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No. 2844

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LABOUR ECONOMICS

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ISSN 0265-8003

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Discussion Paper No. 2844
June 2001

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CEPR Discussion Paper No. 2844

June 2001

ABSTRACT

Disentangling the Minimum Wage Puzzle: An Analysis of Job Accessions and Separations from a Longitudinal Matched Employer–Employee Data Set*

Changes in legislation in mid-1980s Portugal provide remarkable conditions for economic analysis, as the minimum wage increased very sharply for a very specific group of workers. Relying on a matched employer–employee panel dataset, we model gross job flows – accessions and separations – in continuing firms, as well as in new firms and those going out of business, using a Poisson regression model applied to proportions. Worker behaviour is also modelled. Employment trends for teenagers, the affected group, are contrasted against older workers, before and after the rise in the youth minimum wage.

The major effect on teenagers of a rising minimum wage is the reduction of separations from the employer, which compensates for the reduction of accessions (to new and continuing firms) and the rising dismissals from firms closing down. Indications that job attachment for low-wage youngsters rises following an increase in their minimum wage suggest the relevance of supply-side factors overcoming demand forces. In this sense, our results can reconcile some of the previous evidence that has been presented in the empirical literature when analysing the overall impact of the minimum wage on youth employment without looking at its sources.

JEL Classification: D21, J38
Keywords: employment and minimum wage

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* Data for this study were provided by the Department of Statistics, Ministry of Employment and Solidarity. Part of this work was carried out while the second author was visiting the Economics Program, RSSS, Australian National University, whose financial support and stimulating hospitality are gratefully acknowledged. The support while visiting the Bank of Portugal is as well acknowledged. The usual disclaimer applies. We are indebted to Lucena Vieira for her excellent research assistance.

Submitted 29 May 2001

NON-TECHNICAL SUMMARY

The debate over the impact of a rise in the minimum wage on employment remains unsettled. A competitive view of the labour market states that unskilled workers, with low marginal productivity, will be priced out of the labour market and become unemployed following a rise in the minimum wage. That view, however, has been challenged by empirical evidence and by theoretical reasoning.

When analysing the impact of the minimum wage, labour economists have invariably been constrained by two factors. On one hand, the impact of the minimum wage is hard to isolate from that of other economic forces. Ideally, changes in the minimum wage would affect a strictly specific group of workers, otherwise subject to similar conditions as other workers – a situation that very rarely occurs in economics. Even when changes in the minimum wage are large, unpredictable and affect just a particular group of workers, the study to be undertaken still depends crucially on the data available, in particular its quality and detail. On both of these fronts, our study relies on unusually good conditions, enabling the development of the analysis into directions left unexplored by previous studies.

In the mid-1980s the minimum wage increased very sharply in Portugal for a very specific group of workers, those aged 16–18. Relying on a longitudinal data set matching workers and their employers, we analyse gross job flows – accessions and separations – in continuing firms, as well as job accessions into new firms and dismissals from firms going out of business. Worker behaviour is also modelled. Employment trends for teenagers, the affected group, are contrasted against older workers, before and after the rise in the youth minimum wage. The study aims to answer the following questions: Do employers dismiss mainly youngsters, following a rise in the youth minimum wage? Or do youngsters become underrepresented among the newly hired workforce? Do firms that are about to be set up, which are free to choose their labour force from the available pool of workers, hire relatively fewer youngsters than comparable firms did before the minimum wage was raised? Does a rising minimum wage place unbearable constraints on the firms, contributing to firm closure? Looking at the individual level, are the workers directly affected by a rise in the minimum wage less likely to keep their jobs?

Our results indicate that, following an increase in teenage minimum wage, teenagers make up a smaller share of job accessions, and they make up a larger share of the workforce in firms going out of business. These effects, however, are more than offset by a reduction in separations from the employer. Teenagers who are eligible for a wage increase following the rising minimum wage are more likely to stay with their employers and are more likely to stay employed (whether or not in the same firm) than other workers. Rising

minimum wages therefore increase job attachment for low-wage youngsters, reducing the high job turnover characteristic of this group of workers.

The overall impact of rising minimum wages on employment depends on which of the effects predominates in a particular country and period. Clarifying the sources of employment change following an increase in the minimum wage can therefore help reconcile evidence previously presented as contradictory in the empirical literature.

1. Introduction

When analysing the impact of the minimum wage, labour economists have invariably been constrained by two types of factors. On one hand, the impact of the minimum wage is hard to isolate from that of other economic forces. Ideally, the conditions for quasi-experiments should be met, in which case changes in the minimum wage would affect strictly a specific group of workers (treatment group), subject to conditions otherwise similar to other workers (control group), a situation that very rarely occurs in economics. The studies by Card and Krueger (1994, 1995) and Katz and Krueger (1992) have become famous examples of that methodology. However, even when changes in the minimum wage are large, unpredictable and affect just a particular group of workers, the study to be undertaken still depends crucially on the data available, in particular its quality and detail.

On both of these fronts, our study relies on unusually good conditions, enabling the development of the analysis into directions left unexplored by previous studies.

In 1987, the minimum wage for workers aged 17 increased in Portugal by 50% strictly due to changes in the legislation, as it was raised from half to 75% of the full minimum wage. Also in 1987, the minimum wage for workers aged 18 or 19 was raised from 75% to the full minimum wage rate, therefore increasing by 33% due to legal changes *ceteris paribus*. Instead of defining a priori youngsters as a proxy for the group of workers more severely hit by a rising general minimum wage, this study is motivated by a rise in the minimum wage specifically for youngsters, and we are able to directly evaluate the impact on their employment against different control groups.

Longitudinal data matching workers and firms and covering the population of wage-earners in the manufacturing and services private sector in Portugal will be used.

Relying on this large panel data set we can, first of all, quantify and model gross job flows at the firm level. Several studies of the impact of the minimum wage have quantified and explained net job flows at the firm level (Card and Krueger 1994, Katz and Krueger 1992, Pereira 1999). Given that we are able to follow, not

just firms, but workers as well, our study adds to the previous literature by quantifying and modelling employer behaviour regarding both accessions and separations. The analysis is not restricted to firms remaining in business, focusing also on new firms and those closing down. We can therefore disentangle the minimum wage puzzle, by identifying exactly where and how the minimum wage bites: Do employers dismiss mainly youngsters, following a rise in the youth minimum wage? Or is it the case that youngsters become under-represented among the newly hired workers? Do firms that are about to be set up, which are free to choose their labour force from the available pool of workers, hire relatively less youngsters than comparable firms before the minimum wage had been raised? Does a rising minimum wage place unbearable constraints on the firms, contributing to firm closure? Identification of the precise source for changing employment levels can reconcile some of the evidence that has previously been presented in the literature as contradictory.

Secondly, we will rely on micro data on workers to follow a line of analysis previously used by Abowd *et al* (1999), Zavodny (2000) and Currie and Fallick (1996). At the individual level, we can provide a direct answer to the question: are the workers directly affected by a rise in the minimum wage less likely to keep their jobs?

Section 2 provides a detailed description of the institutional framework in Portugal and the changes that took place in the minimum wage. Section 3 overviews changes in the wage distribution and in employment. Section 4.1 models job accessions and job separations in continuing firms, whereas section 4.2 performs a similar exercise for new firms and for firms closing down. Worker behaviour is the subject of section 5 and in the last part of the paper concluding comments are presented.

2. Institutional framework

The national minimum wage was set in 1974, covering at the time workers aged 20 or older and excluding agriculture and domestic work. Ever since, it has been

annually updated by the parliament, under government proposal[1]. Decisions on the level of the minimum wage are taken on a discretionary basis, usually taking into account past and predicted inflation and after consulting the social partners. It is defined as a monthly wage.

