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Privatization and corporate restructuring*

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Abstract

We examine corporate restructuring following privatization using uncommonly rich data on the population of Portuguese firms from 1991-2009. We find that privatization leads to sizable job losses, reflecting reductions in both the number of establishments and in the number of workers per establishment. We find no robust evidence of impacts on the structure of the workforce. The estimated job losses following privatization are consistent with a theory in which the shift in ownership increases the degree of profit orientation and leads to lower job security.

Keywords: Privatization; employment structure; panel data.

JEL Classification: J45; D21; C23

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1 Introduction

The privatization of state-owned enterprises is often advocated on the grounds that the implied ownership shift triggers a process of corporate restructuring that leads to a more efficient use of productive resources.¹ Yet empirical evidence on such a restructuring process is relatively scarce, and most previous research faces important data limitations (Brown et al., 2010). We examine corporate restructuring following privatization using unusually rich data covering the population of Portuguese firms in the 1991-2009 period, when the country adopted an ambitious and broad-based privatization program. We provide theory and evidence that privatization leads to sizable job losses. Perhaps surprisingly, we find no robust evidence of impacts on the structure of the workforce. As privatization programs continue to feature prominently in the policy agenda of many nations across the globe, our findings shed new light on whether and how they will contribute to the structural transformation of the corresponding economies.

We draw on a comprehensive administrative worker-firm data set spanning almost two decades. This data set provides information on the share of state-owned capital in each year and allows us to follow firms over time. It further enables us to decompose employment changes that are due to shifts in the number of establishments and in average establishment size. Using detailed worker-level records, we compute entry and exit rates, and a wide array of measures of the composition of the workforce within each firm. Specifically, we build average measures of worker tenure, age and schooling; skill-measures based on worker occupations; and the share of male employees.

To estimate the impacts of privatization on each of these measures, we first adopt a difference-in-differences type approach. We examine both the universe of firms and the sub-group that recorded ownership shifts during the period of analysis.² We consider two different definitions of private ownership: the 50% cutoff of private capital and the initial tranche of privatization. To get a sense about the extent to which our results might be driven by selection bias, we use an alternative and arguably preferable estimator – namely propensity score matching combined with the firm fixed-effects estimator, in the spirit of Blundell and Costa Dias (2000) and others. The main finding that emerges from the econometric analysis is that privatization leads to sizable job losses. The drop in employment within privatized firms reflects both reductions in the number of establishments and

¹For example, the privatization programs of Greece and Portugal are a flagship in the agenda for structural transformation of these economies under the EU/IMF economic and financial assistance programs. The literature on privatization and efficiency includes Haskel and Sanchis (1995), La Porta and López-de-Silanes (1999) and Brown et al. (2006).

²In the latter case, identification is therefore solely based on differences in the timing of the ownership change.

less employees per establishment. We find no robust evidence of significant impacts of privatization on the average age, gender and skill composition of the workforce, as measured by the aforementioned indicators.

To help interpret our main empirical finding, we outline a theory of corporate ownership and employment determination, drawing on Monteiro et al. (2011) and Bastos et al. (2011). In the model, the ownership regime influences the firm's objective function: private firms maximize profits, while public firms also take consumers' welfare into account. In addition, the degree of job security is higher in public than in private firms. By making the firm more profit oriented, privatization implies that the firm finds it optimal to reduce output in order to achieve a higher market price and thereby increase profits. This output decline leads, all else equal, to a downsizing of the labor force. At the same time, by making jobs less secure, privatization induces greater worker effort. While this increase in effort reduces the effective wage rate, which tends to raise labor demand, it also means that a given output can be produced with fewer workers, which has the opposite effect. The fall in job security following privatization will contribute to reduce employment further if labor demand is sufficiently inelastic.

This paper builds on and contributes to the literature on the employment effects of privatization. The general picture emerging from this literature is mixed. In a study for the UK, Haskel and Szymanski (1993) examine data on 14 privatized companies over 1972-1988 and find that employment fell following the change to more commercial objectives. Bhaskar and Kahn (1995) use information on 31 privatized firms from jute mills in Bangladesh and find that privatization led to sizable employment losses. Drawing on rich firm-level panel data for Hungary, Romania, Russia, and Ukraine, Brown et al. (2010) conclude that the results in all 4 countries consistently reject the hypothesis that privatization induces job losses. Using uncommonly rich panel data on the universe of Portuguese firms, we not only provide further evidence on how privatization impacts on overall employment levels, but also estimate effects on a wide range of indicators on the structure of employment, thereby providing a more comprehensive picture of the process of corporate restructuring following privatization.

The paper proceeds as follows. Section 2 describes the data employed, before Section 3 provides context on the Portuguese privatization program. Section 4 discusses econometric issues and presents the empirical strategy. Section 5 presents the econometric results and examines their robustness. Section 6 presents a theoretical model of corporate restructuring following privatization to help interpret our main results. Section 7 concludes the paper.

