of labor market distress during the Great Recession reduced the high amount of downward nominal wage rigidity in the United States, and some evidence that operative rigidity may have increased during that period. Consistent with Elsby et al. (2016), also Blundell et al. (2014) found more downward flexibility in real wages during the Great Recession in the UK. They provide some evidence that increases in the effective labour supply due to migration and changes in the welfare policy explain the increased flexibility in the UK.

Verdugo (2016) reports that composition adjusted figures for eight Eurozone countries indicate a significant decrease in average wages during the downturn of the Great Recession, particularly in countries most affected by the crisis. Overall, Verdugo (2016) finds no evidence of downward nominal wage rigidity during the Great Recession in most countries in the sample. Similarly Doris et al. (2016) report increasing flexibility in Ireland during the Great Recession. The proportion of all job stayers suffering earnings cuts trebled to over 55%. In addition, they find that between firm differences in pay changes became more important in the peak of the economic crisis, but the majority of earnings changes continued to be driven by within firm rather than between firm forces. Adamopoulou et al. (2016) report that wage rigidities subdued also in Italy during the recessionary years despite the rather rigid institutional setting. They documents a trade-off between wage and employment adjustments. Firms that historically displayed higher levels of wage rigidities were less able to modify wages but exhibited higher worker turnover. A higher share of temporary workers on the other hand increased significantly wage flexibility.

3. The data and dispersion of wages

3.1. The data

The analyses in this paper are based on the harmonized wage structure statistics (HWSS for short) of Statistics Finland for the years 1995-2013. The wage structure statistics are representative of the population of firms larger than five employees (when sampling weights are used), and it is harmonized across the years for differences in industry and occupation classifications and the construction of different wage concepts. It also matches the earnings of workers exactly with the employer firm, in contrast to some other data sources, which match annual earnings to the employer firm at the end of year (e.g. FLEED).

These data include four wage concepts or measures. First, there is the regular *hourly* wage for regular working time and the corresponding *monthly* earnings for *regular working time*. These include basic contractual wages as well as supplementary pay for shift work, working conditions and performance pay and bonuses paid regularly for regular hours worked and based on individual performance. The annual bonuses, often based on group performance or the profitability of the firm, are *not* included. Second, there are hourly wages and monthly earnings for *total working time*, which include also overtime pay. Also monthly working time for regular time and total time are available, the difference being the overtime hours.

Due to some outlying observations, we trim the data by dropping persons whose hourly wages for regular working time are below the 0.1 percentile value or above the 99.9 percentile value each year (calculated for non-zero non-missing wages). After this we checked, that there were no outlying values for monthly earnings to require further trimming.

We deflate nominal values with the consumer price index (1951=100) to obtain corresponding consumption real wages and earnings. The contract wage index (1995=100) is obtained from the time series database (Astika) of Statistics Finland. We use the index for all forms of pay for the private sector[2]. Since the HWSS wage data is for the last quarter of each year we use the last (4^{th}) quarter values of the contract wage index each year to construct the average contract wage rise annually. We also examine producer real wages, which are obtained using the implicit price indices for two-digit industries from National Accounts (Astika) as deflators. We calculate the real consumer and producer wages by dividing the nominal wage with the corresponding price index rebased to 2013=1, so that real wages are measured in 2013 euros.

[2] The Astika database does not include the contract wage index for the years 1995-1999. For these years we used contract wage rises from Marjanen (2002).

3.2. Wage dispersion

We start by describing the development of the dispersion of wages over the period 1995-2013. Dispersion of wages is one aspect of wage flexibility, because it indicates the possibilities for individual, occupational, industrial and firm level factors to affect wages. For example, unions have been found to compress wage dispersion, so an increasing wage dispersion might reflect declining union power in wage setting and therefore more flexible wages. We use the standard deviation of log wages/earnings to highlight the proportional wage differences, which is more robust to extreme values than measures using wage levels. Second, we use different percentile ratios to describe the wage differences in different parts of the distribution; for example the ratio of the 90th percentile to the median and the 10th percentile to the median to describe possibly different developments in the upper and lower parts of the distribution. All our measures are weighted by the sampling weights (to make them representative for the population) and by regular working time of the person. Thereby our results pertain to a randomly selected hour of work, rather than a randomly selected person.

Figure 1. depicts the standard deviations for log hourly wages and monthly earnings. The standard deviations and their development over time for regular working time and for total working time are usually very similar. The dispersion is larger for earnings than hourly wages, because the latter captures also differences in working time across individuals. The rising trends for hourly wages and monthly earnings are quite similar. The increase in the SD for hourly wages is about 4 pp (from 0.32 to 0.36) from 1995 to 2013, and 5 pp (from 0.35 to 0.41) for monthly earnings. The increase in dispersion is somewhat faster during the period 1995-2001 when the economy was still recovering from the early 1990's recession. There is also some further slowdown during the present crisis (after 2008/2009). Wage dispersion (flexibility) seems therefore to be pro-cyclical, increasing in booms and slowing down in downturns.

Figure 2. depicts the development of the P90/P50 and P10/P50 percentile ratios for hourly wages for regular time and monthly earnings for total time (other wage measures behave similarly to these as already shown by the standard deviations). The wage differences increase in a trend like manner both in the upper and lower parts of the distribution until years 2008 (upper) and 2010 (lower) when the changes level off. The P90/P50 ratio increases by about 13 pp for both hourly and monthly wages, and the P10/P50 ratio drops by about 4-5 pp. In relative terms, changes in the upper and lower parts are similar, about 7-8 percent increase in wage differences. Therefore, the wage differences as measured by the P90/P10 differential have widened by about 15 % from 1995 to late 2000's. However, during the last crisis years (from 2008-2010 onwards) this increase has leveled off, with no further increase in wage differentials as measured by the percentile ratios, although the standard

deviations indicated some increase also during this period. A detailed examination of the percentile values reveals that real wages have risen in (almost) all parts of the distribution, but less so in the lower deciles. The increasing wage dispersion in Finland has been due to the increase in highest earnings and a relative constancy of the lowest earnings[3].

Figure 3. presents a decomposition of monthly earnings into within firms variance and between firms variance components. Results for hourly wages are similar. The decomposition is obtained using the formula in Davis and Haltiwanger (1991, fn. 23). The between firms component is the hours weighted variance of average firm wages, and the within firms component is the hours weighted average of variances within each firm. Many countries have experienced increases in the between firm variance that explains (almost) all of the increase in overall variance of wages; see e.g. Barth et. al (2014) and Song et. al (2015). Increases in the between firm component of the variation of wages may reflect two factors. First, it could be that productivity and/or rent-sharing differences between firms are increasing. Second, it could be that the assortative matching of high skilled workers to high wage firms is increasing. Card et.al (2013) find for Germany, that both have about an equal effect on the rise in overall wage inequality (a quarter and a third respectively), with the person-specific component having an additional somewhat larger effect (40%). A third possible explanation is that the variation in monopsony power is increasing between firms (see Council of Economic Advisers, 2016).

For Finland we find, first, that the within firms variance is larger than the between firms variance. Exact comparison with other countries is difficult, because wage measures and periods differ, but it seems that between firms variation of wages in Finland (36-42%) is well within the range of other countries, being less than in countries with more flexible labour market institutions (USA, UK, Ireland), but higher than in late 90's Sweden[4]. Second, both variances have increased, but the increase in between firms variance has levelled off, whereas within firms variance has continued to increase. As a results, the between firms share of total variance increased by 6 pp (from 0.36 to 0.42) during 1995-2001, but has remained more or less flat since then, with some small decline since 2008. During late 1990's, the increase in between firms variance dominated the within firms increase, but during 2000's the overall increase in wage dispersion has occurred within firms, rather than between firms. This implies that during the last decade the increase in wage dispersion has been more related to

[3] The development of the percentiles can be found in the working paper version of this paper; Vainiomäki (2017).
[4] Results in Davis and Haltiwanger (1991) imply a between firms share of over 60% (production and non-production combined) in US during 1975-1986. Faggio et.al. (2007) find that the between share in UK increased from somewhat below 50% to over 50% during the period 1984-1999. Doris et al. (2016) report an increase in the between firms share from 42% to 48% in Ireland during the great recession. Nordström Skans et. al. (2009) show an increase in the between plants share from 20% in 1985 to 30% in 2000 in the Swedish private corporate sector.

characteristics of individuals (e.g. skill bias), or to the characteristics of their jobs (polarization), rather than characteristics of their employer firms or assortative matching. In this respect, the development in Finland seems to differ from that in many other countries during recent years (decade). It is hard to say why Finland is different in this respect. It is unlikely to relate only to labour market institutions, because the rising trend stopped in the early 2000's. If anything, there has been pressure from the employer side towards more decentralized bargaining since then, which should have increased the between firms variation in wages. A possible explanation is that the firm characteristics have not lost importance but the competitive position of firms has become more equal because of more intensive competition due to increasing international trade and outsourcing of low wage jobs.