Since it was first enacted, the minimum wage has undergone several changes, which can be summarised as follows[2]:

– Industry coverage: in 1977, it was extended to cover workers in agriculture, though their wage rate was lower; the following year, domestic work was covered as well, at a rate lower than agriculture. In 1991, the agricultural and the general minimum wages were harmonised and in 1998 the same happened to domestic work.

  Raising the minimum wage for agriculture and for domestic work to the general level took place gradually and the full harmonisation was therefore highly predictable. As such, these changes in the legislation do not provide the conditions for a quasi-experiment to study the impact of changes in the minimum wage. Also, the coverage of agriculture in the data set used is low.

– Firm size coverage: small firms outside agriculture with fewer than 5 workers were allowed to pay the lower minimum set for agriculture, a possibility introduced in 1978 and revoked in 1991. Before 1978, several regimes had existed: in 1974, firms with fewer than 5 workers were exempted; in 1975 and 1976, firms with fewer than 10 workers were declared exempted as well; in 1977 firms with fewer than 10 workers outside agriculture were allowed to pay the minimum set for agriculture, if they proved to be on difficult financial situation.

  On request, firms claiming that the application of the new minimum wage would make them undergo an unbearable rise in labour costs, could as well be allowed to pay the minimum wage set for agriculture. This possibility was introduced in 1978. In 1987, only firms with fewer than 50 workers were

[1] The only exceptions were 1982, when it was not updated, and 1989, when it was updated twice.

[2] Throughout the period, minimum wage reductions applied to handicapped workers.

eligible for this reduction, and the firm size benchmark was lowered to 30 workers in 1988, 20 workers in 1989 and it was revoked in 1990.

Since the minimum wage for agriculture and the general one had been gradually harmonised, the abolition of these exemptions did not lead to a remarkable rise in the applicable minimum wage. On the other hand, the data set does not allow identification of the firms that were requesting and using the latter minimum wage reduction, and it is thus not feasible to study the impact of these changes.

– Age coverage: the ages subject to exemption, as well as the percentage of exemption, changed several times, and a clearer description can be provided by a table. The major changes are highlighted in bold.

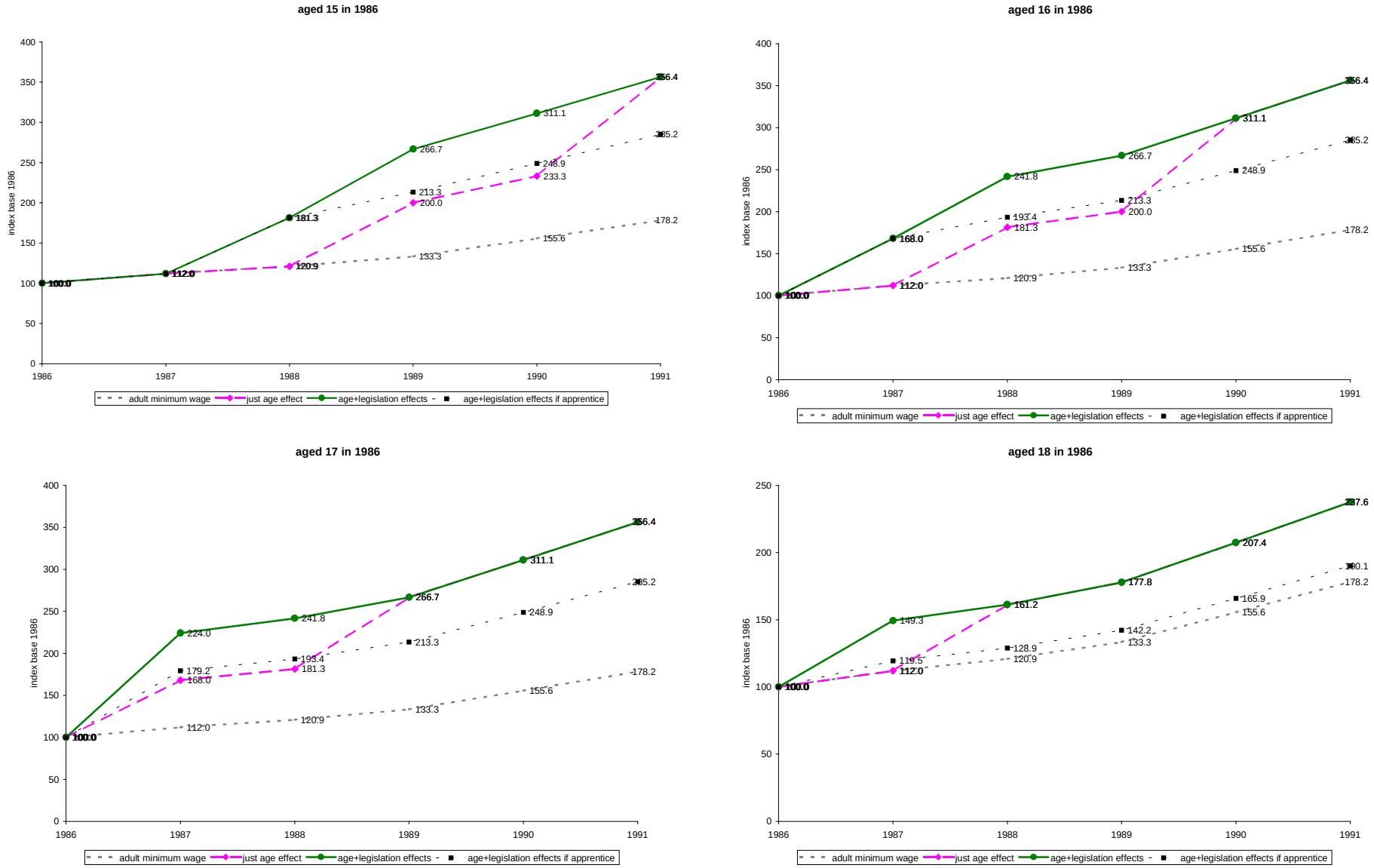
Table 1 – Share of the general minimum wage enforced, according to the age of the worker

year ↓ age →	15	16	17	18	19	20-25
1979 to 1986	50%	50%	50%	75%	75%	100%
1987	50%	50%	**75%**	**100%** (80% if apprentice)	**100%** (80% if apprentice)	100% (80% if apprentice)
1988	**75%**	**75%**	75%	100% (80% if apprentice)	100% (80% if apprentice)	100% (80% if apprentice)

Source: Portugal, *Diário da República*, several issues.

Figure 1 provides a longitudinal perspective, clarifying the changes in the exemptions to the minimum wage applied to a worker in Portugal, as he/she grows older.

Figure 1 – Growth in nominal minimum wage for different age categories, 1986-91



Three changes in the legislation have yielded remarkable wage increases for the ages involved:

– first of all, in 1987 the minimum wage for workers aged 17 increased by 50% due to changes in the legislation *ceteris paribu*s, as it was raised from half to 75% of the full minimum wage;

– secondly, also in 1987, the minimum wage for workers aged 18 or 19 was raised from 75% of the minimum wage to the full minimum, therefore increasing by 33% due to legal changes *ceteris paribus*;

– the third change took place the following year, in 1988, as the minimum wage for workers aged 16 or less was raised from 50% to 75% of the full minimum, thus increasing by 50% due to changes in the legal setting *ceteris paribus*.

Exceptions could however apply to the second change described, if the worker was an apprentice, in which case he would be entitled to 80% of the general minimum wage, instead of the full rate. This exemption could undermine the impact of the rise in the minimum wage that we intend to study, if employers decided to declare the worker as an apprentice to get away without paying him the full minimum wage.

