The impact of the minimum wage on low-wage and young workers: Employment and match evidence*

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Abstract

In Portugal, from 2002 to 2006, the real minimum wage was stable, but it increased quite substantially afterwards. In this context, lower-tail wage inequality widen up to 2006 and declined strongly afterwards. Despite the wide variability of the minimum wage, we always find that employment elasticity is negative for workers whose initial wage is between the old and the new minimum wages. This elasticity is similar to the one obtained in the U.S., a country with a low minimum wage, and smaller than the one obtained for France, a country with a high minimum wage. Extending previous literature, we conclude that match stability is more elastic. Typical of a labor demand schedule, the counterpart to these results is that wages increase more in reaction to a higher minimum wage among surviving matches than for total employment. The impact of the minimum wage on young workers is stronger. Overall, for low-wage workers, there is a detrimental effect of minimum wage on employment, but particularly on match stability, with only minor gains in terms of wages.

Keywords: Minimum wage; Employment and match elasticities; Wage inequality; Spillover

JEL Codes: J23; J38

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1 Introduction

The impact of the minimum wage on securing employment does not tell us directly what is its impact on the probability of keeping the current job. The literature has focused on the impact of the minimum wage on employment, and has overlooked the elasticity of the minimum wage on remaining in the same match. The latter result is important to the discussion of the impact on the internal labor market, typical of most firms in developed economies (Lazear and Shaw 2007).

The main novelty of our paper is to address these two issues and evaluate how the increase in the minimum wage affects the ability of firms to manage the incentives typical of internal labor markets. An increase in the minimum wage within a given employment relationship is expected to have a greater impact on the wage of a low-wage earner as the new minimum may be binding. Also, the higher wage may translate into a smaller probability of securing the same job. Additionally, changes in the minimum wage may alter the internal incentives of firms, in terms, for example, of returns to tenure. If firms have to compress the low-end of the wage distribution they may not be able to conveniently reward the investment in firm-specific capital that occurs as tenure accumulates due to the exogenous interference with the firm's human resources management. The minimum wage 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 due to lower wage increases for wages just above the minimum.

As pointed out by Freeman (1996), research consensus for other countries seems to evolve around the following conclusion: the impact on employment is a debate around zero. 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.

In this study we analyze the impact of minimum wage policy on low-wage earners between 2002 and 2010. This is a quite interesting time in Portugal because a period without real minimum wage gains up to 2006 is followed by a period with quite substantial increase in minimum wage. We estimate a set of models to establish the relationship between minimum wage increases and employment and match stability, 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 or in the same match. Our results indicate small impacts on both probabilities, but nonetheless a lower probability of remaining in the same match. The counterpart to these results is that changes in the minimum wage affect more strongly wages in the same match than wages when we allow the worker to change employer. These two effects complement each other in that they are the expected outcome along a labor demand schedule.

With small disemployment effects and limited shares of minimum wage earners, Autor, Manning and Smith (2010) pointed out that the impact of minimum wage policies on lower-tail wage inequality suggests the existence of wage spillover effects. This means that the impact of minimum wage could go beyond the direct effect on minimum wage earners, so that increases in the minimum wage would trigger increases in the wages of workers not covered by the minimum wage – a "ripple" effect, as Neumark, Schweitzer and Wascher (2004) put it. For example, in a general equilibrium framework, firms that replace minimum-wage earners by workers with slightly higher wages, increase the demand for this type of workers, resulting in higher wages (Teulings 2000, 2003).

Our results confirm this general appraisal. Large 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 wage increases at median wages. However, they are also associated with significant decreases in employment. Our results also show that, for the period of quite substantial increases in minimum wage (2007 onwards), the rates of change of wages up to the 75th percentile have a distinct pattern, with low-wage workers receiving the highest pay rises and medium-wage workers receiving the lowest pay raises.

This evidence suggests that, adding to the "ripple" effect, a compression of pay rises for medium-wage earners may also be taking place. Our heuristic approach to measuring spillover effects is complemented by more sophisticated techniques, such as the one suggested by Autor et al. (2010). In contrast with DiNardo, Fortin and Lemieux (1996), whose methodology assumes that the minimum wage has no effect on the shape of the wage distribution to its right, these authors compare an empirical model of the full latent distribution of wages (purging direct and spillover effects from minimum wage increases) with the observed distribution in order to gauge the spillover effects. Preliminary results obtained by applying this method confirm that there are spillover effects in wages. However, in the case of Portugal this spillover does not seem to be relevant for the wage inequality (50/10 ratio) because of the large proportion of minimum-wage earners.

