EMPLOYMENT AND PRODUCTIVITY IMPLICATIONS OF CHANGES IN THE SLOVAK EMPLOYMENT PROTECTION LEGISLATION

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Abstract

The purpose of this thesis is to assess the effects of the Slovak labor code amendments on firm-level productivity and employment. Before 2007 and after 2011, firing costs were lower as employers could choose between paying severance payment or notice period wage in case of dismissal. These legislative changes are studied to evaluate their employment and productivity implications by using a panel of firms and a difference-in-differences methodology with fixed effects. The thesis takes advantage of the heterogeneity in the factors of production in different industries in a way that more labor-intensive and more volatile industries are expected to be affected to a larger extent. The results suggest that employment turnover decreased after the more stringent dismissal conditions were introduced in 2007; however labor productivity and total factor productivity (TFP) increased, although only for manufacturing firms.

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List of abbreviations

Amadeus	Analyze Major Databases from European Sources
BvD	Bureau van Dijk
CAPEX	Capital expenditures
CD	Cobb-Douglas
DiD	Difference-in-Differences
EPL	Employment protection legislation
FE	Fixed effects
LP	Levinsohn – Petrin
NACE	Statistical classification of economic activities in the European Community
OLS	Ordinary Least Squares
OP	Olley-Pakes
PTA	Parallel trends assumption
SDKÚ-DS	Slovak Democratic and Christian Union – Democratic Party
SMER	Direction – Social Democracy, party in Slovakia
TFP	Total factor productivity
VA	Value added
UB	Unemployment benefit

Introduction

The flexibility of the labor market is a politically sensitive topic. One does not have to go far back in time to remember the protests on the streets of Budapest in the winter of 2018-19 against the labor code amendment which increased the statutory maximum of yearly overtime working hours from 250 to 400 and allowed overtime compensations to be delayed by three years for employees in a working time banking framework[1]. The great upheaval is understandable in a sense that employees generally prefer to maintain some bargaining power in their relation with employers. Employment protection legislation (EPL) is one possible policy tool to achieve this goal as it can stabilize employment by making the dismissal of employees costly for the firms.

On the other hand, excessive employment protection can create frictions in the labor markets as it imposes adjustment costs on firms in relation to hiring and firing (Mortensen and Pissarides, 1994). EPL can also create bad incentives such as shirking from effective work. However, stricter EPL can also be productivity-enhancing in imperfect product markets by incentivizing employees to invest in firm-specific skills and firms to invest in the quality of their workforce (rather than in the quantity) and in more R&D (Koeniger, 2005). Moreover, with lower employment flows, firms do not need to spend as much on trainings for new hires than in a more flexible environment. Thus, the overall effect depends on which channel is more important. Empirical results up to now are inconclusive and highly context-specific.

In recent practice, reforms mostly pointed towards reducing dismissal costs. Many countries have decreased the level of employment protection in the EU against the backdrop of the Great Recession and the European debt crisis in order to tackle mounting cyclical unemployment and the problem of low productivity. Furthermore, less strict EPL was intended

[1] Read more about the amendment of the Hungarian Labour Act:
https://index.hu/english/2018/12/12/hungary_parliament_overtime_passed_scandal_chaos_overtime_banking_protest/
https://www.ft.com/content/609e64c4-03a3-11e9-99df-6183d3002ee1
https://www.ft.com/content/a0268234-fd59-11e8-aebf-99e208d3e521

to lessen the duality of the labor markets where temporary workers are highly vulnerable to shocks while permanent workers are heavily protected from layoffs (Blanchard et al., 2013). The flexibilization involved severance payments cuts in Spain, Portugal, Poland and Estonia; the legally mandated notice period has been shortened in Slovenia; while in Hungary and Italy the possibility of reinstatement as a remedy for unfair dismissal has been reduced in the early 2010s (Armour et al., 2016).

This thesis studies the employment and productivity effects of changes in the legislation in Slovakia. The case of Slovakia is especially interesting as EPL was a cornerstone of the labor market reforms in the 2000s and it mostly evolved together with the electoral cycles in the country. The two governments led by Mikuláš Dzurinda as Prime Minister between 1998 and 2006 implemented policies to increase the competitiveness of the country in pursuit of the EU accession process. As part of this agenda, the second Dzurinda government abolished the simultaneous obligation of notice period wage and severance payment in 2002. However, one year after the Smer-SD party came into power in 2006, this was reintroduced, only to be abolished again in 2011 by the short lived Radičová government (Domonkos, 2016).

These changes in the labor code make it possible to study the effect of employment protection legislation on firm-level productivity and employment in the Slovak Republic using firm-level data. This thesis evaluates the effect of change in the legislation by exploiting industry-specific heterogeneity in labor-intensity and volatility by means of a similar identification strategy that Dougherty et al. (2011) used. While the results are not necessarily generalizable to other countries, I believe that this thesis can contribute to the literature of the employment and productivity implications of EPL by studying the policy changes in Slovakia. Moreover, to my knowledge, there have been only limited previous research conducted using microdata in the Central European region to evaluate the relationship between employment, firm productivity and EPL.

In this thesis, I use a difference-in-differences methodology with fixed effects to identify the employment and productivity effects of the changes in the Slovak employment protection legislation. The results indicate that higher dismissal costs decreased the employment flows from 2007 in both the manufacturing and services sectors. However, it appears that the effect on employment levels is ambivalent; while employment levels are likely to have decreased for manufacturers that are affected to a larger extent, the number of workers grew in the services sectors. The results show that both labor productivity and total factor productivity increased for manufacturing firms in the regime with higher dismissal costs; however there are no significant productivity differences in the case of services. It appears that medium-size and more liquid firms benefited the most from the productivity gains. Besides, absolute employment flows decreased the most for larger companies in the years of higher dismissal costs.

The remainder of the thesis is organized as follows. In Chapter 1, the literature is summarized in relation to EPL, employment and productivity. Chapter 2 provides background information about the Slovak labor market and the context of the changes of the EPL. Chapter 3 is devoted to the description of the data. Section 4 explains the empirical strategy, including the estimation of total factor productivity and the main model. In Section 5, the results are presented along with robustness checks and the study of heterogeneities. In the last part of the thesis, the policy implications of the findings are discussed and the conclusions are drawn.

Chapter 1. Literature review

1.1. The institution of employment protection legislation

Employment protection legislation consists of rules and procedures that regulate the hiring and dismissing of workers. The most important elements of EPL include the regulation of probationary periods, notice periods, severance payments, the procedural requirements and potential sanctions of individual and collective dismissals, and the regulation of fixed-term contracts (European Commission, 2017). Thus, EPL is one subset of labor standard regulation along with other institutions such as working time regulations, work-related safety rules, maternity and sick leaves and possibilities of worker representation.

Historically, EPL coverage expanded together with the growth of the welfare states in the second half of the 20th century among developed countries. It can be viewed as the third generation of regulation of labor after limiting working time from the second half of the 19th century and the introduction of unemployment insurance systems from the early 1910s. EPL started to become part of the national legislations only after 1963, when the International Labour Organization (ILO) published its recommendations concerning termination of employments (Aleksynska and Schmidt, 2014).

There are two main rationales behind the existence of the institution. The first is based on an insurance logic while the second focuses on the social costs of labor market uncertainties. I argue that both of these approaches can be derived from the notion of market failures, specifically from negative externalities. In the theoretical framework of Bertola (2004), employers have perfect access to capital markets and hence, they can insure themselves against the whims of the market. On the other hand, employees are unprotected from labor market fluctuations. In this setting, it can be beneficial for both sides to smooth the effective income of a worker by paying severance payment in the event of dismissal in exchange for lower salary. As this

insurance contract only applies in case of dismissal on economic grounds, a third player (e.g. court) is also needed to evaluate the "fairness" of the dismissal.

The second approach is conceptually not very far from the first one; the main difference is that it focuses on the societal effects and does not necessarily view the relationship between employers and employees as a contract between two similarly empowered parties. The main argument is that the social costs borne by the taxpayers stemming from the dismissal of employees can be higher than the resulting benefit for the firm due to the loss of the employee's firm-specific skills (Hamermesh, 1987). Moreover, long-term unemployment spells are frequently associated with negative social and health effects. Consequently, EPL can be viewed as a policy instrument to internalize the social costs associated with dismissals.

Unemployment benefits can serve the same goal; the key difference between the two is that EPL only protects those from unemployment who are already employed. Therefore, as pointed out by Boeri and Ours (2008), EPL is a redistributive policy tool that has the potential to be less favorable for groups that face more difficulties to enter the labor markets (e.g. the youth and prime-aged women). However, EPL internalizes the social cost of the firing decisions of firms, while UB does not. Boeri et al. (2003) developed a model where the politico-economic equilibrium of the tradeoff between UB and EPL depends on the skill and age structure of the society where the majority prefers EPL if there are more low-skilled employed individuals. This politico-economy approach is useful to provide an explanation for equilibrium outcomes, yet most of the policy analysis focuses on the complementarities and the optimal mix of UB and EPL to maximize social welfare.

EPL has two main components: a transfer component which includes severance payment and notice period salary, and a tax component which refers to procedural costs of dismissals such as trial costs (Boeri and Ours, 2008). If there is a non-zero tax component, the effective cost of labor is higher than in absence of employment protection. This is the case as it is only possible to

intertemporally smooth the transfer part of the costs of dismissal between employees and employers. Additionally, the cost of labor is likely to be higher with EPL when wages are not fully flexible, for instance when there are minimum wage laws in force.

The strictness of employment protection between countries is most commonly compared by the summary indicator of the OECD. The 21 components of this measure are categorized into three main groups: regular contracts, temporary contracts and collective dismissals. The three sub-indexes of regular contracts are procedural inconveniences of dismissals, notice and severance pay conditions and difficulty of dismissal which includes the legal definition of unfair dismissal and possibilities of reinstatement. The two sub-indexes of the temporary contract indicator are fixed-term contracts and temporary work agency employment (OECD, 2013). Countries are given a score based on these aspects.

However, one of the main shortcomings of the OECD indicator is that it does not account for differences in enforcement and implementation. Furthermore, comparison between countries is more problematic when differences are qualitative rather than quantitative. For example, it is straightforward to compare the required severance payment as a function of job tenure, but it is not easy to measure procedural dissimilarities or different conditions for the applicability of the unfair dismissals clause.

General patterns show that southern-European and Nordic countries have stricter EPL while Anglo-Saxon countries have more relaxed regulations. Botero et al. (2004) emphasized the differences between common law and civil law traditions to explain this phenomenon: Anglo-Saxon countries and former British colonies with common law tradition rely more on freedom of contracts while the civil law tradition has a more prescriptive nature. However, as pointed out by Skedinger (2010), this explanation cannot account for the changes in EPL over time.

1.2. The relationship between EPL and employment

The link between EPL, employment and unemployment is far from obvious in the theoretical and empirical literature. One common robust finding, however, is that EPL reduces employment flows and increases job tenures but simultaneously also raises the duration of unemployment. This is understandable as higher dismissal costs make firms more reluctant to dismiss their employees and less prone to hire their new recruits at the same time knowing that their potential dismissal in the future will be more costly. If employment protection reduces turnover, the policy tool can have an anticyclical effect in a sense that it reduces firings in times of recession and may decrease hirings during expansionary periods. However, there is no certainty about the symmetrical effects of EPL depending on the business cycle; it is possible that EPL have more adverse effects after a crisis period and it has the potential to slow down employment growth after it (Blanchard and Wolfers, 2000).

Similar to theoretical expectations, the empirical effects of EPL on employment and unemployment are ambiguous. Some studies found no evidence that stringent EPL would have a significant effect of unemployment or employment (Bassanini and Duval, 2006; Cazes and Nesporova, 2004). Autor et al. (2007) found positive effect of EPL on employment levels, whereas Feldmann (2003) and Botero et al. (2004) estimate higher unemployment rates and lower employment rates associated with stricter employment protection. The clear prediction of lower employment turnover, however, seems to be mostly confirmed by empirical research (Autor et al., 2007; Kugler, 2004). Furthermore, Baboš and Lubyova (2016) find that the probability of exiting unemployment fell by nearly 40% after increasing firing costs in Slovakia in 2007.

Although there is no unequivocal theoretical expectation related to the effect of EPL on overall employment levels, it is likely that EPL has a differential impact on employment based on socioeconomic characteristics. As some elements of EPL such as severance payment and notice period increases with tenure, firms may opt for keeping older employees and refrain from firing

them even if they are not as productive as expected. As workers entering the labor market are typically young, the decreased hiring rate is likely to affect younger generations to a larger extent. Furthermore, it is likely that prime-age women are also more disadvantaged as they may face more entry problem (OECD, 2004).

Some empirical results also reinforce the notion of this heterogeneous effect of EPL. Feldmann (2003), Skedinger (1995) and Botero et al. (2004) find that stringent EPL reduces employment rates and increases the prevalence of unemployment especially among young age groups. Heckmann and Pagés (2000) finds a higher positive relationship between stringent EPL and unemployment for women in their cross-country study.

When examining the effects of the stringency of employment protection one also needs to take into account the regulation and availability of fixed-term contracts. If the protection of these workers is significantly lower compared to workers with regular contracts, firms can circumvent the strict EPL and choose to employ more temporary workers if they want to avoid high dismissal costs. Thus, it is possible that employment flows do not decrease to a large extent with strict EPL when it is relatively easy to dismiss temporary workers. The coexistence of strictly regulated regular contracts and loosely regulated fixed-term contract can result in high labor market segmentation where insiders with regular contracts are well-protected, but outsiders with temporary contracts are easily replaceable. Young (2003) argues that when wages based on fixed-term and permanent contracts are in close relation, the bargaining position of insiders grow as they know that in case of higher wages, employees with permanent contracts are the ones who are dismissed first. Thus, it is possible that the liberalization of permanent contracts decreases employment levels.

Empirical findings mostly confirm the potential threat of labor market segmentation when there is a considerable difference between the protection of regular and permanent contracts. The study of Blanchard and Landier (2002) highlights that the transition rate between temporary and

permanent jobs can be very low when this difference is large in France; furthermore employees go through unemployment spells before they find a permanent job which can entail considerable negative effects of lost human capital.

1.3. The relationship between EPL and productivity

Like the theoretical and empirical literature on the connection between EPL and employment levels, there are no unambiguous effects of stricter regulation on firm and labor productivity. The problem is the same as before: there are multiple possible mechanisms that can point to different directions and only the aggregate outcome is observable for the researcher in absence of feasibility of ideal experimental design.

Stringent EPL may have a negative effect on firm productivity by reducing workers' effort due to higher perceived job stability. For instance, Ichino and Riphahn (2005) find that after the mandatory 12 week long probation period without employment protection, absenteeism in Italian firms becomes more likely. Shirking may be an optimal strategy for employees if it is difficult to monitor performance. When the production process is more standardized and in case there is a tangible and both quantitatively and qualitatively measurable physical output, the probability of shirking may be lower. Thus, intuition suggests that shirking is more prevalent in the services sectors than in manufacturing.

EPL may reduce labor productivity by slowing down the process of creative destruction. Due to lower employment dynamics, more people stay in unproductive or less productive jobs and hence the creation of new jobs may also slow down. On the other hand, as Belot et al. (2002) points out, when job security is higher, labor productivity may also increase through the channel of higher willingness of workers to invest in firm-specific human capital. If it was possible to

dismiss employees at will, they would be less inclined to attain firm-specific skills. Moreover, productivity can also rise as job security may increase the commitment by workers to the firm.

The cost of hiring and firing also affects the willingness of firms to innovate and thus it can change their total factor productivity (TFP). Koeniger (2005) developed a model where strict EPL can encourage innovation by making firms more eager to reduce the probability of exit from the market as it would mean higher dismissal costs. This is possible when the market is not overly competitive, so technological advancement is an important factor of staying in the market. On the other hand, companies can be discouraged from innovation when markets are closer to perfect competition and the possible gains from technology do not outweigh dismissal costs.

