



Wage Inequality Within Firms

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Abstract

This study looks at firms in order to identify the determinants for wage inequality within them. The scope of this study are private Portuguese companies with more than 20 employees. The study uses data from 2016 and *Quadros de Pessoal* – an employee-employer matched dataset provided by the Portuguese Ministry of Labor and Solidarity. The study shows how companies' compensation policies can affect wage inequality. Results remark worker's features such as sex and level of education as influencers in the dispersion of wages. Additionally, on a firm side, the percentage of minimum wage workers, firm size and location are again important in the determination of wage inequality.

JEL Codes: J31; J33; M54; M52

Key word: Wage Inequality; Compensation policies.

Resumo

O presente estudo identifica empresas como órgãos essenciais na distribuição dos rendimentos. O seu âmbito são empresas privadas portuguesas com mais de 20 trabalhadores. São ainda usados dados referentes a 2016 da base de dados *Quadros de Pessoal*. Esta base de dados é fornecida pelo Ministério do Trabalho e da Solidariedade. O estudo apresenta de que forma as políticas de remuneração das empresas podem afetar a desigualdade salarial. Os resultados evidenciam que certas características dos trabalhadores, tais como o sexo e o nível de escolaridade são importantes influenciadores da dispersão dos salários. Adicionalmente, do lado das empresas, a percentagem dos trabalhadores que auferem o salário mínimo, bem como a dimensão e a região geográfica são importantes determinantes da desigualdade salarial.

Códigos JEL: J31; J33; M54; M52

Palavra Chave: Desigualdade Salarial; Políticas de Remuneração.

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Chapter 1

Introduction

The present study has the objective of analyzing wage inequality within enterprises. This theme was chosen based on recent remarks of increasing levels of wage inequality. There is a vast literature that supports this rising of inequality levels (e.g. Carneiro and Varejao (2012) and International Labour Office (2016)).

In the concern of rising levels of wage inequality, Song et al. (2016) argue that firms have become more permissive towards higher compensation packages, specially in higher ends of the wage distribution, for instance for CEOs and Top Managers. On the other hand, Murphy and Topel (2016) note that this phenomenon was not exclusive to the higher tail of the distribution, but there was a consistent increase in disparities along the whole distribution. Nonetheless, they agree that the higher end suffered a more prominent growth in disparities. Other authors claim that increasing levels of inequality are a result of a shortage of skilled workers (Rotemberg (2002) and Murphy and Topel (2016)).

By studying wage inequality, one must look into the source of wages: companies. How companies define their compensation policies, impacts their wage distribution. Firms can opt for policies that incite cooperation or competitive behaviors. Cooperation policies will tend to compress wages as individuals will be less prone to jealous tendencies (Akerlof and Yellen, 1990a). Au contraire, pay for performance policies will reward individuals base on performance Lazear and Rosen (1981). This compensation strategy will likely increase worker competitiveness. This in turn could create some sabotaging issues within peers. Bearing this in mind, companies must choose their compensation strategy with caution. Nowadays, firms usually opt for a combination of several criteria.

Even though companies should be at the heart of wage dispersion discussion, it is important to note that labor market features and wage setting institutions also play an important role. Governments can intervene in labor markets when inequality is perceived as high. Such institutions can intervene by introducing more progressive income taxation, wealth and inheritance taxes, pay regulation and by empowering labor unions. Nonetheless, Murphy and Topel (2016) alert that such measures only treat the symptoms of wage inequality. Subsequently, these institutions should focus on the origin of the issue.

The present study has intends to understand what are the determinants of wage inequality inside firms. For that, *Quadros de Pessoal* was used. *Quadros de Pessoal* is a employee-employer matched dataset that provides information both on workers and firms. This information includes demographic data, such as sex, age, nationality, level of schooling, tenure, working time regime, type of contract and workers' qualification levels. On the side of firms, it provides data related to geographic location, number of employees and gross sales volume. *QP* is a mandatory yearly surveys that includes private firms. This dataset is provided by the Portuguese Ministry of Labor and Solidarity. To illustrate dispersion, four measures of inequality were adopted: P90/P10, P90/P50, P50/P10 and the coefficient of variation (CV). The use of these four different indicators for inequality allow the representation of different stages of the distribution of wages.

This work is divided in eight chapters. The first chapter, to which belong this section is the introduction. The second chapter clarifies the distinction between discrimination, inequality and inequity. The third chapter refers to a literature revision of wage inequality. Chapter four places companies at spotlight as important entities in the shaping of wage inequality. Chapter five considers the impact of labor market features and wage setting institutions on the debate. Chapter 6 provides a framework for the characteristics of the Portuguese labor market. In chapter seven are analyzed the descriptive statistics of the sample under observation, as well as its characterization. Methodology and empirical results are presented on chapter eight.

Chapter 2

Inequality, Equity and Discrimination

Often people may use discrimination, inequality and even inequity as interchangeable concepts. However they have striking differences. Sometimes, individuals are inclined to think that if there's inequality, there is injustice. However, that is not always the case. This section aims at clarifying the distinctions between these three concepts. Nonetheless, some authors may have different positions on these, as perceived along the text.

The Portuguese Law (Law 93/2017, 3rd article, no 1, alinea a.) defines discrimination as any distinction, exclusion, restriction or preference by reason of race and ethnic origin, color, nationality, ancestry and territory of origin, which have as their object or effect the nullification or restriction of the recognition, enjoyment or exercise, on an equal basis, of rights, freedoms and guarantees or economic, social and cultural rights. Discrimination is therefore, by definition, a source of inequality. It arises when equals are being paid unequally. Discrimination should not be acceptable and it is illegal. Furthermore, it results in and contributes to the reinforcement of inequality. Whereas it's possible to discuss the fairness of inequality, discrimination is never fair.

On the other hand, inequality is simply the absence of equality. In the case of wage inequality, it reports how uneven wages are for a certain population. Discrimination can be an aggravating factor in the degree of inequality in wages. Finally, equity is the advocacy of fairness regarding pay. Equity is better explained by the statement that unequals should be paid unequally, as Goerg et al. (2010, p. 748; line 1) explains "As long as the discrimination is based on individual differences, that is, as long as unequal agents are rewarded unequally, there should be little room for fairness considerations to induce dissonance among the agents". Equity also leads to an increase in inequality, since characteristics like productivity, education, seniority, etc, lead to fairly unequal wages. Despite all, wage inequality among women is still greater than among male workers. Furthermore, there is still a large gap between men and women with similar observable characteristics (Carneiro and Varejao, 2012).

If these ideas are taken into consideration, it's possible to say that both inequity and discrimination, despite different in nature, are determinants of inequality. However, these concepts are not used unanimously by academics.

Chapter 3

Wage Inequality

Several authors have been reporting increasing levels of wage inequality within populations (Rotemberg (2002) and Song et al. (2016)). Wage inequality is given by the degree of wage dispersion within a certain group or population. Companies, as they define salaries and compensation policies are at the heart of inequality. Some authors argue that inequality can arise between (Song et al., 2016) and within enterprises. Within firms inequality, also called vertical dispersion reflects the disparity in pay inside each firm, across different positions, for instance the pay difference between the lowest and the highest paid worker (presumably the CEO). Between firms or horizontal dispersion expresses differences in pay between the same job position or the same organizational level but for different firms, while horizontal inequality is typically illustrating workers' disparities. Furthermore, vertical inequality arises because the company puts different weights on different position along its value chain. (Adrian et al., 2017)¹.

One of the reasons behind a reported global increase in inequality is argued to be a result of higher pay packages of CEOs and Top Management. This particularly affects wage inequality within firms, since it centers the majority of earning at the top end of the organization. It has been the case that companies have become more permissive towards higher compensation packages, specially, giving origin to the concept of the "supermanager" (Song et al., 2016)². The author reports an increase in wage inequality, specially at the higher ends of the distribution (Song et al., 2016). Murphy and Topel (2016) remark that the phenomenon of increasing levels of inequality was not unique to the top or bottom of the distribution, but was rather a consistent occurrence for both men and women of all skill levels. Nonetheless, the author recognizes a more prominent disparity growth at the top end of the distribution.

Another cause of increasing wage disparity appointed by some studies is the increasing competition between enterprises, which led to a decrease in the search for low skilled workers and an increase in the demand for high skilled ones (Rotemberg, 2002). Carneiro and Varejao (2012) corroborates the previous statement, reinforcing that wage inequality in itself may have increased the demand for skilled workers. In agreement, Murphy and Topel (2016, p. 104) claimed that market

¹ Adrian et al. (2017) citing Gupta, N., Conroy, S. A. and Delery, J. E. (2012). The many faces of pay variation, *Human Resource Management Review* 22(2): 100–115.

² Adrian et al. (2017) citing Piketty, Thomas, *Capital in the Twenty-First Century*, Harvard University Press, 2013.

forces are favoring skilled workers, which in turn “are the driving force behind wage inequality”. Also for Portugal, Carneiro and Varejao (2012) report an increase in inequality in within group wage differences, however, they note a sharp increase on returns to college education. Murphy and Topel (2016) put forward an explanation for these observations, declaring that the supply of more skilled workers is not enough to meet the labor market’s demand. The author suggests that the solution may lie in attacking the relative scarcity of skilled labor, and should not pass by reducing returns to skill or any form of artificially compressing the wage distribution, which could reduce human capital investment, and consequently, have adverse effects on inequality.