2 Data

In this article we use a longitudinal database matching workers and firms made available by *Instituto de Informática da Segurança Social* (the 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.

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 system (*Caixa Geral de Aposentações*) that was closed to new workers from 2006 onwards.

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. The 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 49.5 per cent of the mean wage and about 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. Developments in the minimum wages have been discretionary, not following a formal rule or indexation. 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 Figure 1, we can see that this was the case in the period from 2002 to 2006.

FIGURE 1; see page 18.

This situation changed from 2007 onwards, a period during which the minimum wage increased markedly in real terms. These recent increases reflected the agreement signed by the government 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 2010.

As shown in Figure 2, up to 2006 the growth of the minimum wage in real terms was quite similar to the median growth rate, 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 mean growth rate. In real terms, since 2007 the growth rate of the minimum wage was higher than the median rate, outpacing the mean in the period from 2008 to 2010. Real wage rates were obtained by deflating the nominal rates of change using consumer prices.

FIGURE 2; see page 18.

The evolution of the share of minimum wage earners (Figure 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. 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).

FIGURE 3; see page 19.

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

FIGURE 4; see page 19.

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 (13.8 per cent for stayers) (Figure 5). After a period of increasing inequality (7.4 per cent for total employees and 3.2 per cent for stayers), the 50/10 ratio decreased by 18.9 per cent between 2006 and 2010 (-16.4 per cent for stayers) (see Cardoso (1998) and, more recently, Centeno and Novo (2009) for a more detailed discussion of the evolution of wage inequality in Portugal). This significant reduction highlights the fact that, in this period, wages in the 10th percentile (where the minimum wage was binding) grew more markedly than in the 50th percentile (i.e. the median).

FIGURE 5; see page 20.

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? Figure 6 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 real change of the minimum wage in the period analyzed).[1] 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.

FIGURE 6; see page 20.

All the results presented in this section remain qualitatively unchanged if we consider only stayers, i.e. employees who stayed for at least two consecutive years in the same firm.

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 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 increases. 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, Kramarz, Margolis and Philippon (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: (i) employed or (ii) in the same match.

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 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

[1] 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.

wages in the first quartile, but not in the first two groups; (iv)-(vi) the 2nd, 3rd, and 4th quartiles of the wage distribution.

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.

4.1 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:

$$y_i = \sum_{k=1}^{6} \beta_k D_{k,i} + X\lambda + \varepsilon_i, \tag{1}$$

where y_i assumes value 1 if individual remains employed from year $t-1$ to t and 0 if (s)he is no longer employed; $D_{k,i}$ 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 and services); firm size dummies (small: 1-25 workers; medium: 26-100 workers; large: more than 100 workers); and tenure dummies (up to 6 months; 7-12 months; 13-36 months; 37-72 months; more than 72 months). And ε_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.[2]

[2]See Angrist and Pischke (2009) for a full discussion of linear probability models vs. probit models.

TABLE 1; see page 22.

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 percentage points 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 percent 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, Machado and Novo 2008).

The following group, composed of those who will have to earn at least the new minimum wage, was 6.5 percentage points 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 percentage point more likely to remain employed than the previous group but almost 3 percentage points 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 were 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.

4.2 Employment: Panel data

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:

$$y_{ijt} = \sum_{k=1}^{6} \left(\beta_k + \gamma_k \Delta W_t^{min}\right) D_{k,ijt} + X\lambda + \varepsilon_{ijt}, \tag{2}$$

where all variables are defined as before and ΔW_t^{min} represents the variation in the real minimum wage in year t. The interaction term between the level of wage $D_{k,ijt}$ and the minimum wage variation in year ΔW_t^{min} captures the impact on the probability of remaining employed in year t 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 into a factor due to the variation in the minimum wage and a wage-group specific factor. The results of the estimation are presented in Table 2, column (1). First, notice that the differences in the probability of remaining employed of each group relatively to the top quartile wage earners are remarkably similar to those reported for the cross-section regressions (coefficients at the top of the Table).[3] Given that these group-specific probabilities are not much affected, this implies that the each percentage point of increase in the minimum wage has a small contribution; the coefficients on the interaction terms give us the marginal effects on the probability of employment.