4. Wage cuts and wage freezes

4.1. Descriptive analysis

As background, Figure 4 shows the development of average real wage growth for different wage measures and the rate of inflation. The increase in real hourly wages has been around 3% annually, but during the recession of the 2010's the wage increases dropped considerably, to below 1.5 %. Thus, the average real wage growth has adjusted downwards during the crisis years. There has been no systematic difference in the overall level of consumption and producer real wage growth, although they may differ considerably in individual years. The average level of price inflation is close to 2% but it has varied strongly between 0% and 4% in individual years. There is a negative correlation between real wage growth and price inflation, so that higher (surprise) inflation curtails real wage growth.

Figure 5 shows the average real wage growth separately for job stayers and job switchers over 3-year periods to smooth the annual variation and get a better picture of the trend in real wage growth. This measure peaks around 2005, and turns to a decline after increasing before that. The decline in overall real wage growth for three-year periods during the recession years is considerable; from 10 % in 2002-2005 to 2 % in 2010-2013 for hourly wages of job stayers. This implies considerable moderation in the average real wage growth after the financial crisis. The real wage growth for job switchers is larger than for those continuing in the same job. Thus, job switches are towards better paying jobs in general.

As descriptive measures for wage rigidity, we report the incidence and size of negative wage changes, as well as the size of the zero spike. We report these in Table 1 for nominal wage changes, real

consumption and real producer wage changes and the deviations of nominal wage changes from the contract wage rise as measured by the change in contract wage index. Large zero spikes and lack of wage cuts are taken as evidence for downward wage rigidity. However, such descriptive measures are affected by measurement error in wages. The share of wage cuts is overestimated and the zero spike underestimated, giving an impression of more wage flexibility than in reality. In the next section we correct for measurement error. Averages of annual wage changes overestimate the size of wage cuts in addition to measurement error also when the cuts are transitory. Wage cuts may be transitory because true wage raises next year compensate for the cuts this year. On the other hand, annual wage changes may underestimate the size of longer-term wage cuts, if the same persons are subject to a series of wage cuts in consecutive years. To decrease these kinds of effects on our results, we calculate the share and size of real wage cuts also over three year periods[5]. Such longer differences are less prone to transitory wage changes, and better capture the cumulative effects over time. The measurement error effect is also smaller as the true wage change over three years is larger, so that the noise to signal ratio declines.

Table 1 present averages across all years 1996-2013 of annual changes for job stayers, i.e. persons who work for the same employer in the same occupation in two consecutive years. If a person changes employers, or the job she performs within the same employer firm, there are no restrictions on the change of her wage or earnings. The first observation is that the results are virtually similar for all age groups and for the prime aged (25 to 55 years old). Therefore, we concentrate on the results for the prime aged since the parametric rigidity results below are for this age group.

The share of zero changes (in practice a very narrow range around zero) is larger for nominal wages than for real wages or the deviations from contract raise. The average zero spike is 2.8% for nominal hourly wages, and 4.3% for full time monthly earnings. The zero share for contract deviations is somewhat larger than for real wages, which is natural as the "normal" annual wage change is presumed to be the annual contracted wage raise, rather than inflation. For producer real wages the zero spike is extremely small. This reflects the fact that price inflation varies across firms, but wage setting is more co-ordinated, so that there is less bunching of producer real wage changes to one particular number.

The shares of nominal or real wage cuts on the other hand are non-negligible. About a third of continuing prime aged workers experience an hourly wage change that is smaller than the contract

[5] Although long-differencing is often used to diminish measurement error and other transitory changes in other areas, we are not aware of other papers on wage rigidity to have used this technique.

wage raise (34.9%), or experience a real wage cut (29.7%). Although wage setting in Finland is based on central or industry level contracts, these numbers indicate that there is room for individual or firm-level local wage setting, which produces smaller wage growth for some workers than the contract wage raises. About 16% experience a nominal wage cut. For monthly earnings corresponding shares are a few percentage points smaller than for hourly wages. In addition, the means of the wage cuts are quite large. The largest mean is -8% for the nominal wage cuts. The average wage cuts for real wages were between -3% and -6%, depending on the wage measure. The smaller mean for real cuts is due to a higher concentration of real cuts close to zero than for nominal cuts, i.e. there is a substantial amount of small nominal wage increases just below inflation.

Although the average share of zero nominal changes is quite small, the zero spike has been substantial in some individual years as seen from Figure 6. It is notable that zero spikes concentrate on years of economic recessions.[6] During normal times, zero nominal spikes are essentially non-existent. On the other hand, the shares and average sizes of nominal wage cuts are quite stable over time, with some tendency for the mean of nominal cuts to increase in absolute terms.

Figure 7 presents the share of real consumption wage cuts and their mean in each year. Both are presented for 1-year changes and 3-year changes. The latter should smooth out measurement error and other transitory changes. The share of real wage cuts has been notably higher than normal during the crisis years 2008, 2011 and 2012. The low share of real wage cuts in 2009-2010 is due to the very low inflation during these years (0 in 2009 and 1.2% in 2010). In 2009, the share of real wage freezes was particularly high, instead of real wage cuts, because there were nominal freezes and inflation was zero. When inflation picked up in 2011-2012, nominal wages did not follow, and 50-60% of workers experienced real wage cuts. The share of 3-year real wage cuts starts to rise after mid 2000's after some decline before that. The share rises to about 40% for job stayers in the height of the recession 2012-2013, which is four times the share in mid 2000's period of economic growth. The share of wage cuts for 1-year changes is larger than for 3-year changes, which implies that part of the wage cuts are measurement error or otherwise transitory. During the recession years 2012-2013 this

[6] The zero spike in 1997 is due to the postponement of contract wage rises in 1997 to the next year, in response to a short downturn. The spikes in 2007 and after are likely to relate to the wage moderation during the financial crisis, but they may partly also reflect the timing of bargaining. Both in 2007 and in 2009 some industries reached a contract only early next year, so there may have not been any contractual wage increases during 2007 or 2009 in these industries. Some part of the zero spike in 2011 may also reflect similar factors, because some of the ongoing industry level contracts lasted until the spring of 2012, so there may have not been contractual wage raises in 2011 in these industries, although the Framework agreement for 2011-2013 was centralized. The information regarding the timing of contracts is from the Annual Reports of the Employer Association. They are available only in Finnish from their Web page https://ek.fi/materiaalipankki/julkaisut-ja-selvitykset/ .

difference becomes smaller, so it seems that wage cuts become more permanent and tend to concentrate on the same persons.

However, the mean of real wage cuts declines during the recent recession. This is probably due to two effects. In some crisis years inflation is low (2009, 2010, 2013), which tends to make real cuts smaller. Another factor is that there are more small real cuts, because contract raises in 2010, 2011 and 2013 were just below inflation, whereas contract raises normally exceed inflation to reward for productivity growth. Nevertheless, these numbers do indicate increasing real wage moderation during the recession years, because the share of real wage cuts increases and the contract wage increases fall below inflation. A larger moderation in wage contracts occurred after our data period. In 2014-2015 contract wage rises were about 0.6% each year. On the other hand, the rising downward nominal wage rigidity seems to limit the size of real wage cuts. If nominal wage freeze limits the nominal cuts, then the size of inflation limits the size of real wage cuts. Therefore, low inflation during the crisis years is one factor limiting the downward adjustment of real wages.

We have also examined wage cuts for job switchers, who change either employer firms or occupation within the same firm (or both). Although the share of real wage cuts are similar for job stayers and switchers, the average size of the cuts is larger for job switchers compared to job stayers. Thus, persons who switch jobs lose even more than those who keep their jobs, whereas overall job switchers gained higher wage growth than job stayers (see figure 5). This implies that job switches that lead to wage cuts are likely to be involuntary.

4.2. Parametric estimates for downward nominal and real wage rigidity

In this section, we apply the methodology developed in the International Wage Flexibility Project (IWFP) to obtain parametric estimates of downward nominal and real wage rigidity. The methodology is explained in more detail in Dickens et. al. (2006) and Böckerman et al. (2010). The IWFP methodology aknowledges that there is measurement error in the observed wages. The first step in the methodology is to estimate the true wage change distribution using a histogram consisting of 75 bins of 1 %-point length and a Zero change bin (in practice a very narrow range around zero). The second step is to estimate the downward nominal and real wage rigidities using the method of moments.

The definition of downward real wage rigidity (DRWR) is based on the idea that some persons obtain wage changes according to the expected rate of inflation (constant real wage) whereas they would

have obtained wage changes below the expected rate of inflation (a real wage cut) without downward real wage rigidity. The amount of downward real wage rigidity is estimated by comparing the true wage change distribution to the notional wage change distribution that is not affected by real or nominal wage rigidities. Because the expected rate of inflation varies across persons, its mean and variance each year are also estimated parameters within the protocol. The estimated real wage rigidity gives the estimated proportion of persons that are affected by real wage rigidity of those persons that are potentially subject to real wage rigidity.

Downward nominal wage rigidity (DNWR) is observed for persons who experience a nominal wage freeze when they would have experienced a nominal wage cut without nominal rigidity. The IWFP protocol estimate for downward nominal wage rigidity is the proportion of persons affected by nominal rigidity of those persons who are potentially subject to nominal rigidity and who are not affected by real rigidity. The rigidity measures therefore vary between 0 (no one is affected by rigidity) to 1 (all potentially subject to rigidity are affected by it). The "total" rigidity measure, which reflects the proportion of persons who are affected either by real or nominal wage rigidity, is calculated as r + (1-r)*n.