As all of these channels can work simultaneously, there is no clearly identifiable effect of EPL on productivity and empirical results are also mixed. Dougherty et al. (2011) examined Indian manufacturing firms and exploited state- and industry-level variation in EPL. They found positive overall effect of relaxed employment protection on labor productivity and TFP. Similarly, Bjuggren (2018) studied the relaxation of seniority rules in Sweden and found negative labor productivity and total productivity effects.

On the other hand, Dolado and Strucchi (2016) used firm-level data in Spain and discovered a negative relationship between the proportion of temporary workers and TFP. Additionally they found that higher conversion rates between temporary and regular contract is associated with higher TFP. Nickell and Layard (1999) report a positive impact of EPL on TFP in their cross-country comparison. Autor et al. (2007) found positive labor productivity and negative TFP effects of more stringent EPL in the US.

In the next part of the thesis, I focus on the specific context of the Slovak employment protection legislation which is followed by the analysis of the productivity and employment implications of the legislative changes.

Chapter 2. The context of EPL in Slovakia

The Slovak economy underwent a prolonged transition period from the centrally planned socialist system of Czechoslovakia to a market coordinated economy from the last decade of the 20th century. The initial shock of the transition was deeper in Slovakia than in Czech lands mostly due to the higher share of heavy machinery production and the existence of more one-factory towns (Jurajda and Mathernova, 2004). The economic restructuring involved systemic downsizing in the heavy industry with job shifting to the service sector.

The transition period entailed massive unemployment, hovering between 12% and 18% in the 90s and constantly above 10% in the 2000s as well, aggravated by the crisis (OECD, 2019b). Long-term unemployment rates were constantly higher than 40% and remained so up to 2019 which is ominously higher than in the other Visegrád countries (OECD, 2019c). As a result of these rather unfortunate phenomena, the reduction of high unemployment remained the focal point of labor market policy goals independent of political affiliation. However, the means of achieving this goal greatly varied and different governments used different elements of the policy mix of unemployment benefits, EPL and active labor market policies (Domonkos, 2016). It can be generally said that left-leaning governments advocated stricter EPL while the centre-right coalition espoused greater flexibilization and pro-market policies (Fabo and Sedláková, 2017).

Pro-market policies gained particular political acceptance after the country was left out from the first round of the EU accession negotiations on accounts of inadequate democratization, corruption and fiscal profligacy during the Mečiar government between 1994 and 1998 (Zachar and Goliaš, 2010). As a result, the new centre-right coalitional government formed in 1998 and led by Mikuláš Dzurinda put pro-market labor market policies, structural reform of the banking sector, financial openness and fiscal discipline high on the agenda to facilitate the integration process. Furthermore, the reforms involved the simplification of the

taxation system by introducing a 19% flat income tax and the same rate for corporate income tax and VAT. The country attracted a considerable amount of foreign direct investment which contributed to increasing rate of economic growth and made Slovakia an important regional hub in the automotive industry (Frigant and Miollan, 2014).

The requirement of fiscal discipline was coupled by the retrenchment of the welfare state and the flexibilization of the labor market. The first important modification in the labor code was carried out in 2003, effective from July (210/2003). It followed the recommendations of the OECD (2002) to reduce the costs of firing and hiring that was presented as a mayor threat of job creation. As a result, termination of employment became more flexible as prior to the reform the law prescribed compulsory three month notice period plus severance payment of two months in case of organizational dismissal.

As Table 1 shows, the amendment changed this in a way that that employers could choose between paying two month of notice period wage or two month of severance pay in case of employees employed for less than 5 years and three month of notice period wage or three month of severance pay for employees employed more than 5 years (Zachar and Goliaš, 2010). Furthermore, the reform made dismissal of temporary contracts easier and employers did not have to pay any social security contribution after these contracts (Fabo and Sedláková, 2017). These changes in the labor code resulted in the lowest EPL index score for temporary contracts at this time in the EU (OECD, 2019a).

The amendment also eased the dismissal procedure in case of unsatisfactory performance (Zachar and Goliaš, 2010). Additionally, the influence of trade unions was also significantly curtailed as after the amendment they lost their veto powers in relation to firing and organizational decisions (Jurajda and Mathernova, 2004). Altogether, all aspects of this reform package pointed towards a more relaxed employment protection.

Table 1. Evolution of dismissal costs in Slovakia.

Time period	Notice period	Severance payment	Logic
Before 2003 (organizational reasons)	3 months	2 months	AND
2003-2007			
Job tenure < 5 years	2 months	2 months	OR
Job tenure > 5 years	3 months	3 months	OR
2007-2011			
Job tenure < 5 years	2 months	2 months	AND
Job tenure > 5 years	3 months	3 months	AND
2011-2012			
Job tenure < 1 year	1 month	1 month	OR
1 year < Job tenure < 5 years	2 months	2 months	OR
Job tenure > 5 years	3 months	3 months	OR
2013-			
Job tenure < 1 year	1 month	0 month	AND
1 year < Job tenure < 2 years	2 months	0 month	AND
2 years < Job tenure < 5 years	2 months	1 months	AND
5 years < Job tenure < 10 years	3 months	2 months	AND
10 years < Job tenure < 20 years	3 months	3 months	AND
Job tenure > 20 years	3 months	4 months	AND

Notes: Table is based on Domonkos (2016) and Zachar and Golias (2010).

Nonetheless, with the change of the government in 2007, the trend toward liberalization reversed. As a result of the new Amendment of 348/2007, it was possible again to accumulate notice period wage and severance payment (see Table 1). Furthermore, in case of job separation due to occupational health risk, employees could get an amount equal to ten month's wages. The dismissal of temporary workers also became more difficult again (Domonkos, 2016).

With the onset of the financial crisis and growing unemployment, voices of greater flexibilization grew louder. The next centre-right Radičová government abolished the coexistence of severance payment and wage in the notice period once again, increased the maximum number and duration of fixed-term contracts and raised working hours in 2011. However, the tide changed again with the election of the second Fico government in 2012, and most of these amendments were revoked, effective from 2013 January 1. Moreover, legislation required

working agencies to hire workers based on standard employment contracts and social contributions were made mandatory for work-agreement contracts (Fabo and Sedláková, 2017).

In the following parts of the thesis, I will analyze the legislative changes between 2004 and 2013 in Slovakia. The change of 2007 will be in my main focus as most of the elements of the reform of 2011 were repealed in the beginning of 2013. As I only have data for the 2004-2013 period, it is not possible to thoroughly analyze the effects of the changes in the legislation in 2003 and 2013.

Chapter 3. Data

During the analysis, I rely on the Amadeus (Analyze Major Databases from European Sources) – European Company Data database collected and maintained by Bureau van Dijk Electronic Publishing. This is a proprietary database that contains financial information from balance sheets and income statements, descriptive data (e.g. address, phone number) and ownership characteristics on approximately 21 million private and public companies from 43 European countries. I focus on the financial branch of the data and complementary firm-specific variables. Slovakia-specific company data is provided by Creditinfo Slovakia s.r.o. (Bureau van Dijk, 2007). I use an unbalanced panel of Slovak firms between 2004 and 2013. This allows me to compare periods with more flexible employment protection legislation and less flexible ones. The tax numbers, as the unique identifier of firms, are anonymized in a hashing procedure by the CEU Microdata team; therefore it is not possible to directly identify companies, only through the hashed identifier.

This database contains firm-level information about 245,232 companies over the period of ten years (2004-2013) which covers most of the registered companies in Slovakia. The official number of registered firms was reported to be close to 260,000 in 2017 by Bisnode, a data analytics organization (Consultancy.eu, 2017). The scope of the database is naturally restricted to registered entities, so it is not possible to analyze the economic activity of companies in the black economy or the dynamics between registered and unregistered firms. However, it is possible that higher firing costs incentivize firms to engage in unrecorded activities.

The database contains balance sheet, income statement and other complementary information. All accounting variables are in book value in thousand EUR which may be different from the market value; nonetheless a comprehensive database is the best available choice for the

analysis and this kind of data is generally available only in book value[2]. The detailed available accounting variables and the structure of the balance sheets and income statements are presented in Appendix A. The complementary variables include the number of employees, place of operation or "city" and NACE industry codes (broken down to the fourth digit).

I only focus on companies where the accounting period coincides with the calendar year. The rationale behind this decision is comparability: as more than 99% of the companies use a 12 month long accounting period from January to December, records with different number of months would make comparison between years problematic. Furthermore, I remove companies with limited financial data; these firms account for one third of the database. They typically do not have data on sales and employees, so it would not be possible to do any relevant analysis with them to evaluate employment flows or productivity. Companies with nonsensical values (negative sales, negative costs, negative assets or negative number of employees) and non-operating ones are also dropped. I define non-operating companies with zero sales or zero assets.

As a basic accounting equality, the two sides of the balance sheet should be equal which can be expressed formally as:

$$Assets = Equity + Liabilities \quad (1)$$

If this condition is not fulfilled, it raises doubts about the reliability of the data. Therefore, as a rule, when the relative difference between the two sides of the balance sheet is greater than 2%, the observation is dropped. This correction affected 0.6% of the firms.

The data contains a few high extreme values in terms of sales that can potentially influence estimations. However, by using natural logarithms, it is possible to reduce the magnitude of this problem. Furthermore, since the database covers most of the Slovak firms, it cannot be viewed as a real sample. For this reason, extreme values are not excluded or windsorized as it would change

[2] The available data is already converted to EUR from SKK for the pre-2009 period.

the nature of the data. For similar reasons, I do not drop observations at the lower end of the distribution either.

In order to be able to compare years, values should be converted to constant prices. Without this step, one would implicitly assume that all sectors are affected by inflation in the same manner; however, this would be an overly simplistic approach. Consequently, industry differences were taken into account to deflate all of the accounting values by using sector-specific price indexes. Variables are always meant in deflated values in the remainder of the thesis, unless otherwise noted. Details on the deflation procedure are presented in Appendix B.

The proportion and the number of firms with low sales, assets and number of employees grew substantially in 2009; this is more than could be explained by the financial crisis and implies that there has been a systematic change in the coverage of the database by the inclusion of smaller firms. To account for this difference, companies corresponding to the condition of with less than 10 employees and with assets or sales worth less than 20 thousand EUR are also excluded. The data quality of smaller firms is usually inferior to bigger ones and small companies are also more likely to be influenced by personal relationships in their dismissal decisions; this is one additional reason to exclude these firms. The mean values of employees and the percentage of small firms by years are presented in Appendix C.1.

After the removal of the smallest companies, the distribution of the key variables is more balanced between years. I present summary statistics on Sales, Fixed assets, Number of employees and the proportion of the latter two (K/L ratio) in Table 2 and additional pooled histograms and line plots of these variables in Appendix C.2. As most of the key variables follow a lognormal distribution and the relative differences are of more importance than the absolute, I conduct the analysis with the natural logarithms of the values. From the summary statistics it is prevalent that the financial crisis left its mark on sales and fixed assets and the relative role of capital over labor increased. However, some part of this change may be due to the different

composition of the sample of firms after 2009. These variations in the sample are addressed by using firm fixed effects in the analysis.

Table 2. Summary statistics of key variables.

Variable	2006	2009	2012
Sales			
Mean	2.756	1,651	1281.4
Median	992	373	211.5
S.D.	4,879.2	3,713.8	3,360.4
Fixed assets			
Mean	1,139.4	832	1,281.4
Median	235.6	64	211.5
S.D.	2,599.4	2,416.1	3360.5
Number of employees (L)			
Mean	64.3	53	51.1
Median	23	23	23
S.D.	125.1	105.2	88.9
K/L			
Mean	26.6	29.9	28.6
Median	10.2	9.6	10.5
S.D.	75.8	83.8	63.7
Y/L			
Mean	68.9	33.4	34.8
Median	36.7	61.6	67.3
S. D.	108.6	100.7	116.4

Notes: Values of sales, total assets and capital are in 2010 EUR constant prices, after balancing the dataset along the 2009 cutoff. S. D. denotes standard deviation.

Based on the "city" variable, a region classifier was created with eight possible values, corresponding to the eight regions of Slovakia, namely: Bratislava, Košice, Banská Bystrica, Prešov, Nitra, Trenčín, Trnava and Žilina. As there are more than 2000 unique townships, I assigned cities to regions where there are more than 35 companies. By this method, only around 5% of the region value is missing on average. It appears that the proportion of firms in the Bratislava region increased substantially in the database in 2009. This remains to be the case after the exclusion of the smallest firms. The regional distribution of companies is presented in Table 3.

Table 3. Distribution of firms by region.

Region	2006	2009	2012
Bratislava	17.2 %	32.8 %	35.3 %
Nitra	12.1 %	11.3 %	11.2 %
Žilina	11.9 %	8.6 %	7.8 %
Košice	9.6 %	8.2 %	7.5 %
Trnava	15.4 %	12.6 %	12. 3 %
Banská Bystrica	8.3 %	6.9 %	7.0 %
Trenčín	10.8 %	7.5 %	6.9 %
Prešov	8.8 %	7.1 %	6.7 %
Missing	5.9 %	5.0 %	5.2%

Firms with real estate or financing services or other services as main sector identifiers are excluded as the production process of these sectors is hardly comparable to others or it aggregates multiple different activities (in case of other services). Furthermore, the book value presented on firms in the financial sector is likely to differ more from the market value. Hence, the thesis focuses on firms in the manufacturing and the services sector (excluding finance and real estate). 2-digit NACE divisions with too few observations are also dropped as the calculation of the sectorial production function would be very imprecise. The distribution of industries by main sectors is presented in Table 4.

Table 4. Number of firms by main sector category.

NACE Rev. 2 main section	Number of companies
A. Agriculture forestry and fishing	1,961
B. Mining and quarrying	90
C. Manufacturing	7,186
D. Electricity, gas, steam and air	325
E. Water supply; sewerage waste management	333
F. Construction	6,416
H. Transportation and storage	3,178
I. Accommodation and food service activities	2,178
J. Information and communication	3,307
M. Professional scientific and technical activities	10,950
N. Administrative and support service activities	4,863
Q. Human health and social work activities	1,072
R. Arts entertainment and recreation	617

Notes: Frequencies are reported on distinct firms over the panel after the removal of trade, financial services, real estate and other services sectors after the exclusion of small firms.

Chapter 4. Empirical strategy

To measure the effect of changes in the severance payment legislation, a treatment and a control group should be identified. Most of the studies of EPL exploit some variation in applicability such as firm size or geography. In case of the reforms of Slovakia, there is no clear rule-based distinction between treatment and control groups as the effect of the reforms was universal. Consequently, it is somewhat difficult to measure the effects of the legislative changes.

However, with some basic assumptions, it is possible to distinguish firms that are more likely to be affected by the reforms from those that are not. Although the assignment of treatment is probabilistic and not deterministic, it is still possible to get closer to the measurement of the impact of the legislation which has added value, provided that the direction of the effect between EPL and productivity is still ambiguous in the literature. The evidence is not necessarily generalizable to other countries, but I argue that it has a considerable explanatory power for Slovakia.