TABLE 2; see page 23.

For the minimum wage earners and the contiguous group the probability of remaining employed decreases by about 0.5 percentage points for each percentage point of increase in the minimum wage. For instance, in 2009, where the real minimum wage increased 6.6 per cent (4.6 percentage points above the average), the probability of remaining employed for a minimum wage earner decrease by (an additional) 2.6 percentage points. Overall, in 2009, minimum-wage earners had a probability of remaining employed 9.8 percentage points (7.2 + 2.6) lower than a top quartile worker. The cross-section estimation indicated a difference of 8.6 percentage points. The other three wage groups, despite not being directly affected by

[3]The values reported assume a real minimum wage increase of about 2 percent, roughly the 2003-2010 average.

the new minimum wage, still have slightly lower probabilities, around 0.2 percentage points 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 employment elasticity to changes in the minimum wage of -0.4 for the US, which is very close to our estimate of -0.6. The elasticities estimated by Abowd et al. (2000) are slightly larger for the US, but clearly larger for France. Machin, Manning and Rahman (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, which 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 -0.2 to -0.4 are in line with 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 (in percentage). 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,

Figure 7 plots these marginal effects and, apart from a rescaling, the shape of the curve is generally equivalent to Figure 6. This implies that 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 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.

FIGURE 7; see page 21.

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 percentage point. 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.

4.3 Employment 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 smaller 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.[4] 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 percentage points. 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, these results imply a larger (in absolute value) elasticity

[4]The wage quartiles are re-defined for each of the sub-samples used.

among young minimum wage earners (-1.3) and slightly lower elasticity in the contiguous group (-4.0).

TABLE 3; see page 24.

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 reverse with manufacturing, in the services sector the larger magnitude is only observed for current minimum-wage earners.

4.4 Match: Panel data

Hitherto, we have considered how changes in the minimum wage affect the probability of remaining employed. This may occur because workers are able to keep their jobs or because they find a new one. Now, we focus on how the stability of the employer-employee match is affected by changes in the minimum wage. The exogenous shock is more likely to be binding for matches than employment. In matches, there is a set of constraints already in place that are hard to circumvent than in newly-created employment. In other words, fixed costs may hinder more matches than employment.

To explore this possibility, we use the same set of regression analysis performed for employment, but considering instead that the dependent variable equals one if the match worker-firm is preserved from one year to the next. Table 4 reports the panel data results.

TABLE 4; see page 25.

Qualitatively, the results are identical to the employment ones. However, quantitatively the minimum wage is clearly more binding in determining the success of matches than for employment. Column (1) of Table 4 typically presents smaller coefficients (more negative) than the equivalent ones for employment (see Table 2).

This comparison allows us to draw two main conclusions. First, the fact that the low-wage-specific coefficients are smaller in the matching regression indicates that, although low-wage workers can still be employed next year, it is more likely that such employment is in another firm. This result confirms the evidence that worker turnover is larger among low-wage workers and may also suggest that there are negative employment spillovers. Firms may let go of such workers, who are typically low-skill, to rehire new workers at the new minimum wage next year. Although some of the workers could be paid only next year's minimum wage, the fact that they already earned more than the current minimum wage may lead them to exit the firm if offered the new minimum wage.

Second, the marginal impact of changes in the minimum wage is clearly strong among minimum-wage earners; they are more likely to terminate their current labor market relationship, about 0.2 (0.74-0.56) percentage points for each percentage point increase in the minimum wage.

Interestingly, the results for the impact of changes in the minimum wage on wages are the mirror imagine of the impact on labor demand. Wages are much more reactive to the minimum wage among matches than among employment (compare columns (2) of Tables 2 and 4). For instance, in matches the minimum-wage-to-wage elasticity is 0.63 for minimum-wage earners, while for overall employment the elasticity is 0.52. It seems that although the minimum wage affects less the probability of employment than of preserving the same match, it does so at the cost of relatively lower wages.

