

THE IMPACT OF THE MINIMUM WAGE ON LOW-WAGE EARNERS*

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*“Advantages and disadvantages tend to equality where there is perfect liberty”
Adam Smith, The Wealth of Nations, Chapter X
Of wages and profit in the different employments of labour and stock*

ABSTRACT

This paper estimates the impact of increases in the minimum wage on employment stability, wages and inequality in Portugal. We use data from 2002 to 2010; from 2002 to 2006 the real minimum wage was stable, but it increased quite substantially afterwards. Lower-tail wage inequality widened up to 2006 and declined strongly afterwards. The results point towards a negative employment elasticity for workers whose initial wage is between the old and the new minimum wages. This elasticity is similar to the one obtained in the US, a country with a low minimum wage when compared to the average wage, and smaller than the one obtained for France, a country with a high minimum wage. The wage elasticity to the minimum wage is naturally higher for workers earning exactly the old minimum wage. The wages of all other workers remain unaffected. These results point to a detrimental effect of minimum wage increases for employment stability of low-wage workers, with only minor gains in terms of wages.

1. Introduction

Policy makers and economists often lead long debates on relevant issues for people’s life. The minimum wage is one of the most debated topics in labor economics. The arguments on the minimum wage policy consider its impact on employment, wages and the distribution of income.

Economists know since the seminal work of Stigler (1946) that the minimum wage can have a positive impact on employment. They also know, but for a longer period, that the minimum wage can have a negative impact on employment. While the latter is probably the most expected result – after all nobody contests that we typically reduce the consumption of apples when its price goes up – the former is also a plausible outcome. Indeed, in markets where an employer (demand) has a significant market power and is able to control the wage that he pays, a legal imposition of a minimum wage may increase the level of employment. The employer has “monopsony power”, which allows him to pay wages below the workers’ marginal productivity. Thus, in a situation where the government increases the wage paid (but not above productivity), the employer still has the incentive to keep the worker. What is more, the higher wage attracts to the labor supply workers otherwise idle. Overall, the minimum wage may increase employment. But in a market where the minimum wage increase eats away the profit margin,

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the impact on employment is perverse. Ultimately, the sign of the impact of the minimum wage on employment is an empirical question.

The main political goal of the minimum wage is to redistribute income to low-paid workers. To achieve this goal most policies incur in several risks. First, the minimum wage increase takes money away from some citizens and pays it to others. In doing this, national output does not increase (except for monopsony markets). Does the money reach its target? Probably not, since rises in the minimum wage may reduce low-wage employment. Second, the minimum wage policy is an exogenous interference with the firm's human resources management. It changes the relative price of workers inside the firm, making those relatively better paid relatively less expensive. This may drive employment away from minimum-wage earners, but may also result in a significant compression of the wage distribution – lower wage increases for wages just above the minimum. As a result, internal labor market characteristics of the firm that deliver positive economic outcomes in terms of productivity, such as returns to tenure, long spells of employment and ports-of-entry may be negatively impacted.

The motivation to change the minimum wage can also rest on other types of arguments. We can use efficiency wage arguments. The level of the minimum wage is interpreted as the lowest level of wages compatible with a given living standard and a fair level of payment in exchange for the services of labor. This can also be supplied with a Keynesian flavor, if we believe that higher wages provide the economy with stronger demand and thus increase the overall output level. Additionally, there may be some general equilibrium effects coming from higher levels of the minimum wage, which may lead firms to create more productive jobs, therefore better paid and workers to demand these types of jobs.

In this study, we analyze the impact of minimum wage policy on low wage earners between 2002 and 2010. This is a quite interesting period in Portugal because a period of no real gains in the minimum wage up to 2006 is followed by a period of quite substantial increase in the minimum wage. In this context, it is interesting to analyze the impact of the minimum wage on low-wage workers and not only on the minimum-wage earners. We will address the following questions: Does the minimum wage help to reduce lower tail wage inequality? Are there employment losses associated with increases in the minimum wage above the average wage increase? Is there a spillover effect from minimum wage increases?

To answer these questions, we estimate a set of models to establish the relationship between minimum wages increases and employment, conditional on a set of characteristics prevailing in the economy at that time. In particular, we study how the interaction of the real minimum wage variation and the worker position in the distribution of wages affects the probability that (s)he remains employed.

Research consensus for other countries seems to evolve around the following conclusion: the impact on employment is a debate around zero (Freeman, 1996). The minimum wage seems to have some impact on the wage distribution, but a much smaller impact (if any) on the income distribution (for a detailed discussion see Brown, 1999, Card and Krueger, 1995 and Neumark and Wascher, 2007). In any case, the initial level and the dimension of the increase in the minimum wage seem to be relevant to set the case. Low increases in the minimum wage are certainly much more employment friendly. What would be difficult after that is to define what a "low increase" is.

Our results confirm this general appraisal. The later and larger updates of the minimum wage lead to significant reductions in lower-tail wage inequality. This compression of wages was both explained by significant wage increases in the lower percentiles and below average increases at median wages. However, they are also associated with significant decreases in employment. A less intrusive minimum wage policy is thus advisable. Adding to this conclusion, it is widely known that workers and job turnover are higher for low-wage workers. The resulting excess worker turnover coming from increased employment instability as a result of minimum wage increases is widely detrimental for productivity, training and progression within the firms' internal labor markets.

2. Data

In this article we use a longitudinal database matching workers and firms made available by *Instituto de Informática da Segurança Social* (Portuguese social security data processing office), which includes all workers who paid contributions to the social security general regime, covering the period from 2002 to 2010. Workers and firms have a unique identification code that allows tracking both over time. One of the advantages of using this information is the administrative nature of the database – registers of mandatory contributions to the Portuguese social security system. Usually, the information in administrative databases is seen as more reliable, being less prone to measurement errors, such as reporting or rounding errors, particularly in wages.

