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Firm ownership and rent sharing

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Abstract

We analyse – theoretically and empirically – how private versus public ownership of firms affects the degree of rent sharing between firms and their workers. Using a particularly rich linked employer-employee dataset from Portugal, covering a large number of corporate ownership changes across a wide spectrum of economic sectors over more than 20 years, we find a positive relationship between private ownership and rent sharing. Based on our theoretical analysis, this result cannot be explained by private firms being more profit oriented than public ones. However, the result is consistent with privatisation leading to less job security, implying stronger efficiency wage effects.

Keywords: rent sharing; private vs public ownership; panel data

JEL Classifications: J45; D21; C23

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1 Introduction

Rent sharing between firms and their workers is a widely documented feature of labour markets in many countries (e.g., Mumford and Dowrick, 1994; Blanchflower et al., 1996; Black and Strahan, 2001; Arai, 2003; Estevão and Tevlin, 2003; Budd et al., 2005; Güertzgen, 2009). Still, the understanding of which characteristics of firms and workers that contribute to the size and extent of such rent sharing is still not fully developed. The present paper explores the effect of an hitherto rather neglected explanatory variable of rent sharing, namely corporate ownership. More precisely, we analyse – theoretically and empirically – how the degree of private versus public ownership of firms affects the level of rent sharing.

To our knowledge, there exists little or no documented theoretical understanding of the link between firm ownership and rent sharing, and so far, the empirical evidence on this relationship is fairly scant and also geographically narrow, almost exclusively limited to economies from Eastern Europe. For example, Grosfeld and Nivet (1999), Dobbeleare (2004) and Luke and Schaffer (2000) explore this relationship in Poland, Bulgaria and Russia, respectively. Monteiro and Portela (2010) is one exception, but their analysis is confined to a specific economic industry (banking) in a Western European economy (Portugal). The evidence from these studies is consensual in suggesting that the degree of rent sharing is larger in publicly owned firms. However, these studies all suffer from some common drawbacks. They all use data representing only one or a subset of industries. Data is also collected at firm level, for relatively short time periods, and contains, at best, a very limited number of firm attributes.[1] In addition, these studies lack a theoretical mechanism that might explain their findings.

By combining a theoretical model with a comprehensive empirical analysis, we are able to contribute both to the literature on rent sharing and to the quite separate literature on public versus private firm ownership. Our empirical contributions rely on the quality and scope of our data as well as various aspects of our empirical methods and strategies.

[1] Monteiro and Portela (2010) is an exception as they use very rich data available for 18 years.

We provide evidence from a country (Portugal) that offers a particularly rich opportunity to analyse the effects of firm ownership changes. Indeed, Portugal has experienced a comprehensive corporate restructuring process, which included both privatisations and nationalisations (although more of the former) of a very large number of firms (more than 1000 in total) in several economic sectors (including both manufacturing and services) over a long period of time. These reforms also led to a number of firms with different ownership configurations (fully private, fully public or mixed ownership) within each industry. These firms are then used as alternative comparison groups to control for industry-specific shocks and to disentangle ownership from industry effects.

We also benefit from a very rich matched employer-employee dataset (*Quadros de Pessoal*) available for more than 20 years. These linked data allows us to build panel datasets defined at different units of observation, firm and worker, as these units are assigned unique and invariant identifiers. Therefore, we are able to control for two sources of unobserved heterogeneity (worker and firm) and to assess directly the importance of the level of data aggregation for the magnitude of rent sharing. In the context of rent sharing, this is, to our knowledge, the first study that accounts for the effect of the level of data aggregation. In our empirical analysis we implement a recent procedure, discussed in Guimarães and Portugal (2009), that allows for the estimation of models with two high-dimensional fixed effects. As we show later, using data disaggregated at worker level and controlling for both sources of heterogeneity significantly reduces the magnitude of rent sharing.

In contrast to most previous studies, when defining firm ownership we do not impose any threshold value of private ownership, but rather treat it as a continuous variable representing the fraction of shares held by private shareholders. The richness of our data also allows us to compare the magnitude of rent sharing, and the respective impact of firm ownership, across different economic sectors.

Our empirical analysis is preceded by a theoretical section where we build a model that combines union-firm wage bargaining with efficiency wage effects, and allows us to

define a measure of the degree of rent sharing. The received theoretical literature does not offer a consensual answer to the question of what distinguishes firms with private and public ownership. The two most commonly explored differences are related to firm objectives and productive efficiency, where the latter can sometimes be a result of the former. Public and private firms having different objectives is a standard approach in the literature on mixed oligopolies, where it is typically assumed that private firms maximise profits while public firms have a broader objective, taking also the interests of consumers and workers into account (see, e.g., DeFraja and Delbono, 1989; Cremer et al., 1991; Haskel and Szymanski, 1993; Ishida and Matsushima, 2009). Regarding productive efficiency, although the empirical literature is far from unanimous, there is ample evidence that private firms have lower production costs than comparable public ones (see Megginson and Netter, 2001, and several references therein). Such a difference in productive efficiency might be explained by agency theory and contract incompleteness.[2]

The two above-mentioned differences between public and private firms are also included in our theoretical analysis, where we explore two alternative hypotheses within the same modelling framework: i) private firms are more profit oriented, and/or ii) private firm ownership implies less job security for workers, leading to increased effort through a stronger efficiency wage effect. While these two hypotheses are clearly not mutually exclusive, we show that the implications for the degree of rent sharing are quite different. This enables us to use the empirical analysis as an implicit test of the relative importance of these two explanations.

Our main empirical result is that rent sharing is significantly higher in firms with a higher degree of private ownership. This result is qualitatively robust to different levels of analysis – firm or worker level. It is also robust to alternative definitions of ownership

[2] For example, Schmidt (1996a, 1996b) shows that the presence of soft budgets implies that managers of publicly owned firms have weaker incentives to minimise costs, since ex ante threats by the owner (government) to shrink or shut down inefficient firms are not credible. In a context of mixed oligopoly, Matsumura and Matsushima (2004) show that higher productive efficiency in private firms could also be due to strategic investment in cost-reducing efforts. In a different approach, Haskel and Sanchis (1995) focus on worker effort rather than managerial effort and find that, under certain conditions, privatisation increases worker effort, which is assumed to be a result of bargaining between firms and workers. See also Cavaliere and Scabrosetti (2008) for a survey of the theoretical literature on privatisation and efficiency.

(based on threshold values of private ownership shares) and to the use of different control groups. Thus, using a particularly rich and extensive panel dataset, we obtain a result that runs contrary to the existing (though scant) empirical literature on this particular topic. Based on our theoretical analysis, this result cannot be explained by differences in the degree of profit orientation and is thus *not* consistent with the hypothesis that the only effect of privatisation is that firms become more profit oriented. However, the result can be explained by stronger efficiency wage effects due to less job security in private firms.

The plan for the rest of the paper is as follows. In the next section, we lay out the conceptual framework to explain how firm ownership can affect the degree of rent sharing. In Section 3, we describe the data and the institutional background, and present descriptive statistics of the sample. The empirical analysis, both at firm and worker level, is reported in Section 4. Section 5 offers further robustness results. We conclude the analysis by Section 6.

2 A theoretical framework

Our point of departure is a right-to-manage bargaining framework where wages are subject to bargaining between a firm and a trade union prior to the firm's choice of employment level. In order to allow for several different effects of public versus private firm ownership, we extend the standard framework in two directions: (i) allowing firms to deviate from profit-maximising behaviour, and (ii) allowing for efficiency wage effects.

Abstracting from non-labour inputs, we assume that the firm's production function is given by $y = \phi L$, where L denotes the level of employment and ϕ is a productivity parameter reflecting worker effort. We allow for efficiency wage effects by assuming that labour productivity is given by

$$\phi = \alpha + \mu \left(w - \overline{w} \right)^{\gamma}, \quad \gamma \in (0, 1), \tag{1}$$

where w is the wage paid by the firm and $\overline{w}$ is the workers' reservation wage level. This is

a standard reduced-form efficiency wage relationship, where worker effort depends, partly, on the difference between inside and outside options.[3] The parameter $\mu \geq 0$ measures the strength of the efficiency wage effect. Thus, as long as μ is strictly positive, the wage level affects production directly through the efficiency wage mechanism, implying that the firm's output can be expressed as $y(w, L) = \phi(w) L$.

Assuming that the firm faces a downward sloping demand curve, $p(y)$, profits are given by

$$\pi(w, L) = R(w, L) - wL, \tag{2}$$

where the revenue function is $R(w, L) = p(y(w, L)) y(w, L)$. We allow for non-profit-maximising behaviour by assuming that the firm's objective function is given by

$$\Phi(w, L) = \pi(w, L) + \delta_s S(w, L) + \delta_u U(w, L), \quad \delta_s \geq 0, \quad \delta_u \geq 0, \tag{3}$$

where $S(\cdot)$ is consumers' surplus and $U(\cdot)$ is union utility (to be defined below). Thus, the parameters δ_s and δ_u are inverse measures of the degree of profit orientation. Strictly positive values of δ_s and δ_u are frequently used assumptions for public firms, reflecting the fact that governments' concern for re-election would lead them to take the preferences of various interest groups into consideration (see, e.g., Haskel and Szymanski, 1993; Haskel and Sanchis, 1995; Ishida and Matsushima, 2009).