These observations are only stronger among young workers (Table 5, columns (1)-(3)). Both the group-specific coefficients and the marginal impact of the minimum wage lead to a considerable lower probability of remaining in the same match. In terms of industry-specific results, columns (4)-(10), these general observations are valid for manufacturing and construction; workers and firms are clearly more prone to terminate their matches.

TABLE 5; see page 26.

5 Conclusion

This article discusses the impact of increases in the minimum wage on four key labor market outcomes: employment, matches, wages and inequality. The recent experience of the Portuguese economy provides an interesting setting to study the consequences of large minimum wage increases. Indeed, comparing to studies that focus on the results from increases of the minimum wage in specific groups of workers, our work provides further insight into 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 median wages. However, individuals paid the minimum wage experienced a decrease in employment stability. We contribute innovatively to the literature by showing that the elasticity of labor demand is larger for specific job matches than for employment as a whole. This may not come as a surprise, but it is key to understand the detrimental effect of the minimum wage at the firm level. As expected along a labor demand schedule, the higher decrease on match demand translates into a higher wage elasticity among surviving matches than that estimated for the overall employment.

The reduced probability of employment is a negative outcome, which may result from both falling demand and contained supply. Future research on the latter effect will complement in a comprehensive way the analysis of the minimum wage policy. In the Portuguese context, it is plausible that contained labor supply results from the interaction of the minimum wage policy with the unemployment insurance system, which grants minimum-wage earners an unemployment benefit close to their previous wage. If that is the case, then such results would 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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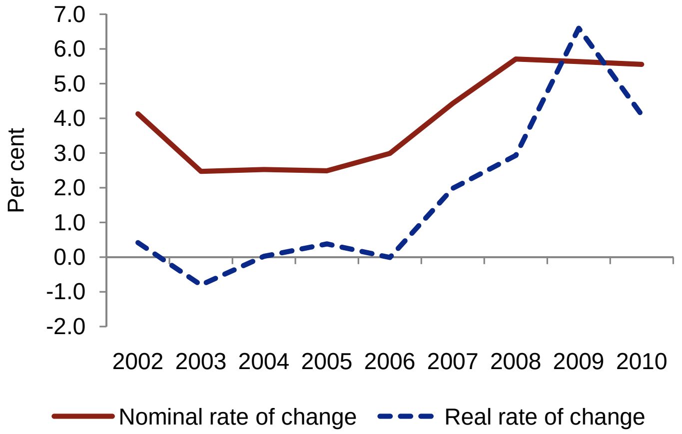