Figure 8 presents three different histograms for wage change distributions for two years, 2001 representing times of normal growth and 2009 the recent recession. First histogram is for the observed wage changes, second for the estimated true wage changes, and the third for the wage changes predicted by the parametric model, that captures the nominal and real wage rigidities. The mean of the estimated expected inflation is also presented (as the yellow bar) to visually inspect how real wage rigidity is affecting the distributions. It is notable that in both years the wage changes pile up to the bin (1 %-point interval) that also includes the expected inflation, whereas there are much less observations to the left of this bin compared to the right of it. This "missing mass" below the expected inflation rate is a visual mark of downward real wage rigidity. Wage changes also pile slightly above the expected inflation rate. This reflects the fact that normally wage increases reward workers for the increasing productivity. The IWFP protocol may capture this as real wage rigidity to the extent that the peak is not too far above the expected inflation, because the protocol allows for some variation in the expected inflation rate.

A spike at the zero bin and missing mass below it is a visual marker for downward nominal wage rigidity. Such a spike is visible in the histogram for the recession year 2009, but not in the histogram for the normal year 2001. Overall, based on the visual inspection of wage change histograms for all years (see the working paper version for them), real wage rigidity characterizes wage determination during normal times, but there is no nominal wage rigidity. This is natural, as there is usually no need

for nominal wage cuts for the majority of workers when the economy and productivity is growing. During an economic downswing, nominal wage rigidity arises, as indicated by the recessionary year 2009. When inflation is low, the nominal and real wage rigidities are essentially indistinguishable. The total rigidity measure captures this trade-off.

Figure 9 presents our estimates for DRWR and DNWR for each year using the HWSS data.[7] These figures also include comparable measures for an earlier period (1986-2000) from Böckerman et.al. (2010). We use the measures for manufacturing blue collar workers for the earlier period as they were estimated using hourly wages for regular working time, similar to the estimates here for the period 1996-2013. Real wage rigidity varies between 0.6 and 1 annually, averaging about 0.8 over the years. For some individual years, like the recession years 1992-1993 (when there were substantial amounts of real wage cuts) and later in 2003 and 2007 (when mean wage growth substantially exceeds expected inflation), the real rigidity has dropped to 0.15-0.35. Otherwise, DRWR has been quite stable over time around an average of about 0.8. That is 80 % of workers potentially subject to DRWR, have been affected by it. Note, that this does not mean that 80 % of all workers are affected by real wage rigidity. The measure is a fraction of workers who would have experienced a real wage cut without rigidities. As indicated by the wage change histograms, a large share (majority) of workers receive wage changes that are larger than expected inflation or even larger than contract wage rises during most years. In this sense, even large DRWR measures do not necessarily mean that wages are affected by DRWR for a large proportion of all workers. However, a large DRWR does indicate that a large share of those workers who would otherwise be subject to real wage cuts, are restricted from experiencing such cuts and receive a real wage freeze instead.

In contrast to the stability of real wage rigidity, we observe an increasing tendency in nominal wage rigidity during the Great Recession years (2007-2013). Before that period DNWR measures have been usually zero or close to it, except for the mini-recession years of early 2000's.[8] It therefore seems, that nominal wage rigidity steps in during business cycle downswings, when there may be some slacking off in real wage rigidity. The combined or total effect of both real and nominal wage rigidities is consistent with the previous statement, as total rigidity is more stable than real wage

[7] The sample for rigidity estimations is restricted in two ways. First, only persons who remain in the same firm and in the same occupation in the two consecutive years are included in the estimation of rigidity measures. As noted above, job changers provide no information about the rigidity or flexibility of wage determination, and therefore they are excluded from the estimations. Second, the sample is restricted to prime aged workers, aged 25-55, to preserve comparability with the previous estimations using the IWFP method.

[8] However, Böckerman et. al. (2010) report high DNWR measure for the 1990's recession years for monthly paid white collar workers and service sector workers, but not for blue-collar hourly paid workers.

rigidity alone. There is some tendency for the total rigidity to have increased during the last years of the recent recession, mainly because nominal wage rigidity has increased.

The IWFP protocol has been applied to Finnish data earlier in Böckerman et. al. (2010) for the years 1986-2000. They used the original Employer association data separately for manufacturing blue-collar workers, manufacturing white-collar workers and the service sector workers. The HWSS data used in this paper are based on the same raw data, but includes more sectors. Therefore, our results are not fully comparable with the earlier ones, but we present some comparisons to obtain a rough picture of possible similarities and/or differences over time.

Comparing the present rigidity measures to the previous ones in Böckerman et.al (2010) for an earlier period, we note from Table 2, that for the overlapping years of 1995/1996-2000/2001 the nominal rigidity is lower in the present results, and the real rigidity is higher. This difference in the overall level of rigidity is likely to be due the differences in wage measures and sectors across the studies. However, the patterns over the cycle are likely to be more comparable. In both cases, we find that the nominal rigidity rises during recessions; during early 90's recession in the IWFP column and after the financial crisis in the HWSS column. During early 90's recession, this was accompanied by a substantial decline in real rigidity, which is not observed during the present crisis. This may be due to the more severe and abrupt nature of the 90's recession, which led to contractual nominal wage freezes. This led to substantial zero spikes during the 90's recession and therefore to high nominal rigidity. Although inflation declined, it remained over 2% during the recession years. Therefore, the real rigidity measures dropped considerably, because inflation exceeded the nominal wage change for most workers. That is, most workers experienced real wage cuts during the 90's recession. During the present crisis, nominal rigidity also rose, although there have not been such large zero spikes. The wage contracts have remained positive and close to inflation (mostly below it) during the financial crisis, which has retained also the real rigidity measures high.

The country comparison in Dickens et al. (2006) placed Finland among the high real rigidity countries together with Sweden and France, and among low nominal rigidity countries together with Germany, Norway, Ireland and Belgium (see their Figure 4). We are aware of only one recent application of the IWFP protocol, so it is difficult to say whether this ranking of countries has changed over time[9]. Given the comparison with the previous Finnish results, and the increasing wage flexibility found in

[9] Deelen and Verbeek (2015) present results for the Netherlands over the years 2006-2012, which places Netherlands also among the high real rigidity and low nominal rigidity countries.

other countries mentioned in the review section, the relative standing of Finland as a high rigidity country has likely not abated.

4.3. Other ways to adjust wage costs

Firms have other margins to adjust wage costs in addition to cuts in contractual (hourly) wages in case the firm faces an adverse shock and it needs to adjust its wage bill. The regular working time or overtime hours for existing workers may be reduced or the firm may lay off (temporarily or permanently) its workers. There is also natural or strategic turnover of workers. If the wage level or working hours of entrants differs from those of leavers, the firms wage costs change. In order to examine the importance of these margins we perform a decomposition of the annual change in the firm's wage bill following the decompositions presented in Fuss (2009) and Deelen (2016), as follows (firm subscript omitted for clarity) [10]

$$\dot{WB}_t = \Big[(N_t - E_{t-1}).\overline{H}_t^S.\overline{w}_t^{hS} + S_t\overline{H}_t^S\left(\overline{w}_t^{hS} - \overline{w}_{t-1}^{hS}\right) + S_t\left(\overline{H}_t^S - \overline{H}_{t-1}^S\right).\overline{w}_{t-1}^{hS} +$$

$$\left(\overline{w}_t^{hN} - \overline{w}_t^{hS}\right)N_t.\overline{H}_t^N - \left(\overline{w}_{t-1}^{hE} - \overline{w}_t^{hS}\right)E_{t-1}.\overline{H}_{t-1}^E +$$

$$\left(\overline{H}_t^N - \overline{H}_t^S\right)N_t.\overline{w}_t^{hS} - \left(\overline{H}_{t-1}^E - \overline{H}_t^S\right)E_{t-1}.\overline{w}_t^{hS}\Big]\cdot\Big[\overline{WB_{it,\,t-1}}\Big]^{-1} \qquad (1)$$

where S_t, N_t and E_t are the numbers of staying, entering, and exiting workers in the firm; $\overline{H}_t^S$ and $\overline{w}_t^{hS}$ denote the average regular working time and hourly wages for job stayers; superscripts N and E denote corresponding averages for entering and exiting workers; and WB denotes the firms total wage bill[11]. The left hand side is the annual percentage change in the firms wage bill as a proportion of the firms average wage bill over the two years. On the right hand side, the first term gives the effect of employment change, the second the effect of change in average hourly wages for job stayers, and the third term gives the effect of changes in average regular working time of job stayers. The term on the second line gives the entry-exit-wage effect due to the differences in the average wages of entrants

[10] We are able to include only direct wage costs in this examination. Employer social security payments, pecuniary or non-pecuniary fringe benefits and annually paid performance bonuses are not included, although they allow for additional margins for labour cost adjustment. The decomposition also assumes that wages reflect (marginal) productivity, so that e.g. worker turnover does not have any further cost effects from productivity differences between entrants and exiters.

