How Do Firm Characteristics Affect Skill Wage Premia in Hungary (1992-2010)?

By

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Abstract

I analyze the association between firm characteristics and within-firm wage premia in Hungary between 1992 and 2010. Using the Hungarian Wage Survey, a linked employer-employee dataset, I use firm level mean wage ratios of high, middle and low skilled worker groups to operationalize wage premia. In a pooled OLS as well as a panel fixed effects model, I estimate the effect of firm size, firm ownership, productivity and the skill-intensity of the industry the firm operates in on firm-level wage premia. According to my results, wage premia are higher in larger, foreign-owned, more productive and more skill-intensive firms, and lower in domestic private firms compared to state-owned ones. Except for skill-intensity and domestic private ownership, these effects are significant even if we control for firm-specific fixed effects. Firm size and foreign ownership increase wage premia especially at the top of the distribution, while productivity at the bottom. The effects do not seem to vary much across different time periods, but some of the firm characteristics show an increasing effect on wage differentials over time.

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Introduction

From the 1980s onwards, wage premia for high skilled workers have been rapidly increasing in the US and other developed countries in spite of a continuous increase of supply of college educated. This trend has been changing to some extent in the 1990s, since then labor markets have been characterized by a polarization of jobs, with increasing wages and employment for high skilled and low skilled workers, but falling wages and employment for the middle skilled (Acemoglu-Autor, 2011).

Increasing wage differentials between skilled and non-skilled workers have inspired labor economists to focus on questions of wage inequality. Theories explained increasing wage premia by the skill-biased nature of technological change. As high skilled workers have a larger productivity gain from new technologies, their wages increase more relative to that of middle and low income workers. At the same time, routinization of job tasks decreases demand for middle skilled workers, leading to a drop in their wages (Acemoglu-Autor, 2011). Besides routinization, globalization of production and offshoring may also be responsible for reduced demand for middle skilled in developed countries (Feenstra-Hanson, 1999).

Although a lot of research has been focusing on the determinants of skill wage premia on a macro level in various countries, not many studies have analyzed how wage premia vary across firms. Do firm characteristics have a significant effect on wage premia inside the firm? How do these effects vary in time? Gaining knowledge about determinants of wage premia may help to understand changes of wage inequality. As Autor (2014) also emphasizes, we should understand “the centrality of the rising skill premium to the overall growth of earnings inequality”.

There is a significant body of literature focusing on the effect of firm characteristics on wages. Among others, Brown and Medoff (1989) detail theories about the association of higher firm size and higher

wages. Foreign or public ownership is usually associated with higher wages (see Lipsey-Sjöholm, 2004; Brown-Earle-Telegdy, 2010), explained to some extent by productivity differences. Industry-specific wage differentials can be interpreted as gains from skill-intensive technology (see Bartel-Sicherman, 1999, Allen, 2001).

However, much less is known about firm characteristics and wage differentials. Some studies such as Earle-Telegdy (2013a) look at differences in terms of wage gains across worker groups. A recent paper by Mueller, Ouimet and Simintzi (2015) argues that literature should focus more on the effect of firm characteristics on wage differentials. They analyze the effect of size on firm-level job-skill ratios on a UK linked employer-employee database. According to their findings, size tends to have a larger effect on wage differentials at the top of the distribution.

Aiming to fill some of the gap of research looking for an effect of firm characteristics on wage differentials, in this paper I investigate the effect of firm characteristics on skill wage premia in Hungary, during the period 1992-2010. I concentrate on four firm characteristics that have been previously found to have a significant relationship with wages, and analyze whether these relationships are heterogeneous in terms of different skill groups. In line with previous research, I expect a positive effect of size, foreign and public ownership, as well as productivity and skill-intensity of the industry on wage differentials.

The Hungarian Wage Survey dataset is a linked employer-employee database about a large sample of Hungarian firms that enables to estimate effects of firm characteristics on wage premia calculated on the firm level from individual observations. Following Mueller et al (2015), I use occupation instead of education to proxy for skills to have a more accurate picture about what kind of skills the individual actually uses performing his or her job. I operationalize wage premia as wage differentials between workers in different occupations. Calculating the ratio of the mean wage of different skill groups gives us a whole picture about the nature of inequality in the firm: high to low skilled workers' mean wage ratio (wage ratio

1/3) describes the spread of wages; high to middle skilled workers' mean wage ratio (wage ratio 1/2) the top of the distribution; middle to low skilled workers' mean wage ratio (wage ratio 2/3) the bottom of the distribution.

I use two methods to investigate the association between firm characteristics and in-firm wage ratios. First I estimate on pooled OLS data with year fixed effects. At the same time, this estimation may merely show a selection bias in the data, hence more advanced econometric tools are used to control for time-invariant firm-specific fixed effects. In the second model, I analyze the relationship within-firm, looking at how changes of firm characteristics might influence wage distribution inside the firm. All my estimations are separately performed for all combinations of firm characteristics and wage ratios.

As the analyzed 19 years of the Hungarian economy have seen many changes from privatization and industrial restructuring in the early 1990s to the crisis in the late 2000s, it is very likely that these firm characteristics have had very different effects on the wage distribution. I define four periods according to major economic changes in order to look at the potential heterogeneity of effects of firm characteristics in time. This way, I perform similar estimations, a pooled OLS model as well as a FE panel mode including firm-specific fixed effects on these reduced samples.

This paper is organized as follows. Section 1 reviews theories explaining changes in wages and wage ratios in the past decades. I detail proofs and caveats of the theory of skill-biased technological change, the hypothesis of routinization and offshoring to create a theoretical framework for my analysis. I review literature focusing on the effect of firm characteristics on wage inequality, and I also give a short overview about the Hungarian labor market 1992-2010. In Section 2, I discuss my data source, the Hungarian Wage Survey, and explain what kind of regression methods I used. Section 3 shows my results from all estimations. The last section provides my conclusions.

1. Theory and Empirics of Wage Inequalities

1.1 Explaining Job Polarization: the Canonical and the Tractable Task-based Model

In this section, I describe trends in wages and wage inequalities in developed economies in the 1980s and 1990s. I review theoretical explanations of increasing wage inequalities, first the canonical model, second the tractable skill-based model and the routinization hypotheses, and third, some alternative explanations as globalization-induced offshoring and industry restructuring. This section aims to establish a theoretical framework for my analysis. Understanding the development of theoretical models about wage inequalities helps to find potential holes that may be filled with conclusions from empirical models.

From the 1980s onwards, there was a large increase in wage inequalities[1] in advanced countries, especially in the United States, that motivated many labor economists to study wage inequality. The period was characterized by a continuous increase of supply of higher educated workers with the expansion of higher education. In a simple equilibrium model, this would have implied a fall in the wage of skilled workers, however, exactly the inverse happened with a rising wage premium for skilled workers in the period. While real wages for skilled workers have constantly been increasing, real wages for non-skilled did not show any significant change in the period, resulting in a rising wage premium. Hence in the 1980s, real wage gains have been monotonically increasing from the bottom to the top of the wage distribution (Acemoglu-Autor, 2011).

However, in the 1990s and 2000s, the increase became non-monotonic with a U-shaped distribution of wage growth. The share of occupations and employment increased for high and low skilled workers compared to middle skilled ones, resulting in a job polarization. The pattern of skill-biased technological

[1] Wage premium for high skilled workers defined as the relative wage of college versus high school graduated workers can be interpreted as the market's valuation of skills.

change followed by job polarization has been prevalent in most developed countries, in the US, in European countries and other OECD countries as well (Katz-Autor, 1999)[2].

The first comprehensive theoretical model explaining increasing wage premia is the canonical model, based on Tinbergen's work (1974, 1975). The idea that increasing wage inequalities in spite of continuously increasing supply of high skilled workers can be best explained by technological change have been formulated by papers like Katz and Murphy (1992), Bound and Johnson (1992), Juhn, Murphy and Pierce (1993), Levy and Murnane (1992) or Card and Lemieux (2001). The canonical model operationalizes the concept of skill-biased technological change by two skill groups who perform two jobs in production of one good where the economy has a factor-augmenting technology.

In details, the canonical model assumes that there are two types of workers in the economy: high and low skilled workers. The model does not make any distinction between skills and occupations, high skilled workers are usually identified as college graduates, who work in different kinds of occupations than low skilled workers. The model assumes a constant elasticity of substitution between high skilled and low skilled workers, who are hence imperfect substitutes in production (Acemoglu-Autor, 2011).

In this model, if technology is constant, the wage of high skilled workers is determined by their supply, and demand as well as the supply and demand of low skilled workers - because of their imperfect substitution. Technology is defined as factor-augmenting, so technological change is interpreted to increase the

[2] For example, Davis (1992) shows that job polarization is prevalent in 9 advanced and 4 emerging economies. Antonzyck, DeLeire and Fitzenberger (2010) compare Germany and the US in terms of job polarization and find that patterns of wage trends and wage inequalities are highly similar. On the other hand, Felgueroso and his co-authors (2010) investigate an opposite pattern from Spain, where wage premium has been falling in the past decades, and find that occupational mismatch and temporary contracts are the most important factors contributing to the fall of the wage skill premium.

productivity of either or both types of workers. This also means technology cannot be skill-replacing (Acemoglu-Autor, 2011).

The model implies that as the relative number of high skilled workers increases in the labor force, wage of low skilled workers also increases because of imperfect substitution between the two groups. This also implies that technological change augmenting either type of labor will lead to the rise of wages of both labor groups. This way, without a regress of technology, declining real wages are not possible in the framework of the model (Acemoglu-Autor, 2011).

Intuitively, high skill augmenting technologies lead to a higher skill premium. This is consistent with Tinbergen's idea about the race between technology and education stating that the skill premium will be determined by the race between high skill augmenting technology and the increasing supply of high skilled workers. This way, there is a log linear increase in the demand of skills assuming we have a constant rate of technological development (Acemoglu-Autor, 2011).

Juhn, Murphy and Pierce (1993) understood SBTC as a process, where computers raised the productivity of workers with skills more, as they could gain more from using the computer for all their tasks than their less skilled counterparts. Autor, Katz and Krueger (1998) interpret SBTC as a complementarity advantage. As computers can mostly be used for tasks done by middle skilled workers, the value of high skilled workers shown by their wage has grown as they are complementary to computers (Card-DiNardo, 2002).