2 Data

We draw on data from *Quadros de Pessoal* for the 1991-2009 period. This data set is an administrative census of the population of firms, their establishments and their workers in the Portuguese corporate sector. It also has information on the collective agreements that cover the workforce. The records of *Quadros de Pessoal* are collected yearly by the Ministry of Employment and participation is compulsory for every firm with wage earners. These same administrative records are used by the Ministry of Employment for checking the firm's compliance with labor law, and must be made available to every worker in a public place of the establishment. The information is generally considered to be highly reliable.

Firms report information on their attributes and those of each employee. The firm records include information on the number of employees, number of establishments, industry code, geographical location, and percentage of capital that is owned by the state and by foreign investors. The set of worker attributes includes monthly wages, gender, schooling, date of starting, occupation and hours worked. The data also include information on the type of contract that covers the workforce (sectoral, multi-firm, firm, mandatory regime). In each year, the worker data can be linked to each establishment and to the firm.³

Using the individual worker files we construct firm-level measures of worker entry and exit rates. The worker entry rate of a firm (in a given year) is measured by the ratio between the number of worker accessions and total employment in the firm, where the number of accessions in a given year is measured by the number of workers with tenure below 1 year. Similarly, the worker exit rate is defined as the ratio between the number of worker separations and total employment, where the number of separations in a firm (in a given year t) is measured by the number of workers that are present at time t but absent at time $t + 1$. We further build a wide range of yearly measures of the structure of employment within firms. In particular, we construct average measures of worker tenure, age and schooling; skill-measures based on workers' occupation; and the proportion of male employees.⁴

³Worker data for 2001 were not collected by the Ministry of Employment and hence this year is excluded from the analysis.

⁴*Quadros de Pessoal* makes it possible to construct occupational categories based on the 1988 International Standard Classification of Occupations (ISCO-88). This classification allows us to define four skill-levels which are based on: i) the level of general education required to perform a job, and ii) the job-related formal training required to perform a job (ILO, 1990). See Appendix A for a detailed description of this classification. We define high-skill occupations as those falling under "Skill level 4".

Table 1. Descriptive statistics

Variables	All firms		Firms that change ownership	
	Mean	Observations	Mean	Observations
Private ownership	.998 (.047)	2,176,207	.648 (.478)	5,948
Total employment (log)	1.888 (1.091)	2,176,207	3.457 (1.837)	5,948
Number of establishments (log)	.093 (.347)	2,176,207	.586 (1.119)	5,948
Establishment size (log)	1.794 (1.017)	2,176,207	2.871 (1.374)	5,948
Entry rate	.091 (.176)	2,176,207	.063 (.123)	5,948
Exit rate	.109 (.205)	2,176,207	.109 (.191)	5,948
Tenure (log)	1.383 (.967)	1,965,412	1.813 (.990)	5,761
Age (log)	3.579 (.245)	2,176,207	3.658 (.184)	5,948
Share of males	.579 (.410)	2,176,207	.600 (.321)	5,948
Schooling>12	.055 (.184)	2,176,207	.203 (.279)	5,948
Schooling years (log)	1.804 (.405)	2,169,419	2.103 (.402)	5,946
Share of skilled workers	.136 (.268)	2,176,207	.107 (.191)	5,948
Firm-level bargaining	.001 (.031)	2,176,207	.106 (.306)	5,948
Multi-firm bargaining	.003 (.054)	2,176,207	.065 (.245)	5,948
Sectoral bargaining	.876 (.326)	2,176,207	.488 (.496)	5,948
Mandatory bargaining	.089 (.282)	2,176,207	.180 (.379)	5,948
Labor productivity (log)	10.782 (1.099)	1,998,919	11.219 (1.565)	5,192
Sales (log)	12.697 (1.561)	1,998,919	14.751 (2.524)	5,192
Monthly wage (log)	6.467 (.429)	2,176,207	7.083 (.574)	5,948

Notes: Standard deviation in parentheses. Labor productivity, sales and monthly wages are expressed in real terms (prices = 2009), using the GDP deflator for the first two variables and the CPI for the third.

Table 1 provides summary statistics on the resulting firm-level panel data. They reveal

a number of interesting stylized facts on both the population of Portuguese firms and the sub-sample of firms that observed ownership changes during the period of analysis. In particular, firms in this latter group tend to be larger (both in terms of employment levels, number of establishments and total sales), more productive and pay higher wages. In addition, they typically have lower entry rates, higher average tenure, and a more educated workforce (although they have a smaller share of workers performing high-skill occupations).

3 The privatization program

Beginning in the 1990s, Portugal implemented one of the most comprehensive privatization programs in the OECD area (OECD, 2001). Taking into account the size of the economy, Portugal is in fact the largest privatizer in the enlarged European Union, with total privatization revenues of about 14% of GDP over the period 1977-2003. The privatization program comprised a large number of firms covering almost all industries.⁵ While the program initially targeted mainly financial sector corporations, it later covered firms from other services and manufacturing. The bulk of the program was achieved by 1999 with a peak in 1997. The pace of reform has slowed down considerably thereafter with few major firms being privatized between 2000 and 2009. The process has recently regained some momentum under the 2011-2014 EU/IMF economic and financial assistance program. But by then the state had already withdrawn its presence in most sectors, such as brewery, paper and pulp, cement, oil and highways.