The two basic assumptions for identification were inspired by the study of Dougherty et al. (2011). These assumptions are the following:

1. Firms are more likely to be affected by EPL changes if they operate in labor-intensive industries.

2. Firms are more likely to be affected by EPL changes if they operate in more volatile industries.

The reasoning goes as follows. Consider a firm with three types of factors of production, namely labor (L), capital (K) and raw materials (M). Assuming a Cobb-Douglas production function, the output of the firm can be defined as:

$$Y = A * L^{\alpha} K^{ß} M^{\gamma} \quad (2)$$

subject to: $C = wL + rK + iM$

where A denotes Total factor productivity (TFP) and α, ß and γ represents the output elasticity with respect to labor, capital and materials, and w, r, and i stand for input prices of these factors, respectively. Based on the cost minimization objective, it can be derived that the unit cost is increasing as labor input prices are higher if other factors are not changing. The exact formula of the unit cost function is the following (see Derivation in Appendix D):

$$c = \left(w^{\left(\frac{\alpha}{\alpha+ß+\gamma}\right)} * r^{\left(\frac{ß}{\alpha+ß+\gamma}\right)} * i^{\left(\frac{\gamma}{\alpha+ß+\gamma}\right)}\right) * \left(\frac{(\alpha+ß+\gamma)*}{A\alpha^{\alpha}ß^{ß}\gamma^{\gamma}}\right)^{\frac{1}{\alpha+ß+\gamma}} \quad (3)$$

In a very simple framework higher severance payment can be viewed as an increase of the unit labor cost, if we define w as

$$w = sal + p * s \quad (4)$$

where *sal* is the salary, *p* is the probability of dismissal, and *sal* is the amount of the severance payment. Since severance payment is regarded as a component of *w*, firms with higher output elasticity with respect to labor (denoted by α) are more likely to be affected by the legislative changes of severance payment. This strategy is useful for identification as it does not imply anything about the direction of the relationship between severance payment and productivity, but it identifies companies that are more likely to be affected. If the unit cost of labor is higher, it can motivate firms to refrain from hiring less productive workers as the marginal product of a new worker is now lower in proportion to the real wage than before. On the other hand, firms might become more reluctant to dismiss their current workers which can result in lower effort of workers but it is also possible that firms start investing more in their available workforce.

Firms are also likely to be more affected if they need to frequently recalibrate their optimal mix of inputs. As a severance payment can be viewed as an adjustment cost, firms operating in industries with more uncertainties will supposedly react more intensively to the change of the input price of labor.

To test the employment impact of the legislative changes, differences of employment levels and flows will be compared between the two groups. Theory does not predict unambiguous consequences of higher dismissal cost on employment levels as EPL can simultaneously reduce occurrences of job separations and new hirings. On the other hand, higher dismissal costs are expected to lead to reductions in employment fluctuations unquestionably as a consequence of increased adjustment costs.

To test differences between employment flows, I will use the formula proposed by Autor et al. (2007):

$$ABS_{ft} = \frac{|E_{ft} - E_{ft-1}|}{(E_{ft} + E_{ft-1})/2} \quad (5)$$

where E_{it} is the employment level of a firm at time *t* and E_{it-1} is the employment level for the previous period. It is easy to see that this metric is bounded within the [0, 2] interval. Alternatively, employment flow can be measured by simply the employment growth rate:

$$\Delta \mathrm{Emp}_{\mathrm{ft}} = \frac{E_{ft} - E_{ft-1}}{E_{ft}} \quad (6)$$

Differences between treated and control sectors are compared by the following model:

$$Emp = \gamma * (\mathrm{LI}_i * \mathrm{Year}_t) + \theta * (\mathrm{Year}_t) + \zeta * \mathrm{Comp}_f + \iota X_{ft} + \eta_{fit} \quad (7)$$

where LI_i denotes labor-intensive industry, $Comp_f$ stands for firm fixed effects, and X_{ft} is a control variable matrix. *Emp* is either measured as employment level or as yearly absolute employment change from Equation (5) or by employment growth rate from equation (6).

For the measurement of productivity differences, I will inspect labor productivity and TFP. Labor productivity is defined as the amount of sales divided by the number of employees (Y/L). The number of working hours would admittedly be a better choice, but there is no

available data on it. As the average annual hours worked and the share of temporary workers did not change considerably during the examined period based on the statistics of OECD (2019a), this is unlikely to have a huge distortionary effect on the results. Unfortunately it is not possible to account for skill differences of workers based on the data.

An alternative measure of labor productivity is the ratio of the value added (VA) of the company and the number of employees. Value added is defined in the dataset as the sum of net income, taxation, costs of employees, depreciation and interest paid. This definition has the advantage that it is also the function of costs, but it also includes elements that are unlikely to be influenced by activities that are not closely related to operations such as financing and investment policy. For this reason, I propose an alternative VA measure which is defined as material costs subtracted from sales.

Total factor productivity is defined as the A parameter from equation (2). By taking the natural logarithm of this equation, TFP can be expressed as a residual term:

$$\ln(Y_{\mathrm{it}}) = \ln(A_{\mathrm{it}}) + \alpha * \ln(L_{\mathrm{it}}) + ß * \ln(K_{\mathrm{it}}) + \gamma * ln(M_{it}) + u_{it} \qquad (8)$$

However, the OLS estimation of the TFP residual is problematic as it does not take into account the possibility of serially correlated productivity shocks. As Mollisi and Rovigatti (2017) emphasized in their paper, the positive relationship between the unobservable productivity shocks and observable level of inputs makes the estimation results from the OLS regression biased.

There have been several attempts to overcome this simultaneity problem. One branch of these alternative approaches uses a control function method that applies a proxy variable to account for unobserved productivity shocks. Olley and Pakes (1996) were the first proponents of this practice; they used the firm's investment decision for proxy. However, as Levinsohn and

Petrin (2000) pointed out, the investment decision of the firm is not a result of one year but comes from accumulation of more periods. Moreover, firms with zero investment in a year cannot be included in the estimation. Since in the Amadeus database there is no separate CAPEX item from the cash flow statements, investment variable is not included. Only the net CAPEX could be derived by calculating the difference of invested capital (defined as the difference between total assets and non-interest-bearing current liabilities) between years. However, this approach would yield a very unstable proxy as sold assets can have a great part in the net CAPEX and this estimation may accumulate measurement problems in different variables.

As noted by Levinsohn – Petrin (2000), another advantage of LP over OP is that the use of intermediate inputs may reduce more the unobserved part of productivity shocks as investment decisions only react to new information. As the authors explain:

> […I]ntermediate inputs will generally respond to the entire productivity term. while investment may respond only to the "news" in the unobserved term. This can happen for two reasons. If the capital input has already adjusted to the "forecastable" component of the productivity process, the investment proxy will only account for the "non-forecastable" component of productivity. Also, productivity may be characterized by two components, a serially correlated component to which investment responds, and a separate firm-time shock that is independent over time, to which investment will not respond, but to which the choice of variable factors will respond. (p. 2)

To address this shortcoming of using investment as a proxy variable, the estimation of the production functions and the resulting firm-level TFPs in this paper is based on the LP methodology. For comparison, Wooldridge's (2009) approach will also be tested. He proposed a one-stage generalized method of moments (GMM) procedure and robust standard errors instead of bootstrapped ones (Mollisi and Rovigatti, 2017).

The estimation of the production functions for each NACE Rev division is useful in two ways. First, it provides us with fitted values of firm-level TFPs. Secondly, the estimated labor elasticity coefficients (α) can be used to classify sectors into labor-intensive or not labor-intensive

ones. Sectors are assigned into these two groups based on the median of the α coefficients. In a few divisions, there are not enough firms to precisely estimate this parameter; therefore these are excluded from the analysis. I inspect manufacturing and services divisions separately as the pooled categorization would likely lead to the result where most of the manufacturing sectors are classified as less labor-intensive and most of the services as more labor-intensive.

Sectors are also categorized into two categories based on their sales volatility. This happens in the following way. First, average and the standard deviation of the yearly sales growth rates are calculated for each firm, and then, sectoral volatility indicators are created based on the median of the absolute relative standard deviation of the companies. Based on this indicator, sectors are categorized as more or less volatile. This is also done separately for manufacturing and services divisions.

The first model to measure the effect of the reforms is a standard DiD estimator:

$$Prod_{fit} = \alpha\, LI_i + ß\, Year_t + \gamma * (\mathrm{LI}_i * \mathrm{Year}_t) + \iota X_{ft} + u_{fit} \qquad (9)$$

where f, t and i are firm, industry and time indexes, respectively. *Prod* is the outcome variable of interest; it can be substituted with ln (Y/L), ln (VA/L) or TFP. LI_i denotes the labor-intensive industry dummy variable, but it can be replaced with sales volatility as well when using the second identification strategy. $Year_t$ is a sequence of year dummy variables, X_{it} stands for the additional control variable matrix and u_{ft} is the error term.[3] In the baseline model, I do not use control variables as these can be also affected by the treatment. Instead, I test heterogeneities in Section 5.3.

Potentially important time-specific control variables are the following:

[3] Alternatively, years can be pooled in a pre-treatment and post-treatment period. For instance, in case of the first reform, the pre-treatment period can be defined as 2004-2006 and the post-treatment period can be 2007-2008.

- Firm size, measured by total assets. Larger firms may have advantages due to economics of scale and also more alternatives to outsource labor or to substitute permanent workers to temporary ones.
- Foreign ownership, a dummy variable if the company has at least one individual foreign owner. Foreign ownership may be associated with technology transfer that can have an effect on productivity.
- Liquidity, measured by the current ratio which is the ratio of current assets and current liabilities. Firms with liquidity constraints face limited choices for the selection of the optimal mix of inputs. Therefore, the adjustment of workforce may last longer.

The γ parameter of the year of the reforms (2007 and 2011) measures the interaction between years and sector classifications based on labor intensity (or volatility). By comparing the coefficients of these interaction terms, we can see how differences between the treatment labor-intensive group and control non-labor-intensive group evolved over time.

The DiD framework involves the parallel trend assumption (PTA) (Angrist-Pischke, 2008). The core of this assumption is that in absence of the legislative change, the two groups would have followed the same trend. It is not possible to directly verify or falsify this claim, one can be more certain by looking at pre-intervention trends. Unfortunately, there are only three years available before the first legislative change in 2007, which allows us to inspect one single change before its implementation when the dependent variable is employment growth rate.[4] Furthermore, standard errors are higher in in 2005 as there are fewer observations in the first years of the panel. What one can additionally do to assess the validity of the PTA is to control for firm-specific fixed effects and use clustered standard errors. Another approach is to aggregate pre- and post-intervention periods. I will take advantage of all of these possibilities.

[4] The reason why the change from 2004 to 2005 is not available is that the 2004 growth rate cannot be calculated as it requires data from 2003 which is not available.

By extending the model with firm fixed effects, it is possible to control for all time constant characteristics such as sector and place of operation of the firm, as well as unobservables. As the labor intensity measure is time-invariant, sector-level fixed effects are not included. In other words, I do not include sector-specific fixed effects as these are perfectly collinear with the labor intensity–year interaction term. By using firm fixed effects, however, the inclusion of sector-specific fixed effects is not necessary. Thus, the resulting extended equation with company fixed effect takes the following form:

$$\ln(Prod_{\mathrm{fit}}) = \gamma * (\mathrm{LI}_i * \mathrm{Year}_t) + \theta * (\mathrm{Year}_t) + \zeta * \mathrm{Comp}_f + \iota \mathrm{X}_{\mathrm{ft}} + \eta_{fit} \quad (10)$$

The remaining part of the error term now only contains idiosyncratic error without unobserved heterogeneity. Throughout the estimation, standard errors are clustered at the company level in order to eliminate serially correlated shocks at the firm level.

In the next part of the thesis, I present my findings. First, results based on the labor-intensity and the sales volatility strategies are discussed in turn. Next, I test the robustness of my findings and examine heterogeneities. Finally, some potential limitations are discussed.

Chapter 5. Results

5.1. Identification based on labor intensity of sectors

In this section, I present the results from the identification strategy which is based on labor intensity as a variable to identify firms that are affected to a higher extent. In the first stage, sector-specific production functions are estimated by using the LP and Wooldridge's methodologies[5]. Material costs from income statements are used as proxy variables for unobserved productivity shocks, number of workers is the freely variable input, and depreciation is the non-adjustable variable. Since the measurement of capital by the bookkeeping value of fixed assets or book value of capital is based on stock quantities, measuring capital in this way may be associated with a significant amount of measurement error[6]. As the cost of depreciation is linked to fixed assets, I use depreciation as the non-adjustable variable as it is believed to reflect the capital usage of a firm in a given year better than a single stock value. By this, I inherently assume that the depreciation schedule is not significantly different for different companies. Since a straight-line linear method is most commonly used in Slovakia, this assumption is not likely to distort the results considerably[7].

In Appendix E, I present the production function coefficients for manufacturing and services sectors, estimated with the LP and Wooldridge methodologies. The categorization based on the output elasticity of labor differs only in case of Beverages, Fabricated metal, Furniture, and the Architectural and engineering services sectors. Some sectors with imprecise estimations

[5] Technically, the estimation is carried out with the help of the *prodest* function in Stata.

[6] The measurement problem of capital has a long-standing history in production function estimation. Collard-Wexler et al. (2016) proposed an extension to the LP method to overcome the measurement problem by using lagged investment as instrumental variable for capital. As I do not have reliable information on investment, I cannot use this method. However, I believe that the use of depreciation as a proxy for capital is a good alternative.

[7] Fixed assets are divided into six categories. The company can only opt for accelerated depreciation method in case of two types of assets: Construction and agriculture machinery and Electric & cooling equipment (Act No. 595/2003, Collection of Laws, Income Tax Code).

are excluded from the analysis and not presented in the tables. Based on the LP classification the labor-intensive sectors are the following:

Manufacturing: Beverages, Textiles, Apparel, Leather, Mineral products, Fabricated metals, Computer electronics, Electrical equipment

Services: Warehousing, Publishing, Computer programming, Information services, Legal and accounting services, Management consultancy services, Architectural and engineering services, Employment services, Travel agency services, Security and investigation

Not surprisingly, the role of material costs is generally larger in the production process in manufacturing industries than in services (see Appendix E). Sectors with lower number of firms are more likely to exhibit increasing returns to scale, such as Telecommunications or Travel agency services. Based on the residual term of the estimated sectoral production functions, it was possible to obtain the TFP for each firm by exponentiation. The baseline results are based on the LP categorization, but results using Wooldridge's method are also tested in Section 5.3.

5.1.1. Employment implications of changed EPL

Firstly, employment patterns are studied using the labor intensity identification. I examine employment levels and flows for manufacturing and services in turn. The difference in employment levels by labor intensity is reflective of whether the reduction in hirings or the reduction in firings is the more dominant form of adaptation to increased dismissal costs. It is expected that absolute employment flows are likely to decrease as a consequence of the reform in 2007 due to increased frictions in the labor market. As labor-intensive companies are affected more, I expect that employment fluctuations decreased to a larger extent in companies operating in more labor-intensive industries.

The simple mean-comparisons of the pre-reform and post-reform periods in Table 5 do not imply significant differences (with the exception of employment levels at services). To control for firm-specific characteristics, I set up a difference-in-differences model with company fixed effects according to Equation (7). The year 2006 is used as a baseline in all cases.

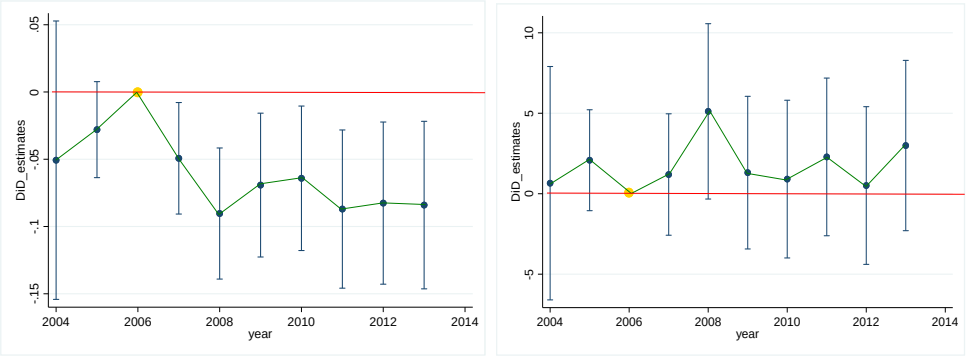
Table 5. Mean values before and after 2007, basic DiD estimates by labor intensity. Employment.

