Downward nominal wage rigidity in Poland

Brzoza-Brzezina, Michal and Socha, Jacek

May 2006

Downward nominal wage rigidity in Poland

Michał Brzoza-Brzezina†, Jacek Socha‡

First draft: May 2006

This draft: November 2006

Abstract

We use data on enterprise level from a survey of medium sized and big companies to test for downward nominal wage rigidity in Poland. We find relatively weak support for downward nominal wage rigidity when average total compensation in the enterprise is taken into account. However, since this result may be affected by job rotation, we propose a method for eliminating its impact and find that downward wage rigidity becomes higher. Moreover, disaggregating the data reveals strong differences between sectors, with no rigidity in highly competitive branches and significant rigidities in monopolized or state-owned sectors. Still, the amount of downward nominal wage rigidity seems lower than in other countries, although, due to differences in data sets, robust comparisons are not possible.

JEL: E24, E31, J3

Keywords: Downward nominal wage rigidity, Poland, inflation

---

†) Michał Brzoza-Brzezina, National Bank of Poland and Warsaw School of Economics.

‡) Jacek Socha (corresponding author: Jacek.Socha@mail.nbp.pl), National Bank of Poland.
We would like to thank W.Charemza, T.Chmielewski, R.Kokoszczyński and the participants of the NBP-SNB Workshop, Łódź University Doctoral Workshop, INFER conference, Warsaw Economic Meeting, NBP seminar and the Magyar Nemzeti Bank conference for helpful comments. We would also like to thank Paweł Strzelecki for providing part of the data. The views expressed do not reflect the Bank's opinion.

1. Introduction

Downward nominal wage rigidity has for many years played an important role in macroeconomics. The notion that workers would be reluctant to nominal wage cuts strongly influences the way economists think about the optimum level of inflation, central banks' inflation targets and optimum currency areas. If a company (or branch, or the whole economy) is hit by an adverse shock (e.g. a sudden fallout in demand), the marginal product of labour falls respective to the real wage. The adjustment, necessary to bring these variables back in line, can take two forms. First, the real wage can fall, second, the marginal product of labour can increase.

The first solution must, unless the inflation rate is high enough to cut the real wage efficiently, involve a drop in nominal wages. If workers are reluctant to have their wages decreased in nominal terms, there is a serious obstacle to this form of adjustment. The second solution can in theory take two forms. First, the marginal product of labour can rise due to technological innovation. Second, enterprises can lay off the least productive workers. In the short run, and this is the right horizon to analyze the consequences of a demand shock, technological innovation seems the least likely solution. Hence, most economists will agree that if a company faces an adverse shock and cannot reduce wages it is likely to cut employment.

Downward nominal wage rigidity (DNWR) has potentially important consequences not only for employment but also for monetary policy. The likelihood of a company becoming constrained by downward wage rigidity depends crucially on the inflation rate. If the inflation rate is high and the company needs to adjust (decrease) the real wage, it might be enough to keep the nominal wage constant for some time. Contrary, with a low inflation rate this may not be possible and nominal wage cuts may be necessary. Hence, DNWR is mentioned as one of the reasons for keeping the inflation rate in the economy above zero, which has implications for central bank inflation targets. Indeed, for this or other[1] reasons central banks usually target slightly positive inflation rates.

[1] The zero bound on nominal interest rates may be another reason. See e.g. Adam and Billi (2004a, 2004b) for a broader discussion.

Another important implication of DNWR relates to the theory of optimum currency areas. If a country that joined a currency union is hit by an asymmetric shock it cannot use the stabilization tools that would have been available to it outside the union. Monetary policy cannot be eased (because there is now a common policy implemented by a common central bank) and the exchange rate cannot depreciate or be devalued (because there is no bilateral exchange rate any more). Hence, the necessary adjustments must involve fiscal policy or go through the labour market. The latter implies either an adjustment of wages or reallocation of the labour force to regions that have not been affected by the shock. Accordingly, wage flexibility becomes an important stabilization tool within a monetary union and determines, among others, the conditions of currency area optimality.

For these reasons we decided to explore the flexibility of the Polish labour market in terms of DNWR. The Polish central bank targets inflation of 2.5% with a tolerance band of +/- 1 percentage point (NBP 2003). It is important to know, whether, due to DNWR, monetary policy should be cautious in allowing inflation dropping below the target for too long periods. Moreover, in a few years Poland is about to join the euro area (Borowski, Brzoza-Brzezina 2004). Although there is no alternative to this process, and the cost/ benefit balance has been assessed unequivocally positive (NBP 2004), a thorough analysis of DNWR can help assess the potential risk carried by asymmetric shocks after joining the euro area. Big rigidities coupled with a lack of labour mobility can generate huge costs of adverse shocks (De Grauwe 2001) and should become another reason for increasing the flexibility of labour market regulations[2].

This paper is structured as follows. In section two we briefly present the current literature on downward nominal wage rigidity. In Section three we discuss the estimation technique and in next section we present the data used in the study. In section five we present the results and we give conclusions in the final section.

2. Literature review

The empirical literature on DNWR is extensive. Most approaches concentrate on the analysis of microdata on wages, either at individual or at company level. These studies are either

[2] Although remaining rare, contrary views have also been presented. See e.g. Dellas, Tavlas (2005).

explicitly based on analyzing the statistical properties of wage change distributions (Kahn 1997, Knoppik, Beissinger 2005, Lebow, Saks, Wilson 2000) or use econometric techniques that aim at finding statistical relationships between wages and a set of variables (e.g. Altonji and Devereux (2000)). Both approaches focus on finding some specific behavior where companies that, according to the model, should have lowered wages, leave them unchanged. In this paper we follow the first, so called histogram location approach, originally proposed by Kahn (1997). We present it in detail in the next section.

Regarding the results, most studies find limited to strong support for the claim that wages are rigid downwards. Kahn (1997) uses microdata on individual wages from the American Panel Study of Income Dynamics (PSID) covering the period 1970-88. She finds substantial evidence of DNWR and provides evidence that the extent of rigidity was relatively stable over the sample period. Kahn recognizes an important obstacle to estimating the extent of rigidity from survey data. People tend to report their wages in rounded numbers which can increase the extent of estimated rigidity.

This phenomenon, known as the measurement error, has been directly approached by Altonji and Devereux (2000) who use a cost function approach to estimate the extent of DNWR in the PSID data. They explicitly introduced the measurement error into their model specification and found that the measurement error comprises approximately 50% of the variance of wage changes in the whole sample. Nevertheless, they conclude that even adjusting for this error, there is substantial downward wage rigidity.