3.1 How much Inequality is too much Inequality?

The debate regarding wage inequality among populations is centered around the level of wage dispersion. Early literature remarks that there is a concept of equality to bear in mind (Akerlof and Yellen, 1990b), whereas, other authors argue that a certain level of dispersion increases worker productivity (tournament models) (Lazear and Rosen, 1981). In other words, (Akerlof and Yellen, 1990b) state that a high degree of inequality can lead to motivational problems, since workers often compare their wages with the ones of their colleagues. Which in turn may affect cooperation inside teams as well as team effort. On the other hand, authors such as Lazear and Rosen (1981); Lallemand et al. (2004) and Goerg et al. (2010) tend to support theories such as tournament models by Lazear and Rosen (1981), that advocate for a pay-for-performance compensation style, which tends to reflect a more dispersed wage distribution.

Chapter 4

The Role of Firms in Defining Inequality

“Firms are the first party to explore when studying wage inequality, after all they are the ones who define employees’ wage” (Mueller et al., 2017a). When a company defines its compensation practices is automatically setting a tune for the dispersion of their wage distribution.

Many authors have suggested that a part of wage inequality can be explained based on wages paid to workers by firms. It is clear then that enterprises have a key role in defining and contributing to wage inequality, and should consequently be studied extensively in the matter. This section explains how firms through management practices, reward and compensation policies influence the dispersion of wages and, in turn, overall wage inequality.

4.1 Equity and Inequity

It’s necessary a deep understanding of equity and inequity, so that one may advocate for social justice or the reduction of economical disadvantages and social unrest (Adams, 1963). Essentially, equity is giving everyone what they need to be successful. Whereas equality is treating everyone the same. Equality aims to promote fairness, but it can only work if everyone starts from the same place and needs the same help.

Whenever there is an exchange between two parties, there is room for a feeling of inequity, meaning that it is possible that one of the parties may get out with an unsatisfactory output. For instance, in the case of an exchange between an employee (who is accepting a pay in exchange for his effort and labor) and an employer (that agrees to pay that fee — the salary), it is possible that one of the parties may feel some injustice. On the side of the employee, he is bringing to the deal his labor attributes, such as his education, intelligence, experience, training, skill, age, sex, ethnic background, social status and effort, and he will be expecting a fair compensation for his attributes (Adams, 1963).

Adrian et al. (2017) suggested three types of equity: external, internal and individual. They claim that internal equity was defined inside each company, and referred to pay differences be-

tween jobs within the same entity, whereas external equity referred to the same discrepancies, but between different entities (its peers or rivals). Finally, the author expressed that individual equity reflected “individual’s perception of the fairness associated with his or her input (e.g. effort) versus output (e.g. pay) compared with that of his or her colleagues in the same or similar jobs in the organization” Adrian et al. (2017, p.166). Inequity exists for an employee whenever he perceives that his inputs and/or outcomes “stand psychologically in an obverse relation” to what he thinks are the inputs and/or outcomes of others (Adams, 1963, p. 424). When the employee convictions are disregarded, and it seems that his inputs and outcomes are not balanced in comparison to those of the others, then a feeling of inequity will arise (Adams, 1963). As a consequence Adams (1963) suggest that inequity has a psychological nature. Following this feeling of unfairness, employees will aim at decreasing these disparities towards an equitable situation. However, not all forms of inequity reduction undertaken by an employee can be beneficial to his employer, since these attempts could compromise production and firm profitability, for instance if employees decide to employ less efforts (Adams, 1963).

In order to understand in which situations individuals will perceive inequity, the company must pay attention to the country’s culture, norms and values (Adams, 1963), given that these features are highly volatile according to their environment. Additionally, individual perceptions of inequity shape management practices and pay determination. Nonetheless, even though this section is related to equity and inequity, the same principles apply for situations of inequality. The next sections aim to clarify the link between inequality and corporate action in the design of the company’s wage distribution.

4.2 Management Practices

Management practices usually comprise the working methods and innovations that managers use to improve the effectiveness of work systems. Common management practices include: empowering staff, training staff, introducing schemes for improving quality, and various forms of new technology.

This section will identify management practices that have a high impact in the dispersion of wages. The following sections will discuss reward management techniques, the determination of pay packages and if a company benefits the most by having a equity perspective or an equality belief.

4.2.1 Reward Management

Companies are becoming more aware of the power that lies behind rewards. Rewards can be used to manage results through the ease of changes and by helping attain performance goals. They can also be used on psychological aspects, such as motivation, innovation, entrepreneurship and encouragement of a beneficial organization environment and culture (Adrian et al., 2017). However, by using a reward system, companies are automatically incurring in a more disperse wage distribution. By doing so, they can affect their employees perceptions of equality. Rewards

are then a form of differentiation within the workforce. As a result, “the importance of fair and equal treatment of workers” should be in the center of organizational management (Goerg et al., 2010, p. 747).

There are several definitions for reward management from different authors. For instance Armstrong and Stephens (2005, p. 3) argue that “reward management deals with the strategies, policies and processes required to ensure that the contribution of people to the organization is recognized by both financial and non-financial means”. Despite the existence of different definitions for reward management, their common ground lays on establishing the definition of rewards and how they are conducted so that they can attract, retain and motivate employees to accomplish target goals set by companies (Adrian et al., 2017). In the view of Adrian et al. (2017, p.159), “individuals are attracted to a job because of the rewards it offers, remain with an employer because they believe that the rewards they receive are fair and equitable, and are motivated to achieve high levels of performance and other desirable behaviors for an organization because they believe that such behaviors will be rewarded”. Once again, some authors seem to consider that the aspect of fairness and equity are of great importance when structuring a reward system. Accordingly, Akerlof and Yellen (1988, p. 45) also defend that in order to work, reward systems must follow worker’s conceptions of equity, stating that “workers who consider themselves fairly treated are likely to work hard, and workers who consider themselves unfairly treated are likely to shirk”. Altogether, the ultimate goal of organizations when it comes to the management of rewards should be to compensate people fairly, in an equitable manner and in a way that is consistent with each individual place within the firm’s internal chain of value. By doing so, corporations will more easily reach their strategic goals. Furthermore, there is more to reward management than pay and employee benefits (financial rewards). Rewards can also be non-financial in character, such as acknowledgment of one’s effort, learning and development opportunities (e.g. training) and trustworthiness (e.g. added job responsibility) (Armstrong and Stephens, 2005). Reward management is therefore, a very complex exercise, that requires an intimate collaboration between managers and several stakeholders, either inside or outside firms, for the sake of its efficiency. This task becomes increasingly difficult as companies become global (Adrian et al., 2017).

Reward systems can additionally, be based on non-performance (time, seniority, skill and competency) and performance (individual or group performance) factors. In order to be effective, rewards must be aligned with an organization’s business strategy and its environment. Rewards are important means to attract potential employees to an organization, retain them and motivate them to meet behaviors that will be beneficial to the firm. Nowadays, when defining an organization’s reward management strategy, managers will tend to include different kinds of rewards and rewards systems, that are created to accommodate the firm’s needs and objectives. There is, nonetheless, a need for caution when defining reward policy. By having a good and functional reward system firms can actually improve their market competitiveness, by achieving their goals and targets (Adrian et al., 2017). On the other hand, when wrongly managed these systems may lead to adverse consequences.

4.3 Pay Determination

Companies need to be aware, when defining their pay policy, that individuals often establish social comparisons within their work environment. The degree of salary dispersion will likely affect their perceptions of fairness, which may have an important impact in their degree of commitment to their jobs. An excess of inequalities can arise motivation and performance issues, as well as pay satisfaction, commitment and turnover (Adrian et al., 2017).

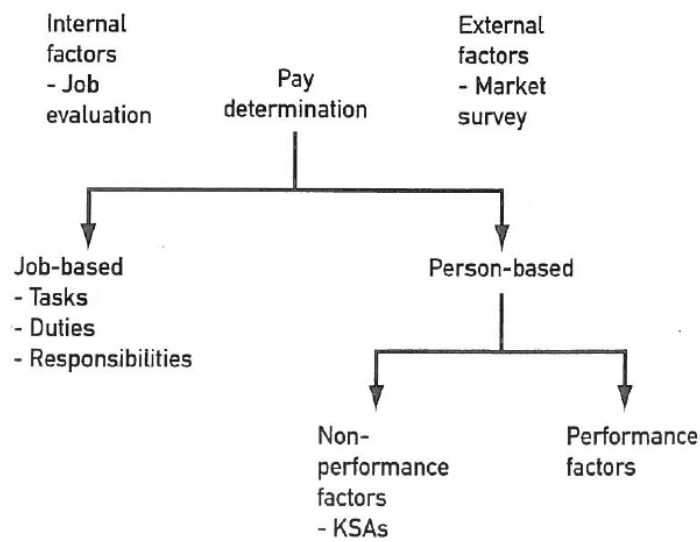


Figure 4.1: Pay determination according to Adrian et al. (2017).

