FIRM-LEVEL LABOUR DEMAND: ADJUSTMENT IN GOOD TIMES AND DURING THE CRISIS

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Firm-Level Labour Demand: Adjustment in Good Times and During the Crisis

Jan Babecký, Kamil Galuščák and Lubomír Lízal*

Abstract

Using a large panel of Czech manufacturing firms with 50 or more employees, we update the firm-level labour demand elasticity estimates for 2002–2009. The economic crisis of 2008–2009 provides a source of variation needed for getting estimates that cover not only times of growth, but also a period of economic contraction. We find that in normal times (until 2007), the short-term elasticity is -0.53 with respect to wages and 0.43 with respect to sales, while the long-term elasticities are close to or below unity, standing at -0.94 for wages and 0.76 for sales. Both the wage and sales elasticities increased during the crisis, suggesting that firms became output demand constrained, but only the sales elasticity is significantly different. The long-term wage elasticity close to -1 in the period before and during the crisis suggests that firms' employment decisions are made within fixed budgets. Finally, we find that the inclusion of workers hired through temporary work agencies does not significantly affect the results, indicating that firms take into account total labour when deciding on employment and that workers hired through temporary work agencies are used as an equal labour demand channel with lower adjustment costs. As an independent comparison, our results are found to qualitatively match the narrative evidence from the ad-hoc firm-level survey on wage and price formation conducted in 2007 and 2009 within the ESCB Wage Dynamics Network.

Abstrakt

S využitím velkého panelu českých podniků zpracovatelského průmyslu s 50 a více zaměstnanci odhadujeme nové elasticity poptávky po práci na úrovni podniků v období 2002–2009. Toto období zahrnuje nejen roky ekonomické konjunktury, ale i krize z let 2008–2009. Nalézáme, že v období růstu (do roku 2007) je krátkodobá elasticita poptávky po práci na mzdách -0,53 a na tržbách 0,43. Dlouhodobé elasticity jsou blízko, resp. pod hodnotou jedna (elasticita pro mzdy -0,94 a tržby 0,76). Poptávkové elasticity na mzdách i tržbách se zvýšily v období krize, kdy podniky čelily poptávkovému omezení, ale pouze u elasticity na tržbách je rozdíl statisticky významný. Dlouhodobá elasticita na mzdách blízko hodnoty -1 v období před i během krize naznačuje, že podniky rozhodují o zaměstnanosti v podmínkách fixních objemů finančních prostředků alokovaných na mzdy. Dále zjišťujeme, že zahrnutí pracovníků najatých prostřednictvím agentur práce významně nemění naše výsledky a že tedy podniky v rozhodování o využití zaměstnanosti jako produkčního faktoru zohledňují celkovou zaměstnanost a agenturní pracovníci jsou tedy jen levnějším kanálem přizpůsobení celkové poptávky po práci. Výsledky jsou kvalitativně srovnatelné s evidencí ze šetření podniků o tvorbě mezd a cen, které realizovala pracovní skupina ESCB Wage Dynamics Network v letech 2007 a 2009.

Keywords: Czech Republic, elasticity, firm-level data, labour demand, sales elasticity, wage elasticity, the crisis of 2008–2009.

JEL Codes: C23, J23, J33, P23.

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1. Introduction

Understanding the link between firm-level production and labour demand is crucial for calibrating the macroeconomic models used for forecasting employment and unemployment. The recent situation on Czech firms' demand side is surprisingly unexplored. While the analysis of unemployment and the process of unemployment-vacancy matching has received quite substantial coverage in the literature – see, among others, Münich et al. (1999) on worker-firm matching, Jurajda and Münich (2003) on long-term unemployment, and Galuščák and Münich (2007) on structural and cyclical unemployment – all these studies focus primarily on the labour supply side and do not explore individual firm behaviour and firm-level data per se.

The Czech Republic had one of the lowest unemployment rates during the early stages of economic transition in the first half of the 1990s. Surprisingly, the most recent information we have on firm-level labour demand elasticity also dates from the first half of the 1990s (Basu et al., 2005).[1] In particular, their estimates cover the period 1990–1993, and the short-term demand elasticity with respect to sales (at the end of their period, in 1993) is 0.5 while the long-term one is 0.9. The short-term employment elasticity with respect to wages is -0.6, but the long-term elasticity is insignificant (at -0.5).[2]

Other studies employing firm-level data (such as Baghdasarian et al., 2001, and Lizal and Svejnar, 2002) focus on investment and the adjustment cost function and their data span does not go beyond 1998 anyway. Undoubtedly, the Czech labour market and firm behaviour have changed substantially since the early stages of economic transition, for example due to large FDI inflows and entry into the European Union, and we need to know what the current link between production and labour demand is.

If we examine labour demand on the firm level, labour demand may naturally differ across particular groups of firms as well as workers. Oversimplifying, all factors which affect the performance of firms and workers may affect the demand for labour, too. The meta survey by Estrin et al. (2009) covers virtually all studies that have attempted to estimate the effect of privatisation and changes in ownership on the performance of firms. Recently, economic analyses have focused on the effects of different ownership structures on standard measures of corporate (mainly financial) performance. The demand for labour may also be skill-specific due to technical change and the possibility of labour-capital substitution. In particular, skill-biased technology

[1] Labour demand elasticities are estimated in Onaran (2008) using aggregate manufacturing data for the Czech Republic and several other Central and Eastern European countries in 1999–2004.

[2] Micevska (2008) reports similar elasticity estimates using firm-level data in Macedonia over 1994–1999.

change increases the relative demand for skilled labour (Acemoglu, 2002). This may also be relevant in the Czech Republic, as fast technical change and increased exposure to foreign competition due to EU membership have increased the weight of high-skilled products in exports. For example, Tarjáni (2007) investigated relative labour demand in Hungary. In this respect, the main contributions of our study are rather modest. We primarily focus on presenting updated labour demand elasticities for the Czech Republic in 2002–2009 using firm-level data for 2000–2009. Second, we test how different the estimated labour demand elasticities are in 'good times' (2002–2007) versus the crisis period (2008–2009).

Indeed, the economic and financial crisis of 2008/2009 provides a source of variation making it possible to get labour demand estimates not only at times of growth, but also during an economic contraction. Do firms change their behaviour during times of crisis? Are short term 'expansion' elasticities different from 'crisis' ones? A fall in aggregate demand is one of the manifestations of the 2008/2009 crisis. Are firms really output demand constrained as well? Do we have losers only? In other words, did some firms benefit from the global crisis? The extension of the sample from 2000 to 2009 allows us to answer such fundamental questions.

Finally, our results, and in particular the impact of the 2008/2009 crisis on labour demand, are assessed against an ad-hoc survey conducted at the firm level in the Czech Republic in 2007 and 2009 within the ESCB Wage Dynamics Network.

The rest of the paper is organised as follows. After this introduction, Section 2 discusses methodological aspects of estimating labour demand. Section 3 describes the data and illustrates some stylised facts. Section 4 presents the labour demand elasticity estimation results. Section 5 compares these results with the findings of the 2007 and 2009 waves of the ad-hoc survey of firms conducted within the Wage Dynamics Network. The last section concludes.

2. Conceptual Framework

The standard labour demand function based on cost minimisation (Hamermesh, 1993) can be written as

$$L = L\,(W, Q, X), \tag{1}$$

where L is the labour demand function, W stands for the real wage, Q is production (or sales) and X are other relevant control factors. This specification is used for the labour demand function of a firm that faces a given level of output. As the period we will cover is characterised by open

markets and competition, the exogenously given demand assumption is likely to hold, but we also test for possible endogeneity of *Q*. If the wage is also exogenously determined, OLS estimation of the operationalised equation (1) gives consistent estimates. However, wage determination is more likely to be endogenously determined, affected by the legal form or trade union influence (Prasnikar et al., 1994). Therefore, our estimation method needs to account for this possibility using the instrumental variable or GMM technique.

Basu at al. (2005) use the following general form of the operationalised equation (1):

$$\ln L_{it} = \alpha_{0i} + \alpha_1 \ln L_{it-1} + \beta_1 \ln Q_{it} + \beta_2 \ln Q_{it-1} + \gamma_1 \ln W_{it} + \gamma_2 \ln W_{it-1} + \delta_1 X_{it} + \delta_2 X_{it-1} + \varepsilon_{it}. \quad (2)$$

Subscript *i* is the firm index and *t* is the time index. *L* denotes labour employed, *Q* stands for real output or sales (for example, Micevska, 2008, uses value added per worker instead), *W* is the real wage and *X* are other control variables that are deemed relevant for firms' labour demand and that can also exhibit a lag structure. Finally, α_{0i} is the firm-specific fixed effect. The short-term elasticity of employment with respect to real output (sales) is given by coefficient β_1. Coefficient γ_1 characterises the short-term employment elasticity with respect to real wages. Long-term elasticities are obtained under the assumption that the variables do not change from one period to another (i.e., they achieved their equilibrium levels, $Y_{it} = Y_{it-1}$), in which case equation (2) becomes a static one:

$$(1 - \alpha_1) \ln L_{it} = \alpha_{0i} + (\beta_1 + \beta_2) \ln Q_{it} + (\gamma_1 + \gamma_2) \ln W_{it} + (\delta_1 + \delta_2) X_{it} + \varepsilon_{it}. \quad (2')$$

Then the long-term sales (output) elasticity is given by $(\beta_1 + \beta_2)/(1 - \alpha_1)$ and the long-term real wage elasticity is defined as $(\gamma_1 + \gamma_2)/(1 - \alpha_1)$.