Fehr and Goette (2000) were testing the hypothesis by which in an environment of price stability workers become accustomed to nominal wage cuts and oppose them less. To examine this argument they use Swiss data, where inflation has been very low during much part of the 1990s. Somewhat surprisingly they find however, that downward rigidity of nominal wages does not vanish over time in an environment of stable prices.

The results in favor of DNWR have been confirmed by studies based on international data. Knoppik and Beissinger (2005) apply a panel version of the histogram location approach to microdata from the European Community Houseold Panel covering twelve of the European Union’s old Member States. The estimates give point to significant downward rigidity of wages both at the national and EU wide level. Holden and Wulfsberg (2005) explore the existence of DNWR in 19 OECD countries, but contrary to the previous study, their estimation is based on data collected at industry level. Despite the fact that data aggregation is likely to decrease the extent of rigidity, they find support for DNWR. However the results point at a steady decrease of DNWR over time, from 70% of prevented wage cuts in the 1970s to 11% in the late 1990s. In another paper (Holden and Wulfsberg 2004) they find similar results for 14 European countries.

Lebow, Saks and Wilson (2003) present very important evidence regarding various components of employees' compensation. They convincingly argue that from the point of view of the employer total compensation of the employee matters more than his pure wage. They analyze data from the Employment Cost Index database of the Bureau of Labor Statistics. This database contains detailed information on wages and benefits at company level. Their estimations repeat the result of strong downward rigidity of pure wages. However, total compensation shows substantially less rigidity supporting the claim that employers use benefits to adjust compensation downwards in the case of negative shocks. Nevertheless, the amount of enterprises affected by downward rigidity of total compensation remains substantial (30%), although lower than if only pure wages are taken into account (47%).

An even stronger result is obtained for Australian data by Dwyer and Leong (2000). They use a set of individual data to show that wages in Australia are rigid downwards. Moreover, broad measures of earnings display downward rigidity just to a lesser extent than pure wages. This suggests only a small role for variations in non-wage remuneration to offset the effects of wage rigidity in Australia.

Recently a team of researchers (Dickens et al. (2006)) analyzed labour market data (31 sets) in 16 developed countries covering the period 1970-2003 (data on individual, pure wages). They found evidence of both downward nominal and real wage rigidities, although these rigidities varied substantially across countries. Moreover, their results suggest that variation in the extent of union presence in wage bargaining plays a role in explaining differing degrees of rigidities among countries.

It is also important to mention that all the above studies confirm the impact of the inflation rate for the extent of DNWR. The lower the inflation rate, the bigger part of the nominal wage change distribution would fall below zero if there were no rigidities. Hence, in presence of DNWR, the lower the inflation rate, the bigger part of wage changes will be prevented from adjusting.

Another important aspect of DNWR is its impact on employment. As mentioned in the introduction, if a company facing a negative shock cannot reduce wages it is likely to cut employment. However, in a monopolistically competitive environment firms can also choose to decrease its profit margins and wait for the situation to improve without cutting employment. The cost if laying people off and training newcomers once the situation improves could be a good explanation for such behavior. Consequently, it is not enough to show that DNWR exists in order to prove that the inflation rate has, via DNWR, a significant and permanent impact on employment. This is a necessary condition, but one has also to show that if wages are rigid downwards employers cut employment.

Contrary to the first problem the second one has not been covered widely in the literature. One reason is that the histogram location approach is based on data aggregation and does not allow for identification of the companies or individuals affected by DNWR. This problem has been overcome by Altonji and Deveruex (2000). Their approach based on a panel Tobit model allows for the identification of individuals, and so enables further investigation into the employment consequences of DNWR for the affected person. Altonji and Devereux find some evidence that workers who are overpaid because of wage rigidity are less likely to quit. On the contrary they do not find support for the hypothesis that DNWR causes layoffs.

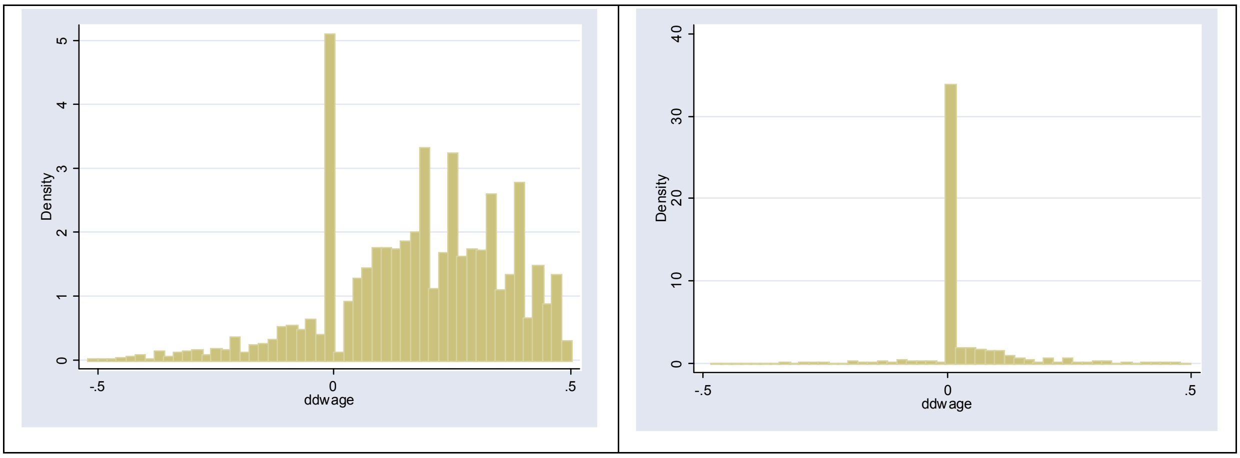
Lebow, Saks and Wilson (2003) provide macro evidence pointing in the same direction. If lower inflation increases the extent of wage rigidity, which causes unemployment, there should exist macro evidence of a downward sloping long-term Phillips curve. However the aggregate data does not support this hypothesis. Still, given the limited amount of research in this area the impact of DNWR on employment is far from certain and requires further investigation.

Finally, regarding studies of wage rigidity in Poland, two papers should be mentioned. Babetski (2006) analyzes real wage flexibility in four Central European countries (Czech Republic, Hungary, Poland and Slovakia) with aggregate data. Using various statistical approaches (time series, panel estimates and cointegration techniques) he concludes that real wages are not flexible in the analyzed economies.

Yamaguchi (2005) uses individual data on pure wages from the labor force survey to test for DNWR in Poland. He finds strong evidence for DNWR especially in the period after 1998, when inflation declined to single-digit levels. Yamaguchi argues that the reduced inflation rate could have contributed to the high unemployment rate in Poland. Since this is the only available study for Poland based on micro-data, and the results are very strong, we briefly reproduce them below.