Workers are represented by a trade union whose objective is to maximise a Stone-Geary-type utility function given by

$$U(w, L) = (w - \overline{w})^{\theta} L, \tag{4}$$

where the parameter $\theta > 0$ measures how much the union values wages relative to employment. A standard interpretation of θ is that it represents the relative power of insiders versus outsiders, where the former are more protected against layoffs and want to push up wages to a larger degree than the latter (see, e.g., Sanfey, 1995).

[3] Similar functional forms are used by, e.g., Summers (1988) and Garino and Martin (2000).

Assuming Nash bargaining with zero fallback payoff for both players, the wage is given by

$$w^* = \arg\max \left\{ \beta \ln U\left(w, L\left(w\right)\right) + \left(1-\beta\right) \ln \Phi\left(w, L\left(w\right)\right) \right\}, \tag{5}$$

where $\beta \in (0,1)$ represents the relative bargaining strength of the union and $L\left(w\right)$ solves $\partial \Phi\left(w, L\right) / \partial L = 0$.

By some manipulation of the first-order condition of the maximisation problem specified in (5), we can express the bargained wage as follows:

$$w^* = \left(1-\rho\right) \overline{w} + \rho \left(\frac{R\left(w,L\right)}{L} + \delta_s \frac{S\left(w,L\right)}{L} + \delta_u \frac{U\left(w,L\right)}{L} \right), \tag{6}$$

where

$$\rho := \frac{\beta\left(\theta - \eta\right)}{\beta\left(\theta-\eta\right) + \left(1 - \left(\kappa + \delta_s \psi + \delta_u \xi\right)\right)\left(1-\beta\right)}, \tag{7}$$

$$\kappa := \frac{\partial}{\partial w}\left(\frac{R\left(w,L\right)}{L}\right), \quad \psi := \frac{\partial}{\partial w}\left(\frac{S\left(w,L\right)}{L}\right), \quad \xi := \frac{\partial}{\partial w}\left(\frac{U\left(w,L\right)}{L}\right) \tag{8}$$

and

$$\eta := -\frac{\partial L\left(w\right)}{\partial w} \frac{\left(w - \overline{w}\right)}{L}. \tag{9}$$

With the above wage formulation, the degree of rent-sharing is given by the parameter ρ, which depends on the parameters β, θ, δ_s and δ_u, as well as the endogenous variables κ, ψ, ξ and η.[4,5] Thus, there are several different channels through which the degree of rent-sharing is determined. It is straightforward to confirm that the degree of rent-sharing (ρ) is increasing in β, θ, δ_s, δ_u, κ, ψ and ξ, while decreasing in η. However, these channels are obviously not all independent of each other. A change in any of the exogenous parameters (β, θ, δ_s, δ_u) will generally have indirect effects on rent-sharing through the endogenous

[4] If we assume away non-profit-maximising behaviour and efficiency wage effects, i.e., $\delta_s = \delta_u = \kappa = 0$, the wage formulation in (6), and the corresponding rent-sharing coefficient, are similar to the ones derived by Mumford and Dowrick (1994).

[5] Notice that a well-defined maximisation problem implies $\theta > \eta$ and $\kappa + \delta_s \psi + \delta_u \xi < 1$ for $w = w^*$.

variables (κ, ψ, ξ, η).[6,7]

How is the degree of private versus public firm ownership likely to affect the degree of rent-sharing? Assuming that the wage orientation (θ) and relative bargaining strength (β) of unions are constant across different ownership configurations, we postulate two different (but not necessarily mutually exclusive) hypotheses about the effects of firm ownership changes (privatisations or nationalisations), both of which have a foundation in existing theory.

(i) Privatisation implies a change in firm objectives towards more profit orientation. A standard assumption in the economics literature on private versus public corporate ownership is that private firms maximise profits while public firms maximise something else, usually some linear combination of profits and the utility of different interest groups in the economy. In our model, this hypothesis corresponds to an inverse relationship between the degree of private ownership and the parameters δ_s and δ_u; in other words, privatisation of a firm implies a reduction in one or both of δ_s and δ_u. A reduction in δ_s or δ_u will directly reduce the degree of rent-sharing, but this direct effect is complemented by potential indirect effects through κ, ψ, ξ and η, making the overall effect a priori ambiguous.

(ii) Privatisation implies a reduction in job security for workers. With respect to labour market characteristics, an important difference between public and private firms (at least in most European countries) is that workers in public firms are subject to specific employment rules which, due to more restrictive dismissal rules, allow them to enjoy a higher degree of job security (see, e.g., Friebel and Magnac, 2007; OECD, 2008). It seems

[6] While η represents the elasticity of labour demand, κ, ψ and ξ measure the marginal wage effect on, respectively, revenues per worker, consumers' surplus per worker and union utility per worker, for a given level of employment (i.e., the marginal efficiency wage effect). Notice also that $\xi = 1$ for a rent-maximising union ($\theta = 1$).

[7] The bargained wage in (6) is an interior solution. However, if δ_s and δ_u are sufficiently large, this solution implies negative profits for the firm. Thus, if we impose a limited liability constraint on the firm, the solution might be one where this constraint binds. Suppose that the profits of the firm must be at least B (in the case of a public firm, B might even be negative). If this constraint binds, the firm will always set employment such that $w = -\frac{B}{L} + \frac{R(\cdot)}{L}$, implying that the rent-sharing coefficient is equal to one (i.e., the maximum degree of rent-sharing). For the remainder of the analysis, we disregard this possibility, which essientially implies that we assume $\delta_s + \delta_u$ to be sufficiently small for an interior solution to exist.

reasonable to expect that the degree of job security would influence the strength of any efficiency wage effect. More specifically, a relative improvement in inside versus outside options should have a stronger motivational effect on workers (in terms of effort) if the degree of job security is lower.[8] In the extreme case of 100% job security, there would be no efficiency wage motive for expending effort, since the inside option can be secured with certainty.[9] In our model, we would therefore expect an inverse relationship between the degree of job security and the parameter μ in the labour productivity function (1). From (7) we see that μ does not affect the degree of rent-sharing directly, but only indirectly through κ, ψ, ξ and η.

In order to analyse the effects of δ_s, δ_u and μ on the degree of rent-sharing, we need to make some assumptions on the demand function $p(y)$. In the following we will consider two different cases: linear and iso-elastic demand. Closed-form solutions for the key variables are presented in Table 1. The most important observation we can make at this stage is to notice that neither η nor $\kappa + \delta_s\psi + \delta_u\xi$ depend on the weight placed on consumers' surplus (δ_s). Since $(R + \delta_s S + \delta_u U)/L$ is also independent of δ_s, it follows from (6) that the bargained wage is likewise independent of the degree to which the firm cares about consumers' surplus. Consequently, there are no indirect effects through the bargained wage and we can conclude that changes in δ_s do not affect the degree of rent-sharing between a firm and its workers, as measured by the parameter ρ. This conclusion holds for the case of linear as well as for iso-elastic demand, and it holds regardless of whether there are efficiency wage effects or not. Thus, the only way a change in profit orientation can affect the degree of rent-sharing is through the weight on union utility in the firm's objective function.

Having excluded the possibility of a (positive or negative) relationship between δ_s and ρ, the two remaining parameters of interest are δ_u and μ, implying two very different mechanisms for firm ownership to affect rent-sharing. In order to analyse these two mech-

[8] See also Goerke (1998) for a discussion of stronger efficiency wage effects in private firms due to lower job security.

[9] Although higher job security reduces the efficiency wage effect, there might of course still be a positive relationship between wages and effort, for example due to fair wage considerations (Akerlof and Yellen, 1990), even for the case of 100% job security.

Table 1: Closed-form solutions for key variables

	Linear demand	Iso-elastic demand
p	$a - by$	$\left(\frac{a}{y}\right)^{\frac{1}{\varepsilon}}$
S	$\frac{b}{2}y^2$	$\frac{p(y)y}{\varepsilon-1}$
L	$\frac{a\phi-\omega}{b\phi^2(2-\delta_s)}$	$\frac{a}{\phi}\left(\frac{(\varepsilon+\delta_s-1)\phi}{\varepsilon\omega}\right)^{\varepsilon}$
$\frac{R+\delta_s S+\delta_u U}{L}$	$\frac{a\phi+w+\delta_u\varpi^\theta}{2}$	$\frac{\varepsilon w-\delta_u\varpi^\theta}{(\varepsilon-1)}$
κ	$\frac{\gamma\mu(2\omega-\delta_s a\phi)}{\varpi^{1-\gamma}(2-\delta_s)\phi}$	$\frac{\gamma\mu(\varepsilon-1)\varepsilon\omega}{\varepsilon\phi(\varepsilon+\delta_s-1)\varpi^{1-\gamma}}$
ψ	$\frac{\gamma\mu(a\phi-\omega)}{\varpi^{1-\gamma}(2-\delta_s)\phi}$	$\frac{\gamma\mu\omega}{\phi(\varepsilon+\delta_s-1)\varpi^{1-\gamma}}$
ξ	$\theta\varpi^{\theta-1}$	$\theta\varpi^{\theta-1}$
$\kappa+\delta_s\psi+\delta_u\xi$	$\frac{w\gamma\mu\varpi^\gamma+\delta_u\varpi^\theta(\theta\phi-\gamma\mu\varpi^\gamma)}{\phi\varpi}$	$\frac{w\gamma\mu\varpi^\gamma+\delta_u\varpi^\theta(\theta\phi-\gamma\mu\varpi^\gamma)}{\phi\varpi}$
η	$\frac{\phi\varpi+(a\phi-2w)\gamma\mu\varpi^\gamma+\delta_u\varpi^\theta(2\gamma\mu\varpi^\gamma-\theta\phi)}{\phi(a\phi-\omega)}$	$\frac{\varepsilon\left(\phi\varpi-\delta_u\varpi^\theta(\theta\phi-\gamma\mu\varpi^\gamma)-w\gamma\mu\varpi^\gamma\right)+\gamma\mu\omega\varpi^\gamma}{\phi\omega}$