The general specification (2) can be reduced to one of three particular cases: (i) a partial adjustment model; (ii) a static model; or (iii) a first difference model. In the case of the partial adjustment model, the coefficient α_1 on the lagged dependent variable in (2) is not zero, other explanatory variables being static ($\beta_2 = \gamma_2 = \delta_2 = 0$). For the static (complete adjustment) model, there are no lagged explanatory variables at all ($\alpha_1 = \beta_2 = \gamma_2 = \delta_2 = 0$). Finally, equation (2) transforms into the first difference model if $\alpha_1 = 1$, $\beta_2 = -\beta_1$, $\gamma_2 = -\gamma_1$, $\delta_2 = -\delta_1$. Which of the three forms is more appropriate depends on the data. Basu et al. (2005) report that usually any of these three sets of restrictions were rejected, thus the general form (2) was estimated.

The estimation method needs to account for the potential inconsistency of fixed-effect dynamic panels (Arellano and Bond, 1991). The econometric approach calls for the use of the instrumental variable or GMM techniques, where lagged levels and differences can serve as potential

instruments (Arellano and Bover, 1995; Blundell and Bond, 2000). The particular choice of instruments employed (i.e., the orthogonality conditions used) depends also on the nature of the error process, and the validity of the instruments (i.e., the assumptions that allow the use of more powerful instruments) should be tested using appropriate Hausman-type tests (Matyas and Sevestre, 2008; Wooldridge, 2002).

As instruments, Basu et al. (2005) use industry dummy variables, district dummy variables, ownership, the preceding year value of firm assets interacted with industry dummy variables, the current and lagged average values of sales, wages and employment of firms in the neighbouring three-digit industry, and the average value of the lagged assets of firms in the neighbouring three-digit industry. The neighbouring three-digit industry is defined as the next three-digit industry with respect to the industry the firm belongs to, within the same two-digit industry. For the last three-digit industry within the two-digit industry, the most similar three-digit industry is chosen.

Following the equation (2), our empirical specification takes the following form of a first difference model, removing the firm-specific fixed effects:

$$\Delta \ln L_{it} = \alpha_1 \Delta \ln L_{it-1} + \beta_1 \Delta \ln Q_{it} + \beta_2 \Delta \ln Q_{it-1} + \gamma_1 \Delta \ln W_{it} + \gamma_2 \Delta \ln W_{it-1} + \sum \delta_j \, ind_{jt} + \Delta \varepsilon_{it}, \quad (3)$$

where L is the number of workers (either own workers only, or the total number of workers including those hired through temporary work agencies), Q are real sales (deflated using the producer price index in manufacturing, PPI), W is the real wage (obtained as the total firm-level wage bill divided by the number of workers and deflated by the consumer price index, CPI), ind_j are industry dummies and ε_{it} is the error term, which is assumed to be white noise. All variables (employment, sales, wages, CPI, PPI) are yearly averages. Notice that we use sales instead of output, for two main reasons. First, sales better reflect firms' activity (ability to sell products) than production, especially at a time of crisis, since a decrease in demand could cause some part of production to go to stocks. Second, sales are a directly measurable variable, while output needs to be calculated using additional information such as changes in stocks, which makes sales less subject to measurement errors. Next, while real sales are obtained using the PPI deflator, which reflects firms' revenues, real wages are constructed using the CPI, since this index better reflects the process of wage setting. Indeed, based on a firm-level survey, Babecký et al. (2008) report that 60 percent of Czech firms confirm that inflation is reflected in wage changes.[3] The price index

[3] The results from the same firm-level survey conducted in 17 European countries indicate that wages are often adjusted to inflation in European firms either through formal indexation clauses set at the national level or through informal mechanisms following wage negotiation processes or firm-level policies (see Druant et al., 2012).

that is commonly used by firms and workers/unions to form expectations about future inflation is the CPI.[4]

We estimate equation (3) as well as its versions without lagged variables on the right hand side using IV estimation in the period 2002–2009 and report both the short-term and long-term elasticities of labour demand with respect to real wages and real sales. Although the data are available since 2000, we lose two years of observations due the inclusion of dynamics in equation (3) and the presence of differenced terms. Thus, the estimates are available since 2002. Using the whole sample in 2002–2009 captures overall changes in the economy. In order to better illustrate changes over time, we repeat the estimation based on the balanced sample where the same firms are observed throughout the period. In that case however, for several periods of time we commonly lack data for some firms, owing, for example, to firm entry, break-up and exit, and therefore the set of firms on which the estimation is exercised is somewhat smaller than the full set. Hence, we face a trade-off between having a balanced panel and trying to maximise the number of observations available. The effect of missing observations in the balanced panel could be mitigated by estimating equation (3) using sub-periods. Such an approach was followed by Basu et al. (2005), who estimate their model for consecutive two-year panels. In fact, this was the only feasible solution for estimating labour demand on the pre-transition and earlier transition data since firm turnover was substantial because of the restructuring process. In order to illustrate the variation of the estimated coefficients over time, we also report estimates from consecutive short panels: for each year in 2002–2009, observations from the current and two previous years are used to produce estimations for a given year. As another alternative, we also report estimates from consecutive short panels based on the balanced dataset. When interpreting estimations on the balanced data, one should keep in mind that such estimations are conditional on firms' survival.

We use the same set of instruments as Basu et al. (2005) for wages, sales and lagged labour. In particular, district dummy variables capture differences in district-level employment.[5] The preceding year value of firm assets interacted with industry dummy variables is used as an instrument, as capital is quasi-fixed and determined before employment is chosen by the firm in the current year. The current and lagged average values of sales, wages and employment of firms in the neighbouring three-digit industry proxy for the economic situation within the industry. The average value of the lagged assets of firms in the neighbouring three-digit industry controls for

[4] In the Czech Republic, the collective agreement coverage is about 50 percent of employees, see Hájková et al. (2011).

[5] If a firm has plants located in different districts, the information for the whole firm refers to the headquarter's district. In that case, the district dummies are still valid but weaker instruments. They are then of a similar power as neighbouring district instruments when the geographical proximity argument is used instead of economic proximity; in our case we have clear economic linkage due to business operations with the headquarter district.

investment opportunities during the business cycle. Finally, a dummy variable for foreign ownership and industry dummy variables are also used as instruments. In contrast to Basu et al. (2005), we also use the Herfindahl index of market concentration as another instrument in the pooled sample estimation to capture changes in market concentration within industries over time.[6] We use the Hausman test for testing whether real sales are exogenous, while we also test for overidentifying restrictions (see Wooldridge, 2002). We assume that wages are endogenous as they are computed as the wage bill divided by the number of workers which is a left-hand side variable (see above).[7] Finally, lagged labour on the right hand side in (3) is not exogenous as it is correlated with the error term which contains ε_{it-1}.

In what follows, we estimate the firm-level elasticities of labour demand, addressing the role of firm size and type of industry. In addition, the recent economic slowdown provides an additional benefit as a source of substantial variation needed for getting estimates of labour demand elasticities that cover not only times of growth, but also a period of economic contraction. Before presenting the estimates, we thus investigate how firms adjust their demand for labour and labour costs due to the 2008/2009 financial and economic crisis.

3. Data Description and Stylised Facts

To provide background for the interpretation of our results, Table 1 illustrates key Czech macroeconomic indicators for the period 2002–2009. The growth of the economy slowed at the beginning of the period, as documented by low GDP growth in 2002 and by a drop or low growth in real value added and real sales in manufacturing in 2003. In subsequent years – until 2007 – the economy accelerated. There followed a slowdown in 2008 and a massive drop in output growth in 2009. A similar cyclical pattern was observed in the number of employees, while the unemployment rate peaked in 2004 and declined until 2008. The average real wage in the total economy as well as in manufacturing exhibited relatively stable growth over the sample period and decelerated sharply in 2008 and 2009 due to the crisis. Overall, the indicators shown in Table 1 illustrate the profound impact of the crisis on the economy and on manufacturing industry in particular.

---<Table 1 about here>---

[6] The index is defined as the sum of the squared market share (based on sales) of each firm in the industry.