Our study concentrates on the changes that took place in 1987. These changes in the legal framework of the minimum wage in Portugal define the setting for a quasi-experiment in economics, as first argued by Pereira, who used in her study the second change described (for more details, see Pereira (1999)).

3. Overview: aggregate data suggest that youth employment *increased* following a sharp rise in the youth minimum wage

Preliminary evidence on the impact of the rise in the minimum wage, based on aggregate figures, suggests that traditional economic theory is challenged. The evidence is instead consistent with the literature indicating that a rise in the minimum wage does not inexorably lead to declining employment.

Note first of all the impact of the legal changes on the average wage of the different age groups, relying on three cross-sections of data.

Table 2 – Growth in the average wage of full-time wage earners, by age group, 1986-1989 (*)

Age	1987	1988	1989
16	1.16	**1.21**	1.17
17	**1.21**	1.14	1.15
18	**1.21**	1.12	1.13
19	**1.18**	1.12	1.13
20	1.15	1.11	1.13
21	1.14	1.12	1.12
22	1.14	1.12	1.13
23	1.14	1.12	1.14
24	1.14	1.12	1.14
25-29	1.14	1.10	1.13
30-34	1.15	1.10	1.15
35-39	1.14	1.09	1.13
40-65	1.16	1.11	1.14
>=66	1.16	1.12	1.13

Source: Computations based on Portugal, MTS (1986-1989).

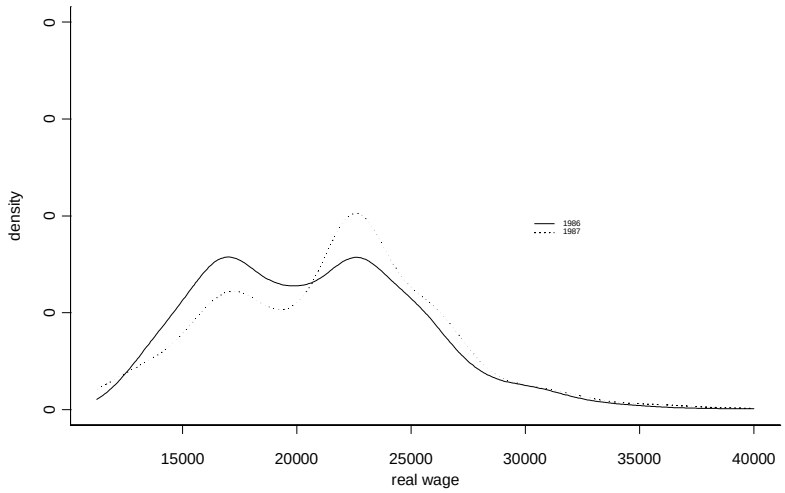
Note: (*) Computed as $\overline{w}_{a,\,t} \big/ \overline{w}_{a,\,t-1}$, where $\overline{w}_a$ stands for the average wage of the age group *a*, and the subscript *t* denotes time.

Wages increased most sharply precisely for the groups of workers affected by the rise in the minimum wage (see highlights in bold). Between 1986 and 1987, the average wage for workers aged 17, 18 or 19 increased the most, while all the other age categories had a much lower and very homogeneous wage growth. The rise in the legal minimum wage thus seems to have had a relevant impact on the wages of the eligible workers, indicating that the possibility to declare a worker as an apprentice was not extensively used by employers[3]. The same pattern holds for the year afterwards, as the groups of workers affected by changes in the minimum wage — those aged 16 or less — saw their average wage rise the most.

Visual inspection of the wage distribution stresses the relevance of the changes that took place.

[3] Note also that the share of apprentices in the age categories directly affected by the change in the legislation did not increase during this period (see appendix).

Wage distribution, teenagers, 1986 versus 1987



In 1986, the wage distribution for teenagers aged 17 to 19 presented a sharp peak at 75% of the national minimum wage. That was precisely the subminimum wage legally allowed for workers aged 18 or 19. The distribution presented a less pronounced peak at the full minimum wage. By 1987, the subminimum wage peak had almost vanished, and the share of teens at the current minimum wage had increased sharply. The kernel plot therefore indicates that compliance to the new minimum wage regulation was widespread, as the rise in the applicable minimum wage did shift subminimum teenager wages to the new minimum wage level.

The impact on employment resulting from these sharp wage changes does not exhibit the pattern predicted by competitive theory.

Table 3 – Growth in number of full-time wage-earners by age groups, 1986-1989 (*)

age	1987	1988	1989
16	1.060	**1.148**	1.092
17	**1.052**	1.094	1.119
18	**1.043**	1.090	1.106
19	**1.061**	1.066	1.108
20	*1.086*	1.042	1.108
21	*1.082*	1.051	1.088
22	*1.109*	1.054	1.099
23	1.063	1.083	1.095
24	1.055	1.041	1.136
25-29	1.014	0.995	1.071
30-34	1.023	1.002	1.032
35-39	1.029	0.983	1.001
40-65	1.027	0.996	1.049
>=66	1.041	0.988	1.096
total	1.033	1.012	1.077

Source: Computations based on Portugal, MTS (1986-1989).

Note: (*) Computed as $L_{a,\,t} \big/ L_{a,\,t-1}$, where L_a stands for employment of age group *a*, and the subscript *t* denotes time.

While total employment increased by 3.3% between 1986 and 1987, the number of jobs taken by workers aged 17 to 19 increased more sharply, by 4% to 6%. Nevertheless, the group aged 20 to 22 presented even higher employment growth rates. The following year, while total employment increased by 1%, the youngest workers had a much higher employment growth, which compensated for the decline in the employment of prime-age workers. This level of analysis therefore dismisses the existence of any negative impact on employment resulting from the sharp rise in the minimum wage for specific age groups.

A longitudinal perspective can shed another light on the issue. Following workers over time, we can directly check whether youngsters who were earning sub-minimum wages tended to loose their jobs following the sharp increase in their legal minimum wage. Results reinforce the initial hint, as the rise in the minimum wage did not have the negative employment consequences predicted by traditional economic theory.

Table 4 – Mobility out of employment for 1986 full-time wage-earners, by age and wage categories

age in 1986	wage in 1986	situation in 1987		
		employed full-time	wage earner not full-time	out of employment
16-18	below minimum	**65.96**	4.24	29.80
	at minimum	59.91	3.66	36.42
	between min86 and min87	75.65	4.41	19.94
	at/barely above min87 *	67.87	4.10	28.03
	above min87 x 1.1	71.72	4.71	23.57
19-25	below minimum	56.55	5.12	38.33
	at minimum	57.63	3.26	39.11
	between min86 and min87	67.66	4.79	27.54
	at/barely above min87 *	65.91	4.32	29.77
	above min87 x 1.1	71.66	3.70	24.64
26-35	below minimum	56.67	6.32	37.02
	at minimum	60.06	3.45	36.49
	between min86 and min87	70.64	5.46	23.89
	at/barely above min87 *	71.83	4.32	23.85
	above min87 x 1.1	78.09	3.56	18.36
36-65	below minimum	45.61	22.85	31.53
	at minimum	23.7	3.75	72.55
	between min86 and min87	56.67	6.32	37.02
	at/barely above min87 *	60.06	3.45	36.49
	above min87 x 1.1	70.64	5.46	23.89

Source: Computations based on Portugal, MTS (1986-1987).
Note: (*) “Barely above” is defined as not exceeding the minimum plus 10%.

Workers aged 16 to 18 and earning sub-minimum wages in 1986 were a year later eligible for a sharp wage rise. These workers would therefore, according to competitive theory, be at risk of loosing their job. Indeed, if workers were paid the value of their marginal product, the rise in the minimum wage would drive sub-minimum workers out of employment. Instead, table 4 shows that, in the age groups affected, the share of workers who remain in employment is higher for

those initially earning the sub-minimum wage than for those at the full minimum. Whereas 66% of the youngsters aged 16 to 18 employed at sub-minimum wages in 1986 were still employed a year later, just 60% of those earning the full minimum kept their employment status.