Figure 4.1 takes under consideration how companies determine salaries. This figure portrays the view of (Adrian et al., 2017). On a first hand, the firm must place itself in the destined job market, alongside its peers and competitors. Then the firm must choose in each way to place itself. For that, it can choose a leading, matching or lagging approach. If the firm decides for a lead approach, then it is required to pay higher wages than those attributed by the market. This type of policy is recurrent when firms are aiming at attracting and retaining talent. When opting for a matching approach, the firm is compelled into following wages given by the market (usually, reflects a company that is competing on other levels besides pay). Finally, a lag approach indicates the company is paying less than what is dictated by the market. These firms are usually cost driven. The decision to adopt a lead, match or lag approach depend on an organization's business strategy and may have a considerable weight in terms of costs and performance. Secondly, there is the need to define the importance of the job position within the firm's internal chain. Job positions can be job or person based. In job-based positions, pay is usually determined by considering job related factors, such as job tasks, duties and responsibilities. This practice should guarantee the same pay for employees who perform the same tasks. By contrast, when pay is defined by person related factors, these evaluate employees' characteristics, such as knowledge, skills, abilities, competencies and performance. Nowadays, in most positions both job and person related factors are used in the determination of pay. At last, when using person-based factors, firms should decide in each way

to evaluate employees, for that they can choose performance and non-performance approaches. When choosing non-performance, companies will value a more "collectivist" way of working and an attention for equality issues. Companies usually opt for these type of policies when the cost of monitoring employees is high. On the other hand, companies may decide for a more equitable compensation policy and prefer a pay for performance method. "Evidence suggests that equity is not merely a matter of getting a fair day's pay for a fair day's work nor is inequity simply a matter of being underpaid" (Adams, 1963, p.422).

Nevertheless, it is argued that pay distribution is not only affected by pay policy but also by employee perception. Rotemberg (2002) state that there is a connection between salary dispersion and individual productivity that can influence the actual wage distribution and affect worker turnover, given that if workers disagree with their employers evaluation of their performance, they will be inclined to quit the company and, contrarily, remain in the company if they receive a positive feedback.

4.3.1 Cooperation or Competition?

There are two extremes to determine a pay compensation based on person base factors: cooperation and competition. Cooperation is usually based on equality policies, whereas competition better reflects an equity philosophy. A cooperation environment is better explained by the work of Akerlof and Yellen (1990b), which describe that workers need to have an environment of equality in order to be productive. Their work relies on the fact that workers often compare wages with their peers, either internal or externally. Their study also remarks that whenever employees wage falls short of what they perceive to be fair, their efforts are also reduced, which in turn damages firm performance. On the other hand, there are theories such as efficiency wages and tournament competition that suggest pay should be distributed taking into account individual performance. These theories also postulate that salary should increase along the hierarchal chain, given that higher salaries at the top will encourage those at the bottom to worker harder (Ortin-Angel and Salas-Fumás, 2002).

Nonetheless, the literature is not unanimous about which direction firms should choose. For instance, many authors defend that unequals being treated unequally can positively motivate individuals (Winter, 2004). While authors such as Akerlof and Yellen (1990a) claim that wage dispersion can affect employee morale. Moreover, many companies prefer equality policies since they often demand fewer monitoring costs. Nonetheless, Goerg et al. (2010, p. 750; line 32) remark that in situations only driven by equality policies, when pay is not linked to performance, employees might engage in free rider behaviors. In order to avoid these type of behaviors, companies can introduce rewards (financial or non-financial), so as to induce workers to exert more efforts into their tasks. The reasoning is that workers anticipate that employees with more at stake will try harder, which, in turn, will motivate others to do the same (Goerg et al., 2010). This line of thought is often applied to hierarchies. On the other extreme, whenever the company relies most on pay for performance, generating an environment of competitiveness, that can lead certain employees ("hawks") to sabotaging their peers, possibly hurting firm performance (Lazear, 1989).

One way for the firm to avoid these "hawks" in the workforce is by attempting to discover these candidates through the analysis of their soft skills during the recruitment process.

In the end, companies must be cautious in choosing a pay system, considering the type of environment they mean to create. Enterprises must establish an appropriate match between their pay strategy, their monitoring procedures and employees perceptions (Lallemand et al., 2004). In certain occasions rewards can motivate teams to achieve various goals, however, large pay gaps, specially when there is a close contact between workers (Akerlof and Yellen, 1988) may affect individual perceptions of fairness. "Capturing this fundamental tension between employers' desires to reward abler workers and workers' possible aversion to pay inequality is at the heart" of reward management (Charness and Kuhn, 2007, p. 696).

Chapter 5

Wage-setting Institutions

Even though each company is responsible for its compensation policy and the magnitude of its wage dispersion, countries usually establish some type of policies or institutions whose purpose is to regulate the labor market. With increasing levels of inequalities, policymakers are putting forward policies that aim at reducing this rise. Such policies include more progressive income taxation, wealth and inheritance taxes, pay regulation, and substantial empowerment of labor unions (Murphy and Topel, 2016). However, they alert that these policies are only designed to treat inequality symptoms and not solve it. For that, they suggest that policymakers should consider the management of a shortage of skilled labor, which they appoint as the main cause for increasing inequality levels.

Governments can choose whether or not to intervene in the labor market, as well as their degree of intervention. By not intervening, a government is choosing to allow the market to self regulate. However, self regulation can lead to severe injustice issues. Consequently, usually governments tend to have some sort of intervention on labor markets. Whenever there are feelings of large inequalities, governments may feel compelled to intervene. In this case, perceptions of inequality may affect wages by shifting policies (Rotemberg, 2002). The most common of these forms is the establishment of a national minimum wage, further discussed in the next section.

Unfortunately, the present study does not control for the weight that wage-setting institutions may have on wage inequality. Nonetheless, these institutions and control mechanisms play a relevant role in the determination of salary negotiations, and are as result, an important factor in the determination of wage inequality.

5.1 Minimum Wage

Portugal and Cardoso (2006, p. 990) define minimum wage as “as the base monthly payment, excluding overtime and other nonbasic components of pay”. There is a seemingly contradictory evidence on the effects of the minimum wage on the labor market. For once, it is said that an increase in minimum wages could lead to a high unemployment rate, as companies will likely hire fewer employees given the additional labor costs. However Portugal and Cardoso (2006)

also noted that following a sharp increase of the minimum wage in Portugal in 1987, the level of employment didn't take a cut, on the contrary, an expansion was observed, which in turn it did not indicate a negative impact of minimum wages on employment levels.

Furthermore, regarding its weight on inequality, literature has suggested that by compressing wages for lower tail workers, the setting of a minimum wage can contain wage dispersion for lower levels of the wage distribution (Centeno and Novo, 2009).

Chapter 6

Characteristics of the Portuguese Labor Market

This section will present a framework regarding the economic background and characteristics of the Portuguese employed population for 2016, such as the percentage of men and women, the unemployment rate, education, age and size of firms.

6.1 Workers

This section will consider workers characteristics in the labor market, bearing only in mind the share of the population that is employed. In 2016, the percentage of women in the Portuguese working population was of 47.5% (table 6.1). Whereas, when speaking of individuals who are unemployed, according to the data from Pordata, there was an 11.1% unemployment rate, 11.2% relating to women unemployment rate and 11% for men — table 6.2.

Table 6.1: Employed Population by Sex, 2016, %

Total	Men	Women
51.9%	56.9%	47.5%

Source: Pordata — Employment rate: total and by sex

Table 6.2: Unemployment Rate by Sex, 2016, %

Total	Men	Women
11.1 %	11 %	11.2 %

Source: Pordata — Unemployment rate: total and by sex

Table 6.3 refers to the overall level of education of the Portuguese workforce. According to the data, the degree of education with most attendees is college, with 26% of workers attending and/or detaining a college diploma. Similarly, almost the same percentage of people also detain a high school degree — 25.7%. Both of these schooling levels have very close attendance rate. It is

then possible to say that more than 50% of the working population in Portugal has at least a high school diploma, which means that they obtained at least 12 years of schooling. However, there are still 20.4% of the employed population that only attended school until the 9th grade, which was defined as the mandatory level of schooling until 2009. After that, this limit was set to 12 years of schooling, equivalent to the high school diploma. Furthermore, table 6.3 states that in 2016, 12.3% of the working population had 6 years of schooling (2nd grade) and 13.9% only had attended elementary school. Finally, less than 2% of workers had no level of education, meaning they are presumably illiterate (they cannot write or read).

Table 6.3: Employed Population by Education, 2016, Thousands

Employed Population with Complete Schooling Degree						
Total	None	Elementary School	2nd Grade	3rd Grade	Secondary Education	Tertiary Education
4605.2	78.4	641.4	565.8	941.7	1182.1	1195.8
100%	1.7%	13.9%	12.3%	20.4%	25.7%	26.0%

Source: Pordata — Employment: total and by highest level of education completed

In terms of age groups, table 6.4 expresses that the most numerous group are employees with ages between 25 and 44 years old. Employees of this age group represent almost half of the working population. The group with less significance is people with age superior to 65 years old. This result is linked to the retiring age, which was set to 66.7 years old in 2016. Moreover, people with less than 25 years depict a similar rate of presence in the workforce. This is expected since the number of young people who attend college is increasing, and have therefore a tendency of adjourning their labor market debut. Lastly, people aging between 45 and 54 years old sum 25.4% and workers within 55 and 64 years old total 15.4% of the employed population.