	Non-labor-intensive				Labor-intensive				DiD	
	Manufacturing		Services		Manufacturing		Services		Manuf.	Services
	Pre	Post	Pre	Post	Pre	Post	Pre	Post		
Ln (L)	3.80	3.66	3.53	3.25	3.76	3.58	3.41	3.22	-0.04 (0.04)	0.09** (0.04)
K/L	23.06	24.15	35.53	34.03	18.9	23.2	21.37	25.21	3.3 (2.4)	5.34 (4.51)
Employment growth rate	-0.0	0.09	-0.06	0.10	0.02	0.07	-0.04	0.15	-0.04 (0.03)	0.03 (0.1)
Absolute employment flow	0.21	0.30	0.20	0.41	0.21	0.28	0.22	0.41	-0.02 (0.03)	-0.02 (0.03)

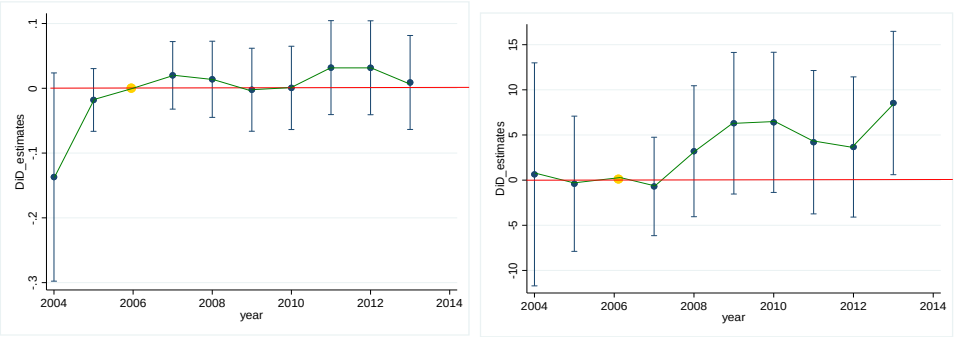
Notes: Standard errors in parentheses for the DiD estimates. Pre-reform period is 2004-2006 and post-reform period is 2007-2008.

The results in Figures 1-2 suggest that labor-intensive manufacturers reacted to the reform by reductions in hirings rather than by firing less workers. The point estimate indicates a 5% negative difference between the two groups in 2007 which widens to 9% by 2008 and remains stable afterwards. Concomitantly, the point estimate of the K/L ratio for labor-intensive firms in the manufacturing sectors increased by 5 units in 2008 relative to the comparison group, however it reverted back afterwards. On the other hand, there are no statistically significant differences in employment levels between the two groups in the services sector.

Figures 1-2. Employment level and K/L ratio differences (manufacturing).



Figures 3-4. Employment level and K/L ratio differences (services).

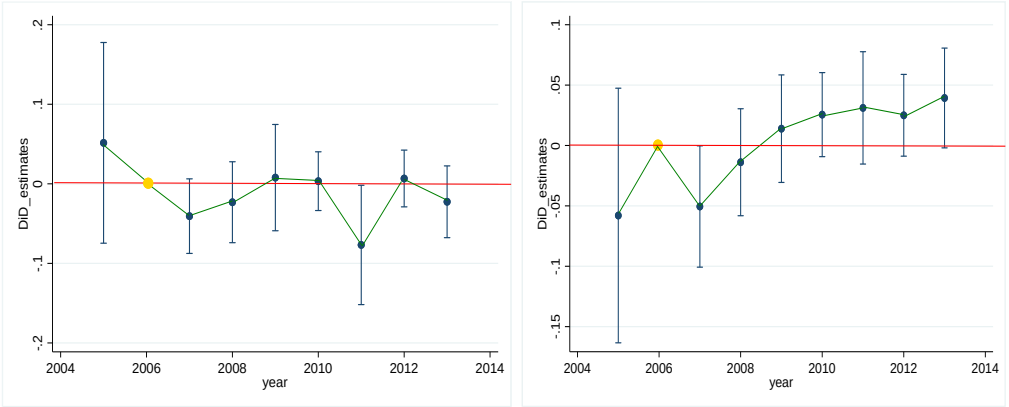


Notes: The DiD estimates on the horizontal axes are the coefficients from Equation (7), where the K/L ratio is also substituted into *Emp*. Employment level is on the left, K/L ratio is on the right side. Vertical bars indicate 95 % confidence intervals. 2006 is used for a reference year.

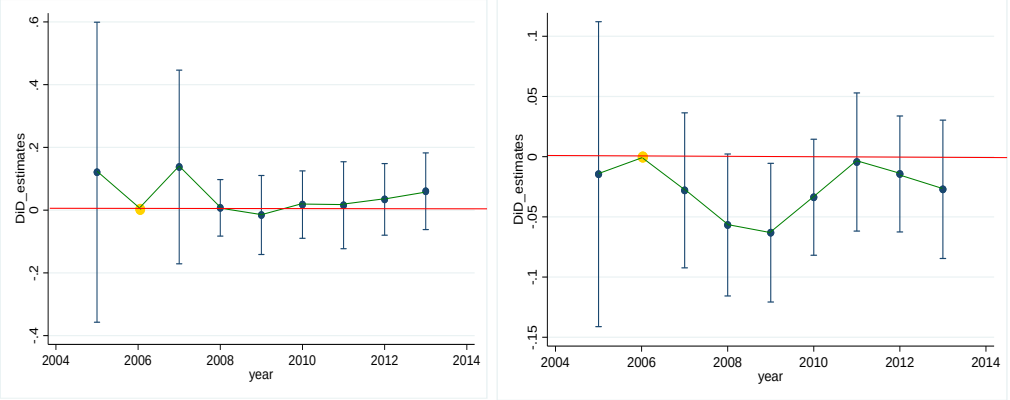
In correspondence with the results of employment levels, Figures 5 and 6 show that the difference in employment growth rate was significantly lower for labor-intensive manufacturing firms in 2007. Moreover, employment growth rate difference was also lower for the treatment group in 2011, the last year when the inflexible legislation was in force. If this is true, one possible explanation would be that firms anticipated the legislative change in 2011 and they postponed the expansion of the workforce until the more flexible dismissal conditions were introduced. The absolute employment flow indicator in Figure 6 indicates that employment fluctuations of the labor-intensive manufacturing sectors decreased in 2007 in comparison to the other group; however, there are no statistically significant differences between the two groups afterwards. Furthermore, point estimates suggest a fast adjustment process as absolute differences between the two groups remained relatively stable.

In services, there was no significant difference in employment growth rate between the two groups, but during the less flexible regime labor-intensive sectors demonstrated considerably lower absolute employment flows (see Figures 7-8). Altogether, there are more supporting than contradictory signs that the introduction of higher dismissal costs is associated with lower employment flows for both manufacturers and service firms. Hence, the theoretical prediction that higher dismissal costs results in lower employment flows appears to be correct in this setting.

Figures 5-6. Employment growth rate (left) and absolute employment flow (right) estimates (manufacturing).



Figures 7-8. Employment growth rate (left) and absolute employment flow (right) estimates (services).



Notes: The DiD estimates on the horizontal axes are the coefficients from Equation (7). Vertical bars indicate 95 % confidence intervals. 2006 is used for a reference year.

5. 1. 2. Productivity implications of changed EPL

Unlike in the case of employment flows, theoretical considerations do not unambiguously point to one direction about the effect of EPL on productivity. For this reason, I do not have preliminary expectations. First, the effect of EPL on labor productivity will be studied, followed by the examination of TFP. In this section, I will use the VA/L measure for labor productivity where VA is defined as sales reduced by material costs. For TFP, I use the LP method. Alternative specifications and robustness checks are presented in Section 5.3. The basic DiD results for productivity are shown in Table 6. These indicate only positive labor productivity difference in the case of manufacturing.

Table 6. Mean values before and after 2007, basic DiD estimates by labor intensity. Productivity.

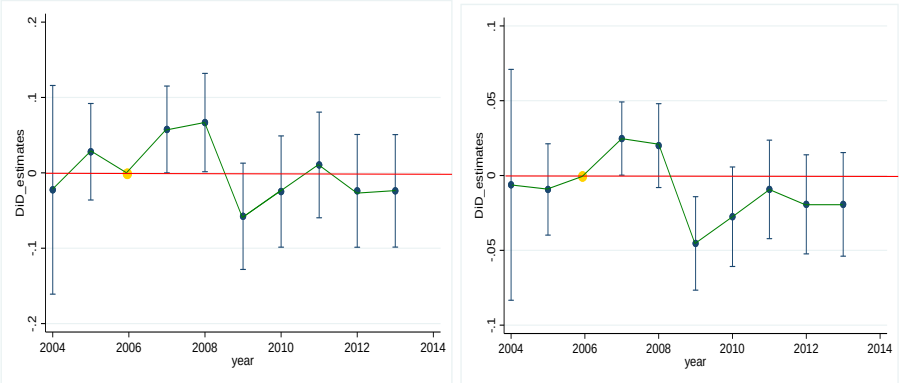
	Non-labor-intensive				**Labor-intensive**				**DiD**	
	Manufacturing		Services		Manufacturing		Services		Manuf.	Services
	Pre	Post	Pre	Post	Pre	Post	Pre	Post		
Ln (VA/L)	2.77	2.81	3.09	3.04	2.87	2.98	3.43	3.42	0.07* (0.04)	0.05 (0.06)
TFP	1.66	1.64	2.58	2.53	2.49	2.50	3.10	3.05	0.03 (0.03)	0.00 (0.05)

Notes: Standard errors in parentheses for the DiD estimates. Pre-reform period is 2004-2006 and post-reform period is 2007-2008.

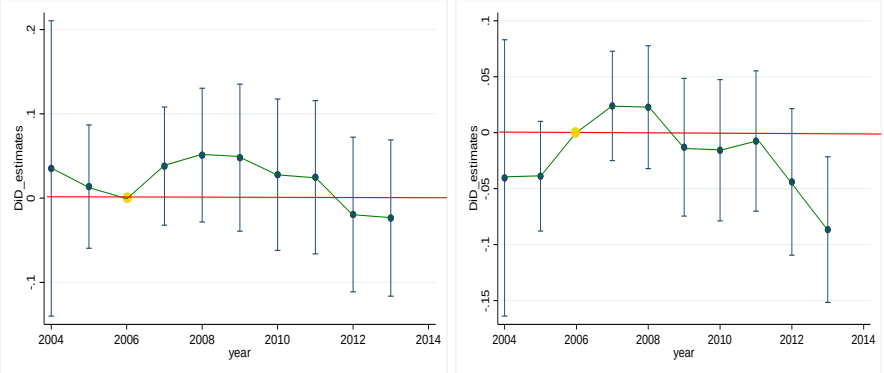
After controlling for firm fixed effects, the results in Figures 9-12 show that labor productivity and TFP increased in 2007 and 2008 for the labor-intensive group in comparison to the control group. The point estimates indicate a 5% increase in labor productivity and a TFP increase of 0.03 in these years for manufacturing. However, there appears to be no significant differences in case of services, although the point estimates point to the same direction. Another eye-catching element of Figures 9 and 10 is that the financial crisis presumably affected labor productivity and TFP of labor-intensive firms negatively in 2009 compared to the other group. Macroeconomic indicators show that the impact of the financial crisis first hit the Slovak economy significantly in late-2008. Thus, it is likely that the potential differential impact of the

crisis exerts considerable influence on estimations from 2009. This potential distortionary impact of the crisis is further discussed in Section 5.3.

Figures 9-10. Labor productivity (left) and TFP (right) estimates (manufacturing).



Figures 11-12. Labor productivity (left) and TFP (right) estimates (services).



Notes: The DiD estimates on the horizontal axes are the coefficients from Equation (10). Vertical bars indicate 95 % confidence intervals. 2006 is used for a reference year.

5.2. Identification based on sales volatility of sectors

The division of sectors by sales volatility resulted in partly different classification than based on labor intensity.[8] Approximately 50% and 30% of the companies are reclassified from treatment to control group or vice versa by this identification strategy for manufacturing and

[8] See detailed classification by labor intensity in Appendix E.

services, respectively. The list of more volatile sectors with the sales volatility identification strategy is the following:

Manufacturing: Leather, Mineral products, Basic metals, Fabricated metals, Electrical equipment, Motor vehicles, Furniture

Services: Advertising, Computer programming, Information services, Health, Recreation, Security, Architectural and engineering services, Travel agency services

5.2.1. Employment implications of changed EPL

The basic DiD estimates in Table 7 do not indicate any differences between firms based on volatility. By adding firm fixed effects, results are somewhat different.

Table 7. Mean values before and after 2007, basic DiD estimates by sales volatility. Employment.

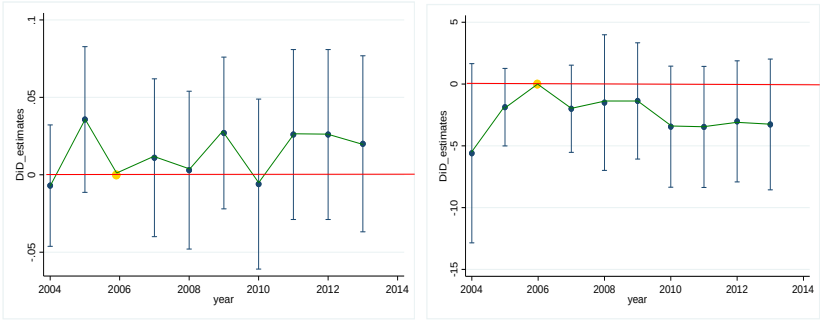
	Less volatile industries				**More volatile industries**				**DiD**	
	Manufacturing		Services		Manufacturing		Services		Manuf.	Services
	Pre	Post	Pre	Post	Pre	Post	Pre	Post		
Ln (L)	3.84	3.64	3.47	3.19	3.71	3.48	3.48	3.27	0.07 (0.04)	0.06 (0.04)
K/L	23.57	25.43	37.85	40.93	18.8	22.10	21.37	21.69	1.8 (2.3)	-3.5 (4.4)
Employment growth rate	0.02	0.00	-0.08	0.08	0.07	0.09	-0.05	0.15	0.03 (0.03)	0.03 (0.1)
Absolute employment flow	0.22	0.28	0.22	0.40	0.20	0.29	0.21	0.41	0.03 (0.03)	0.01 (0.03)

Notes: Standard errors in parentheses for the DiD estimates. Pre-reform period is 2004-2006 and post-reform period is 2007-2008.

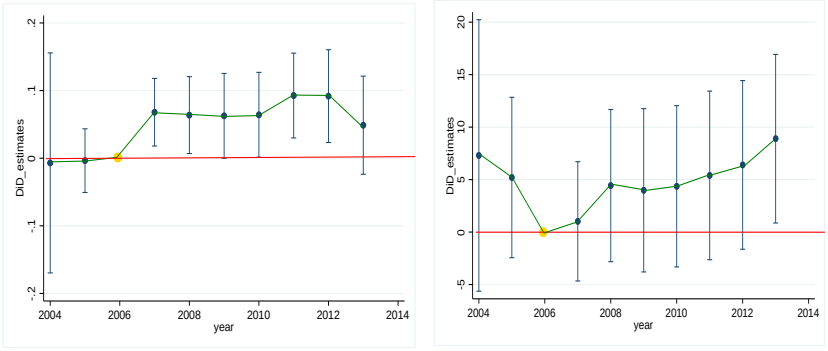
The employment level and the K/L ratio of manufacturing firms did not differ significantly by volatility with fixed effects either (see Figures 13-14.). However, it appears that firms in more volatile services sectors increased their workforce compared to the control group, although their K/L ratio did not change significantly (see Figures 15-16.). These findings are not in

contradiction with the results based on labor intensity, rather it indicates that the labor intensity of a sector is a more important factor in the determination of employment levels in industries and differences in sales volatility is more important in services.

Figures 13-14. Employment level and K/L ratio differences (manufacturing).