If instead of taking teenagers at the minimum wage as the control group, we consider older workers on sub-minimum wages, similar results are reached. The share of subminimum wage workers remaining in employment is higher in the ages directly affected by the rise in the minimum wage than for older workers.

4. Modelling both sides of the recruitment policy of the firm: job accessions *versus* job separations

Firms may change the composition of their labour force following a rise in the minimum wage for a particular group of workers, namely to get rid of workers whose marginal productivity falls below the new minimum wage. This section models job flows distinguishing between: hirings by companies newly set; dismissals from companies that close down; hirings by continuing firms; separations from continuing firms.

We will concentrate on the share of teenagers in total job accessions/separations involving workers aged up to 35 years. Whereas overall figures for job accessions and separations may be influenced by the business cycle, concentrating on the share of teenagers in those flows can highlight changes in employer policies following the rise in the youth minimum wage. Indeed, considering just the flows for workers aged up to 35 we are comparing similar groups, expected to be affected in a similar way by trends in the business cycle.

Insight into the impact of minimum wages on worker flows was obtained via regression analysis. Since the number of teenage workers is taken as the dependent variable, a count regression model is appropriate, particularly because the number of events exhibits a preponderance of zeros and small values.

The Poisson regression model, for grouped data, writes as:

$$\mu(x) = \{N\}\{g(\beta \mid x)\} \qquad (1)$$

where $\mu(x)$ is the expected value of the number of events (in this case, the number of teenage workers), x is the vector of explanatory variables and β the

vector of the corresponding coefficients, and *N* denotes the size of the risk set in the units in which the events occur (in this case, the firm's flow of workers less or equal than 35 years of age).

The loglinear model corresponding to this specification (for N counts with independent Poisson distribution), is:

$$ln\left\{\frac{\mu(x)}{N}\right\} = x'\beta \qquad (2)$$

where $\frac{\mu(x)}{N} = \lambda(x)$ is the rate of incidence of the event (the proportion of teenage workers).

With *s* independent groups (*s* firms) each with a vector $x_i=(x_{i1}, x_{i2},\ldots,x_{ik})$ of *k* explanatory variables, the likelihood function is given by

$$L(n \mid \mu) = \prod_{i=1}^{s} \mu_i^{n_i} \{exp(-\mu_i)\} / n_i! \,. \quad [4] \qquad (3)$$

The corresponding log likelihood estimating equation is:

$$\ln L = \sum_i n_i x_i'\beta + n_i \ln N_i - \exp(x_i'\beta) N_i - \ln(n_i!) \qquad (4)$$

Because of overdispersion, the variance function (*V*) is allowed to have a multiplicative factor ϕ, ($V(\mu)=\phi\mu$), which is obtained dividing the deviance by the degrees of freedom.[5] The model is estimated by quasi-likelihood techniques.[6]

To compare the before and after treatment situations for the affected group with that of the control group, the most common methodology has been the 'difference in differences' approach, which accounts for permanent heterogeneity across the groups and for business cycle effects. In that case, the difference between

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[4] For details, see Cameron and Trivedi (1998).

[5] For the Poisson distribution, the deviance is computed as

$$2\sum_i w_i \{n_i \, ln(n_i / \mu_i) - (n_i - \mu_i)\},$$

where w_i is the known dispersion weight.

[6] Allowing for overdispersion has no effects on the parameter estimates. However, the procedure adopted implies that the covariance matrix is multiplied by ϕ and the scale deviance and the log likelihoods used in likelihood ratio tests are divided by ϕ.

employment before and after the rise in the minimum wage (the 'first difference') is computed for each group of workers, cancelling out permanent characteristics of the group; the difference between these two measures is the 'second difference', quantifying the impact of the treatment, which is not influenced by macroeconomic shocks affecting both groups of workers in the same way. Contrasts and similarities with the methodology we are using should be highlighted.

Our methodology similarly takes into account four different groups of workers: teenagers (aged 17 to 19, the treatment group), older workers (aged 20 to 35, the control group), each before and after the rise in the minimum wage. Instead of relating the four groups using two differences, we use one ratio and one difference, which should as well control for macroeconomic shocks affecting both groups and for permanent differences between the treatment and control groups. On the other hand, instead of dealing with the stock of employment before and after the legislation change, we are interested in two other variables, which are the sources of employment changes — job accessions and job separations (each requiring, for its computation, data on the period they refer to plus data on the previous period). Finally, instead of ordinary least squares, a Poisson regression model is more adequate in this framework.

4.1. Trends in continuing firms

Consider first the recruitment and dismissal policy in continuing firms. The first regression in table 5 compares the recruitment policy in 1986, before the change in the minimum wage, with that of 1988, a year and two months after the rise in the minimum wage. The second one compares 1986 and 1989, therefore allowing for a longer lag on the impact of the minimum wage on recruitment policies. Data for the control year of 1986 and the year under analysis (1988 or 1989) have been pooled, and a year dummy variable aims at capturing the impact of the policy change. The affected group and the control group — workers aged 20 to 35 — were kept in the sample.

Table 5 – Share of teenagers hired by continuing firms, Poisson regression model applied to proportions

	pooled data 1986 and 1988		pooled data 1986 and 1989	
	parameter estimate	standard error	parameter estimate	standard error
year 1988 (dummy)	-0.046	0.008		
year 1989 (dummy)			-0.056	0.008
firm size	-0.066	0.003	-0.056	0.003
firm hiring rate	-0.060	0.027	-0.014	0.026
market concentration (Herfindahl index)	-0.639	0.045	-0.764	0.046
N	61 379		64 233	
Pearson chi-square	59 405		62 067	

Notes: Controlling for the industry (7 dummies), and public or foreign ownership of the company. Firm size is in logs.
Source: Computations based on Portugal, MTS (1985-89).

After the rise in the youth minimum wage, companies decreased the share of teenagers among their newly-hired workforce. Note that both for 1988 and 1989, the dummy variable is negative and significant. In 1988, the share of teenagers in overall job accessions to continuing firms was 5% lower than in 1986; in 1989, it was 6% lower than in 1986. In that sense, results on the behaviour of employers concerning their hiring policy following a rise in the minimum wage lend support to the competitive view of the labour market, as there seems to have been a shift away from teenagers.

Table 6 – Share of teenagers dismissed from continuing firms, Poisson regression model applied to proportions

	pooled data 1986 and 1988		pooled data 1986 and 1989	
	parameter estimate	standard error	parameter estimate	standard error
year 1988 (dummy)	-0.111	0.008		
year 1989 (dummy)			-0.111	0.008
firm size	-0.062	0.003	-0.064	0.003
firm separation rate	0.320	0.020	0.359	0.019
market concentration (Herfindahl index)	-0.830	0.049	-1.039	0.052
N	77 725		82 220	
Pearson chi-square	81 299		84 811	

Notes: Controlling for the industry (7 dummies), and public or foreign ownership of the company. Firm size is in logs.
Source: Computations based on Portugal, MTS (1985-89).

However, the share of teenagers in job separations also decreased following the rise in the minimum wage. Indeed, it was 11% lower in 1988 or 1989 than in 1986. These results contrast with those of the previous table, indicating that the workers affected by a sharp rise in the minimum wage are not over-represented among those afterwards separating from their employers.