Figure 1: Minimum wage nominal and real growth rates

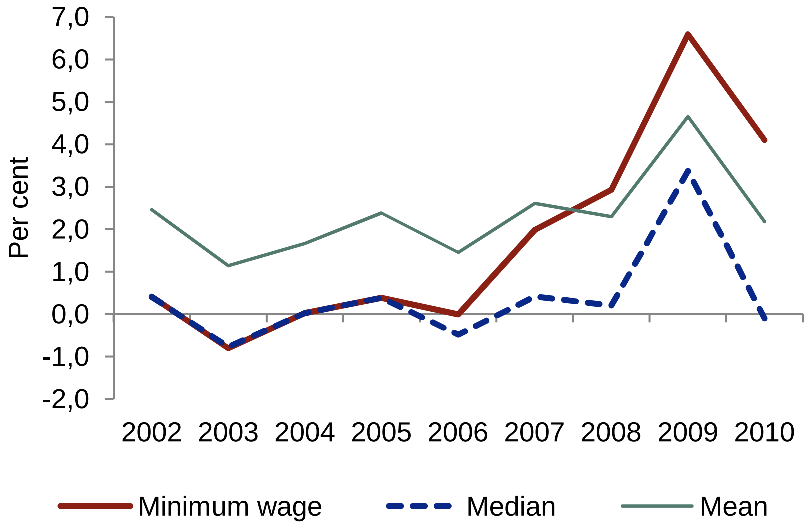

Figure 2: Minimum wage, median and mean real wage growth rates

Figure 3: Share of minimum-wage earners

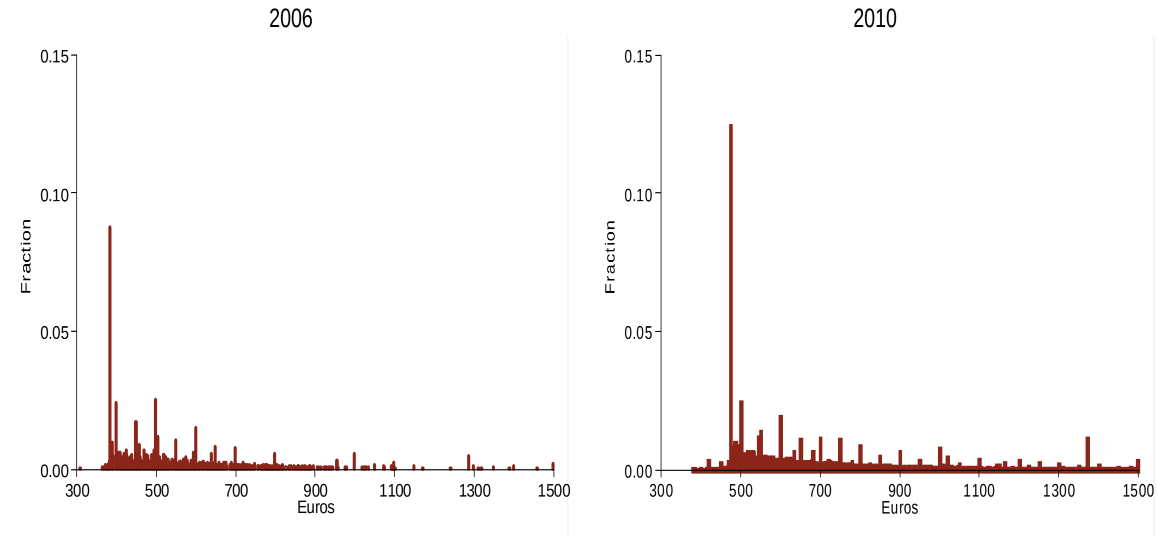

Figure 4: Wage distributions in 2006 and 2010

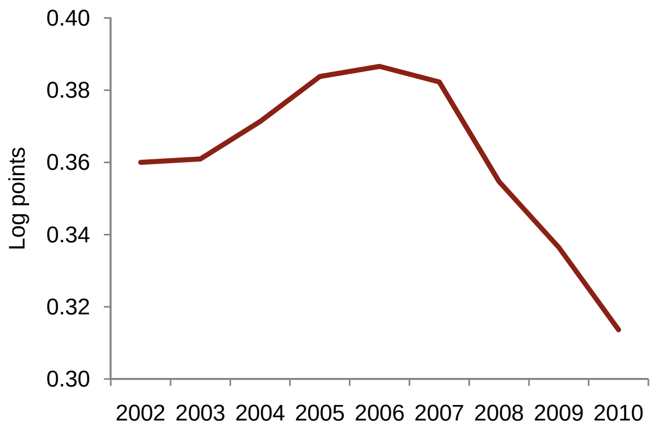

Figure 5: Wage inequality: 50/10 ratio

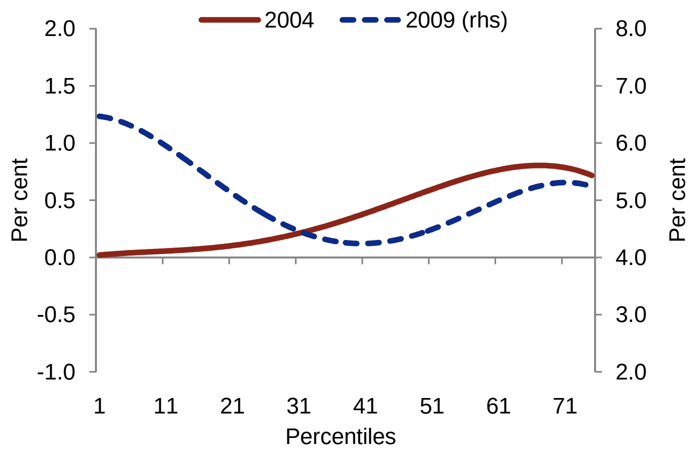

Figure 6: Wave effect: Real wage growth rate up to the 75th percentile of previous year wage distribution

Figure 7: Wage regressions: Marginal impact of a percentage point increase in the real minimum wage on wage growth by wage-level.