[11] Fuss (2009) used daily wages and had only a sample of workers in firms. Our exact decomposition, like that in Deelen (2016), is therefore an improvement to the approximate decomposition in Fuss (2009) on two accounts; we have full wage bill in the firms instead of a sample, and we have a more detailed measure of labour input in hours. Measurement error in hours should be minimal as it originates from payroll accounts of the firms.

and exiters, and the term of the third line gives a similar effect from average working time for entrants and exiters.[12] The overtime effect is calculated as the difference between the total wage bill (including overtime) and the wage bill for regular working time. All firm level averages are weighted by the individual worker's regular working hours. The aggregate decomposition is obtained as a weighted average of these firm level components, weighted by the sampling weight of firms.

Table 3. presents the results for this decomposition averaged over all (continuing) firms and years 1996-2013. The decomposition is averaged separately for firms in "good state" – sales increasing from the previous year – and firms in "bad state" – sales declining from previous year. Except for the employment change component, there are no major differences in the components between firms in good and bad state. The wage bill is increasing strongly in firms that face positive changes in their sales, because the firms are employing new workers. Conversely, the wage bill is declining by over 6% in firms facing declining sales, because the firms are employing less workers. On the other hand, the average wage bill growth due to wage growth of job stayers in growing sales firms is 2 % per year, whereas it is only somewhat smaller at 1.5% in declining sales firms. The differences also in other margins between good and bad state firms are quite small, including the adjustment of overtime.

It therefore seems that the bulk of downward adjustment in wage costs falls on layoffs of workers in firms facing negative shocks. In this respect, our results are very similar to those for the Netherlands in Deelen (2016). However, it must be stressed, that these results do not necessarily imply causality from sales reductions to employment declines due to rigid wages. It is possible that the causality is reversed, that is, a firm may be cutting its operations for some other reason than high wages. Then it is reductions in production and employment, which lead to reclining sales.

To partially correct for reverse causality, we use changes in operating profits to stratify firms in to good and bad state. We then ran fixed effects regressions for each component in the decomposition using a bad state indicator ($Dbadstate_{i,t}$) as a regressor. The indicator is one if the firm's profits drop from the previous year, and zero otherwise. We ran three different specifications for each component ($y_{i,t}$) of the decomposition in equation (1). First, using only the current bad state indicator as a regressor, to mimic the results in previous Table 3, as follows

[12] The changes in the composition of the firm's work force between the two years, caused by the possibility that low-skilled workers are being fired more often than high-skilled workers, does not have any effect on the employment change component, because it is calculated using the average wages of job stayers, who work in the firm in both years. The possible selective firing of low-skilled affects our decomposition for the total wage bill through the "entry-exit wages" component, the second line in equation (1), to the extent that the skill-composition of new entrants, their average wages and their numbers, differs from those of laid off exiters.

$$y_{i,t} = \alpha + \beta . Dbadstate_{i,t} + \gamma_i + \varepsilon_{i,t}. \quad (2)$$

Second, we used the lagged bad state indicator as a regressor to control for reverse causality. Third, we added year dummies as regressors to control for common year effects so that the bad state effects would reflect only differences between firms in otherwise similar (macroeconomic) conditions. In addition, firm fixed effects γ_i in all regressions control permanent differences between firms. The results are in Table 4.[13]

It is notable that the bad state coefficients are smaller and less significant when the lagged indicators are used, so reverse correlation is playing a considerable role in Table 3. The addition of time dummies does not have a material effect on the results, so the results do reflect differences between firms facing different circumstances, rather than general cyclical effects. The coefficients on employment change, stayer wage change and entry-exit hours effect remain significantly negative at the 5% level. The hourly wage cuts of job stayers diminish the firms wage bill by about 0.14% in a firm experiencing negative profit changes compared to firms facing growing profits. The comparable effect for the decline in employment is over 5 times larger at approximately 0.76%. The shorter working hours of entering workers compared to exiting workers decreases the firms wage bill by an additional 0.21%. In total, the wage bill change is 1.24% lower in bad state firms compared to good state firms, based on this model. It is still true that the bulk of the adjustment occurs via employment, but the numbers are far smaller than in the decomposition using current sales change. This indicates that reverse causality has likely affected those estimates substantially, but the relative contribution of different components is not affected.

As another simple attempt to examine the responsiveness of wages to firm-level shocks, we examine correlations between firm-level employment changes and changes in firm-level producer real wages. To obtain these correlations we run regressions for firm's average wage changes on its current and lagged employment changes (three lags) controlling for year effects and differences between industries (at one digit level) and the full set of year-industry interactions. These are reported in Table 5 using the number of workers as the employment measure. Results using hours worked as the employment measure were very similar and therefore not reported. In the first column, the coefficients (elasticities) are small and only the second lag is significant. This correlation does not reflect pro-cyclical business cycle effects common for all firms, because year-industry effects control for business cycles that are allowed to vary between industries. It is more likely due to firm-level

[13] It should be noted, that the results in Tables 3 and 4 are likely to be affected also by sample selection, because they are restricted to continuing firms. In particular, the contribution of employment changes in case of negative shocks in likely to be too small, because we omit employment losses in firms that have gone bankrupt.

(demand) shocks, which produce the positive overall correlation between wages and employment. This equation does not strictly identify any structural relationship, but to the extent that these results are mainly driven by firm-level demand shocks (and not by changes in firm-level wage pressure), the small coefficients imply that "local" wage setting curve is very flat. Note again, that the year and industry effects essentially control for the aggregate wage setting effects common to all firms, such as centralized (industry level) contracts and their responsiveness to aggregate unemployment, so these results do not necessarily imply flat overall wage setting curves.

In order to examine if this relationship has changed during the financial crisis we stratify by periods (1995-2008 and 2009-2013) in column 3. There is not much difference between them, but if anything, the effects are larger during the crisis years. Second, to examine asymmetries between employment increases and declines, we stratify by employment growth or decline in column 5. Current and first lag is significant only for employment growth, but second and third lags are significant for firms experiencing declines in employment. This means, that wages increase faster when employment grows than wages are cuts when employment declines. The effect is furthermore asymmetric, as the size of wage cuts (0.008 using the sum of all lags) is almost half of the wage increases (0.014) when employment grows. Such asymmetricity is consistent with loss aversion on the employee side. It can lead to downwardly sticky wages because workers disfavor losses caused by nominal wage cuts. Adding the lagged dependent on the right hand side has no material effect of the results. The negative autocorrelation of wage changes probably reflects both the measurement error and regression towards mean effects.

Overall, it seems that the primary margin to adjust wage costs in firms is the adjustment of employment, rather than other possible margins, such as wages, overtime or regular working hours, or turnover of employees. Especially wage cuts of existing workers are not used to any substantial amount in order to adjust to negative shocks, as probably expected given the wage rigidity estimates above. Furthermore, the firm-level (local) wage responses to firm-level employment shocks seem very small, in particular downwards.

There is likely to be some trade-off between wage rigidity and employment adjustment when firms face negative shocks, but its importance is difficult to evaluate due to possible reverse causality effects. Whether the rigidities are an important reason for unemployment is also likely to depend on the general business cycle conditions as well as the idiosyncratic demand and financial conditions of the firms. Furthermore, with inflexible labour markets, firing at bad times can be the best way for the firms to get rid of unwanted workers.

In general, it is very difficult to assess the employment consequences of wage rigidity. First, the rigidity measures are uncertain, because the counterfactual distribution needed for their definition is itself uncertain. They also build on the assumption that the wage distribution above the median is not affected by rigidities. However, if union wage contracts have a normative effect, which reduces wage increases above the median, there is a countervailing downward effect on the average wage growth. Second, in line with the gift-exchange idea, workers or their unions can repay their employers by satisfying for lower wage rises during good times, if their employer firm abstains from wage cuts in bad times. Similarly, Elsby (2009) argued that firms may abstain from wage increases in order to avoid costly wage cuts in the future. Third, as argued by Elsby et al. (2016), the profitability of the employment relation is dictated by the present value of the difference between productivity and wages over the whole duration of the relation. A termination of the employment relation is not efficient, when there is a temporary reduction in productivity, if the present value remains positive. Therefore, firms may not lay off workers during brief downturns. To back this, Elsby et al. (2016) cite employer's comments from Bewley (1999) to the effect that wage cuts and layoffs are not substitutes, when the firms suffer from lack of demand and have excess labour. Direct empirical evidence for the employment costs of wage rigidities is thin. Dias et al. (2013) is one of the few published studies, finding that wage flexibility reduces the probability of layoffs at the firm level. However, this paper takes nominal wage freezes as an indication of real wage flexibility somewhat unorthodoxically.