Table 6.4: Employed Population by Age Group, 2016, Thousands

Total	<25	25-44	45-54	55-64	>65
4605.2	262.4	2231.2	1169.3	708.3	234
100%	5.7%	48.4%	25.4%	15.4%	5.1%

Source: Pordata — Employment: total and by age group

6.2 Firms

As mentioned, firms are at the heart of wage inequality. This section describes firm features in the context of the Portuguese labor market. Table 6.5 reports the number of firms by their dimension. Micro companies comprise between 1 and 10 workers, and account for 96.2% of all firms in the country. Small companies have between 11 and 49 workers and represent about 3.2% of the Portuguese companies. Medium firms possess between 50 and 249 employees and large firms have more than 250 workers. Despite employing more workers, medium and large firms together account for less than 1% of all firms in the market. Mueller et al. (2017b) speculate that global

trends in inequality may be explained by an increase in the size of the largest enterprises. By attempting to study wage inequality, the present study will withdraw all micro companies from the sample, studying only companies with more than 20 employees.

Table 6.5: Firms by Size, 2016

Firms by Size				
Total	Micro	Small	Medium	Large
1214206	1167993	38866	6248	1099
100%	96.2%	3.2%	0.5%	0.1%

Source: Pordata — Enterprises: total and by size; Small and medium-sized enterprises: total and by size

All firms can be distinguished by industry. In the present section, the sector denomination considered was the one provided by Pordata. The next table will consider the percentage of minimum wage workers by sector (table 6.6). First of all, the percentage of people receiving the minimum wage is 23.3%. There are sectors that contribute more than other to this result. Housing and Food services is the sector that books more workers receiving the minimum wage, where 35.7% of the workers in this sector earn minimum wage salaries. Next, construction, transforming industries, gross and retail trade, real estate activities, human health activities and social welfare are sectors of activity where at least 20% of the workers receive minimum wage compensations. The sector of electricity, gas and water has less than 1% of employees who receive minimum wage, reckoning the sector with the lowest percentage of minimum wage earners. Financial and insurance activities also compute very low numbers of minimum wage workers – possibly because this field often demands a college degree.

Table 6.6: Minimum Wage by Sector of Economic Activity, 2016, %

% of Minimum Wage Workers by Sector of Economic Activity				
Total 23.3%	Mining and Quarry	Manufacturing	Electricity, Gas and Water	Construction
	10.2%	25.9%	0.2%	22.1%
	Whole Sale and Retail Trade	Transportation and Storage	Accommodation and Food Service Activities	Financial and Insurance Activities
	25.2%	12.1%	35.7%	1.3%
	Real State Activities	Education	Human Health and Social Work Activities	Other Sectors
	29.8%	13.7%	27.6%	

Source: Pordata - Employees with national minimum wage by sector of economic activity - Mainland (%)

Chapter 7

Data Description

This study uses data from *Quadros de Pessoal*, an employer-employee matched dataset. This database is constructed based on mandatory yearly surveys filled by a vast majority of private companies in Portugal. Private companies with at least one worker are obliged to fill a standard form with information about the firm, establishments and employees. Therefore, it provides information on both a firm and a worker level. *Quadros de Pessoal* is provided by the Portuguese Ministry for Labor and Solidarity and it includes information related to the workers' characteristics such as identification number, the company and the establishment that employs them, demographic data, for instance, sex, age, nationality, level of schooling, tenure, date of last promotion, professional category, professional situation, working time regime, type of contract and qualification levels. *QP* great advantage is that it allows the combination of firms, establishments and workers for the Portuguese private sector. On a firm level, the information included, besides identification number, relates to location, CAE (Activity Sector Code), number of employees and sales. Regarding establishments, the variables included are the identification number, location, company, number of workers and CAE. Furthermore, it also presents information on wages, base wages, regular, irregular and overtime payments, as well as paid hours per month. Additionally, these data report to October of 2016. The dataset used in this study was built from *QP*.

This study will comprise an analysis of wage inequality within enterprises for 2016, in Portugal. Wage inequality is here illustrated by four dependent variables:

- Coefficient of variation (CV)
- P90/P10
- P90/P50
- P50/P10

This study follows the suggestion of Song et al. (2016, p. 14) that states that “Because inequality is a concept about the entire income distribution, simple summary statistics (such as the variance and select percentiles) reported above can mask interesting and important variation hidden in various parts of the distribution”. As a result, the study looked for variables that would

be able to represent different stages of the wage distribution. All dependent variables were computed individually through variable *wage_h* (hourly wage) for each firm and then aggregated. The aim of their construction is to illustrate dispersion in compensations packages. As a consequence they represent wage inequality inside firms on various levels. The coefficient of variation (CV) represents a generalized, less sensible, measure of dispersion, translating the degree of variation in wages, and is constructed dividing the mean of hourly wages by its standard deviation. The other three dependent variables are ratios of percentiles. P90 represents the top 10% earners; P50 represents the median worker of each firm wage distribution. Finally, P10 represents workers on the lower end of the distribution, the lower 10% earners. When establishing these ratios, the aim is to draw a connection between top, middle and lower earners. In order to calculate hourly wages, the following rule was applied:

$$wage_h = \frac{rbase + prest_reg + prest_irreg}{hnormal} \quad (7.1)$$

In the equation above, *rbase* represents the base salary, *prest_reg* and *prest_irreg* regular and irregular installments, correspondingly. The resulting sum is divided by the total number of hours worked by the employee in October of 2016 (the month where *QP* data are collected), characterized by variable *hnormal*. To this formulation, salary observations inferior to half of the minimum wage were dropped as well as observations 20 times superior to the P99. Outside this interval such observations were considered outliers. Additionally, only companies with more than 20 employees were included, as firms with few employees do not have enough influence to become wage setters, and are less likely to contribute to the determination of wage inequality. For the consideration of this investigation, a company is small in size if it has between 20 and 49 employees; it is a medium enterprise if has between 50 and 249 employees, and a large firm if it has more than 250 employees.

7.1 Descriptive Statistic

This section attempts to describe further the dataset as well as each variable individually. In order to do it consider table 2 in the appendix where descriptive statistics (number of observations; mean; standard deviation; minimum and maximum value) for each variable are displayed. As stated, the only year under analysis is 2016. The first set of variables takes under consideration variables that relate to workers' characteristics, for instance, sex, age, level of education and contract type. The second set pertains to firm's attributes such as its share of minimum wage workers, sales per worker, dimension, industry (CAE) and its geographic location. All variables were computed for each firm individually, and then aggregated. For instance variable *PWomen* represents the percentage of women in each company. All variables that report to a proportion were calculated in a similar manner. Altogether, in the present database there are 17278 observations, which translate into 17278 firms under the scope. This number of enterprises was reached by excluding firms with

less than 20 employees from the sample. This limitation, does not imply, however, that wage inequality and is not a problem for firms with less than 20 employees.

Pertaining to workers' characteristics, on average, 46% of the workers in the sample are female, wherein some companies can be all male and others all female, given that the variable can assume a value of zero (the firm has no women in its workforce) and one, which indicates that it is an all female firm. In order to assess the role of employee age in inequality, three age groups were created: individuals aging less than 35 years old (*PAge_35*), aging between 35 and 55 years old (*PAge_35_55*), limits included and higher than 55 years old (*PAge_55*). The data in table 2 shows that, on average, companies have a bigger share of workers aging between 35 and 55 years old, which represent 57% of the workforce in the data. Succeeding is the younger group, which embodies 29% of all workers and finally, the older group which speaks for 11.4%. The first two age groups are rated between 0 and 1, meaning that there are companies that are only composed with young people, and companies where only employees aging between 35 and 55 years old work. However, on the company with the highest share of people aging over 55 years old, these individuals mark 79.2% of their workforce. Following workers' characteristics, two variables were generated to record the level of education. *PEduc_1* refers to the proportion of individuals who did not attain a college diploma or attended college, whereas *PEduc_2* refers to workers who at least attended college. On average, companies have more employees who didn't attend college (78.6%) than otherwise (18.3%). Relating to education there are also companies that have a single worker who has attended college, and there are also companies that only hire highly educated individuals. In the same line of thought, type of contracts were analyzed, and summarized in permanent, temporary and non-defined. On permanent contracts the employee has a contract with a no ending clause. On the other hand, temporary are by its nature finite, with a fixed or an uncertain term. On average, companies have more temporary contracts with their employees on the workforce than permanent ones. Also, some companies only hire temporary labor, and other have a permanent labor force.