Table 1: Employment status: Year-by-year linear probability and probit models, 2003-2010

	Linear probability model							
$I(Employment_t)$	2003	2004	2005	2006	2007	2008	2009	2010
Wage level indicator:								
$W_{t-1} = W_{t-1}^{min}$	-8.32	-7.81	-9.00	-8.40	-7.96	-8.98	-8.61	-7.24
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$W_{t-1} < W_t^{min}$	-6.53	-7.08	-7.72	-7.56	-7.47	-7.71	-7.78	-6.72
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$W_t^{min} \leq W_{t-1} \leq Q_{.25}(W_{t-1})$	-5.46	-5.33	-6.16	-5.58	-5.87	-5.97	-5.53	-4.85
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$W_{t-1} \in Q_{.5}(W_{t-1})$	-4.10	-3.55	-3.84	-3.32	-3.82	-4.45	-4.65	-3.51
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$W_{t-1} \in Q_{.75}(W_{t-1})$	-2.43	-1.95	-2.18	-1.68	-2.38	-2.45	-2.55	-1.90
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Probit model							
$I(Employment_t)$	2003	2004	2005	2006	2007	2008	2009	2010
Wage level indicator:								
$W_{t-1} = W_{t-1}^{min}$	-8.92	-8.31	-9.70	-8.90	-8.81	-9.99	-9.48	-7.77
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$W_{t-1} < W_t^{min}$	-7.30	-7.90	-8.72	-8.61	-8.40	-9.08	-9.11	-7.77
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$W_t^{min} \leq W_{t-1} \leq Q_{.25}(W_{t-1})$	-6.20	-6.06	-7.08	-6.28	-6.85	-7.30	-6.73	-5.71
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$W_{t-1} \in Q_{.5}(W_{t-1})$	-4.74	-4.23	-4.63	-3.99	-4.62	-5.54	-5.66	-4.32
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$W_{t-1} \in Q_{.75}(W_{t-1})$	-2.92	-2.45	-2.78	-2.23	-3.08	-3.37	-3.38	-2.51
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
No. 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
Other control variables	– Yes –							

Notes: p-values in parentheses. $Q_{.75}(W_{t-1})$ stands for the 3rd quartile of year's $t-1$ wage distribution; similarly for other quartiles. 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 relatively to those with wages in the top quartile. For instance, an individual earning the minimum wage in 2002 will be 8.3 percentage points less likely to remain employed in 2003 than an individual with a wage in the top quartile, but otherwise equal (age, gender, industry, etc).

Table 2: Employment status and wages: Firm fixed effects linear probability

	Employment (1)	Wages (2)	Elasticity (3)=(1)/(2)
Wage level indicator:			
$W_{t-1} = W_{t-1}^{min}$	-7.21	15.80	
	(0.000)	(0.000)	
$W_{t-1} < W_t^{min}$	-5.88	14.69	
	(0.000)	(0.000)	
$W_t^{min} \leq W_{t-1} \leq Q_{.25}(W_{t-1})$	-4.42	12.05	
	(0.000)	(0.000)	
$W_{t-1} \in Q_{.5}(W_{t-1})$	-2.56	9.22	
	(0.000)	(0.000)	
$W_{t-1} \in Q_{.75}(W_{t-1})$	-1.11	5.35	
	(0.000)	(0.000)	
$\Delta W_t^{min,real} \times$ Wage level indicator:			
$W_{t-1} = W_{t-1}^{min}$	-0.56	0.52	-1.08
	(0.000)	(0.000)	
$W_{t-1} < W_t^{min}$	-0.45	0.09	-5.26
	(0.000)	(0.000)	
$W_t^{min} \leq W_{t-1} \leq Q_{.25}(W_{t-1})$	-0.26	-0.16	1.64
	(0.000)	(0.000)	
$W_{t-1} \in Q_{.5}(W_{t-1})$	-0.31	-0.06	5.23
	(0.000)	(0.000)	
$W_{t-1} \in Q_{.75}(W_{t-1})$	-0.17	-0.22	0.76
	(0.000)	(0.000)	
No. of observations	17,377,525	14,721,929	
Other control variable	– Yes –		