These results contrast with those obtained by Pereira (1999). In her outstanding study, she found that the rise in youth minimum wage significantly reduced employment. However, she has modelled net employment changes at the firm level relying on a balanced panel of firms observed before and after the policy change.[7] This strategy of keeping a balanced panel of firms to analyse net employment changes by age groups may bias the results. Workers aged 19 or 18 in 1986 are bound one or two years later, respectively, to join the control group of workers aged 20 to 25. Therefore, the size of the affected group is bound to decline while expanding the size of the control group, unless the company sticks to a recruitment policy of actively and continuously hiring youngsters. This condition is very restrictive, as it would mean a continuous expansion of the company's labour force unless workers were exiting at a concomitant pace, a situation that may hold for certain sectors with very high worker turnover and almost exclusively young workers, such as the fast food industry analysed in the USA, but that is less feasible for the Portuguese economy as a whole. An older control group would reduce this problem and indeed the results are no longer significant in two out of three regressions if workers aged 30 to 35 are taken as the control group. Our separate analysis of job accessions and job separations, looking at the relevance of teenagers in each of these flows, is meant to overcome this problem. Moreover, our coverage of the existing firms in the economy is broader, since we have considered all the firms recruiting workers in the year of 1986, to compare with all the firms that recruited workers in the year of 1988 or 1989 (similarly for dismissals). In the following section we also take into account new firms and firms going out of business.

4.2. Trends in new firms and in firms closing down

We go on to inspect the impact of the rise in the minimum wage on firm closure and firm creation. This analysis provides a more complete picture of the impact of the minimum wage in an economy known to be characterized by very high levels of firm creation and firm destruction (Mata and Portugal, 1994) (Mata *et al*, 1995).

[7] As such, her sample includes approximately 22 thousand firms observed in 1986 and 1988 with workers aged 18 to 35 (and approximately 20 thousand once the years of 1986 and 1989 are considered).

Table 7 – Share of teenagers hired by new firms, Poisson regression model applied to proportions

	pooled data 1986 and 1988		pooled data 1986 and 1989	
	parameter estimate	standard error	parameter estimate	standard error
year 1988 (dummy)	-0.036	0.015		
year 1989 (dummy)			-0.028	0.015
firm size	-0.105	0.006	-0.090	0.006
market concentration (Herfindahl index)	-2.163	0.182	-2.631	0.161
N	22 344		24 177	
Pearson chi-square	21 627		23 778	

Notes: Controlling for the industry (7 dummies), and public or foreign ownership of the company. Firm size is in logs.
Source: Computations based on Portugal, MTS (1985-89).

Firms set in 1988, a year after the policy change, recruited a 4% lower share of teenagers than those set in 1986. Just like accessions to continuing firms, these results lend support to the idea that rising minimum wages reduce the demand for the affected workers. Nevertheless, by 1989 that impact on admissions into new firms had vanished.

Table 8 – Share of teenagers dismissed from firms closing down, Poisson regression model applied to proportions

	pooled data 1986 and 1988		pooled data 1986 and 1989	
	parameter estimate	standard error	parameter estimate	standard error
year 1988 (dummy)	0.058	0.020		
year 1989 (dummy)			0.059	0.019
firm size	-0.129	0.008	-0.113	0.007
market concentration (Herfindahl index)	-1.661	0.223	-1.876	0.232
N	12 012		13 257	
Pearson chi-square	12 269		13 506	

Notes: Controlling for the industry (7 dummies), and public or foreign ownership of the company. Firm size is in logs.
Source: Computations based on Portugal, MTS (1985-89).

Also in line with traditional theory, we find that teenage workers are over-represented in the labour force of firms closing down in 1988 or 1989, when compared to the situation before the rise in the youth minimum wage.

In synthesis, looking at firm entry and exit and at recruitment by continuing firms would lend support to standard economic theory. As a matter of fact, firms set up in 1988 or 1989 increased their tendency to employ older workers when compared

to similar firms[8] set up in 1986, as the share of teenagers in total hirings declined. Also, youngsters were increasingly represented among firms going out of business. Pointing in the same direction, their share in total hirings by continuing firms declined. However, results for separations from continuing firms reveal that job separations for teenagers declined following the rise in the minimum wage.

The above modelling approach captures mainly demand forces and an analysis from a worker point of view could add further light on this issue.

5. Modelling worker flows: rising minimum wage increases job attachment?

This section models retention rates from a worker standpoint, specifically for youngsters affected by the rise in the minimum wage, compared to a control group, to answer the question: did youngsters who were earning sub-minimum wages tend to loose their jobs following the sharp increase in their legal minimum wage? Before progressing to present the results, let us briefly discuss the dependent variable of the logit model, alternative specifications for the minimum wage variable, and alternative definitions of the control group and control period.

The dependent variable

The model on worker transitions explicitly tests the hypothesis that, when the minimum wage is raised, workers in the affected group will have a lower probability of keeping their job than unaffected workers. We will model the probability that a worker will remain with the same employer. However, the probability of loosing a job and becoming unemployed has been more frequently debated in the literature and therefore the probability of remaining employed (whether or not with the same employer) will also be modelled and its results will be presented in appendix.

The minimum wage variable

Three alternatives were used to specify the minimum wage variable:

– *Wage gap*: according to competitive reasoning, the probability of remaining employed should be lower the greater the change required in the worker's wage

[8] Firms in the same industry, with the same type of ownership (public, private or foreign), size and profitability as proxied by the degree of market concentration.

to adjust to the new minimum wage. The distance between the worker's previous wage and the new minimum wage (wage gap) has been used in the literature as an independent variable to capture the impact of changes in the minimum wage (Card and Krueger 1994, Currie and Fallick 1996, Zavodny 2000). It was computed as:

$$wage\ gap_i = \frac{\min w_t - w_{86,i}}{w_{86,i}} \quad ,$$

for worker *i*, a teenager initially earning subminimum wage *w*; it is zero otherwise.

– *Subminimum wage teenagers*: an alternative specification disregards how far subminimum wages deviate from the minimum wage, to consider simply whether or not a worker was a subminimum wage worker in the initial period.

– *Teenagers*: An even more general specification considers simply whether a worker is a teenager, to measure the employment impact of a rise in the youth minimum wage.

Sample and control groups

The treatment and the control groups should be very similar (Meyer 1995). We have therefore restricted our analysis to low wage workers aged 16 to 35. The behaviour of subminimum wage workers is contrasted against that of other low wage workers, defined alternatively as: i) workers *at* the minimum wage; ii) workers *marginally above* the minimum wage (wage above the minimum but below 1.1 x minimum). The later results are reported in appendix.

The combination of alternative samples and alternative specifications of the minimum wage variable defines different treatment and control groups. In tables 9 to 12, workers below the minimum wage and *at* the minimum wage are defined as the low wage group. The first specification includes a dummy variable for teenagers, besides the control variables. Therefore, low wage teenagers (aged 16 to 18 in 1986) are implicitly taken as the treatment group, and the control group are low-wage workers aged 19 to 35. The second specification considers a dummy variable for subminimum wage workers, plus that variable interacted with the teenager dummy. As such, the treatment group are subminimum wage teenagers, compared against subminimum wage workers aged 19 to 35. The third

specification highlights, for subminimum wage teenagers, the impact of the distance from the new minimum wage on retention probabilities. The same specifications of the regressions are combined with the definition of low wage workers as those barely above the minimum wage, reported in appendix.

Period under analysis

Workers employed in 1986, a year before the rise in the minimum wage, were kept for analysis, to explain their probability of remaining employed in 1988, a year and two months after the rise in the minimum wage took place.[9]

To check that the differences in behaviour that we are capturing are indeed due to changes in the minimum wage, and not due to permanent contrasts across the groups of workers, the same regressions were ran for a different time period, when the impact of the rise in the minimum wage would most certainly already have vanished (1991 to 1993).