The information on wages refers to gross monthly values, reported in October of each year. The database includes different types of compensation, namely permanent, variable, vacation and Christmas bonuses, and other pay. To increase comparability, we used the permanent wage adjusted for a fixed work period of 30 days, *i.e.* we divided the permanent compensation by the actual number of days worked in the month and multiplied by 30.

In addition to wages and the number of days worked in October, this database also includes other variables, such as job tenure and variables related to workers (for example, gender, age and worker status – employees, self-employed or other) and firms' characteristics (for instance, region and size), covering all activity sectors. The coverage in public administration, health and education has been increasing over time, as new civil servants are enrolled in the social security general regime, instead of the specific civil servant social security scheme.

The original database was restricted to salaried workers, whose wage was at least 80 per cent of the minimum wage established by law (taking into account the legal possibility of a 20 per cent reduction in minimum wages earned by apprentices and trainees). Furthermore, inconsistent and missing reports on gender, age and job tenure were dropped. So, our sample has almost 25 million year/worker/firm observations, an average of 2.7 million workers in each year.

3. The evolution of minimum wage in Portugal: 2002-2010

The Portuguese minimum wage legislation was introduced in 1974, defining the legal minimum wage for employees with at least 20 years of age, excluding agriculture, domestic work and firms with up to 5 workers. Since then, this legislation has undergone several adjustments and currently there are no exceptions by age, activity sector or firm size. The minimum wage is the same for all employees except apprentices and trainees (whose minimum wage can be reduced by 20 per cent) and disabled workers (reductions between 10 and 50 per cent).

In 2002 the minimum wage was 348 euros, representing 50.3 per cent of the mean wage and 70 per cent of the median wage. In 2010 the minimum wage had increased to 475 euros, which represent 52.2 per cent of the mean wage and 73.1 per cent of the median wage.¹ Developments in the minimum wages have been discretionary, not following a formal rule or indexation – each year the government, after consulting representatives of workers and employers, proposes a new figure for the minimum wage. Nevertheless, the rate of change of the minimum wage has typically tracked the expected inflation, resulting in changes of the real minimum wage close to zero. In Chart 1, we can see that this was the case in the period from 2002 to 2006.

This situation changed from 2007 onwards, a period during which the minimum wage increased markedly in real terms (Chart 1). These recent increases reflected the agreement signed by the government

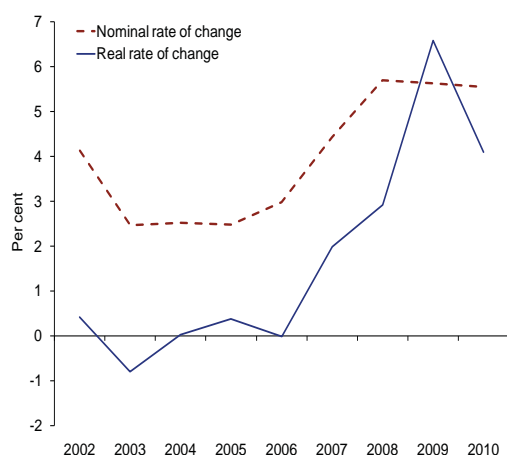
¹ The median of a distribution represents the value for which 50 per cent of the observations are below (and, likewise, 50 per cent of the observations are above).

and the representatives of workers and employers, in December 2006. The main goal of this agreement was to have a minimum wage of 500 euros by 2011. The agreed roadmap, put in place up to 2010, set the minimum wage at 403 euros in 2007, 426 euros in 2008, 450 euros in 2009 and 475 euros in 2010.

As shown in Chart 2, up to 2006 the growth of the minimum wage in real terms was quite similar to the median wage, for all employees who stayed for at least two consecutive years in the database (in the same firm or not), being, on average, about 1.8 percentage points below the growth rate of the mean wage. In real terms, since 2007 the minimum wage increased more sharply than the median wage, outpacing the mean wage in the period from 2008 to 2010.²

Chart 1

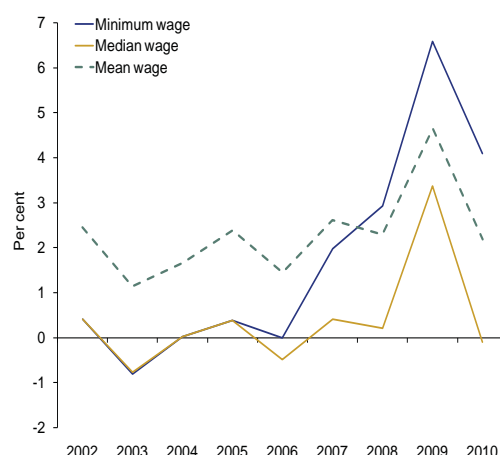
DEVELOPMENTS IN THE MINIMUM WAGE



Note: Real wage rates were obtained by deflating the nominal rates of change using consumer prices.

Chart 2

REAL WAGE RATES



Note: Mean and median wages obtained from Social Security data and authors' calculations.