Although SBTC is a common hypothesis explaining wage inequality changes and also largely supported by empirical evidence, there have certainly been some critical voices claiming that SBTC may not be the only or the most important reason for increasing wage inequalities in the US. Card and DiNardo (2002) argue that SBTC is an inadequate tool to explain changes in US wage distribution as increasing skill wage premia are not the only change that should be interpreted. Although SBTC is good at explaining differences by

skills, it cannot explain the stability of the race differential, the closing of the gender gap or the differences of education wage gaps for younger and older cohorts (Card-DiNardo, 2002).

Lemieux (2006) criticizes SBTC arguing that increases of wage inequalities are largely explained by other factors than technology. He investigates how composition effects of workers play a role in changing inequalities. He finds that as the number of more educated and more experienced workers increased, this led to a per se increase in inequality. This way, increase in wage differentials is mostly explained by composition effects, and SBTC only explains a small part of the residual (Lemieux, 2006).

Moreover, if we try to apply the very simple SBTC model to explain changes in skill premium in the US, we see that its predictive power is not very high from the 1990s onwards. The 1990s have a raising wage premium that is coinciding with a slowdown in the increase of high skilled workers supply, however, the model suggests a rise in overall inequality only if the skill premium is rising (Acemoglu-Autor, 2011).

Acemoglu and Autor (2011) also criticized the canonical model along several dimensions. First of all, there has been a real wage decline for medium skilled in the 1990s which cannot be explained by the model, where technological development can only lead to increase or stagnation of wages for a certain skill group. In the model, there are no differences between workers in one particular skill group, this way, changes of differentials inside a skill group are not easy to interpret. Moreover, the model does not explain either composition of employment by occupation, or allocation of skill groups across occupations. The consequences of worker substitution with technology cannot be interpreted in the model, partially because technology is interpreted as exogenous, not as responding to changes in the supply of workers. Moreover, the model does not say anything about the effects of offshoring and outsourcing either.

Reviewing critical approaches to SBTC, some authors argued that criticisms do not seem to hold on an empirical ground. In Autor, Katz and Kearney (2008), and even more in detail in Acemoglu and Autor (2011), a modified version of the original SBTC hypothesis is proposed, the tractable task-based or

Ricardian model. In this model, skill-biased technological change should be interpreted as a routinization process, where information technology is complementing abstract tasks performed by high skilled, highly educated workers, and is substituting for routine tasks performed (previously) by middle skilled workers. For this explanation to hold, the distinction between skills and job tasks is essential, meaning that although occupations depend on education, education in itself does not perfectly predict the nature of the task performed by the individual (Autor-Katz-Kearney, 2008; Acemoglu-Autor, 2011).

They assume an economy where the final good is produced by a combination of a continuum of tasks. This way, the factors of production are high, middle and low skilled workers as well as capital, given a certain technology. We assume that each task can be performed by every worker, and the sets of tasks are divided to three parts done by three types of labor based on skills (high, middle and low), based on their comparative advantages as well as changes in supply and demand of different types of workers. Hence, the substitution in the production is between skills across tasks (Acemoglu-Autor, 2011).

In this model, a factor-augmenting increase in productivity for one group of workers may actually reduce the wage of other groups if it is shrinking the set of tasks they perform. This means that task-replacing technologies exist, which also implies that declining real wages are possible (Acemoglu-Autor, 2011).

If we would like to interpret changes in the US and other advanced countries in this framework, it may actually explain both the increasing skill premium of the 1980s and the job polarization of the 1990s. In the 1980s, skill-biased technological change led to declining wages as well as declining employment for the low skilled. In the 1990s, the penetration of ICT replaced middle skilled people, reducing their wages and employment as employers became incentivized to substitute employees performing routine tasks with computers. At the same time, technological development raised relative demand for complementary occupations such as abstract and elementary manual tasks which are mostly performed by high and low skilled workers. These tasks require interpersonal and environmental adaptability so they cannot be

automated by computers. This way, higher demand and real wages for high and low skilled workers increased. This trend has been highly similar for men and women. The decline in middle skilled occupations has been offset by an increase in high skilled occupations for women, while for men, about half has been accrued to high skilled and half to service occupations (Acemoglu-Autor, 2011).[3]

The main prediction of the Ricardian model is that if the relative market price of the tasks in which a skill group holds comparative advantages declines, the relative wage of that skill group should also decline – even if the group reallocates its labor to a different set of tasks, because of the comparative advantage assumption. This way, a change in wages will be the result of the changes in the employment share of the group as well as their changing supply (Acemoglu-Autor, 2011).

They also argue that technological change is endogenous and dependent on the supply of skills. Autonomous changes in skill supplies that may be results of demographic trends, evolving preferences or shifts in private and public education may actually induce changes in technology. This way, factor-augmenting technologies and comparative advantage differences both respond endogenously to skill supplies (Acemoglu-Autor, 2011).

Evidence about the growth of low-skill service jobs may be an additional proof for the SBTC hypothesis (Autor-Dorn, 2013). Autor and Dorn claim that although alternative hypothesis were not able to interpret the polarization of the US labor market in the 1990s, the SBTC hypothesis modelled as in Acemoglu-Autor (2011) was able to do so.

Some authors argue that it is changes in international trade such as the increasing prevalence of offshoring and outsourcing that are the most important factors explaining increasing wage premia[4]. Offshoring and

[3] Goos, Manning and Solomons (2010) offer evidence that declines in routine-intensive employment seem to be the largest cause for job polarization in most countries. Michaels et al (2009) show that in countries with more developed ICT sector, job polarization is more prevalent, proving that computer substitution for routine tasks may be the explanation for job polarization.

[4] See for example: Feenstra-Hanson (1999), Grossman-Rossi-Hansberg (2008)

outsourcing to less developed countries may disproportionately reduce demand for middle skilled workers, resulting in falling wages and employment for this workers group. Similarly, changing industry composition could also have led to changes in the demand of tasks. Feenstra and Hanson (1999) argue that increasing international trade may lead to higher inequality in the country of origin of the offshoring company.

Studies comparing the routinization hypothesis and offshoring often find that although both effects may be important, routinization seems to matter more for increasing wage inequalities.[5] Obviously, these explanations are not mutually exclusive and all of them may explain a part of the increase in wage inequalities. In my estimations, I will also investigate, whether effects on wage differentials predicted by the routinization hypothesis are significant.

1.2 Firm-level Characteristics and Wages

Acemoglu and Autor's tractable task-based model provides a comprehensive explanation for changes in skill wage premia in developed countries. At the same time, as it only looks at wage premia on an aggregate level. My paper uses the model as a framework of analysis, and aims to analyze wage premia inside firms. In the following section, I review articles dealing with the effect of firm characteristics on wages and wage premia. My analysis concentrates on the effects of firm characteristics on skill wage premia, however, results from the literature focusing on direct wage effects are an important first step to be able to set up hypotheses regarding wage differentials.

Although the literature is very divergent about what we actually include in the term firm characteristics, ranging from features easy to measure as size or ownership to more fuzzy concepts of norms and culture,

[5] See for example: Goos-Manning-Solomons (2009), Firpo-Fortin-Lemieux (2009), Autor-Dorn (2010), Michaels (2009)

in this paper, I concentrate only on a limited number of characteristics, 1) size of the firm defined by number of full-time employees, 2) ownership status of the firm (foreign, domestic private and domestic public), 3) productivity of the firm defined as net sales divided by the number of employees, 4) skill-intensity of the industry where the firm operates.

According to the literature, higher firm size is usually associated with higher wages (see for example Brown-Medoff, 1989, Oi-Idson, 1999). This finding seems to be universal for most countries. One of the explanations claims that large firms are the ones using more advanced technology, this is the reason why their more productive workers are rewarded by higher wages. In this case, workers self-select to larger firms. Other explanations mention that larger companies are either unionized or fear from unionization, hence granting higher wages for their workers; again others interpret higher wages in larger companies as a compensation for disamenities of working by a larger firm (Brown-Medoff, 1989).

In this paper, I am interested in the effect of firm size not on wages, but on wage differentials, hence the heterogeneity of the size-wage effect on different skill groups. According to the routinization hypothesis, if larger firm size is associated with a higher wage premium for the high skilled, this may be a proof that larger firms routinize more.

Mueller, Ouimet and Simintzi (2015) use UK firm level data to investigate the effect of firm size measured by number of employees on skill wage premia. They distinguish 9 skill groups based on IDS job categories, and calculate skill-wage ratios for all job-skill pairs. Looking at the effect of firm size on wage differentials, they find that larger firm size is associated with higher job-skill ratios for most pairs, especially when at least one of the pair is at the bottom of the distribution. Even analyzing within-firm changes, and controlling for firm fixed effects, results hold showing a significant increase of wage premia with a higher firm size (Mueller et al, 2015).

The effect of increasing firm size is larger on top-bottom and top-middle skill premia, than on middle-bottom ratios. This heterogeneity can be interpreted so that the gains of an increase in firm size will disproportionately lead to the increase of wages for the high skilled than for the middle and low skilled. According to the authors, it is unclear whether it is firm growth per se that on average contributes to a wider wage distribution in the UK, or this finding is merely a proof for the routinization hypothesis by Acemoglu and Autor (2011), if we assume that larger firms are more likely to automatize routine jobs. However, whichever the case, the proof that larger firms have a more unequal wage distribution may provide an alternative explanation for growing inequality of wages attributing this growth merely to a growth in terms of average firm size (Mueller et al, 2015).

Firms can be classified into three ownership categories: foreign, domestic private and state. Several articles concentrated on the effects of firm ownership on wages, and on wages of different groups of workers. Usually a positive association is found between privatization and wages (see for example Lipsey, 2002). There are various theories explaining this positive effect of foreign ownership, such as shared gains from innovation, restructuring leading to improved firm performance, compensating differentials associated with higher effort, or efficiency wages to reduce worker turnover. Most of them are associated with some kind of productivity gain after foreign ownership (Earle, Telegdy and Antal, 2012).

At the same time, this might merely be a selectivity bias, not a causal effect. Studies using firm-level data investigated the effect of an ownership change using more advanced methods as fixed effects or matching, most of the time finding a significant wage increase of wages (see for example Feliciano and Lipsey, 2006; Lipsey and Sjöholm, 2004, Conyon et al, 2002). Others using linked employer-employee data often do not find any causal relationship between foreign ownership and increased wages (see for example Heyman et al, 2007; Andrews et al, 2007/2008).