5. Conclusions and discussion

Overall, wage dispersion in Finland increased quite substantially from mid 90's until the financial crisis of 2007-2008, but after that it remained constant or grew slowly depending on the measure used. The between firms share of wage variance increased during late 1990's, but during 2000's the slowing increase in wage dispersion has occurred mostly within firms, rather than between firms. The latter development in Finland is different from that in many other countries where between-firms variation in wages has risen during recent decades as reported by Barth et. al (2014) and Song et. al (2015) for USA, Faggio et.al. (2007) for UK, Doris et al. (2016) for Ireland and Nordström Skans et. al. (2009) for Sweden. The labour market institutions have remained largely stable in Finland over this period, so their changes have not caused the increase in wage dispersion. Rather the existing institutions have been flexible enough to allow for the increasing wage dispersion both within and between firms caused by some other factors. A possible reason is that during the last decade the increase in wage dispersion has been more related to characteristics of individuals (e.g. skill bias), or

to the characteristics of their jobs (polarization), rather than characteristics of their employer firms (productivity, rents, monopsony) or assortative matching. Another possibility is that the productivity dispersion between firms and their monopoly power have diminished compared with the 1990's, because the Finnish economy is more open to foreign competition than before. The reasons for changes in within and between firms wage dispersion and possible productivity-wage gaps are left for future research.

The average increase in real hourly wages dropped to about half of its historical level after the financial crisis. This downward adjustment of the average real wage growth implies considerable real wage moderation during the Great Recession in Finland. This development is consistent with downward real wage adjustment during the Great Recession in UK and other European countries as reported in Blundell et al. (2014) and Verdugo (2016). In contrast, there has been less downward real wage adjustment in the USA than during previous recessions. In Finland, it is likely that the strong centralized elements in wage setting have enabled the coordinated decline in wage inflation during the downturns. This is consistent with the importance of relative wage comparisons as an obstacle to downward wage adjustment. Piekkola (2007) reports union wage moderation during the recovery period after 1994 in Finland due to massive unemployment.

The concentration of wage changes to zero spikes have been modest for both nominal and real wages, but for individual years during recessions, zero nominal spikes have been considerable. Moreover, the share of real wage cuts has increased strongly during the Great Recession, similar to what Doris et al. (2016) report for Ireland. To account for biases due to measurement error in these simple measures for wage rigidity we applied the methodology developed in the International Wage Flexibility Project (IWFP). The parametric estimates of downward nominal and real wage rigidity show that downward real wage rigidity has been quite stable since mid 1980's, but during some individual recessions years it has abated. In contrast to the stability of real wage rigidity, we observe an increasing tendency for nominal wage rigidity after the financial crisis. The restrictions on wage setting, caused by downward nominal rigidities, have become more binding during the crisis years, when desired wage changes have declined due to slow inflation and productivity growth as well as poor demand conditions and increasing unemployment. It seems that the centralized wage setting institutions in Finland uphold the nominal wage freezes as the last boundary, after which strong downward rigidity steps in.

Overall, nominal wage rigidity seems to bind during business cycle downswings, when there may be some slacking off in real wage rigidity. Our findings are in contrast to Verdugo (2016) who found no evidence of downward nominal wage rigidity during the Great Recession in most countries in the

sample of eight Eurozone countries (including Finland) using observed shares of wage cuts and other measures not corrected for measurement error. However, observed shares overestimate true wage cuts due to measurement error, giving an impression of more downward flexibility that in reality. Our measurement error corrected measures showed increasing downward nominal wage rigidity during the Great Recession in Finland, in contrast to Verdugo (2016). If nominal wage freezes limit nominal wage cuts, then the size of inflation limits the size of real wage cuts. Therefore, low inflation during the crisis years is one factor that has reduced the downward adjustment of real wages in Finland.

We find that the primary margin to adjust wage costs in firms is the adjustment of employment, rather than other possible margins, such as hourly wages, overtime or regular working hours, or turnover of employees, even after controlling reverse causality. Especially wage cuts of existing workers are not used to any substantial amount in order to adjust to negative shocks. This is similar to what Deelen (2016) and Fuss (2009) have found for Netherlands and Belgium respectively. Regressing firm-level wage changes on employment changes we find that wages increase faster when employment grows, but wage cuts are delayed and muted when employment declines. These results are consistent with the micro-level downward wage rigidity estimates above. There may be some trade-off between downward wage stickiness and employment loss when firms face negative shocks, but its importance is difficult to evaluate, and remain a task for future research.

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Table 1. Shares of negative and zero wage changes and average of negative wage changes, 1996-2013

Wage measure and group	Share negative	Share zero	Average negative
Nominal, hourly, all	16.0 %	2.8 %	-8.1 %
Nominal, hourly, 25-55	15.8 %	2.8 %	-7.8 %
Nominal, monthly, full time, all	10.3 %	4.3 %	-7.8 %
Nominal, monthly, full time, 25-55	10.3 %	4.3 %	-7.6 %
Real, hourly, all	30.3 %	1.0 %	-5.6 %
Real, hourly, 25-55	29.7 %	1.0 %	-5.4 %
Real, monthly, full time, all	26.8 %	1.4 %	-4.2 %
Real, monthly, full time, 25-55	26.1 %	1.4 %	-4.2 %
Contract, hourly, all	35.4 %	1.5 %	-4.7 %
Contract, hourly, 25-55	34.9 %	1.6 %	-4.6 %
Contract, monthly, full time, all	32.4 %	2.2 %	-3.3 %
Contract, monthly, full time, 25-55	31.9 %	2.3 %	-3.3 %
Producer real, hourly, 25-55	35.9 %	0.3 %	-6.1 %
Producer real, monthly, full time, 25-55	33.9 %	0.3 %	-4.8 %

Note: All numbers are for annual changes for job stayers, i.e. persons who work for the same employer in the same occupation in two consecutive years.

Table 2. Comparison of rigidity measures with previous ones for Finland

Period	IWFP nominal	HWSS nominal	IWFP real	HWSS real
1986-1990(1991)	0.15		0.51	
1991(1992)-1993(1994)	0.70		0.09	
1994(1995)-2000(2001)	0.21	0.03	0.59	0.79
2002-2007		0.09		0.54
2008-2013		0.41		0.77

Note: The IWFP numbers from Böckerman et al. (2010) are unweighted averages of measures estimated separately for three sectors: manufacturing blue collar workers, manufacturing white collar workers and service sector workers. The blue collar results are for hourly wages, like the HWSS, but the other two sectors are for monthly earnings. The depression period is 1992-1994 for the service sector and 1991-1993 for the other two sectors. The start and end years of other periods are affected consistently with this.

Table 3. Decomposition of the change in wage bill by Sales status, average over all years 1996-2013

Component	Firm's sales increase	Firm's sales decrease	Difference
Stayer wage change	2.0 %	1.5 %	-0.5 %
Stayer hours change	0.4 %	0.3 %	-0.2 %
Employment change	4.9 %	-6.3 %	-11.2 %
Entry-exit wages	-0.6 %	-0.4 %	0.3 %
Entry-exit hours	1.5 %	1.6 %	0.1 %
Total change (regular time)	8.2 %	-3.3 %	-11.5 %
Overtime pay	0.2 %	-0.1 %	-0.3 %
Number of firm-year obs	66226	36858	

Note: weighted by hours at individual level and by sampling weights at firm level.

Table 4. Regressions for the wage bill decomposition by firm's profit status

Current Profits change

	(1) empl_change	(2) stayer_wage	(3) stayer_hours	(4) entry_exit_wage	(5) entry_exit_hours	(6) sum_effects	(7) overtime_effect
$Dbadstate_t$	-0.0221***	-0.00153***	0.0000693	0.00479***	0.00117	-0.0176***	-0.000859***
	(-7.73)	(-4.18)	(0.25)	(4.14)	(1.15)	(-5.96)	(-3.67)
N	103091	103091	103091	103091	103091	103091	103091
R^2	0.001	0.000	0.000	0.000	0.000	0.000	0.000

Lagged Profits change

	(1) empl_change	(2) stayer_wage	(3) stayer_hours	(4) entry_exit_wage	(5) entry_exit_hours	(6) sum_effects	(7) overtime_effect
$Dbadstate_{t-1}$	-0.00921**	-0.00148***	-0.0000749	-0.00143	-0.00242*	-0.0146***	0.000575*
	(-2.92)	(-3.86)	(-0.28)	(-1.22)	(-2.52)	(-4.76)	(2.40)
N	78850	78850	78850	78850	78850	78850	78850
R^2	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Lagged Profits change and time effects

	(1) empl_change	(2) stayer_wage	(3) stayer_hours	(4) entry_exit_wage	(5) entry_exit_hours	(6) sum_effects	(7) overtime_effect
$Dbadstate_{t-1}$	-0.00762*	-0.00139***	-0.0000105	-0.00133	-0.00209*	-0.0124***	0.000519*
	(-2.40)	(-3.65)	(-0.04)	(-1.13)	(-2.17)	(-4.03)	(2.15)
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	78850	78850	78850	78850	78850	78850	78850
R^2	0.006	0.030	0.001	0.002	0.001	0.005	0.002

Robust t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. . All regressions include firm fixed effects. Weighted by hours at individual level and by sampling weights at firm level.