Visually, downward wage rigidity is best presented on histograms of wage changes. In absence of DNWR the distribution of wage changes is expected to be smooth. However, if wages are rigid downwards, part of the distribution that should fall below zero will be missing and will be accumulated at the zero bar (a detailed explanation is given in section 3). This can be clearly seen at figure 1, where wage change histograms in Poland, respectively in 1994 and 2005 are presented. The data comes from the labor force survey (the same as used by Yamaguchi). Eyeballing the graphs is enough to see large parts of the distributions missing in the left tails and strong concentration at zero. Downward nominal wage rigidity is more than evident and its extent increases as inflation falls (from 32% in 1994 to 2% in 2005) and the whole distribution shifts left.

Fig. 1: Histograms of wage changes in Poland in 1994 and 2005 (labour force survey data)



Source: Central Statistical Office, own calculations

Our approach, as explained in detail in the next section, differs substantially from the study of Yamaguchi. We use data on enterprise level on total compensation of employees. We see several reasons to motivate such an approach. First, from the employer's point of view total compensation is certainly more important than the pure wage. It is without doubt the rigidity of total compensation, not of the pure wage, that can force the employer to reduce employment. Second, our data, collected directly at enterprises is free from the measurement error, while the labor force survey almost certainly is not. The third reason relates to the question, whether data to test DNWR should be collected at individual or company level. Since here the answer is not as clear-cut as in the previous cases, we discuss it in slightly more detail.

To analyze the problem let us assume a simple framework[3] where the enterprise employs two workers of marginal productivity equal to the real wage. Now, let us assume that worker A is hit by a positive shock of size σ_A and worker B by a negative shock of size σ_B to marginal productivity (assume $\sigma_A+\sigma_B>0$). The employer should now increase worker A's and decrease worker B's wage. However, if worker B opposes the wage cut the employer is left with two solutions:

- First, he can increase workers A's wage by σ_A, leave B's wage unchanged and lay him off as soon as possible (we assume that he does not give up part of his profit margin).
- Second, he can raise worker A's wage by $(\sigma_A+\sigma_B)$ and leave B's wage unchanged. In the second case he does not have to lay off B, because on aggregate marginal productivities remain equal to real wages.

Assuming that we are interested in estimating DNWR as guidance to possible layoffs and the employer decides on the first solution, we should measure DNWR on individual level. Only then will we detect worker B's case when his unchanged wage signals his layoff. However, if the employer decides on the second solution, taking individual data will be misguiding, since the presence of DNWR will not be a reason for layoffs. In that case it seems more appropriate to look at aggregate data, which shows that the average wage rises by $(\sigma_A+\sigma_B)/2$ and does not signal DNWR.

[3] See Elsby (2006) for a formal model of wage averaging (compression).

Which solution the employer will choose depends probably on such factors as the cost of laying off people and employing new ones on their place and the likelihood that worker A, if underpaid relative to his new productivity level, will quit the job.

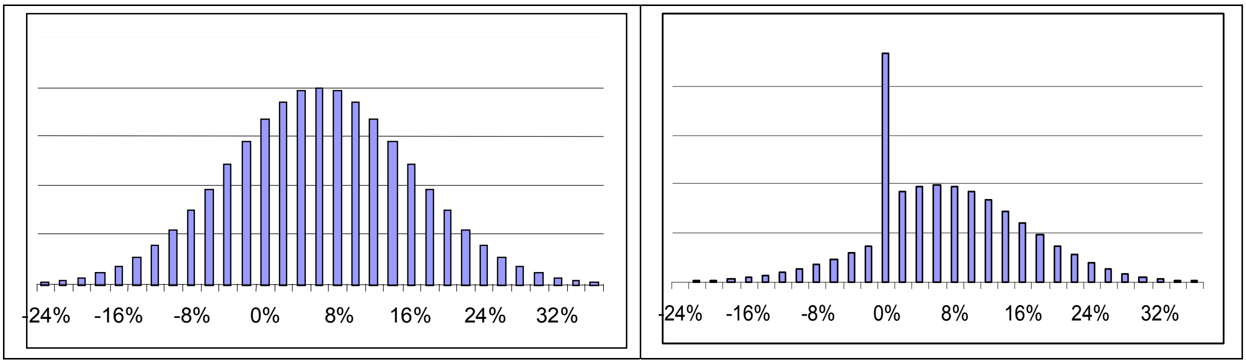
Although we did not take up this issue explicitly in this paper, intuitively we think that there are good reasons to believe that, at least in Poland, employers can be expected to average out (at least temporary) shocks to productivity between workers instead of running into the problem of individual DNWR[4]. This is because of high unemployment rate (more than 16% in the period 2001-2006), being a factor preventing workers from quitting jobs, even if they feel underpaid relatively to their marginal productivity (at least if this is considered temporary). Accordingly, there are reasons to believe that undertaking the study at the enterprise level might have some advantages as opposed to the individual level. Still, we think that this problem requires further investigation in the future.

3. Model

Our model is based on the paper by Kahn (1997). This approach refers to the observation made in the previous section that in absence of DNWR the distribution of wage changes can be expected to be smooth through the point of zero[5], while in the presence of DNWR a part of wage cuts will be missing and these observations will be accumulated at zero. This reflects the assumption that if wage cuts are opposed some employers simply do not change the wages as the second best solution. This is illustrated in figure 2. The left panel shows a hypothetical distribution of wage changes in the absence of DNWR. In the right panel, some wage cuts have been prevented and are missing from the left tail. Instead employers decided not to change wages – hence the pile-up at zero.

[4] Elsby (2006) presents empirical evidence for such behavior in the UK and US.
[5] Of course there can be other than DNWR reasons for wage changes to be accumulated at zero, for instance wage contracts. For simplicity we leave this out while discussing the histogram evidence on DNWR. However, the test we use takes account of other kind of rigidities and distinguishes them explicitly from DNWR.

Fig. 2. Hypothetical distributions of wage changes without and with DNWR.



The Kahn test is based on the assumption that in the absence of DNWR the proportion of observations accumulated in a bar a given distance from the median should remain constant over time. If, however DNWR exists, the bars falling below zero will be proportionally diminished and the missing observations will be accumulated at zero. Formally this is estimated using the following system of equations:

$$PROP1_t = a_1 + b \cdot a_1 \cdot DNEG1_t + (c - b\sum_{i=2}^{n} a_i) \cdot DZERO1_t$$

$$PROP2_t = a_2 + b \cdot a_2 \cdot DNEG2_t + (c - b\sum_{i=3}^{n} a_i) \cdot DZERO2_t$$

(1) .