According to *Quadros de Pessoal*, between 1991 and 2009 a total of 313 firms were transferred from public to private control (defined as private capital above 50%). The restructuring process further implied that a non-negligible number of firms were transferred from private to public control, while others experienced more than one ownership change during the period of analysis.⁶ In our data set, these two categories amount to 153 and 115 firms, respectively.

4 Empirical strategy

We aim to estimate the causal impacts of private versus public ownership on a wide range of indicators of corporate restructuring. We begin with a standard fixed-effects method

⁵See Bastos et al. (2011) for further institutional details on the Portuguese privatization program.

⁶Although there was no nationalization program in place during the period of analysis, the restructuring process sometimes led to newly privatized firms being acquired by existing public firms in the same industry.

using the panel structure of the data set as follows:

$$Y_{it} = \beta Private_{it} + \delta \mathbf{X}_{it} + \nu_i + \eta_r + \theta_k + \tau_t + \mu_{it}, \quad (1)$$

where Y_{it} is the outcome of interest for firm i in year t , and $Private_{it}$ is a dummy variable that takes the value of one when the firm has private ownership and zero otherwise. The set of regressors further includes: \mathbf{X}_{it} , a vector of firm attributes; ν_i , a firm fixed-effect; η_r , a region effect; θ_k , an industry fixed-effect; τ_t , a year effect; and, finally, μ_{it} , an exogenous disturbance. The firm fixed-effects absorb the impacts on Y_{it} of any time-invariant unobserved firm characteristics. The estimated parameter β is therefore a measure of the differential behavior of outcome Y after the ownership change, stripping out the role of such time-invariant heterogeneity. In some specifications, we will include as well industry-specific time trends to account for the role of idiosyncratic shocks at the sector-level.

A critical issue in examining corporate restructuring due to ownership shifts is how to account for selection bias. The firm fixed-effects approach described above accounts for selection based on time-invariant firm characteristics (e.g., initial revenues or productivity). We further apply the fixed-effects estimator on the sub-sample of firms that observed ownership changes during the period of analysis. In this case, identification of the effects of interest is solely based on differences in the timing of the ownership shift, which may plausibly be uncorrelated with changes in Y . However, time-varying firm attributes may impact on privatization decisions differentially. In particular, selection into privatization may be driven by lagged firm attributes that could be correlated with the indicators of corporate restructuring we consider. To deal with this issue, we adopt a combination of propensity score matching and the fixed-effects estimator, in the spirit of Blundell and Costa Dias (2000) and others.⁷ The propensity score matching technique allows us to control for the selection bias by restricting the comparison to differences within carefully chosen firm pairs that are characterized by similar observable pre-privatization characteristics and trends. The aim of this technique is to build the unobservable counterfactual on how privatized plants would have behaved had they remained state-owned. The underlying assumption is that conditional on observable firm attributes that are relevant for the privatization decision, potential outcomes for treated (privatized) and non-treated (non-privatized) firms are orthogonal to treatment status.

In our application, the propensity score is the predicted probability of a firm being privatized. We estimate this probability using a logit model, drawing on pre-treatment

⁷Related applications using firm-level data include, among many others, Conyon et al. (2002), Girma and Görg (2007), Heyman et al. (2007), Arnold and Javorcik (2009) and Guadalupe et al. (2012).

observations for privatized firms. A firm falls in the control group if it has some public capital but does not experience any ownership change over the period of analysis. To match treated and control firms, we use the Mahalabonis distance in two variables: estimated propensity score and year. The former variable ensures that treated firms are matched with control-group firms with similar pre-treatment observable characteristics and trends, while the latter ensures that observations for each treatment-control pair belong to the same year. The matched sample is composed of all treated firms and corresponding (nearest) control firms. Observations referring the latter group are weighted by the total number of times the same firm is used as control. We then apply the standard firm fixed-effects method described above on this balanced sample.

5 Results

5.1 Fixed-effects estimates

In Tables 2 to 5, we report the fixed-effects estimates of the effects of privatization on the various indicators of corporate restructuring we consider. All regressions include the dummy variables for collective agreement, industry, region and year. The upper panel in each table considers the population of firms, while the lower panel considers only firms that changed ownership during the period of analysis. For each outcome considered, we report results with and without industry trends.

The results in column (1) and (2) of Table 2 suggest that privatization leads to sizable job losses. The estimated effect is at about 22-23% when using the full sample, and falls to 13%-16% when we exploit only the timing of privatization to identify the effect of interest. Changes in firm-level employment can be decomposed into changes in the number of establishments and in average establishment size. Since OLS is a linear operator, the regressions reported in columns (3) to (6) additively decompose the employment effects of privatization on each of these margins. They suggest that most employment losses are due to a decline in the average establishment size, although we also tend to observe a negative and significant impact on the number of establishments.⁸

⁸Further results (not reported but available upon request) suggest that privatization leads to a significant fall in the total number of reported working hours within the firm, as would be expected.