Brown, Earle and Telegdy (2010) investigate the effect of privatization on wages for four countries, Hungary, Romania, Ukraine and Russia. From an intuitive economic point of view, privatization may have either a positive, or a negative effect on wages and employment. If non-productive workers are laid off, that reduces employment, at the same time, the productive ones staying will get higher wages because of the increased productivity of the company.

Interestingly, the authors find that privatization does not have a significant negative effect in any of the countries. While privatization to a domestic owner shows a small negative effect on worker's wage, foreign privatization has a positive effect, sometimes even large effect on wages. The authors explain the increase in wages due to foreign ownership with a productivity improvement (Brown, Earle and Telegdy, 2010).

This research is continued by Earle and Telegdy (2013a) on a more detailed database for Hungary, where they look for ownership effects in case of privatized companies sold to foreign owners. [6] The article finds that change of ownership is associated with a consistently positive wage premium in most cases and for all groups of workers. This might be only an effect of selection bias, however, even after controlling for firm characteristics, the authors find a smaller, but still significant effect of foreign ownership on wages. They also add that foreign ownership may make greater difference in less developed countries like Hungary (Earle-Telegdy, 2013a).

The article also looks at the potential heterogeneity of effects on different kinds of workers. Although all groups of workers experience a wage increase, these effects vary somewhat by individuals. Workers with higher skills benefit the most from working at a foreign-owned company (Earle-Telegdy, 2013a).

[6] Csengődi et al (2003) analyze the effect foreign takeovers on wages on the similar dataset, although for a shorter time period (1986-2001) with similar findings.

Productivity of a firm is usually defined as net sales over the number of full time employees. Based on the SBTC theory, productivity of workers increases by skills, because higher skilled workers are able to benefit more from technology. This is reflected in their higher wages, at the same time, it is not obvious how this affects wage premia of skilled workers. More skilled workers lead to a more productive firm that could imply larger differences in wages within-firm, if workers at the bottom of the skill distribution get "further away" from high skilled workers in terms of productivity differences. However, it could also happen that in more productive firms, even low skilled workers are more productive. According to the routinization hypothesis, we should expect that wages of low skilled and high skilled complementary to wages of middle skilled within-firm should be higher, while wages of middle skilled should be lower.

Many articles have been investigating the relationship between productivity of workers and their wages, finding positive association between proxies of productivity and wage,[7] but they mostly concentrate on the existence of the relationship on an individual level. The analysis of the relationship between firm productivity and the dispersion of wages has hence been done in an indirect way. As I have already mentioned, papers dealing with foreign ownership often explain the effect of foreign ownership on wages with some kind of productivity increase (for example Brown, Earle and Telegdy, 2010).

Skill-intensive industries, also called high tech industries in manufacturing and knowledge-intensive industries in services, may be expected to have larger wage differentials between skilled and non-skilled workers. This can be explained by the routinization hypothesis: as more skill-intensive industries use more advanced technology, differences between skilled and non-skilled workers increase as technology increases the productivity of skilled workers more than that of non-skilled ones.

[77] See for example Hellerstein-Neumark-Troske (1999), Haegeland-Klette (1997)

Bartel and Sicherman (1999) find that more skill-intensive industries pay higher wages, but this wage premium seems to be explained by the sorting of more able workers into more technology-intensive industries. Dunne-Schmitz (1995) have similar results, but their effects seem homogenous across production and non-production workers, that may be a proxy for non-skilled and skilled worker differences.

Looking for factors behind skill-biased technological change, Allen (2001) looks at determinants of wage gaps between different groups of workers. He finds that wage gaps in schooling, which is the closest to skills, increased the most in industries with rising R&D and high capital-labor ratio. At the same time, he found mixed effects for high tech industries.

1.3 Wage Changes in the Hungarian Labor Market

In this section, I will shortly review literature about wage changes in the Hungarian labor market. Although some of this literature is already a bit outdated, it is important to see political as well as economic changes in the labor market that may explain time variation of the coefficient estimates from the regressions.

Literature about wage inequality in Hungary has largely focused on trends of wages from the end of 1980s till today. Articles by Kertesi and Köllő (1997, 2002), and by Kézdi (2002) have been focusing on effects of transition on wage distribution. Recently, Antal (2011) has been dealing with wage dispersion from before transition, 1986, till 2008. This direction of research has tried to understand the reasons for dramatically increasing skill premia in Hungary. Increasing wage differentials in the early 1990s were explained by the transition, while foreign capital inflow seems responsible for the continuation of this increase after 1995.

Kézdi (2002) analyzes trends of employment and wages after the transition, exploring differences between different skill groups. He uses cross-sectional data from various sources: household surveys, individual

level wage surveys as well as firm- and industry information from balance sheets that are linked to individual earnings data (Kézdi, 2002).

He finds that wage and employment differences have been dramatically increasing in favor of the high skilled workers during transition in Hungary. Looking for explanations for increasing wage premia, he divides the post-transition years of Hungary into two periods, the first until 1995, where the effects of transition have been most important in explaining wage differences, and the second from 1995 till 1999 (from which year his most recent data originates), which has been characterized by an increasing wage difference due to technological change (Kézdi, 2002).

Transition in Hungary was associated with many changes potentially affecting wages, and increasing wage premia for the high skilled. The compressed wage structure of the socialist economy has become a lot more differentiated because of economic changes such as price liberalization and privatization, political changes as free entrepreneurship and the rule of low as well as changes integrating Hungary in the world economy as the restructuring of international trade and the significant foreign capital inflow. There has been a large reallocation of employment towards more skill-intensive industries with significant although selective drop in employment for some sectors of the economy. These changes were complemented with other industries upgrading their skill composition (Kézdi, 2002).

In the second period, it is changes within-industries that led to a further increase in wage premia. This period mirrors the international process of skill-biased technological change in the Hungarian context. Privatization as well as the opening of the borders led to significant FDI inflow in the country that has been followed by technology transfer and development requiring workers with high skills (Kézdi, 2002).

Kézdi (2002) also estimates how effects of changes in firm characteristics affect wage changes. According to his results, increasing concentration level in the industry decreases skill premium. This may be explained by bargaining power of the employer, so that a higher concentration leads to less job opportunities of

workers, even high skilled ones, and consequently to a lower skill premium. He finds significant earnings advantage for foreign owned firms. At the same time, he finds a changing effect of labor productivity (defined as the ratio of return per employee), with an important effect in 1999, but no effect before. Similarly, firm size does not seem to matter before transition, but seems important determinant of wages after that. He concludes that it cannot be ruled out that these effects are only significant because of measurement problems and selection bias (Kézdi, 2002).

Kertesi and Köllő (2002) use the Hungarian Wage Survey data to estimate the effect of transition on human capital and skill wage premia. Although the article mostly focuses on estimating the difference in terms of the effect of transition on different experience groups, it has some interesting findings related to wage inequalities. They find that returns to schooling started to dramatically increase after transition and stabilized only after 1993. During transition, job destruction was particularly important for unskilled jobs, 48% of which disappeared, but also the market for skilled labor faced a contraction of 11%. From 1995 onwards, the number of skilled jobs started to increase at a similar rate than how it has been lost before, but unskilled jobs stagnated and real wages for them decreased further. Estimating several models, Kertesi and Köllő (2002) conclude that increasing skill wage premia are existent for all groups, however, gains are significantly larger for younger, less experienced cohorts (Kertesi-Köllő, 2002).

Antal (2011) uses the same dataset, although on a larger time horizon (1986-2008) to analyze dispersion of wages in transition. He finds that the wage spread above the median have constantly been rising since transition, while the dispersion of below-median employees declined. The spreading out of the distribution started in 1992, but has since continued. In this dispersion, low skilled men lost the most, while high skilled women gained the most. The male-female wage gap has declined which is completely in line with experiences of other CEE countries (Antal, 2011).

Antal (2011) also investigates what reasons may explain the increase in the dispersion of wages. He finds that the very significant minimum wage increase in 2002 has had a significant reducing effect on inequality only at the bottom of the distribution explaining a large part of inequality reduction 2000-2002. By decomposing within-firm and between-firm inequality, Antal finds that between firm inequality started to increase sharply after transition – from being officially non-existent in socialist times - , while within-firm inequality started to fall. Firms that have been on the market for a longer period seem to pay higher wages to their employees. This way, increasing age of firms further from transition may be a reason for the increase in inequality (Antal, 2011).

2. Data and Methods

2.1 About the Hungarian Wage Survey

The dataset I used for my analysis is the Hungarian Wage Survey, hereinafter HWS. HWS is a linked employer-employee database that includes individual level information about workers and firm level information about their employers at the same time, thus allowing to analyze the effect of firm level characteristics on data based on an individual level.

Data collection for the HWS is carried out by the Central Statistical Office of Hungary in form of a survey filled out by a sample of Hungarian firms in May of each year. HWS data are available for 1986, 1989 and yearly from 1992 to 2011, I used the dataset from 1992 to 2010. As we have observations from 19 years, we are able to analyze long term trends of wages and wage ratios in Hungary.

There have been some significant changes in firm sampling during the period. In 1986 and 1989, all firms were included in the sample. From 1992, only companies with more than 20 employees were surveyed, but this was complemented with a random sample of smaller firms from 1994 onwards (11-20 employees 1994-1999, and 5-20 employees 2000-2010) (Antal, 2011). To avoid changes of effects due to sampling, I estimate my analysis only on a database including firms over 20 employees. At the same time, imperfect sampling of the firm composition of the economy does not bias my results as I only use firm-level characteristics in the analysis. My results are interpretable on average for firms with more than 20 employees. After excluding firms with no observable employment data we have a database of 35,263 firms.

Sampling of employees has also been largely changed in the period, but it has been either universal or random in all periods for all employee groups. This does not cause a problem for my analysis, as I am only

using individual-level data to construct firm-level wage ratios that can be considered insensitive to sampling changes in case we accept that sampling has been random. As individuals are not matched across years[8], this database can be considered a panel only at the level of firms. My analysis focuses on workers either in manufacturing or in services, individuals working in agriculture are hence excluded from the sample.

