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The Incidence of Pension Contributions

What matters: marginal or average rates?

Nicole Bosch, Casper van Ewijk, Maja Micevska Scharf, Sander Muns

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The Incidence of Pension Contributions

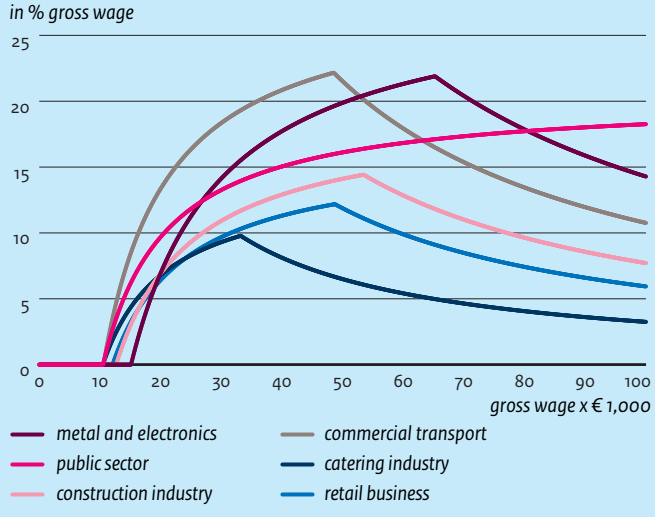
The **increase** in labor cost over time due to a **higher average** pension contribution rate is

70%

We find that the incidence of the pension contribution on employers is 70%. This indicates that employers shift less to employees than found in earlier studies.

This is surprising as pension contributions go together with personal benefits. The bargaining model and sticky wages seem more applicable to explain our findings than the standard model of incidence, at least in the short to medium run.

Average pension contribution rate



CPB Discussion Paper

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The Incidence of Pension Contributions: What matters: marginal or average rates?*

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Abstract

This paper investigates the incidence of pension contributions using a unique longitudinal administrative dataset covering individual employees at different pension funds in the Netherlands for the period 2006-2012. With a panel-based difference-in-difference approach, we estimate the response of wages, labor cost and hours worked to both marginal and average contribution rates, which provides us insight into the mechanisms underlying incidence. In contrast to the standard demand and supply model of labor we find that average contribution rates matter more for incidence than marginal rates. Moreover, we find that a substantial part of the burden (some 70%) is borne by employers. This is in line with the statutory contribution rates (on average 70-30 for employers and employees) but could also be explained by other factors such as non-salience or bargaining. Together our findings indicate that incidence is best explained by a bargaining model of wages, at least in the short and medium term considered in our analysis.

Keywords: Incidence, pension contributions, labor supply

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1 Introduction

Falling interest rates and rising longevity have caused major increases in contribution rates in funded defined benefit (DB) pension systems. In the Netherlands pension contributions doubled from 5.3% on average in 2000 to 10.9% in 2015.[1]

How these higher pension contributions affect the economy depends crucially on how the burden is shared between employers and employees. As far as it leads to higher labor costs for employers it may affect output and prices on product markets (Barrios et al., 2017) while as far as the burden is borne by workers by lowering net wages this could affect labor supply.

This split of the burden between employers and workers is the (economic) "incidence" of pension contributions and can differ from the statutory incidence. The *statutory* incidence of a tax simply indicates who formally pays the tax, while the *economic* incidence measures who actually bears the burden of a tax taking into account responses in labor supply and wages. We briefly refer to economic incidence as incidence. The main objective of this paper is to empirically assess the incidence of pension contributions.

Using a unique longitudinal administrative dataset containing individual information on pension contributions, labor costs and hours worked allows us to look into detail into the mechanism determining the incidence of pension contributions. These data include – statutory – employer and employee rates. On average the statutory employer-employee split is about 70%-30%, but this split and the contribution rates vary a lot across pension funds. We exploit the variation within and between pension funds, and over time to identify the wage and labor supply responses at the individual level. And, interestingly, as pension plans typically feature both income floors and income caps we are able to assess the impact of marginal and average rates separately.

In contrast with the large literature on taxable income[2], the literature on the response to payroll taxes and pension contributions is relatively limited (Saez et al., 2012, 2019; Adam et al., 2018). This is surprising as payroll taxes average at 22.6% of labor costs, while income taxes average at 13.4% of labor costs in OECD countries.[3] The Dutch averages of 22.3% for payroll taxes (excluding pension contributions) and 15.2% for income taxes are not very different from the OECD averages. On top of this, an average Dutch worker faced a marginal contribution rate of 20.9% in 2016. This percentage is among the highest

[1] Source: Statistics Netherlands Statline

[2] Examples include Feldstein (1995); Gruber and Saez (2002); Saez (2003); Blomquist and Selin (2010); Kleven and Schultz (2014).

[3] OECD (2017), Taxing wages 2015-2016, Table 1.2.

worldwide.[4]

According to the standard demand and supply model of labor, the incidence is determined by the relative elasticities of demand and supply. The statutory split of a tax is irrelevant for the market equilibrium, this is the standard Invariance of Incidence Proposition (IIP). The IIP assumes flexible wages, and equal salience of employer and employee contributions. The IIP clearly breaks down if wages are sticky; then employer contributions determine hourly labor cost while employee contributions feed into net wages. Furthermore, IIP can be violated if employer and employee contributions are valued differently, for instance because one (e.g., the employee contribution) is more salient than the other. For social security contributions also the benefit side is relevant. As the benefit accrues to the employee (and not to the employer), the incidence of pension contributions can be expected to differ from the incidence of income taxes. In theory, the incidence of social security concerns only the implicit tax, that is the contribution net of the implied benefit to the individual (Summers, 1989; Gruber, 1997; Ooghe et al., 2003; Disney, 2004). In practice, however, the benefit side of contributions may not be valued on the same footing as the contributions that have to be paid out of salaries (Iturbe-Ormaetxe, 2015). Also in our analysis we find that pension contributions tend to be seen as a net cost rather than as a net benefit.

The theoretical literature predicts different effects of marginal and average tax rates. Most discussions of incidence use the standard demand and supply model of the labor market to show that the incidence depends on demand and supply elasticities (Fullerton and Metcalf, 2002). What matters in this model is the marginal tax rate as this determines the wedge between the labor cost and the wage received by workers. Average tax rates are irrelevant to the explanation of incidence.[5] In contrast, average tax rates do play a role in bargaining models of wage determination. For example, in the search model of labor markets (Pissarides, 1985; Mortensen and Pissarides, 1999) wages follow from the negotiation between employers and workers on the division of the quasi-rents. Higher average tax rates then reduce the quasi-rents. And, as this loss is shared between workers and employers labor cost will rise and net wages will fall according to the bargaining power of employers and employees. The marginal tax rate may also matter in the bargaining model, but for a different reason. The marginal tax reduces the incentive for demanding higher wages thus effectively lowering the bargaining strength of workers and therefore leading to lower wages and labor cost (Boone and Bovenberg, 2002).