Notation: $\varpi := w - \overline{w}$; $\omega := w - \delta_u\varpi^\theta$

anisms, we rely on numerical simulations based the expressions derived in Table 1. The effects of a change in firm objectives (δ_u) for the cases of linear and iso-elastic demand are reported in Table 2, while the corresponding effects of a change in job security (μ) are reported in Table 3. In each case, we show the results for different values ("low" and "high") of union wage orientation (θ) bargaining power (β). Since the degree to which firms take consumers' surplus into account has been shown to have no effect on rent-sharing, we set $\delta_s = 0$. Furthermore, we include each of the two mechanisms separately, by setting $\mu = 0$ when examining changes in firm objectives, and setting $\delta_u = 0$ when analysing changes in job security.[10]

Consider first the effects of a change in firm objectives towards more profit orientation (Table 2). This will naturally lead to a lower bargained wage and higher profits. The effects on employment and revenues are ambiguous and depend on whether the union is wage oriented ($\theta > 1$) or employment oriented ($\theta < 1$). A shift towards more profit orientation will increase (reduce) employment and revenues if the union is wage (employment) oriented. If the firm bargains with a rent-maximising union ($\theta = 1$), employment and

[10] Analysing changes in firm objectives in the presence of efficiency wage effects, or analysing changes in job security in the presence of non-profit-maximising behaviour, would not qualitatively alter the main results.

Table 2: Change in firm objectives

Part A: linear demand

	$\theta = 1$				$\beta = \frac{1}{2}$			
	$\beta = \frac{1}{4}$		$\beta = \frac{3}{4}$		$\theta = \frac{1}{2}$		$\theta = \frac{3}{2}$	
	$\boldsymbol{\delta_u = 0}$	$\boldsymbol{\delta_u = \frac{1}{4}}$	$\boldsymbol{\delta_u = 0}$	$\boldsymbol{\delta_u = \frac{1}{4}}$	$\boldsymbol{\delta_u = 0}$	$\boldsymbol{\delta_u = \frac{1}{4}}$	$\boldsymbol{\delta_u = 0}$	$\boldsymbol{\delta_u = \frac{1}{4}}$
w	0.300	0.333	0.500	0.600	0.314	0.374	0.467	0.530
L	0.350	0.350	0.250	0.250	0.343	0.365	0.267	0.259
R	0.228	0.228	0.188	0.188	0.225	0.232	0.196	0.192
π	0.123	0.111	0.063	0.038	0.118	0.095	0.071	0.055
η	0.143	0.143	0.600	0.600	0.167	0.167	0.500	0.500
$\boldsymbol{\rho}$	**0.222**	**0.276**	**0.545**	**0.615**	**0.250**	**0.322**	**0.500**	**0.560**

Parameter values: $\delta_s = \mu = 0, \quad a = b = \alpha = 1, \quad \overline{w} = \frac{1}{5}$

Part B: iso-elastic demand

	$\theta = 1$				$\beta = \frac{1}{2}$			
	$\beta = \frac{1}{4}$		$\beta = \frac{3}{4}$		$\theta = \frac{1}{2}$		$\theta = \frac{3}{2}$	
	$\boldsymbol{\delta_u = 0}$	$\boldsymbol{\delta_u = \frac{1}{4}}$	$\boldsymbol{\delta_u = 0}$	$\boldsymbol{\delta_u = \frac{1}{4}}$	$\boldsymbol{\delta_u = 0}$	$\boldsymbol{\delta_u = \frac{1}{4}}$	$\boldsymbol{\delta_u = 0}$	$\boldsymbol{\delta_u = \frac{1}{4}}$
w	0.250	0.267	0.350	0.400	0.240	0.266	0.400	0.470
L	4.000	4.000	2.041	2.041	4.340	6.153	1.562	1.321
R	2.000	2.000	1.429	1.429	2.083	2.480	1.250	1.149
π	1.000	0.933	0.714	0.612	1.042	0.846	0.625	0.528
η	0.400	0.400	0.857	0.857	0.333	0.333	1.000	1.000
$\boldsymbol{\rho}$	**0.167**	**0.211**	**0.300**	**0.364**	**0.143**	**0.246**	**0.333**	**0.383**

Parameter values: $\delta_s = \mu = 0;\ a = \alpha = 1;\ \varepsilon = 2;\ \overline{w} = \frac{1}{5}$

revenues are independent of δ_u. Our parameter of foremost interest is the rent-sharing parameter ρ, and we see that the effect of a change in firm objectives is qualitatively unambiguous. All else equal, more profit oriented firms will engage in less rent-sharing with their workers. This result, which is quite intuitive, holds whether demand is linear or iso-elastic.[11]

The effects of changes in the degree of job security (interpreted as changes in μ) are given in Table 3. Intuitively, a stronger efficiency wage effect leads to higher wages, productivity and total rents.[12] The effect on employment is ambiguous; increased labour

[11] Notice that, in these numerical examples, the degree of profit orientation does not affect labour demand elasticity (η) in equilibrium. In this case, it follows clearly from (7) that there is a positive relationship between δ_u and ρ. The independence between δ_u and η does no longer hold in the presence of efficiency wage effects ($\mu > 0$). However, numerical simulations with different parameter configurations (for $\mu > 0$) confirm the robustness of the positive relationship between δ_u and ρ.

[12] As shown by Garino and Martin (2000), wage bargaining and efficiency wage effects have mutually reinforcing effects on equilibrium wages.

productivity has a labour-saving effect if demand is linear, while there might be a labour-augmenting effect with iso-elastic demand.[13] For the parameter configurations considered in Table 3, though, the relationship between job security and rent-sharing does not depend on the shape of the demand function. In both cases, an increase in μ leads to a higher degree of rent-sharing between the firm and its workers.

Table 3: Change in job security

Part A: linear demand

	$\theta = 1$				$\beta = \frac{1}{2}$			
	$\beta = \frac{1}{4}$		$\beta = \frac{3}{4}$		$\theta = \frac{1}{2}$		$\theta = \frac{3}{2}$	
	$\boldsymbol{\mu = \frac{1}{4}}$	$\boldsymbol{\mu = \frac{3}{4}}$	$\boldsymbol{\mu = \frac{1}{4}}$	$\boldsymbol{\mu = \frac{3}{4}}$	$\boldsymbol{\mu = \frac{1}{4}}$	$\boldsymbol{\mu = \frac{3}{4}}$	$\boldsymbol{\mu = \frac{1}{4}}$	$\boldsymbol{\mu = \frac{3}{4}}$
w	0.254	0.301	0.362	0.504	0.259	0.297	0.346	0.485
L	0.487	0.401	0.3312	0.245	0.480	0.406	0.352	0.256
ϕ	0.558	0.738	0.601	0.914	0.561	0.733	0.595	0.900
R	0.198	0.208	0.159	0.174	0.197	0.209	0.166	0.178
π	0.07 4	0.009	0.040	0.050	0.072	0.089	0.044	0.053
κ	0.244	0.481	0.187	0.375	0.238	0.488	0.190	0.378
η	0.188	0.281	0.633	0.691	0.203	0.273	0.553	0.648
$\boldsymbol{\rho}$	**0.264**	**0.316**	**0.575**	**0.598**	**0.281**	**0.307**	**0.539**	**0.578**

Parameter values: $\delta_s = \delta_u = 0$; $a = b = 1$; $\overline{w} = \frac{1}{5}$; $\alpha = \gamma = \frac{1}{2}$

Part B: iso-elastic demand

	$\theta = 1$				$\beta = \frac{1}{2}$			
	$\beta = \frac{1}{4}$		$\beta = \frac{3}{4}$		$\theta = \frac{1}{2}$		$\theta = \frac{3}{2}$	
	$\boldsymbol{\mu = \frac{1}{4}}$	$\boldsymbol{\mu = \frac{3}{4}}$	$\boldsymbol{\mu = \frac{1}{4}}$	$\boldsymbol{\mu = \frac{3}{4}}$	$\boldsymbol{\mu = \frac{1}{4}}$	$\boldsymbol{\mu = \frac{3}{4}}$	$\boldsymbol{\mu = \frac{1}{4}}$	$\boldsymbol{\mu = \frac{3}{4}}$
w	0.265	0.297	0.383	0.445	0.250	0.271	0.463	0.590
L	2. 007	2. 075	1. 030	1. 101	2. 223	2. 383	0.733	0.695
ϕ	0.564	0.734	0.607	0.871	0.556	0.700	0.628	0.969
R	1. 064	1. 234	0.791	0.979	1. 112	1. 291	0.678	0.820
π	0.532	0.617	0.395	0.490	0.556	0.646	0.339	0.410
κ	0.231	0.487	0.184	0.387	0.251	0.545	0.180	0.366
η	0.434	0.497	0.870	0.888	0.350	0.381	1. 034	1. 081
$\boldsymbol{\rho}$	**0.197**	**0.247**	**0.324**	**0.355**	**0.167**	**0.207**	**0.362**	**0.399**

Parameter values: $\delta_s = \delta_u = 0$; $a = 1$; $\varepsilon = 2$; $\overline{w} = \frac{1}{5}$; $\alpha = \gamma = \frac{1}{2}$

Due to our decomposition of the different forces that determine the degree of rent-sharing, we are able to pinpoint the exact mechanism that drives the positive relationship

[13] In general, higher labour productivity has two opposite effects on labour demand. On the one hand, the demand for labour increases due to the decrease in the effective wage rate (w/ϕ).On the other hand, it takes fewer worker to produce a certain quantity of output, which, all else equal, reduces labour demand. The first effect is more likely to dominate if product demand is iso-elastic rather than linear.

between μ and ρ. From the numerical simulations we see that the result is driven by the positive relationship between μ and κ. More specifically, the positive relationship between μ and ρ is caused by the fact that lower job security reinforces the positive relationship between wages and rents per worker. In other words, the stronger the rent-augmenting effect of wages, the more the firm is willing to share the rents with its workers (in the form of higher wages).