2.2 Operationalization of Variables and Estimation Methods

My variables of interest are inside-firm wage premia of working groups with different skills. Measurement of skill premia is not completely trivial. In the literature, skills are usually defined by either education or by occupation. Although education and occupation are correlated, occupation is a better measure of the skills actually necessary for a job than education. Workers with similar education may perform very different tasks, and similarly the same task may be performed by workers with different education. According to Acemoglu-Autor (2011), job polarization may be explained by the change of demand for different skills in the economy, as technology reduces demand for middle skilled, performing mainly tasks possible to be routinized. Hence, without an adequate measure of skills, this hypothesis is not testable.[9]

Fortunately, the HWS includes data about the individuals' occupation that I can use as a close proxy of the skills he or she uses. The International Standard Classification of Occupations (ISCO) by the International Labor Organization (ILO) distinguishes between 10 categories of occupations (see Table 1). Individuals of armed forces occupations are not included in the dataset, and I also exclude skilled agricultural workers.

[8] There are actually some methods identifying individuals across years, for an example see Kertesi-Köllő (2000). At the same time, they are somewhat imperfect as they largely reduce the sample of firms.

[9] According to the data, occupation and education are correlated with each other to some extent but there is not perfect one-to-one mapping between them.

To measure skill premia, I create three skill groups: high skilled (1), middle skilled (2) and low skilled jobs (3). Table 1 shows how the original ISCO categorization is converted into the three skill-based categories.

Table 1. Skills and ISCO descriptions

ISCO	ISCO description	3 categories
1	Managers	High skilled (1)
2	Professionals	High skilled (1)
3	Technicians and associate professionals	High skilled (1)
4	Clerical support workers	Middle skilled (2)
5	Service and sales workers	Low skilled (3)
6	Skilled agricultural, forestry and fishery workers	Excluded
7	Craft and related trades workers	Middle skilled (2)
8	Plant and machine operators, and assemblers	Low skilled (3)
9	Elementary occupations	Low skilled (3)
0	Armed forces occupations	Not available

Note: Descriptions are based on the ISCO (International Standard Classification of Occupations) by the International Labor Organization.

Wage inequality could be measured by standard inequality measures (Gini coefficients, Theil coefficients, etc.) calculated for wages. At the same time, these measures are not that straightforward to interpret and do not use the information about the occupations and consequently, about the job tasks individuals perform. This way, I decided to operationalize wage premia as ratios of mean wages for skill groups, similarly to Mueller et al (2015) with the difference of having only three skill categories instead of nine. Hence, wage ratios 1/2, 2/3, 1/3 are calculated dividing the mean wage of high skilled with that of the middle skilled, the mean wage of middle skilled with that of the low skilled and the mean wage of high skilled with that of the low skilled, respectively. Logarithmized wage premia calculated on a firm level will be used as dependent variables in the estimations. It is important to note that although the database does

not contain information about all employees of the firm, as we use mean wages from a randomly selected sample, this should not have any significant biasing effect.

These three wage ratios are very easy to interpret, moreover they have the advantage to capture top-bottom, top-middle and middle-bottom changes of wages inside one variable each. This way, wage effects in different parts of the distribution will separately be shown by the measures.

In the estimations, I use various firm level characteristics: size of the firms, ownership, productivity and skill-intensity of the industry. Size of the firms is operationalized as the logarithmized number of full-time employees working at the firm. As I already mentioned, firms with less than 20 employees are not included in the analysis because of sampling changes.

Ownership of the firms is captured by two variables: foreign ownership dummy that equals one if more than 50% of the firm is foreign-owned and zero otherwise, and private ownership dummy that equals one if more than 50% of the firm is privately owned and zero otherwise. Productivity of the firm is defined as the logarithm of net sales on real 2007 prices divided by the number of employees.

To test the routinization hypotheses by Acemoglu-Autor (2011), I use skill-intensity of the industry as a potential explanatory variable. The skill-intensity variable is created based on a classification by Eurostat (see Eurostat, 2015). Based on NACE codes, Eurostat distinguishes high, medium-high, medium-low and low technology industries in manufacturing, and knowledge-intensive and non-knowledge-intensive industries in services. I define skill-intensive firms as those being characterized high-tech, medium-high-tech or knowledge-intensive by Eurostat, using the Hungarian version of NACE characterization, TEAOR codes to create the skill-intensity variable.

I estimate regression models to investigate the effect of firm characteristics on inside-firm wage premia. I run all the regressions for the three wage ratios (top-middle, middle-bottom and top-bottom), and for the four explanatory variables separately, hence having 12 estimates from the model specifications.

First, I estimate the effect of firm characteristics on all firm-year observations in the following way:

$$\text{(1a) } lwr_i^{1/2} = \alpha + \beta\, size_i + \sum_{j=1992}^{2010} \gamma_j\, year_j + u_i\,,$$

Where $lwr_i^{1/2}$ is the logarithmized ratio of the mean wage of the high skilled (1) and the mean wage middle skilled (2) on a firm-level, $size_i$ is the logarithmized number of full-time employees of the firm, $year_j$ refers to years dummies (reference year=1992), and u_i is the error term. Similar regressions have been estimated with all combinations of regressors $lwr_i^{1/2}$, $lwr_i^{1/3}$, $lwr_i^{2/3}$, and explanatory variables $size_i$, $ownership_i$, $productivity_i$, and $skill - intensity_i$.

Model (1) is a pooled OLS model, estimated as if all firm-year observations were independent observations. The regression model contains year fixed effects to control for year-specific factors, at the same time, no controls for firm-specific factors have been included. Clustered standard errors on the firm level account for no heteroscedasticity and serial correlation coming from the correlation between firm-specific errors.

From Model (1), the coefficients can be interpreted in the following way: in a given year, 1% more employees at the firm will be associated with on average β percent higher wage premium of high skilled compared to middle skilled. Based on previous literature (see Chapter 2), I expect firm size to have a positive sign in determining wage premia. Coefficients are expected to be highest in case of top-bottom comparison ($lwr_i^{1/3}$).

The analogous model for firm ownership is the following:

$$(1b)\ lwr_i^{1/2} = \alpha + \beta\, foreign_i + \delta\, private_i + \sum_{j=1992}^{2010} \gamma_j\, year_j + u_i\ ,$$

It is important to see that in this equation, I compare three types of firms: foreign-owned private firms, domestic private firms and domestic state-owned firms. The reference group is domestic state-owned firms. Comparing foreign-owned private firms to domestic private ones, the wage premium is expected be on average β percent higher for high skilled workers compared to middle skilled ones in the same year. Comparing domestic private-owned to domestic state-owned, δ is the difference on average in log wage ratios. Hence, β will contain δ in itself as all foreign-owned firms are private, and the difference between β and δ will show the difference between foreign and domestic private firms.

According to the literature, I expect foreign ownership to have a significant positive sign, but private ownership a significant negative one. Similarly to Model (1a), the strongest relationship is expected for $lwr_i^{1/3}$. Equations for productivity (1c) and skill-intensity (1d) are similar to Model (1a). It is expected that both productivity and skill-intensity of the industry will have a positive sign, increasing wage premia for skilled workers.

Although Models (1a-1d) show an association between firm characteristics and wage premia, it is not clear whether these effects come from the fact that large and small firms are systematically different from each other in several respects causing wage premia differences, or if it is actually the change in the size of the firm that makes a difference in itself. Similarly, is it that state-owned firms are by nature very different from private-owned ones? What if they get privatized, would wage differentials significantly change? These questions cannot be answered from Models (1a-1d), which consequently cannot really be used to draw policy lessons.

At the same time, benefitting from the panel structure of the HWS database, where the same firms can be observed in different years, we are able to analyze the effects of firm characteristics' changes on wage

premia. Our panel dataset gives us the possibility to look at the effect of changes in the following model with firm-specific as well as year-specific fixed effects:

$$\text{(2a) } lwr_{i,t}^{1/2} = \alpha + \beta\, size_{i,t} + \sum_{j=1992}^{2010} \gamma_j\, year_{j,t} + \theta_i + u_{i,t}\ ,$$

Where notations are similar to model (1a), and θ_i refers to firm-specific fixed effects. Similarly to Model 1, I run 12 equations of Model 2 for all combinations of log wage ratios and explanatory variables.

In case of Model 2, interpretation of the coefficients may be the following: changing the number of employees with 1% in firm i would imply a change of β percent in the log wage differentials of the high and the middle skilled employees of the firm, given the same year. In this case, coefficients can be interpreted as effects of within-firm changes on wage premia.

Expectations of the coefficients are similar to those in Model 1. However, if we receive decrease of coefficients or no significant effect in this case while we had significant estimates in Model 1 that means that it is not my variables of interest, but other systematic differences between firms correlating with my variables that imply changes in wage premia.

Besides analyzing within-firm changes, I would also like to know, whether the relationship between firm characteristics and wage premia has changed over time. For this purpose, I run the above regressions (1a-d) through (2a-d) for 4 intervals. The intervals were constructed to mirror changes in the Hungarian economy.

The first interval runs from 1992 to 1995. This period was an era of restructuring of industries after transition as well as an era of intense privatization (Kézdi, 2002). Moreover, 1995 is the starting point of a significant austerity package (but it is expected to have some time lag in its effect). There is no reason to expect significantly different signs for size or productivity than in the previous two models. At the same time, ownership effects might be especially interesting to investigate, given that lots of the changes in

ownership took place in that period. Moreover, restructuring of industries may lead to less clear estimates for skill-intensity effects than in later periods.

In the second period from 1996 to 2001, the Hungarian economy started to have similar trends to advanced economies, for instance Kézdi (2002) attributes increases in wage premia to the skill-biased technological change in this period. The endpoint of the period is a very significant minimum wage increase in 2002, significantly changing the position of the low skilled who usually are the ones receiving minimum wage (Antal, 2011). In this period, signs of the explanatory variables are expected to be mostly in line with the coefficient estimates from (1a-d).

The third period lasts from 2002 to 2006, while the fourth from 2007 to 2010. The break between these two periods is marked by 2006, when the growth of incoming speed of FDI was highest (Antal, 2011). At the same time, I do not expect very significant differences between these two periods, it is more the importance than the sign of the coefficients that may change. In these periods, the sign of foreign ownership is particularly interesting, because of the high FDI inflow. Signs are otherwise expected to be similar to those in Model (1a-d).

Models 1a-d run on separate interval periods are labelled Models 3a-d. The interpretation of these models is of course similar to those in 1a-d, only for a shorted time period. My main interest here is how coefficients vary across periods.