Table 5. Firm-level regressions between wage changes and employment changes

	(1)	(2)	(3)	(4)	(5)	(6)
Dlnempl	0.00163	0.00228*				
	(1.66)	(2.32)				
dlnempl(t-1)	0.00162	0.00216*				
	(1.67)	(2.26)				
dlnempl(t-2)	0.00277**	0.00276**				
	(3.06)	(3.09)				
dlnempl(t-3)	0.00132	0.00151*				
	(1.78)	(2.07)				
dependent(t-1)		-0.171***				
		(-16.39)				
dlnempl*			0.00146	0.00186		
D(1996-2008)			(1.13)	(1.43)		
dlnempl*			0.00187	0.00290*		
D(2009-2013)			(1.27)	(1.98)		
dlnempl(t-1)*			0.00110	0.00203		
D(1996-2008)			(0.87)	(1.61)		
dlnempl(t-1)*			0.00240	0.00236		
D(2009-2013)			(1.61)	(1.63)		
dlnempl(t-2)*			0.00268*	0.00281*		
D(1996-2008)			(2.17)	(2.30)		
dlnempl(t-2)*			0.00291*	0.00259*		
D(2009-2013)			(2.21)	(2.00)		
dlnempl(t-3)*			0.00189	0.00190		
D(1996-2008)			(1.91)	(1.94)		
dlnempl(t-3)*			0.000436	0.000932		
D(2009-2013)			(0.40)	(0.86)		
dependent(t-1)*				-0.138***		
D(1996-2008)				(-10.06)		
dependent(t-1)*				-0.231***		
D(2009-2013)				(-14.83)		

	(1)	(2)	(3)	(4)	(5)	(6)
dlnempl*					0.00626***	0.00657***
Ddlnempl>0					(3.63)	(3.79)
dlnempl*					-0.00205	-0.00187
Ddlnempl<0					(-1.49)	(-1.30)
dlnempl(t-1)*					0.00398**	0.00564***
Ddlnempl>0					(2.64)	(3.79)
dlnempl(t-1)*					0.00172	0.00116
Ddlnempl<0					(1.13)	(0.78)
dlnempl(t-2)*					0.00359**	0.00386**
Ddlnempl>0					(2.65)	(2.91)
dlnempl(t-2)*					0.00421**	0.00446**
Ddlnempl<0					(2.69)	(2.89)
dlnempl(t-3)*					-0.000146	-0.000243
Ddlnempl>0					(-0.15)	(-0.25)
dlnempl(t-3)*					0.00408**	0.00482***
Ddlnempl<0					(2.90)	(3.41)
dependent(t-1)*						-0.162***
Ddlnempl>0						(-13.92)
dependent(t-1)*						-0.186***
Ddlnempl<0						(-10.80)
N	62847	62665	62847	62665	62847	62665

Robust t statistics in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

All models include year effects, one-digit industry effects and their interactions.

Figure 1. Standard deviations for real hourly and monthly wages

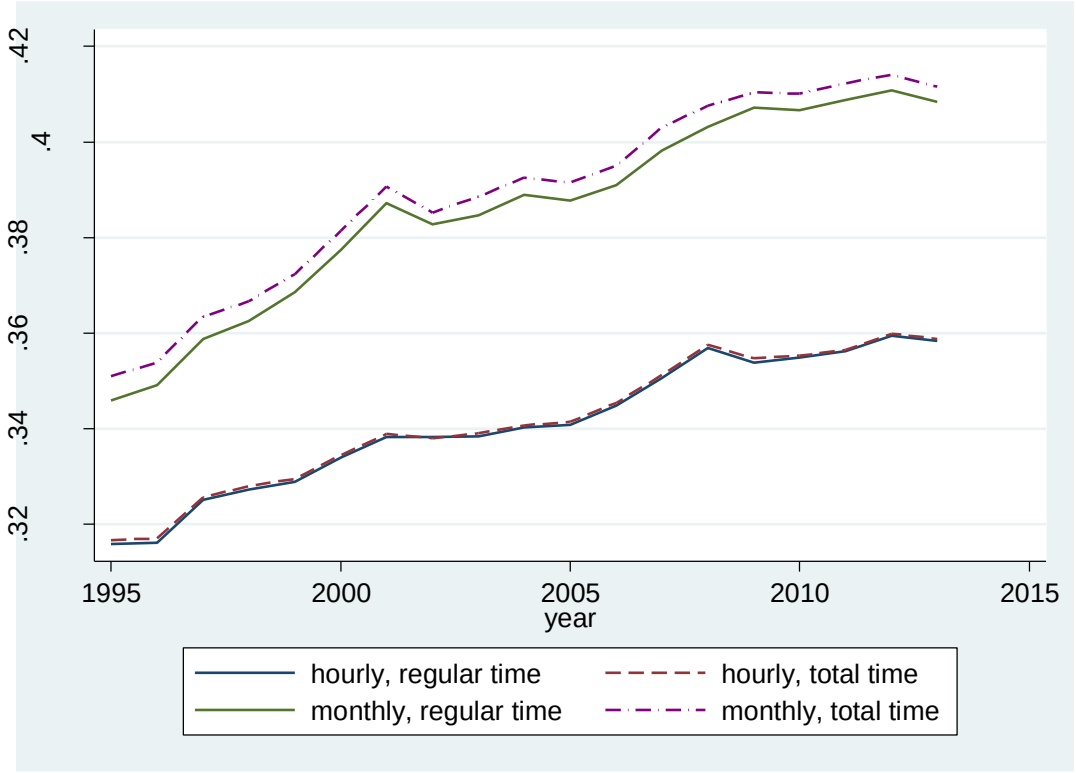


Figure 2. Percentile ratios for hourly and monthly wages

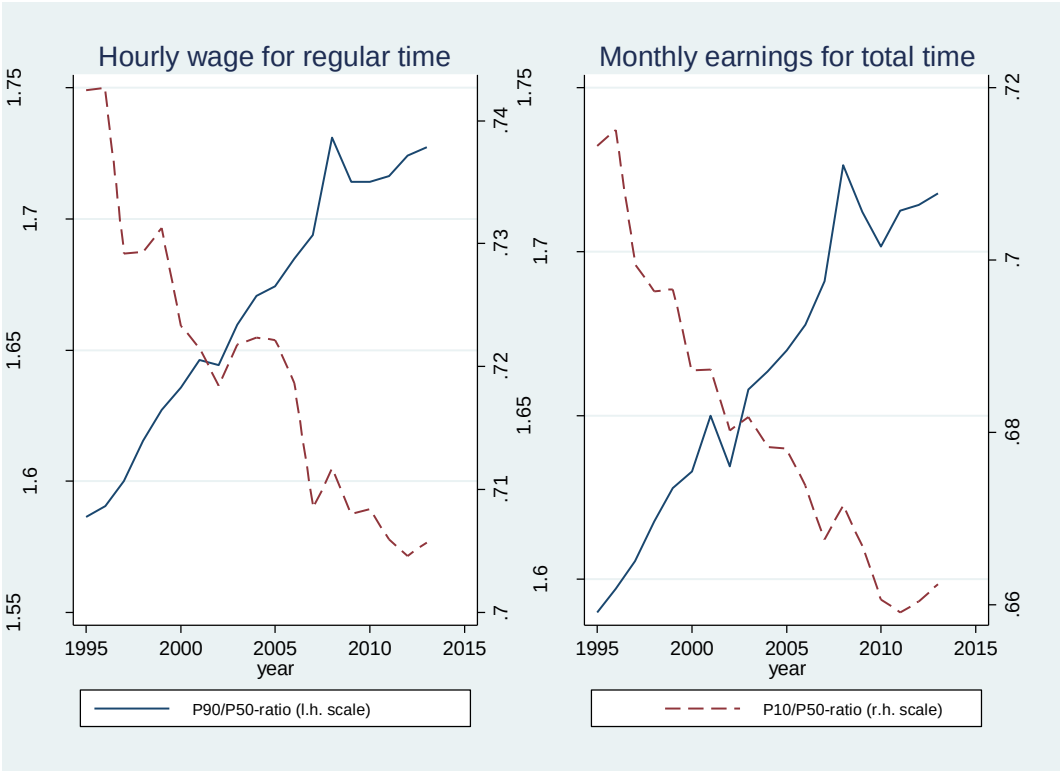


Figure 3. Within and between firms decomposition for variance of monthly earnings