Numerous attempts with different parameter configurations suggest that the main results reported above hold more generally. The only exception is for the case of linear demand, where low values of α might reverse the previously reported positive relationship between μ and ρ. This leads us to the following conclusion: If an increase in private firm ownership leads to less rent-sharing, this is most likely explained by a shift in firm objectives towards more profit orientation. However, we cannot rule out an efficiency wage explanation. On the other hand, if an increase in private ownership leads to more rent-sharing, this can only be explained (within our class of possible explanations) by an efficiency wage mechanism related to changes in job security.

3 Data and institutional background

3.1 Data

In the empirical analysis we rely on data from *Quadros de Pessoal* (QP). This is a comprehensive matched employer-employee dataset collected annually for the Portuguese economy. QP provides rich and detailed information for each firm or worker observed. For instance, we know the number of employees, sales, precise geographic location and legal status of each firm. The worker records contain a number of different characteristics, such as gender, education, age, labour earnings, length of working time, exact admission date in the firm and wage bargaining regime.

For the specific purposes of this study, QP offers several advantages that are particularly relevant. First, QP covers virtually the whole corporate sector, comprising both state-owned and privately owned firms. It also contains detailed information about the

ownership structure of each firm. In particular, the exact ownership shares held by the state and private owners are known at each moment in time. This allows us to build a continuous variable – intensity of private ownership – in order to assess the effects private versus public ownership on the degree of rent-sharing. Traditionally, related literature (on public-private wage differentials and effects of privatisation) has relied on a dichotomous ownership variable which obviously depends on a pre-defined threshold of private (public) ownership share.[14] We are also able to distinguish between domestic and foreign private shareholders.

Second, our linked data allows us to build panel datasets defined at different observed units. As firms and workers are assigned unique and invariant identifiers, it is possible to follow each unit over time and then build panel datasets at different levels.[15] Therefore, beyond the control of different sources of fixed unobserved heterogeneity (worker and firm), we are able to assess directly the importance of the level and the quality of data for the magnitude of rent sharing. Until now, despite the flurry of studies on this topic, no study has yet controlled for this specific dimension.

Finally, QP are available since the mid-80s. This extensive time coverage makes the data particularly appropriate for our analysis. During this period, Portugal launched an ambitious and successful privatisation program which fully reversed the ownership of several companies that had been nationalised after the April revolution of 1974 (OECD, 2001). The privatisation program involved a large number of firms covering almost all industries. Initially, privatisation took place mainly in the financial sector (banking and insurance) but later spread to other services and manufacturing.[16] The process has not yet been concluded but the government has withdrawn its presence in most sectors, such as brewery, paper and pulp, cement, oil and highways. In some strategic sectors (telecommunications and energy) the state has retained a qualified stake in capital or special voting rights ('golden shares'), which allows some control of firm management. Therefore, QP

[14] In the present study, we also use the dichotomous approach as a robustness check (Section 5).

[15] Notice that, in contrast with other rich datasets, our data covers all workers (not only worker samples) within each firm.

[16] For details about the privatisation program in Portugal, see Sousa and Cruz (1995) and OECD (2001, 2003).

not only offers a group of firms that switch ownership over time, which is important for identification of the effects, but also contains a number of firms with different ownership shares in each industry. As we document below, we use this latter group of firms to control for industry-specific shocks and to disentangle ownership from industry effects.

We have performed extensive checks to guarantee the accuracy of firm and employee data. Excluding agriculture, our initial panel for the period 1986-2007 comprises 757 984 firms. Information on ownership structure is absent for 40% (303 253) of these firms and incomplete for another 7% (54 401). After numerous consistency checks on the variables related to ownership structure, we are able to recapture missing information on 47 301 firms. We drop the remaining 7 100 firms with missing information. We also drop 35 firms for which information on ownership structure is unreliable and 68 563 which appear only once in the total panel. After these initial checks we kept 379 033 firms for the analysis. Almost all these firms (99,6%) do not experience any change in ownership structure over time. Among these, 377 364 are fully private, 287 are fully public and 121 have mixed private-public ownership. The remaining 1 261 firms experience a change in public-private ownership shares. Due to computational limitations, we further restrict the panel by keeping a random sample of 5% of the fully private firms.

We then merged the resulting firm panel with worker records.[17] We include only full-time wage earners working at least 25 hours per week, aged between 16 and 65. The resulting panel comprises information on 16 498 fully private firms, 252 fully public firms, 98 firms with mixed public-private ownership and 950 firms that change public-private ownership structure, yielding a total of 118 475 firm-year observations which correspond to 4 717 568 worker-year observations.

3.2 Descriptive statistics

The left graph of Figure 1 displays the net change in private ownership for the 950 firms over the period 1986-2007, while the one on the right shows the corresponding distribution

[17] Before merging, the worker records has been extensively cleaned to remove inconsistencies and to improve missing longitudinal linkages.

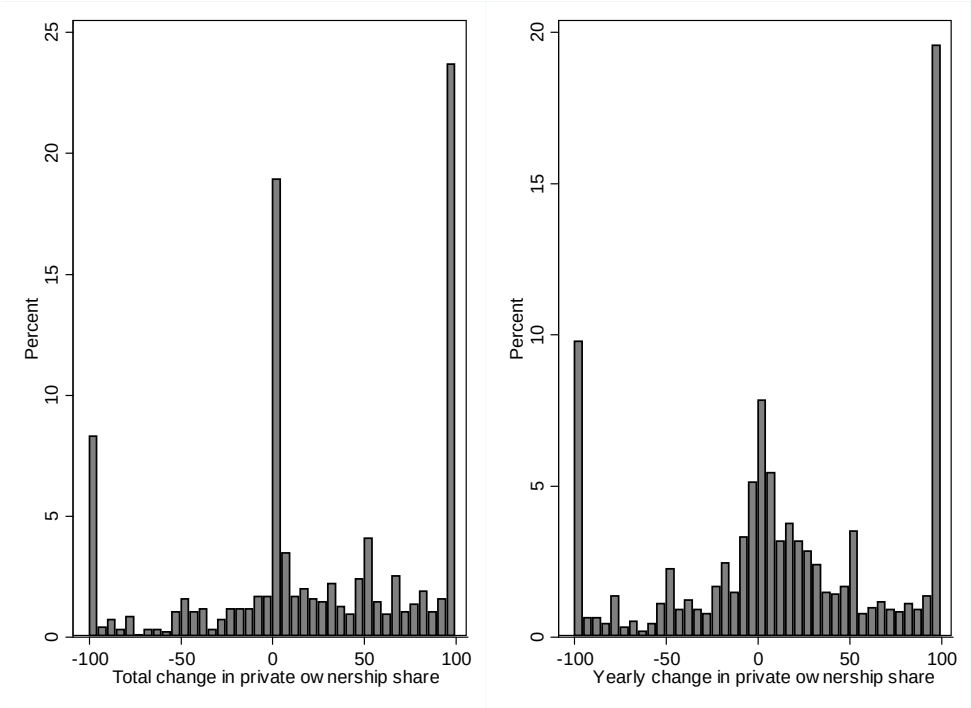

Figure 1: Distribution of ownership changes

of *yearly* changes (1 543 in total).[18] Both graphs exhibit substantial positive and negative variations in the private ownership share, implying the coexistence of contrasting reforms: privatisation and nationalisation. Nevertheless, privatisations are clearly more abundant. Almost two thirds of the 1 543 yearly changes in private ownership are positive. In net terms, 566 (231) firms experience an increase (reduction) in private ownership while 153 firms are subject to symmetric ownership changes over time. Full privatisation involves 203 firms (around 21%) while full nationalisation includes 70 (below 8%). Moreover, the number of firms that changed from a public majority to a private majority (351) is almost three times the number of firms that changed in the opposite direction (120). Finally, in terms of *speed* of ownership changes, firms experience on average less than 2 (1543/950 = 1.62) rounds on the sale of shares. Approximately 60 per cent of firms were sold in the first round whereas only 6 per cent involved four or more rounds.

Figure 2 shows the distribution of the net change in private ownership for 950 firms

[18] The graph on right side of Figure 1 displays changes in ownership shares that are different from zero.

across 18 industries over the period 1986-2007. As the figure illustrates, the distribution of net changes (mainly the positive ones) is spread across all industries, although it is more noticeable within the service industries. We use this group of changing ownership firms along with firms with different ownership – fully private, fully public and mixed ownership – within each industry to control for specific business cycles and to disentangle ownership from industry effects.