Table 2. Private ownership and size

	Total employment (log)		Number of establishments (log)		Establishment size (log)	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: All firms</i>						
Private ownership	-.215*** (.045)	-.228*** (.045)	-.067*** (.026)	-.069*** (.025)	-.149*** (.034)	-.159*** (.033)
Adjusted R^2	.872	.873	.748	.745	.857	.858
Observations	2,176,207		2,176,207		2,176,207	
<i>Panel B: Firms that change ownership</i>						
Private ownership	-.162*** (.038)	-.126*** (.036)	-.041** (.020)	-.021 (.021)	-.121*** (.032)	-.105*** (.030)
Adjusted R^2	.900	.906	.892	.897	.859	.864
Observations	5,948		5,948		5,948	
Industry trends	no	yes	no	yes	no	yes

Notes: Significance levels: * : 10% ** : 5% *** : 1%. Each column reports the coefficient for private ownership obtained separately in a regression for each dependent variable. Private ownership is an indicator variable that equals one if the firm has at least 50 percent private ownership. All columns control for four wage bargaining regimes and include firm, year, industry and region fixed effects. Standard errors are clustered by firm.

In Table 3 we look at effects of ownership changes on entry and exit rates. The results suggest that job losses reported earlier are mainly driven by higher exit rates. In Tables 4 and 5, we examine whether and how privatization is followed by significant changes in the structure of the workforce. Given the evidence pointing to job losses, it is particularly important to examine the extent to which these might be associated with changes in the structure of employment. We look at impacts on average measures of worker tenure, age and schooling; skill-measures based on worker occupations; and the proportion of male employees. Consistent with the impacts reported earlier on job losses and exit rates, we find a statistically significant decline in average worker tenure. Perhaps surprisingly, however, the results do not show robust evidence of significant impacts on the measures of age, gender, and skill composition of the workforce.

Table 3. Private ownership and worker flows

	Entry rate		Exit rate	
	(1)	(2)	(3)	(4)
<i>Panel A: All firms</i>				
Private ownership	.009* (.005)	.010* (.005)	.012** (.006)	.011* (.006)
Adjusted R^2	.258	.259	.336	.337
Observations	2,176,207		2,176,207	
<i>Panel B: Firms that change ownership</i>				
Private ownership	.004 (.006)	.003 (.006)	.012** (.006)	.012** (.006)
Adjusted R^2	.204	.206	.421	.423
Observations	5,948		5,948	
Industry trends	no	yes	no	yes

Notes: Significance levels: * : 10% ** : 5% *** : 1%. Each column reports the coefficient for private ownership obtained separately in a regression for each dependent variable. Private ownership is an indicator variable that equals one if the firm has at least 50 percent private ownership. All columns control for four wage bargaining regimes and include firm, year, industry and region fixed effects. Standard errors are clustered by firm.

Table 4. Private ownership and worker attributes

	Tenure (log)		Age (log)		Share of males	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: All firms</i>						
Private ownership	-156*** (.034)	-.153*** (.034)	-.018*** (.007)	-.015** (.006)	-.006 (.009)	-.005 (.009)
Adjusted R^2	.719	.721	.681	.683	.807	.807
Observations	1,965,412		2,176,207		2,176,207	
<i>Panel B: Firms that change ownership</i>						
Private ownership	-.109*** (.032)	-.091*** (.032)	-.005 (.006)	-.005 (.006)	-.013 (.008)	-.010 (.009)
Adjusted R^2	.778	.785	.713	.718	.783	.785
Observations	5,761		5,948		5,948	
Industry trends	no	yes	no	yes	no	yes

Notes: Significance levels: * : 10% ** : 5% *** : 1%. Each column reports the coefficient for private ownership obtained separately in a regression for each dependent variable. Private ownership is an indicator variable that equals one if the firm has at least 50 percent private ownership. All columns control for four wage bargaining regimes and include firm, year, industry and region fixed effects. Standard errors are clustered by firm.

Table 5. Private ownership and education

	Schooling > 12		Schooling years (log)		Share of skilled workers	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: All firms</i>						
Private ownership	.004 (.009)	.004 (.009)	.008 (.009)	.006 (.009)	.003 (.007)	.002 (.007)
Adjusted R^2	.706	.708	.778	.779	.534	.540
Observations	2,176,207		2,169,419		2,176,207	
<i>Panel B: Firms that change ownership</i>						
Private ownership	-.005 (.009)	-.003 (.009)	-.002 (.009)	-.004 (.009)	-.005 (.007)	-.004 (.007)
Adjusted R^2	.753	.758	.859	.864	.598	.601
Observations	5,948		5,946		5,948	
Industry trends	no	yes	no	yes	no	yes

Notes: Significance levels: * : 10% ** : 5% *** : 1%. Each column reports the coefficient for private ownership obtained separately in a regression for each dependent variable. Private ownership is an indicator variable that equals one if the firm has at least 50 percent private ownership. All columns control for four wage bargaining regimes and include firm, year, industry and region fixed effects. Standard errors are clustered by firm.