The empirical literature on wage and labor responses to (payroll) taxes distinguishes

[4] OECD Pensions Outlook 2018, Table 1.2

[5] The supply schedule is usually taken to be the compensated supply schedule (Lehmann et al., 2013).

two different approaches. One approach is to exploit discontinuities in payroll tax schedules and compares distributions around the thresholds to identify the incidence (Alvaredo et al., 2017). In their application for the Netherlands, Bosch and Micevska-Scharf (2017) find that the statutory incidence matters since the burden of social security contributions close to thresholds is fully borne by employers. Cross-sectional data suffices for this kind of analysis.

Another approach is to exploit tax variation over time and across individuals in a *panel* framework (Lehmann et al., 2013). This approach follows the seminal paper by Gruber and Saez (2002) on the elasticity of U.S. taxable income to income taxes. Using French data throughout the period 2003-2006, Lehmann et al. (2013) analyze the impact on labor cost per worker of both income and payroll tax rates in the short term (one year). The statutory incidence of income taxes is fully on employees, while the payroll tax is fully paid by employers. For the impact of income taxes Lehmann et al. (2013) find a significant response to the *marginal* net-of-tax rate of 0.2 on labor cost, but no significant response for the *average* net-of-tax rate. In contrast, for payroll taxes they find no significant effect for marginal net-of-tax rate, but a significant effect of the *average* net-of-payroll tax rate of -0.9. The latter effect is not significantly different from minus one. These results suggest that the incidence of the average payroll tax is fully on employers while the average income tax is effectively borne by workers. The impact of marginal income tax rates may be explained their impact on labor supply. The result for the average rates suggests that the statutory incidence prevails for both income taxes (fully paid by employees) and payroll taxes (fully paid by employers) over a one-year time period. A plausible explanation is that gross wages (excluding employer payroll taxes) are sticky in France at this time horizon. A similar finding is reached in the United Kingdom, where Adam et al. (2018) conclude that in the short and medium run the statutory incidence determines the economic incidence. In their study, employees adjust hours in response to changes to marginal employee rates while average employers rates affect labor cost through hourly labor cost.

In our study we follow Lehmann et al. (2013) in distinguishing between marginal and average tax rates. In contrast to their study, we focus exclusively on the impact of pension contributions. As pension contributions are determined at an aggregate level by individual pension funds this allows us to exploit more sources of variation in contribution rates, thus improving the identification. To be more specific, first, the variation in average and marginal rates of pension funds provides us with varying average and marginal rates across pension funds. Second, there is variation within pension funds among individuals with different income. Due to lower income caps, individuals start paying pension contributions

above this income threshold. The different distance to this lower cap generates variation of average tax rates among individuals. Third, there is considerable variation over time due to discretionary decisions on pension contributions by individual pensions funds during our observation period, 2006-2012. These three sources of variation are unique and enable us to separate the effects of the average and marginal tax rates. In addition, we also can observe hours worked, and thus distinguish between *hourly* and total labor cost (per worker). Finally, also the statutory shares of pension contributions paid by employees and employers vary over time and across pension funds. Both we can use for providing more insight into the (mechanism of) incidence.

We use a rich administrative dataset that contains detailed job-level variables for the entire working population such as information on individual earnings and hours worked. Compared to survey data, the advantage of administrative data is that measurement error is smaller. We supplement this dataset with pension contribution rates and information on lower and higher income cap of 30 major pension funds thus creating a unique new datafile.

Our main findings are as follows. First, average rates are more relevant to labor cost than marginal rates. At a two-year horizon the response of labor cost per worker to a change in average pension contribution rates is 70%; for the marginal rate no significant effect is found. Second, the actual incidence happens to be similar to the average statutory incidence. This is in line with the findings in Lehmann et al. (2013) who explain their results by sticky wages. However, we tested for funds with different changes in employee and employer shares and still find the similar coefficient (-0.7). This suggests that it may not be statutory rates, and thus sticky wages, that determine incidence, and that one has to consider alternative explanations. Third, taking these results together the bargaining model is most consistent with the results found. Fourth, labor supply (hours per worker) is unresponsive to both marginal and average pension contribution rates. This can reflect a negligible response in hours worked through e.g. institutional barriers (regulation on working hours) or non-salience of pension contributions. Finally, the estimation of the separate impacts of employer and employee pension contribution rate renders unsatisfactory results due to the positive correlation between the employer and employee parts, and the low variation over time of the employee rate. This leads to counterintuitive signs of the coefficients found.

Our contribution to the literature is twofold. First, we are the first to empirically estimate the incidence of pension contributions and disentangle the effects of average and marginal contribution rates. Second, we relate our findings to the theoretical literature in which we explicitly include a bargaining model of rent-sharing. Our results are clearly

at variance with the standard labor demand and supply model; alternative models such as a bargaining model seems to be more appropriate. However, we look at a three-year period, it can well be that over a longer time horizon the standard model is still the most relevant. Empirical research so far suggests that this longer run may be longer than often assumed. This would be an interesting avenue for further research.

The paper is organized as follows. Section 2 describes the Dutch pension system. Alternative theoretical models are discussed in Section 3. In Section 5 we present our empirical methodology. Section 6 discusses the dataset. Estimation results are given in Section 7. Section 8 concludes.

2 Pension system in the Netherlands

The Dutch pension system features a three pillar system consisting of a flat-rate basic state old-age pension (first pillar), a quasi-mandatory labor-related pension (second pillar), and a voluntary individual pension (third pillar). Statistics Netherlands estimates the relative size of the 2011 entitlements by pension pillar at 50% (first pillar), 44% (second), and 6% (third) (Bruil et al., 2015).

The pension contribution in the first pillar is a Pay-As-You-Go tax on labor income and imputed income from owner-occupied housing. During the pension period, the first pillar pension benefit depends on the current household composition and on the number of years resided in the Netherlands in the fifty years before one is eligible for a first pillar pension benefit.

Second and third pillar pension contributions are tax deductible up to a maximum level amount that depends on earned labor income. The pensions are in both pillars funded. Second pillar pensions are organized along sectoral, occupational, or company lines. There is no statutory obligation for employers to offer a pension scheme to their employees. Nevertheless, collective labor agreements ensure that pension schemes are mandatory for most employers. As a result, more than 85% of the workers is an active participant in a second pillar pension scheme. [6]

The small third pillar consists of voluntary pension contributions in individual accounts. Dutch tax regulations limit the subsidy on individual pension savings by a downward impact of past year's second pillar contributions and accruals on current year's maximum on tax deductible third pillar contributions. As such, an employee facing a high second pillar contribution rate has less room in the next year for a tax deductible contribution in the third pillar.