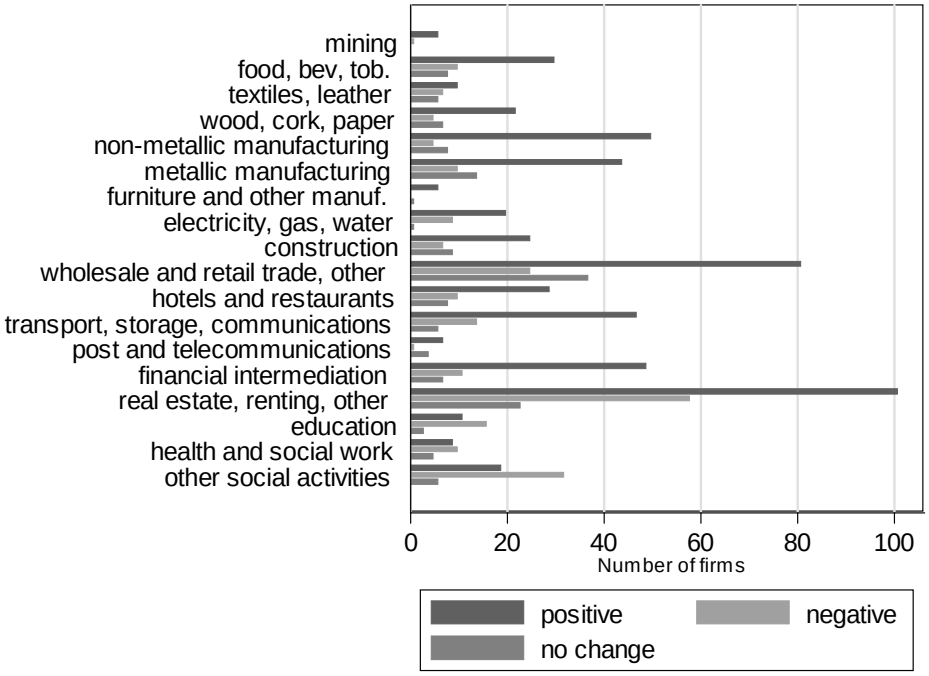

Figure 2: Distribution of net changes in private ownership

Table 4 reports means and standard deviations of variables for the four groups of firms defined according to ownership status: changing ownership, fully public, fully private and mixed ownership. Summary statistics are presented using data aggregated at firm and worker level. The wage variable is the logarithm of hourly wage computed as the ratio between overall monthly wage actually paid to each employee (including the base wage, tenure-related and other regularly paid components) and normal working time (hours). For measuring rents per worker, we use the logarithm of revenues per worker. Ideally,

it would be preferable to use net revenue per worker net of non-labor costs (see, e.g., Mumford and Dowrick, 1994). However, to the extent that variation in the share of non-labor costs occurs mainly *across* rather than *within* industries, the availability of multiple units (both firms and workers) per industry, and the use of industry fixed effects in the regressions, will capture most of this variation.[19] Both variables, wages and rents per worker, have been deflated and are expressed in real terms (prices for 2007) using CPI and GDP deflators, respectively.

Table 4 shows significant variation across the four groups of firms. Changing ownership firms are large firms which pay on average the highest (unconditional) hourly wage and exhibit the higher level of rents per worker, probably reflecting the higher fraction of foreign shareholders. These firms have a relatively old and experienced, though well educated, workforce. Fully public firms, on the contrary, despite being the largest, exhibit the lowest level of rents per worker and pay on average the second largest hourly wage to the oldest and most experienced workforce in the country. This remarkably high pay level of public firms is likely to reflect considerable differences with respect to collective wage bargaining. Public employees are mainly covered by firm-level wage agreements while the majority of employees from other firms are covered by multi-firm wage agreements.

In contrast to public firms, fully private firms are the smallest in Portugal and pay the lowest (unconditional) hourly wage to the youngest, least experienced and less educated workforce. Finally, mixed ownership firms are in many aspects somewhat between fully private and public firms. For instance, mixed ownership firms are larger (smaller) and pay better (worse) than private (public) firms to an older (younger) and more (less) experienced workforce than private (public) firms. Nevertheless, the level of rents in mixed ownership firms is much larger than in either public or private firms, probably reflecting the use of the most educated employees in the country. These firms also employ the largest proportion of female workers.

[19] The use of revenues per worker as a proxy for measuring rents, in similar context, has also be done by Grosfeld and Nivet (1990), Nickell and Wadhwani (1990), Van Reenen (1996), Carneiro and Portugal (2008), among others.

Table 4: Descriptive statistics

	Changing ownership		Fully public firms		Fully private firms		Mixed ownership	
Aggregation level	Firm	Worker	Firm	Worker	Firm	Worker	Firm	Worker
Log hourly wage	1.818	1.890	1.969	1.864	1.204	1.341	1.883	1.648
	(.565)	(.565)	(.475)	(.494)	(.400)	(.506)	(.554)	(.653)
Rents per worker	11.324	11.640	10.579	10.313	10.717	10.772	10.879	10.883
	(1.517)	(1.349)	(1.740)	(1.673)	(1.120)	(1.253)	(1.589)	(1.390)
Private ownership share	.763	.620	0	0	1	1	.506	.464
	(.370)	(.438)	-	-	-	-	(.280)	(.299)
Foreign capital	.214	.334	0	0	.017	.185	.111	.199
	(.410)	(.471)	-	-	(.138)	(.388)	(.315)	(.399)
Log firm size	3.758	7.022	4.555	8.739	1.868	4.416	2.811	4.951
	(1.874)	(1.582)	(2.307)	(1.317)	(1.100)	(2.006)	(1.574)	(1.205)
Age	39.599	41.331	38.439	42.443	37.840	36.662	37.733	38.985
	(6.213)	(10.057)	(5.738)	(10.106)	(7.63)	(11.241)	(6.216)	(11.117)
Tenure	9.756	14.640	7.718	16.544	6.281	7.894	5.066	8.952
	(6.473)	(9.659)	(6.628)	(9.961)	(5.223)	(8.145)	(4.202)	(9.105)
Tenure < 1	.113	.050	.146	.042	.151	.150	.192	.141
	(.177)	(.218)	(.212)	(.200)	(.241)	(.357)	(.269)	(.348)
Schooling	8.917	8.293	10.133	7.793	7.345	6.890	10.459	8.614
	(3.222)	(4.104)	(2.927)	(3.884)	(2.923)	(3.559)	(3.689)	(4.662)
Gender	.359	.262	.385	.225	.397	.387	.449	.484
	(.269)	(.440)	(.249)	(.418)	(.352)	(.487)	(.307)	(.500)
Firm-level bargaining	.075	.289	.287	.907	.0002	.002	.062	.257
	(.259)	(.453)	(.450)	(.291)	(.014)	(.0480)	(.232)	(.437)
Multi-firm bargaining	.665	.660	.177	.059	.876	.943	.398	.499
	(.463)	(.474)	(.373)	(.236)	(.309)	(.232)	(.467)	(.500)
Other wage agreement	.260	.050	.534	.034	.124	.055	.539	.244
	(.430)	(.219)	(.492)	(.182)	(.308)	(.228)	(.480)	(.430)
Observations	10343	2062547	1318	1255079	106635	1287482	395	15967
Firms/workers	950	425092	252	194608	16498	370957	98	6012

Notes: Standard-deviations in parenthesis.

4 Empirical analysis

We start our analysis by examining how ownership affects rent sharing at firm-level. In order to control for firm-specific unobserved heterogeneity, we exploit the longitudinal nature of the data and estimate a firm fixed-effects model. More precisely we estimate the following specification:

$$w_{jt} = \alpha \overline{w}_{jt} + \beta_1 R_{jt} + \beta_2 \left(R_{jt} \cdot P_{jt}\right) + \mathbf{y}_{jt}\boldsymbol{\gamma} + \upsilon_j + \lambda_v + \tau_r + \theta_t + \varepsilon_{jt}, \tag{10}$$

where w_{jt} refers to the logarithm of the average hourly wage of firm j in year t, $\overline{w}_{jt}$ is the reservation wage (to be defined below) for workers in firm j in year t, R_{jt} measures the logarithm of revenues per worker, P_{jt} represents the fraction of privately owned shares, $\mathbf{y}_{jt}$ is a vector of firm characteristics, υ_j is a pure firm unobserved fixed effect, λ_v is a pure industry effect, τ_r is a pure region effect, θ_t is a pure time effect and ε_{jt} is an exogenous disturbance. Our main interest lies in the coefficients α, β_1 and β_2. The first coefficient measures how wages react to the reservation wage, which is influenced by outside employment opportunities. Measuring the reservation wage (outside option) is problematic as it should take into account several aspects of the labour market such as local unemployment, the level of unemployment benefits and the expected real wage for each worker. In absence of this information, we compute the reservation wage as the minimum of the logarithm of hourly wage defined at firm level, per year, industry and county.[20,21] The coefficient β_1 measures the elasticity of wages with respect to revenues per worker for fully public firms, while $\beta_2/100$ indicates how much this elasticity changes when the degree of private ownership increases by one percentage point.[22]

[20] As Luke and Schaffer (2000) and Basu et al. (2005) discuss, there is a number of approaches, none universal, that have been adopted for defining the alternative wage. It can be computed as averages or minimum wages from particular regions or sectors or assumed to be proportional to them, using a local unemployment rate that lowers the alternative wage by exerting downward pressure on wages and decreasing the probability of obtaining employment. Given the richness of our data, and to guarantee that the actual wage is larger than the reservation wage, we follow Card et al. (2009) and define the reservation wage as the minimum wage within industry, region and year.