Notes: p-values in parentheses. $Q_{.75}(W_{t-1})$ stands for the 3rd quartile of year's $t-1$ wage distribution; similarly for other quartiles. See text for the full set of variables included. Conditional on a 2% increase in the real minimum wage (roughly, the average in the period), 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, an individual earning the minimum wage in a particular year will be 7.2 percentage points less likely to remain employed in the following year than an individual with a wage in the top quartile, but otherwise equal (age, gender, industry, etc). In addition, for each percentage point above 2% in the growth rate of the minimum wage, employment probability decreases by 0.56 percentage points.

Table 3: Employment status and wages: Firm fixed effects linear probability by age level and industry

	Young workers (< 25 years)			Manufacturing			Construction			Services		
	Employ	Wages	ε_W^E	Employ	Wages	ε_W^E	Employ	Wages	ε_W^E	Employ	Wages	ε_W^E
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Wage level indicator:												
$W_{t-1} = W_{t-1}^{min}$	-6.72			-5.70			-6.48			-8.03		
	(0.000)			(0.000)			(0.000)			(0.000)		
$W_{t-1} < W_t^{min}$	-7.36			-5.43			-6.82			-5.85		
	(0.000)			(0.000)			(0.000)			(0.000)		
$W_t^{min} \leq W_{t-1} \leq Q_{.25}(W_{t-1})$	-10.35			-4.32			-5.91			-4.09		
	(0.000)			(0.000)			(0.000)			(0.000)		
$W_{t-1} \in Q_{.5}(W_{t-1})$	-5.28			-3.26			-3.90			-1.85		
	(0.000)			(0.000)			(0.000)			(0.000)		
$W_{t-1} \in Q_{.75}(W_{t-1})$	-2.41			-1.71			-2.42			-0.56		
	(0.000)			(0.000)			(0.000)			(0.000)		
$\Delta W_t^{min,real} \times$ Wage level indicator:												
$W_{t-1} = W_{t-1}^{min}$	-0.74	0.55	-1.35	-0.71	0.70	-1.02	-0.61	0.64	-0.95	-0.46	0.46	-1.01
	(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)	
$W_{t-1} < W_t^{min}$	-0.38	0.09	-4.04	-0.45	0.37	-1.20	-0.51	0.35	-1.43	-0.27	-0.09	3.04
	(0.000)	(0.001)		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)	
$W_t^{min} \leq W_{t-1} \leq Q_{.25}(W_{t-1})$	-2.25	-0.36	-	-0.54	0.23	-2.35	-0.27	0.15	-1.83	-0.15	-0.32	0.47
	(0.000)	(0.318)		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)	
$W_{t-1} \in Q_{.5}(W_{t-1})$	-0.27	-0.08	3.47	-0.28	0.12	-2.33	-0.45	0.30	-1.50	-0.26	-0.16	1.64
	(0.000)	(0.001)		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)	
$W_{t-1} \in Q_{.75}(W_{t-1})$	-0.24	-0.01	-	-0.12	-0.06	1.93	-0.33	-0.04	-	-0.14	-0.24	0.61
	(0.000)	(0.630)		(0.000)	(0.000)		(0.000)	(0.043)		(0.000)	(0.000)	
No. 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	
Other control variables	– Yes –											

Notes: ε_W^E stands for the employment-to-wage elascity. See notes to Table 2.