[6] Source: CBS (2018) https://www.cbs.nl/nl-nl/maatwerk/2018/45/witte-vlek-op-pensioengebied-2016

Our analysis concerns the large second pillar, that is, on labor-related pensions. The Dutch second pillar is, as a share of GDP, among the highest worldwide. In total, the Dutch second pillar scheme amounts to 25 to 30 billion of annual savings during our sample period.[7]

Pension contributions are paid if an individual's gross wage exceeds a certain lower limit (in Dutch: franchise). This lower limit is usually close to the annual first pillar state pension as it represents an implicit anticipation of the first pillar state pension benefit. Since second pillar pensions are organized in a decentralized manner, there is a large variation in contribution rates, accrual rates, indexation ambition, and lower limits *across pension funds* (Figure 1–2 and Table B.1–B.5). Within pension funds, labor costs and hours worked vary among individuals (Figure 3) which leads to a large *within pension fund* variation in two year changes of labor costs and average contribution rates (Figure 4). Besides the aforementioned cross-sectional variation, there is also intertemporal variation in pension fund contribution rates, lower limits, and labor costs.

The large variation across individuals and over time provides the opportunity to identify the labor cost response to changes in contribution rates. Shares of employer and employee contributions fluctuate as well, though with a smaller magnitude over time (Table B.7).

Second pillar pension schemes can be of the defined benefit (DB) type or the defined contribution (DC) type. DB schemes aim at a stable and predictable pension benefit during the pension stage, typically resulting in about 70% of the average wage rate throughout one's career. Pension schemes of the DC type aim at a stable contribution rate during the working period. In both DB and DC schemes, contribution rates can be split into an employee part and an employer part.

About 94% of Dutch second pillar pension contributions is paid to a DB scheme.[8] Participants accrue entitlements by an annual accrual rate of typically two per cent of the earned wage (in excess of a lower limit).[9] Regardless of age (and thus investment horizon), the accrual rates are fixed which makes benefits not actuarially fair. Young (old) participants face an accrual rate lower (higher) than actuarially fair.[10]

Extreme shocks to the funding ratio of a pension fund − due to financial shocks, demographic effects, legislation, or a combined effect − can be smoothed by raising contribution

[7] Source: Dutch Central Bank.

[8] Source: Dutch Central Bank.

[9] Since 2015, fiscal regulations have lowered the maximal accrual rate to 1.875%.

[10] Apart from that, contribution rates differ from actuarial fairness due to e.g. mark-ups to recover from low funding ratios or the desire to smooth contribution rates over time in response to shocks in interest rates.

Figure 1: Marginal pension contribution rate between lower and upper limit (in thousands of euros) of several pension funds for fulltime employee, 2010.

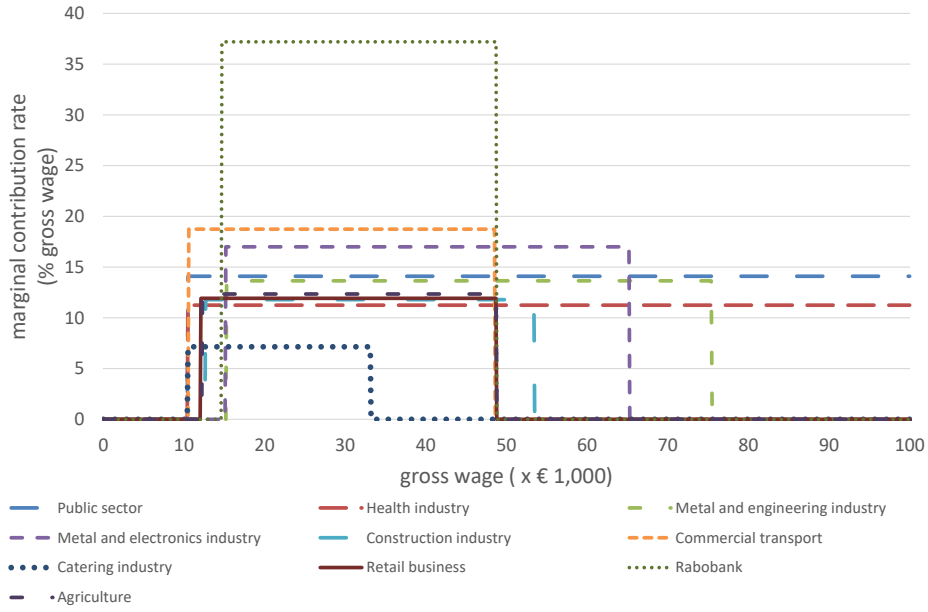
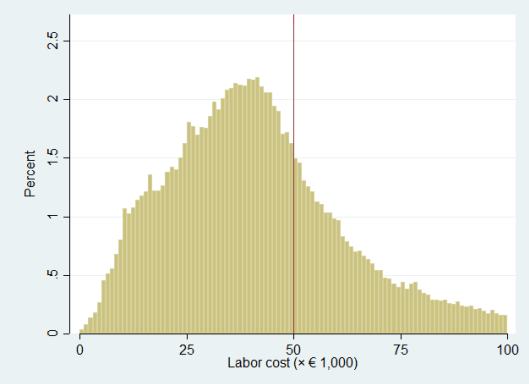


Figure 2: Average pension contribution rates by gross wage (in thousands of euros) of several pension funds for fulltime employee, 2010.

Figure 3: Individual variation, 2010.

(a) Histogram labor costs.



(b) Part-time factor by labor cost.

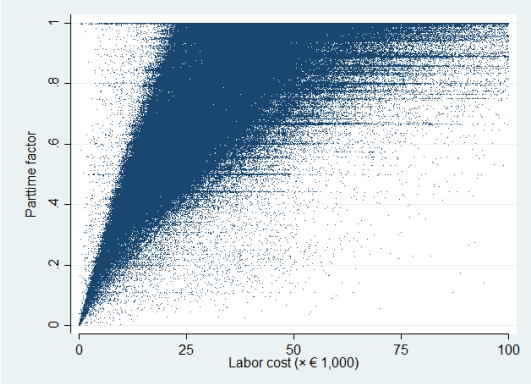
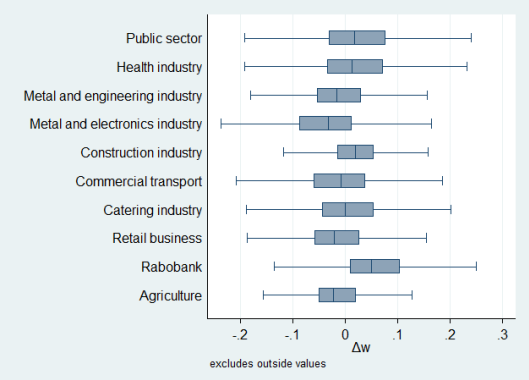
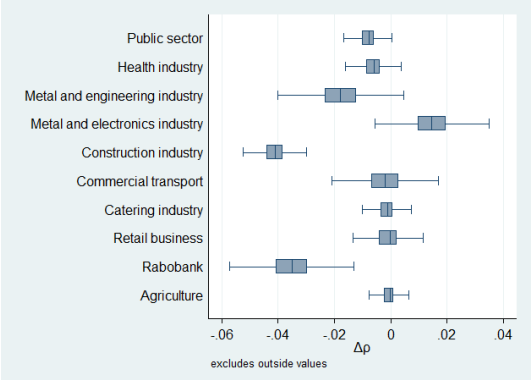


Figure 4: Individual variation within ten large pension funds, change 2008-2010.
In both boxplots, whiskers extend to include all data points within 1.5 interquartile range of the upper and lower quartile.