Table 9 – Probability of remaining with the same employer from 1986 to 1988, ***men*** *(logit model)*

Sample group: workers below and at the minimum wage

	parameter estimate	standard error	parameter estimate	standard error	parameter estimate	standard error
intercept	-4.445	0.523	-3.53	0.61	-5.246	0.642
teenager	**0.512**	0.023				
submin			-0.162	0.024		
submin * teenager			**0.574**	0.025		
wage gap					**0.59**	0.044
tenure	0.075	0.004	0.076	0.004	0.066	0.004
tenure<1	-0.201	0.023	-0.205	0.023	-0.235	0.023
apprentice	0.044	0.02	0.049	0.02	0.116	0.019
wage86	0.331	0.053	0.247	0.061	0.412	0.065
schooling (7 dummies)	yes		yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	0.079	0.006	0.081	0.006	0.091	0.006
foreign	*0.017*	0.091	*0.026*	0.091	*-0.004*	0.091
public	*0.051*	0.121	*0.064*	0.122	*0.067*	0.121
N	61 669		61 669		61 669	
Chi-squared	2140.5		2208		1836.3	

Source: Computations based on Portugal, MTS (1986-88).

[9] We have as well modelled their probability of remaining employed in 1987, two months after the rise in the minimum wage, despite this time lag being too short for the change in the legislation to have taken effect. For example, Neumark (1999) claims that the effect of changes in the minimum wage is felt most strongly with a one year lag. Nevertheless, our results are robust (though not as strong as in the reported regressions). Analysing the separations from 1986 to 1989 would be strongly influenced by the military draft for males aged 20-21 in 1989 and therefore we have not progressed to consider that longer lag. Note however that eighteen year olds in 1986 were already affected by the military service in 1988.

Table 10 — Probability of remaining with the same employer from 1986 to 1988, ***women*** *(logit model)*

Sample group: workers below and at the minimum wage

	parameter estimate	standard error	parameter estimate	standard error	parameter estimate	standard error
intercept	-4.802	0.568	-5.41	0.673	-4.58	0.647
teenager	**0.237**	0.025				
submin			*0.005*	0.022		
submin * teenager			**0.275**	0.027		
wage gap					**0.239**	0.05
tenure	0.044	0.003	0.044	0.003	0.04	0.003
tenure<1	-0.291	0.022	-0.288	0.022	-0.308	0.022
apprentice	0.133	0.02	0.126	0.02	0.16	0.019
wage86	0.375	0.057	0.437	0.067	0.353	0.065
schooling (7 dummies)	yes		yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	0.122	0.007	0.121	0.007	0.128	0.007
foreign	0.282	0.044	0.284	0.044	0.281	0.044
public	*0.162*	0.118	*0.17*	0.118	*0.142*	0.118
N	59 825		59 825		59 825	
Chi-squared	2207.2		2227.9		2141.8	

Source: Computations based on Portugal, MTS (1986-88).

Teenagers were more likely to keep their jobs, from 1986 to 1988, than older workers (see specification 1 in tables 9 and 10). Looking at the second specification, a consistent pattern emerges. In general, male workers on subminimum wages are more likely to leave their job (see the coefficient on the subminimum variable), which could partly be associated with poor job satisfaction resulting from a low wage. However, teenagers earning subminimum wages in 1986 are much more likely to remain with their employer than subminimum wage workers in general. The change in the legislation led to a wage rise that may have increased job attachment for the affected group of workers. The wage gap variable (specification 3) is as well positive and highly significant, revealing that teenagers initially earning the lowest wages, and therefore subject to the highest wage raise, are the workers most likely to stick to their employers. These effects are robust to the choice of the control group, be it workers at the minimum wage or marginally above the minimum (see tables B2 and B3 in appendix). The magnitude of the effects is much larger for men than for women.[10]

We have tested whether these results hold when analysing the probability that the worker will remain employed, whether or not with the same employer, since that is

[10] The wage of the worker was included among the regressors. Following Abowd *et al* (1999), it is intended to capture heterogeneity in labour force attachment across the wage distribution.

the central variable in most of the previous literature. The previous results do hold, revealing that, after the rise in the youth minimum wage, teenagers were more likely to remain employed than older workers, and subminimum wage teenagers were more likely to remain employed than older subminimum wage workers (tables B4 to B7 in appendix).

What if minimum wages had not increased? Would teenagers have shown the same pattern of behaviour anyway? Interestingly, that pattern of behaviour changes considerably once the impact of the rise in the minimum has vanished. The wage gap variable becomes irrelevant in explaining the probability that a men will remain with the same employer from 1991 to 1993; the impact of being a subminimum wage teenager is halved (second specification in table 15); the impact of being a teenager is cut by a factor of four (see the first specification). For women, the results are less clear-cut. Women reveal basically the same pattern of behaviour in both periods (1986-88 and 1991-93), irrespective of the rise in the youth minimum wage in 1987.

Table 11 — Probability of remaining with the same employer from 1991 to 1993, ***men*** *(logit model)*

Sample group: workers below and at the minimum wage

	parameter estimate	standard error	Parameter Estimate	standard error	parameter estimate	standard error
Intercept	-6.655	0.747	-7.287	0.927	-5.187	0.851
teenager	**0.116**	0.022				
submin			-0.083	0.025		
submin * teenager			**0.248**	0.025		
wage gap					*-0.03*	0.064
tenure	0.068	0.004	0.07	0.0042	0.064	0.004
tenure<1	-0.396	0.021	-0.391	0.021	-0.402	0.021
apprentice	0.089	0.02	0.069	0.02	0.124	0.019
wage91	0.571	0.071	0.634	0.087	0.433	0.08
schooling (7 dummies)	yes		yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	*-0.004*	0.005	*-0.006*	0.006	*0*	0.005
foreign	*-0.06*	0.071	*-0.051*	0.071	*-0.074*	0.071
public	*-0.076*	0.179	*-0.075*	0.179	*-0.083*	0.179
N	62 474		62 474		62 474	
chi-squared	1771.8		1837.4		1745.4	

Source: Computations based on Portugal, MTS (1991-93).

Table 12 — Probability of remaining with the same employer from 1991 to 1993, ***women*** *(logit model)*

Sample group: workers below and at the minimum wage

	parameter estimate	standard error	parameter estimate	standard error	parameter estimate	standard error
intercept	-9.057	0.776	-7.55	0.926	-8.18	0.844
teenager	**0.225**	0.021				
submin			*-0.151*	0.023		
submin * teenager			**0.321**	0.023		
wage gap					**0.266**	0.067
tenure	0.048	0.003	0.05	0.003	0.045	0.003
tenure<1	-0.383	0.019	-0.38	0.019	-0.4	0.018
apprentice	0.082	0.018	0.069	0.018	0.117	0.017
wage91	0.79	0.073	0.651	0.087	0.706	0.08
schooling (7 dummies)	yes		yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	0.11	0.006	0.117	0.006	0.113	0.006
foreign	*-0.016*	0.037	*-0.017*	0.037	*-0.03*	0.037
public	-1.008	0.167	-1.04	0.168	-1.01	0.167
N	72788		72788		72788	
Chi-squared	2300.7		2395.1		2200.5	

Source: Computations based on Portugal, MTS (1991-93).

These results contrast with those obtained in several previous studies. In the work by Currie and Fallick (1996) for the USA, the affected group of workers was found to have lower probability of remaining employed than low wage workers who were not affected by the rise in the minimum wage. Similarly, the larger the wage gap, and therefore the larger the wage increase due, the lower the probability that the worker remained employed. Zavodny (2000) found that the probability to remain employed in the USA following a rise in the minimum wage is lower for low wage teens than for high wage teens. Abowd *et al* (1999) as well found that disemployment effects are more pronounced for workers directly affected by the rise in the minimum wage than for those initially marginally above the new minimum wage.