[21] Using alternative measures for the reservation wage, such as the mean wage within industry, region and year, yields similar results for the remaining coefficients of interest.

[22] Notice that our theoretical analysis is based on the concept of *average* rent sharing, where the degree of rent sharing is defined as the share of the worker's revenue contribution that is paid back to her as wage.

The vector $\mathbf{y}_{jt}$ includes further controls for firm size (log of number of employees), a dichotomous variable indicating the presence of foreign shareholders, average age of workers, average tenure of workers, share of workers with tenure less than one year, average schooling, share of females and two dummy variables that identify three different regimes of wage bargaining: firm level, multi-firm bargaining and other. To control for unobserved industry effects, we include a full set of seventeen industry-dummies, corresponding to the economic classification code defined at the 2-digit level. In addition, the regressions include six regional dummies defined at NUT2 to account for disparities in earnings across regions.

4.1 Firm-level analysis

Table 5 displays the results obtained when using specification (10) or some simplified versions of it. The first three columns use all firms sampled, while columns 4 to 6 restrict our control groups to fully public, fully private and mixed ownership, respectively. For each estimate, the standard errors are clustered at firm level to accommodate for non-independence of firms over time.

Table 5: Rent sharing across ownership: firm fixed-effects estimates

		vs. All firms		vs. Fully public firms	vs. Fully private firms	vs. Mixed ownership
	(1)	(2)	(3)	(4)	(5)	(6)
Reservation wage	.003**	.004***	.004***	.009**	.004***	.013**
	(.001)	(.001)	(.001)	(.004)	(.001)	(.005)
Rents per worker (R)	.021***	.024***	.013**	.007*	.011*	.008
	(.002)	(.002)	(.005)	(.004)	(.006)	(.005)
R*Private share			.012**	.011*	.015**	.010
			(.005)	(.006)	(.006)	(.007)
Private share		.047***	-.090	-.117	-.116	-.113

Continued on next page...

In contrast, the empirical analysis measures rent sharing at the *margin*. There is little reason to expect, theoretically or empirically, that average and marginal rent sharing are equal. However, in the present paper we are not primarily interested in the magnitude of rent sharing *per se*, but rather how the degree of rent sharing is affected by firm ownership. Nevertheless, the interpretation of our empirical results, in light of the theoretical analysis, relies on the assumption that firm ownership affects average and marginal rent sharing in a qualitatively similar way.

... table 5 continued

		vs. All firms		vs. Fully public firms	vs. Fully private firms	vs. Mixed ownership
	(1)	(2)	(3)	(4)	(5)	(6)
		(.016)	(.061)	(.075)	(.074)	(.084)
Foreign dummy		.007	.007	.011	.007	.012
		(.014)	(.014)	(.019)	(.014)	(.019)
Firm size		.034***	.034***	-.003	.037***	-.001
		(.004)	(.004)	(.009)	(.004)	(.010)
Age		.004***	.004***	.010***	.004***	.009***
		(.0004)	(.0004)	(.002)	(.0004)	(.002)
Tenure		.001	.001	-.002	.001	-.002
		(.0007)	(.0007)	(.003)	(.0007)	(.003)
Tenure < 1		.013**	.014***	-.013	.014***	-.022
		(.005)	(.005)	(.024)	(.005)	(.025)
Education		.021***	.021***	.061***	.020***	.057***
		(.002)	(.002)	(.006)	(.002)	(.007)
Female		-.101***	-.101***	-.106**	-.101***	-.108**
		(.010)	(.010)	(.044)	(.010)	(.045)
Firm-level bargaining		.101**	.101**	.152***	.067*	.172***
		(.043)	(.043)	(.046)	(.037)	(.050)
Multi-firm bargaining		.058***	.058***	.094***	.056***	.111***
		(.008)	(.008)	(.032)	(.008)	(.036)
Observations	118691	118691	118691	11661	116978	10738
R^2	.219	.23	.23	.364	.23	.344
LogLikelihood	-2859.526	-1995.225	-1989.5	-486.196	-1908.7	-1058.946
RMSE	.248	.246	.246	.253	.246	.268

Notes: Significance levels: $*$: 10% $**$: 5% $***$: 1%. All regressions include firm, time, industry and region fixed effects. RMSE is root mean squared error.

Column 1 reports baseline estimates from our simplest model, which includes controls for firm, time, industry and regional fixed effects. The estimates show that wages react positively (as expected) to the outside wage option and the estimated elasticity of wages

with respect to rents per worker is 0.021. Then we add eight firm observable attributes and two variables to account for different regimes of collective wage bargaining. As can be seen from column 2, the specification of the model improves and the estimated effect of rents on wages increases, though marginally, to 0.024.[23] This figure is well within the range of elasticities found in the domestic rent-sharing literature, between 0.006 and 0.086, as reviewed by Monteiro and Portela (2010). For instance, Margolis and Salvanes (2001) find elasticities between 0.002 and 0.03 for France and between 0.006 and 0.01 for Norway, while Arai (2003) reports an elasticity of 0.01 for Sweden.

The remaining estimates shown in column 2 are almost all significant and show the expected sign. Wages increase with the fraction of private shareholding, firm size, average age, tenure, and schooling of the workforce. Average wages are particularly large in firms that bargain at firm level, even though multi-firm wage agreements lead to a sizeable wage premium. Our results also point to a noteworthy gender penalty: average wages decline by 1% when the share of female workers increase by ten percentage points.

Column 3 breaks down the effect of rents per worker on wages according to the ownership of the firm. Hence, while fully public firms exhibit a significant rent-sharing elasticity of 0.013, raising the share of private ownership by ten percentage points increases it, on average, by 0.0012. This interaction term is statistically significant (with a standard error of 0.005 and a corresponding p-value of 0.018). Its inclusion in the model eliminates the direct effect of private shareholding on wages, suggesting that rent-sharing is a plausible mechanism to explain wage differences across firms with different ownership.

This result is robust to the use of alternative comparison groups, such as fully public or private firms, as shown in columns 4 and 5. Comparing with mixed ownership firms, column 6, however, yields a slightly lower estimate, which is statistically insignificant (with a standard error of 0.007 the coefficient is marginally insignificant). Notice, however, that this latter model contains much more noise, probably due to a reduced number of firms in the comparison group, as the standard errors are larger for all variables.

[23] Therefore, the size of the positive relation between rents per worker and wages is mainly captured by unobserved time, firm, industry and regional fixed effects levels.

Throughout specifications 4 to 6 presented in Table 5 the additional covariates show, in general, the expected sign and statistical significance.

In sum, our empirical analysis so far, using firm-level data, provides a clear and unambiguous result: an increase in private ownership leads to more rent-sharing, as measured by the elasticity of wages to revenues per worker. Based on our theoretical analysis, this result cannot be explained by more profit-oriented objectives in firms with larger private shareholdings. However, the result is consistent with an increased efficiency wage effect due to less job security in firms with more private ownership.

4.2 Worker-level analysis

In order to account for the role of worker and firm unobserved heterogeneity, we estimate a similar specification to (10) defined at worker level:

$$w_{ijt} = \alpha \overline{w}_{ijt} + \beta_1 R_{jt} + \beta_2 \left(R_{jt} \cdot P_{jt}\right) + \mathbf{y}_{jt}\boldsymbol{\gamma} + \mathbf{x}_{it}\boldsymbol{\delta} + \Psi_i + \upsilon_j + \lambda_v + \tau_r + \theta_t + \varepsilon_{jt}, \quad (11)$$

where w_{ijt} is the logarithm of hourly wage of worker i employed in firm j in year t, $\overline{w}_{ijt}$ is the reservation wage for the corresponding worker i. The reservation wage is defined as the minimum wage for similar workers in terms of education, gender, occupation, experience and who work in the same industry and year. R_{jt} and P_{jt} are defined as previously whereas the vector $\mathbf{y}_{jt}$ now includes two variables that account for firm size (log of number of employees) and foreign ownership effects. The vector $\mathbf{x}_{it}$, defined at worker level, comprises the following variables: the age of the employee and its square, his tenure (continuous variable), a dummy variable indicating if tenure is less than one year, the number of schooling years and two dummy variables identifying the regime of wage bargaining of each employee: firm-level bargaining, multi-firm bargaining or other. Ψ_i is the employee unobserved fixed effect and $\upsilon_j, \lambda_v, \tau_r$ and θ_t are defined as previously.

Table 6 presents results from individual wage estimations when we do not control for unobserved firm fixed effects ($\upsilon_j = 0$). Like Table 5, the first three columns use all employees working in any of the four firm categories, while columns 4 to 6 restrict our control

groups to employees from fully public, fully private and mixed ownership firms, respectively. For each estimate, the standard errors are clustered at worker level to accommodate for non-independence of workers over time. An innovative aspect of our study is that we use all workers from the same firms used in the estimation of (10), which allows us to compare the effect of different levels of analysis – firm or worker – on the magnitude of rent sharing.[24]

An inspection of Table 6, column2, shows two striking results: individual wages are much more responsive to the reservation wage and the magnitude of rent sharing, while statistically significant, drops remarkably. More precisely, estimates for the wage response to the reservation wage increases from 0.004 to 0.241 while the rent-sharing elasticity drops from 0.024 to 0.004. The remaining estimates from column 2 are all significant, though the magnitude of the effects tends to be lower than previously.