Creating interval periods has the additional advantage that also estimates from model (2a-d) with fixed effects panel models may be reproduced, investigating whether effects of within-firm changes differ by period. These models are labeled as 4a-d. Similarly, models 4a-d have the same interpretations as models 2a-d, only for a shorter time period. Although we expect similar coefficients in sign to those in 2a-d, it may happen that there are not going to be enough changes in firm characteristics in the time period to measure any significant effects.

3. Results

3.1 Descriptive statistics

In Table 1, we can see mean wages calculated for all firm-year observations by skill groups. In line with my expectations, mean wages increase by skills, firm-level average wage is 244,770 HUF, 130,629 HUF and 102,055 HUF for high, middle and low skilled workers respectively. At first sight, differences between high and middle skilled workers seem larger than between middle and low-skilled. Moreover, it is important to note that the wage of high skilled workers seems to have a much wider distribution.

Table 2. Distribution of mean wages by skill group[10]

Skill group	Observations	Mean	25%	50%	75%	Std. Dev.
High (1)	93739	244770	129404	194475	300111	192327
Middle (2)	104702	130629	86901	114677	155176	69063
Low (3)	63140	102055	73650	91030	117807	51568

Note: Mean wages have been calculated for all firm-year observations. The table shows real wages on 2010 prices.

Mean wage ratios calculated on a firm-year observation level are presented in Table 2. We can see that we have a large number of observations regarding all three wage ratios. On average, high skilled workers earn 1.8 times more than middle skilled workers, and 2.2 times more than low skilled workers working in the same firm. Differences between high and middle skilled workers are higher than those between middle and low skilled, at the same time this latter is also very significant.

Table 3. Distribution of mean wage ratios

Skill group pairs	Observations	Mean	25%	50%	75%	Std. Dev.
High/middle (1/2)	79707	1.822	1.200	1.592	2.116	1.105
High/Low (1/3)	50404	2.226	1.388	1.926	2.643	1.403
Middle/Low (2/3)	52689	1.294	1.013	1.204	1.470	0.471

Note: Mean wage ratios have been calculated for all firm-year observations.

[10] If not specified otherwise, all Tables and Figures are based ont he author's calculations using the Hungarian Wage Survey data, 1992-2010.

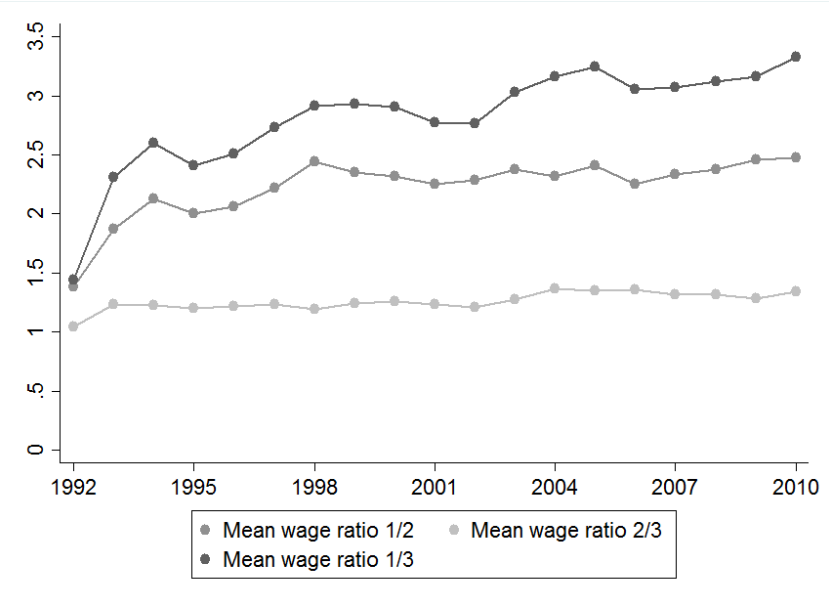
We would also like to look at changes in terms of mean wage differentials by year. Figure 1 shows the evolution of changes of mean wage ratios by year. Note that mean wage ratios here are computed on the level of the whole economy, not on the firm-level. The logarithmized form of this measure is usually presented in other papers as a standard measure of wage inequality. In my regressions, we use a logarithmized form of mean wage ratios calculated on a firm level. Looking at Figure 2, we see the evolution of changes of mean wage ratios generated on the firm level by year, in this sense mean wage ratios shown in Table 2 are presented by year here.

Figure 1 shows that wage differentials in Hungary have been rapidly increasing in the early 1990s, especially wages of high-skilled compared to both other skill groups. From 1995, wage differentials continue to increase, although at a much slower speed. For example, high skilled wages are at the end of the 1990s on average about 2.9 times higher than low skilled wages, and 2 times higher than middle skilled wages, while this number raises to 3.2 and 2.5 respectively by 2010.

At the same time, on Figure 2, we can see the evolution of mean wage ratios calculated on a firm level. Increases in terms of wage differentials are very rapid in the early 1990s, however, levels of wage premia stabilize afterwards. At the beginning of the period, there are almost no wage differences between high and medium skilled workers on average, in 2010, high skilled workers earn on average two times more than middle skilled ones.

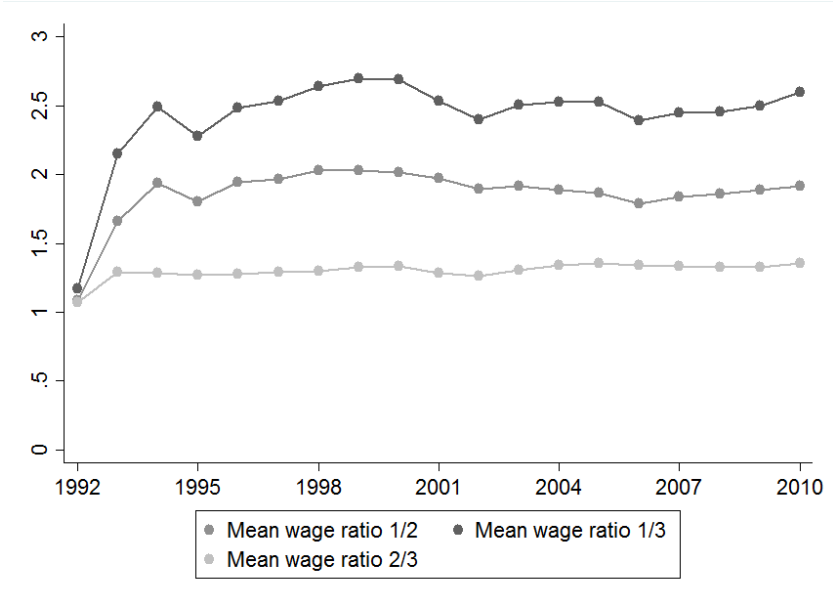
Comparing Figure 1 and 2 suggests that after 1995, it is not within-firm wage premia changes that caused the increase in wage premia, but it is rather the composition of firms that changed. If there are certain firm characteristics that are associated with higher wage premia, and the share of these firms increased in the whole economy that could have caused the increase in wage premia that we see on Figure 1.

Figure 1. Mean wage ratios by skill group



Note: Mean wage ratios presented on this Figure are based on mean wages calculated for all three skill groups by year.

Figure 2. Firm-level mean wage ratios by skill group



Note: Mean wage ratios have been calculated for all firm-year observations.

Distribution of firm-level characteristics of interest are presented in Table 3. On average, firms have 189 full-time employees, but standard deviation of size is very high suggesting that we have some firms with extremely large number of observations.[11]

If we look at the evolution of mean firm size by year (see Appendix 1a), we see a slightly decreasing trend in the early 1990s. Looking at the trend without the outliers, we see that although a significant part of this trend is explained by the fall of the size of the largest outlier company, even without that, the fall in numbers is very significant. After 1995, there is no clear trend though, on average, mean firm size varies between 150 and 200.

On average, about 17% of firms are foreign-owned, while about 66% privately owned. Private ownership including foreign as well as domestic private firms increases from 23% to 91%, with two periods of particularly steep increase, from 1992 to 1994 and from 2006 to 2007. Consequently, state ownership shows a decrease from 77% to about 9%. Foreign ownership is slightly but constantly increasing over the whole period from 5% in 1992 to 26% of all the firms in 2010.

For productivity, we have a smaller number of observations, as unfortunately the productivity variable is only available till 2007. On average, firms have a real productivity of 0.4 defined as net sales in real terms (2007 prices) over the number of full-time employees. We see that productivity has a constantly increasing trend over the whole sample.

[11] We see that there are at least two very large outlier companies. One of them employs more than 100,000 individuals in 1992, but with a rapidly decreasing size in time. The other one is also significantly larger than any other companies with around 50,000 employees, with a size quite stable in time. Although it may be feared that these two firms may bias the estimations, I decided to keep them in the sample, because they are not measurement errors, but large public companies that indeed account for a very significant number of workers.

On average, 18% of the firms are skill-intensive with an increasing trend from on average 14% in 1992 to 22% in 2010 (see Appendix 1d). In the dataset, we have firms from 60 industries on the 2-digit NACE code level, from which 19 are labelled skill-intensive.

Table 4. Firm-level characteristics

	Observations	Mean	25%	50%	75%	Std. Dev.
Number of employees	122992	189	40	72	151	1015
Foreign ownership	118627	0.170	-	-	-	0.376
Private ownership	118627	0.658	-	-	-	0.475
Productivity	92839	0.402	-0.295	0.378	1.070	1.102
Skill-intensity of the industry	122992	0.179	-	-	-	0.383

3.2 Results

3.2.1. Size

As I already mentioned in the previous chapter, my expectation for the effect of firm size on wage ratios is a positive sign. We can see results of the pooled OLS model (1) and the panel fixed effects (FE) model (2) in Table 1. Both models include year-specific fixed effects, and the second model includes firm-specific fixed effects as well, while the pooled OLS controls for firm-specific measurement errors by clustered standard errors.