.

$$PROPn_t = a_n + b \cdot a_n \cdot DNEGn_t + c \cdot DZEROn_t$$

where PROPn denotes the proportion of observations in bar n percentage points below the median. DNEGn is a dummy variable taking the value 1 if the bar n percentage points below the median is completely negative and DZEROn is a dummy variable taking the value 1 if the bar n percentage points below the median contains zero.

To understand how the test works let us concentrate on bar s percentage points below the median in three different quarters, one when it contains only positive numbers, one when it contains zero and one when it contains only negative numbers.

In case of the “positive” quarter both DNEGs and DZEROs will be zero. Hence the only free parameter is a_s and it measures the average proportion of observations in bar s (if it contains only positive values).

In case of the “negative” quarter DNEGs will be one and DZEROs will be zero. The equation boils down to:

(2) $$PROPs_t = a_s(1+b)$$

and the parameter b estimates by how much this bar is decreased because of falling in negative regions (i.e. representing wage cuts). In other words, b measures the extent of DNWR. If b=0 there is no downward wage rigidity, if b=-1 the rigidity is extreme – all nominal wage cuts are prevented.

Finally, if in a given quarter the bar s percentage points below the median contains zero, DZEROs will be one and DNEGs will be zero. In this case we estimate:

(3) $$PROPs_t = a_1 + (c - b\sum_{i=s}^{n} a_i)$$

The term $b\sum_{i=s}^{n} a_i$ reflects the assumption that all nominal wage cuts that have been prevented (in all the other bars in a given quarter) end up as zero wage change. The parameter c reflects the assumption that other sources of nominal wage rigidity (for instance wage contracts) may be present, hence boosting the “zero” bar.

Additionally, we perform an extended version of the Kahn test based on Lebow, Saks and Wilson (2003). This modification deals with the problem that the original test includes the constraint that the prevented wage cuts must be piled up at the “zero” bar. However, as Lebow, Saks and Wilson note, augmenting pure wages with benefits results in a sharp decrease of the bar containing zero, while the bars near zero rise. This suggests that the original Kahn test might understate the extent of DNWR.

The modification allows the prevented compensation cuts to be accumulated in one of the three bars: the one containing zero and those immediately below and above it. This version of the test is based on estimating the following set of equations:

$$PROP1_t = a_1 + b \cdot a_1 \cdot DNEG1_t + (c - b \cdot d \sum_{i=2}^{n} a_i) \cdot DZERO1_t - e \cdot b \sum_{i=1}^{n} a_i DN1_t - (1 - d - e) \cdot b \sum_{i=3}^{n} a_i DP1_t$$

$$PROP2_t = a_2 + b \cdot a_2 \cdot DNEG2_t + (c - b \cdot d \sum_{i=3}^{n} a_i) \cdot DZERO2_t - e \cdot b \sum_{i=2}^{n} a_i DN2_t - (1 - d - e) \cdot b \sum_{i=4}^{n} a_i DP2_t$$

(4) $\quad \vdots$

$$PROPn_t = a_n + b \cdot a_n \cdot DNEGn_t + c \cdot DZEROn_t - e \cdot b \cdot a_n \cdot DNn_t$$

where DNn is a dummy variable that is 1 if the bar n percentage points below the median contains -0.01 and DPn is a dummy variable that is 1 if the bar n percentage points below the median contains 0.01. The parameter e measures the fraction of prevented compensation cuts that accumulate at the bar immediately below the "zero" bar, and the parameter d the fraction of prevented cuts that are piled up at the "zero" bar. Consequently the fraction (1-d-e) is accumulated at the bar containing 0.01.

Both systems are then estimated using SUR with cross and intra-equation restrictions. In order to deal with the fact that the dependent variable is nonnegative (histogram bars), we perform a logistic transformation to the equations. This means that for the sth equation in (1) we estimate:

(5) $$\ln\left(\frac{PROPs_t}{100 - PROPs_t}\right) = \ln\left[\frac{a_s + b \cdot a_s \cdot DNEGs_t + (c - b \sum_{i=s}^{n} a_i) \cdot DZEROs_t}{100 - \left(a_s + b \cdot a_s \cdot DNEGs_t + (c - b \sum_{i=s}^{n} a_i) \cdot DZEROs_t\right)}\right]$$

4. Statistical data

As it has been already mentioned in section 2, the strength (though not the existence) of DNWR depends strongly on the unit of observation. As the accurate data on the wages per employee (for a large number of employees in a representative number of enterprises) in several consecutive periods is very rare, most research is based on data from individual workers surveys. But as research shows, workers perception of wage change can be biased (especially during low inflation periods where wage changes can be minor). Moreover, besides wages, workers usually receive bonuses and benefits. Employees are less likely to oppose changes in those benefits than in their wages, but from the enterprise perspective those are also labour costs. That is why analysing DNWR from the firm's point of view, we should ask the question whether enterprises can flexibly adjust total compensation.

To examine this thesis we used enterprise level data from Poland. The analyses were done on individual data from corporate financial reporting (Central Statistical Office forms: F-01 profit and loss account). The reporting duty applies to all non-financial enterprises employing over 49 people. F-01 reports are submitted quarterly and contain data available as of the last day of every quarter (in the case of stock variables) as well as the total values since the year start (in the case of streams). Besides the financial figures, the reports bring full information about labour costs of the firm (remuneration plus social benefits and other smaller expenses) and the number of working persons in the enterprise. That information allows us to calculate the average total compensation per employee in the analysed enterprises on quarterly basis.

The unit of observation was defined as year to year change in remuneration per employed person in the enterprise. This definition allowed as obtain between 15 and 25 thousand of observations per quarter. The analysed period covered 35 quarters (Q1 1996 to Q3 2005). The enterprises included in the study covered between 69 and 79% of the working population in the enterprise sector. Size is an undeniable advantage of our dataset.

The data set is characterised by an overrepresentation of large companies because small and micro enterprises were not represented in the reports. Still, due to its size it appears to be a good sample of businesses. It can be the basis for a methodologically sound verification of the formulated hypotheses as far as medium and large enterprises are concerned. Some information about the size of the utilised set as well as the basic statistics are presented in Table 1 and Table 2.

Tab. 1: Basic information about the data set

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Number of enterprises in the dataset (yearly average)	21794	23483	25802	16563	17052	16229	15623	15315	15125	15280
Number of working persons in the analysed enterprises in thousands (yearly average)	4622769	4255171	4308364	4142247	4003380	3824336	3511723	3513760	3523406	3595522

Source: Own calculations

Methodological problems

The perfect data for analysing DNWR would be information about wages and salaries (plus social contributions) and a full spectrum of bonuses for all individual workers in a representative sample of companies. But as perfection seldom exists in real live, researchers dealing with this problem, as it was earlier mentioned, usually use either data from household surveys (e.g. American Panel Study of Income Dynamics – Kahn 1997, European Community Household Panel – Knoppik, Beissinger 2005) or small sample of enterprise data (Fehr, Goette 2000). Even Lebow et. al (2003), who used a large sample of enterprise data, observed only average wages in a narrowly defined job within an establishment[6].