(a) Labor costs.



(b) Average pension contribution rate.



rates, lowering the indexation of pension entitlements, or, ultimately, cutting pension entitlements. Though pension regulations restrict the available measures to some extent, the smoothing mechanisms entail intergenerational risk sharing. The other side of the coin is that this risk sharing obscures the linkage between contributions and benefits. As a result, DB schemes are not necessarily actuarially fair.

In defined-contribution (DC) schemes contribution rates tend to be more stable, at the expense of less certain and more volatile pension entitlements and benefits. DC schemes are more common for firm-specific funds, particularly at firms paying higher wages since high income earners tend to accept a more risky pension benefit. As these DC schemes cover only a minority of workers, our analysis focuses on DB schemes.

3 Theory

A major novelty of our study is that we are able to estimate the effects of marginal and average contribution rates separately. Moreover, we can distinguish between employer contributions and employee contributions. It is not always straightforward to assess how these parameters will influence wages and labor supply. Moreover, there exist different views on the potential effects depending on the theoretical viewpoint taken. Before going to the empirical model we will therefore first provide some theoretical background on the effects that can be expected in the empirical analysis. By considering pension contributions as a tax, we adopt some principles from the taxable income literature. We start with the demand and supply model of labor and discuss its underlying assumptions in Section 3.1, and then discuss a bargaining model of rent-sharing in Section 3.2. Finally, in Section 4.1 we consider consequences of sticky wages for labor market responses. A summary of this discussion can be found in Table 1.

We focus on the incidence of pension contributions by investigating the effects on (hourly) labor cost, gross wages, net wages, and labor supply in terms of hours per worker. These are the variables we can test for in our empirical analysis. Posted wages or "gross wages" are equal to labor cost minus employer contributions. We neglect the effect on total employment; since we focus on individual behavior, total employment falls beyond the scope of our analysis. Moreover, we also neglect behavioral responses other than the hours response. Strictly speaking, these can affect the hourly labor cost too. The taxable income literature points to the existence of such non-hours responses (Blomquist and Selin, 2010). First, individuals can increase productivity by supplying more effort without increasing the hours worked. Second, there can be a shift from high taxed income to more tax favorable fringe benefits. In both cases the impact of a higher tax rate on

labor cost may be overstated; we believe that these effects are fairly small compared to the decision on hours worked. Third, tax reforms may induce individuals to change jobs or change the participation decision (extensive margin). Since our analysis is along the intensive margin, this can only be an issue if the characteristics of the job changers differ substantially from the job keepers.

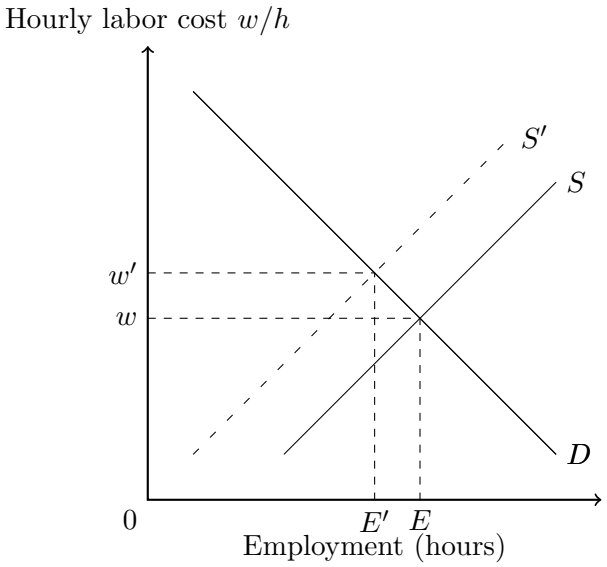
3.1 Demand and supply model of labor supply

Consider for the moment the pension contribution as a tax. Later we will relax this assumption. According to the standard textbook perfect market model of the labor market the incidence of taxes and payroll taxes such as social security contributions (SSC) is fully determined by the wage elasticities of demand ($\varepsilon_D < 0$) and supply ($\varepsilon_S > 0$). A higher tax leads to a fall in net wages by $\varepsilon_D/(\varepsilon_S - \varepsilon_D)$ and a rise in labor cost by $|\varepsilon_S|/(\varepsilon_S - \varepsilon_D)$. It is often assumed that the demand elasticity for labor is high; then the share on net wages approaches one, and all incidence is on the workers (Saez et al., 2019). For lower demand elasticities the burden is shared between workers and employers according to the elasticities. This may vary according to the circumstances, depending on how easily employers can substitute workers for another (at the individual level), or how easily they can adjust their production capacity (at the firm or sectoral level). Typical for this standard model as well as other familiar models (see Lehmann et al. (2013) for a discussion) is that posted or gross wages are irrelevant, as is the division of tax rates between employers and employees. This is known as the "invariance of incidence proposition". Furthermore, in the standard model only marginal tax rates matter for incidence. The marginal rates determine the wedge between labor cost and net wages, and supply and demand elasticities determine how the tax burden is divided between employees and firms. It is common to use the compensated supply elasticity in the literature on incidence (Saez, 2010). Average wages are irrelevant for marginal decisions. This holds for the standard model, but also in a wider class of models that derive wages and labor supply from maximizing some smooth objective function. [11] Average tax rates may, however, affect the equilibrium in a different manner, namely through the income effect on labor supply. A higher average tax may result in a larger supply of labor graphically illustrated with a rightward shift of the labor supply curve and therefore lower wages and labor costs in equilibrium. This is a different mechanism than usually considered in the incidence literature. In practice, the income effect is generally thought to be smaller than the substitution effect.

The incidence of pension contributions in the standard model can be illustrated by the familiar graph of demand and supply schedules for labor, both shown as a function

[11] Lehmann et al. (2013) present a model based on a generalized, smooth objective function.

Figure 5: Effect of an increase in the pension contribution rate on hourly labor costs



Notes: This figure shows the effect of an increase in the pension contribution rate on hourly labor costs following a standard labor demand and supply model.

of marginal labor cost per hour w/h. An increase in the marginal contribution rate for pensions or more precisely, the implicit tax entailed in the pension contribution - causes the supply schedule to shift to the left (from S to S'), leading to a new equilibrium with higher labor cost and lower labor supply. Flexible wages facilitate the adjustment to the new equilibrium. The increase in labor cost depends on the slopes of the two curves. The increase in labor cost and therefore the incidence on the employer is smaller as demand is more elastic, and thus the demand (D) curve flatter. In the extreme case of an infinitely elastic demand the higher marginal tax is fully translated in lower net wages and labor cost w remain constant. The burden is then fully on the employees. What happens to gross wages depends on the share of the employer and employee parts in (the change of) the pension contribution together with the demand and supply elasticities. For instance, if statutory rates for marginal pension contributions are $^2/_3 - ^1/_3$ for employers and employees – as indicative for the Netherlands – and the demand elasticity happens to be half of the supply elasticity, then the actual incidence also coincides with the statutory incidence. A change in the pension contribution then leaves the gross wage unaffected. Finally, unless demand or supply is fully inelastic, a higher contribution rate always leads to lower labor supply (in terms of hours).