The evolution of the share of minimum wage earners (Chart 3) can be split in two distinct periods: (i) from 2002 to 2006 this share remained fairly stable, around 8 per cent; (ii) since 2007 the share of minimum wage earners increased markedly, from 8.9 per cent in 2007 to 12.4 per cent in 2010. This evolution was common to most activity sectors, being more striking in manufacturing and construction.³

The impact of the minimum wage growth can also be seen through the distributions of wages and wage changes. A simple visual inspection reveals that the minimum wage is a key factor in the wage distribution, being the mode of the distribution (Chart 4).⁴

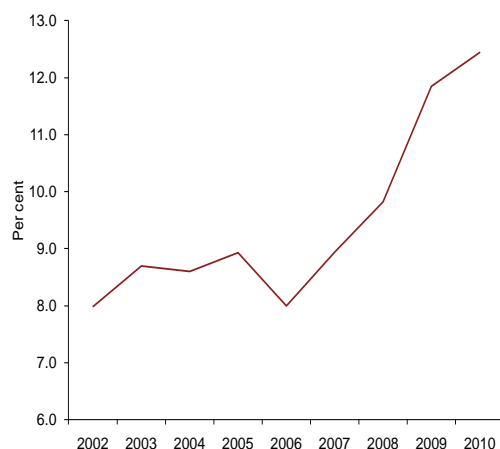
Moreover, the percentile up to which the minimum wage is binding increased. While, on average, from 2002 to 2006, the minimum wage was binding up to the 10th percentile, in 2010 it was binding up to the 15th percentile. This means that in 2010 15 per cent of the employees had a wage lower than or equal to the minimum wage.

Looking at the distributions of nominal wage changes over time, the impact of the minimum wage is also noticeable (Chart 5). Up to 2006, these distributions showed a high concentration on zero and values close to the observed/expected inflation rates (used as a reference for bargaining and minimum

2 Real wage rates were obtained by deflating the nominal rates of change using consumer prices.
3 To avoid slight differences due to rounding, we considered that an employee earned the minimum wage if its wage falls in a 2-euro interval centered on the legal minimum wage (minimum wage +/- 1 euro).
4 The mode of a distribution is the value that occurs most frequently among the sample.

Chart 3

SHARE OF MINIMUM-WAGE EARNERS

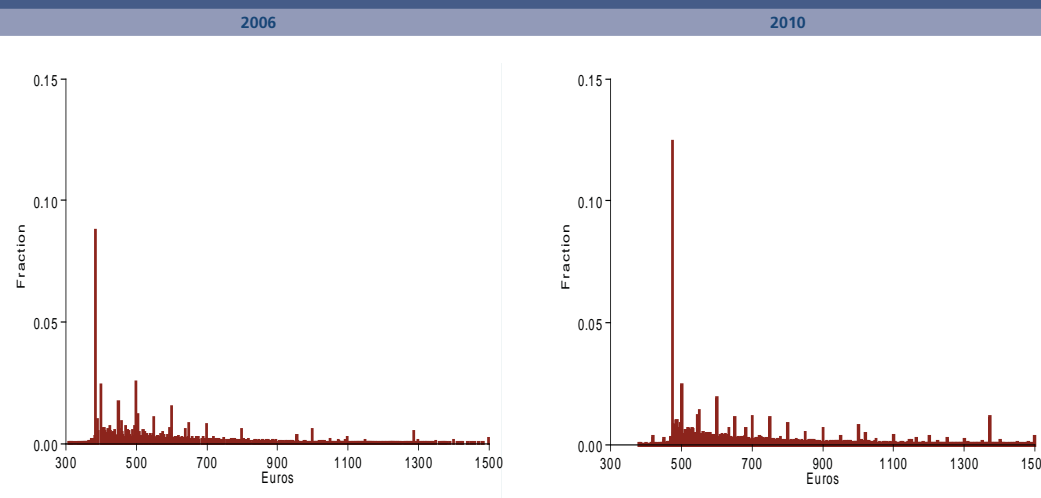


Sources: Social Security data and authors' calculations.

Note: We considered that an employee earned the minimum wage if its wage falls in a 2-euro interval centered on the legal minimum wage (minimum wage +/- 1 euro).

Chart 4

WAGE DISTRIBUTIONS



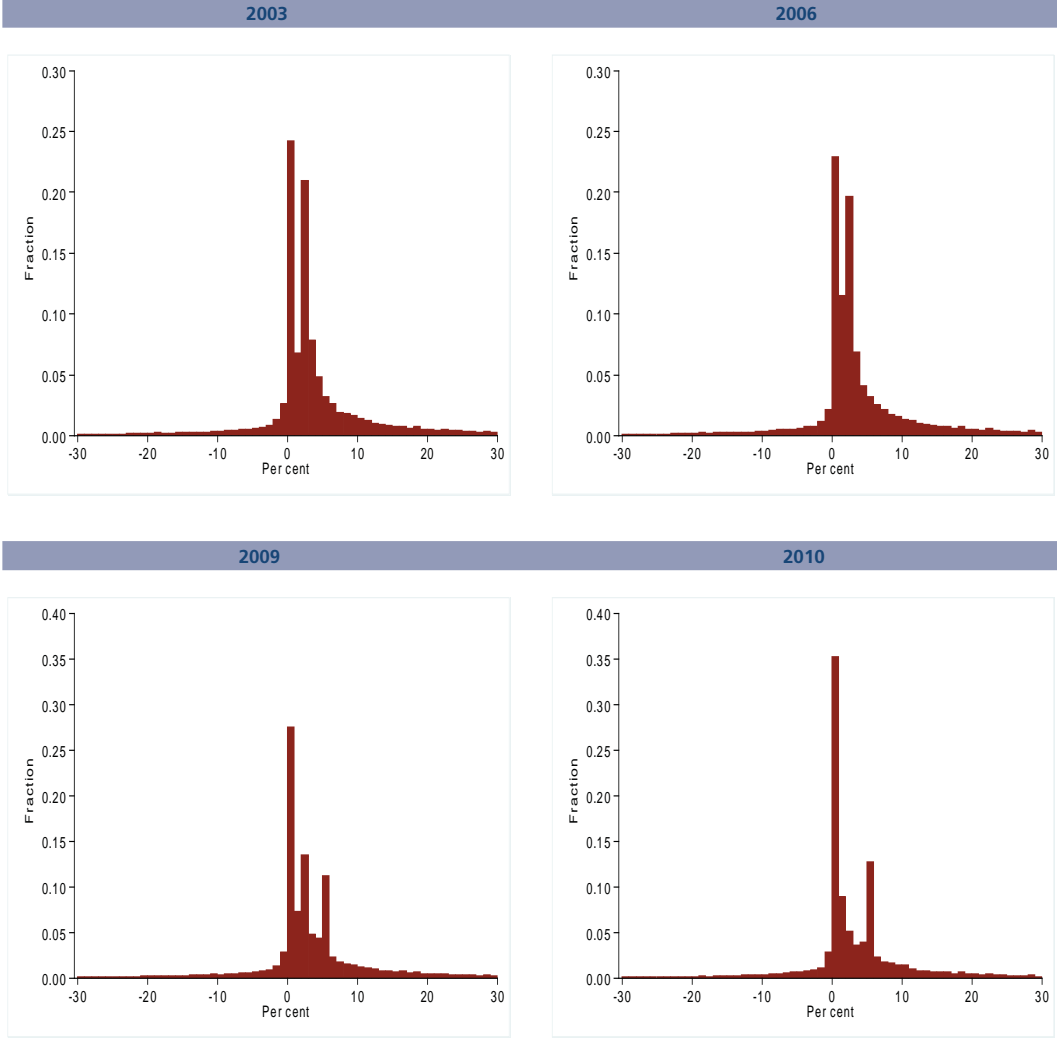
Sources: Social Security data and authors' calculations.