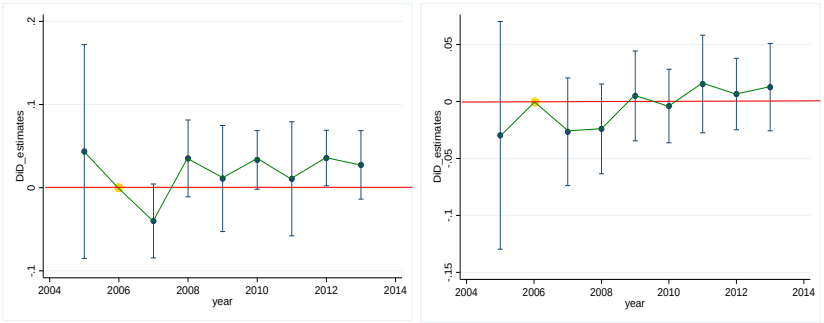
Figures 15-16. Employment level and K/L ratio differences (services).



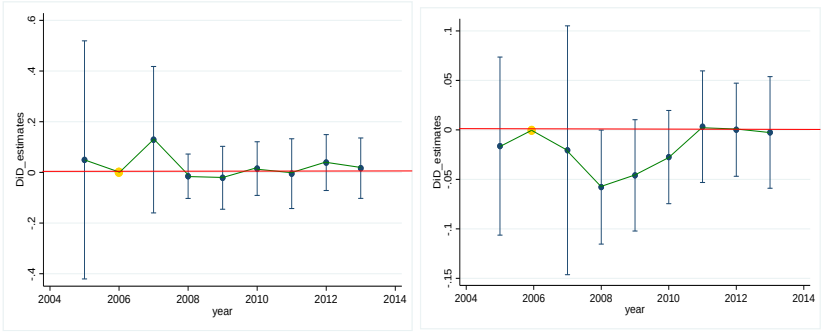
Notes: The DiD estimates on the horizontal axes are the coefficients from Equation (7), where the K/L ratio is also substituted into *Emp*. Employment level is on the left, K/L ratio is on the right side. Vertical bars indicate 95 % confidence intervals. 2006 is used for a reference year.

As presented in Figures 17-20, employment flow results based on sales volatility are similar to those from the identification strategy using labor intensity. The main change is that the difference in the employment growth rate is not significantly distinguishable between the two groups in 2011. However, these results reinforce the previous findings that absolute employment flows decreased in years of stricter EPL and employment growth rate dropped in 2007 for manufacturing firms.

Figures 17-18. Employment growth rate (left) and absolute employment flow (right) estimates (manufacturing).



Figures 19-20. Employment growth rate (left) and absolute employment flow (right) estimates (services).



Notes: The DiD estimates on the horizontal axes are the coefficients from Equation (7). Vertical bars indicate 95 % confidence intervals. 2006 is used for a reference year.

5.2.2. Productivity implications of changed EPL

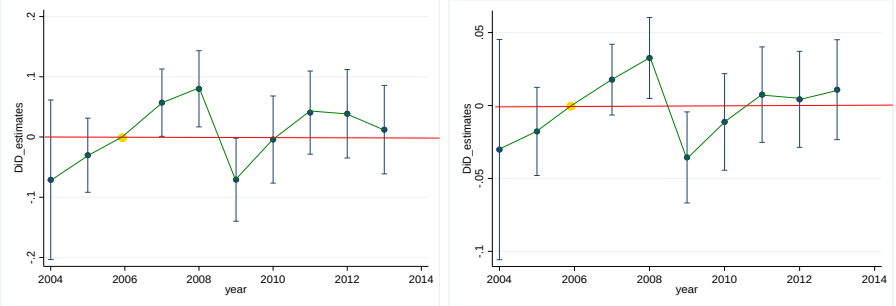
The productivity results of the sales volatility approach are very similar to those of the labor intensity strategy. Basic DiD estimates indicate that manufacturing firms in more volatile industries could take advantage from the stricter EPL in 2007 and 2008. The effect is attenuated after controlling for firm characteristics (see Figures 21-22). At the same, there are no statistically significant differences between the two groups in the services sectors with fixed effects either (see Figures 23-24).

Table 8. Mean values before and after 2007, basic DiD estimates by sales volatility. Productivity.

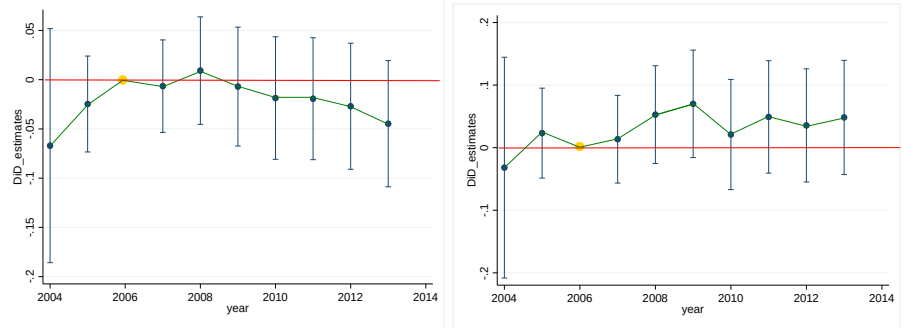
	Less volatile industries				More volatile industries				DiD	
	Manufacturing		Services		Manufacturing		Services		Manuf.	Services
	Pre	Post	Pre	Post	Pre	Post	Pre	Post		
Ln (VA/L)	2.74	2.73	3.00	2.98	2.93	3.07	3.48	3.44	0.16*** (0.04)	-0.02 (0.06)
TFP	1.85	1.79	2.34	2.29	2.36	2.40	3.26	3.30	0.10*** (0.03)	-0.00 (0.05)

Notes: Standard errors in parentheses for the DiD estimates. Pre-reform period is 2004-2006 and post-reform period is 2007-2008.

Figures 21-22. Labor productivity and TFP estimates (manufacturing).



Figures 23-24. Labor productivity and TFP estimates (services).



5.3. Robustness checks and heterogeneities

In this section, I test whether the results are sensitive to alternative specifications or are there any heterogeneities based on firm size or liquidity. It appears that using the methodology of Wooldridge for categorization and for the calculation of TFP does not alter significantly the baseline results for the pre-crisis period. Alternative measurements of labor productivity do not

seem to change the results to a large extent either. However, the results fail the robustness tests from 2009 for manufacturing sectors. Hence, the validity of the results is likely to be restricted to the period of 2004-2008. Detailed figures of the different specifications are presented in Appendix G. The main results of the robustness checks are summarized in Table 9.

Table 9. Results of the robustness checks.

Identification strategy	**Labor intensity**								**Sales volatility**			
Categorization	LP		Wooldridge						NA (not changing)			
Outcome variable	ln(Y/L)		ln(VA/L)		ln(Y/L)		TFP		ln(Y/L)		TFP (WD)	
Manuf./services	M	S	M	S	M	S	M	S	M	S	M	S
Similar patterns in 2007 and 2008?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Similar patterns in 2009 and after?	No	Yes	No	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes

To test the differential effects of the change in the legislation, I categorize firms into three groups based on their number of employees in accordance with the criteria of the European Commission (2003): 1-49 as small, 50-249 as medium and above 249 as large companies. Since large companies may operate more effectively and probably adjust labor faster, it is a logical expectation that the reform affected them less than smaller firms. In Table 10, differences are presented in a DiD framework with firm and year fixed effects. It seems that medium size manufacturers experienced the highest productivity gains from the reform in 2007. Moreover, it was mostly larger firms that responded to the change by reducing workforce.

Table 10. Differential effects by firm size (manufacturing).

Identification: Labor intensity (LP)				
Firm size	Ln(VA/L)	TFP (LP)	Ln(L)	Absolute employment flows
Small	0.025 (0.032)	-0.00 (0.14)	-0.00 (0.02)	0.04 (0.03)
Medium	0.063* (0.035)	0.038** (0.016)	-0.027* (0.017)	-0.01 (-0.03)
Large	-0.02 (0.1)	0.03 (0.05)	-0.087** (0.037)	-0.19** (0.09)
Identification: Sales volatility				
Small	0.07** (0.03)	0.03 (0.02)	0.02 (0.017)	0.015 (0.03)
Medium	0.137*** (0.034)	0.03* (0.018)	0.009 (0.018)	0.014 (0.03)
Large	0.13 (0.08)	0.08 (0.07)	-0.02 (0.037)	-0.04 (0.07)

Notes: Standard errors in parentheses for the DiD estimates. Pre-reform period is 2004-2006 and post-reform period is 2007-2008.

Liquidity-constrained firms have fewer opportunities to optimize their inputs; hence they may face longer adjustment process as a consequence of the reform. This intuition is supported by empirical evidence; as shown in Table 11, liquidity-constrained firms did not benefit from the reform significantly. Liquidity-constrained firms are defined as lower current ratio than 0.5. I define firms moderately liquid when the current ratio is between 0.5 and 1; whereas liquid firms are the ones with higher current ratio than 1.

Table 11. Differential effects by liquidity (manufacturing).

Identification: Labor intensity (LP method)				
Firm size	Ln(VA/L)	TFP (LP)	Ln(L)	Absolute employment flows
Illiquid	-0.01 (0.11)	0.02 (0.06)	-0.003 (0.10)	-0.09 (0.13)
Moderately liquid	0.08 (0.06)	0.02 (0.03)	-0.15*** (0.046)	-0.02*** (0.01)
Liquid	0.09** (0.04)	0.03* (0.02)	-0.06** (0.03)	-0.01 (0.04)
Identification: Sales volatility				
Illiquid	0.10 (0.12)	0.05 (0.05)	-0.06 (0.10)	-0.01 (0.14)
Moderately liquid	0.11** (0.06)	0.04* (0.02)	-0.03 (0.04)	-0.01 (0.03)
Liquid	0.15*** (0.04)	0.04** (0.02)	0.04 (0.03)	-0.05 (0.004)

Notes: Standard errors in parentheses for the DiD estimates. Pre-reform period is 2004-2006 and post-reform period is 2007-2008.

The same heterogeneity tests for services are presented in Appendix H. The results show similar differential effects based on firm size and liquidity. There was not enough variation in the foreign ownership variable to test differential effects; therefore this heterogeneity test was not possible.

5.4. Potential limitations

As noted in the previous chapter, the applied identification strategies are based on the assumption of parallel trends. There are only one or two years of data available before the first legislative change in 2007; therefore it is not possible to be more confident about the validity of this assumption. If technological growth was not factor-neutral, this can also partly explain differences in productivity trends. If we assume factor-neutral technological progress, productivity outcomes of companies by labor intensity of the industries should have evolved in the same manner. Factor-neutral technological progress is a brave assumption; however results from the alternative identification strategy hints that productivity differences by the labor intensity of sectors is not solely attributable to factor-biased technological progress. Furthermore, the possibility that the productivity of labor-intensive manufacturing sectors jumped significantly only in the year of the reform due to only technological progress is intuitively not very likely.

As the results from the robustness checks indicate, it is not possible to confidently assess the productivity differences between companies in the post-crisis period. For this reason, it is only possible to evaluate the effect of the introduction of higher dismissal costs in 2007, but not its reversal in 2011. As it appears that the impact of the crisis varies across the treatment and control groups, it is only safe to compare the years between 2004 and 2006 with the 2007-2008 period. As the PTA seems convincing before 2007, this comparison is likely to be a valid.

Some further limitations are driven by data restrictions. It is not possible to distinguish between workers based on their skills as there is only one headcount variable for each firm for each year. Furthermore, the examination of entry and exit of firms is problematic as the coverage of the database was less comprehensive prior to 2009. Measurement problem of some variables is mitigated by data cleaning steps presented in Chapter 3, but it is not entirely eliminated.

Conclusion and policy relevance

This thesis examined the effects of legislative changes in employment protection on productivity and employment in Slovakia. The main findings suggest that more stringent protection decreased employment flows, although no unambiguous effect on employment levels was found. Furthermore, it appears that higher dismissal costs is associated with increased labor productivity and total factor productivity for manufacturing firms, but no significant productivity impact was identified among services. The results indicate that employment flows mostly reduced at larger companies and productivity increased to a larger extent for medium-sized and more liquid firms. The results fail the robustness tests for the post-crisis period but show consistency before.

The results of employment flows are in line with the theoretical prediction that firms decrease the frequency of quantitative adjustment of labor when dismissal costs are higher. My findings are commensurate with the results of Baboš and Lubyova (2016) who used a panel of individuals and found that the legislative change decreased the probability of exiting unemployment by 40%. Both of these findings highlight the redistributive nature of EPL as it only protects those who already have a job but not those who are unemployed. Moreover, EPL can make entry especially difficult for young individuals and prime-aged women and also increase the unequal bargaining position between "insiders" with regular contracts and "outsiders" with permanent ones. For these reasons, EPL should not be applied in isolation but it should be viewed as one possible element of the policy mix of active labor market policies and unemployment benefits.

The Slovak reform of 2007, in this respect, falls short of this advice as it mostly focused on the EPL element. Moreover, there were no larger modifications in these other two policy instruments during the SMER-SD government between 2006 and 2010. Therefore, future governments in power should not use EPL as a symbolical policy tool to show their support or

resistance towards greater labor market flexibility, rather they should find the optimal balance between the different elements of the policy mix. As there is strong evidence that stringent EPL reduces employment flows and increases duration of unemployment, increased hiring costs should be complemented with active labor market policies.

The positive productivity results of this thesis may to some extent counteract the potential negative effects of decreased employment flows. However, these positive effects are only quantifiable in case of manufacturers which implies that the overall productivity improvement in the economy may not be large. Furthermore, productivity gains are mostly reaped by firms if they are not compensated by increased wages. Hence, EPL can indirectly contribute to higher income share of capital over labor.

However, it is instructive that more stringent EPL can increase productivity, so the oft-quoted productivity-enhancing argument for relaxed employment protection may be misguided. Instead, it is possible that there is an optimal level of protection below which the productivity-decreasing mechanisms such as decreased worker attachment and lower firm-specific human capital investment can be dominating. This is a reasonable assumption as the Slovak labor code was one of the most flexible one before 2007 in Europe.

The heterogeneous effects of the more stringent EPL also highlight the redistributive nature of the policy tool. It appears that the smallest and largest companies do not gain as much from the legislative change as medium-sized and more liquid companies. Furthermore, manufacturing and services sectors are affected differently. If these differential impacts are not justifiable by economic considerations, the allocative efficiency of the economy may be unnecessarily distorted. Hence, future EPL reforms should take into account all of these redistributive effects and counterbalance them if they are deemed economically or socially objectionable.