Neumark and Wascher (1995, 1995a) explicitly considered supply side effects. They concluded that, following a rise in the minimum wage, high-skill teenagers may leave school to start working, substituting for low-skilled teens, whose marginal revenue falls below the new minimum wage. According to Neumark and Wascher, the weak youth disemployment effects detected by some studies could result simply from the fact that teenagers are encouraged to leave school, driving out of work less skilled teens previously employed. In that case there would be strong disemployment effects on teenagers already in work, but they would not be

captured by the analysis, just because there would be rising demand (and supply) for more skilled youngsters. Explicitly modelling the retention rates, we do not find support for that hypothesis for the Portuguese case, as the retention rate is higher for teens earning subminimum wages than for the unaffected groups of workers. Moreover, the fact that, following the rise in the youth minimum wage, there is a decrease in the opportunities for job accessions by teenage relative to older workers, as shown in section 3, reduces the impact that the minimum wage might have pulling teenagers out of school.

6. Conclusion

This study goes beyond the explanation of net employment changes by worker types at the firm level following a rise in the minimum wage. It models gross job flows — both accessions and separations — in continuing firms, as well as in new firms and those going out of business, relying on a matched employer-employee panel dataset. We have also modelled worker behaviour following the rise in the minimum wage. Scrutiny of the sources of changes in employment for the affected group of workers can help reconcile some of the evidence that had previously been presented in the literature as contradictory, contributing to disentangle the minimum wage puzzle.

It has previously been documented that low wage workers in general have higher turnover rates, either because they have less incentives to remain with their employer, thus being more prone to quit, or because they are the first to be dismissed in case of adverse conditions. Our evidence is consistent with that view. A general pattern emerges, with workers earning below the minimum generally presenting lower retention rates, and those earning higher wages revealing higher propensity to remain in employment.

Concentrating on the impact of changes in the minimum wage, our results are as well consistent with the idea that employers change the demand for labour against youngsters once the youth minimum wage is increased. In fact, the share of teenagers among newly hired workers in continuing firms decreases, indicating a substitution effect away from youngsters. Also, new firms decrease the share of youngsters they hire. Moreover, teenagers are over-represented in firms closing down after the rise in the youth minimum wage.

However, the previous results capture mainly demand side effects and the picture changes considerably once the retention of workers in the firm is analysed. In fact, the share of teenagers in job separations in continuing firms decreases following the rise in the minimum wage. From a worker perspective, we find that teenagers are much more prone to keep their employment following a rise in the youth minimum wage than older workers, and subminimum wage teenagers are more prone to keep their employment than other subminimum wage workers. This result points to the relevance of supply side factors, as job attachment for low wage youngsters may rise following an increase in their minimum wage, reducing the high job turnover that is characteristic of low wage workers.

The major impact of the minimum wage is therefore the reduction of quits and in general the reduction of separations from the employer, which compensates for the reduction of accessions (to new and continuing firms) and the rising dismissals from firms closing down.

For women the results are not as clear. Since women tend to have a more stable attachment to their employer, switching jobs less frequently, there is thus less room to compensate for the negative impact that rising minimum wages have on employment through the reduction of accessions. As such, the literature has most often found that women are more severely hit by a rising minimum wage.

Appendix A: Dataset and concepts used

This study is based on a longitudinal data set matching firms and workers in the Portuguese economy, from 1985 to 1993. Both units can be followed over time. The data set is gathered every year by the Ministry of Employment and Solidarity, based on a inquiry that every establishment with wage-earners is legally obliged to fill in. The response rate is extremely high, and in fact the population of firms with wage-earners in manufacturing and the services private sector, is covered. No restrictions are imposed on the wage-earners covered (for example, there are no age restrictions and no limits beyond which wages would not be reported). Reported data include the firm's location, industry, employment, sales, ownership, legal setting, and the worker's gender, age, skill, occupation, schooling, admission date, earnings, duration of work, as well as the mechanism of wage bargaining. Each firm entering the database is assigned a unique identifying number and it can thus be followed over time. The Ministry implements several checks to ensure that a firm that has already reported to the database is not assigned a different identification number. The worker identification number is based on a transformation of his/her social security number.

A firm is considered a new firm if it had never previously reported to *Quadros de Pessoal*. A firm is reported as having gone out of business the first year it fails to report if it never again returns to the data base. A firm is considered a continuing one if it reported both in the previous and the current period. The regressions on the share of teenagers recruited by continuing firms includes all continuing firms that recruited workers. Similarly, the regressions for dismissals by continuing firms include all the continuing firms that dismissed workers.

Out of approximately 100 thousand companies reporting to *Quadros de Pessoal* each year in mid-'eighties, the following meet the sampling criteria.

Table A1 – Sample sizes (number of firms with workers in the age bracket 16-35)

	pooled 1986 and 1988	pooled 1986 and 1989
new firms	22 344	24 177
firms out of business	12 012	13 257
continuing firms that hired workers	61 379	64 233
continuing firms that dismissed workers	77 725	82 220

Since the minimum wage in Portugal is defined as a monthly wage rate, only full-time wage earners were considered in the analysis. The wage in the analysis refers to the reported base monthly wage.

Appendix B: Additional tables

Table B1 – Share of apprentices, by age group, 1985-1989

%

age	1986	1987	1988	1989
16	0.838	0.847	0.837	0.835
17	0.779	0.774	0.761	0.761
18	**0.625**	**0.617**	**0.597**	0.583
19	**0.493**	**0.503**	**0.483**	0.459
20	0.349	0.367	0.372	0.357
21	0.250	0.281	0.283	0.286
22	0.197	0.213	0.230	0.224
23	0.153	0.175	0.182	0.184
24	0.120	0.138	0.150	0.147
25-29	0.058	0.073	0.082	0.090
30-34	0.025	0.034	0.034	0.000
35-39	0.016	0.022	0.022	0.000
40-65	0.010	0.014	0.012	0.000
>=66	0.021	0.026	0.027	0.000
Total	0.104	0.116	0.122	0.127

Source: Computations based on Portugal, MTS (1986-1989).

Table B2 – Probability of remaining with the same employer from 1986 to 1988, **men** (logit model)

Sample group: workers below and ABOVE the minimum wage

	parameter estimate	standard error	parameter estimate	standard error	parameter estimate	standard error
intercept	-5.796	0.49	-4.06	0.607	-6.94	0.597
teenager	**0.506**	0.023				
submin			-0.212	0.024		
submin * teenager			**0.548**	0.025		
wage gap					**0.618**	0.043
tenure	0.064	0.003	0.061	0.003	0.056	0.003
tenure<1	-0.213	0.023	-0.224	0.023	-0.24	0.023
apprentice	0.044	0.02	0.076	0.02	0.132	0.019
wage86	0.473	0.049	0.312	0.06	0.589	0.06
schooling (7 dummies)	yes		yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	0.072	0.005	0.07	0.006	0.081	0.005
foreign	*0.104*	0.076	*0.099*	0.076	*0.078*	0.076
public	*0.08*	0.102	*0.107*	0.102	*0.101*	0.102
N	66876		66876		66876	
Chi-squared	2495.2		2535.2		2198.9	

Source: Computations based on Portugal, MTS (1986-88).