The subsequent variables were created to depict some firm's features. Firstly, *PMin_Wage* pictures the proportion of minimum age earners in each firm, meaning that 17.3% of workers in the sample earn the minimum wage. Nonetheless, taking into consideration the variable's minimum and maximum values, there are companies that don't have any minimum wage worker and others that only pay minimum wages. Companies were also characterized by their industry. This study figures 20 industries depicted in table 1 in the appendix. The codes used here correspond to CAE rev. 3, with one letter. The most prominent sector is *CAE_C*, manufacturing, to where 30% of the companies in the sample belong. Table 2 allows to observe how companies are distributed by CAE. Each one of the CAE variables represent a dummy, so when a company belong to a certain sector it will take a value of one, and zero otherwise. Next, *gs_pemp* marks a connection between firm's gross sales and the number of employees in each firm. This variable is put in the model to simulate firm performance with the worker as a measure unit. It exhibits gross sales per worker, which on average, are 132 thousand euros. Regarding firm size, the sample is constituted by small, medium and large firms. The most predominant type of firms are small firms (*Firm_dim_1*) that

add up to 64% of the sample, followed by medium firms (*Firm_dim_2*) that represent roughly 31% of all firms and finally, large firms (*Firm_dim_3*) which only account 4.8% of the total number of companies. Additionally, Finally, region in Portugal was considered. These regions include North, Algarve, Center, Lisbon, Alentejo and islands (Azores and Madeira). The North of Portugal is the region with the highest number of firms, followed by Lisbon and then Center. Algarve and Alentejo, together account for less than 10% of the total number of enterprises. Additionally, the islands are where less firms are located, together amounting to 4% of the sample.

7.2 Wage Inequality by Descriptive Statistic

This section presents levels of inequality by the use of descriptive statistics. This was achieved by asking for the average value for each dependent variable if a certain trait was verified. On a first hand, table 7.1 portrays overall inequality levels within the sample, exposing the average wage per hour in the data, as well as the average results for the four inequality measures used by this study. On average, individuals in the sample receive 7.06€ per hour worked. One of the dependent variables is the Coefficient of Variation (CV), which is a general measure of dispersion, and given that by studying inequality one is actually studying the dispersion of wages, the CV is an instrument often used in studies of this type. For hourly wages, the CV assumes a value lower than 1, the distribution is considered to be of low variance. Regarding the ratios of inequality, and as expected, the P90_10 is the ratio that presents the highest value, followed by P90_50 and the lowest value is given by the P50_10 ratio. These results meet the expectations and they can be interpreted into the 10% top earners receiving 2.43 times the salary of the bottom 10% of the distribution; the top 10% also gain 1.78 times the wage of the median worker. And finally, the median worker collects, on average, 1.34 times the wage of the bottom 10%. The next subsections will analyze inequality levels considering certain workers' and firms' characteristics.

Table 7.1: Overall Inequality Measures, 2016

Mean Values				
WAGE_H	P90_10	P90_50	P50_10	CV
7.06	2.43	1.78	1.34	0.52

Source: Quadros de Pessoal (2016)

7.2.1 Inequality by Workers' Characteristics

This section aims at mapping inequality based on worker's characteristics. It takes into consideration sex, age, education and type of contract. To evaluate sex matters into the determination of wage inequality, a variable representing the proportion of women in each company was created. Averages for inequality variables were computed when the firm has more women than men (female firms) and when there are more men than women (male firms). The results are showed in table 7.2. According to these results, wages are lower for female firms. In the concern of inequal-

ity values, results are not certain. Female firms tend to have lower levels of inequality in middle to bottom positions (P50_10), as well as in top to bottom (P90_10). However, in top to middle positions and overall dispersion, both male and female firms have very close inequality levels. On a final note, table 7.2 also states that there are more male firms than female firms.

Table 7.2: Inequality by Sex, 2016

Sex	+ Men	+ Women
P90_10	2.48	2.36
P90_50	1.78	1.79
P50_10	1.37	1.29
CV	0.51	0.52
Obs	9693	7387

Source: *Quadros de Pessoal (2016)*

Next, inequality levels for different age groups was documented. For such, three dummy variables were created, each representing a different age group. Three age groups were considered: individuals aging below 35 years old, between 35 and 55 (limits included), and aging more than 55 years old. Whenever the worker belongs to a certain age group, then the corresponding variable will undertake the value of one. As a result, each firm will have a different combination of values for each variable. These variables were summed and then divided by the number of employees in each firm, resulting in three final variables that represent the percentage of each age group for a given company. Companies that have more than 50% of employees aging below 35 years old will be called young firms and are exhibited in the first column of table 7.3. This denomination only respect employees' age and not the time of existence of firms. Companies where at least half of their workforce is constituted of employees aging between 35 and 55 years old, limits included, will be called middle aged firms (column 2); and, at last, firms in which the majority of the employees has more than 55 years old will be called senior firms and are portrayed in column 3 of the same table. For starters, senior companies are rare, and middle aged firms the most common.

There is a striking difference wage wise concerning different aged firms. Senior firms have very large hourly wages. Seniority may be playing a big part in this wage difference. The lowest wages are registered in younger firms, corroborating an antiquity and employee experience theory. Middle aged firms are the most predominant in the sample. This result is explained by the largest portion of the workforce being included in this age group. Furthermore, senior firms record higher levels of inequality in overall and for all positions of the wage distribution. Likewise, middle aged firms also report higher inequality than young firms for all positions of the distribution, however, in terms of overall inequality, both middle aged and young firms are very close.

Inequality was also evaluated based on workers' education. Table 7.4 reports the results. Workers were divided as having attended college or not. Similarly to other variables, two variables translate the percentage of employees in each category. The first column presents inequality levels for firms that are mostly composed of employees who did not attend college (non college firms) and column 2 shows inequality levels for firms that have more than 50% of its workforce

Table 7.3: Inequality by Age Groups, 2016

Age	<35	35-55	>55
WAGE_H	6.53	7.32	11.18
P90_10	2.28	2.48	2.90
P90_50	1.74	1.80	1.93
P50_10	1.29	1.35	1.52
CV	0.53	0.52	0.63
Obs	2102	12145	26

Source: Quadros de Pessôal (2016)

attending college (college firms). As expected, salaries are higher for companies with a larger proportion of highly educated employees. This is explained by higher returns to education for university degrees. According to Portugal et al. (2018), improvement in workers' levels of education was a major contributor to the increase of wages from 1988 to 2013 in Portugal. However, and although employees are better compensated in these firms, inequality is higher, considering all positions of the wage distribution. To note that in college firm, the top 10% earn 3.58 times the wage of the bottom 10%. This value for P90_10 is well above the sample average of 2.43 (table 7.1). Furthermore, and as anticipated, there are more companies where the number of individuals who did not attend college surpass those who did.

Finally, this sections looks also for inequality when considering workers' type of contract. An employment contract is an agreement between a worker and a firm in which the worker commits to provide a given service in exchange of a compensation. Two variables illustrate this feature. The first embodies a permanent contract, where employees have a continual contract with the company. On the other hand, a temporary contract has an ending and it may have a fixed or an uncertain term. These results are portrayed in table 7.5. Companies where more than a half of the workforce has a permanent contract tend to be more frequent than companies where temporary contracts are dominant. In these type of firms, wages are typically higher, and so are inequality levels, even though only slightly.

In conclusion, and according to this analysis, all chosen variables in this section that illustrate workers characteristics seem to be important in explaining inequality levels inside firms.

7.2.2 Inequality by Firms' Characteristics

This section aims to determine which variables representing firm traits will be relevant in explaining inequality within firms. It takes into consideration firm dimension, the percentage of minimum wage workers inside firms and its location.

Essentially, firms in the sample are considered to be small, medium or large. Companies with less than 20 employees are excluded and therefore, the sample doesn't contain micro companies. In consequence, here small firms have between 20 and 49 employees. Considering table 6.5, it is expected that the sample has a higher number of small firms than the other two types. As stated by table 7.6, more than a half of the companies in the sample are small in size. Even though

Table 7.4: Inequality by Schooling Level, 2016

Schooling	< College	College
WAGE_H	6.33	13.06
P90_10	2.28	3.58
P90_50	1.76	1.96
P50_10	1.28	1.80
CV	0.50	0.63
Obs	15265	1746

Source: Quadros de Pessoal (2016)

small enterprises are prevalent, wages tend to be on average lower, as well as inequality levels. Large firms exhibit higher wages and levels of inequality. This corroborates the conclusions of Mueller et al. (2017b) that larger firms tend to pay higher salaries on average. Even though this last statement is valid, the P50_10 is very similar to all firm sizes, which could indicate that dispersion in middle to bottom positions is roughly independent of firm size.

Moreover, table 7.7, considers the percentage of minimum wage workers in each firm. The first column translate inequality values for firms who have less than 50% of minimum wage workers and column 2 the opposite situation. It is clear that firms in which the majority of workers earns the minimum wage, will have lower expected wages, as demonstrated by this table. Since the share of minimum wage workers in Portugal is about 23% (table 6.6), firms with such a high percentage of minimum wage workers are less common in the labor market, however, the sample still has 1794 firms where there are at least 50% of minimum wage earners. To note that, inequality levels also seem to be lower in this type of firms.

Finally, this section takes into consideration firm geography. For that, it was used the NUTs II demomination present in *Quadros de Pessoal*, which divides Portugal in 6 regions: north, Algarve, center, Lisbon, Alentejo and islands. Table 7.8 compares wages and inequality levels across different regions. The north, center and Lisbon are regions of high firm density. Per contra, Algarve, Alentejo and both archipelagos have lower firm mass. In terms of wages, Lisbon is by far the region where hourly wages are higher. Other regions tend to have similar hourly wages. With the exception of Lisbon, inequality levels across regions seem very close to each other, which implies that geography may not play a major role in defining inequality in these regions. However, inequality levels in Lisbon are dissimilar to other regions. The capital consistently shows higher inequality levels than other regions.