The absence of any significant effect of privatization on skill composition is interesting in relation to a recent empirical study by Chong et al. (2011), who use survey data to analyse the effect of pre-privatization labor policies on privatization prices. They find a negative effect of voluntary retrenchment programs on net privatization prices and suggest that this could be due to adverse selection where mostly high-skilled workers (with higher outside options) tend to leave the firm, leading to a deterioration of the firm's labor stock with a corresponding drop in the privatization price. However, this mechanism cannot be directly verified due to a lack of data on worker attributes. Although the purpose and focus of our study are clearly different, the richness of our data in terms of workforce attributes potentially allows for a more direct verification of such a mechanism. However, we find no evidence of any skill deterioration during the privatization process.

For robustness, we check if our results are sensitive to the definition of private ownership. Thus far, we have used the threshold of 50% of private capital to determine whether the firm is privately- or state-owned. It might be argued, however, that the process of

corporate restructuring induced by the shift in ownership begins even before this threshold is reached. We therefore define a date of ownership change and use this instead of the threshold level of private capital for defining private ownership. We follow the standard approach in the literature (see, e.g., Megginson et al., 1994) of defining the privatization (nationalization) date as the date of the first transfer of property rights from public (private) to private (public) hands for firms that eventually cross the threshold level of 50% of private capital. Reassuringly, the results (reported in Appendix B) are qualitatively and quantitatively very similar.

5.2 Fixed-effects estimates on the matched sample

We now turn to the details of the matching procedure we adopt. Table 6 reports the estimates yielded by the logit selection equation. As mentioned above, selection into privatization may be driven by lagged firm attributes that could be correlated with the indicators of corporate restructuring we use. As potential drivers of such selection processes, we consider lagged values of sales, labor productivity, monthly wages and real sales growth. As is standard, we also include the variable year, to account for the dynamics of the privatization program. It is important to note that the inclusion of these lagged variables implies that we lose a significant number of firms. In particular, those firms that were privatized in the beginning of the sample period (1991 and 1992) and those that have missing values for some of these variables. The final sample employed in this analysis comprises 145 privatized firms. The results of the logit selection equation provide support for the concern that selection into privatization is indeed non-random, with evidence that smaller and more productive firms are more likely to be privatized.

Table 6. Logit model for propensity score estimation

	Private ownership
Lag sales (log)	-.454*** (.085)
Lag labor productivity (log)	.531*** (.110)
Lag monthly wage (log)	.243 (.235)
Lag real sales growth	.001 (.001)
Year	-.208*** (.031)
Industry dummies	yes
Observations	1,191

Notes: Significance levels: * : 10% ** : 5% *** : 1%. Private ownership is an indicator variable that equals one if the firm has at least 50 percent private ownership. Standard errors clustered by firm.

We then implement the matching procedure, following the strategy laid out above. Table C.1 in the appendix provides a set of standard tests of matching quality. Panel A reports inference output of t-tests comparing the treated and control groups (actually assigned by the matching procedure), and indicates that there is no statistically significant difference in the means of all variables included in the selection equation between treatment and control groups. Panel B shows that the selection model estimated on the matched sample has a lower and statistically insignificant explanatory power, as expected, since the treated and control groups are equal in the observable characteristics used in the selection model. Panel C reports the output of a Hotelling T^2 test of the joint null of equal means of all variables. This test is applied to the treatment and controls groups and reveals that the hypothesis that vectors of means are equal for the two groups cannot be rejected.

Table 7. Results from matching difference-in-differences

	Total employment (log) (1)	Number of establishments (log) (2)	Establishment size (log) (3)
Private ownership	-.132*** (.045)	-.067** (.035)	-.065 (.041)
Adjusted R^2	.917	.924	.855
Observations	2,940	2,940	2,940
		Entry rate (4)	Exit rate (5)
Private ownership		-.003 (.007)	.009 (.012)
Adjusted R^2		.412	.482
Observations		2,940	2,940
	Tenure (log) (6)	Age (log) (7)	Share of males (8)
Private ownership	-.030 (.026)	-.009* (.005)	.002 (.008)
Adjusted R^2	.823	.721	.834
Observations	2,881	2,2940	2,940
	Schooling > 12 (9)	Schooling years (log) (10)	Share of skilled workers (11)
Private ownership	.010 (.010)	-.004 (.010)	-.004 (.008)
Adjusted R^2	.803	.849	.674
Observations	2,940	2,939	2,940

Notes: Significance levels: * : 10% ** : 5% *** : 1%. Each column reports the coefficient for private ownership obtained separately in a regression for each dependent variable. Private ownership is an indicator variable that equals one if the firm has at least 50 percent private ownership. All columns control for four wage bargaining regimes and include firm, year, industry and region fixed effects. Bootstrapped standard errors, 300 replications.