The biggest disadvantage of our dataset is the lack of information about individual workers compensation (we do not have even data on the structure of wages within the enterprise), so we are only able to calculate the average total compensation for a particular enterprise. Such an average enterprise-wide wage can change for two reasons. First, there can be a wage change in the enterprise. Second, there can be job rotation (even without net employment change), which can lead to the wage structure change. This results in changing average enterprise-wide wage.

Our first approach is based on the full sample, which does not allow for an explicit treatment of the impact job rotation has on estimated wage rigidity. Hence, analysing these results, one has to keep in mind that it is an imperfect measure which can lead to a bias in our estimation of the DNWR phenomenon.

[6] In such situation there are some problems due to the averaging procedure (see. Lebow et. al 2003)

The impact of job rotation can not be extracted unless we have (or can generate) data on wages of job stayers. However, due to some irregularities in the distribution of employment changes, we are able to calculate the extent of DNWR among job stayers. The details of this procedure are given in the next section. Still, due to some necessary assumptions, one has to treat this result as an approximation.

5. Estimation results

In the paper we follow Kahn (1997) and Lebow at al (2003). If we look at the histograms of wage changes it is difficult to conclude that the DNWR is a problem for Polish enterprises (see Figure 3 and Figure 4). The spike at the "zero" bar is almost invisible and the distribution of wage changes is not as skewed as in foreign studies. The statistics presented in Table 2 also do not give any hints about the existence of DNWR in the data. The amount of negative observations is quite substantial while observations equal zero are very rare.

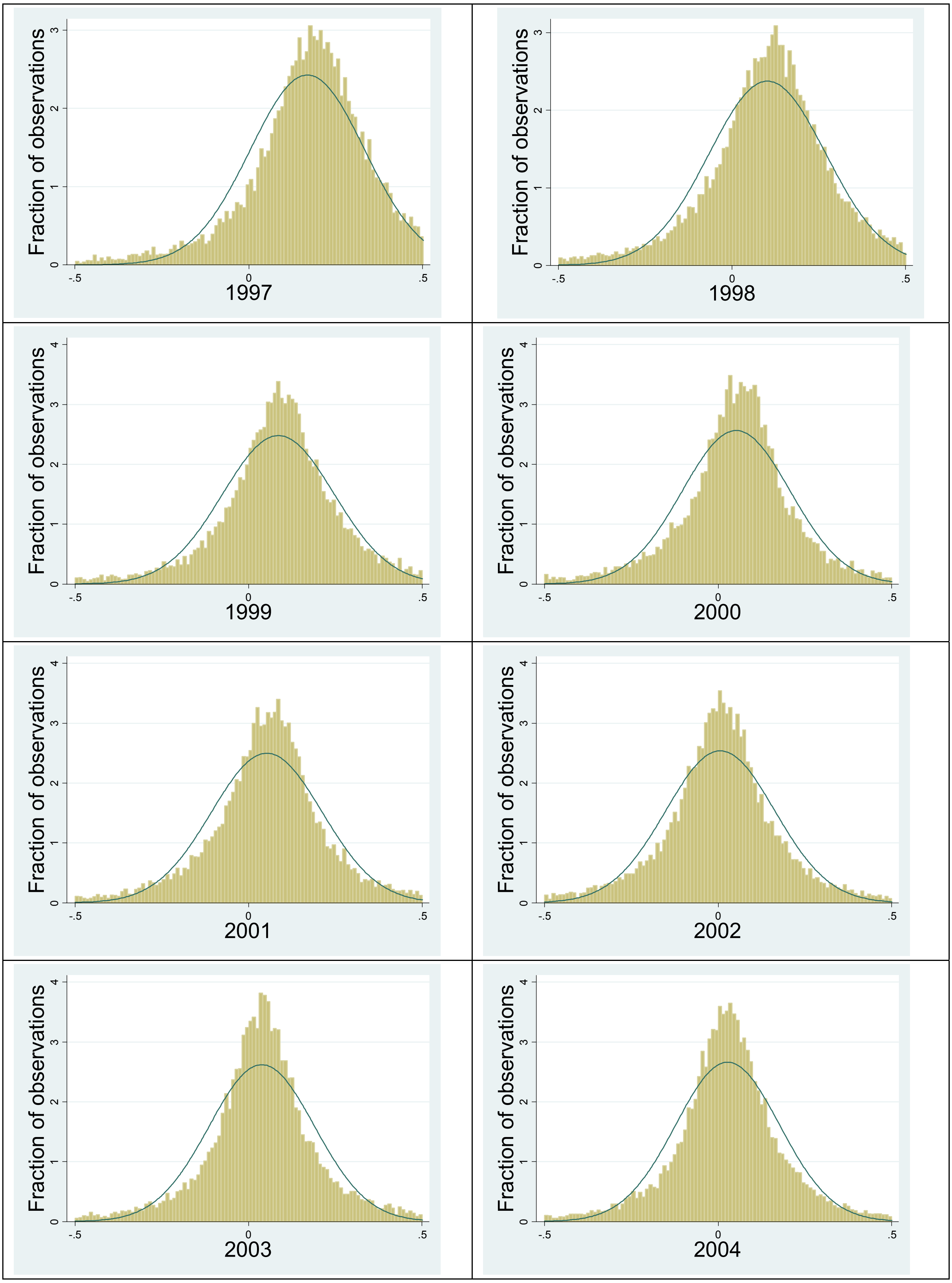
To formally check this hypothesis, in the first step, we have calculated the standard Kahn test for enterprises from all sectors (equation 1). The results are presented in Table 3. Coefficient estimates of the parameter b confirm only slight downward nominal wage rigidity in Polish enterprises. Accordingly, only 0.7% of Polish enterprises experience problems with DNWR. The parameter of interest is very low compared with 30% obtained by Lebow at al (2003) but statistically significant. The statistical significance of the $b(p)$ parameter suggests that DNWR might be a problem in some sub-groups of enterprises (e.g. state-owned). In the next step we have tested our hypothesis in several sub-groups of enterprises in the data set (see Table 3).