When we add an interaction term to account for the private ownership effect (column 3) the rent-sharing elasticity for public firms drops to 0.001, while the marginal effect of private ownership remains closer to earlier findings obtained with firm level data. Indeed, raising the degree of private ownership by ten percentage points increases the elasticity, on average, by 0.0007. Once more, notice that the inclusion of this interaction term reverses the direct effect of private ownership on wages.

Table 6: Rent sharing across ownership: worker fixed-effects estimates

		vs. All firms		vs. Fully public firms	vs. Fully private firms	vs. Mixed ownership
	(1)	(2)	(3)	(4)	(5)	(6)
Reservation wage	.245***	.241***	.241***	.221***	.270***	.254***
	(.001)	(.001)	(.001)	(.001)	(.001)	(.002)
Rents per worker (R)	.003***	.003***	.001***	.00009	.003***	.003***
	(.0001)	(.0001)	(.0001)	(.0001)	(.0002)	(.0002)
R*Private share			.007***	.004***	.007***	.004***

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[24] In order to strictly compare the effect of the level of analysis – firm or worker – we would like ideally to estimate wage regressions at worker level controlling only for firm fixed effects. Nevertheless, that is not feasible as the number of firms is very large in our dataset.

... table 6 continued

		vs. All firms		vs. Fully public firms	vs. Fully private firms	vs. Mixed ownership
	(1)	(2)	(3)	(4)	(5)	(6)
			(.0002)	(.0003)	(.0003)	(.0003)
Private share		.018***	-.064***	-.034***	-.048***	-.024***
		(.0007)	(.003)	(.003)	(.004)	(.004)
Foreign dummy		.022***	.022***	.022***	.017***	.016***
		(.0006)	(.0006)	(.0006)	(.0007)	(.0007)
Firm size		.019***	.019***	.018***	.022***	.013***
		(.0004)	(.0004)	(.0005)	(.0005)	(.0006)
Age		.049***	.049***	.056***	.045***	.053***
		(.0002)	(.0002)	(.0003)	(.0003)	(.0004)
Age^2		-.0003***	-.0003***	-.0003***	-.0003***	-.0003***
		(.000002)	(.000002)	(.000003)	(.000003)	(.000003)
Tenure		.001***	.001***	-.002***	.002***	-.001***
		(.0001)	(.0001)	(.0001)	(.0001)	(.0002)
Tenure < 1		-.031***	-.031***	-.042***	-.029***	-.045***
		(.0006)	(.0006)	(.0008)	(.0006)	(.001)
Education		.004***	.004***	.003***	.003***	.001***
		(.0003)	(.0003)	(.0003)	(.0003)	(.0004)
Firm-level bargaining		-.013***	-.013***	-.025***	.003	-.009***
		(.002)	(.002)	(.002)	(.002)	(.002)
Multi-firm bargaining		-.013***	-.012***	-.021***	.004**	-.009***
		(.002)	(.002)	(.002)	(.002)	(.002)
Observations	4621075	4621075	4621075	3317626	3350029	2078514
R^2	.534	.545	.545	.586	.508	.552
LogLikelihood	2298199	2351418	2352510	1740772	1752771	1129998
RMSE	.147	.145	.145	.143	.143	.14

Notes: Significance levels: $*$: 10% $**$: 5% $***$: 1%. All regressions include worker, time, industry and region fixed effects. RMSE is root mean squared error.

Columns 4 to 6 suggest that the comparison group matters for determining the mag-

nitude of rent-sharing in public and private firms. For instance, when we compare workers from changing ownership firms to those from fully public firms, rent sharing in public firms vanishes. The corresponding figure is 0.003 if we instead compare with private or mixed firms. Similarly, the marginal effect of private ownership on rent-sharing is almost twice as high when we compare with private firms, relative to using fully public or mixed ownership firms as the control groups. Nevertheless, despite all divergences in magnitude, the results reported so far are all qualitatively similar, suggesting that rent-sharing increases with the degree of private ownership.

Table 7: Rents and ownership: worker and firm fixed-effects estimates

		vs. All firms		vs. Fully public firms	vs. Fully private firms	vs. Mixed ownership
	(1)	(2)	(3)	(4)	(5)	(6)
Reservation wage	.241***	.235***	.235***	.221***	.266***	.256***
	(.0002)	(.0002)	(.0002)	(.0002)	(.0002)	(.0003)
Rents per worker (R)	.002***	.002***	.001***	.0001**	.003***	.003***
	(.00005)	(.00005)	(.00007)	(.00007)	(.0001)	(.0001)
R*Private share			.002***	.003***	.005***	.005***
			(.0001)	(.0001)	(.0001)	(.0002)
Private share		.022***	-.007***	-.024***	-.025***	-.033***
		(.0002)	(.001)	(.002)	(.002)	(.002)
Foreign dummy		.012***	.012***	.013***	.015***	.016***
		(.0002)	(.0002)	(.0002)	(.0002)	(.0002)
Firm size		.009***	.009***	.007***	.032***	.026***
		(.00005)	(.00006)	(.00009)	(.00006)	(.0001)
Age		.036***	.036***	.048***	.040***	.049***
		(.00005)	(.00005)	(.00006)	(.00005)	(.00008)
Age^2		-.0003***	-.0003***	-.0003***	-.0003***	-.0003***
		(5.75e-07)	(5.75e-07)	(7.47e-07)	(6.54e-07)	(9.20e-07)
Tenure		.001***	.001***	-.0005***	-.00002	-.002***
		(1.00e-05)	(1.00e-05)	(1.00e-05)	(1.00e-05)	(.00002)
Tenure< 1		-.027***	-.027***	-.040***	-.025***	-.042***
		(.0003)	(.0003)	(.0004)	(.0003)	(.0005)

Continued on next page...

... table 7 continued

		vs. All firms		vs. Fully public firms	vs. Fully private firms	vs. Mixed ownership
	(1)	(2)	(3)	(4)	(5)	(6)
Education		.003***	.003***	.003***	.002***	.001***
		(.00003)	(.00003)	(.00003)	(.00003)	(.00004)
Firm-level bargaining		.045***	.045***	.062***	.049***	.057***
		(.0004)	(.0004)	(.0005)	(.0005)	(.0006)
Multi-firm bargaining		.051***	.051***	.067***	.049***	.059***
		(.0004)	(.0004)	(.0005)	(.0004)	(.0005)
Observations	4621075	4621075	4621075	3317626	3350029	2078514
R^2	.934	.938	.938	.929	.943	.936
LogLikelihood	2228913	2364161	2364433	1723254	1723641	1099604
RMSE	.149	.145	.145	.144	.145	.143

Notes: Significance levels: $*$: 10% $**$: 5% $***$: 1%. All regressions include firm, worker, time, industry and region fixed effects. RMSE is root mean squared error.

Table 7 displays results when we account simultaneously for worker and firm unobserved heterogeneity. Given the high dimension of our matched employer-employee data, the solution to the estimation problem is not trivial. In our estimations we follow the feasible iterative procedure discussed in Guimarães and Portugal (2009). The authors propose an exact solution for the least squares estimation of the model with two fixed effects; i.e., their solution controls jointly for unobserved heterogeneity at the worker and firm level, dealing with the great number of workers and firms available in the dataset. One could argue that a one-way fixed-effects controlling for spell effects (worker within a given firm) is readily available. However, such a solution is not an appropriate one as we would be only controlling for possible correlations between worker and firm specific unobserved heterogeneity, and not for each heterogeneity separately. Once the worker moves to a new firm we would assume it as a new worker. Our preferred solution takes both the worker and the firm as whole identities, accounting for worker heterogeneity that runs over firms,

as well as for firm heterogeneity that applies to different workers employed by the firm in different moments of time.

Compared with Table 6, controlling for unobserved heterogeneity from both sides of the labour market improves a great deal the specification of the model, measured either by R^2 or Log Likelihood of the model. The results in Table 7 are thus derived from our preferred specifications. Columns 1 and 2 show that the inclusion of both sources of unobserved heterogeneity does not affect the wage responses to the reservation wage but affects the magnitude of the rent-sharing elasticity. Indeed, while the former remains similarly strong in magnitude and significance, the latter, though statistically significant, drops from 0.003 to 0.002. Moreover, as before, the rent-sharing elasticity remains unchanged even after the introduction of several (statistically significant) controls for observable attributes from both firm and worker. While the size of the rent-sharing elasticity is now quite low when compared to previous studies, we are not aware of any study that uses such a rich set of observable attributes and controls for both sources of unobserved heterogeneity.

Our results from the worker level analysis suggest, once more, that rent-sharing is higher in private firms. Even though the difference is substantially attenuated when we make the extension to control for two instead of one source of unobserved heterogeneity, private firms still exhibit a level of rent sharing three times higher than publicly owned firms (0.003 and 0.001, respectively).

5 Robustness checks

We now extend our empirical analysis in several different directions. Tables 8 and 9 explore the robustness of our analysis by (i) considering alternative definitions for some key variables, (ii) using alternative estimation methods and (iii) splitting data according to independent variables. More precisely, Table 8 reports some robustness checks obtained using only data aggregated at firm level, while Table 9 reports further robustness checks produced with data aggregated both at firm (Panel A) and worker level (Panel B). In the analysis with worker level data, we use our preferred specification which accounts for both

sources of unobserved heterogeneity.