Table 5. Effect of firm size on log wage ratios in OLS (1) and Panel FE (2)

	(1) Log wage rate 1/2	(1) Log wage rate 1/3	(1) Log wage rate 2/3	(2) Log wage rate 1/2	(2) Log wage rate 1/3	(2) Log wage rate 2/3
Firm size	0.050***	0.062***	0.007***	0.019***	0.021***	0.001
	(0.003)	(0.003)	(0.002)	(0.003)	(0.005)	(0.003)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes

Observations	79,707	50,404	52,689	79,707	50,404	52,689
R-squared	0.082	0.122	0.024	0.112	0.187	0.041
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1						

Results are altogether in line with expectations. In Model (1) firm size has a significant positive effect on wage differentials. Comparing the wage differential between high skilled and low skilled employees inside two firms, one of which has 1% more employees, high skilled workers working in the larger firm earn on average 6% more than the ones working in the smaller one. Wage differentials are higher at the top of the distribution, with top workers gaining 5% more with increasing firm size than workers in the middle, but workers in the middle only earning 0.7% more with increasing firm size than workers in the bottom. Although this number may seem small, if we think about two firms, one with 20 and another with 40 employees, the second being 100% larger than the first one, associated potentially with an average 7% wage premium for middle skilled and 62% for high skilled in comparison to low skilled, that is an economically very significant difference.

At the same time, this might only be an effect of other systematic differences between large and small firms, not necessarily the effect of firm size itself. We estimate Model (2), a fixed effect panel model that concentrates on the effect of firm size changes within the same firm. Effects of firm size on skill-wage premia are lower, but they still stay significant in case of high skilled workers that earn on average 2.1% more in a 1% larger firm than low skilled ones, and on average 1.9% than middle skilled ones.

It seems that firm size does indeed have a significant effect even if we control for firm-specific fixed effects. However, this effect is largely concentrated on the top of the distribution, high skilled workers receiving a higher wage premia.

How does this effect change in time? Looking at Table 6, we can see the effect of firm size on wage premia in four different periods. I seems that there is a common pattern, large positive effects of wage premia,

especially at the top of the distribution in the pooled OLS model, but effects disappearing when controlling for other firm-specific effects. Moreover, it is interesting to note that wage premia associated with larger firm size have somewhat been increasing across periods. For example, the effect of a 1% increase in firm size on wage premia of high skilled compared to low skilled workers has been 1.8% between 1992 and 1995, but the effect of a similar increase was already 7% between 2007 and 2010.

There is a contradiction between results for Model (2) and Model (4) in this case. Significant positive effect of increase in firm sizes on wage premia in case of the whole period can be shown, while it does not seem to be significant for shorter periods. Most likely, it is due to the too small number of firm size changes that reduces the significance of our estimates.

There are some exceptions where I get significant results in model (4). In the first period, firm size has a significant positive effect on wage differentials between high and middle skilled workers, and similarly in the second period, although this effect is only significant on a 10% level. According to the literature, explanations for firm size effects are usually based on some kind of productivity measures. Although firm size may have been very closely correlated with productivity in the first two periods even within-firm, this effect disappeared after 2001. As we also investigated the effect of productivity on wage premia, we will see whether it is some kind of productivity-size change in the background going on.

Table 6. Changes of effect of firm size on log wage ratios in OLS (3) and Panel FE (4)

	(3) Log wage rate 1/2	(3) Log wage rate 1/3	(3) Log wage rate 2/3	(4) Log wage rate 1/2	(4) Log wage rate 1/3	(4) Log wage rate 2/3
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes
1992-1995						
Firm size	0.018***	0.026***	0.000	0.032***	0.012	0.000
	(0.003)	(0.004)	(0.003)	(0.009)	(0.013)	(0.010)

Observations	18,764	11,725	12,697	18,764	11,725	12,697
R-squared	0.210	0.313	0.066	0.327	0.477	0.122
1996-2001						
Firm size	0.047***	0.066***	0.006*	0.015*	0.016	-0.008
	(0.004)	(0.006)	(0.003)	(0.008)	(0.012)	(0.009)
Observations	24,118	13,874	15,086	24,118	13,874	15,086
R-squared	0.013	0.028	0.003	0.002	0.005	0.005
2001-2006						
Firm size	0.063***	0.076***	0.012***	0.004	-0.005	-0.008
	(0.004)	(0.005)	(0.003)	(0.007)	(0.008)	(0.006)
Observations	22,074	15,038	15,081	22,074	15,038	15,081
R-squared	0.026	0.036	0.005	0.003	0.008	0.006
2007-2010						
Firm size	0.071***	0.073***	0.007***	-0.023	-0.062**	0.019
	(0.003)	(0.004)	(0.003)	(0.018)	(0.029)	(0.021)
Observations	14,751	9,767	9,825	14,751	9,767	9,825
R-squared	0.033	0.031	0.001	0.010	0.007	0.002
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1						

3.2.2. Ownership

Regressions show what effect foreign-ownership and private-ownership have on wage premia compared to state-owned domestic companies as reference group. Results for the pooled OLS model and the panel FE model can be seen in Table 3.

In line with my expectations, foreign ownership has a positive, while private ownership has a negative association with wage premia in the simple pooled OLS model. This is similar to the findings of previous research discussed above.

Interestingly, foreign ownership seems to have a positive effect only at the top of the distribution. The fact that effects are smaller for top-middle ratios than for top-bottom ratios is even more underlined in the model with firm-specific fixed effects, where changes in firm ownership from domestic to foreign only have an effect on the wage premium of high skilled workers compared to middle skilled ones. At the same

time, this effect is significant both statistically and economically, a 1% increase in firm size causes on average a 2.5% increase in wage premia at the top of the distribution.

Effects of private ownership are significantly negative in the first model for all skill wage differentials, but they lose significance entirely in case we include firm-specific fixed effects. This suggests that although private firms seem to pay less wage premia, it is not the privatization of a firm itself that reduces wage premia, but other characteristics systematically different between private and public firms.

It is important to note that the difference between privately owned domestic and foreign firms is very large if we do not control for firm-specific fixed effects, suggesting that the sale of the firm to a foreign investor would increase wage premia by on average 17% between high and middle skilled workers. But from Model 2, it appears that this relationship is only a selection bias effect, and the real effect of ownership change of the firm on wage premia between high and middle skilled is only about 2.5%.

Table 7. Effect of firm ownership on log wage ratios in OLS (1) and Panel FE (2)

	(1) Log wage rate ½	(1) Log wage rate 1/3	(1) Log wage rate 2/3	(2) Log wage rate 1/2	(2) Log wage rate 1/3	(2) Log wage rate 2/3
Foreign	0.120***	0.093***	0.012	0.025***	0.001	0.002
	(0.009)	(0.012)	(0.008)	(0.010)	(0.013)	(0.009)
Private	-0.050***	-0.098***	-0.027***	0.007	0.009	-0.002
	(0.007)	(0.009)	(0.005)	(0.005)	(0.007)	(0.005)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes
Observations	76,885	48,401	50,729	76,885	48,401	50,729
R-squared	0.088	0.122	0.026	0.111	0.186	0.041
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1						

If we investigate the changes in effects of firm ownership through 1992-2010, we find some very interesting results. It is a consistent pattern over all periods, that foreign ownership significantly increases wage premia for high skilled workers compared to middle skilled, while private ownership has a negative association with wage premia between high and middle, and high and low skilled workers. Moreover, there is an increasing trend in the coefficients, with more significant and higher effects for later time periods.

For example, if we compare coefficients for foreign ownership in the first and the last period, we see that between 1992 and 1995, foreign ownership has been associated with an on average almost 5% wage premium for high skilled workers compared to middle skilled ones, while between 2007 and 2010, differences between high skilled and middle skilled workers associated with foreign ownership increased up to 22%. Moreover, wage differentials at the bottom of the distribution also become significant in case of the estimations for the last period.

A very similar pattern is to see in terms of the effect of private ownership. In the last period, negative association of private ownership with wage differentials is clear for all comparisons, and coefficients become a lot larger than they were in period 1.

It is interesting to note that wage differentials between high and middle skilled workers seem to be larger in foreign firms than in state-owned firms, however, wage premia between high and low skilled are larger in public firms. This suggests that foreign-owned firms pay a large wage premium mostly for high skilled workers, while in public firms, high and middle skilled also receive a large skill wage gain.

However, all these effects disappear in case I include firm-level fixed effects. We do not find any significant effect of ownership changes within-firm for these short periods. In this sense, results are highly similar to those from Table 7. The fact that we do not find significant effects within-firm may be explained with the argument that the relationship between ownership and wage ratios is only an effect of selection bias,

where foreign and public firms are associated with other factors increasing wage differentials, but it is not the sale to foreign buyers that increases or privatization to domestic owners that decreases wage premia.

Table 8. Changes of effect of firm ownership on log wage ratios in OLS (3) and Panel FE (4)

	(3) Log wage rate 1/2	(3) Log wage rate 1/3	(3) Log wage rate 2/3	(4) Log wage rate 1/2	(4) Log wage rate 1/3	(4) Log wage rate 2/3
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes
1992-1995						
Foreign	0.047***	0.020	0.008	0.005	0.025	0.002
	(0.013)	(0.018)	(0.014)	(0.039)	(0.050)	(0.038)
Private	-0.030***	-0.050***	-0.012	0.013	0.016	0.000
	(0.008)	(0.011)	(0.008)	(0.013)	(0.018)	(0.013)
Observations	18,045	11,264	12,206	18,045	11,264	12,206
R-squared	0.213	0.317	0.067	0.328	0.479	0.122
1996-2001						
Foreign	0.048***	-0.001	-0.020	0.038*	-0.014	0.009
	(0.016)	(0.022)	(0.014)	(0.020)	(0.027)	(0.020)
Private	-0.076***	-0.128***	-0.028***	-0.016	-0.016	-0.002
	(0.013)	(0.017)	(0.010)	(0.012)	(0.015)	(0.011)
Observations	23,428	13,483	14,661	23,428	13,483	14,661
R-squared	0.013	0.020	0.004	0.003	0.005	0.005
2001-2006						
Foreign	0.105***	0.074***	0.016	0.012	0.012	0.033
	(0.016)	(0.021)	(0.013)	(0.024)	(0.032)	(0.022)
Private	-0.094***	-0.158***	-0.048***	0.004	0.010	0.016
	(0.013)	(0.015)	(0.009)	(0.016)	(0.019)	(0.014)
Observations	20,661	13,887	14,037	20,661	13,887	14,037
R-squared	0.037	0.042	0.012	0.003	0.008	0.006
2007-2010						
Foreign	0.224***	0.225***	0.037***	0.015	-0.011	0.002
	(0.010)	(0.015)	(0.010)	(0.023)	(0.033)	(0.024)
Private	-0.101***	-0.140***	-0.040***	0.014	0.034	0.030
	(0.012)	(0.015)	(0.009)	(0.026)	(0.033)	(0.024)
Observations	14,751	9,767	9,825	14,751	9,767	9,825
R-squared	0.050	0.039	0.004	0.010	0.004	0.003
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1						

3.2.3. Productivity

A version of SBTC suggests that as firms get more productive, skill premia increase because increased productivity of the firm is associated with a larger productivity increase for high skilled workers than for low skilled ones. In this sense, productivity of the firm may be expected to have a positive association with wage premia.