[7] The time aggregation also violates the assumption that wages are exogenous as using annual data, annual wage rates contain the accumulated effect of firms' labour decisions during the year (see Galuščák and Münich, 2005). Finally, wages are not truly exogenous due to possible wage setting negotiations on both individual as well as industrial levels with trade unions as well as due to rigidity.

For the purpose of the estimation we use a large panel of all manufacturing firms with 50 or more employees in 2000–2009 containing yearly balance sheet data and income statement information gathered by the Czech Statistical Office. While the dataset contains information on the number and wages of own employees, we complement the dataset with firm-level information on workers hired through temporary work agencies.[8]

The sample covers economically active firms with non-zero employment, wages and sales in a given year. Nominal wages per employee are deflated using the consumer price index. Sales are deflated using the producer price index in manufacturing. Summary statistics for the key variables – the number of workers (own workers as well as own plus TWA workers), real wages and real sales – are illustrated in Table 2. The number of observations per year varies between 1,277 and 2,095. Data on the number of TWA workers are available since 2005 only.

---<Table 2 about here>---

Table 3 shows the breakdown of the number of firms and employees by the type of manufacturing industry, also differentiating between own and TWA workers. In total, we distinguish 11 industry groups based on the two-digit level of the NACE classification. Several facts emerge from Table 3. First, the number of TWA employees represents only a small fraction of total employment. Second, there is a clear decline in employment in 2008 and 2009, the period of economic contraction. Third, this decline in employment is common for both own and TWA workers.

---<Table 3 about here>---

While Table 3 presents the numbers of employees, Table 4 illustrates the sample employment changes in percentages, by the same 11 industry groups. As indicated by the last three rows, the period of 2008–2009 is characterised by an overall decline in employment of 0.9% in 2008 and 15.1% in 2009. TWA employees were hit even harder; their decline in employment was 2.1% in 2008 and a dramatic 46.3% in 2009. Notice that the number of TWA employees was also growing much faster than that of own employees in the period before the crisis, in 2006 and 2007 (24%–30% versus 0.5%–1.2%). Next, as indicated in Table 4, there is large variation in employment dynamics across industries, in particular during the crisis. For example, the number of TWA employees increased by as much as 150% in 2008 in *Furniture, other manufacturing, recycling*

[8] In 2008 and 2009, the numbers of TWA workers are yearly averages from quarterly datasets covering all manufacturing firms with 50 or more employees. In 2005–2007, the yearly averages are from monthly data covering all firms in manufacturing with 100 or more employees and all systemically important firms with 50–99 employees.

(NACE 36–37), while declining by 36% in the same industry in 2009. In *Metals* (NACE 27–28), the number of TWA workers declined by 17% in 2008 and by 53% in 2009.[9]

---<Table 4 about here>---

4. Estimation Results

Table 5 presents the labour demand estimates for 2002–2009 based on several versions of equation (3) where the dependent variable refers to own employees in the firm. In column 1, the short-run elasticities of wages and sales are -0.60 and 0.55 respectively, while the long-run elasticities are -0.92 and 0.84. In the next two columns we show the estimates of the first-difference static model (column 2) and the full first-difference dynamic model as in equation (3), where lagged wages and lagged sales are included (column 3). Based on this comparison, column 1 is our preferred model for the overall sample, as the lagged labour coefficient estimate is significant and the estimates of lagged wages and lagged sales are not significant in column 3.

We see that the elasticities do not differ significantly by firm size (column 4). During the 2008/2009 crisis, the short-term employment elasticity with respect to sales is significantly higher than during the pre-crisis period until 2007, but the employment elasticity with respect to wages is not statistically different (column 5). While the demand elasticities are not affected by firm size in the period covering both normal and crisis times (column 4), during the crisis the employment elasticity with respect to sales is higher for firms with 100–249 employees (firms with 250 or more employees being the reference group, see column 6). This suggests that manufacturing firms are more output demand constrained during the crisis and that firms with 100–249 employees are hit particularly hard by the crisis.

---<Table 5 about here>---

In Table 5 we examine the effect of firm size and the crisis period using the interactions with dummy variables, while industry dummies capture the effects of different industries. As a robustness check we repeated the estimation from columns 1 and 5 in Table 5 separately by firm size and by industry. The results, presented in Table A1 in the Appendix, confirm that the elasticities do not differ by firm size, while medium-sized firms (with 50–99 workers) have insignificantly lower wage elasticity than larger firms. During the crisis, the sales elasticity is higher for very large firms with 250 or more workers only. This does not contradict the results in

[9] The employment changes reported in Table 4 are based on the full sample, so the firms are not necessarily the same in each year.

column 6 in Table 5, where the reference group contains all firms in the pre-crisis period, while here the reference group covers firms of the same size group. In sum, very large firms were the most negatively affected by the crisis, as indicated by higher sales elasticity during the crisis.[10]

The labour demand function may also differ by industry, as the technology used for production is not the same across industries. Repeating the estimation in Table 5 by industry suggests that sales elasticity is higher in *Metals* than in *Food*. During the crisis, sales elasticity increased significantly in *Electrical and optical machinery* and in *Motor vehicles*, indicating that those export-oriented industries were hit particularly hard by the crisis.[11]

The comparison of short- and long-term elasticities in normal and crisis times is summarised in Table 6. In normal times (until 2007, column 1), the short-term elasticity is -0.53 with respect to wages and 0.43 with respect to sales. The long-term elasticities are -0.94 and 0.76 respectively. As expected, the long-term elasticities are higher than the short-term ones. Both the wage and sales elasticities increased during the crisis (column 2), but the difference is statistically significant only in the case of sales elasticity. The higher elasticity with respect to sales during the crisis reflects the fact that firms became output demand constrained. The long-term elasticity with respect to wages is close to -1 in the periods before and during the crisis, suggesting that employment decisions are made by firms within fixed budgets. Similar results are obtained when the demand function is estimated on subsamples before and during the crisis (see columns 3 and 4).

---<Table 6 about here>---

To assess changes in the demand elasticities over time, we repeat the estimation using short panels. The results are presented in the Appendix, where Table A2 shows estimates of the static model and Table A3 the dynamic model in equation (3). In each year, the elasticities are statistically significant, but they change from year to year. While the main results are presented for own workers, the inclusion of TWA workers among firm employment (reported in the bottom parts of Tables A2 and A3) does not significantly affect the results.[12] This suggests that

[10] The Hausman test confirms that real sales are endogenous in the labour demand estimation, while the overidentifying restrictions are not rejected (except for column 2), so our choice of instruments is valid. Furthermore, we also performed an AR2 test to see whether the set of instruments in levels is valid in our first difference dynamic model. The results of this test (not reported) reject the presence of an AR2 process. Finally, the instruments are relevant as suggested by significant F-statistics of the test of joint significance of the instruments from the first stage regressions (not reported).

[11] The sales elasticity is also marginally higher in *Food* during the crisis period. Sales are less sensitive to the business cycle in this particular industry, so the effect of the crisis may be more pronounced. The labour demand estimates by industry are available from the authors upon request.

[12] In this case we assume that TWA workers earn the same wage as own employees in the firm. Data on TWA workers are only available since 2005, thus the estimates are reported since 2006 for the static specification and since 2007 for the dynamic one. While the wage bill used to construct the firm average wage remunerates own

employment decisions in firms are the same regardless of whether or not TWA employees are included, so the firm takes into account total employment. However, as third-party hired employees are less costly to dismiss (there are no severance payments), they are the first to go and their dismissal is faster than that of own employees.[13]

In Tables A4 and A5 we repeat the estimation using short panels based on the balanced dataset. Although the number of observations is lower, these results illustrate the changes in elasticities over time behind the results reported in Table 5 with the same firms in the sample. In particular, sales elasticity increased in 2009 and the rise in sales elasticity in the crisis period is more pronounced than in the estimates in Tables A2 and A3 based on the unbalanced sample.[14]

We also test whether real sales are exogenous using the Hausman test. The sales are exogenous in short panels (see the F-statistics and the significant level in Tables A2–A5), indicating that firms are price and demand takers in the short run.[15] However, in the long run firms affect the market, as illustrated by the significant F-statistics reported in Table 5.

The next two tables summarise a comparison of our results with those reported in the literature on firm-level labour demand elasticities with respect to real wages (Table 7a) and sales or output (Table 7b) estimated for Central and Eastern European countries.[16] Most of the estimates relate to

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employees, firms may use other short-term employment by means of other personnel expenses. The information on other personnel expenses, which also includes severance payments, is available for firms with 250 or more employees only. We therefore repeated the estimation using the sample with 250 or more employees, where we included TWA workers in firm employment and other personnel expenses in the average wage. We assumed that TWA workers earn either the same wage as own employees (based on the wage bill including other personnel expenses) or a lower wage (calculated from the wage bill without other personnel expenses), reflecting the fact that severance payments are not paid to TWA workers. The results are very similar for these two assumptions. Hence, we rely on the average wage computed using the wage bill without other personnel expenses in this paper.