Benefit of pensions

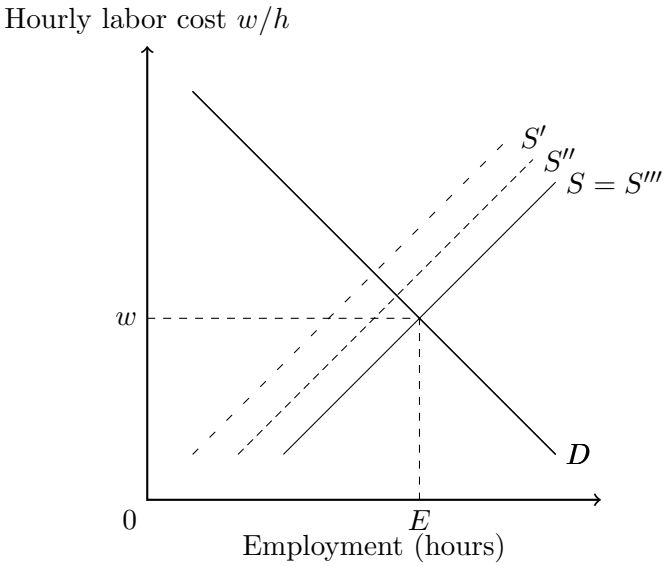
All this assumes that the pension contribution is considered by the employee as a net tax. If pensions are fully salient only the implicit tax in the pension contribution matters, that is the part of the contribution that is not matched by a - marginal - benefit in terms of a higher pension for the individual worker. The impact of the marginal benefit of pension contributions is shown in the figure by the downward shift in the S schedule from S' to S". To what extent employees see pension contributions as a tax is an empirical issue. In theory, pension contributions may even represent a net benefit for workers, namely if participation in the pension scheme is very attractive to workers.[12] In the graph this would shift the S-curve to a position at the right of the original S-curve. There are some indications that pension contributions in the German notional defined contribution system are perceived as a benefit rather than a tax (Dolls et al., 2018). Pension contributions in the defined benefit schemes are more likely to be perceived as an implicit tax (Brinch et al., 2017). First, workers tend to undervalue the benefits of pensions in the distant future, due to myopia (or short-term bias).[13] Second, the typical Dutch pension scheme is a rather complex collective defined-benefit scheme in which the relation between contributions and benefits at the individual level is quite opaque. Moreover, the system features a pay-as-you-go element which leads to an implicit tax in Dutch pensions (Bonenkamp, 2009). Finally, the variation in contributions we focus on in our analysis is mainly driven by financial decisions of pension funds, and are normally not matched by an according variation in accrual rates of pension rights.[14]

[12]The implicit tax may depend on the state of the pension fund too; marginal benefits tend to be higher when contributing to pension funds with a strong funding position. But there are other factors as well affecting the marginal benefits of pension contributions at the individual level, e.g. the tax regime that tends to be favorable for pensions. Furthermore, pension contributions are not strictly actuarially fair between men and women due to differences in life-expectancy. The same is true for workers with different education levels. Finally, Dutch pension schemes tends to favor older workers relative to younger workers as pension accruals are uniform and not corrected for the time horizon until retirement.

[13]This may be different for labor unions who act on behalf of individual workers in wage negotiations. However, in the standard model of the labor market it is the labor decision of the individual worker that matters for the incidence of the pension contributions. For an individual, the marginal pension contribution rate and the valuation of the accrued pension is relevant. This may be different in a bargaining context to be discussed below.

[14]If for example contributions are raised to strengthen the reserves of the pension fund, it will be future generations that benefit from the higher pension contributions now. On the other hand, if pension contributions are raised after a bad shock to the pension fund the benefits of the higher contributions will to a large extent leak away to pensioners.

Figure 6: Effect on hourly labor costs conditional on valuation pension benefits



Notes: This figure shows how the different valuation of the pension benefits affects labor costs after an increase in the pension contribution rate. The supply S' represents the case where pension contribution rates are perceived as a tax. When individuals value the accrued benefits the supply curve shifts downward. In case of a positive implicit tax this is represented by S". If the increase in the pension contribution rate is offset by an equal valuation of the benefit (zero implicit tax rate), the curve shifts further downward by S"'. In that case there is no effect on employment.

3.2 Bargaining model

A problem of the standard model is that it cannot explain the incidence of average contribution rates, although these seem to play a role in practice too (Adam et al., 2018; Lehmann et al., 2013), as also in our analysis. For this we need a different framework. Average taxes do play a role in a bargaining model with a rent sharing approach for wage determination. For example, consider search models of labor markets where employers and workers negotiate on the wage (Pissarides (1985); Mortensen and Pissarides (1999)). The typical Nash bargaining solution implies that employees and workers share the quasi-rents (or 'surplus') according to their bargaining power. For this see e.g. Boone and Bovenberg (2002) who study the role of marginal and average taxes in a search model of the labor market. This model gives a simple solution for labor cost and net wages. The labor cost per worker (w) and the net wage (w_n) are given by

$$w = \frac{hy}{1 + \frac{1-\theta}{\theta}\frac{\rho}{\tau}} \qquad\qquad w_n = \frac{hy}{\frac{1}{\rho} + \frac{1-\theta}{\theta}\frac{1}{\tau}},$$

where θ is the bargaining power of workers, y is the labor productivity per hour, τ is the marginal net-of-tax rates, and ρ is the average net-of-tax rates (see appendix A.1). According to these results labor cost per worker increase with productivity, marginal net-of-tax rate, and the bargaining power of workers, and decreases with the average net-of-tax rate. Here, the average tax rate influences the labor cost as a determinant of the quasi-rent. Higher average tax rates reduce the surplus, and as the loss in surplus is shared between workers and employers, labor cost will rise and net wages will fall in accordance with the bargaining power of workers θ. Note that in the bargaining model the marginal tax (and the marginal benefit) matters too, but for a different reason than in the standard demand and supply model: a marginal tax reduces the marginal gain of demanding higher wages for workers, thus effectively lowering their bargaining strength. To put it differently, a given rise in wage costs causes a smaller rise in after-tax wages, thereby weakening the incentive for workers to demand high wages, thus leading to lower net wages and labor cost in the bargaining solution.

As in the standard model the impact also depends on how the benefits of the higher pension contribution are valued by workers and labor unions. Again, what is important is whether changes in contribution rates are matched by an equivalent change in benefits. There may be a difference with the standard model as in a bargaining context it could be the perception of labor unions rather than of individual workers that matters. If labor unions are more forward-looking and less myopic than individual workers, the benefits may be better appreciated, so that more incidence on net wages may be accepted.