Table B3 – Probability of remaining with the same employer from 1986 to 1988, **women** (logit model)

Sample group: workers below and ABOVE the minimum wage

	parameter estimate	standard error	parameter estimate	standard error	parameter estimate	standard error
intercept	-8.42	0.518	-5.182	0.666	-9.004	0.589
teenager	**0.224**	0.024				
submin			-0.203	0.022		
submin * teenager			**0.243**	0.026		
wage gap					**0.335**	0.049
tenure	0.03	0.002	0.029	0.002	0.028	0.002
tenure<1	-0.329	0.022	-0.332	0.022	-0.341	0.022
apprentice	0.106	0.02	0.124	0.02	0.135	0.019
wage86	0.777	0.052	0.466	0.067	0.836	0.059
schooling (7 dummies)	yes		yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	0.133	0.006	0.13	0.006	0.136	0.006
foreign	0.385	0.038	0.388	0.038	0.387	0.038
public	0.262	0.109	0.3	0.109	0.253	0.109
N	76033		76033		76033	
Chi-squared	3271.4		3347.937		3228.4	

Source: Computations based on Portugal, MTS (1986-88).

Table B4 – Probability of remaining employed from 1986 to 1988, **men** (logit model)

Sample group: workers below and AT the minimum wage

	parameter estimate	standard error	parameter estimate	standard error	parameter estimate	standard error
intercept	-1.304	0.501	-0.778	0.59	-2.56	0.604
teenager	**0.388**	0.023				
submin			-0.114	0.023		
submin * teenager			**0.446**	0.024		
wage gap					**0.527**	0.042
tenure	0.052	0.004	0.052	0.004	0.045	0.004
tenure<1	-0.043	0.022	-0.045	0.022	-0.067	0.022
apprentice	-0.035	0.019	-0.034	0.019	*0.013*	0.018
wage86	0.087	0.05	*0.04*	0.059	0.214	0.061
schooling (7 dummies)	yes		Yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	0.056	0.006	0.057	0.0057	0.064	0.005
foreign	*-0.059*	0.088	*-0.051*	0.088	*-0.071*	0.088
public	*-0.033*	0.119	*-0.024*	0.119	*-0.021*	0.118
N	61669		61669		61669	
Chi-squared	1154.5		1215.3		1014.8	

Source: Computations based on Portugal, MTS (1986-88).

Table B5 – Probability of remaining employed from 1986 to 1988, **men** (logit model)

Sample group: workers below and ABOVE the minimum wage

	parameter estimate	standard error	parameter estimate	standard error	parameter estimate	standard error
intercept	-2.982	0.473	-1.081	0.587	-4.605	0.565
teenager	**0.401**	0.022				
submin			-0.208	0.023		
submin * teenager			**0.443**	0.024		
wage gap					**0.582**	0.041
tenure	0.045	0.003	0.042	0.003	0.039	0.003
tenure<1	-0.073	0.022	-0.08	0.022	-0.093	0.022
apprentice	-0.06	0.019	-0.033	0.019	*0.002*	0.018
wage86	0.264	0.048	*0.086*	0.058	0.427	0.057
schooling (7 dummies)	yes		yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	0.043	0.005	0.04	0.005	0.048	0.005
foreign	*0.081*	0.076	*0.077*	0.076	*0.065*	0.076
public	*-0.048*	0.101	*-0.023*	0.101	*-0.03*	0.101
N	66876		66876		66876	
Chi-squared	1313.7		1393.6		1182.9	

Source: Computations based on Portugal, MTS (1986-88).

Table B6 – Probability of remaining employed from 1986 to 1988, **women** (logit model)

Sample group: workers below and AT the minimum wage

	parameter estimate	standard error	parameter estimate	standard error	parameter estimate	standard error
intercept	-1.58	0.564	-2.351	0.672	-1.385	0.636
teenager	**0.225**	0.026				
submin			*0.027*	0.022		
submin * teenager			**0.245**	0.027		
wage gap					**0.232**	0.05
tenure	0.024	0.003	0.023	0.003	0.021	0.003
tenure<1	-0.26	0.022	-0.258	0.022	-0.276	0.022
apprentice	0.176	0.019	0.173	0.019	0.2	0.019
wage86	0.117	0.057	0.194	0.067	*0.097*	0.064
schooling (7 dummies)	yes		yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	0.078	0.007	0.076	0.007	0.083	0.007
foreign	0.078	0.046	0.082	0.046	0.077	0.046
public	*-0.066*	0.119	*-0.06*	0.119	*-0.085*	0.119
N	59825		59825		59825	
Chi-squared	1517.9		1525.3		1464.9	

Source: Computations based on Portugal, MTS (1986-88).

Table B7 – Probability of remaining employed from 1986 to 1988, **women** (logit model)

Sample group: workers below and ABOVE the minimum wage

	parameter estimate	standard error	parameter estimate	standard error	parameter estimate	standard error
intercept	-5.38	0.518	-1.829	0.667	-6.034	0.583
teenager	**0.219**	0.024				
submin			-0.218	0.022		
submin * teenager			**0.226**	0.027		
wage gap					**0.343**	0.049
tenure	0.015	0.002	0.013	0.002	0.012	0.002
tenure<1	-0.296	0.022	-0.298	0.022	-0.306	0.022
apprentice	0.124	0.02	0.144	0.02	0.15	0.019
wage86	0.53	0.052	0.187	0.066	0.595	0.059
schooling (7 dummies)	yes		yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	0.087	0.006	0.083	0.006	0.089	0.006
foreign	0.21	0.04	0.213	0.04	0.211	0.04
public	*0.077*	0.112	*0.112*	0.112	*0.07*	0.112
N	76033		76033		76033	
Chi-squared	1942		2026.2		1912.7	

Source: Computations based on Portugal, MTS (1986-88).

Table B8 – Probability of remaining with the same employer from 1991 to 1993, **men** (logit model)

Sample group: workers below and ABOVE the minimum wage

	parameter estimate	standard error	parameter estimate	standard error	parameter estimate	standard error
intercept	-8.39	0.677	-7.24	0.916	-7.534	0.765
teenager	**0.125**	0.022				
submin			-0.136	0.026		
submin * teenager			**0.236**	0.025		
wage gap					*0.045*	0.064
tenure	0.063	0.003	0.062	0.003	0.06	0.003
tenure<1	-0.413	0.021	-0.414	0.021	-0.416	0.02
apprentice	0.055	0.021	0.049	0.02	0.095	0.019
wage91	0.733	0.064	0.63	0.086	0.652	0.072
schooling (7 dummies)	yes		yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	0.018	0.005	0.015	0.005	0.021	0.005
foreign	-0.149	0.061	-0.143	0.061	-0.159	0.061
public	*-0.183*	0.132	*-0.193*	0.132	*-0.189*	0.132
N	65714		65714		65714	
Chi-squared	2613.3		2675.5		2582.1	

Source: Computations based on Portugal, MTS (1991-93).

Table B9 – Probability of remaining with the same employer from 1991 to 1993, **women** (logit model)

Sample group: workers below and ABOVE the minimum wage

	parameter estimate	standard error	parameter estimate	standard error	parameter estimate	standard error
intercept	-12.472	0.625	-8.767	0.887	-12.5	0.686
teenager	**0.202**	0.018				
submin			-0.191	0.021		
submin * teenager			**0.297**	0.023		
wage gap					**0.376**	0.066
tenure	0.03	0.002	0.028	0.002	0.028	0.002
tenure<1	-0.373	0.016	-0.374	0.016	-0.385	0.016
apprentice	0.062	0.016	0.074	0.016	0.098	0.016
wage91	1.113	0.059	0.769	0.083	1.114	0.065
schooling (7 dummies)	yes		yes		yes	
industry (7 dummies)	yes		yes		yes	
firm size	0.133	0.005	0.133	0.005	0.134	0.005
foreign	*-0.02*	0.025	*-0.016*	0.025	*-0.026*	0.025
public	-0.714	0.123	-0.713	0.123	-0.719	0.123
N	116150		116150		116150	
Chi-squared	4471.7		4570.8		4379.8	

Source: Computations based on Portugal, MTS (1991-93).

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