[13] See Table 4, which shows the dismissal of TWA workers was faster in some industries during the crisis. We also repeated the estimation in Table 5 for TWA workers. The results suggest that the sales elasticity is higher than for own employees, supporting the view that TWA workers are the first to go. On the other hand, the wage elasticity is also higher but insignificant, as we maintain the assumption that TWA workers earn the same wage as own employees. The exact wage of TWA workers is thus unmeasured but assumed to have a certain value, resulting in insignificant estimates. The labour function estimates for TWA workers are available from the authors upon request.

[14] We also repeated the estimation from Table 5 using the balanced sample. The results (available from the authors upon request) support the view that the increase in sales elasticity is higher than in the case of the unbalanced sample, while the impact by firm size is insignificant (unlike in column 6 in Table 5).

[15] The Herfindahl index of market concentration is low and stable for most industries in 2000–2009, and decreasing in *Motor vehicles and other transport equipment* (NACE 34–35) – see Table A6. This also suggests that the market power of firms is low within industries and that the demand for firm output might be exogenous.

[16] For evidence on labour demand elasticities in Western European countries see, for example, Navaretti et al., 2003 (11 EU economies, national and multinational firms, 1994–2010), Buch and Lipponer, 2010 (German and foreign multinational firms, 2001–2004), and Bohachova et al., 2011 (German firms, 2000–2009). Overall, there is substantial heterogeneity in labour demand elasticities across countries, particularly for the national firms. For the multinational enterprises, wage and sales elasticities are found to be somewhat lower compared to the national ones.

the pre-transition and earlier transition periods; two studies (Domadenik and Vehovec, 2003, and Micevska, 2008) report estimates for the second half of the 1990s. Our study is the only one using data for 2002–2009.

---<Tables 7a,b about here>---

Regarding the Czech Republic, there are two studies available with which we can compare our results, namely Singer (1996) and Basu et al. (2005). First, one can notice that all the elasticities reported in Singer (1996) are much lower (not exceeding 0.11 in absolute terms even for long-term elasticities) compared not only to our estimates, but also to the estimates for other countries. This could be related to a unique feature of Singer's data set – this is the only study employing monthly data; all the other studies listed are based on yearly data sets. Given that firms are more likely to follow a yearly rather than a monthly cycle in adjusting employment and wages, a finding of lower elasticities within a year compared to the year-to-year changes looks plausible. Otherwise, our estimates of short-term elasticities with respect to sales as well as wages are close to those reported in Basu et al. (2005). While our estimate of long-term elasticity with respect to wages is close to unity, Basu et al. (2005) find insignificant elasticity for most of the periods. On the other hand, the long-term elasticities with respect to sales are close to or just below unity in Basu et al. (2005) as well as in our paper. Our results are similar to those in Basu et al. (2005), who found rising elasticities in the early 1990s to the levels observed in market economies. Hence, the elasticities were not affected since the early transition years, for example due to FDI inflows and entry into the European Union.

The employment elasticities reported for other Central and Eastern European countries exhibit some common patterns. First, the long-term elasticities are higher in absolute terms than the short-term ones. Second, the long-term elasticities with respect to sales are close to or just below unity. Third, the long-term elasticities with respect to wages in a number of cases exceed unitary values, which indicates an overreaction of employment to real wages. Notice that such overreaction may be related to estimation issues (namely the difficulty of making inferences about long-term parameters in short panels when the parameters are changing) in combination with the role played by inflation expectations in the wage-setting process.

5. Comparison of the Results with the Firm-Level Survey

As an independent qualitative comparison, in this section we contrast our results with the stylised facts obtained from a CNB ad-hoc firm-level survey on wage and price setting conducted in the second half of 2007 and in June 2009, coordinated within the ESCB Wage Dynamics Network. Although the WDN survey does not contain explicit information on firm-level labour demand, the survey nevertheless presents unique evidence on how firms respond to either hypothetical demand shocks (the 2007 wave) or actual shocks (the 2009 wave).

The 2007 wave of the survey contains detailed information on the determinants of wage and price-setting practices in Czech firms, the presence and sources of wage rigidity, and the reactions of firms to hypothetical shocks (see Babecký et al., 2008, for detailed information on the survey design and results, and Babecký et al., 2010, for a discussion of alternative ways of measuring wage rigidity and cross-country evidence on wage rigidity based on the WDN survey of European firms). The survey questions largely refer to firms' practices during the preceding five years, or to their expected reactions to hypothetical shocks. The survey results show that in response to unanticipated shocks such as a demand drop, an increase in the cost of an intermediate input or a wage increase, firms would mainly reduce costs by reducing non-labour costs and temporary employment. The adjusting role of temporary employment is what we also observe from Table 4 on the level of 11 industries.

The survey was updated in June 2009 to assess firms' responses to actual shocks and to investigate the main channels of the impact of the crisis on Czech firms and on wage flexibility in a situation of an economic downturn. The same firms were contacted in this second wave as those that had participated in the first wave of the survey. The results revealed that over half of the Czech firms surveyed had been strongly or very strongly affected by the 2008/2009 crisis in the form of lower demand (Hájková et al., 2009). Above-average difficulties had been experienced by firms in manufacturing. The survey results also indicated that nominal wage cuts had been extremely rare and that the frequency of nominal wage freezes had increased during the crisis of 2008/2009. Given the rigidity in base wages, firms had extensively used alternative cost-cutting strategies, for example cutting hours of work or employment and adjusting non-wage labour costs.

Table 8 shows the ways in which firms respond to an unexpected fall in demand. While the hypothetical reaction to an unexpected fall in demand was investigated in the 2007 questionnaire, firms were asked about the actual fall in demand in 2009. Among the four available adjustment strategies – a reduction in prices, margins, output or costs – the cost reduction strategy dominates, being used by about 87% of the firms surveyed in 2007 and 88% in 2009.

---<Table 8 about here>---

A reduction in costs can, in turn, be achieved via several channels, as reported in Table 9. Among the six channels listed, base wages are undoubtedly inelastic downward. A reduction in base wages is the least frequent adjustment channel.[17] This was virtually non-existent in 2007 (more precisely, over the five preceding years on average), and only about 4% of firms adopted a reduction in base wages in 2009. On the other hand, cutting flexible wage components to adjust costs increased from 18% in 2007 to 25% in 2009. Adjustment via the number of hours worked increased from 3.5% in 2007 to 12.2% in 2009. However, as the survey results reveal, the most important adjustment channels are reductions of employment (both permanent and temporary) and non-labour costs. While 19% of firms reported adjustment via permanent employment in 2007, the number was almost twice as high in 2009, reaching 43%. Cutting temporary employment rose from 27% in 2007 to 38% in 2009. One can also notice that in normal times adjustment via temporary employment is somewhat higher than adjustment via permanent employment, while during the crisis the situation is reversed. This reflects firms' perceptions about the duration of the crisis: if the fall in demand is perceived as long-lasting, firms cut permanent workers more intensively, while in a situation of an expected temporary fall in demand, adjustment via temporary employment is more frequent. Lastly, the use of adjustment via non-labour costs increased from 42% in 2007 to 55% in 2009.

---<Table 9 about here>---

How do these stylised facts compare to our labour demand estimates? First, during 2008/2009 we find a statistically significant increase in employment elasticities with respect to sales, while employment elasticities with respect to real wages did not significantly increase. The increase in the employment elasticities to sales during the crisis corresponds to the use of adjustment strategies listed in Tables 8 and 9: the adjustment in employment was more often used in 2009 than as indicated in the 2007 responses, while a reduction in output (and prices), and hence also sales, remained at the comparable levels or even decreased in 2009. On the other hand, a reduction in base wages was the least frequent adjustment channel in both 2007 and 2009 (Table 9). In a situation of rigid nominal wages and decreasing inflation, real wages change by only a small margin. This corresponds to higher standard errors of the estimated wage elasticities in 2008/2009 and, overall, to an insignificant change compared to the pre-crisis period.

[17] Reasons for (downward) wage rigidity are discussed by Babecký et al. (2010). Overall, wage rigidity in base wages is related to workforce composition, labour market institutions, and the extent of trade unions.

6. Conclusions

In this paper we presented updated firm-level labour demand elasticities in the Czech Republic for 2002–2009. We provided new evidence of firms' labour demand, in normal and crisis times, controlling for industry and firm size. Compared to the earlier estimates for the pre-1993 period (Basu et al., 2005), the current long-term elasticities are broadly in a range typical for a market economy, that is, not far from unitary values. Similar to Basu et al. (2005) and other studies estimating labour demand, we find that the long-term elasticities are higher than the short-term ones.