4 Comparison of tax effects in different models

Endogenous labor supply in the bargaining model

The standard bargaining model with rent-sharing takes labor supply per worker as given. The model can, however, be easily adapted for endogenous labor supply, for example, by taking the hours offered as determined by the worker (right to manage) (see appendix A.1). Then labor supply in hours depends on the wage rate and the marginal tax rate. The latter may vary across workers. The marginal tax rate thus influences the equilibrium along two different channels. First, a higher marginal tax acts as a disincentive for workers to ask high wages in the bargaining process, thus leading to lower wages. Second, higher tax rates lower the reward for supplying additional labor, thus depressing hours supplied by workers and lowering overall output per worker. Hourly wage rates and hourly labor cost are unaffected, however, as these are determined in the bargaining process (see the appendix). The loss in output due to a lower labor supply in hours is shared by employers and workers leading to proportionally lower labor cost and net wages per worker.

It may be noted that demand for labor plays no role at all with regard to individual wages and labor cost. This does not mean it is irrelevant, however; it determines the total demand for labor and employment. Each employer balances the marginal cost of posting a vacancy against the expected returns taking account of the probability of success in matching. With free entry (infinite demand elasticity) marginal expected returns should equate the marginal cost of posting a vacancy. Together this determines the size of employment and the tightness on the labor market.[15]

4.1 Disequilibrium, sticky wages and non-salient tax rates

While in the bargaining framework average tax rates do matter for net wages, labor cost and labor supply, there is still no role for gross wages and the statutory division of tax rates (i.e., SSC rates) between employers and employees rates. A number of papers suggest that these institutional factors may be relevant too, at least in the short and medium term. Several explanations are at hand here. First, taxes and in particular SSC rates may be less salient than presumed in these theoretical models (Chetty, 2009). There is evidence that the employer contribution tends to be less salient than a contribution that falls on workers (Iturbe-Ormaetxe, 2015). Moreover, for SSC contributions it is often hard to find out

[15]Through this channel higher marginal tax rates affect total employment. The sign of this effect is ambiguous, however, as on the one hand lower wages (by the lower incentive to bargain) increase the gains of posting vacancies for employers, but on the other hand if less hours are supplied per worker the gains are depressed.

what exactly is the marginal benefit for the individual worker. This definitely is relevant for pension contributions in the Netherlands as the pension contract is little transparent and may involve substantial transfers between generations. Other evidence suggests that wages may be sticky (i.e., rigid) in the short and medium term. If posted or gross wages are rigid, SSC contributions will be distributed between employers and employees according to the statutory rates. Wages may be sticky because several frictions can make adjustments costly. Saez et al. (2019) suggest that also equity concerns may curb wage differentiation between (generations of) workers within a firm or sector. In the presence of rigid wages markets do not clear, and the impact of employer and employee rates depends on which side of the market is binding. Marginal employee rates may affect the number of hours individuals would like to supply. Whether this notional supply materializes in more hours worked, depends on which side of the market is binding. If demand is binding then only labor cost matter, and the employer decides on the amount of labor. If supply is binding then lower employee SSC rates increase lead to an actual increase in hours supplied. Also, institutions may matter here; for example, whether individual workers do have the right or not to adjust the hours supplied.

Table 1 summarizes the effects according to the different approaches. Note that the signs are expressed for the "net-of-tax rates" that is, the fraction of income left after taxation, so 1 – tax rate. The signs are thus just the reverse for readers who are more familiar with expressing the effects for the tax rates. In this table it is assumed that the pension contribution features a positive implicit tax. We present the expected effects on hours, hourly labor costs and labor costs according to the three aforementioned models.

Labor supply (hours)

In the standard model labor supply is determined by substitution and income effects. An increase in the marginal net-of-tax rate (lower marginal tax rate) induces individuals to supply more hours, whereas an increase in the average net-of-tax rate reduces hours through the income effect. In the bargaining model a higher marginal net-of-tax-rate also induces greater labor supply through the higher marginal revenue for workers. In addition, also the wage increases here as the higher net-of tax rate strengthens the bargaining position of workers. For the average net-of-tax rates we find that in the bargaining model wages and labor supply tend to increase with average net-of-tax rates, as there is a larger surplus to be distributed between workers and employers. Both models assume flexible wage adjustments. With sticky gross wages –and no restrictions on net wages or labor costs–, the effect on hours supplied will depend on the change in employee contributions if the supply side is binding, and on the change in employer contributions if the demand

side is binding.

Hourly labor costs

There is a clear difference in the impact of the marginal net-of-tax rate on labor cost in the standard model vis-à-vis the bargaining model. In the first model hourly labor cost per worker fall as workers expand their labor supply thus depressing wages in equilibrium. In the bargaining model a higher net-of-tax increases the incentive to bargain for higher wages, thus leading to higher wages and labor costs. For an increase in the average net-of-tax rate the standard model predicts increasing hourly labor cost (through the income effect on labor supply), while the rent-sharing model predicts a fall in hourly labor cost due to a larger surplus. With sticky gross wages the effect of the average net-of-tax rate on hourly labor costs depends purely on the employer part in the contribution rate. The marginal rate is irrelevant here as changes in labor supply cannot affect wages if they are sticky.

Labor costs

The total effect on labor costs is given by the combination of the effects on labor supply (hours) and the hourly labor costs. The signs are indicated in the table. In the standard model total labor costs increase with marginal net-of-tax rates when the elasticity of labor demand exceeds unity (in absolute terms), this is usually assumed to be the case. In the rent-sharing model higher marginal net-of-tax rates unambiguously increase total labor costs, because workers have an incentive to ask for higher wages, which will result in higher labor cost in equilibrium. A higher average net-of-tax rate on labor cost influences total labor costs through two opposite effects. On one hand, the higher surplus reduces hourly labor costs, but on the other hand labor supply may increase as also wages rise. The net effect depends on the elasticity of hours supplied. With sticky gross wages, the effect on labor supplied depends on which side of the market is binding. If the demand side is binding, only the employer rates are relevant, and it depends on the demand elasticity (> 1 or < 1, in absolute terms) whether labor cost increase or decrease. If the supply side is binding then employee rates are decisive. Total labor costs do not respond to lower average employee taxes if wages are sticky and the demand side is binding. If the supply side is binding the income effect may decrease labor supply, thus also leading to lower total labor cost.