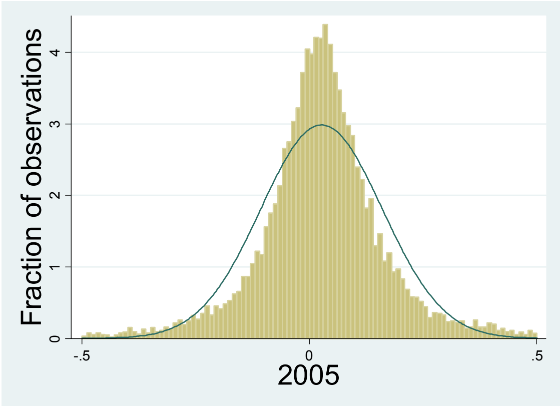
Tab. 2: Distribution of gross wages in the dataset

	Number of observation	Median	Standard deviation	% of observations = 0	% of observations < 0
all enterprises	506265	8.0	35.5	2.4	27.8
private	457622	8.4	35.6	2.3	27.9
public	48643	5.7	35.1	3.5	27.0
manufacturing	214829	7.3	37.9	2.6	29.3
energy	18448	8.5	25.1	2.8	18.3
trade	106391	8.5	30.7	2.3	26.8
transport & telecommunication	26137	8.2	32.6	2.7	22.9

Source: Own calculations

Fig. 3: Distribution of changes in wages ($\Delta\log(wage)$) and salaries and normal distribution density function*.





Source: Own calculations
(*) data are for the fourth quarter of given year (third quarter for 2005).

Tab. 3: Formal tests of downward nominal wage rigidity (t-stat. in parenthesis)

Kahn test	***b***	% of employees
all enterprises	**-0.007** (-4.148795)	**100**
private	**-0.005** (-2.967336)	**75,3**
public	**-0.112** (-7.155199)	**24,7**
manufacturing	**-0.002** (-0.641465)	**44,7**
energy	**-0.101** (-5.541775)	**5,7**
trade	**-0.004** (-1.046904)	**12,3**
transport & telecommunication	**-0.029** (-2.854529)	**12,1**

Source: Own calculations

The results for sub groups were mixed. Higher than average and statistically significant parameters were obtained in public enterprises, energy section (absolute value around 0.1) and transport and telecommunication (absolute value around 0.03). Firms from those sections of the economy are characterised by stronger, than average, union coverage which can be the source of DNWR. The energy and transport sectors are also characterised by a significant fraction of large state owned (or former state owned) enterprises and natural monopolies with large barriers of entry. The parameter values obtained for public and energy sectors suggest that more than 10% of enterprises face DNWR. On the other hand in highly competitive sectors like manufacturing or in sectors with weak trade unions (e.g. trade) DNWR is absent (less than 0,4% of enterprises experience problems with DNWR)[7].

As was mentioned earlier, the Kahn test may understate the extent of downward nominal wage rigidity. For this reason in the second step we have carried out the modified Kahn test (equation 4). As it can be seen from Table 4, due to the construction of the modified Kahn test, it stronger confirms the existence of DNWR. The coefficient values suggest that in the public sector around 35% of enterprises face DNWR and in the energy sector there are almost 20% of such firms. The results for public enterprises and energy sector are much closer to those obtained by Lebow et. all (2003), but still results for the general population confirm lack (or very slight) DNWR in Polish enterprises.

Tab. 4: Modified Kahn test (t-stat. in parenthesis)

modified Kahn test	***b***	% of employees
all enterprises	**-0.019643** (-3.955766)	**100**
private	**-0.012103** (-3.580120)	**75,3**
public	**-0.355935** (-8.727415)	**24,7**
manufacturing	**-0.020180** (-1.690426)	**44,7**
energy	**-0.188255** (-4.422205)	**5,7**
trade	**-0.044139** (-1.551115)	**12,3**
transport & telecommunication	**-0.095915** (-3.402855)	**12,1**

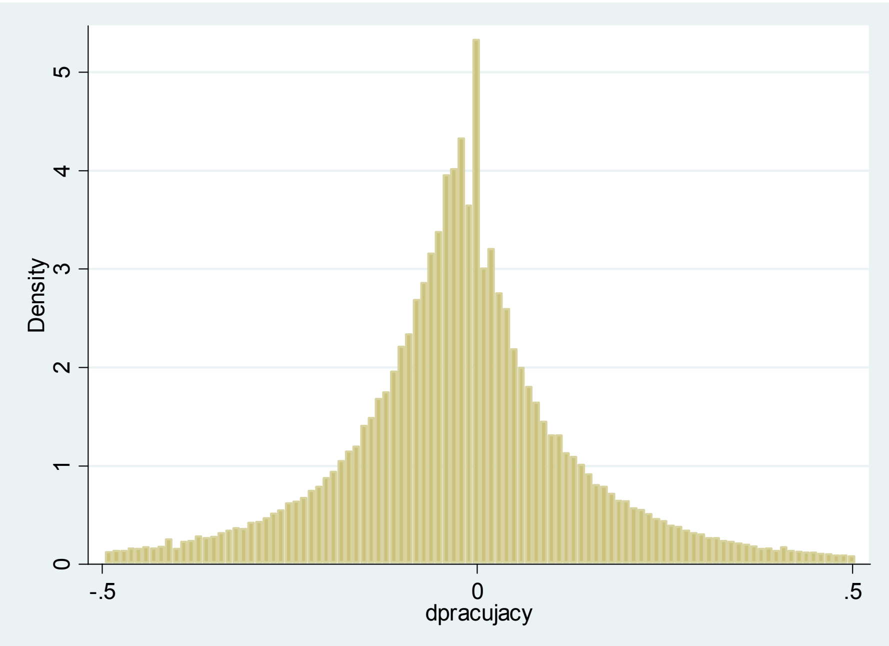
Source: Own calculations

As already mentioned, our unit of measurement generates one problem. Formally the above results only say about the enterprises ability to adjust the labour costs. However, since we do not explicitly observe average wages of job stayers, we cannot say to what extent the relatively low level of rigidity results from adjusting compensation and to what from adjusting the structure of the workforce (e.g. laying off most expensive workers). In other words, the above estimates should rather be treated as the lower bound of the true DNWR at enterprise level in Poland.

[7] Since inflation in Poland decreased over the estimation sample, the variance decreased as well. We redid the whole estimation controlling for the changing variance, but the results were only slightly influenced. For this reason we do not report them in the paper.

The estimation of the impact of job rotation on our results is impossible unless we have data on compensation of job stayers. Our dataset does not provide this information explicitly. However, we find an interesting irregularity in the data, which allows us to approximate the impact of interest. This irregularity relates to the overrepresentation of enterprises that do not change the number of employees over the year. Such overrepresentation is a phenomenon known also in other countries (e.g. Caballero et al. (1997), Vermeulen (2006)), and is explained by hiring and firing costs and by indivisibility of labor among others. The presence of such phenomenon in our data set can be seen on the histogram of employment changes in the whole sample (fig. 4). The spike at zero is evident and without applying sophisticated techniques one can assume that the zero bar is approximately 50% higher than it would have been in the absence of employment rigidity[8]. This gives us a subsample, where the extent of job rotation (and hence its impact on wage rigidity) is smaller than in the general sample.