Given the evidence supporting the validity of the research design, we now turn to the estimates of the causal effects of privatization on the outcomes considered earlier. Table 7 reports the fixed-effects estimates based on the matched sample. The results are, in general, fairly similar to those reported above: privatization induces sizable job losses, reflecting in part a reduction in the number of establishments. The remaining estimates remain qualitatively similar, although some impacts are somewhat less precisely estimated. Since the implementation of the matching procedure entails a significant drop in sample

size, we should nevertheless remain cautious in drawing strong conclusions about such insignificant results.

6 A theoretical discussion

We can explain our main empirical result – the negative employment effect of privatization – by using a theoretical framework similar to Monteiro et al. (2011) and Bastos et al. (2011), where privatization is modelled as having potentially two different effects: *increased profit orientation* and *less job security* (leading to higher worker effort).

Consider a single firm with a production function

$$y = eL, \tag{2}$$

where L is the number of labor units used and e is effort per labor unit. Assuming that the firm faces a downward-sloping demand curve, given by the inverse demand function $p(y)$, the profits of the firm are

$$\pi = p(y)y - wL, \tag{3}$$

where w is the wage rate per unit of labor.⁹ Allowing for firm objectives that differ from pure profit maximization, the objective function of the firm is assumed to be

$$\Omega = \pi + \alpha S, \tag{4}$$

where

$$S = \int_0^y (p(x) - p(y)) dx \tag{5}$$

is consumers' surplus and $\alpha > 0$ is the weight attached to consumers' surplus in the objective function of the firm. Choosing L to maximize Ω , the optimal employment level chosen by the firm is implicitly given by

$$(1 - \alpha) p'(y)y + p(y) = \omega, \tag{6}$$

⁹We assume here that the wage level is exogenously given. However, the employment effects of privatization in this theoretical framework are qualitatively similar if we endogenise wages by assuming that they are decided in bargaining between the firm and a trade union, as in Monteiro et al. (2011), or that they are a result of firm-specific 'fair wage' policies, as in Bastos et al. (2011). Empirical results from additional regressions (not reported but available upon request) show that our findings hold when controlling for wages.

where $\omega := \frac{w}{e}$ is the *effective* wage rate.¹⁰ From (6) we can derive how increased profit orientation or less job security affects the optimal employment level.

Totally differentiating (6), the effect of increased profit orientation (i.e., a reduction in α) on optimal employment is given by

$$\frac{\partial L}{\partial \alpha} = \frac{p'(y) L}{(1 - \alpha)(p''(y)y + p'(y)) + p'(y)} < 0. \quad (7)$$

This is quite intuitive. All else equal, a higher consideration for consumers' surplus implies operating at a higher level of output, with a correspondingly lower price. Consequently, if privatization implies a change in firm objectives towards more profit-orientation, the firm will optimally reduce output in order to achieve a higher market price and thereby increase profits. All else equal, this implies a downsizing of the labor force.

The other postulated effect of privatization is a reduction of job security.¹¹ Applying a standard efficiency wage argument, we assume that worker effort depends negatively on the degree of job security.¹² Consequently, following this line of reasoning, privatization is likely to lead to higher worker effort. How does this affect employment? Totally differentiating (6) with respect to L and e , this particular effect of privatization is (after some algebraic manipulations) analytically given by

$$\frac{\partial L}{\partial e} = \frac{L}{e}(\eta - 1), \quad (8)$$

where

$$\eta := -\frac{\partial L}{\partial w} \frac{w}{L} = \frac{-\omega}{y[(1 - \alpha)(p''(y)y + p'(y)) + p'(y)]} \quad (9)$$

is the wage elasticity of labor demand. Thus, higher worker effort leads to lower employment if labor demand is sufficiently inelastic ($\eta < 1$), and higher employment otherwise ($\eta > 1$). This ambiguity is the result of two counteracting effects. On the one hand, higher worker effort reduces the effective wage rate (ω), which tends to increase labor demand.

¹⁰The second-order condition is given by

$$e^2 [(1 - \alpha)(p''(y)y + p'(y)) + p'(y)] < 0,$$

which requires that the demand function is 'not too convex'.

¹¹In most countries (including Portugal), workers in public firms are subject to specific employment regulations which, due to more restrictive dismissal rules, allow them to enjoy a higher degree of job security than private sector workers (see, e.g., Friebel and Magnac, 2007; OECD, 2008; Viana, 2007, pp. 11-12).

¹²See Bastos et al. (2011) for a more thorough discussion of this assumption with references to empirical evidence.