wages). From 2007 onwards, the distribution of wage changes had three spikes - at zero, at the observed/expected inflation rate value and at the rate of change of the minimum wage (in 2010, the first two spikes collapsed into a single spike, reflecting the low positive inflation observed in that year).

Since the minimum wage strongly influences the dispersion on the left tail of the wage distribution, it plays a significant role in the evolution of wage inequality, as measured by the ratio between the wages in the 50th and 10th percentiles. This ratio decreased by 12.9 per cent between 2002 and 2010 (Chart 6). After a period of increasing inequality (7.4 per cent up to 2006), the 50/10 ratio decreased by 18.9 per cent between 2006 and 2010. This significant reduction highlights the fact that wages in the 10th percentile (where the minimum wage was binding) grew more markedly than in the 50th percentile (*i.e.* the median). Although common to most activity sectors, this evolution was clearer in manufacturing and construction.

Chart 5

WAGE CHANGE DISTRIBUTIONS



Sources: Social Security data and authors' calculations.

Therefore, this evidence suggests that the stronger increases in minimum wages in recent years contributed to reducing wage inequality. Previous studies on the role played by the minimum wage in the evolution of the 50/10 inequality ratio in Portugal include Cardoso (1998) and, more recently, Centeno and Novo (2009). For the period after 1995, the results in the latter work also suggest that the minimum wage (mildly) contributed to the reduction of the 50/10 ratio, especially in the case of female workers.

Answering to the question on the impact of minimum wages on wage inequality is not clear cut. This issue has been extensively discussed in the literature. For example, DiNardo *et al.* (1996) proposed a semiparametric procedure to analyze the effect of several factors (including changes in the minimum wage) over the entire wage distribution. Using data for the US, the authors found that the increase in the real minimum wage between 1973 and 1979 contributed to the decrease in wage inequality. Also for the US, Autor *et al.* (2010) found a small impact of the minimum wage on the lower tail inequality, but highlighted that this impact could go beyond the direct effect on low-wage workers, through spillover effects.

Does the evolution of minimum wages only affect low-wage workers? Chart 7 shows the rate of change of wages up to the 75th percentile in 2004 (nil real change of the minimum wage) and in 2009 (highest

Chart 6

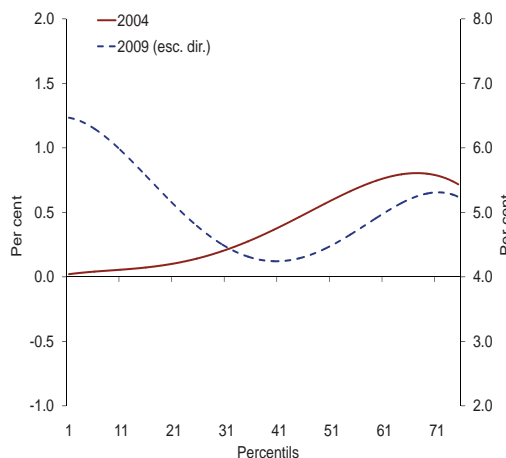
WAGE INEQUALITY: 50/10 RATIO



Sources: Social Security data and authors' calculations.
Note: The chart presents the logarithm of the ratio between the 50th and the 10th percentiles of the wage distribution.

Chart 7

WAVE EFFECT – REAL RATE OF CHANGE OF WAGES UP TO THE 75TH PERCENTILE OF WAGE DISTRIBUTION



Sources: Social Security data and authors' calculations.

real change of the minimum wage in the period analyzed).⁵ In 2004 the trend in wage rates over the wage distribution was positive. In contrast, in 2009, low-wage workers received the highest pay rises. This is true not only for minimum wage earners, but also for workers with wages slightly above the minimum wage. In turn, medium-wage workers received the lowest pay rises.

4. Results

The debate on the impact of the minimum wage on employment and, in general, in the economy and society, is one that will be ultimately settled by the empirical evidence. Theoretically, there are models in which the minimum wage may lead to a decrease in employment, but there are also models that imply an increase. The last decade in Portugal has been characterized by both rather meager increases in the minimum wage, but also by rather generous ones. It bears asking, what has been the impact of such political choices? To address this question, we follow a line of research developed, among other, by Abowd *et al.* (2000) and Neumark *et al.* (2004). We estimate a set of models that analyze how the interaction between the real minimum wage increases and the worker position in the distribution of wages determines the probability that (s)he remains employed.