Expected positive signs seem to be significant in the pooled OLS model. Interestingly, effects are slightly higher at the bottom of the distribution, increasing wage differences between middle and low skilled more than wage differences between high and middle skilled. If we also include firm-specific fixed effects in the model, within-firm productivity changes seem to have a significant effect only at the bottom of the distribution. This means that a 1% increase in productivity is associated with a 1% increase in the low wage rate between middle and low skilled.

This suggests that the theory of heterogeneous productivity increase is to some extent justified. A productivity increase of the firm increases wages, and most likely productivity of the high and middle skilled in a more or less similar way, but it fails to increase wages of the low skilled.

Table 9. Effect of firm productivity on log wage ratios in OLS (1) and Panel FE (2)

	(1) Log wage rate 1/2	(1) Log wage rate 1/3	(1) Log wage rate 2/3	(2) Log wage rate 1/2	(2) Log wage rate 1/3	(2) Log wage rate 2/3
Productivity	0.029***	0.059***	0.031***	0.002	0.015***	0.010***
	(0.004)	(0.005)	(0.003)	(0.003)	(0.005)	(0.003)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes
Observations	58,237	36,402	38,618	58,237	36,402	38,618
R-squared	0.081	0.134	0.036	0.122	0.209	0.044
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1						

Unfortunately, data about the productivity of the firms are only available until 2007, this way, we can only look at the heterogeneity of its effects in three periods. If we look at the model without firm-specific fixed effects, we see a highly similar pattern for all periods, and productivity seems to play a more and more important role in explaining wage differentials over time. Similarly to the model I discussed above, in the first period, differences are higher between middle and low skilled workers than between high and middle skilled ones. This period is characterized by very significant changes in terms of industry and firm structure. It seems that firms increasing their productivity divided net sales' gains unequally, disproportionately increasing wages of more skilled workers. At the same time, wage differentials become more or less of the similar in the second and third period. While productive firms seem to be associated with higher wage premia for the skilled, productivity gains are divided by and large equally between skill groups.

When controlling for firm-specific effects, effects of productivity usually disappear. There are only two very interesting exceptions for this in period two. Between 1997 and 2001, the effect of a 1% increase in productivity is associated with a 1% decrease of differentials between high and middle skilled, but a 1% increase between middle and low skilled workers. This implies that in this period, winners of productivity gains were usually middle income workers, as they were the ones whose wages increased the most relative to the other two skill groups.

Table 10. Changes of effect of firm productivity on log wage ratios in OLS (3) and Panel FE (4)

	(3) Log wage rate 1/2	(3) Log wage rate 1/3	(3) Log wage rate 2/3	(4) Log wage rate 1/2	(4) Log wage rate 1/3	(4) Log wage rate 2/3
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes
1992-1995						
Productivity	0.007	0.026***	0.016***	0.004	-0.010	-0.016
	(0.005)	(0.007)	(0.005)	(0.010)	(0.014)	(0.010)

Observations	16,401	10,350	11,232	16,401	10,350	11,232
R-squared	0.206	0.319	0.071	0.326	0.483	0.121
1996-2001						
Productivity	0.024***	0.051***	0.027***	-0.012**	0.011	0.014**
	(0.006)	(0.009)	(0.005)	(0.006)	(0.009)	(0.006)
Observations	22,410	13,020	14,171	22,410	13,020	14,171
R-squared	0.004	0.013	0.007	0.002	0.005	0.005
2001-2006						
Productivity	0.048***	0.082***	0.043***	0.006	0.003	-0.003
	(0.005)	(0.007)	(0.004)	(0.006)	(0.007)	(0.005)
Observations	19,426	13,032	13,215	19,426	13,032	13,215
R-squared	0.015	0.032	0.024	0.004	0.009	0.005
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1						

3.2.4. Skill-intensity of the industry

According to SBTC theory, technology and skilled labor are complements, while technology is a substitute for unskilled labor. This way, technology-intensive industries usually give higher wage premia to their skilled workers because of their more advanced technology. Hence, skill-intensity of the industry is expected to have a positive sign in my estimations, at least on wage differentials between high skilled workers and others.

In Model (1), it seems that skill-intensive industries are associated with a higher wage premium for all comparisons of skill groups. For example, if we compare a firm operating in a skill-intensive industry with a firm in a non-skill-intensive one, the wage premium of high skilled workers compared to low-skilled workers is expected to be on average 5.2% higher in the firm in the skill-intensive industry. Wage differentials are somewhat larger at the top of the distribution, but no large differences in terms of coefficients. At the same time, if we control for firm-specific effects, every significant effect disappears. This is most likely the case because it is not very common for a firm to change industries, and no significant effects can be estimated from very few variation in the data.

Table 11. Effect of skill-intensive industry on log wage ratios in OLS (1) and Panel FE (2)

	(1) Log wage rate 1/2	(1) Log wage rate 1/3	(1) Log wage rate 2/3	(2) Log wage rate 1/2	(2) Log wage rate 1/3	(2) Log wage rate 2/3
Skill-intensity	0.038***	0.052***	0.033***	-0.004	0.018	0.018
	(0.008)	(0.011)	(0.007)	(0.012)	(0.018)	(0.013)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes
Observations	79,707	50,404	52,689	79,707	50,404	52,689
R-squared	0.070	0.105	0.025	0.111	0.187	0.041
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1						

If we look at changes of the effect of skill-intensity of the industry, we see a very interesting pattern, which is very different from findings for other explanatory variables. From 1992 to 1995, skill-intensity of the industry actually has a negative sign for wage premia between high and middle skilled workers, which is completely the opposite of the initial expectation. It is true that in this period of rapid industry restructuration, firms may have changed industry and hence skill-intensity status in a very fast, although not necessarily stable way. Moreover, as we saw from the descriptive statistics, only few firms have been operating as skill-intensive ones for a long enough period of time that effects of higher productivity could show.

In line with this argument, skill intensity seems to matter from 1996 onwards for wage premia at the top of the distribution. Moreover, the expected positive association seems to get stronger over the periods. The largest effect can be observed in period 2007-2010, when wage premia for high skilled compared to low skilled workers tend to be on average 7% higher in skill-intensive industries.

At the same time, these effects do not hold in case we control for firm-specific fixed effects. The argumentation is similar to model (2), as firms do not often change industries, this may be caused by the lack of variation in the skill-intensity of firms.

Table 12. Changes of effect of skill-intensive industry on log wage ratios in OLS (3) and Panel FE (4)

	(3) Log wage rate 1/2	(3) Log wage rate 1/3	(3) Log wage rate 2/3	(4) Log wage rate 1/2	(4) Log wage rate 1/3	(4) Log wage rate 2/3
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes
1992-1995						
Skill-intensity	-0.025**	-0.010	-0.001	-0.017	-0.178	-0.052
	(0.011)	(0.018)	(0.013)	(0.141)	(0.195)	(0.113)
Observations	18,764	11,725	12,697	11,725	11,725	12,697
R-squared	0.208	0.311	0.066	0.477	0.000	0.123
1996-2001						
Skill-intensity	0.032**	0.066***	0.023	0.018	0.034	0.036
	(0.014)	(0.022)	(0.014)	(0.020)	(0.031)	(0.023)
Observations	24,118	13,874	15,086	24,118	13,874	15,086
R-squared	0.002	0.007	0.003	0.002	0.005	0.005
2001-2006						
Skill-intensity	0.070***	0.061***	0.048***	-0.010	-0.005	-0.006
	(0.012)	(0.014)	(0.010)	(0.031)	(0.041)	(0.029)
Observations	22,074	15,038	15,081	22,074	15,038	15,081
R-squared	0.007	0.007	0.007	0.003	0.008	0.006
2007-2010						
Skill-intensity	0.055***	0.069***	0.047***	0.002	0.005	-0.012
	(0.010)	(0.014)	(0.010)	(0.022)	(0.033)	(0.023)
Observations	14,751	9,767	9,825	14,751	9,767	9,825
R-squared	0.005	0.005	0.004	0.010	0.004	0.002
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1						

Conclusion

In my thesis, I was interested in the effect of firm characteristics on firm-level skill wage differences in Hungary, and how these effects vary over the time period 1992-2010. As a theoretical framework, I used the skill-biased technological change assumption that explains increases in skill wage premia with changes in technology, and decreasing wages for middle skilled workers with an automatization of middle skilled tasks and falling demand for middle skilled workers.

Although there is a rich literature focusing on the connection between firm characteristics and wage levels, association between firm characteristics and wage ratios is a much less well-researched topic. I decided to look at the differences in wage premia associated with firm characteristics as firm size, firm ownership, productivity and skill-intensity of the industry where the firm operates.

I defined three groups of workers based on their occupations: high, middle and low skilled. Using a linked database of Hungarian employer-employee data, the Hungarian Wage Survey for 1992-2010, I operationalized firm-level wage differentials as skill-wage ratios within-firms.

Estimating the relationship between firm-level characteristics and wage ratios with a pooled OLS model, my results are mostly in line with expectations according to previous literature. I found a significant large and positive association between firm size, foreign ownership, productivity, skill-intensity of the industry and wage differentials. Firm size and foreign ownership show a stronger association at the top of the distribution, meaning that firm size and foreign ownership mean a disproportionately higher wage premium for high skilled than for middle or low skilled workers. Productivity on the other hand has a larger effect at the bottom of the distribution, with a larger premium for middle skilled workers in comparison to low skilled ones, than for high skilled workers to middle skilled ones. Domestic private ownership at the

same time shows a significant negative association with wage differentials, which is more pronounced at the top of distribution.

It is important to see though, that these effects only mean associations, and do not necessarily show a causal effect, but may also be the result of a selection bias. Hence, I also estimated panel FE models, where I also included year-specific and firm-specific effects. Panel FE models show the effect of a change in firm characteristics on wage differentials in the same firm, hence they can be used to look at effects on a firm-level, not only at an aggregate level of the economy.