On the other hand, higher effort means that a given output can be produced with fewer workers, which tends to reduce the demand for labor. The relative strength of these two effects depends on the wage elasticity of labor demand. If demand is inelastic ($\eta < 1$), a reduction in the effective wage rate leads to a less-than-proportional increase in the demand for effective labor units. Thus, the firm does not need the entire existing labor force (which is now more productive due to higher effort) in order to meet the increased demand for effective labor units, causing total employment to drop.¹³

From (9) we see that the degree of profit orientation (inversely measured by α) generally affects the wage elasticity of labor demand, which complicates the relationship between worker effort and employment if privatization leads to both higher profit orientation and higher worker effort. These general relationships are greatly simplified if we consider the special case of linear demand. Assuming that the inverse demand function is given by $p = a - by$, the optimal level of employment is given by

$$L = \frac{a - \omega}{\phi(2b - \alpha)}. \quad (10)$$

It is relatively straightforward to show that the wage elasticity of labor demand (at the optimal employment level) is given by

$$\eta = \frac{\omega}{a - \omega} \quad (11)$$

and does not depend on the degree of profit orientation. The condition $\eta < 1$ translates into $\omega < \frac{a}{2}$, implying that higher worker effort will reduce employment if the effective wage rate is sufficiently low to begin with.

Summing up, it is theoretically possible to explain the negative relationship between privatization and employment both as a result of increased profit orientation and as a result of less job security. However, besides the underlying assumption of a negative relationship between job security and worker effort, the latter explanation also requires that labor demand is sufficiently inelastic.

7 Conclusion

We have examined corporate restructuring following privatization using unusually rich data covering the population of Portuguese firms over the period 1991-2009, when the

¹³These insights are not novel, and the relationship between worker productivity and labor demand, given by (8), was first shown by Dowrick and Spencer (1994). See also Lommerud et al. (2006) for further analysis and discussion.

country adopted one of the most ambitious privatization programs in the OECD. We have provided evidence that a shift from public to private ownership leads to sizable job losses, reflecting both a reduction in the number of establishments and less employees per establishment. Perhaps surprisingly, our estimates provide no robust evidence that privatization influences the structure of the workforce, as measured by a variety of indicators.

To help interpret our main empirical finding – that privatization leads to sizable job losses – we have presented a theoretical model in which the ownership shift increases the degree of profit orientation and reduces the degree of job security. Greater profit orientation leads, all else equal, to an unambiguous reduction in employment levels. Less job security can have a similar impact, but only if labor demand is sufficiently inelastic.

Appendix A: Definition of skill groups

In the econometric analysis, we include a group of dummy variables to control for the skill level associated with the worker's occupation, as defined in the ISCO-88 classification. Table A.1 presents the definition of skill groups.

Table A.1. Description of ISCO skills

Skill	Description	ISCO Major group
Skill level 1	Competence associated with general education usually acquired by completion of compulsory education.	(9) Elementary occupations
Skill level 2	Requires knowledge as for first skill level, but typically a longer period of worker-related training or work experience.	(4) Clerks; (5) Service workers and shop and market sales workers; (6) Skilled agriculture and fishery; (7) Craft and related workers; (8) Plant and machine operators and assemblers
Skill level 3	Requires a body of knowledge associated with a period of post-compulsory education but not to degree level.	(3) Technicians and associate professionals
Skill level 4	Normally requires a degree or an equivalent period of relevant work experience.	(1) Legislators, senior officials and managers; (2) Professionals

Appendix B: Alternative definition of private ownership

In this appendix we report fixed-effects estimates analogous to those presented in Tables 2–5, but based on an alternative definition of private ownership. In particular, we define a date of ownership change and use this date instead of the 50% threshold level of private capital. Under this alternative definition, privatization (nationalization) coincides with the first transfer of property rights from public (private) to private (public) hands (for firms that eventually cross the threshold level of 50% of private capital). Reassuringly, the results reported in tables B.1-B.4 are qualitatively and quantitatively very similar.

Table B.1. Private ownership and size

	Total employment (log)		Number of establishments (log)		Establishment size (log)	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: All firms</i>						
Private ownership	-.198*** (.058)	-.220*** (.056)	-.094*** (.037)	-.099*** (.037)	-.104** (.041)	-.121*** (.040)
Adjusted R^2	.872	.873	.748	.749	.857	.858
Observations	2,176,207		2,176,207		2,176,207	
<i>Panel B: Firms that change ownership</i>						
Private ownership	-.135*** (.044)	-.114*** (.043)	-.054** (.026)	-.044 (.027)	-.082** (.039)	-.070* (.036)
Adjusted R^2	.899	.905	.892	.897	.859	.864
Observations	5,948		5,948		5,948	
Industry trends	no	yes	no	yes	no	yes

Notes: Significance levels: * : 10% ** : 5% *** : 1%. Each column reports the coefficient for private ownership obtained separately in a regression for each dependent variable. Private ownership is an indicator variable that equals one when the first transfer of property rights from public to private hands occurs for firms that eventually reach at least 50 percent private ownership. All columns control for four wage bargaining regimes and include firm, year, industry and region fixed effects. Standard errors are clustered by firm.