It is easy to imagine that those most affected by a minimum wage increase scheduled for next year are the current year's minimum wage earners themselves. However, all other individuals whose current wage is below next year's minimum wage will also be directly affected, although to smaller and varying degrees than the minimum wage earners. All other workers will not be directly affected by the new minimum wage. In our model, we will consider six levels of wage earners, hypothesizing that the further away a worker is from the new minimum wage, the less the probability of remaining employed is affected by the change in the minimum wage. The six groups are: (i) the current minimum-wage earners; (ii) those earning more than today's minimum wage, but below the new minimum wage; (iii) those with wages in the first quartile, but not in the first two groups; (iv)-(vi) the 2nd, 3rd, and 4th quartiles of the wage distribution.

⁵ We are implicitly assuming that the evolution of the wages in the top-25 per cent of the distribution are not influenced by changes in the minimum wage.

Since we consider the impact of a variation in next year's minimum wage conditional on being employed in the current year, our estimate of the impact is a lower bound of the overall impact on the economy because it ignores the impact on the transition from unemployment and inactivity to employment.

Year-by-year

We start our study by considering 8 cross-sections of workers for the years of 2003 to 2010. The estimation sample excludes agriculture, wages below the legal minimum wage and missing observations for nationality, activity sector, job tenure and firm size. The results of cross-section estimation are interpretable as long-term relationships, in that each individual represents a cohort in different stages in the life cycle of the labor market. Additionally, over the years the minimum wage changes were dramatically different, with real wage losses and large real wage gains (see Section 3). This variability, apart from year specific effects, shall reflect itself on the different years' impact estimates.

We consider the following simple model specification:

$$Y_i = \sum_k \beta_k D_{k,i} + X\lambda + u_i$$

where Y_i assumes value 1 if individual i remains employed from year t to $t+1$ and 0 if (s)he is no longer employed in $t+1$; $D_{k,i}$, for $k = 1, 2, \dots, 6$ is a dummy variable that assumes value 1 if the wage in year t is in one of the 6 wage categories defined above. The matrix X includes variables with worker, firm and match characteristics, namely: a quadratic term in the age of the worker; gender indicator; foreigner indicator; sector dummies (extractive; manufacturing; construction); firm size dummies (small: 1-25 workers; medium: 26-100; large: 101 or more workers); and tenure dummies (up to 6 months; 7-12 months; 13-36 months; 37-72 months; and more than 72 months). And u_i is a conventional error term. We estimated this model using both a linear probability model and a probit model. As it can be seen in Table 1, the results do not depend on the choice of the method, but for computational reasons in the remaining of the paper, we report only the results of the linear probability model.⁶

A Portuguese forty-year-old male, working in a large services firm, in 2002, with more than 6 years of tenure and a wage falling in the top quartile had a 95 per cent probability of remaining employed in 2003. Relatively to such individuals in the top quartile, the group of minimum wage earners in 2002 was 8.3 p.p. less likely to hold a job in 2003 (Table 1, column 1). In other words, the probability of non-employment for the minimum wage earner is 13.3 per cent, *i.e.*, 166 per cent higher than that of the top quartile worker. This result is not surprising in view of the evidence that low-wage workers have higher on-the-job rotation rates (Centeno *et al*, 2008).

The following group, composed of those who earn at least the new minimum wage, was 6.5 p.p. less likely to be among salaried workers than top earners. The next group, which is the first one not directly affected by the new minimum wage, is 1 p.p. more likely to remain employed than the previous group but almost 3 p.p. more likely than the group of minimum wage earners. The difference relative to the top quartile falls monotonically for the other groups.

The remaining columns of Table 1 repeat the exercise for the 2004-2010 period. The estimates are remarkably stable across the years, with slightly lower probabilities of being employed in years of economic downturn. There is also a tenuous increase in the probability of losing employment in years where the real (or nominal) minimum wage increases were more significant, particularly among the group of individuals earning more than the current minimum wage but less than next year's.

⁶ See Angrist and Pishke (2009) for a full discussion of linear probability models vs. probit models.

Table 1

	YEAR-BY-YEAR LINEAR PROBABILITY AND PROBIT MODEL, 2003-2010															
	Employment															
	Linear probability model					Probit model										
	2003	2004	2005	2006	2007	2008	2009	2010	2003	2004	2005	2006	2007	2008	2009	2010
Wage group:																
Current minimum wage	-8.32 (0.000)	-7.81 (0.000)	-9.00 (0.000)	-8.40 (0.000)	-7.96 (0.000)	-8.98 (0.000)	-8.61 (0.000)	-7.24 (0.000)	-8.92 (0.000)	-8.31 (0.000)	-9.70 (0.000)	-8.90 (0.000)	-8.81 (0.000)	-9.99 (0.000)	-9.48 (0.000)	-7.77 (0.000)
Less than next year's minimum wage	-6.53 (0.000)	-7.08 (0.000)	-7.72 (0.000)	-7.56 (0.000)	-7.47 (0.000)	-7.71 (0.000)	-7.78 (0.000)	-6.72 (0.000)	-7.30 (0.000)	-7.90 (0.000)	-8.72 (0.000)	-8.61 (0.000)	-8.40 (0.000)	-9.08 (0.000)	-9.11 (0.000)	-7.77 (0.000)
More than next year's minimum wage but less than 1 st quartile	-5.46 (0.000)	-5.33 (0.000)	-6.16 (0.000)	-5.58 (0.000)	-5.87 (0.000)	-5.97 (0.000)	-5.53 (0.000)	-4.85 (0.000)	-6.20 (0.000)	-6.06 (0.000)	-7.08 (0.000)	-6.28 (0.000)	-6.85 (0.000)	-7.30 (0.000)	-6.73 (0.000)	-5.71 (0.000)
2 nd quartile	-4.10 (0.000)	-3.55 (0.000)	-3.84 (0.000)	-3.32 (0.000)	-3.82 (0.000)	-4.45 (0.000)	-4.65 (0.000)	-3.51 (0.000)	-4.74 (0.000)	-4.23 (0.000)	-4.63 (0.000)	-3.99 (0.000)	-4.62 (0.000)	-5.54 (0.000)	-5.66 (0.000)	-4.32 (0.000)
3 rd quartile	-2.43 (0.000)	-1.95 (0.000)	-2.18 (0.000)	-1.68 (0.000)	-2.38 (0.000)	-2.45 (0.000)	-2.55 (0.000)	-1.90 (0.000)	-2.92 (0.000)	-2.45 (0.000)	-2.78 (0.000)	-2.23 (0.000)	-3.08 (0.000)	-3.37 (0.000)	-3.38 (0.000)	-2.51 (0.000)
Number of observations	2 063 683	2 100 410	2 118 697	2 137 751	2 176 748	2 250 426	2 293 273	2 236 537	2 063 683	2 100 410	2 118 697	2 137 751	2 176 748	2 250 426	2 293 273	2 236 537