Table 1: Expected effects of an increase in the net-of-tax rates

effect on		*Standard model*	*Bargaining*	*Sticky gross wage*
labor supply (hours)	β_τ (marginal)	+ (substitution effect)	+ (bargaining incentive and substitution effect)	+ if ee and S binding + if er and D binding 0 otherwise
	β_ρ (average)	− (income effect)	+ (larger surplus → higher wage)	− if S binding (income effect) 0 otherwise
hourly labor cost	β_τ (marginal)	− (more labor supply)	+ (bargaining incentive)	0
	β_ρ(average)	+ (less labor supply)	− (larger surplus)	− if er 0 if ee
total labor cost	β_τ (marginal)	+ (−) for high (low) demand elasticity	+	+ if ee and S binding + if er and D binding 0 otherwise
	β_ρ (average)	− (+) for high (low) demand elasticity	−(+) for low (high) supply elasticity	− if er − if ee and S binding (less labor) 0 otherwise

5 Estimation methodology

5.1 Model specification

We estimate four different empirical models with a panel-based difference-in-difference method. This is a standard method in the elasticity of taxable income literature (Lehmann et al., 2013; Weber, 2014; Adam et al., 2018). Firstly, we estimate the elasticity of real labor costs w_{it} to marginal and average pension contribution rates

$$\Delta \log w_{it} = \alpha + \beta_\tau \Delta \log \tau_{it} + \beta_\rho \Delta \log \bar{\rho}_{it} + \gamma X_{i,t-2} + u_{it}, \tag{1}$$

where w is the real labor cost of the individual employee i, in year t, and Δ is the two-year change between period $t-2$ and t.[16] A two-year difference Δ is also adopted in the baseline specification in Weber (2014). The delay of two years can be advocated by the delay from wage adjustments in collective labor agreements. Then, each β coefficient in (1) is a mix of the one-year response to changes in contribution rates starting in year t and the two-year responses to changes in contribution rates starting in year $t-1$. Delayed responses to earlier changes in contribution rates are captured by the error term u_{it}. Weber (2014) contrains an in-depth analysis on the econometric issues in estimating equation (1). The sensitivity analysis we perform on the number of lags indicates that effects are not very different for one-year differences (Lehmann et al., 2013) or three-year differences (Gruber and Saez, 2002; Kleven and Schultz, 2014).

Equation (1) includes two net-of-rates:[17] the marginal net-of-contribution rate τ and the average net-of-pension contribution rate $\bar{\rho}$. The exogenous variables in $X_{i,t-2}$ include individual characteristics, pension fund dummies, year dummies, and a ten-piece linear spline of base-year labor cost $f(\log w_{i,t-2})$ and base-year labor cost growth $g(\log(w_{i,t-2}) - \log(w_{i,t-3}))$ (see Section 5.3). The error term u_{it} captures time-variation and unobserved heterogeneity across individuals.

The bar on ρ indicates the difference between the compensated and uncompensated marginal elasticity. The uncompensated elasticity ρ of labor cost to marginal net-of-contribution rates is evaluated at the uncompensated labor cost. In contrast, the corresponding compensated elasticity $\bar{\rho}$ isolates the effect of the marginal net-of-pension contribution rate by compensating the effect on labor cost due to changes in the average net-of-contribution rate. Our interest is in this isolated effect. Following Lehmann et al. (2013), the compensated (uncompensated) marginal elasticity is obtained by using a *predicted* average net-of-pension contribution rate $\bar{\rho}$ (the *actual* average net-of-contribution

[16] In the baseline model, labor costs w are exclusive of social security contributions which were very stable throughout our sample period.

[17] Recall that the net-of-tax rate equals one less the corresponding tax rate.

rate ρ) for the average net-of-contribution rate. Similar to the standard approach in the tax literature (Gruber and Saez, 2002), the predicted average net-of-contribution rate is obtained by applying the pension scheme in year t on the inflated base-year gross wage: $g\bar{w}_{i,t-2} = gw_{i,t-2}\pi_{t-2}\pi_{t-1}$ with π_{t-i} the average growth in gross wages gw between period $t-i$ and $t-i+1$.

Our second estimation involves the elasticities of the real hourly labor cost w/h,

$$\Delta \log \left(\frac{w_{it}}{h_{it}} \right) = \alpha + \beta_\tau \Delta \log \tau_{it} + \beta_\rho \Delta \log \bar{\rho}_{it} + \gamma X_{i,t-2} + u_{it}. \tag{2}$$

Suppose the behavioural effect is captured by the hours response, and not by job changes, changes in effort, or shifts towards fringe benefits. The hourly labor cost is then unaffected by behavioral effects such that the coefficient β_ρ on the average net-of-contribution rate in (2) reflects the incidence of pension contributions.[18]

Thirdly, we can estimate the elasticities of hours worked,

$$\Delta \log h_{it} = \alpha + \beta_\tau \Delta \log \tau_{it} + \beta_\rho \Delta \log \bar{\rho}_{it} + \gamma X_{i,t-2} + u_{it}. \tag{3}$$

The estimate for the elasticities β_τ and β_ρ in (3) refer to the behavioral effect in terms of the hours response after a change in the net-of-tax rates τ and ρ.

Finally, we study the effects of employee rates (τe and $\bar{\rho e}$) and employer rates (τr and $\bar{\rho r}$). Split the explanatory variables in (1),

$$\Delta \log w_{it} = \alpha + \beta_{\tau e} \Delta \log \tau e_{it} + \beta_{\tau r} \Delta \log \tau r_{it} + \beta_{\rho e} \Delta \log \bar{\rho e}_{it} + \beta_{\rho r} \Delta \log \bar{\rho r}_{it} + \gamma X_{i,t-2} + u_{it}. \tag{4}$$

The employee (employer) net-of-rate is with respect to the gross wage (labor cost w), which is standard in the literature. Even though employer rates are in practice communicated in terms of gross wages (excluding employer contributions), expressing employer rates in terms of labor costs ensures that the net wage simply equals the product $\rho e\, \rho r\, w$.

In the baseline estimates, we weight individuals by the inverse of the corresponding pension fund size as measured by the number of participants. This is important because the largest pension funds are much larger than the other pension funds (Table B.6). As a sensitivity test, we perform unweighted regressions. We use robust standard errors that adjust for heteroskedasticity and cluster standard errors by pension fund since individuals within the same pension fund tend to face similar shocks to pension contributions and labor costs.

[18] A change in contractual hours affects the part time factor and thus the lower limit on pension contributions. The hourly rate is unaffected if actual hours worked does not change. If only actual or only contractual hours worked changes, the hourly labor cost can change (Figure 2).

5.2 Potential endogeneity of pension contributions

A causal interpretation of the pension contribution rates in equation (1) is only valid if the change in contribution rates ($\Delta \log \tau$ and $\Delta \log \bar{\rho}$) is uncorrelated with the error term u. However, several sources of endogeneity can result in a nonzero correlation.

First, there could be omitted variables such as pension fund characteristics and macroeconomic conditions that simultaneously affect labor costs and contribution rates. To correct for this, we included pension fund dummies[19] and year dummies as exogenous variables in $X_{i,t-2}$. Year dummies pick up macroeconomic conditions such as the inflation rate. Wages could be more sticky when the inflation rate is low, as nominal wages are more sticky than real wages. Still, time-varying characteristics of pension funds are a source of variation. One way to correct for this is to include interacted pension fund and year dummies. Unfortunately, this would also capture relevant variation caused by pension contributions.