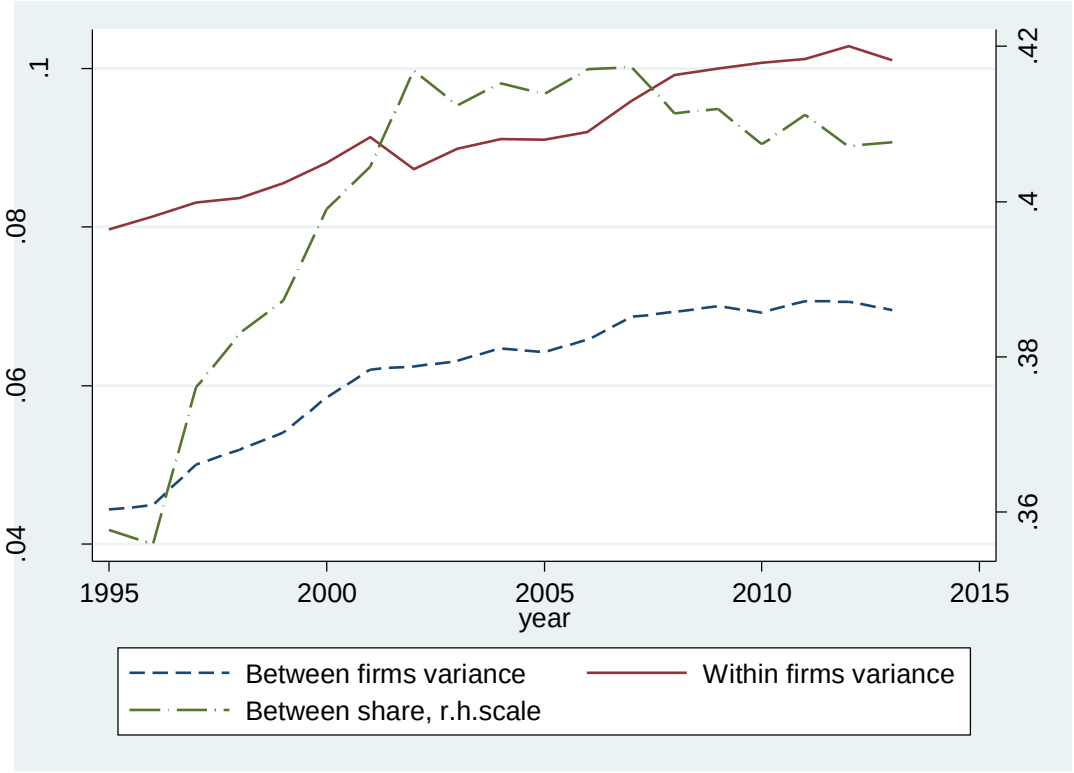


Figure 4. Average real consumption wage increases and inflation

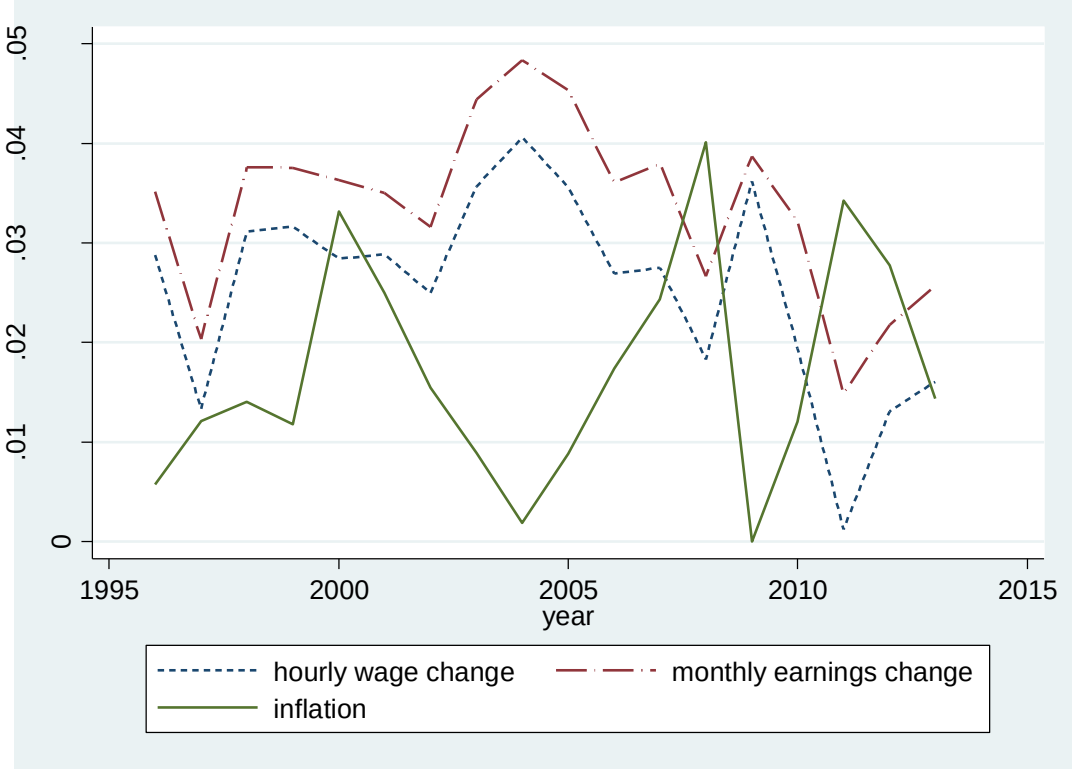


Figure 5. Average real wage change over the previous 3-year period

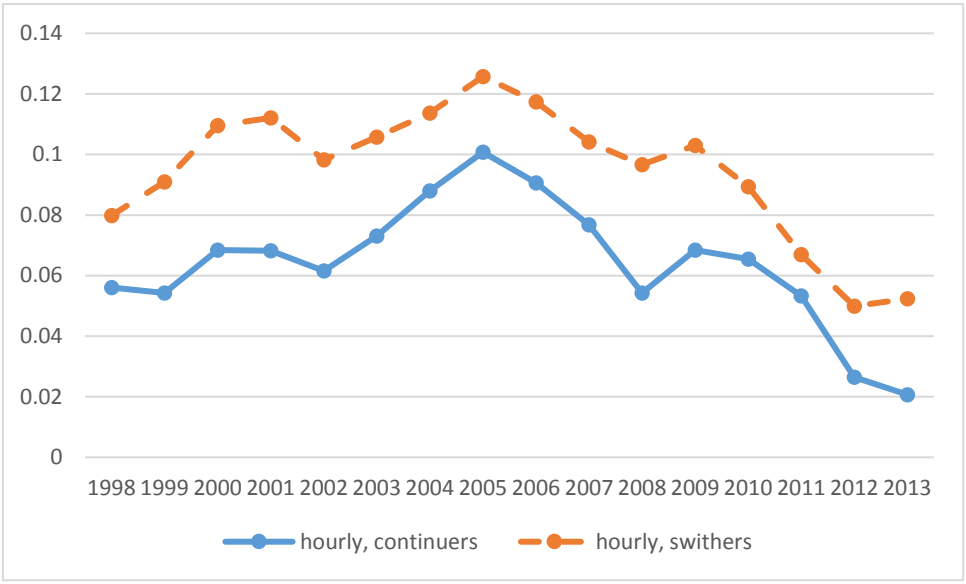


Figure 6. Incidence and size of nominal wage freezes and cuts for hourly wages

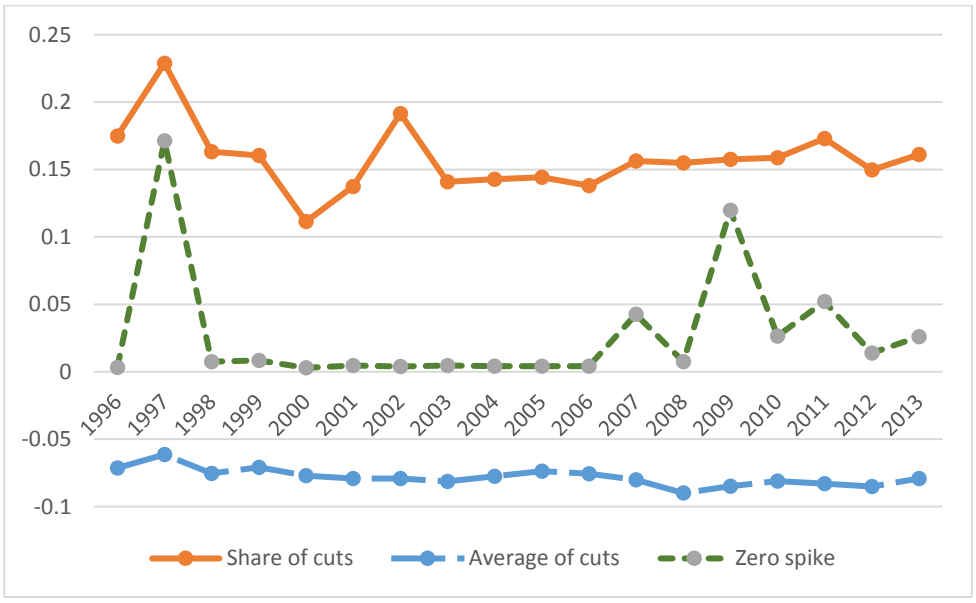


Figure 7. Incidence and size of real wage cuts for hourly wages

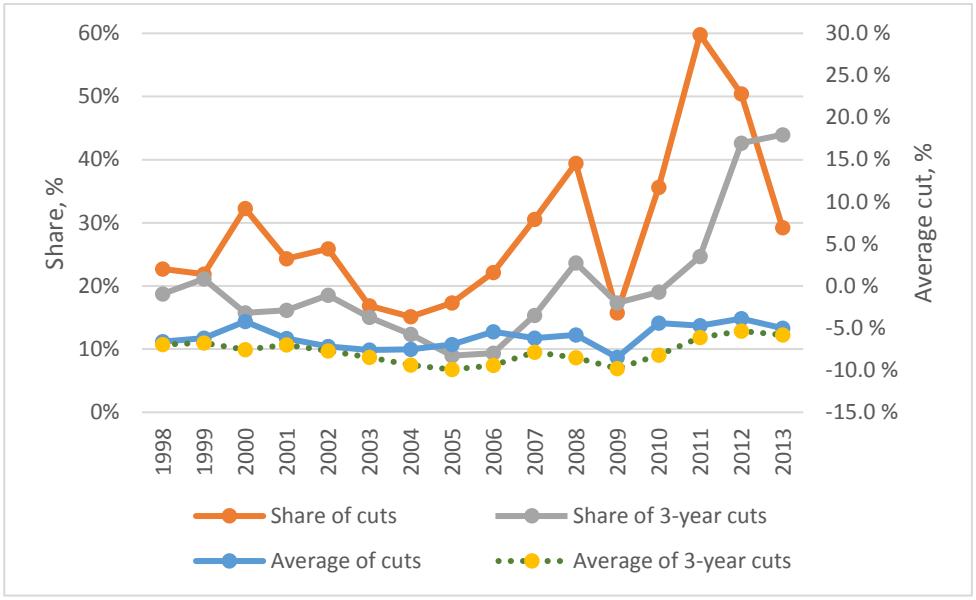


Figure 8. Histograms for observed, estimated true and parametric wage change distributions for two years