Sources: Social Security data and authors' calculations.

Notes: p-values in parentheses. The remaining control variables included in the model are omitted from the Table; see text for the full set of variables included. Coefficients were multiplied by 100 to be interpretable as the percentage change in the probability of remaining employed between two consecutive years for each level of the initial wage relative to those with wages in the top quartile. For instance, an individual earning the minimum wage in 2002 will be 8.3 p.p. less likely to remain employed in 2003 than an individual with a wage in the top quartile, but otherwise equal (age, gender, industry, etc).

Over time

Note that our cross-section analysis does not account specifically for the variations in the real minimum wage; rather, it shows how the conditional probability of employment varies among the different wage groups. Therefore, we cannot yet attribute to those policy options the variability in employment. To address this issue in a more satisfying way, we extend our analysis to panel data models. We take advantage of our panel with 17.4 million observations of about 2.2 million individuals per year, over the 2003-2010 period and estimate the following model using a firm (j) fixed-effects estimator:

$$Y_{ijt} = \sum_k (\beta_k D_{k,ijt} + \varphi_k D_{k,ijt} * MW_t) + X\lambda + u_{ijt}$$

where all variables are defined as before and MW_t represents the variation in the real minimum wage in year t . The interaction term between the level of wage in year t ($D_{k,ijt}$) and the minimum wage variation in year $t + 1$ captures the impact on the probability of remaining employed in year $t + 1$ at the different wage levels due to the minimum wage variation. Note that the specification imposes the mild hypothesis that individuals in the top wage quartile are not affected by variations in the real minimum wage. Additionally, the regression model includes year fixed-effects.

The cross-section results gave us a first rough measure of how the probability of employment varies across the wage distribution. With panel data, we will be able to breakdown this probability in two factors: one factor associated with a level effect for each wage-group; and another corresponding to the group specific marginal effect, associated with to the variation in the minimum wage, which also captures the change in the minimum wage level (interaction $D_{k,ijt} \times MW_t$). The results of the estimation are presented in Table 2, column (1).

Interpreting the results is not straightforward, given the existence of interaction variables in the model. The impact of changes in the minimum wage is captured through the β_k and φ_k parameters. The first parameter captures the level effect, while the second is associated with the marginal effect. In order to allow a direct interpretation of the first impact, the variable that measures the change in the minimum wage was re-centered to the sample average (2 per cent). Thus, the level impact, β_k , should be seen as the one that corresponds to a change in the minimum wage equal to the sample average. The marginal impact, φ_k , is not affected by this transformation and has always a direct interpretation.

For workers earning less than next year minimum wage (the two first groups) the probability of remaining employed decreases by about 0.5 p.p. for each percentage point of increase in the minimum wage. For instance, in 2009, where the real minimum wage increased 6.6 per cent, the probability of remaining employed for a minimum wage earner decrease by (an additional) 2.6 p.p.. Overall, in 2009, minimum-wage earners had a probability of remaining employed of 9.8 p.p. lower than a top quartile worker. This is decomposed in 7.2 p.p. associated with the level impact evaluated at the average increase for the real minimum wage, and 2.6 p.p. due to the marginal impact because the real minimum wage increased above the average rate. The cross-section estimation indicated a difference of 8.6 p.p.. The remaining wage groups, despite not being directly affected by the new minimum wage, still have slightly lower probabilities, around 0.2 p.p. less for each percentage point increase in the real minimum wage.

We conclude that all groups of workers are to some extent affected by the minimum wage. But, are there differences between them? In other words, are the coefficient estimates statistically different from each other? We run hypothesis testing for the equality of the impact on the first group of individuals earning more than next year's minimum wage to the two groups below next year's minimum wage. In both cases, we reject the hypothesis of equality, suggesting that the minimum wage is naturally more binding for low-wage earners.

Our results are closer to those obtained for the US and the UK than for France. In particular, Currie and Fallick (1996) obtain an elasticity to changes in the minimum wage of -0.4, which is close to our estimate

Table 2

PANEL DATA FIRM FIXED-EFFECTS LINEAR PROBABILITY MODEL			
	Employment (1)	Wages (2)	Elasticity (3)=(1)/(2)
Wage group (β):			
Current minimum wage	-7.21 (0.000)	15.80 (0.000)	
Less than next year's minimum wage	-5.88 (0.000)	14.69 (0.000)	
More than next year's minimum wage but less than 1 st quartile	-4.42 (0.000)	12.05 (0.000)	
2 nd quartile	-2.56 (0.000)	9.22 (0.000)	
3 rd quartile	-1.11 (0.000)	5.35 (0.000)	
Percentage change in the real minimum wage times group indicators (φ):			
Current minimum wage	-0.56 (0.000)	0.52 (0.000)	-1.08
Less than next year's minimum wage	-0.45 (0.000)	0.09 (0.000)	-5.26
More than next year's minimum wage but less than 1 st quartile	-0.26 (0.000)	-0.16 (0.000)	1.64
2 nd quartile	-0.31 (0.000)	-0.06 (0.000)	5.23
3 rd quartile	-0.17 (0.000)	-0.22 (0.000)	0.76
Number of observations	17 377 525	14 721 929	

Sources: Social Security data and authors' calculations.