Table B.2. Private ownership and worker flows

	Entry rate		Exit rate	
	(1)	(2)	(3)	(4)
<i>Panel A: All firms</i>				
Private ownership	.002 (.005)	.004 (.006)	.012* (.006)	.011* (.006)
Adjusted R^2	.258	.259	.336	.337
Observations	2,176,207		2,176,207	
<i>Panel B: Firms that change ownership</i>				
Private ownership	-.004 (.006)	-.004 (.006) (.007)	.013** (.006)	.012* (.006)
Adjusted R^2	.204	.206	.421	.423
Observations	5,948		5,948	
Industry trends	no	yes	no	yes

Notes: Significance levels: * : 10% ** : 5% *** : 1%. Each column reports the coefficient for private ownership obtained separately in a regression for each dependent variable. Private ownership is an indicator variable that equals one if the firm has at least 50 percent private ownership. All columns control for four wage bargaining regimes and include firm, year, industry and region fixed effects. Standard errors are clustered by firm.

Table B.3. Private ownership and worker attributes

	Tenure (log)		Age (log)		Share of males	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: All firms</i>						
Private ownership	-.152*** (.036)	-.155*** (.036)	-.021*** (.007)	-.018** (.006)	.007 (.009)	.008 (.009)
Adjusted R^2	.719	.721	.681	.683	.807	.807
Observations	1,965,412		2,176,207		2,176,207	
<i>Panel B: Firms that change ownership</i>						
Private ownership	-.096*** (.036)	-.086** (.036)	-.0003 (.006)	-.0005 (.006)	-.002 (.009)	.0003 (.010)
Adjusted R^2	.777	.785	.713	.718	.783	.785
Observations	5,761		5,948		5,948	
Industry trends	no	yes	no	yes	no	yes

Notes: Significance levels: * : 10% ** : 5% *** : 1%. Each column reports the coefficient for private ownership obtained separately in a regression for each dependent variable. Private ownership is an indicator variable that equals one if the firm has at least 50 percent private ownership. All columns control for four wage bargaining regimes and include firm, year, industry and region fixed effects. Standard errors are clustered by firm.

Table B.4. Private ownership and education

	Schooling > 12		Schooling years (log)		Share of skilled workers	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: All firms</i>						
Private ownership	.016* (.010)	.014 (.010)	.013 (.010)	.013 (.010)	.007 (.007)	.004 (.007)
Adjusted R^2	.706	.708	.778	.779	.537	.540
Observations	2,176,207		2,169,419		2,176,207	
<i>Panel B: Firms that change ownership</i>						
Private ownership	-.0002 (.010)	.001 (.010)	-.006 (.011)	-.006 (.010)	-.007 (.007)	-.006 (.007)
Adjusted R^2	.752	.758	.859	.864	.598	.602
Observations	5,948		5,946		5,948	
Industry trends	no	yes	no	yes	no	yes

Notes: Significance levels: * : 10% ** : 5% *** : 1%. Each column reports the coefficient for private ownership obtained separately in a regression for each dependent variable. Private ownership is an indicator variable that equals one if the firm has at least 50 percent private ownership. All columns control for four wage bargaining regimes and include firm, year, industry and region fixed effects. Standard errors are clustered by firm.

Appendix C: Balancing tests

Table C.1 reports the tests of matching quality discussed in section 5.2.

Table C.1. Indicators of matching quality

<i>Panel A: Standardized bias and t-test</i>					
Variables	Mean		Absolute bias	<i>t</i> -test	
	Treated	Control		<i>t</i>	<i>p</i> -value
Lag sales (log)	15.318	15.093	8.6	0.75	0.451
Lag labor productivity (log)	11.392	11.572	11.8	-0.90	0.367
Lag monthly wage (log)	7.157	7.142	2.7	0.24	0.813
Lag real sales growth	24.066	28.029	3.5	-0.23	0.820
Year	2000.3	2000.1	3.5	0.27	0.790
<i>Industries</i>					
Food, beverages and tobacco	0.048	0.021	18.0	1.29	0.199
Wood, cork and paper	0.034	0.014	12.3	1.15	0.253
Non-metallic products	0.069	0.055	7.3	0.49	0.628
Metallic products	0.041	0.090	26.9	-1.66	0.097
Electricity, gas and water	0.110	0.090	6.9	0.59	0.559
Construction	0.021	0.014	4.9	0.45	0.653
Wholesale and retail trade	0.055	0.103	24.3	-1.52	0.129
Hotels and restaurants	0.055	0.021	17.6	1.54	0.125
Transport and storage	0.110	0.124	3.8	-0.36	0.716
Post and telecommunications	0.028	0.014	9.6	0.82	0.411
Financial intermediation	0.117	0.145	11.2	-0.69	0.488
Real estate and other	0.145	0.152	1.8	-0.16	0.869
Education	0.041	0.055	7.3	-0.55	0.585
Health and social work	0.048	0.028	9.5	0.92	0.358
Other social services	0.062	0.076	4.1	-0.46	0.644
<i>Panel B: Pseudo R² and test of joint significance of regressors</i>					
Sample	Pseudo R ²	χ^2	<i>p</i> -value		
Unmatched	0.252	222.61	0.000		
Matched	0.055	22.28	0.235		
<i>Panel C: Hotelling T² test</i>					
	<i>T</i> ²	<i>F</i> -stat	<i>p</i> -value	Observations	
	22.475	1.050	0.404	290	

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