Again, all variables considered in for firm's characteristics in this section are likely to be important in the determination of wage inequality. Next section will analyze inequality determinants more closely

Table 7.5: Inequality by Type of Contract, 2016

Contract	Permanent	Temporary
WAGE_H	7.30	6.38
P90_10	2.49	2.25
P90_50	1.81	1.69
P50_10	1.35	1.31
CV	0.53	0.48
Obs	13040	3460

Source: Quadros de Pessoal (2016)

Table 7.6: Inequality by Firm Size, 2016

Size	Small	Medium	Large
WAGE_H	6.69	7.55	8.89
P90_10	2.33	2.59	2.71
P90_50	1.73	1.87	1.92
P50_10	1.32	1.37	1.38
CV	0.43	0.62	0.92
Obs	11036	5408	834

Source: Quadros de Pessoal (2016)

Table 7.7: Inequality by Percentage of Minimum Wage Workers, 2016

Minimum Wage	<50%	>50%
WAGE_H	7.37	4.57
P90_10	2.52	1.67
P90_50	1.82	1.49
P50_10	1.36	1.12
CV	0.53	0.36
Obs	15364	1794

Source: Quadros de Pessoal (2016)

Table 7.8: Inequality by Geography (NUTs II), 2016

Geography	North	Algarve	Center	Lisbon	Alentejo	Azores	Madeira
WAGE_H	6.17	6.73	6.38	9.27	6.44	6.11	6.73
P90_10	2.25	2.36	2.30	2.86	2.28	2.29	2.39
P90_50	1.73	1.78	1.73	1.92	1.73	1.78	1.78
P50_10	1.28	1.32	1.33	1.45	1.32	1.27	1.33
CV	0.48	0.52	0.48	0.60	0.47	0.52	0.52
Obs	6465	650	3981	4449	988	387	358

Source: Quadros de Pessoal (2016)

Chapter 8

Methodology and Empirical Results

8.1 Econometric Model

In order to understand what are the determinants of wage inequality within firms, four equations were estimated, one for each inequality indicator.

$$\begin{aligned} P90_10_i = & \alpha + \beta_1 PWomen_i + \beta_2 PAge_35_55_i + \beta_3 PAge_55_i + \beta_4 PETertiary_2_i + \sum_{k=1}^7 \mu_k PQual_i^k \\ & + \beta_7 Tenure_i + \beta_5 PTemporary_i + \beta_6 PND_Contract_i + \beta_8 PMin_Wage_i \\ & + \sum_{k=1}^{19} \delta_k CAE_i^k + \beta_9 Medium_Firm_i + \beta_{10} Large_Firm_i + \sum_{k=1}^6 \theta_k Location_i^k \\ & + \beta_{11} Sales_i + \eta_i \end{aligned} \tag{8.1}$$

$$\begin{aligned} P90_50_i = & \alpha + \beta_1 PWomen_i + \beta_2 PAge_35_55_i + \beta_3 PAge_55_i + \beta_4 PETertiary_2_i + \sum_{k=1}^7 \mu_k PQual_i^k \\ & + \beta_7 Tenure_i + \beta_5 PTemporary_i + \beta_6 PND_Contract_i + \beta_8 PMin_Wage_i \\ & + \sum_{k=1}^{19} \delta_k CAE_i^k + \beta_9 Medium_Firm_i + \beta_{10} Large_Firm_i + \sum_{k=1}^6 \theta_k Location_i^k \\ & + \beta_{11} Sales_i + \eta_i \end{aligned} \tag{8.2}$$

$$\begin{aligned}
P50_{10i} = & \alpha + \beta_1 PWomen_i + \beta_2 PAge_{35_55i} + \beta_3 PAge_{55i} + \beta_4 PETertiary_2i + \sum_{k=1}^7 \mu_k PQual_i^k \\
& + \beta_7 Tenure_i + \beta_5 PTemporary_i + \beta_6 PND_Contract_i + \beta_8 PMin_Wage_i \\
& + \sum_{k=1}^{19} \delta_k CAE_i^k + \beta_9 Medium_Firm_i + \beta_{10} Large_Firm_i + \sum_{k=1}^6 \theta_k Location_i^k \\
& + \beta_{11} Sales_i + \eta_i
\end{aligned} \tag{8.3}$$

$$\begin{aligned}
CV_i = & \alpha + \beta_1 PWomen_i + \beta_2 PAge_{35_55i} + \beta_3 PAge_{55i} + \beta_4 PETertiary_2i + \sum_{k=1}^7 \mu_k PQual_i^k \\
& + \beta_7 Tenure_i + \beta_5 PTemporary_i + \beta_6 PND_Contract_i + \beta_8 PMin_Wage_i \\
& + \sum_{k=1}^{19} \delta_k CAE_i^k + \beta_9 Medium_Firm_i + \beta_{10} Large_Firm_i + \sum_{k=1}^6 \theta_k Location_i^k \\
& + \beta_{11} Sales_i + \eta_i
\end{aligned} \tag{8.4}$$

Where variables that represent levels of qualification, industry and location are represented in a compressed form to allow a better visualization of the models. In order to avoid multicollinearity one of the categories was omitted, in variables that represent a proportion or are a set of dummy variables. For qualifications levels, the omitted category is the first level of qualification that illustrates the percentage of individuals that are top managers and professionals. Accordingly, the same process was applied in the handling of CAE variables that depict the sector of economic activity of each firm. This study uses CAE codes, rev.3, with one letter, that has 20 classifications. The models then figure 19 dummy variables where *CAE_A* is the omitted category, representative of agriculture, animal production, hunting, forestry and fishing industries. Similarly, the same was performed for variables that express the firm location regionally: *Location*. There are seven regions in Portugal, using NUT2 classification. In the models, they are portrayed by six dummy variables, in which Lisbon is the omitted category. The list of all variables that belong to each of the compressed group of variables are listed in table 1, in the appendix.

In conclusion, the models showed in this section were estimated using the Ordinary Least Square (OLS) method, with robust heteroscedastic standard errors.

8.2 Results and Discussion

This section presents the discussion for the estimation of inequality equations, in the private sector, in Portugal for 2016. The main purpose of this study is to learn which are the determinants of

wage inequality within enterprises. Having that in mind, it matters the estimation of each variable coefficient, as well as its individual significance, and global model significance. As mentioned, in the study figure four different definitions of wage inequality within the wage distribution for each company: the first measures top to bottom inequality (P90_10), the second top to middle inequality (P90_50), the third, middle to bottom and finally, the Coefficient of Variation (CV) represents an overall measure of inequality within the company wage distribution. The estimation of the models are displayed on table 3.

On a first hand, how workers' characteristics influence wage dispersion within firms will be presented. The first variable in the model is representative of sex. In all cases, the presence of more women in firms leads to a decrease in wage inequality, given by a negative coefficient. However, this variable is only significant for the first three models. Age groups are considered next. The effect of age groups in wage inequality is ambiguous according to the results. Middle age workers tend to contribute to inequality on top to bottom positions when compared to younger workers (aged below 35 years old - omitted category). The same applies to middle to lower positions, however, in terms of overall inequality, they seem to reduce it in comparison to the younger age group. Their effect on inequality is not significant in top to middle positions. Senior workers, on the contrary, seem to increase inequality in comparison to younger workers in top to bottom positions and in middle to bottom positions. These are the only times when this variable is significant. In the matter of education, and corroborating returns to education, more workers with a tertiary level of education seem to contribute to an increase in overall and all levels of wage inequality, given that this variable is always significant and its coefficient positive. This is specially the case for top to bottom positions, as it presents the higher coefficient, which indicates that higher educations widens the gap between top and bottom earners. This result is consistent with literature that reports higher returns to educations, specially in top positions (Machado and Mata, 2001). As explained, *PQual* are a set of variables that illustrate the proportion workers in each firm that belong to a given qualification level. The omitted category is *PTop_Manager*. From the results, it's possible to note that only the bottom levels of qualifications contribute to wage inequality. This relation is negative in comparison to the omitted category, which means that qualifications levels reduce inequality in top to bottom positions, when compared to the omitted category. Regarding qualifications in top to middle positions, these tend to increase inequality, where only top qualifications levels are important in explaining these fluctuations. Furthermore, the set of variables reveals negative coefficients in the estimation of the model pertaining to P50_10, where variables are significant, indicating that more employees in these categories contribute in a decrease in inequality for middle to bottom positions, then more employees in the first qualification level (omitted). Unlike the outcomes for P50_10, CV results show all positive coefficients for all levels of qualifications. When considering tenure, it's weight in defining inequality is not clear. The variable is not significant in explaining P90_10 fluctuations. Additionally, it appears to reinforce overall and top to middle inequality, but has the opposite effect in middle to bottom inequality. The worker type of contract are only relevant in the determination of inequality in middle to lower positions. Temporary contracts are enablers of a higher wage inequality in comparison to perma-

nent ones. The same is true for other type of contracts. Nevertheless, workers' characteristics are not the only determinant in wage inequality (International Labour Office, 2016).