Table 4: Match status and wages: Firm fixed effects linear probability

	Match (1)	Wages (2)	Elasticity (3)=(1)/(2)
Wage level indicator:			
$W_{t-1} = W_{t-1}^{min}$	-7.22	12.53	
	(0.000)	(0.000)	
$W_{t-1} < W_t^{min}$	-6.26	11.43	
	(0.000)	(0.000)	
$W_t^{min} \leq W_{t-1} \leq Q_{.25}(W_{t-1})$	-4.65	9.42	
	(0.000)	(0.000)	
$W_{t-1} \in Q_{.5}(W_{t-1})$	-2.52	7.50	
	(0.000)	(0.000)	
$W_{t-1} \in Q_{.75}(W_{t-1})$	-0.79	4.58	
	(0.000)	(0.000)	
$\Delta W_t^{min,real} \times$ Wage level indicator:			
$W_{t-1} = W_{t-1}^{min}$	-0.74	0.63	-1.18
	(0.000)	(0.000)	
$W_{t-1} < W_t^{min}$	-0.47	0.24	-1.98
	(0.000)	(0.000)	
$W_t^{min} \leq W_{t-1} \leq Q_{.25}(W_{t-1})$	-0.27	0.00	–
	(0.000)	(0.891)	
$W_{t-1} \in Q_{.5}(W_{t-1})$	-0.30	0.00	–
	(0.000)	(0.675)	
$W_{t-1} \in Q_{.75}(W_{t-1})$	-0.09	-0.17	0.54
	(0.000)	(0.000)	
No. of observations	17,733,720	13,239,530	
Other control variables	– Yes –		

Notes: p-values in parentheses. $Q_{.75}(W_{t-1})$ stands for the 3rd quartile of year's $t-1$ wage distribution; similarly for other quartiles. See text for the full set of variables included. Conditional on a 2% 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, an individual earning the minimum wage in a particular year will be 7.2 percentage points less likely to remain in the same match in the following year than an individual with a wage in the top quartile, but otherwise equal (age, gender, industry, etc). In addition, for each percentage point above 2% in the growth rate of the minimum wage, the probability of staying in the same match further decreases by 0.74 percentage points.

Table 5: Match status and wages: Firm fixed effects linear probability by age level and industry

	Young workers (< 25 years)			Manufacturing			Construction			Services		
	Match	Wages	ε_M^E	Match	Wages	ε_M^E	Match	Wages	ε_M^E	Match	Wages	ε_M^E
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Wage level indicator:												
$W_{t-1} = W_{t-1}^{min}$	-7.65			-6.88			-8.00			-7.35		
	(0.000)			(0.000)			(0.000)			(0.000)		
$W_{t-1} < W_t^{min}$	-8.78			-6.75			-9.31			-5.42		
	(0.000)			(0.000)			(0.000)			(0.000)		
$W_t^{min} \leq W_{t-1} \leq Q_{.25}(W_{t-1})$	-13.83			-5.50			-8.19			-3.57		
	(0.000)			(0.000)			(0.000)			(0.000)		
$W_{t-1} \in Q_{.5}(W_{t-1})$	-6.24			-4.14			-5.88			-1.22		
	(0.000)			(0.000)			(0.000)			(0.000)		
$W_{t-1} \in Q_{.75}(W_{t-1})$	-2.83			-2.00			-3.42			0.24		
	(0.000)			(0.000)			(0.000)			(0.000)		
$\Delta W_t^{min,real} \times$ Wage level indicator:												
$W_{t-1} = W_{t-1}^{min}$	-1.10	0.69	-1.60	-1.30	0.76	-1.72	-0.98	0.72	-1.36	-0.45	0.58	-0.78
	(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)	
$W_{t-1} < W_t^{min}$	-0.32	0.32	-1.02	-0.80	0.43	-1.88	-0.74	0.46	-1.62	-0.09	0.12	-0.72
	(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)		(0.002)	(0.000)	
$W_t^{min} \leq W_{t-1} \leq Q_{.25}(W_{t-1})$	-3.71	-0.36	-	-0.96	0.27	-3.54	-0.58	0.28	-2.04	0.02	-0.14	-
	(0.000)	(0.276)		(0.000)	(0.000)		(0.000)	(0.000)		(0.417)	(0.000)	
$W_{t-1} \in Q_{.5}(W_{t-1})$	-0.26	0.12	-2.22	-0.44	0.13	-3.27	-0.90	0.26	-3.40	-0.11	-0.07	1.59
	(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)	
$W_{t-1} \in Q_{.75}(W_{t-1})$	-0.15	0.13	-1.17	-0.21	-0.06	3.81	-0.50	0.02	-	0.00	-0.19	-
	(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.322)		(0.848)	(0.000)	
No. of observations	2,227,341	1,411,280		4,501,769	3,636,771		2,170,375	1,460,903		11,061,576	8,141,856	
Other control variables						– Yes –						

Notes: ε_M^E stands for the match-to-wage elascity. See notes to Table 4.