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Appendices

Appendix A: Structure of the financial statements

All of the data elements are available for the balance sheet, but the costs of goods sold and the gross profit lines are missing from the income statement. The structure of the balance sheet and income statement follows the following form based on the user guide of BvD (2007):

Table A.1. Structure of the balance sheet

Name of line	Formula	Name of line	Formula
a: Intangible assets		g: Capital	
b: Tangible assets		h: Other shareholder funds	
c: Other fixed assets		III. Shareholder funds	g + h
I. Fixed assets	a + b + c		
d. Debtors		i: Non-current liabilities	
e. Cash and		j: Current liabilities	
f. Other current assets		IV. Liabilities and equity	i + j
II. Current assets	d + e + f		
Total assets	I. + II.	Total equity and liabilities	III. + IV

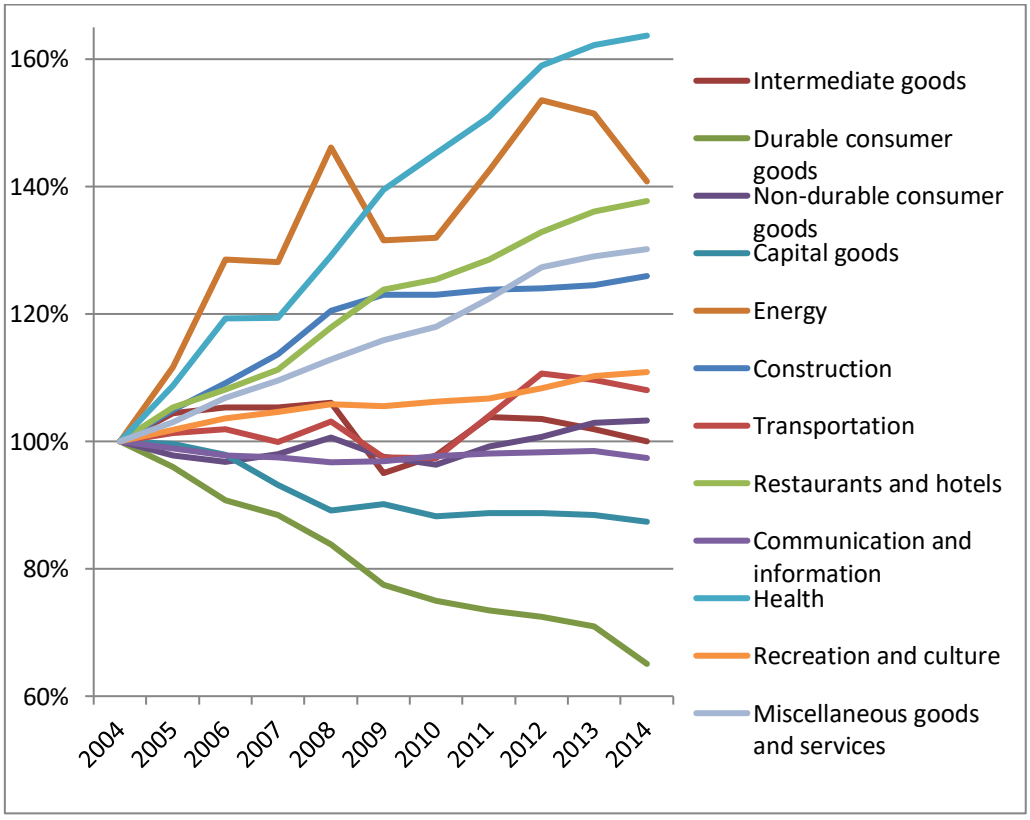
Table A.2. Structure of the income statement

Name of line	Formula
a: Sales	
b: Cost of goods sold	
I. Gross profit	a -b
c: Material costs	
d: Costs of employees	
e: Depreciation and amortization	
f: Other operating expenses	
II. Operating expenses	c + d + e + f
III. Operating profit (EBIT)	I - II.
g: Financial revenues	
h: Financial expenses	
IV. Financial profit	g - h
i: Extraordinary revenues	
j: Extraordinary expenses	
V. Profit from extraordinary	i – j
VI. Profit or loss before tax	III. + IV. + V.
k: Taxation	
VII. Net income	VI - k

Appendix B: Description of deflators

The deflators used for each sector was selected based on the best possible available match. Producer price indexes have been used for NACE divisions 1-35 based on the categorization of Eurostat (Main Industrial Groupings): Intermediate goods, Durable consumer goods, Non-durable consumer goods, Capital goods, Construction and Energy. All of the companies in the 1-35 division were assigned to one of these categories based on their four-digit NACE Rev. codes. Services Producer Price Index (SPPI) was not available for Slovakia; therefore consumer price indexes are used in case of services. I expect that there are no significant differences between CPI and SPPI in these sectors; therefore this method is not considered to be overly distortionary. The evolution of the indexes is presented in Figure B.1. All of the accounting variables have been systematically deflated in the dataset by the adequate value for each year by means of a *foreach* loop.

Figure B.1. Inflation in Slovakia by sector (2004 = 100%).



Appendix C: Additional descriptive statistics

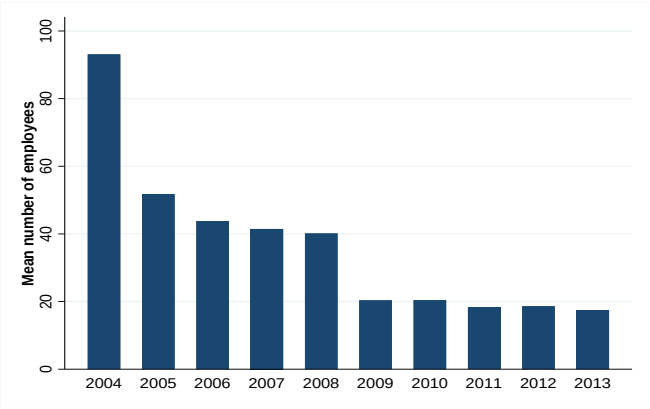
C.1. Comparison of variables before and after the removal of small firms.

Table C. 1. 1. Proportion of small companies by year.

Year	Number of companies	% of firm with less than 10 employees
2004	5,388	21.2 %
2005	11,161	39.2 %
2006	15,834	51.8 %
2007	18.959	44.6 %
2008	20,000	45.9 %
2009	49,627	57.4%
2010	56,817	52.0%
2011	63,893	49.3%
2012	70,384	45.0%
2013	70,611	46.6%

Notes: Values are presented after general data cleaning steps, before removing small companies.

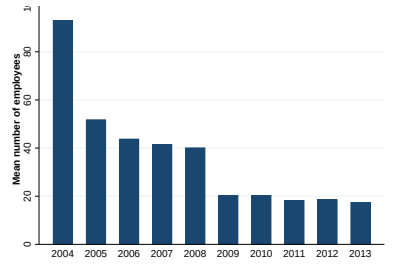
Figure C. 1. 1. Mean number of employees.



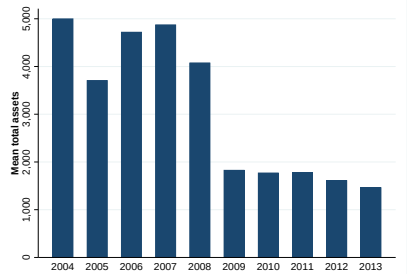
C.2. Comparison of variables before and after the removal of small firms.

Before removing small firms

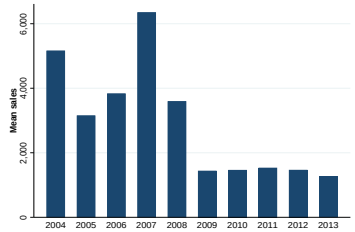
Number of employees



Total assets

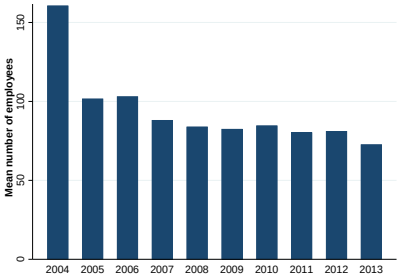


Sales

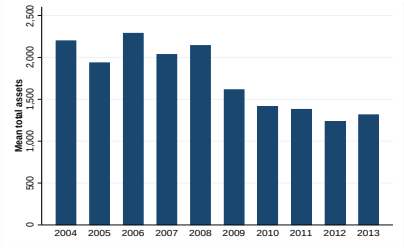


After removing small firms

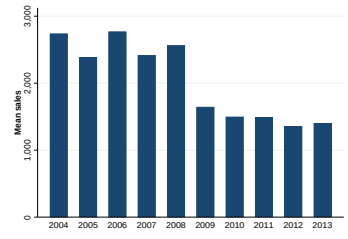
Number of employees



Total assets



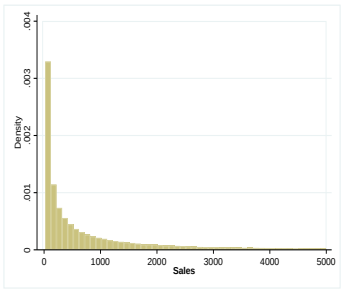
Sales



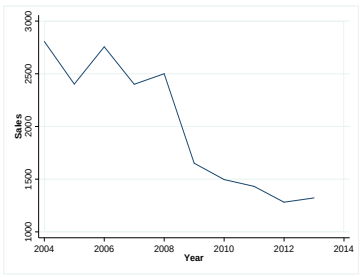
C.3. Pooled histograms and line plots.

Figures C.3. 1-10. Pooled histograms and line plots of Sales, Number of employees, Fixed assets, K/L ratio, Labor productivity.

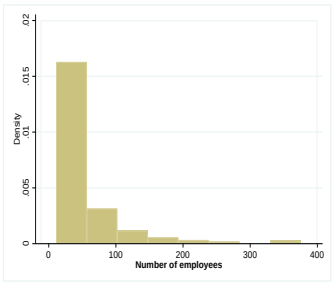
Sales



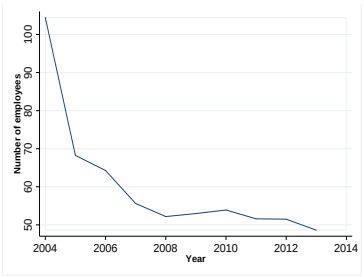
Sales



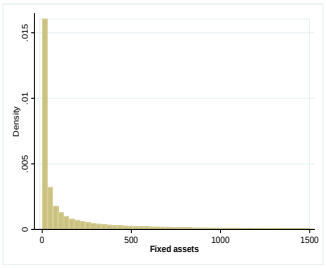
Number of employees



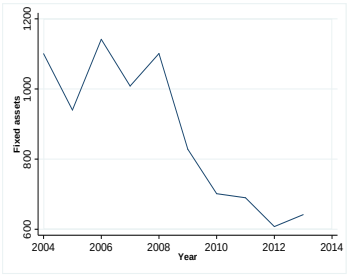
Number of employees



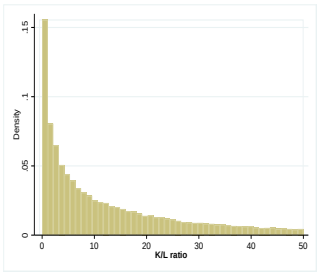
Fixed assets



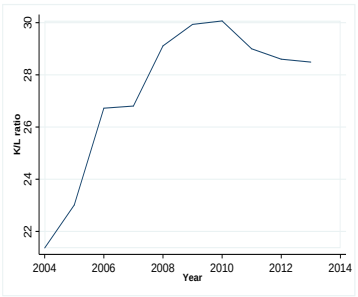
Fixed assets



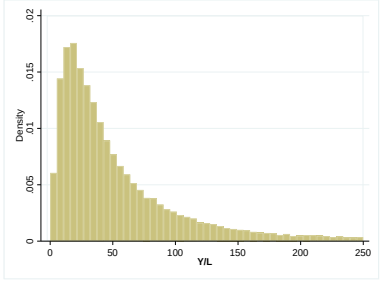
K/L ratio



K/L ratio

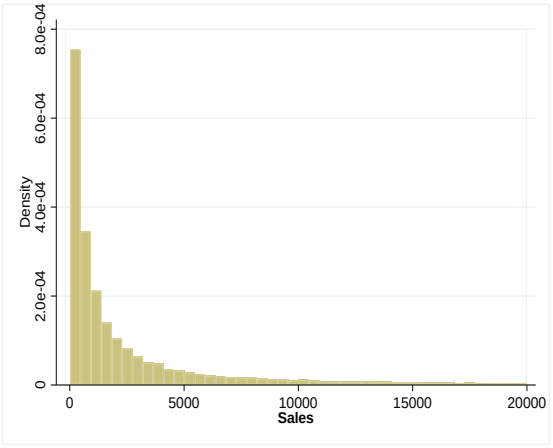


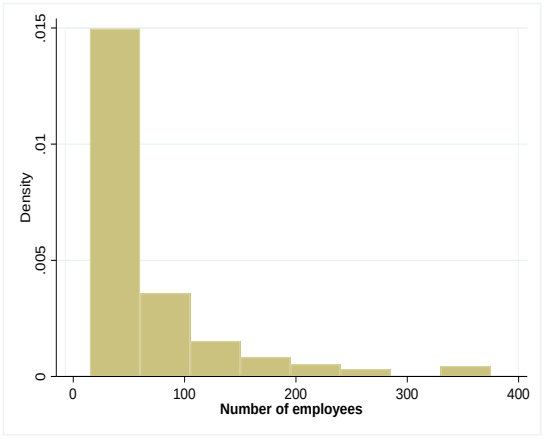
Y/L ratio

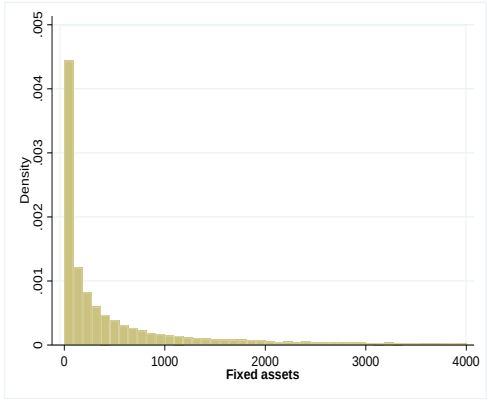


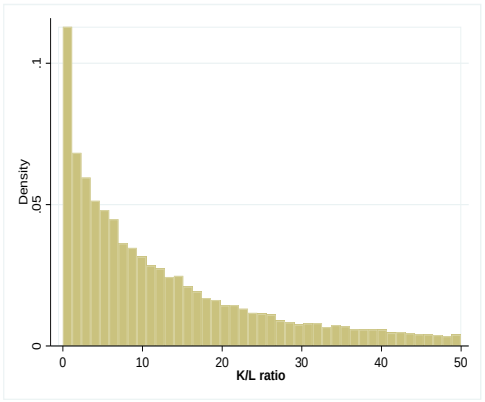
Y/L ratio

Figures C.4. Histograms and summary statistics for the manufacturing sectors:









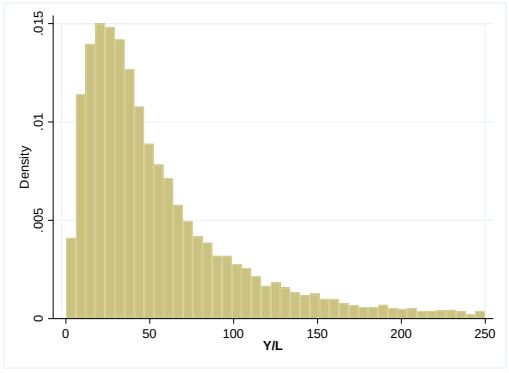


Table C.4.1. Summary statistics of key variables (Manufacturing sector).

Variable	2006	2009	2012
Sales			
Mean	3,637.7	2,916.5	2,732.5
Median	1,366.7	926.4	678
S.D.	5,761.1	5,029.2	5,178.4
Fixed assets			
Mean	1,284.4	1,322.5	982.3
Median	308.9	250.5	131.2
S.D.	2,610.7	2,880.6	2,391.9
Number of employees (L)			
Mean	78.3	68.9	59
Median	38	38	38
S.D.	153.7	134.7	93.8
K/L			
Mean	22.4	26.8	26.5
Median	9.5	11	11.4
S.D.	52	55.3	52.5
Y/L			
Mean	39.7	61.8	72.3
Median	66.8	37.3	44.8
S.D.	90.8	86.6	99.3

Notes: Values of sales, total assets and capital are in 2010 EUR constant prices, after balancing the dataset along the 2009 cutoff. S. D. denotes standard deviation.