Notes: p-values in parentheses. The remaining control variables included in the model are omitted from the Table; see text for the full set of variables included. Conditional on a 2 percent increase in the real minimum wage, the coefficients were multiplied by 100 to be interpretable as the percentage change in the probability of remaining employed between two consecutive years for each level of the initial wage relatively to those with wages in the top quartile. For instance, with an increase of 2 per cent in the minimum wage, in relation to an individual with a wage in the top quartile, but otherwise equal (age, gender, industry, etc), a minimum-wage earner will be 7.2 p.p. less likely to remain employed in the following year. Additionally, for each percentage point of increase in the minimum wage above 2 per cent the probability of staying employed decreases by 0.56 p.p..

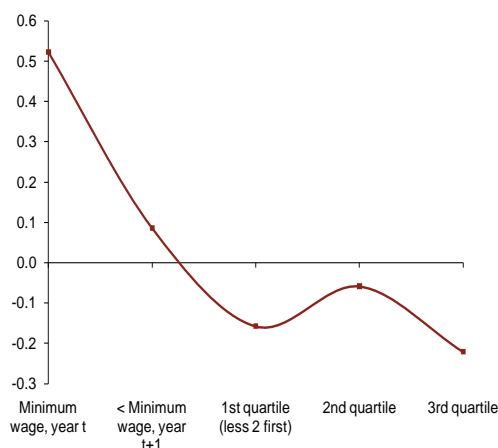
of -0.6. The elasticities estimated by Abowd *et al.* (2000) are slightly larger for the US, but clearly larger for France (their estimates are close to -0.6 and -2.1, respectively). Machin *et al.* (2003) study the impact of the introduction of the minimum wage in the UK and find also a small impact on employment. The evidence gathered for Portugal is ambiguous. Using a legislative reform that raised the minimum wage for workers aged 15 to 19 years, Portugal and Cardoso (2006) show that it resulted in a larger reduction of separations than in hirings. Using the same reform, Pereira (2003) reports a reduction in employment among such workers. The estimated employment-minimum wage elasticities of Pereira (2003) are in the interval -0.2 to -0.4, slightly smaller than our estimates.

The new minimum wage imposes an exogenous constraint on firms. Firms must adjust their production process to accommodate this raise in labor costs. In doing so, they can opt for adjusting their wage bill, they can opt for adjusting the quantity of labor (number of workers and hours worked) or a combination of these. We have seen that firms adjust downwards the amount of labor. Now, we explore how the wages of the different workers are adjusted. We use the same specification (equation (2)), changing only the dependent variable to the log difference between the real wage in year $t+1$ and in year t . Table 2, column (2), reports the estimates of the percent impact on the wage growth for the same group of workers relatively to the top quartile.

The first noticeable fact is that the marginal impact of a percentage point increase in the real minimum wage is positive for those below next year's minimum wage and negative for those above it. This pattern resembles the wave effect discussed earlier in Section 3. Indeed, Chart 8 plots these marginal effects and, apart from a rescaling, the shape of the curve is generally equivalent to Chart 7. This implies that

Chart 8

WAGE REGRESSIONS: MARGINAL IMPACT OF A PERCENTAGE POINT INCREASE IN THE REAL MINIMUM WAGE



Sources: Social Security data and authors' calculations, based on the results in Table 2, column 2.

increases in the real minimum wage are not innocuous for non-minimum-wage earners. The spillover on the other individuals' wages is negative, suggesting that firms adjust the other wage gains downwards to accommodate exogenous increases in the minimum wage. For those concerned with wage inequality, this outcome contributes towards a more uniform wage distribution. But as always, there might be too much of a good thing and the negative impact on employment must be also considered. Indeed, the negative outcome in employment may deliver a smaller (if any) decrease of income inequality. Furthermore, given the higher incidence of long-term unemployment among low-wage workers, this impact may even be increasing over time.

Having studied the impact on employment and wages, we are now in conditions of computing wage demand elasticities. Table 2, column (3), reports the wage demand elasticities of each group (the ratio of the employment to wage coefficients). The elasticity of minimum-wage earners is -1.1, indicating that for each percentage point increase in wages, employment decrease by slightly more than 1 p.p.. The elasticity among the group earning below next year's minimum wage is strong, -5.3, resulting primarily from having a small wage variation due to the minimum wage and a negative impact on employment similar to the minimum-wage earners.