Our results corroborate the findings of the survey on wage and price formation of Czech firms conducted in 2007 and 2009. In particular, the effect of the 2008/2009 global crisis was seen in the Czech Republic chiefly as a fall in external demand. Consequently, the fall in demand obviously affected firms' demand for labour. In a situation of prevailing wage rigidities (both nominal and real), the bulk of the adjustment occurred via a reduction in prices, margins, output and costs. The cost reduction, in turn, was achieved mainly via adjustment of employment (both permanent and temporary), hours of work and non-labour costs. Of particular interest is that the estimated employment elasticities with respect to sales increased in 2008–2009, reflecting large adjustment to employment and sales, while the employment elasticities with respect to real wages did not change in a statistically significant manner, arguably due to limited variation in wages during the crisis.

We also assessed the sensitivity of the results with respect to the type of workers (own versus TWA) and the type of remuneration (wages only or wages plus other personnel expenses) as well as over time (by estimating labour demand in short panels). First, we find that the inclusion of workers hired through temporary work agencies does not significantly affect the results, indicating that firms take into account total labour when deciding on employment. The dismissal of TWA workers is faster than that of own employees, as TWA workers are less costly to dismiss due to the absence of severance payments. Similarly, the inclusion of other personnel expenses (related to short-term employment) has no significant effect on the estimated demand elasticities. Finally, the estimation of labour demand using short panels confirms an increase in employment elasticities with respect to sales during the crisis of 2008/2009.

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Tables

Table 1: Key Macroeconomic Indicators, 2002–2009

	2002	2003	2004	2005	2006	2007	2008	2009
GDP (at constant prices)	1.9	3.6	4.5	6.3	6.8	6.1	2.5	-4.1
Value added in manufacturing (at constant prices)	5.4	-1.0	13.2	11.9	14.6	9.2	7.8	-11.9
Real sales in manufacturing	4.1	1.9	11.9	3.0	8.6	10.3	-5.2	-11.6
Real wage								
- total	5.9	5.7	3.5	3.0	4.0	4.3	1.4	2.2
- manufacturing	4.5	5.0	4.8	2.7	3.9	4.4	2.1	0.8
Number of employees								
- total	-0.3	-2.6	0.8	1.8	1.9	2.9	1.3	-2.0
- manufacturing	-1.3	-4.4	1.1	1.9	2.5	2.4	1.0	-6.6
Unemployment rate	7.3	7.8	8.3	7.9	7.1	5.3	4.4	6.7

Note: Year-on-year changes in %, average ILO unemployment rate in %. Sales in manufacturing deflated using the producer price index in manufacturing. Average wage deflated using the consumer price index.

Source: Authors' calculations based on Czech Statistical Office data.

Table 2: Sample Summary Statistics, 2002–2009

	2002			***2003***		
	N	**Mean**	***Std. Dev.***	**N**	**Mean**	***Std. Dev.***
Log own workers	1660	290	*391*	1816	268	371
Log own+TWA workers	0			0		
Log real wage	1660	183	*60*	1816	192	64
Log real sales	1660	552636	*1569111*	1816	573676	1743342
	2004			**2005**		
	N	**Mean**	***Std. Dev.***	**N**	**Mean**	***Std. Dev.***
Log own workers	2095	250	372	1558	316	674
Log own+TWA workers	0			1558	328	765
Log real wage	2095	202	68	1558	208	66
Log real sales	2095	569220	1736611	1558	852046	4881905
	2006			**2007**		
	N	**Mean**	***Std. Dev.***	**N**	**Mean**	***Std. Dev.***
Log own workers	1433	328	408	1356	339	414
Log own+TWA workers	1433	342	439	1356	358	459
Log real wage	1433	216	67	1356	228	71
Log real sales	1433	937740	3482000	1356	1012136	3614259
	2008			**2009**		
	N	**Mean**	***Std. Dev.***	**N**	**Mean**	***Std. Dev.***
Log own workers	1277	346	431	1329	287	343
Log own+TWA workers	1277	364	472	1329	297	362
Log real wage	1277	234	73	1329	237	82
Log real sales	1277	1011833	3838901	1329	826729	2577523

Notes: Average real wage and real sales per year in CZK thousands.

Source: Authors' calculations based on Czech Statistical Office data.

Table 3: Number of Firms and Employment in Manufacturing Industries, 2002–2009

NACE codes		2002	2003	2004	2005	2006	2007	2008	2009
15-16	*Food products, beverages and tobacco products*								
	N	255	279	281	187	208	197	168	177
	Own empl.	62597	67520	63752	54157	60297	56388	46465	47333
	TWA empl.	0	0	0	849	1397	2167	1496	1300
	All empl.	0	0	0	55006	61694	58555	47961	48633
17-19	*Textiles, wearing apparel and leather*								
	N	195	219	215	111	88	78	66	64
	Own empl.	64199	58433	50498	30363	26268	23712	19638	14978
	TWA empl.	0	0	0	151	119	144	72	18
	All empl.	0	0	0	30514	26387	23856	19710	14996
20-22	*Wood, pulp and paper, publishing and printing*								
	N	92	112	134	136	110	94	85	86
	Own empl.	18940	21066	22593	23493	21345	19144	17831	16957
	TWA empl.	0	0	0	536	305	550	304	140
	All empl.	0	0	0	24029	21650	19694	18135	17097
23-24	*Chemicals and oil processing*								
	N	72	73	77	59	50	42	45	44
	Own empl.	17309	18225	16902	17807	17020	16154	16609	12872
	TWA empl.	0	0	0	65	132	202	513	401
	All empl.	0	0	0	17872	17152	16356	17122	13273
25	*Rubber and plastic products*								
	N	86	108	125	97	94	85	99	112
	Own empl.	19497	20766	22474	22011	24007	22420	27324	25133
	TWA empl.	0	0	0	596	667	892	1299	911
	All empl.	0	0	0	22607	24674	23312	28623	26044
26	*Other non-metallic mineral products*								
	N	92	100	174	93	80	80	85	88
	Own empl.	26687	23238	49490	23743	24166	23506	23409	21244
	TWA empl.	0	0	0	309	294	299	298	282
	All empl.	0	0	0	24052	24460	23805	23707	21526
27-28	*Metals*								
	N	304	293	334	221	207	210	193	210
	Own empl.	77642	70140	73089	64479	57632	60786	62487	50378
	TWA empl.	0	0	0	3231	3204	4421	3252	1398
	All empl.	0	0	0	67710	60836	65207	65739	51776
29	*Machinery and other equipment*								
	N	214	246	306	231	211	201	202	207
	Own empl.	62653	64162	71725	68070	69208	68142	63956	57049
	TWA empl.	0	0	0	2127	2797	4285	3851	1614
	All empl.	0	0	0	70197	72005	72427	67807	58663
30-33	*Electrical and optical machinery and equipment*								
	N	184	202	237	201	183	169	157	161
	Own empl.	62776	69339	78244	77989	77573	74277	74337	60320
	TWA empl.	0	0	0	4735	6002	6748	6652	2788
	All empl.	0	0	0	82724	83575	81025	80989	63108

Table 3: Number of Firms and Employment in Manufacturing Industries, 2002–2009 (continued)

NACE codes		2002	2003	2004	2005	2006	2007	2008	2009
34-35	*Motor vehicles and other transport equipment*								
	N	123	138	145	173	166	164	142	143
	Own empl.	57910	62538	64116	97809	81995	85845	80165	66612
	TWA empl.	0	0	0	7100	4389	5838	5143	3455
	All empl.	0	0	0	104909	86384	91683	85308	70067
36-37	*Furniture, other manufacturing, recycling*								
	N	43	46	67	49	36	36	35	37
	Own empl.	11560	10928	11557	11847	10574	9718	9894	8915
	TWA empl.	0	0	0	296	583	185	459	267
	All empl.	0	0	0	12143	11157	9903	10353	9182
Total	N	*1660*	*1816*	*2095*	*1558*	*1433*	*1356*	*1277*	*1329*
	Own empl.	*481770*	*486355*	*524440*	*491768*	*470085*	*460092*	*442115*	*381791*
	TWA empl.	*0*	*0*	*0*	*19992*	*19888*	*25730*	*23337*	*12574*
	All empl.	*0*	*0*	*0*	*511760*	*489974*	*485822*	*465452*	*394365*

Note: Employment as number of persons – own employees, TWA employees, all employees.
Source: Authors' calculations based on Czech Statistical Office data.