Figures C.5. Histograms and summary statistics for services

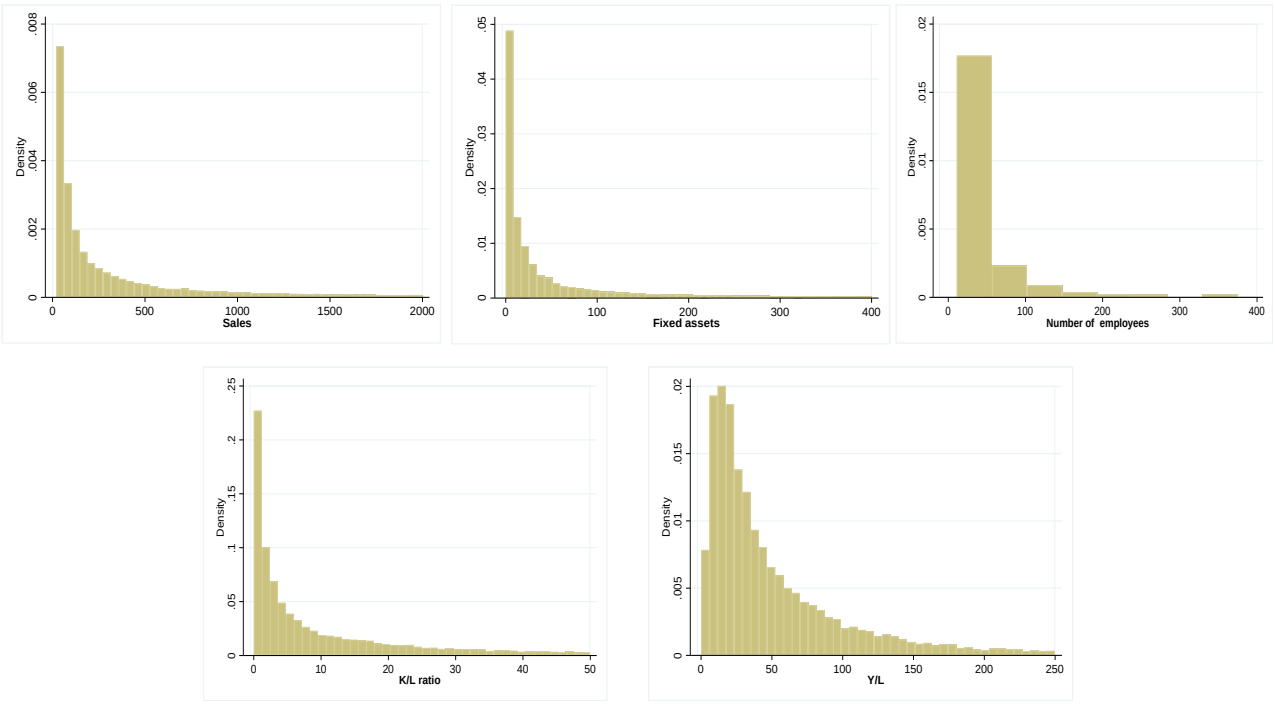


Table C.5.1. Summary statistics of key variables (Sevices sector).

Variable	2006	2009	2012
Sales			
Mean	2,208.9	1,084.9	851.1
Median	581.6	178.9	123.2
S.D.	4,584.0	2,991.1	2,663.3
Fixed assets			
Mean	971.0	557.0	370.8
Median	94.8	22.4	15.7
S.D.	2,872.2	2,284.5	1,743.0
Number of employees (L)			
Mean	61.1	46.0	52.0
Median	15	17	23
S.D.	138.1	106.4	108
K/L			
Mean	31.7	30.6	25.0
Median	7.2	5.0	5.1
S.D.	105.9	114.4	69.0
Y/L			
Mean	75.3	63.0	67.6
Median	34.6	30.5	34.5
S.D.	123.8	115.3	124.1

Notes: Values of sales, total assets and capital are in 2010 EUR constant prices, after balancing the dataset along the 2009 cutoff. S. D. denotes standard deviation.

Appendix D: Derivation of the CD unit cost function

As a starting point:

$$Y = A * L^{\alpha} K^{ß} M^{\gamma}$$

subject to: $C = wL + rK + iM$, assuming linearity

The Lagrange function can be defined as:

$$L = wL + Rk + iM - \lambda(f(L,K,M)-Y)$$

The first order conditions are:

$$\frac{\partial L}{\partial L} = A\lambda\alpha L^{\alpha-1} K^{ß} M^{\gamma} = w$$

$$\frac{\partial L}{\partial K} = A\lambda L^{\alpha} ß K^{ß-1} M^{\gamma} = r$$

$$\frac{\partial L}{\partial M} = A\lambda L^{\alpha} K^{ß} \gamma M^{\gamma-1} = i$$

$$\frac{\partial L}{\partial \lambda} = AL^{\alpha} K^{ß} M^{\gamma} = Y$$

It follows that:

$$\frac{w}{r} = \frac{\alpha}{ß}\frac{K}{L} \text{ and } \frac{w}{i} = \frac{\alpha}{\gamma}\frac{M}{L}$$

$$K = \frac{w}{r}\frac{ß}{\alpha} L \text{ and } M = \frac{w}{i}\frac{\gamma}{\alpha} L$$

By substituting back to the production function:

$$Y = AL^{\alpha+ß+\gamma} * \left(\frac{w}{r}\frac{ß}{\alpha}\right)^{ß} * \left(\frac{w}{i}\frac{\gamma}{\alpha}\right)^{\gamma}$$

The conditional factor demands are the following:

$$L = \left(\frac{Y}{A}\right)^{\left(\frac{1}{\alpha+ß+\gamma}\right)} \left(\frac{r}{w}\frac{\alpha}{ß}\right)^{\left(\frac{ß}{\alpha+ß+\gamma}\right)} \left(\frac{i}{w}\frac{\alpha}{\gamma}\right)^{\left(\frac{\gamma}{\alpha+ß+\gamma}\right)}$$

$$K = \left(\frac{Y}{A}\right)^{\left(\frac{1}{\alpha+ß+\gamma}\right)} \left(\frac{w}{r}\frac{ß}{\alpha}\right)^{\left(\frac{\alpha}{\alpha+ß+\gamma}\right)} \left(\frac{i}{r}\frac{ß}{\gamma}\right)^{\left(\frac{\gamma}{\alpha+ß+\gamma}\right)}$$

$$M = \left(\frac{Y}{A}\right)^{\left(\frac{1}{\alpha+ß+\gamma}\right)} \left(\frac{w}{i}\frac{\gamma}{\alpha}\right)^{\left(\frac{\alpha}{\alpha+ß+\gamma}\right)} \left(\frac{r}{i}\frac{\gamma}{ß}\right)^{\left(\frac{ß}{\alpha+ß+\gamma}\right)}$$

By substituting into the cost function it follows that:

$$C = \left(\frac{Y}{A}\right)^{\left(\frac{1}{\alpha+ß+\gamma}\right)} (wL + rK + iM)$$

By plugging in factor demand functions and with further transformations we arrive at the total cost function:

$$C = \left(\frac{Y}{A}\right)^{\left(\frac{1}{\alpha+ß+\gamma}\right)} \left(w^{\left(\frac{\alpha}{\alpha+ß+\gamma}\right)} * r^{\left(\frac{ß}{\alpha+ß+\gamma}\right)} * i^{\left(\frac{\gamma}{\alpha+ß+\gamma}\right)}\right) * (\alpha + ß + \gamma) * \left(\frac{1}{\alpha^{\alpha} ß^{ß} \gamma^{\gamma}}\right)^{\frac{1}{\alpha+ß+\gamma}}$$

To obtain the unit cost function, we need to divide by Y:

$$c = \left(w^{\left(\frac{\alpha}{\alpha+ß+\gamma}\right)} * r^{\left(\frac{ß}{\alpha+ß+\gamma}\right)} * i^{\left(\frac{\gamma}{\alpha+ß+\gamma}\right)}\right) * \left(\frac{(\alpha+ß+\gamma)*}{A\alpha^{\alpha} ß^{ß} \gamma^{\gamma}}\right)^{\frac{1}{\alpha+ß+\gamma}}$$

Appendix E. Production function estimations

Table E.1. Production function estimation for manufacturing sectors.

Method	Levinsohn - Petrin				Wooldridge				N
Sector	Lab.	Cap.	Mat.	C	Lab.	Cap.	Mat.	C	
Food	0.23*** (0.00)	0.11*** (0.00)	0.66*** (0.00)	0	0.19*** (0.00)	0.09*** (0.00)	0.54*** (0.00)	0	396
Beverages	0.31*** (0.02)	0.17*** (0.05)	0.64*** (0.05)	1	0.19*** (0.04)	0.18*** (0.05)	0.33*** (0.03)	0	66
Textiles	0.35*** (0.01)	0.09** (0.04)	0.59*** (0.03)	1	0.28*** (0.02)	0.07** (0.03)	0.59*** (0.04)	1	90
Apparel	0.43*** (0.01)	0.09*** (0.02)	0.44*** (0.01)	1	0.41*** (0.01)	0.14*** (0.03)	0.52*** (0.03)	1	203
Leather	0.45*** (0.02)	0.11*** (0.03)	0.38*** (0.03)	1	0.40*** (0.02)	0.07* (0.04)	0.43*** (0.04)	1	72
Wood	0.23*** (0.00)	0.09*** (0.02)	0.64*** (0.01)	0	0.19*** (0.02)	0.08*** (0.02)	0.61*** (0.02)	0	312
Paper	0.09*** (0.00)	0.05*** (0.01)	0.84*** (0.00)	0	0.06*** (0.01)	0.09*** (0.01)	0.65*** (0.03)	0	65
Chemicals	0.18** (0.07)	0.13 (0.08)	0.67*** (0.21)	0	0.09*** (0.02)	0.11*** (0.03)	0.51*** (0.03)	0	76
Rubber & plastic	0.18*** (0.00)	0.11*** (0.01)	0.68*** (0.00)	0	0.17*** (0.01)	0.08*** (0.02)	0.72*** (0.02)	0	341
Mineral products	0.36*** (0.02)	0.14*** (0.01)	0.74*** (0.03)	1	0.25*** (0.02)	0.04 (0.03)	0.69*** (0.03)	1	210
Basic metals	0.14*** (0.01)	0.02*** (0.01)	0.77*** (0.00)	0	0.14*** (0.01)	0.03* (0.02)	0.77*** (0.02)	0	61
Fabricated metals	0.27*** (0.00)	0.15*** (0.01)	0.50*** (0.00)	1	0.18*** (0.01)	0.13*** (0.01)	0.59*** (0.01)	0	865
Computer, electronics	0.31*** (0.03)	0.05 (0.05)	0.50*** (0.07)	1	0.29*** (0.02)	0.10*** (0.04)	0.48*** (0.03)	1	114
Electrical equip.	0.36*** (0.01)	0.14*** (0.02)	0.48*** (0.01)	1	0.31*** (0.01)	0.13*** (0.03)	0.56*** (0.02)	1	201
Motor vehicles	0.25*** (0.02)	0.14*** (0.03)	0.56*** (0.02)	0	0.17*** (0.02)	0.18*** (0.03)	0.65*** (0.03)	0	112
Furniture	0.15*** (0.00)	0.09*** (0.01)	0.78*** (0.00)	0	0.20*** (0.02)	0.07*** (0.02)	0.68*** (0.02)	1	161
Median labor coefficient	0.26					0.19			

Notes: Bootstrapped and robust standard errors in parenthesis in case of LP and Wooldridge, respectively. C denotes category. 1 in column 5 and 9 represent labor-intensive categorization. N denotes number of companies in the sector. Lab., Cap. , Mat. stands for Labor, Capital and Materials. These parameters are estimates for coefficients from equation (2).

Table E.2. Production function estimation for services.

Method	Levinsohn – Petrin				Wooldridge				N
Sector	Lab.	Cap.	Mat.	C	Lab.	Cap.	Mat.	C	
Land transport	0.31*** (0.01)	0.07*** (0.00)	0.44*** (0.00)	0	0.15*** (0.00)	0.10*** (0.00)	0.55*** (0.00)	0	748
Warehousing	0.72*** (0.04)	0.07 (0.08)	0.10 (0.09)	1	0.61*** (0.04)	0.12* (0.07)	0.48*** (0.07)	1	254
Accommodation	0.44*** (0.01)	0.08*** (0.02)	0.63*** (0.01)	0	0.35*** (0.02)	0.08*** (0.02)	0.55*** (0.03)	0	336
Food services	0.22*** (0.00)	0.09*** (0.00)	0.73*** (0.00)	0	0.18*** (0.02)	0.07*** (0.01)	0.63*** (0.03)	0	597
Publishing	0.84*** (0.11)	0.15*** (0.05)	0.26** (0.12)	1	0.94*** (0.05)	0.04 (0.06)	0.24*** (0.07)	1	89
Telecommunication	0.45*** (0.10)	0.31** (0.15)	0.31*** (0.10)	0	0.33*** (0.07)	0.56*** (0.09)	0.07 (0.07)	0	36
Computer programming	0.64*** (0.01)	0.22*** (0.04)	0.27*** (0.02)	1	0.65*** (0.03)	0.13*** (0.04)	0.34*** (0.03)	1	330
Information services	1.00*** (0.05)	0.23*** (0.07)	0.07* (0.04)	1	1.09*** (0.09)	0.22** (0.10)	0.10 (0.09)	1	69
Legal and accounting services	0.91*** (0.02)	0.20*** (0.07)	0.30*** (0.07)	1	1.06*** (0.06)	0.16** (0.07)	0.27*** (0.08)	1	236
Management consultancy services	0.71*** (0.03)	0.27*** (0.00)	0.33*** (0.05)	1	0.89*** (0.06)	0.03 (0.07)	0.35*** (0.06)	1	261
Architectural and engineering services	0.54*** (0.01)	0.15*** (0.03)	0.32*** (0.03)	1	0.56*** (0.03)	0.14*** (0.04)	0.42*** (0.03)	0	491
Advertising and market research	0.47*** (0.04)	0.37*** (0.06)	0.14 (0.09)	0	0.45*** (0.07)	0.37*** (0.09)	0.25*** (0.07)	0	272
Employment services	0.64*** (0.02)	0.11* (0.06)	0.19*** (0.06)	1	0.66*** (0.03)	0.16*** (0.06)	0.20*** (0.04)	1	138
Travel agency services	1.13*** (0.06)	0.13 (0.12)	0.07 (0.13)	1	1.50*** (0.16)	0.39*** (0.14)	0.19 (0.15)	1	72
Security and investigation	0.55*** (0.01)	0.08** (0.03)	0.34*** (0.01)	1	0.61*** (0.01)	0.05* (0.03)	0.32*** (0.03)	1	264
Services to buildings	0.43*** (0.02)	0.13*** (0.04)	0.40*** (0.02)	0	0.50*** (0.02)	0.12*** (0.04)	0.57*** (0.04)	0	186
Administrative and support services	0.48*** (0.10)	0.18*** (0.05)	0.37*** (0.08)	0	0.52*** (0.05)	0.23*** (0.06)	0.43*** (0.06)	0	269
Health	0.31*** (0.01)	0.18*** (0.03)	0.43*** (0.01)	0	0.26*** (0.01)	0.13*** (0.02)	0.41*** (0.03)	0	371
Recreation	0.22*** (0.05)	0.38*** (0.08)	0.22*** (0.07)	0	0.14 (0.09)	0.28** (0.11)	0.33*** (0.10)	0	92
Median labor coef.	0.54				0.56				

Notes: Bootstrapped and robust standard errors in parenthesis in case of LP and Wooldridge, respectively. C denotes category. 1 in column 5 and 9 represent labor-intensive categorization. N denotes number of companies in the sector, Lab., Cap. , Mat. stands for Labor, Capital and Materials. These parameters are estimates for coefficients from equation (2).