In these models, I had less significant coefficient estimates than in the previous case, however, there still are some important findings to interpret. Positive effects of size and foreign ownership are only significant at the top of the distribution, showing that the gain of an increased firm size or foreign ownership are disproportionately concentrated by high skilled workers. Productivity gains on the other hand, seem to be associated with an increase of wage differentials at the bottom, hence between middle and low income workers. This way, high and middle income workers benefit most from productivity gains. Domestic private ownership and the skill-intensity of industries are not significant in these specifications. The non-significance of the industry's skill-intensity can be explained by the fact that there are not many changes of industry, hence variation may be too low to show any significant effects.

To investigate the potential heterogeneity of the effect of firm characteristics in time, I also look at the relationship of firm characteristics and wage differentials in four separate periods in the sample. Similarly, I estimate a pooled OLS model and a panel fixed effects model for these restricted samples.

According to the results of the pooled OLS model, size has a large positive effect on wage differentials, and this effect is increasing over time. Similarly, foreign ownership is associated with a large positive and increasing effect, especially for the top of the distribution. The effect of productivity is also significantly positive, but more concentrated at the bottom of the distribution. Domestic private ownership shows a

negative association with wage differentials, somewhat increasingly over time. These results are highly similar to results from the whole sample and usually show somewhat increasing effect of firm level characteristics on wage differentials. Skill-intensity of industry is somewhat different in these specifications. Although it also shows an increasing pattern, it actually starts from a negative sign in the first period to increase continuously afterwards. How can we explain that? Most likely, this is to be explained by the dramatic industry restructuring between 1992 and 1995.

What happens if we control for firm-specific fixed effects? It is important to see that we lose a lot of variation in our data. In these short time periods, there are not many changes in firm-level characteristics, implying that most likely not many of the coefficient estimates are significant. Results are in line with these expectations. I only find significant effects in case of firm size and to some extent, in case of productivity. Increasing firm size still has a significant positive effect at the top of the distribution, increasing wage differentials between high and middle skilled workers in the first and second period, but this effect disappears in subsequent periods. In case of productivity, we have a quite interesting result for the second period, 1996-2001, where we find a negative effect of productivity increase for the top-middle ratio, while a positive effect on the middle-bottom ratio. This means that in case of a productivity increase, differences between real wages of high and middle skilled decreased, while differences between wages of middle and low skilled increased in this period.

Summarizing the results from the regression models, we may conclude that initial assumptions about the sign of relationships were usually correct in the Hungarian context. We found that across firms, larger, more productive, foreign firms operating in a skill-intensive industry tend to pay higher wage premia for their high and middle skilled workers. Even if we look at changes within firms, some of the coefficients stay significant.

Interestingly, effects of foreign ownership and firm size are larger for high skilled workers, suggesting that the routinization hypothesis may be supported in these cases. This is not completely in line with expectations, because it was exactly the productivity of the firm and the skill-intensity of the industry that I expected to show evidence for this hypothesis. However, the effect of productivity increase seems to be symmetrically positive for both high and middle skilled workers.

Changes of these effects in time do not seem to show any surprising pattern. Effect of firm size, firm ownership and productivity increases in time, however, almost all effects disappear for the shorter periods if we control for firm-specific fixed effects. This may be explained by limited variance of the firm characteristics during these short periods.

What do these findings tell us about the Hungarian labor market? As I mentioned in the section about descriptive statistics, it seems that changes in wage premia seem to be at least partially driven by changes in firm composition in Hungary. As the ratio of foreign-owned, more productive and larger firms increases, so does the mean wage differential between high, middle and low skilled workers. As this ratio has constantly been increasing over the last decades, wage premia have risen significantly. Even the effects of the crisis, from which two years have already been included in the sample, did not seem to change this pattern. Much less certain is however, how these processes will continue in the future. The wave of increasing public ownership in Hungary from the beginning of the 2010s will certainly yield very interesting changes to analyze concerning wage inequalities.

At the same time, it is clearly not only firm composition that is driving my results. I found significant association between firm characteristics and wage differentials for most of the variables. Even after controlling for firm-specific effects, I find that firm level characteristics have a significant and large effect. This proves that any policy-making dealing with wage inequality should definitely include thinking about firm-level wage inequalities as well as firm composition effects in the economy.

Certainly, this research could be continued to many further directions. I found quite similar patterns of firm characteristics on wage premia, it would be interesting to know whether these similarities show only a correlation between these variables, or they would add additional explanatory power in case they were included in a comprehensive model of wage premia. Moreover, it is also possible that interactions between variables could make the understanding of drivers of wage inequality even more clear.

Also, we should not forget that there are several other possible firm-level explanatory variables of wage premia that I did not include in my analysis such as geographical differences, culture and norms in the firm, or even more detailed measures of industry variation. Continuing the research including these variables could also lead to some interesting results.

Some studies (for example Antal, 2011) have pointed out the significance of minimum wage changes in explaining wage premia. Moreover, as my sample has been restricted to firms that had over 20 employees, findings are not really generalizable for these small enterprises. Controlling for effects of minimum wage changes as well as sampling bias could also mean an important direction of further research.

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Appendix

Figure 3. Mean firm size by year

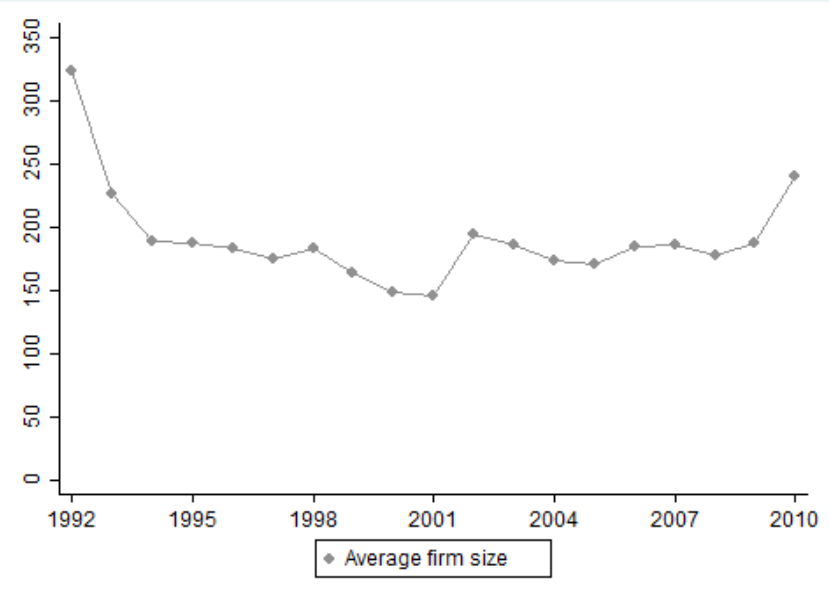

Figure 4. Firm ownership by year (% of foreign owned and privately owned)

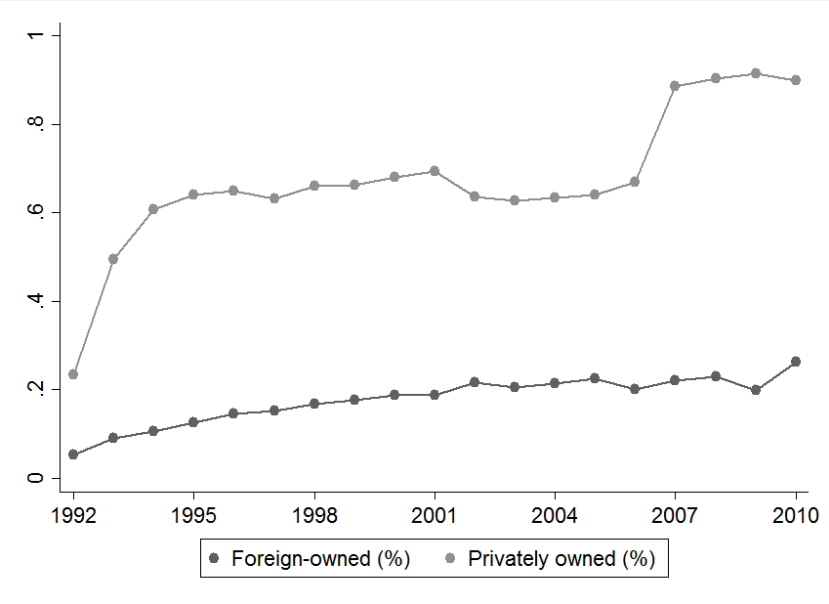

Figure 5. Mean productivity by year

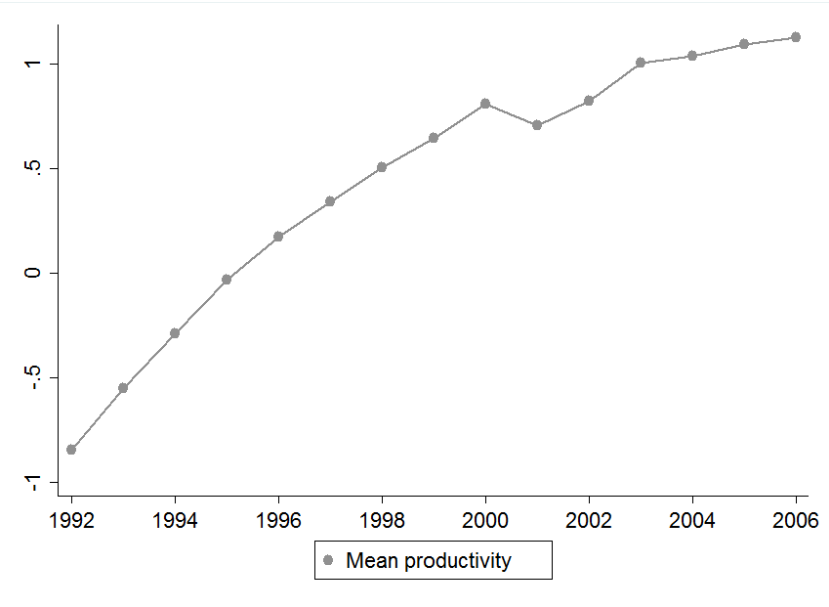

Figure 6. Skill intensity of industries by year (% of skill-intensive)