Table 4: Change in Employment by Manufacturing Industries, 2002–2009

NACE codes	Empl. type	2002	2003	2004	2005	2006	2007	2008	2009
15-16	*Food products, beverages and tobacco products*								
	Own empl.	0.0	-0.2	-3.1	-2.4	-4.4	-0.7	-1.7	-2.6
	TWA empl.					6.3	23.3	-4.6	-18.0
	All empl.					-4.2	0.0	-1.8	-3.1
17-19	*Textiles, wearing apparel and leather*								
	Own empl.	-7.7	-10.3	-7.5	-4.5	-5.4	-2.7	-8.6	-14.8
	TWA empl.					-22.1	15.8	-5.9	27.3
	All empl.					-5.4	-2.6	-8.6	-14.8
20-22	*Wood, pulp and paper, publishing and printing*								
	Own empl.	-0.6	-1.5	0.4	0.9	2.0	1.1	-2.5	-11.5
	TWA empl.					-7.6	16.5	-25.4	-38.8
	All empl.					1.9	1.4	-3.0	-11.8
23-24	*Chemicals and oil processing*								
	Own empl.	-2.1	7.8	-4.0	0.8	0.5	0.7	-2.3	-6.5
	TWA empl.					46.3	103.3	15.0	-35.6
	All empl.					0.8	1.3	-1.9	-7.8
25	*Rubber and plastic products*								
	Own empl.	3.2	0.6	4.8	4.5	5.5	2.2	-0.9	-12.6
	TWA empl.					9.5	63.2	24.3	-28.7
	All empl.					5.6	3.6	0.0	-13.3
26	*Other non-metallic mineral products*								
	Own empl.	-2.4	-2.1	-1.8	0.2	-4.0	-3.7	0.1	-11.0
	TWA empl.					11.5	10.6	-1.6	-17.8
	All empl.					-3.8	-3.6	0.0	-11.1
27-28	*Metals*								
	Own empl.	-2.9	-3.7	1.0	0.8	-0.7	1.2	1.1	-17.2
	TWA empl.					15.4	31.4	-17.4	-52.9
	All empl.					0.1	2.8	0.0	-18.9
29	*Machinery and other equipment*								
	Own empl.	-4.2	-7.6	-0.6	1.6	1.8	1.6	-1.6	-14.9
	TWA empl.					11.7	57.0	-7.2	-61.6
	All empl.					2.1	3.8	-1.9	-17.7
30-33	*Electrical and optical machinery and equipment*								
	Own empl.	-3.3	1.1	7.1	0.8	3.8	3.8	0.7	-19.1
	TWA empl.					46.4	24.1	11.3	-59.9
	All empl.					6.0	5.2	1.5	-22.6
34-35	*Motor vehicles and other transport equipment*								
	Own empl.	4.9	0.6	2.3	4.1	3.3	3.7	-0.4	-13.4
	TWA empl.					21.6	30.3	-10.7	-28.3
	All empl.					4.1	5.1	-1.1	-14.2
36-37	*Furniture, other manufacturing, recycling*								
	Own empl.	-6.3	-7.6	-4.4	-0.2	-2.3	-6.8	1.6	-11.1
	TWA empl.					77.9	-68.8	149.0	-35.9
	All empl.					0.1	-10.1	4.3	-12.0
Total	*Own empl.*	*-2.3*	*-2.8*	*0.0*	*1.0*	*0.5*	*1.2*	*-0.8*	*-13.5*
	TWA empl.					*23.7*	*29.5*	*-2.1*	*-46.3*
	All empl.					*1.3*	*2.4*	*-0.9*	*-15.1*

Note: Average industry-level employment changes for firms observed in the sample in a given year. Year-on-year changes in %.

Source: Authors' calculations based on Czech Statistical Office data.

Table 5: Labour Demand Estimates, 2002–2009

	(1)	(2)	(3)	(4)	(5)	(6)
ΔLog labour (-1)	0.3419***		0.5074***	0.3460***	0.4319***	0.3806***
	[0.0641]		[0.1199]	[0.0649]	[0.0809]	[0.0671]
ΔLog wage	-0.6028***	-0.7275***	-0.7642***	-0.5982***	-0.5316***	-0.5418***
	[0.0908]	[0.0853]	[0.2076]	[0.1186]	[0.1071]	[0.1011]
ΔLog sales	0.5544***	0.6540***	0.5880***	0.4982***	0.4328***	0.5052***
	[0.0425]	[0.0380]	[0.0515]	[0.0960]	[0.0732]	[0.0505]
ΔLog wage(-1)			0.4003			
			[0.2448]			
ΔLog sales(-1)			-0.1547			
			[0.1027]			
ΔLog wage*size(50-99)				-0.0052		
				[0.1324]		
ΔLog wage*size(100-249)				-0.0021		
				[0.1064]		
ΔLog sales*size(50-99)				-0.1052		
				[0.1522]		
ΔLog sales*size(100-249)				0.1466		
				[0.1282]		
ΔLog wage*period08/09					-0.3694	
					[0.3240]	
ΔLog sale*period08/09					0.2308**	
					[0.0946]	
ΔLog wage* period08/09*size(50-99)						-0.1093
						[0.6835]
ΔLog wage* period08/09*size(100-249)						-0.455
						[0.4627]
ΔLog sales* period08/09*size(50-99)						0.0888
						[0.2024]
ΔLog sales* period08/09*size(100-249)						0.2346***
						[0.0815]
N	12524	12524	12524	12524	12524	12524
Long-run wage elasticity	-0.916***		-0.739***	-0.915***	-0.936***	-0.875***
Long-run sales elasticity	0.843***		0.880***	0.762***	0.762***	0.816***
Hausman test for exogeneity of sales[x]	42.90***	56.09***	28.34***	37.50***	85.34***	100.78***
Overidentifying restrictions test[xx]	99.24	172.40***	77.84	97.96	88.75	97.77

Note: *** p<0.01, ** p<0.05, * p<0.1; heteroskedasticity-robust standard errors in brackets. Industry dummies not reported.

[x] F-statistics and significance level reported (H0: real sales are exogenous).

[xx] Chi2-statistics and significance level reported (H0: overidentifying restrictions not rejected).

Table 6: Employment Elasticities with Respect to Real Wages and Real Sales

	(1)	*(2)*	*(3)*	*(4)*
Period	2002-2007	2008-2009	2002-2007	2008-2009
Short run				
Wages	-0.532***	-0.901***	-0.532***	-0.404**
	[0.107]	*[0.282]*	*[0.090]*	*[0.161]*
Sales	0.433***	0.664***	0.395***	0.553***
	[0.073]	*[0.050]*	*[0.067]*	*[0.066]*
Long run				
Wages	-0.936***	-1.586***	-0.934***	-1.181**
	[0.190]	*[0.529]*	*[0.163]*	*[0.518]*
Sales	0.762***	1.168***	0.694***	1.616**
	[0.085]	*[0.189]*	*[0.065]*	*[0.643]*

Note: (1)–(2) based on column 5 in Table 5;
(3) based on column 1 in Table 5 estimated in 2002–2007;
(4) based on column 1 in Table 5 estimated in 2008–2009;
(5)–(6) based on column 5 in Table 5, balanced sample;
heteroskedasticity-robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1.

Table 7a: Employment Elasticities with Respect to Real Wages – Firm-Level Estimates

Country	Estimation period	Short-term	Long-term	Study
Croatia	1995-2000	-0.69	-1.01	Domadenik and Vehovec (2003)
Czech Rep.	1989–1990	-0.39	n.a.	Basu et al. (2005)
Czech Rep.	1990–1991	insign.	-1.19	Basu et al. (2005)
Czech Rep.	1991–1992	-0.96	insign.	Basu et al. (2005)
Czech Rep.	1992–1993	-0.61	insign.	Basu et al. (2005)
Czech Rep.	1992–1993, M	-0.04...-0.07	-0.07...-0.11	Singer (1996)
Czech Rep.	2002–2007	-0.53	-0.94	This study
Czech Rep.	2008–2009	-0.90	-1.60	This study
Hungary	1986–1989	-0.56	n.a.	Köllõ (1997)
Hungary	1986–1989	-0.50…-1.41	-1.61…-1.88	Körösi (1998)
Hungary	1988–1989	insign.	n.a.	Basu et al. (2005)
Hungary	1989–1990	insign.	insign.	Basu et al. (2005)
Hungary	1989–1992	-0.17	n.a.	Köllõ (1997)
Hungary	1990–1991	insign.	-4.76	Basu et al. (2005)
Hungary	1990–1995	-0.44…-1.07	-1.60…-2.62	Körösi (1998)
Hungary	1991–1992	-0.83	-5.02	Basu et al. (2005)
Hungary	1992–1993	-0.25	n.a.	Köllõ (1997)
Macedonia	1994–1999	-0.43...-0.68	-1.25...-2.76	Micevska (2008)
Poland	1988–1989	-0.40	n.a.	Basu et al. (2005)
Poland	1988–1989	-0.22	-0.7*	Basu et al. (1997)
Poland	1989–1990	-0.48	-0.51	Basu et al. (2005)
Poland	1989–1990	-0.41	-1.00*	Basu et al. (1997)
Poland	1989–1990	-0.03	n.a.	Grosfeld and Nivet (1997)
Poland	1990–1991	-0.57	-0.70	Basu et al. (2005)
Poland	1992–1993	-0.29	-0.71*	Basu et al. (1997)
Poland	1992–1994	-0.13	n.a.	Grosfeld and Nivet (1997)
Slovak Rep.	1989–1990	-0.33	n.a.	Basu et al. (2005)
Slovak Rep.	1990–1991	0.40	insign.	Basu et al. (2005)
Slovak Rep.	1991–1992	-0.25	n.a.	Basu et al. (2005)
Slovenia	1995–2000	-0.47	-0.40	Domadenik and Vehovec (2003)

Note: * Static (cross-sectional) estimates; insign. – estimates which are not statistically significant at 10% level; n.a. – not available.