Appendix F: Regression tables of the main results

Table F.1. DiD results for Manufacturing by labor intensity

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	**ln (L)**	**K/L**	**Emp. growth rate**	**Absolute emp. flow**	**ln (VA/L)**	**TFP (LP)**
2004#Labor-intensive ind.	-0.05	1.47	NA	NA	-0.04	-0.06
	(0.07)	(3.77)			(0.07)	(0.04)
2005#Labor-intensive ind.	-0.03	2.40	0.05	-0.06	0.04	-0.01
	(0.02)	(1.59)	(0.06)	(0.05)	(0.03)	(0.02)
2007#Labor-intensive ind.	-0.05***	1.70	-0.04*	-0.05**	0.06**	0.02*
	(0.02)	(1.91)	(0.02)	(0.03)	(0.03)	(0.01)
2008Labor-intensive ind.	-0.09***	5.02**	-0.02	-0.01	0.06*	0.02
	(0.03)	(2.46)	(0.03)	(0.02)	(0.03)	(0.01)
2009#Labor-intensive ind.	-0.08***	2.62	0.01	0.02	-0.04*	-0.05***
	(0.03)	(2.41)	(0.03)	(0.02)	(0.04)	(0.02)
2010#Labor-intensive ind.	-0.07**	1.61	0.01	0.03	-0.02	-0.03*
	(0.03)	(2.50)	(0.02)	(0.02)	(0.04)	(0.02)
2011#Labor-intensive ind.	-0.09***	2.45	-0.07*	0.03	0.01	-0.01
	(0.03)	(2.52)	(0.04)	(0.02)	(0.04)	(0.02)
2012#Labor-intensive ind.	-0.08***	0.84	0.01	0.03	-0.02	-0.02
	(0.03)	(2.53)	(0.02)	(0.02)	(0.04)	(0.02)
2013#Labor-intensive ind.	-0.08***	3.00	-0.02	0.04*	-0.02	-0.02
	(0.03)	(2.71)	(0.02)	(0.02)	(0.04)	(0.02)
Constant	1.69***	84.43***	-0.23**	0.80***	0.49***	1.52***
	(0.10)	(9.95)	(0.10)	(0.08)	(0.14)	(0.08)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Observations	21,612	21,612	18,094	18,094	21,289	20,627
R-squared	0.09	0.04	0.03	0.21	0.07	0.05
Number of companies	4,171	4,171	3,846	3,846	4,136	3,962

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table F.2. DiD results for Services by labor intensity

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	**ln (L)**	**K/L**	**Emp. growth rate**	**Absolute emp. flow**	**ln (VA/L)**	**TFP (LP)**
2004#Labor-intensive ind.	-0.11	0.29	NA	NA	0.03	-0.04
	(0.08)	(6.19)			(0.09)	(0.06)
2005#Labor-intensive ind.	-0.02	-0.12	0.09	-0.01	0.01	-0.04
	(0.02)	(3.67)	(0.24)	(0.06)	(0.04)	(0.02)
2007#Labor-intensive ind.	0.02	-0.37	0.14	-0.03	0.04	0.02
	(0.03)	(2.70)	(0.15)	(0.03)	(0.03)	(0.02)
2008Labor-intensive ind.	0.01	3.54	0.00	-0.06*	0.05	0.02
	(0.03)	(3.57)	(0.05)	(0.03)	(0.04)	(0.03)
2009#Labor-intensive ind.	-0.01	6.22	-0.02	-0.06**	0.05	-0.02
	(0.03)	(3.83)	(0.06)	(0.03)	(0.04)	(0.03)
2010#Labor-intensive ind.	-0.01	6.31	0.01	-0.04	0.03	-0.02
	(0.03)	(3.79)	(0.05)	(0.02)	(0.04)	(0.03)
2011#Labor-intensive ind.	0.01	4.55	0.02	-0.00	0.02	-0.01
	(0.04)	(3.90)	(0.07)	(0.03)	(0.04)	(0.03)
2012#Labor-intensive ind.	0.02	4.18	0.04	-0.02	-0.02	-0.05
	(0.04)	(3.88)	(0.06)	(0.02)	(0.04)	(0.03)
2013#Labor-intensive ind.	-0.00	8.60	0.01	-0.02	-0.02	-0.09***
	(0.04)	(3.88)	(0.06)	(0.03)	(0.04)	(0.03)
Constant	2.24***	-	-0.22	0.65***	0.64***	1.51***
	(0.10)	106.94***	(0.25)	(0.08)	(0.13)	(0.10)
		(15.26)				
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Observations	21,190	21,190	17,114	17,114	20,986	19,518
R-squared	0.07	0.06	0.00	0.23	0.16	0.08
Number of companies	5,665	5,665	5,001	5,001	5,610	5,217

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table F.3. DiD results for Manufacturing by sales volatility

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	**ln (L)**	**K/L**	**Emp. growth rate**	**Absolute emp. flow**	**ln (VA/L)**	**TFP (LP)**
2004#Volatile_ind	-0.01	-5.59	NA	NA	-0.07	-0.03
	(0.06)	(3.70)			(0.07)	(0.04)
2005#Volatile_ind	0.04	-1.52	0.04	-0.04	-0.03	-0.02
	(0.02)	(1.59)	(0.07)	(0.05)	(0.03)	(0.02)
2007#Volatile_ind	0.01	-2.04	-0.03*	-0.03*	0.06**	0.02*
	(0.02)	(1.82)	(0.02)	(0.02)	(0.03)	(0.01)
2008#Volatile_ind	0.00	-1.87	0.03	-0.03*	0.08**	0.03**
	(0.02)	(2.78)	(0.02)	(0.02)	(0.03)	(0.01)
2009#Volatile_ind	0.03	-1.37	0.00	0.01	-0.07**	-0.04**
	(0.03)	(2.40)	(0.03)	(0.02)	(0.04)	(0.02)
2010#Volatile_ind	-0.01	-3.45	0.03	-0.00	-0.00	-0.01
	(0.03)	(2.51)	(0.02)	(0.02)	(0.04)	(0.02)
2011#Volatile_ind	0.03	-3.70	0.01	0.02	0.04	0.01
	(0.03)	(2.53)	(0.03)	(0.02)	(0.04)	(0.02)
2012#Volatile_ind	0.03	-3.13	0.03	0.01	0.04	0.00
	(0.03)	(2.53)	(0.02)	(0.02)	(0.04)	(0.02)
2013#Volatile_ind	0.02	-3.27	0.02	0.01	0.01	0.01
	(0.03)	(2.73)	(0.02)	(0.02)	(0.04)	(0.02)
Constant	1.69***	25.94***	-0.21**	0.80***	2.43***	2.21***
	(0.11)	(2.82)	(0.10)	(0.08)	(0.08)	(0.04)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Observations	22,448	22,597	18,795	18,795	21,591	21,084
R-squared	0.08	0.00	0.03	0.21	0.02	0.02
Number of companies	4,319	4,327	3,987	3,987	4,149	4,048

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table F.4. DiD results for Services by sales volatility

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	**ln (L)**	**K/L**	**Emp. growth rate**	**Absolute emp. flow**	**ln (VA/L)**	**TFP (LP)**
2004#Volatile_ind	-0.01	7.32	NA	NA	-0.07	-0.02
	(0.08)	(6.59)			(0.09)	(0.07)
2005#Volatile_ind	-0.01	5.00	0.07	-0.02	-0.03	0.02
	(0.02)	(3.96)	(0.25)	(0.06)	(0.04)	(0.02)
2007#Volatile_ind	0.07***	1.02	0.18	-0.02	-0.01	0.01
	(0.03)	(2.93)	(0.18)	(0.06)	(0.03)	(0.02)
2008#Volatile_ind	0.06**	4.44	-0.02	-0.06**	0.01	0.05
	(0.03)	(3.76)	(0.05)	(0.03)	(0.04)	(0.03)
2009#Volatile_ind	0.06*	3.98	-0.01	-0.05*	-0.01	0.07*
	(0.03)	(3.97)	(0.06)	(0.03)	(0.04)	(0.03)
2010#Volatile_ind	0.07**	4.36	0.01	-0.03*	-0.02	0.02
	(0.03)	(3.92)	(0.05)	(0.02)	(0.04)	(0.03)
2011#Volatile_ind	0.10***	5.02	0.01	0.00	-0.02	0.05
	(0.04)	(4.10)	(0.07)	(0.03)	(0.05)	(0.03)
2012#Volatile_ind	0.09***	6.39	0.05	-0.00	-0.03	0.04
	(0.04)	(4.11)	(0.06)	(0.02)	(0.05)	(0.03)
2013#Volatile_ind	0.05	8.66**	0.03	-0.00	-0.05	0.05
	(0.04)	(4.11)	(0.06)	(0.03)	(0.05)	(0.03)
Constant	3.01***	26.29***	-0.07	0.67***	2.84***	1.51***
	(0.07)	(5.39)	(0.21)	(0.05)	(0.08)	(0.10)
Year fixed effects	YES	YES	YES	YES	YES	YES
Firm fixed effects	YES	YES	YES	YES	YES	YES
Observations	20,723	21,987	17,740	17,740	20,569	20,115
R-squared	0.04	0.01	0.01	0.23	0.06	0.08
Number of company id	5,533	5,837	5,159	5,159	5,495	5,354

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix G: Productivity results with alternative specifications

Figure G.1. ln (Y/L) differences by labor intensity (LP) for manufacturing.

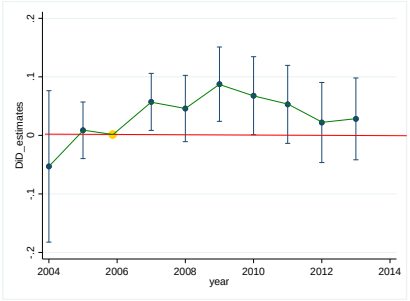


Figure G.2. ln (VA/L) differences by labor intensity (WD) for manufacturing.

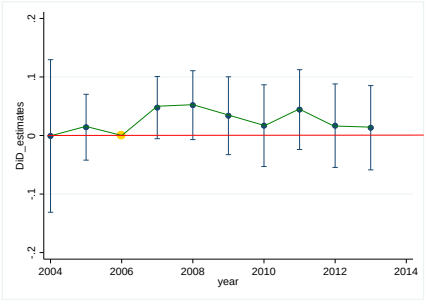


Figure G.3. ln (Y/L) differences by labor intensity (WD) for manufacturing.

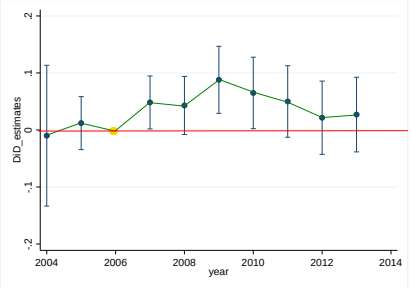


Figure G.4. TFP differences by labor intensity (WD) for manufacturing.

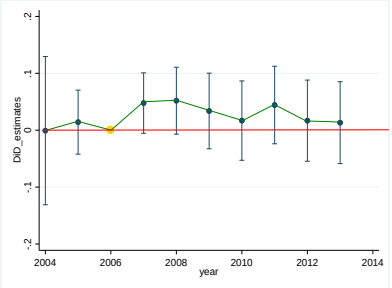


Figure G.5. ln (Y/L) differences by sales volatility for manufacturing.

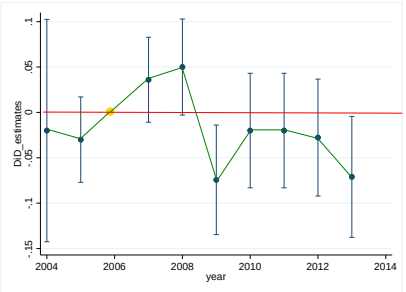


Figure G.6. TFP (WD) differences by sales volatility for manufacturing.

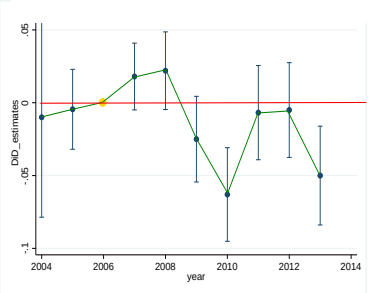


Figure G.7. ln (Y/L) differences by labor intensity (LP) for services.

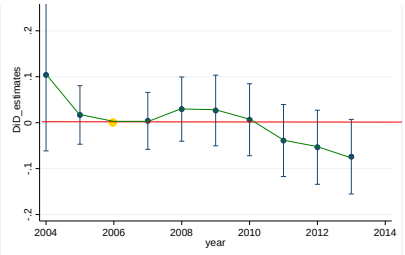


Figure G.8. ln (VA/L) differences by labor intensity (WD) for services.

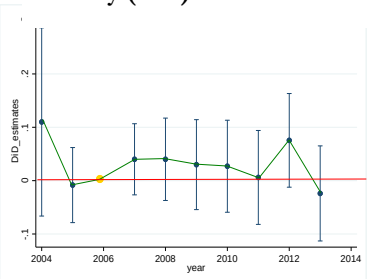


Figure G.9. ln (Y/L) differences by labor intensity (WD) for services.

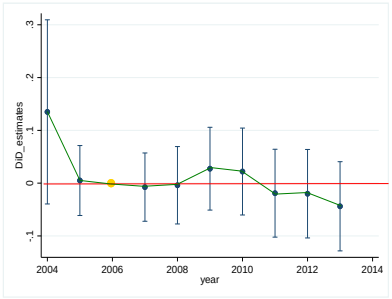


Figure G.10. TFP differences by labor intensity (WD) for services.

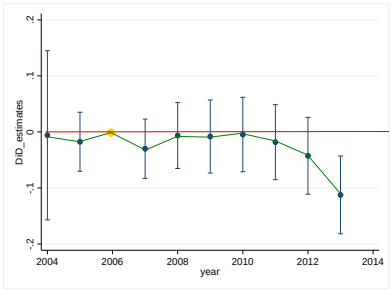


Figure G.11. ln (Y/L) differences by sales volatility for services.

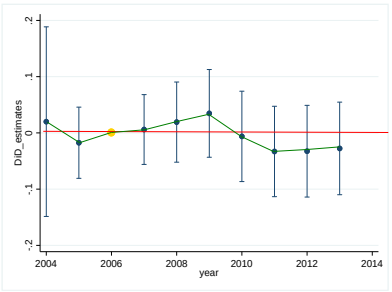
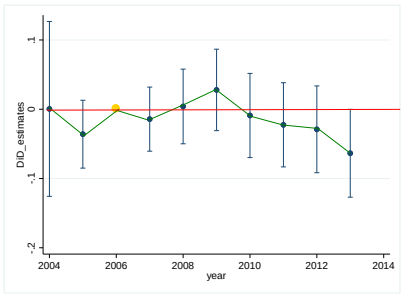


Figure G.12. TFP (WD) differences by sales volatility for services.



Appendix H: Heterogeneity tests for services

Table H.1. Differential effects by firm size (services).

Identification: Labor intensity (LP)				
Firm size	**Ln(VA/L)**	**TFP (LP)**	**Ln(L)**	**Absolute employment flows**
Small	0.06	0.03	-0.02	-0.02
	(0.04)	(0.03)	(0.02)	(0.03)
Medium	0.04	0.17***	0.06**	-0.01
	(0.04)	(0.05)	(0.03)	(0.05)
Large	-0.01	0.11	-0.02	-0.03**
	(0.1)	(0.07)	(0.04)	(0.01)
Identification: Sales volatility				
Small	0.05	0.02	0.00	0.02
	(0.04)	(0.03)	(0.02)	(0.03)
Medium	0.09*	0.16***	0.05*	-0.01
	(0.05)	(0.06)	(0.03)	(0.05)
Large	0.15*	0.11*	0.04	-0.02**
	(0.09)	(0.06)	(0.05)	(0.01)

Notes: Standard errors in parentheses for the DiD estimates. Pre-reform period is 2004-2006 and post-reform period is 2007-2008.

Table H.2. Differential effects by liquidity (services).

Identification: Labor intensity (LP)				
Firm size	**Ln(VA/L)**	**TFP (LP)**	**Ln(L)**	**Absolute employment flows**
Illiquid	0.08	0.05	-0.065	-0.17
	(0.14)	(0.12)	(0.1)	(0.15)
Moderately liquid	0.12*	0.05	-0.08	-0.01
	(0.07)	(0.05)	(0.07)	(0.07)
Liquid	0.02	0.06*	0.06**	-0.04*
	(0.04)	(0.04)	(0.03)	(0.02)
Identification: Sales volatility				
Illiquid	0.10	-0.02	-0.07	-0.02
	(0.12)	(0.11)	(0.1)	(0.09)
Moderately liquid	0.11*	-0.05	0.07	-0.05
	(0.06)	(0.04)	(0.06)	(0.03)
Liquid	0.15**	0.07*	0.05*	-0.03*
	(0.06)	(0.04)	(0.03)	(0.02)

Notes: Standard errors in parentheses for the DiD estimates. Pre-reform period is 2004-2006 and post-reform period is 2007-2008.