Moving on to characteristics related to companies, and focusing on the percentage of minimum wage workers, as expected, the more minimum wage workers a firm has, the lower inequality levels are. This is consistent for all four measures of inequality and agrees with literature predictions. In terms of industry impact, there are industries that are more relevant to the determination of wage inequality than others. The majority of them has negative coefficients, signaling that inequality is lower for these sectors in comparison to the hidden one (*CAE_A* – agriculture, animal production hunting, forestry and fishing). Nonetheless, some CAEs still have positive coefficients, such as whole sale and retail trade as well as repair of motor vehicles and motorcycles (*CAE_G*), real state activities (*CAE_L*) and artistic, entertainment, sports and recreational activities (*CAE_R*), corresponding to higher inequality levels than the hidden variable. Finally, there are still others where both signs are exhibited, for instance, transportation and storage (*CAE_H*), education (*CAE_P*), other service activities (*CAE_S*) and activities of international organizations and other extra-territorial institutions (*CAE_U*). For these, in a given inequality measure, they can express more or less inequality levels based on their coefficient sign. Additionally, it was found that firm size was for all levels of inequality a major variable to take into consideration. In relation to small firms (hidden category), larger companies tend to have higher levels of inequality for all positions of the wage distribution. Concerning geographical location, most regions are significantly relevant in explaining inequality for all four indicators (only the islands are exception, as they are only significant for three indicators). Moreover, their coefficient are always negative, pointing out that all regions present minor inequality levels than Lisbon. At last, nominal productivity (*Sales*) only seems to be important to determine inequality in the middle to the bottom of the distribution, and according to the data, as it increases, inequality levels decrease for the bottom half of the distribution. This is the variable in the models, in lack of a better choice, used to evaluate firm performance based on worker's productivity. These poor results may be due to the fact that this variable is not a good indicator for firm performance. As remarked by Rotemberg (2002), it is very difficult to assess the connection between worker productivity and firm performance, since in order to understand it, it is necessary to observe workers' output. According to the results of Lallemand et al. (2004), there should be a positive connection between wage dispersion and firm performance, which declare that their results are more in line with a tournament model perspective, where wage dispersion increases worker effort, leading to an improvement on firm performance. The authors suggest that little wage inequality hurts firm performance due to the lack of incentives (Lallemand et al., 2004).

Finally, all models have the same number of observations. Furthermore, when studying the R^2 for each model, it's possible to understand that some models are better at explaining the dependent variable than other. For instance, the same set of variables is better at explaining fluctuations in the P50_10 ratio than in the others. Additionally, considering the same set of variables, it appears that they are worse at explaining variations in top to middle inequality (P90_50). One of the explanations for these lower R^2 is that some important explanatory variables may be missing from

the analysis.

Chapter 9

Conclusion

Rising levels of inequality have been reported by several academics. The present study has intends to understand what are the determinants of wage inequality inside firms. Using *Quadros de Pessoal* four measures of inequality were adopted: P90/P10, P90/P50, P50/P10 and the coefficient of variation (CV). The use of these four different indicators for inequality allowed the representation of different stages of the distribution of wages.

Both descriptive statistics and the econometric analysis carried out reveal, as expected that women on average reduce wage inequalities. The most significant results indicate that a higher percentage of workers with a tertiary education indicate a larger dispersion of earnings. Results also remark that the minimum wage compresses wages at the lower end of the distribution, and as the percentage of minimum wage workers increases, inequality levels inside firms are expect to diminish. Furthermore, medium and larger firms show on average a more disperse wage distribution than small firms. It is also possible to assert that given the higher coefficients for large firms and taking into consideration the inequality analysis using descriptive statistics, that in larger firms, wages are even more dispersed than in medium enterprises. Finally, considering firm location, higher levels of inequality were registered for Lisbon than in any other region.

The most important limitations in this study are the fact that the database doesn't have information regarding companies' pay schemes and compensation strategies. For future studies, a crossing with other databases that detain this type of information might be interesting.

Appendices

Variable	Description
P90/P10	Inequality ratio of Percentile 90 and Percentile 10
P90/P50	Inequality ratio of Percentile 90 and Percentile 50
P50/P10	Inequality ratio of Percentile 50 and Percentile 10
CV	Coefficient of Variation
PWomen	Percentage of women in each firm
Age Groups	Percentage of individuals in a firm that belongs to a certain age group.
PAge_35*	Percentage of individuals in a firm that is aged less than 35 years old.
PAge_35_55	Percentage of individuals in a firm that is aged between 35 and 55 years old.
PAge_55	Percentage of individuals in a firm that is older than 55 years old.
Education Levels	Percentage of the highest level of education achieved by the worker
PESecondary*	Percentage of individuals in each firm that has reached at most a high school degree
PETertiary	Percentage of individuals in each firm that has at least attended college or higher
Qualification Level	Variables illustrating the percentage of individuals with a certain level of qualification for each firm level
PTop_Manager*	Percentage of top managers and professionals in each firm
PMiddle_Managers	Percentage of other managers and professionals in each firm
PForeman	Percentage of foremen and supervisors in each firm
PHighly_Skilled	Percentage of highly skilled personnel in each firm
PSkilled	Percentage of skilled personnel in each firm
PSemi_Skilled	Percentage of semi-skilled personnel in each firm
PUnskilled	Percentage of unskilled personnel in each firm
PApprentices	Percentage of practitioners and apprentices in each firm
Tenure	Seniority - years of experience in the present company

Variable	Description
Contract Type	Percentage of workers with a certain contract type
PPermanent*	Percentage of individuals in each firm with a permanent work contract
PTemporary	Percentage of individuals in each firm with a fixed term contract
PND_Contract	Percentage of individuals in each firm with a non-defined contract type
PMin_Wage	Percentage of minimum wage workers in each firm
Activity Sector (CAE)	Dummy variables for industries (CAE 1 letter, Rev. 3)
CAE_A	1 if the company is centered around agriculture, animal production, hunting, forestry and fishing; 0 otherwise
CAE_B	1 if the company is centered around mining and quarrying; 0 otherwise
CAE_C	1 if the company is centered around manufacturing; 0 otherwise
CAE_D	1 if the company is centered around electricity, gas, steam, hot and cold water and cold air; 0 otherwise
CAE_E	1 if the company is centered around Water collection, treatment and distribution; sanitation, waste management and depollution; 0 otherwise
CAE_F	1 if the company is centered around construction; 0 otherwise
CAE_G	1 if the company is centered around whole sale and retail trade; repair of motor vehicles and motorcycles ; 0 otherwise
CAE_H	1 if the company is centered around transportation and storage; 0 otherwise
CAE_I	1 if the company is centered around accommodation and food service activities; 0 otherwise
CAE_J	1 if the company is centered around information and communication activities; 0 otherwise

Variable	Description
CAE_K	1 if the company is centered around financial and insurance activities; 0 otherwise
CAE_L	1 if the company is centered around real state activities; 0 otherwise
CAE_M	1 if the company is centered around consulting activities, scientific, technical and similar; 0 otherwise
CAE_N	1 if the company is centered around administrative and support service activities; 0 otherwise
CAE_O	1 if the company is centered around public administration and defense; compulsory social security; 0 otherwise
CAE_P	1 if the company is centered around education; 0 otherwise
CAE_Q	1 if the company is centered around human health and social work activities; 0 otherwise
CAE_R	1 if the company is centered around artistic, entertainment, sports and recreational activities; 0 otherwise
CAE_S	1 if the company is centered around other service activities; 0 otherwise
CAE_U	1 if the company is centered around activities of international organizations and other extra-territorial institutions; 0 otherwise
Company Size	Dummy variables for company size
Small_Firm*	1 if company has between 20 and 49 employees; 0 otherwise
Medium_Firm	1 if company has between 50 and 249 employees; 0 otherwise
Large_Firm	1 if company has 250 or more employees; 0 otherwise
Firm Location	Geographical location of each company
North	1 if firm is located in the North; 0 otherwise
Algarve	1 if firm is located in Algarve; 0 otherwise
Center	1 if firm is located in the Center; 0 otherwise
Lisbon*	1 if firm is located in Lisbon; 0 otherwise

Variable	Description
Alentejo	1 if firm is located in Alentejo; 0 otherwise
Azores	1 if firm is located in Azores; 0 otherwise
Madeira	1 if firm is located in Madeira; 0 otherwise
Sales	Sales Volume per employee (in millions of euros)

Table 1: Variable Codification and Description

Descriptive Statistics Table					
Variables	Obs	Mean	Stand. Dev	Min	Max
Year	17278	2016	0	2016	2016
P90_10	17278	2.429334	2.030974	1	197.615
P90_50	17278	1.783811	0.7837059	1	52.41317
P50_10	17278	1.33743	0.3565013	1	8.411386
CV	17278	0.515398	0.4450018	0	12.32647
PWomen	17278	0.460225	0.3101913	0	1
PAge_35	17278	0.289714	0.1763683	0	1
PAge_35_55	17278	0.571378	0.1499981	0	1
PAge_55	17278	0.109377	0.0917273	0	0.7924528
PESecondary	17278	0.786616	0.2128504	0	1
PETertiary	17278	0.182518	0.212106	0	1
PTop_Manager	17278	0.078856	0.1429478	0	1
PMiddle_Managers	17278	0.049996	0.0960032	0	1
PForeman	17278	0.05028	0.0763766	0	1
PHighly_Skilled	17278	0.071377	0.12647	0	1
PSkilled	17278	0.3825	0.2640255	0	1
PSemi_Skilled	17278	0.214025	0.2247781	0	1
PUnskilled	17278	0.095899	0.1614046	0	1
PApprentices	17278	0.027436	0.0826664	0	1
Tenure	17278	8.72077	5.217549	0	33.95454
PPermanent	17278	0.661925	0.2499119	0	1
PTemporary	17278	0.302795	0.2479922	0	1
PND_Contract	17278	0.005749	0.0372637	0	1
PMin_Wage	17278	0.173358	0.21542	0	1
CAE_A	17278	0.017942	0.1327441	0	1
CAE_B	17278	0.004746	0.068729	0	1