Heterogeneity: Young workers and sector of activity

It is a well-established fact in the literature that the minimum wage is more binding among low-skilled and young workers, those more prone to earn low wages due to lower productivity. Column (1) of Table 3 reports the results of an identical exercise to those reported above, but considering a sub-sample of workers aged less than 25 years.⁷ Overall, the results indicate that young workers employment is more sensitive to variations in the real minimum wage. This is particularly true for the group earning exactly the current year's minimum wage; for each percentage point increase in the minimum wage, the probability of remaining employed falls 0.74 p.p.. This is almost a third higher than the effect estimated for the population of workers considered (0.56). In column (2), we see that the impact on real wages of the minimum wage variation is similar in magnitude to the previous estimates, but it is typically statistically non-significant for the group of individuals earning already above next year's minimum wage. Together,

7 The wage quartiles are re-defined for each of the sub-samples used.

Table 3

	PANEL DATA FIRM FIXED-EFFECTS LINEAR PROBABILITY MODEL BY AGE LEVEL AND INDUSTRY											
	Young workers (less than 25 years)			Manufacturing			Construction			Services		
	Employment (1)	Wages (2)	Elasticity (3)	Employment (4)	Wages (5)	Elasticity (6)	Employment (7)	Wages (8)	Elasticity (9)	Employment (10)	Wages (11)	Elasticity (12)
Wage group (β):												
Current minimum wage	-6.72 (0.000)			-5.70 (0.000)			-6.48 (0.000)			-8.03 (0.000)		
Less than next year's minimum wage	-7.36 (0.000)			-5.43 (0.000)			-6.82 (0.000)			-5.85 (-4.090)		
More than next year's minimum wage but less than 1 st quartile	-10.35 (0.000)			-4.32 (0.000)			-5.91 (0.000)			-4.09 (0.000)		
2 nd quartile	-5.28 (0.000)			-3.26 (0.000)			-3.90 (0.000)			-1.85 (0.000)		
3 rd quartile	-2.41 (0.000)			-1.71 (0.000)			-2.42 (0.000)			-0.56 (0.000)		
Percentage change in the real minimum wage times wage group indicator (φ):												
Current minimum wage	-0.74 (0.000)	0.55 (0.000)	-1.35	-0.71 (0.000)	0.70 (0.000)	-1.02	-0.61 (0.000)	0.64 (0.000)	-0.95	-0.46 (0.000)	0.46 (0.000)	-1.01
Less than next year's minimum wage	-0.38 (0.000)	0.09 (0.001)	-4.04	-0.45 (0.000)	0.37 (0.000)	-1.20	-0.51 (0.000)	0.35 (0.000)	-1.43	-0.27 (0.000)	-0.09 (0.000)	3.04
More than next year's minimum wage but less than 1 st quartile	-2.25 (0.000)	-0.36 (0.318)	-	-0.54 (0.000)	0.23 (0.000)	-2.35	-0.27 (0.000)	0.15 (0.000)	-1.83	-0.15 (0.000)	-0.32 (0.000)	0.47
2 nd quartile	-0.27 (0.000)	-0.08 (0.001)	3.47	-0.28 (0.000)	0.12 (0.000)	-2.33	-0.45 (0.000)	0.30 (0.000)	-1.50	-0.26 (0.000)	-0.16 (0.000)	1.64
3 rd quartile	-0.24 (0.000)	-0.01 (0.630)	-	-0.12 (0.000)	-0.06 (0.000)	1.93	-0.33 (0.000)	-0.04 (0.043)	-	-0.14 (0.000)	-0.24 (0.000)	0.61
Number of observations	2 184 150	1 720 885		4 456 811	3 878 574		2 120 848	1 698 736		10 799 866	9 144 619	

Sources: Social Security data and authors' calculations.

Notes: p-values in parentheses. See notes to Table 2, to the list of variables included and an interpretation of the results.

these results imply a larger (in absolute value) elasticity among young minimum wage earners (-1.3) and slightly lower elasticity in the contiguous group (-4.0).

Different industries have different human capital requirements. This in turn implies that workers with different skills allocate to each industry accordingly. In industries with lower human capital requirements, the prevalence of minimum-wage earners is stronger. For such firms, an exogenous increase in the minimum wage may have far stronger impacts than in an industry where there are few such workers. To study this possibility, we consider three sub-samples by industry type: manufacturing, construction, and services. Columns (4)-(12) present the estimates for the impact of the minimum wage increases on employment and wages.

There are three noteworthy facts to take away from this exercise. First, the larger impacts on employment occur in manufacturing and the smaller in the services sector. Second, in the case of manufacturing, the larger magnitudes, which were typically observed for the two groups below next year's minimum wage, are extended to the third wage group. In other words, in manufacturing, those that stand to lose with a minimum wage increase are not only those that will have to be legally raised, but also those earning already slightly above that new legal threshold. Third, in contrast with manufacturing, in the services sector the larger magnitude is only observed for current minimum-wage earners.

5. Conclusion

This article discusses the impact of increases in the minimum wage on three key labor market outcomes: employment, wages and inequality. Our results point to negative and small elasticities of employment to increases in the minimum wage. The disincentives that increases in the minimum wage generate are small but they are economically significant, especially in a period of protracted economic and productivity growth. Economic theory is used as a guide to interpret these results. The impact of increases in the minimum wage depends on the structure of the market, but also on the relevance of the level and increase in the minimum wage.

The recent experience of the Portuguese economy provides an interesting setting to study the consequences of large minimum wage increases. Indeed, this is a challenge to naïve results that extrapolate the results from increases of the minimum wage in specific groups of workers to a more general conclusion regarding the overall impact of minimum wage increases. In Portugal, lower-tail wage inequality fell sharply since 2007. We see this as a direct positive impact on the wages of low-paid individuals and an indirect (or spillover) negative effect on the wages of median wages, an effect that deserves attention in future research. However, individuals paid the minimum wage experienced a decrease in employment stability. The reduced probability of employment is a negative outcome, which may result from both falling demand and contained supply. The latter effect can be seen as the interaction of the minimum wage policy with the unemployment insurance system that grants minimum-wage earners an unemployment benefit close to their previous wage. In this context, the potential positive impact of the minimum wage increase on labor supply may be much more limited. The smaller probabilities of employment would translate into a wider income distribution. However, inequality may be reduced by the unemployment insurance system, even if at the cost of lower incentives to work.

These results highlight the need for a comprehensive policy, in which minimum wage increases take into account the evolution of productivity gains. A set of policies that increases the cost of labor and at the same time increases the protection of workers in unemployment is bounded to generate lower employment and higher unemployment.

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