Source: Svejnar (1999), Micevska (2008) and authors' updates.

Table 7b: Employment Elasticities with Respect to Sales (Output) – Firm-Level Estimates

Country	Estimation period	Short-term	Long-term	Study
Croatia	1995–2000	0.43	0.94	Domadenik and Vehovec (2003)
Czech Rep.	1989–1990	insign.	n.a.	Basu et al. (2005)
Czech Rep.	1990–1991	0.12	0.94	Basu et al. (2005)
Czech Rep.	1991–1992	0.59	0.94	Basu et al. (2005)
Czech Rep.	1992–1993	0.50	0.89	Basu et al. (2005)
Czech Rep.	1992–1993, M	0.03–0.05	0.05–0.07	Singer (1996)
Czech Rep.	2002–2007	0.43	0.76	This study
Czech Rep.	2008–2009	0.66	1.17	This study
Hungary	1986–1989	0.19	n.a.	Köllõ (1997)
Hungary	1986–1989	0.30–0.74	0.69–1.06	Körösi (1998)
Hungary	1988–1989	0.60	n.a.	Basu et al. (2005)
Hungary	1989–1990	0.24	insign.	Basu et al. (2005)
Hungary	1989–1992	0.35	n.a.	Köllõ (1997)
Hungary	1990–1991	0.65	0.77	Basu et al. (2005)
Hungary	1990–1995	0.53–0.79	0.52–0.97	Körösi (1998)
Hungary	1991–1992	0.46	0.84	Basu et al. (2005)
Hungary	1992–1993	0.23	n.a.	Köllõ (1997)
Macedonia	1994–1999	0.31–0.57	0.85–1.31	Micevska (2008)
Poland	1988–1989	0.23	n.a.	Basu et al. (2005)
Poland	1988–1989	0.34	0.83*	Basu et al. (1997)
Poland	1989–1990	0.15	0.45	Basu et al. (2005)
Poland	1989–1990	0.25	0.81*	Basu et al. (1997)
Poland	1989–1990	0.06	n.a.	Grosfeld and Nivet (1997)
Poland	1990–1991	0.19	0.23	Basu et al. (2005)
Poland	1992–1993	0.23	0.72*	Basu et al. (1997)
Poland	1992–1994	0.25	n.a.	Grosfeld and Nivet (1997)
Slovak Rep.	1989–1990	0.10	n.a.	Basu et al. (2005)
Slovak Rep.	1990–1991	0.06	0.97	Basu et al. (2005)
Slovak Rep.	1991–1992	0.33	n.a.	Basu et al. (2005)
Slovenia	1995–2000	0.54	0.86	Domadenik and Vehovec (2003)

Note: * Static (cross-sectional) estimates; insign. – estimates which are not statistically significant at 10% level; n.a. – not available.

Source: Svejnar (1999), Micevska (2008) and authors' updates.

Table 8: Firms' Response to a Fall in Demand: Which of the Following Strategies Were Relevant or Very Relevant to Facing a Fall in Demand?

	Reduce prices		Reduce margins		Reduce output		Reduce costs	
	2007	2009	2007	2009	2007	2009	2007	2009
Total	51.3	34.0	54.4	40.0	52.1	48.5	86.7	88.3
- manufacturing	49.4	37.2	57.9	44.1	62.4	71.0	87.7	92.3
- other industries[a)]	53.5	30.3	50.4	35.2	**40.0**	**21.5**	85.6	**83.9**
- small firms	38.1	28.4	44.0	28.4	33.7	39.6	90.1	84.2
- medium firms	54.6	34.0	63.7	45.3	45.1	45.0	83.5	76.0
- large firms	52.9	35.4	52.3	40.3	**59.9**	52.1	87.5	95.2
- exporters	53.2	39.1	52.6	42.7	64.8	67.4	85.8	93.9
- non-exporters	50.2	31.3	55.0	38.6	**46.6**	**38.7**	87.0	**85.5**

Note: Strategies adopted during crisis (answers received in June and July 2009 – 2009 columns). Answers to hypothetical reaction to unexpected fall in demand as received in autumn 2007 (2007 columns). Weighted answers in % from 241 firms with 20 or more employees.
[a)] Other industries in business sector. Small firms with 20–49 employees, medium-sized firms with 50–199 employees, large firms with 200 or more employees.
Exporters: Firms with more than half of revenue from sales of main product on foreign markets in 2006. Statistically significant differences from reference value (manufacturing, small firms, exporters) at 10% in bold.

Source: CNB ad-hoc survey.

Table 9: Main Channels through Which the Reduction of Costs Is Achieved

	Reduce base wages		Reduce flexible wage components		Reduce permanent employment		Reduce temporary employment		Adjust hours worked		Reduce non-labour costs	
	2007	2009	2007	2009	2007	2009	2007	2009	2007	2009	2007	2009
Total	0.0	3.9	18.3	25.1	18.7	42.9	26.6	37.5	3.5	12.2	42.4	54.6
- manufacturing	0.0	4.1	11.4	25.4	19.2	52.6	31.1	43.1	4.4	17.9	43.6	43.8
- other industries[a)]	0.0	3.7	**26.0**	24.7	18.2	**31.9**	21.6	**31.1**	2.5	**5.7**	41.0	**66.9**
- small firms	0.0	2.8	23.3	17.9	17.3	27.8	26.5	29.3	0.0	2.8	54.8	49.3
- medium firms	0.0	6.7	23.9	39.7	17.9	36.6	20.4	44.0	7.1	17.3	36.6	57.4
- large firms	0.0	2.8	14.4	20.0	19.4	49.3	29.5	36.5	2.7	12.1	42.0	54.5
- exporters	0.0	7.3	10.0	27.0	16.5	55.4	35.6	41.0	2.6	25.3	39.9	49.0
- non-exporters	0.0	**2.3**	**22.5**	24.4	20.0	**36.7**	**22.0**	35.7	4.0	**6.1**	43.5	57.9

Note: See previous table

Source: CNB ad-hoc survey.

Appendix: Additional Results

Table A1: Labour Demand Estimates by Firm Size, 2002–2009

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	size (50–99)		size (100–249)		size (250+)	
ΔLog labour (-1)	0.3662**	0.3807**	0.3968***	0.4584***	0.4477***	0.5258***
	[0.1648]	[0.1677]	[0.0602]	[0.0789]	[0.0831]	[0.0896]
ΔLog wage	-0.6725***	-0.6653***	-0.4854***	-0.3878***	-0.4487***	-0.4825***
	[0.1861]	[0.2049]	[0.1100]	[0.1280]	[0.1277]	[0.1600]
ΔLog sales	0.4700***	0.4544***	0.5211***	0.4518***	0.4901***	0.3259***
	[0.0700]	[0.0896]	[0.0420]	[0.0858]	[0.0674]	[0.0838]
ΔLog wage*period08/09		-0.2147		-0.3047		0.0882
		[0.4487]		[0.2815]		[0.2675]
ΔLog sales*period08/09		0.259		0.1317		0.3767***
		[0.1662]		[0.1097]		[0.1105]
N	2322	2322	5969	5969	4233	4233
Long-run wage elasticity	-1.061***	-1.074***	-0.805***	-0.716***	-0.812***	-1.018***
Long-run sales elasticity	0.742***	0.734***	0.864***	0.834***	0.887***	0.687***

Note: Based on columns (1) and (5) in Table 5.

Heteroskedasticity-robust standard errors in brackets; *** p<0.01, ** p<0.05, * p<0.1. Industry dummies not reported.