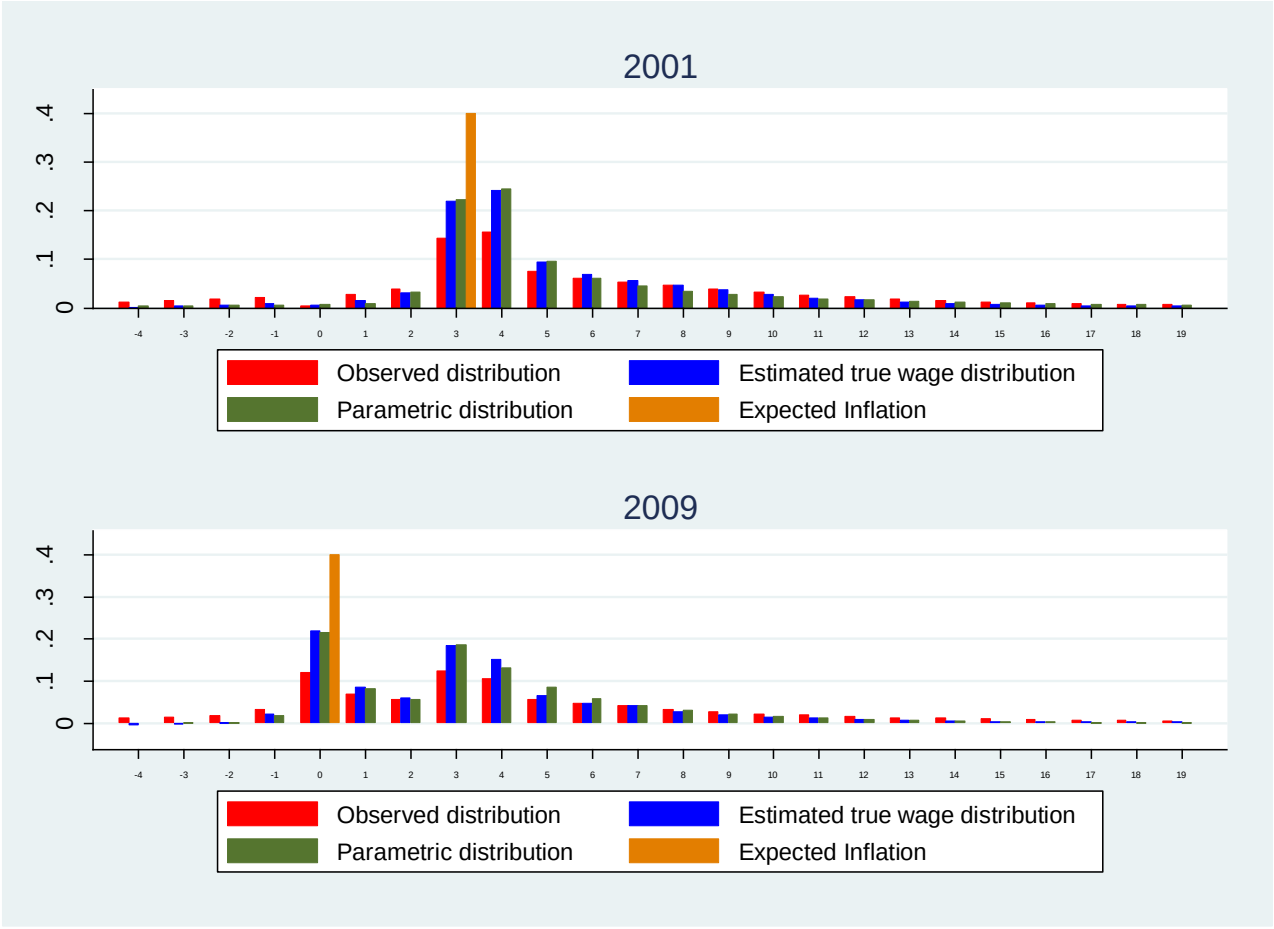
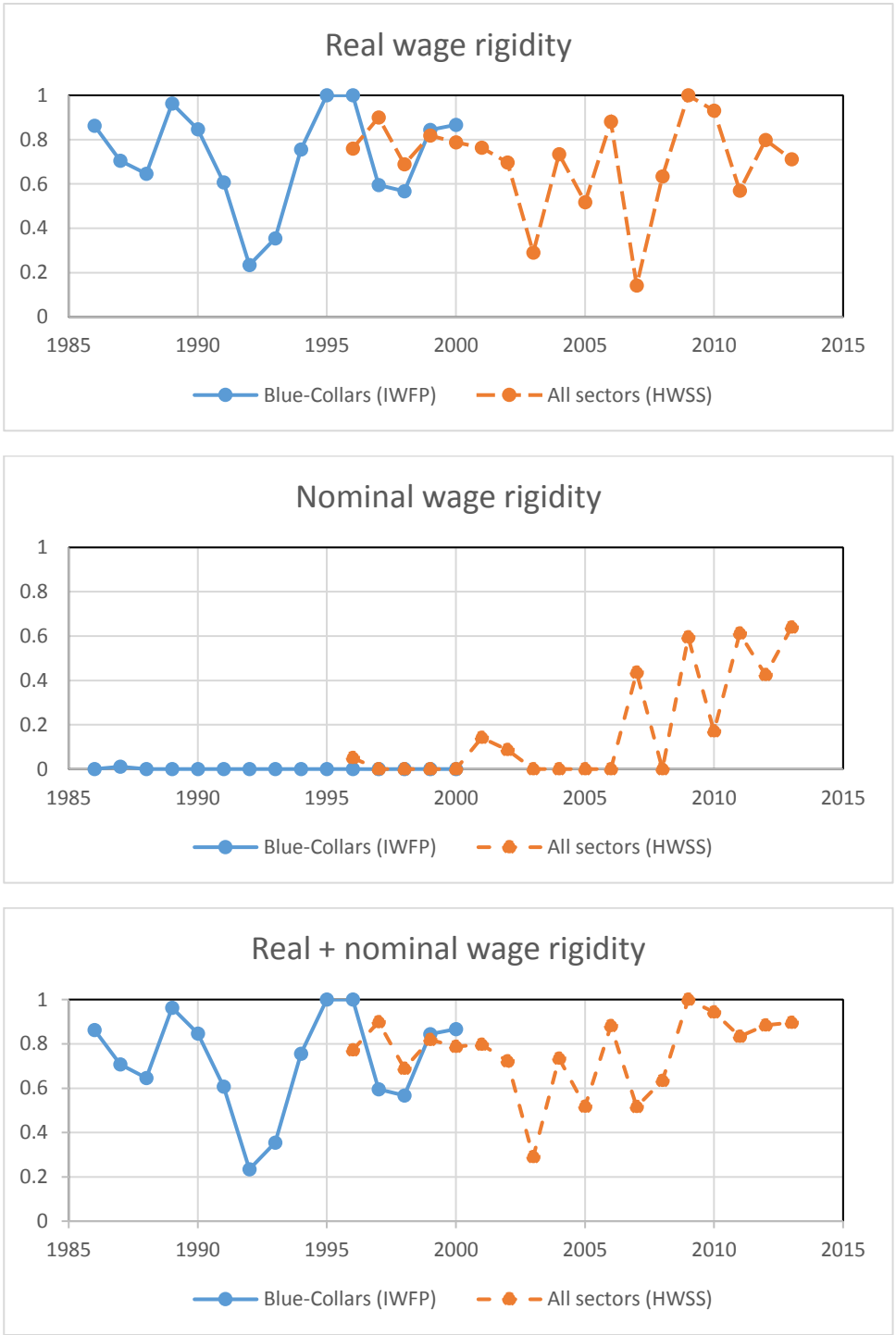


Figure 9. Parametric measures for wage rigidity



Note: Values for 1986-2000 are from Böckerman et al. (2010) for hourly wages of blue-collar manufacturing workers. Values for 1996-2013 are the author's estimates for hourly wages for all private sector workers in the HWSS data.