Descriptive Statistics Table					
Variables	Obs	Mean	Stand. Dev	Min	Max
CAE_C	17278	0.302871	0.4595131	0	1
CAE_D	17278	0.001563	0.039501	0	1
CAE_E	17278	0.009029	0.0945929	0	1
CAE_F	17278	0.073851	0.2615361	0	1
CAE_G	17278	0.166802	0.3728095	0	1
CAE_H	17278	0.045665	0.2087636	0	1
CAE_I	17278	0.064012	0.2447815	0	1
CAE_J	17278	0.021009	0.1434196	0	1
CAE_K	17278	0.015164	0.1222077	0	1
CAE_L	17278	0.00463	0.0678896	0	1
CAE_M	17278	0.031485	0.1746298	0	1
CAE_N	17278	0.035479	0.1849916	0	1
CAE_O	17278	0.011923	0.1085413	0	1
CAE_P	17278	0.032932	0.1784639	0	1
CAE_Q	17278	0.123973	0.3295599	0	1
CAE_R	17278	0.008971	0.094292	0	1
CAE_S	17278	0.027897	0.1646818	0	1
CAE_U	17278	5.79E-05	0.0076077	0	1
Small_Firm	17278	0.638731	0.4803821	0	1
Medium_Firm	17278	0.312999	0.4637274	0	1
Large_Firm	17278	0.04827	0.2143413	0	1
North	17278	0.374175	0.4839232	0	1
Algarve	17278	0.03762	0.1902812	0	1
Center	17278	0.230409	0.4211066	0	1
Lisbon	17278	0.257495	0.437267	0	1
Alentejo	17278	0.057183	0.2321978	0	1
Azores	17278	0.022398	0.1479797	0	1
Madeira	17278	0.02072	0.1424495	0	1
Sales	17278	0.132432	0.9603265	0	108.9844

Table 2: Descriptive Statistics

Source: Quadros de Pessoal (2016)

	P90_10	P90_50	P50_10	CV
PROPWOMEN	-0.3822*** (0.0702)	-0.056** (0.0267)	-0.2063*** (0.0088)	-0.0018 (0.0151)

	P90_10	P90_50	P50_10	CV
PAGE_35_55	0.3679*** (0.1135)	-0.0161 (0.0455)	0.2074*** (0.0186)	-0.0526** (0.0238)
PAGE_55	1.1627** (0.4809)	0.1726 (0.1365)	0.2931*** (0.0358)	-0.008 (0.0438)
PETertiary	1.4586*** (0.1249)	0.5975*** (0.054)	0.3602*** (0.0239)	0.3657*** (0.0348)
PMiddle_Managers	-0.3332 (0.3017)	0.4169*** (0.0969)	-0.3509*** (0.0502)	0.1453*** (0.0389)
PForeman	-0.2079 (0.3198)	0.5184*** (0.1146)	-0.3906*** (0.0511)	0.4311*** (0.055)
PHighly_Skilled	-0.654*** (0.2337)	0.2161*** (0.0788)	-0.471*** (0.0451)	0.1958*** (0.0451)
PSkilled	-1.5439*** (0.3791)	-0.1381 (0.11)	-0.5805*** (0.0411)	0.1129*** (0.0434)
PSemi_Skilled	-1.3859*** (0.3685)	0.0798 (0.1126)	-0.6517*** (0.0416)	0.1917*** (0.0429)
PUnskilled	-1.428*** (0.3762)	0.0584 (0.112)	-0.6544*** (0.0422)	0.1966*** (0.0446)
PApprentices	-1.4065*** (0.3434)	-0.105 (0.1102)	-0.5275*** (0.0444)	0.1532*** (0.0546)
Tenure	0.0016 (0.0057)	0.0098*** (0.0019)	-0.0032*** (0.0007)	0.0059*** (0.0009)
PTemporary	-0.0215 (0.0593)	-0.0088 (0.0268)	0.0214* (0.0119)	0.0179 (0.0153)
PND_Contract	0.2554 (0.2777)	0.0167 (0.1362)	0.1946** (0.0953)	0.0902 (0.0925)
PMin_Wage	-0.551*** (0.0417)	-0.2745*** (0.0238)	-0.1441*** (0.0103)	-0.1618*** (0.0152)
CAE_B	-0.292*** (0.1092)	-0.1313* (0.0722)	-0.0938*** (0.0256)	-0.0011 (0.0615)
CAE_C	-0.0166 (0.0759)	-0.0275 (0.0465)	-0.0087 (0.0182)	0.0125 (0.0215)
CAE_D	-0.8026*** (0.2009)	-0.3797*** (0.1058)	-0.1193*** (0.0427)	-0.03 (0.1466)
CAE_E	-0.2428*** (0.0848)	-0.0721 (0.0573)	-0.079*** (0.022)	0.0345 (0.0596)
CAE_F	-0.1629** (0.0806)	-0.1223** (0.049)	-0.0181 (0.0216)	-0.0622*** (0.0229)

	P90_10	P90_50	P50_10	CV
CAE_G	0.1837* (0.1063)	0.0205 (0.0508)	0.0559*** (0.0185)	0.0244 (0.0219)
CAE_H	-0.1274 (0.0804)	-0.1957*** (0.0488)	0.0919*** (0.0232)	-0.0016 (0.0287)
CAE_I	0.0979 (0.0739)	-0.0084 (0.0472)	0.0538*** (0.0192)	0.0414* (0.0239)
CAE_J	-0.7625*** (0.2001)	-0.3644*** (0.103)	-0.1212*** (0.0267)	-0.1022** (0.0405)
CAE_K	-0.0933 (0.1937)	-0.2015*** (0.0671)	0.0355 (0.0381)	-0.1129*** (0.0323)
CAE_L	0.6737*** (0.2413)	0.217** (0.1093)	0.1386** (0.0649)	0.082 (0.0649)
CAE_M	-0.5215*** (0.1371)	-0.2681*** (0.0607)	-0.0559** (0.026)	-0.1068*** (0.0275)
CAE_N	-0.1003 (0.1032)	-0.1326** (0.0545)	0.0283 (0.0215)	-0.0538** (0.0272)
CAE_O	-0.3332*** (0.0883)	-0.3057*** (0.0511)	0.0134 (0.0211)	-0.146*** (0.0259)
CAE_P	0.2141 (0.1853)	-0.1498** (0.0701)	0.36*** (0.0334)	-0.0513* (0.0305)
CAE_Q	-0.0336 (0.091)	-0.001 (0.0485)	0.0249 (0.0179)	-0.0347 (0.0239)
CAE_R	1.177** (0.5018)	0.4152** (0.1959)	0.0995*** (0.0362)	0.0842* (0.0504)
CAE_S	-0.2002* (0.1075)	-0.1578*** (0.054)	0.0543** (0.0244)	-0.0654** (0.03)
CAE_U	-1.2735*** (0.2202)	-0.9074*** (0.0749)	0.214*** (0.0239)	-0.2911*** (0.0303)
Medium_Firm	0.2012*** (0.0269)	0.0895*** (0.0122)	0.0466*** (0.0051)	0.1577*** (0.0072)
Large_Firm	0.2384*** (0.0535)	0.1065*** (0.0265)	0.0493*** (0.0105)	0.4262*** (0.0334)
North	-0.179*** (0.0381)	-0.0637*** (0.0164)	-0.0377*** (0.0067)	-0.0501*** (0.0097)
Algarve	-0.2124*** (0.0521)	-0.0573** (0.0245)	-0.0327*** (0.0108)	-0.0278* (0.016)
Center	-0.192*** (0.041)	-0.0972*** (0.0167)	-0.0011 (0.0069)	-0.0506*** (0.0099)

	P90_10	P90_50	P50_10	CV
Alentejo	-0.1999*** (0.0454)	-0.0992*** (0.0228)	-0.0045 (0.0091)	-0.0528*** (0.0158)
Azores	-0.19*** (0.0489)	-0.0631** (0.0299)	-0.0507*** (0.0139)	-0.0285 (0.0247)
Madeira	-0.207*** (0.0621)	-0.0701* (0.0364)	-0.0471*** (0.0167)	-0.0433** (0.0221)
Sales	-0.0094 (0.0105)	0.0017 (0.0071)	-0.0049** (0.0021)	0.0011 (0.0032)
cons	3.3117*** (0.2923)	1.7073*** (0.1019)	1.7459*** (0.0431)	0.2782*** (0.0466)
R ²	0.1053	0.0885	0.3689	0.1256
Obs	17278	17278	17278	17278

Table 3: OLS Table - Exports

Source: Computations of the author based on *Quadros de Pessoal (2016)*

Note: Significance levels *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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