Figure 4: Histogram of employment changes (y-o-y) in the full sample.



Source: Own calculations

In what follows we estimate the extent of DNWR in the subsample of enterprises that did not change[9] employment (on net basis) in the given quarter (respective to the analogous quarter of

[8] We calculate the theoretical height of the zero bar as average of its four neighboring bars to be 3.55. The true zero bar's height is 5.33, i.e. 50.2% more.

[9] We take enterprises which changed employment by less than +/- 0.5%.

the previous year). This subsample is substantially smaller than the whole sample, but still leaves us with 550 - 1230 observations per quarter. Our estimate of b amounts to 2% and 3,3%[10] in the standard and modified Kahn tests respectively. This estimate relates to a population with an overrepresentation of job stayers. However, we would like to calculate b in the population of job stayers (non-rotating enterprises) only. To do this, note that in our subsample the number of enterprises affected by DNWR equals the sum of the enterprises affected by DNWR among those that rotate employment like the sample average ("normal" height of the bar) and those (overrepresented) enterprises which do not change employment.

(6) $$b_{SS}N_{SS} = b_{AR}N_{AR} + b_{NR}N_{NR}$$

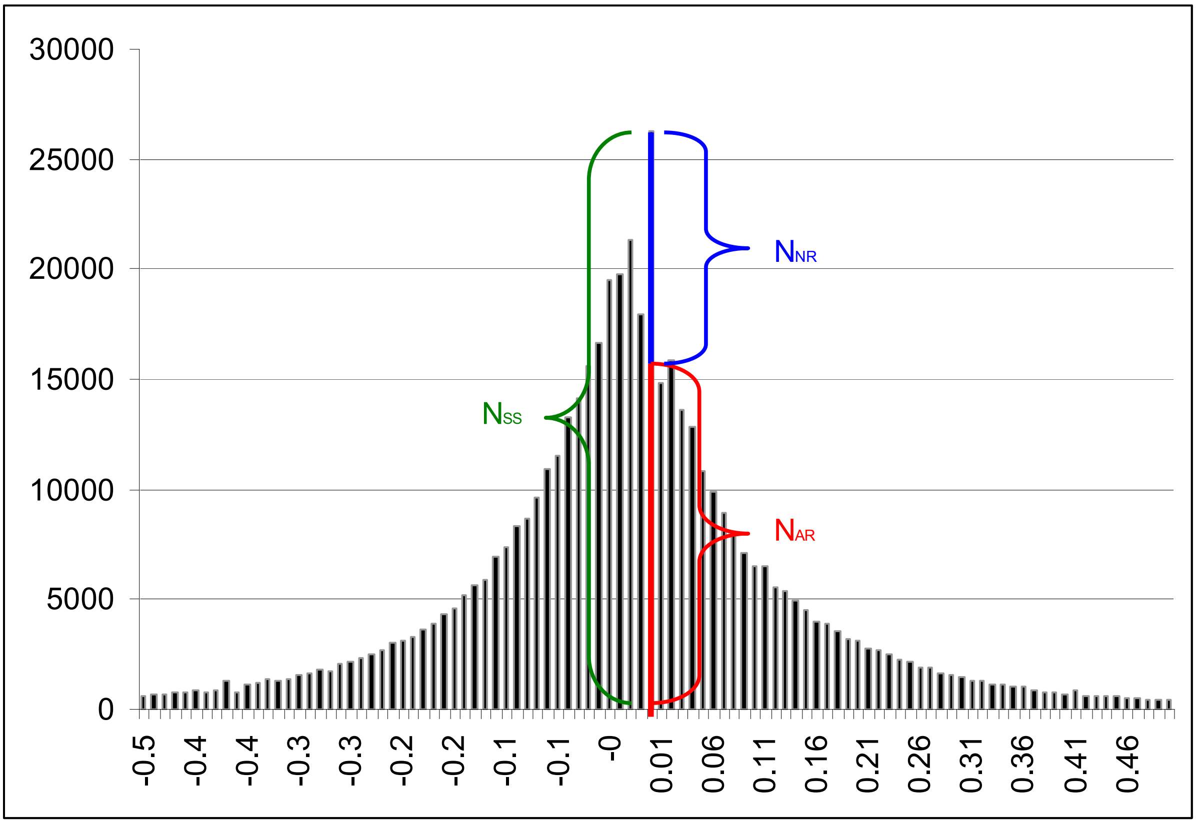
where all variables relate to our subsample and denote:

- b_{SS} - proportion of enterprises affected by DNWR,
- N_{SS} – total number of observations,
- b_{AR} - proportion of enterprises affected by DNWR that rotate employment like the sample average,
- N_{AR} – number of enterprises that rotate employment like the sample average ("normal" height of the bar),
- b_{NR} - proportion of enterprises affected by DNWR among overrepresented enterprises which do not rotate employment,
- N_{NR} - number of overrepresented enterprises which do not rotate employment.

A graphical presentation of N_{SS}, N_{AR} and N_{NR} is given in figure 5. The variables b_{SS}, b_{AR} and b_{NR} are respective proportions of enterprises affected by DNWR in each group.

[10] Due to numerical problems we were not able to estimate the modified Kahn test for the model in logs. Instead we estimated the original system (4).

Figure 5: Histogram (number of observations) of employment changes (y-o-y) in the full sample



Source: Own calculations

Dividing both sides by N_{NR} and rearranging we obtain:

(7) $$b_{NR} = b_{SS}\frac{N_{SS}}{N_{NR}} - b_{AR}\frac{N_{AR}}{N_{NR}}$$

Since we can (approximately) state the extent of overrepresentation of enterprises in the zero employment change bar, expression (7) can be used to calculate the proportion of enterprises affected by DNWR in enterprises which do not rotate employment. It must be, however noted that this result is based on the following important assumption: if there were no overrepresentation in the zero employment change bar, the extent of DNWR affection between zero net employment changers would be equal to the full sample average. Under this assumption $b_{SS}=b_{FS}$, where b_{FS} is the proportion of enterprises affected by DNWR in the full sample.

Assuming (as approximation to the calculation in footnote 8) $\frac{N_{SS}}{N_{NR}} = 3$ and $\frac{N_{AR}}{N_{NR}} = 2$ we use equation (7) to calculate DNWR among non-rotating enterprises (b_{NR}) to be 4.6% and 5.9% in the standard and modified Kahn tests respectively. Due to data shortage we are not able to repeat this exercise for selected sectors.