Table A2: Estimation Results Using Short Panels[a)] – Basic Specification

	2002	2003	2004	2005	2006	2007	2008	2009
Own workers								
ΔLog wage	-0.4783***	-0.5176***	-0.6124***	-0.3819**	-0.9952***	-0.5042***	-0.6044***	-0.4603***
	[0.1231]	[0.1182]	[0.1400]	[0.1584]	[0.2319]	[0.1544]	[0.1302]	[0.1699]
ΔLog sales	0.4442***	0.4257***	0.4196***	0.3855***	0.3136***	0.3262***	0.4493***	0.5134***
	[0.0570]	[0.0633]	[0.0566]	[0.0980]	[0.1040]	[0.0890]	[0.0964]	[0.0540]
N	1660	1816	2095	1558	1433	1356	1277	1329
Haus. test	0.92	2.57	0.52	0.39	0.44	0.62	0.73	2.72*
Own and TWA workers								
ΔLog wage					-0.9749***	-0.4721***	-0.6326***	-0.4974***
					[0.2400]	[0.1665]	[0.1361]	[0.1712]
ΔLog sales					0.3152***	0.3380***	0.4582***	0.5152***
					[0.1044]	[0.0836]	[0.0966]	[0.0535]
N					1433	1356	1277	1329
Haus. test					0.68	0.65	0.51	1.09

Note: [a)] For each year listed in the table, observations from the current and two previous years are used to produce the estimations. *** p<0.01, ** p<0.05, * p<0.1, heteroskedasticity-robust standard errors in brackets. Industry dummies not reported. Hausman test for exogeneity of sales (H0: real sales are exogenous, F statistics reported).

Table A3: Estimation Results Using Short Panels – Dynamic Specification

	2002	2003	2004	2005	2006	2007	2008	2009
Own workers								
ΔLog labour (-1)	0.1282**	0.4212***	0.1578	0.1575**	0.5240***	0.5155***	0.4628***	0.4087***
	[0.0605]	[0.1234]	[0.1058]	[0.0769]	[0.0804]	[0.0834]	[0.1338]	[0.1448]
ΔLog wage	-0.5157***	-0.5525***	-0.5874***	-0.4858***	-0.9173***	-0.3539**	-0.5369***	-0.4914***
	[0.1227]	[0.1249]	[0.1346]	[0.1590]	[0.2076]	[0.1397]	[0.1342]	[0.1622]
ΔLog sales	0.4142***	0.3535***	0.3849***	0.3869***	0.2360***	0.2650***	0.3905***	0.4681***
	[0.0597]	[0.0631]	[0.0650]	[0.1045]	[0.0807]	[0.0796]	[0.1050]	[0.0582]
N	1660	1816	2095	1558	1433	1356	1277	1329
LR wage el.	-0.592***	-0.955***	-0.697***	-0.577***	-1.927***	-0.73**	-0.999***	-0.831***
LR sales el.	0.475***	0.611***	0.457***	0.459***	0.496***	0.547***	0.727***	0.792***
Haus. test	0.25	1.07	0.22	0.51	0.74	1.10	0.48	1.46
Own and TWA workers								
ΔLog labour (-1)						0.4940***	0.3649**	0.3457**
						[0.0805]	[0.1824]	[0.1416]
ΔLog wage						-0.3597**	-0.5790***	-0.5286***
						[0.1565]	[0.1462]	[0.1628]
ΔLog sales						0.2726***	0.4119***	0.4781***
						[0.0753]	[0.1075]	[0.0573]
N						1356	1277	1329
LR wage el.						-0.711**	-0.912***	-0.808***
LR sales el.						0.539***	0.649***	0.731***
Haus. test						1.19	0.34	0.46

Note: See Table A2.

Table A4: Estimation Results Using Short Panels, Balanced Sample – Basic Specification

	2002	2003	2004	2005	2006	2007	2008	2009
Own workers								
ΔLog wage	-0.2968***	-0.4631***	-0.6078***	-0.4272***	-0.6889***	-0.3810**	-0.4180***	-0.6416***
	[0.1096]	[0.1614]	[0.1293]	[0.1630]	[0.1553]	[0.1545]	[0.1432]	[0.1764]
ΔLog sales	0.3861***	0.4272***	0.3871***	0.3482***	0.2378***	0.2370***	0.2831***	0.5430***
	[0.0611]	[0.0920]	[0.0678]	[0.0538]	[0.0685]	[0.0648]	[0.0590]	[0.0928]
N	700	770	876	857	876	874	843	839
Haus. test	0.87	3.58*	0.04	1.77	0.04	0.10	0.07	2.49
Own and TWA workers								
ΔLog wage					-0.6528***	-0.3840*	-0.4405***	-0.6404***
					[0.1852]	[0.2106]	[0.1535]	[0.1790]
ΔLog sales					0.2386***	0.2404***	0.3311***	0.5513***
					[0.0694]	[0.0676]	[0.0619]	[0.0921]
N					876	874	843	839
Haus. test					0.26	0.01	0.07	1.58

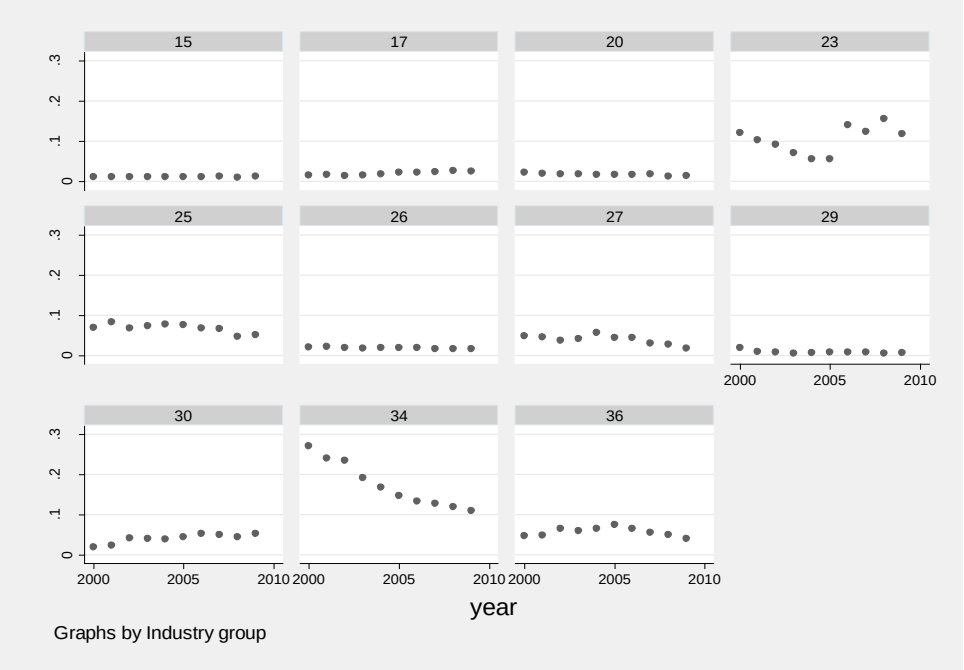
Note: See Table A2.

Table A5: Estimation Results Using Short Panels, Balanced Sample – Dynamic Specification

	2002	2003	2004	2005	2006	2007	2008	2009
Own workers								
ΔLog labour (-1)	0.2427***	0.3795***	0.1055	0.2437***	0.4183***	0.4357***	0.2876	0.3747***
	[0.0580]	[0.0871]	[0.0857]	[0.0764]	[0.0860]	[0.0985]	[0.2095]	[0.1038]
ΔLog wage	-0.3145***	-0.5264***	-0.5824***	-0.4443***	-0.6500***	-0.2045	-0.4306***	-0.5863***
	[0.1087]	[0.1534]	[0.1257]	[0.1511]	[0.1483]	[0.1418]	[0.1437]	[0.1717]
ΔLog sales	0.3806***	0.3587***	0.3521***	0.2756***	0.1953***	0.2068***	0.2548***	0.4861***
	[0.0611]	[0.0910]	[0.0750]	[0.0608]	[0.0590]	[0.0583]	[0.0608]	[0.0915]
N	700	770	876	857	876	874	843	839
LR wage el.	-0.415***	-0.848***	-0.651***	-0.587***	-1.117***	-0.362	-0.604***	-0.938***
LR sales el.	0.503***	0.578***	0.394***	0.364***	0.336***	0.367***	0.358***	0.777***
Haus. test	1.64	1.51	0.09	0.34	0.15	0.04	0.26	0.98
Own and TWA workers								
ΔLog labour (-1)						0.4141***	0.0934	0.2985***
						[0.0858]	[0.2823]	[0.1019]
ΔLog wage						-0.2528	-0.4501***	-0.6021***
						[0.2153]	[0.1451]	[0.1751]
ΔLog sales						0.2179***	0.3209***	0.5026***
						[0.0602]	[0.0679]	[0.0919]
N						874	843	839
LR wage el.						-0.431	-0.496***	-0.858***
LR sales el.						0.372***	0.354***	0.717***
Haus. test						0.00	0.03	0.44

Note: See Table A2.

Table A6: Herfindahl Index of Concentration in Manufacturing Industry Groups, 2000–2009



Note: Sum of squared market share of each firm in industry (based on sales; firms with 20 or more employees).

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