Table 8: Robustness checks: analysis with firm level data

Private ownership concept	Private firm=1 if private shares >= 50%						Continuous
Estimation method	FE			GMM			FE
Sample	vs. All	Private firms	Public firms	vs. All	Private firms	Public firms	Weighted by employment
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Reservation wage	.004***	.004***	.007	.004**	.003*	.012	.012*
	(.001)	(.001)	(.009)	(.002)	(.002)	(.008)	(.006)
Rents per worker (R)	.014***	.025***	.003	.036	.100***	.056	-0.001
	(.005)	(.002)	(.004)	(.088)	(.012)	(.037)	(.004)
R*Private	.011**			.071			.010*
	(.005)			(.095)			(.006)
Observations	118691	114670	4021	56871	54973	1788	5865521
LogLikelihood	-1989	-1370	621				2114248
RMSE	.246	.245	.209	.245	.244	.167	.169
Hansen-J				.310	.407	.098	
DF				1	1	1	

Notes: Significance levels: $*$: 10% $**$: 5% $***$: 1%. RMSE is root mean squared error. DF stands for degrees of freedom.

Column 1 from Table 8 presents the results of specification (10) when ownership is defined as a binary variable using the common threshold of 50% for private ownership.[25] The restriction of equal returns (both to fixed unobserved effects and firm attributes) imposed on private and public firms is relaxed in columns 2 and 3, where we estimate a separate wage equation for each type of firm.

Changing the concept of ownership and allowing the process of wage formation to differ across ownership categories only confirms our previous findings. As before, the magnitude

[25] Our results are not sensitive to different cut-off values.

of rent sharing is significantly larger in private than in public firms (columns 1 and 2). However, column 3 indicates that labour earnings in public firms react neither to local conditions nor to firm rents. Notice that these results should be read with some caution as the sample size drops remarkably.

Even though we have a rich set of observable firm attributes and control for firm, worker and other unobserved fixed effects, we empirically address the possibility that controlling for rents' endogeneity reverses our previous findings. In columns 4 to 6 we adopt the ownership concept and partition considered in the previous three columns and, in the absence of external instruments, we use lagged rents as instruments for current rents.[26] By construction, these are correlated with current rents, but – assuming no serial correlation in the error term – are not correlated with the residuals in a firm level equation. To be precise, in column 4 we instrument firm rents, and the respective interaction term, using the first and second lags of firm rents and the first lag of the interaction term, while in column 5 and 6, we instrument firm rents using its first and second lags. All other explanatory variables are assumed to be exogenous.

Performing a GMM fixed-effects type of estimation, which provides efficient estimates of the relevant coefficients as well as consistent estimates of the standard errors, our main finding from the previous analysis is, once more, qualitatively confirmed. While the Hansen-J test of over-identifying restrictions validates the instruments chosen in each specification, the standard errors of the coefficients of interest are now much larger and weaken the precision of the estimates. The only exception is presented in column 5. Using instruments, the rent-sharing coefficient for private firms is significant and four times larger than the one previously found, while the corresponding figure for public firms, though much larger, is not significant (its standard error is 0.037 with a corresponding p-value of 0.125). Notice that the higher rent-sharing elasticity obtained when instrumenting firm rents is a common finding in the rent-sharing literature.

So far, in our firm level analysis, we have weighted all firms equally when estimating

[26] It is not possible to accommodate instrument variables within our routine that accounts for firm and worker unobserved fixed effect.

the effect of ownership on rent sharing. Nevertheless, Table 4 shows that firm size varies substantially across different ownership configurations. In particular, public firms are much larger than private firms. Weighting observations by employment will increase the importance of large firms (which are mainly public) and reduce the influence of small firms (with larger rent sharing) in the estimation. Thus, we would expect that weighting observations by firm size will reduce the estimated level of rent sharing. Indeed, column 7 shows that weighting by employment reduces the rent effect for both types of firms while the interaction term that accounts for the effect of private ownership on rent sharing is in line with earlier estimates.

Following the received literature, our measure of rents has been expressed in per capita terms. If firms adjust the labour force in terms of working hours rather than number of employees, our rent measure might be biased in either direction. It turns out, as column 1 from Table 9 shows, that controlling for working hours only reinforces our earlier findings. The rent effect becomes clearly stronger in private than in public firms, using either firm and worker level data. However, the magnitude of rent sharing in public firms evolves in opposite directions in the two analyses. In fact, while the rent effect disappears in public firms when using firm level data, it becomes even stronger when using worker level data. These contrasting findings, when seen in conjunction, suggest that labour adjustments differ across ownership categories and that the level of analysis does matter for the magnitude of rent sharing.

Table 9: Robustness checks: analysis with firm and worker level data

Panel A: Firm level data, firm FE						
Sample	Rents per hour	Survival of firm > 4	Manufacturing	Services	Private share increase	Private share decline
	(1)	(2)	(3)	(4)	(5)	(6)
Reservation wage	.004***	.004***	.007**	.003*	.004***	.003**
	(.001)	(.002)	(.003)	(.002)	(.001)	(.002)
Rents per worker (R)	.003	.011**	.026***	.010*	.013***	.013**
	(.005)	(.005)	(.010)	(.006)	(.005)	(.007)

Continued on next page...

... table 9 continued

	(1)	(2)	(3)	(4)	(5)	(6)
R*Private share	.029***	.016***	.008	.013**	.011**	.018***
	(.005)	(.006)	(.010)	(.006)	(.005)	(.007)
Observations	118691	99942	26239	92452	118319	83392
LogLikelihood	-1819	-5112	3801	-4264	-2031	5135
RMSE	.246	.255	.210	.253	.246	.228

Panel B: Worker level data, worker and firm FE

Sample	Rents per hour	Survival of firm > 4	Manufacturing	Services	Private share increase	Private share decline
	(1)	(2)	(3)	(4)	(5)	(6)
Reservation wage	.2300***	.2307***	.2753***	.2055***	.2308***	.2078***
	(.0004)	(.0004)	(.0007)	(.0005)	(.0004)	(.0005)
Rents per worker (R)	.0023***	.0013***	.0051***	-.0002**	.0016***	.0013***
	(.0001)	(.0001)	(.0004)	(.0001)	(.0001)	(.0002)
R*Private share	.0032***	.0022***	.0079***	.0004	.0013***	.0030***
	(.0002)	(.0002)	(.0005)	(.0003)	(.0002)	(.0003)
Observations	4621079	4493329	1423761	3156913	4579285	2775270
R^2	.9092	.9075	.9054	.9067	.9094	.9118
RMSE	.1943	.1941	.1894	.1941	.1944	.1908

Notes: Significance levels: $*$: 10% $**$: 5% $***$: 1%. RMSE is root mean squared error.

Intuitively, we would expect stronger rent effects for firms that stay longer in the market. However, results obtained from imposing a firm survival restriction of four years (column 2) seem to be inconclusive. While rent sharing is always larger in private than in public firms, in both analyses, the rent-sharing effect increases only marginally for private firms when using data at firm level. For public firms, rent effects in both analyses are in line with previous findings.

We would also like to explore the possibility that our estimated effects might vary across different sectors of the economy, due to institutional or other differences that have

not yet been accounted for in our empirical analysis. One potentially important institutional heterogeneity is that wage bargaining takes place mainly along industry divisions in manufacturing, while in services wage bargaining along occupational divisions is more common. In order to account for such differences, we have run separate regressions for manufacturing and services. Columns 4 and 5 disclose important discrepancies across these two sectors. Rent sharing is substantially higher in manufacturing than in services, with figures (at firm level, not shown) for the wage-rents elasticity of 0.034 and 0.021, respectively**.** It is also clear that the evidence of higher rent sharing in private than in public firms depends both on the sector and level of analysis. The effect of increased private ownership on rent sharing is positive in both sectors for both levels of analysis. However, at firm level the effect is statistically significant only for services, while at worker level the effect is significant only for manufacturing.

Given the institutionally rich Portuguese context, with both privatisations and nationalisations of firms, it is natural to ask whether increases and reductions in private ownership lead to similar (symmetric) rent-sharing effects. Columns 6 and 7 split the data according to the sign of yearly changes in private ownership.[27] The results reveal that the relationship between ownership and rent sharing is not particularly sensitive to this partition of the data, though the effect of private ownership on rent sharing tends to be larger for nationalisations than for privatisations.

6 Concluding Remarks

Private firms tend to share the rents with their workers to a larger extent than their public counterparts. This (perhaps surprising) result is the main conclusion of our empirical analysis based on an extensive and rich linked employer-employee dataset, covering a large number of ownership changes (in both directions) across a wide spectrum of economic sectors in Portugal over a long time period.

When seen in the light of our underlying theoretical framework, the perhaps most

[27] Notice that, since we include in both estimations data referring to no changes in ownership, the sum of observations in these two columns exceeds the total number of observations in the data.

interesting implication of this result is that it cannot be explained by the often postulated hypothesis that private firms are more profit oriented than public ones. Rather, our result, when seen in conjunction with the theoretical analysis, indicates that other differences are more important. Specifically, we have shown that a positive relationship between the degree of private ownership and rent sharing can be explained by a higher efficiency wage effect due to less job security in private firms.

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