This result is still lower than in the most comparable study of Lebow et. all (2003). However, it cannot be considered negligible, especially that the amount of DNWR in selected sectors is substantially higher. It should also be repeated that we estimate DNWR on the enterprise level, which due to averaging procedures must be lower than on the individual level. Hence low DNWR at enterprise level is not necessarily inconsistent with high DNWR at individual level (evidenced in the LFS data).

One important reason for the relatively low DNWR in Poland may be high unemployment. Since 1998/1999 till 2003 the economy has suffered a period of stagnation. Enterprises have made large reductions in their staff and the unemployment rate has surged to almost 20%. That is why wage pressure has not been very strong during that time and, as anecdotal evidence shows, hard financial situation forced enterprises even to nominal wage cuts. The recovery on the labour market was delayed (in comparison to the general economic recovery) and it has not started before 2005. If this explanation is true, the rapid decline of unemployment observed since 2005 could be a factor behind higher DNWR in the future.

6. Conclusions

Using a unique set of panel data from Polish enterprises we tested for the presence of downward nominal wage rigidity among Polish enterprises. Our unit of measurement was average total compensation per employee in a given enterprise. Using the standard Kahn (1997) test and its modified version (Lebow et al 2003) we find that only 0.7% - 2% of enterprises are affected by DNWR. However, our unit of observation generates one problem. Since we do not explicitly observe average wages of job stayers (we only observe net flows), we cannot say to what extent the relatively low level of rigidity results from flexibility of compensation and to what from adjusting the structure of the workforce (e.g. laying off most expensive workers). In other words, the above estimates should rather be treated as the lower bound of the true DNWR at enterprise level in Poland.

In order to overcome this problem we exploit an important irregularity in the data. This irregularity relates to the overrepresentation of enterprises that do not change the number of employees over the year. This gives us a subsample, where the extent of job rotation (and hence its impact on wage rigidity) is smaller than in the general sample. Using estimates for this subsample we calculate DNWR among job stayers to be 4.6% and 5.9% in the standard and modified Kahn tests respectively. Although this still seems to be relatively low, interpreting these results, one has to take into account that:

- due to averaging and the impact of bonuses, rigidity of average compensation in an enterprise is always lower than rigidity of individual wages. Hence our results do not necessarily stand in contrast to the results based on individual wages (Yamaguchi 2005),
- the DNWR phenomenon was stronger confirmed in particular sections of the economy. In the public sector and in the energy section more than 10% of firms face such a problem (before adjusting for job rotation),
- the presented results seem lower than in most international studies. However, due to differences in data sets, robust comparisons are impossible,
- one of potential explanations of the relatively low DNWR in Poland is its very high unemployment rate. If this explanation is correct, the recently observed and further expected decline in unemployment can make the DNWR issue more pronounced in the future.

Summing up, DNWR is present in the Polish data both at the individual level (pure wages) as well as at the enterprise level (total compensation). In particular the extent of rigidity in the data set we used is relatively small. Nevertheless, due to its mild presence in the whole dataset and substantial presence in selected sectors of the economy, the central bank should probably not neglect it. This relates both to the current inflation level and to the prospective entry into the eurozone, where wage flexibility will play a pronounced role in bringing the economy to equilibrium after occurrence of asymmetric shocks.

References

Adam, K., Billi, R.M. 2004 a. „Optimal Monetary Policy Under Commitment with a Zero Bound on Nominal Interest Rates", ECB WP 377, European Central Bank, Frankfurt.

Adam, K., Billi, R.M. 2004 b. „Optimal Monetary Policy Under Discretion with a Zero Bound on Nominal Interest Rates", ECB WP 380, European Central Bank, Frankfurt.

Altonji, Joseph G. and Devereux, Paul J. 2000, 'Is there Nominal Wage Rigidity? Evidence from Panel Data', in: *Research in Labor Economics*, 19, 383-431.

Babetski, I. 2006. Aggregate Wage Flexibility in Selected New EU Member States", mimeo, Czech National Bank.

Borowski, J., Brzoza-Brzezina, M. 2004. "Designing Poland's Macroeconomic Strategy on the Way to the Euro Area", EUI Working Paper 2004/10.

Caballero Ricardo, Engel Eduardo, John Haltiwanger, 1997, Aggregate Employment Dynamics: Building from Microeconomic Evidence, *American Economic Review.*

Dellas, H., Tavlas, G. 2005. "Wage Rigidity and Monetary Union", *The Economic Journal,* 115, pp. 907-927.

Dickens, W.T., Goette, L., Groshen, E.L., Holden, S., Messina, J., Schweitzer, M.E., Turunen, J., Ward, M.E. 2006. „How wages change: micro evidence from the International Wage Flexibility Project", Working Paper No 96, National Bank of Belgium.

Dwyer, J., Leong, K. 2000. "Nominal Wage Rigidity in Australia", Research Discussion Paper 2000-08, Reserve Bank of Australia.

Elsby, M.W. 2006. "Evaluating the Economic Significance of Downward nominal Wage rigidity", NBER Working Paper 12611.

Fehr, E., Goette, L. 2000, "Robustness and Real Consequences of Nominal Wage Rigidity", *IERE Working Paper Series* 44, May.

de Grauwe, P. 2001. "Economics of Monetary Union", Oxford University Press, Oxford.

Holden, S, Wulfsberg, F., 2004. "Downward Nominal Wage Rigidity in Europe", CESifo Working Paper 1177.

Holden, S, Wulfsberg, F., 2005. "Downward Nominal Wage Rigidity in the OECD", Norges Bank Working Paper No. 2004/5.

Kahn, Shulamit (1997), 'Evidence of Nominal Wage Stickiness from Microdata', in: *American Economic Review*, 87(5), 993-1008.

Knoppik, C., Beissinger, T. 2005. “Downward Nominal Wage Rigidity in Europe: An Analysis of European Micro Data from the ECHP 1994-2001”, IZA Discussion Paper 1492, IZA, Bonn.

Lebow, D.E., Saks, R.E., Wilson, B.A. 2003, “Downward Nominal Wage Rigidity: Evidence from the Employment Cost Index”, in: *Advances in Macroeconomics*, 3(1).

NBP 2003. “Monetary Policy Strategy Beyond 2003”, National Bank of Poland, Warsaw.

NBP 2004. “A Report on Costs and Benefits of Poland’s Adoption of the Euro”, ed. J.Borowski, National Bank of Poland, Warsaw.

Vermeulen, P. 2006. “Employment Stickiness in Small Manufacturing Firms”, Working Paper 640, European Central Bank, Frankfurt.

Yamaguchi, S. 2005. “Wage Flexibility in Turbulent Times: A Practitioner’s Guide, with an Application to Poland”, IMF WP/05/134.