Second, because of nonlinearities in the pension contribution system (Figure 2), there could be reverse causality. The lower threshold for gross wages on pension contributions implies that the marginal contribution rate can change with income and thus labor costs. To resolve this issue, we instrument the change in the marginal contribution rate by calculating the predicted marginal contribution rate which is based on the inflated base year's gross wage, i.e., $g\bar{w}_{i,t-2} = gw_{i,t-2}\pi_{t-2}\pi_{t-1}$.[20]

Let $C_{it}(w)$ denote the pension contribution rate that corresponds to labor cost w of individual i in year t. An instrument for the marginal net-of-contribution rate is

$$\bar{\tau}_{it} = 1 - \frac{\partial}{\partial w} C_{it}(\bar{w}_{i,t-2}). \tag{5}$$

Using (5), we instrument the two-year change in the marginal net-of-pension contribution rate,

$$\Delta \log \bar{\tau}_{it} = \log \bar{\tau}_{it} - \log \tau_{i,t-2}. \tag{6}$$

The predicted change in marginal rates is very often zero if labor costs exceed 50,000 euro (Figure 1 and Table B.3). In addition, the relation between labor cost and average contribution rates is decreasing above the upper limit, if existent (Figure 2). Therefore, we drop in the baseline model all observations with labor costs above 50,000 euro.

[19] An alternative to pension fund dummies is to include funding ratios. Unfortunately, data on funding ratios is not available for the entire sample period.

[20] A similar approach is in Auten and Carroll (1999); Gruber and Saez (2002); Kopczuk (2005); Saez et al. (2012); Lehmann et al. (2013). Serial correlation in wage growth may indicate that a greater number of lags is required for the instruments (Weber, 2014).

Notice that the average net-of-contribution rate ρ is already included as a predicted rate in (1)–(4) to ensure that the effect on τ is a compensated elasticity (see Section 5.1).

5.3 Potential changes in labor costs unrelated to pension contributions

Another methodological concern are exogenous changes in labor costs unrelated to pension contributions and taxes. For instance, technological progress might affect labor costs if it favors high-skilled workers compared to low-skilled workers. Another source relates to mean reversion. An unexpected low income in period $t-2$ is more likely to be followed by a higher income in period t. This is problematic in estimating equation (1), since base-year income $w_{i,t-2}$ (and thus $\Delta w_{i,t}$) is then correlated with the error term u_{it}.

Including a function of base-year income might control for both sources of methodological issues. This function can be linear (Auten and Carroll, 1999) or a flexible 10-piece spline (Gruber and Saez, 2002). Nonetheless, the source of both methodological issues differs which calls for different corrections. This motivates us to follow Kopczuk (2005) and Kleven and Schultz (2014) who use two ten-piece linear splines, one spline based on base year growth rates $\log(w_{i,t-2}/w_{i,t-3})$ that controls for mean reversion, and another spline based on base year levels $\log(w_{i,t-2})$ that controls for shifts in the wage distribution. The downside is an additional lag term, which disables a year of observations in the regression.

6 Data

We use a rich administrative dataset that contains detailed job-level and earnings variables for the entire working population. The data is on a monthly basis and starts in January 2006 and ends in December 2012.[21] For each job and each month, the dataset includes the number of days worked, hours worked (regular and overtime), and earnings.[22] Earnings are reported in full without any cap, and on forms directly filed by employers to the fiscal administration. The earnings variables can be considered reliable as the fiscal administration checks tax filings.

Pension contributions are missing in the administrative dataset. Calculating all pension contributions has proven cumbersome. In each year in our sample period, more than 600 pension schemes existed[23] with extremely differentiated rules and thresholds, both

[21] The datasets are accessed through a remote connection to non-public micro datasets of Statistics Netherlands.

[22] Monthly earnings are broken down into various types: regular earnings, overtime earnings, bonuses, and other forms of earnings.

[23] Source: Dutch Central Bank.

across funds and over years. We constructed pension contributions using historic contribution rates of the 30 largest pension funds (about 80% of active participants).[24] We merge the job-level dataset with a municipal database with personal records. This procedure yields very detailed labor market and socio-demographic information on individuals.

The analysis is based on a sample of wage earners born between 1957 and 1987 and aged between 21 and 55 years in our sample period. Older ages are excluded since early retirement schemes may affect the participation decision and hours worked. For each year, we only include individuals who worked the entire year and did not change job to another collective labor agreement. An individual with a change in status on the covariate having partner or the covariate having children, is dropped in the corresponding years. Other years of such individuals are included as we do not expect an effect on labor income.

The full sample includes 7,532,106 employee-year observations. Table B.6 reports for each pension fund and each year the resulting number of included participants. Particularly, the pension funds in the public sector and in the health industry are both large. In our sample, about one third of the participants is enrolled in the pension fund for public sector workers (ABP). Another twenty percent participates in the pension fund for the health industry (PFWZ). Collective labor agreements are sector-wide, which means that wage rates and some features of the pension contribution scheme are simultaneously determined for the entire sector. As such, within-pension fund dependence is larger than between-pension fund dependence (Figure B.1).

Table 2 reports the descriptive statistics of individual characteristics that we include as control variables or that we use in our sensitivity analysis. We include age, gender, partner and children as control variables. In our sensitivity analyses we exclude the banking sector, public sector workers, or include those whose labor costs are above 50,000 euro. Although we drop many observations because of the last income selection (see Figure 7) we run a sensitivity check. Each individual is weighted by the inverse of the size of the pension fund to ensure that each pension fund has an identical weight in the estimation. That is, each of the 30 pension funds in our sample has a weight of 3.3%, including the public sector.[25]. In our sample, almost 60% are men and the average age equals 40 years. Most participants are couples with children.[26]

Table 3 presents some characteristics of the pension schemes in our sample period. Pension contribution rates tend to increase during our sample period. The statutory

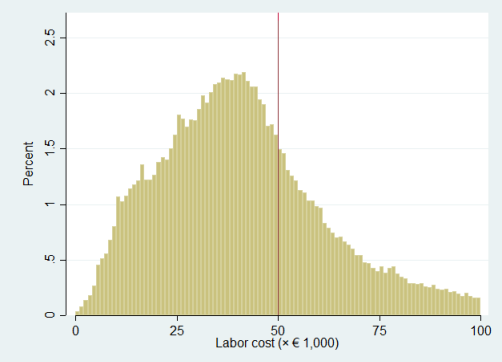
[24]https://www.dnb.nl/en/statistics/index.jsp

[25]Without weighting, the share of the public sector fund would increase to 35.3%. In contrast, the share of the banking sector (ABN Amro, ING, and Rabobank) would decrease to 4%.

[26]The descriptive statistics of the household control variables are very similar with and without the weighting scheme. In other words, pension fund size is unrelated to household status.

Figure 7: Labor cost, 2010.

(a) Weighted



Notes: Frequency table of labor cost. Red line indicates income at 50K.

incidence of pension contributions is for 69% (9.8/(9.8+4.37)) at the employer and for 31% at the employee. On average, a lower income cap of 11,780 euro applies. For this reason, the marginal tax (18.36%) rate is higher than the average tax rate (14.16%). The employer contribution rate is in the banking sector much higher and more volatile (Table B.7). The employee contribution rate is in the banking sector much lower if existent at all. The higher total contribution rate and the substantially different statutory incidence may have a large impact on the regression results.

The largest pension funds for employees in the insurance sector are missing in our dataset since such funds are individual defined contribution (DC) pension schemes (see Section 2).

The appendix contains for each pension fund–year combination the mean labor cost (Table B.1), the lower threshold (Table B.2), the upper threshold (Table B.3), the mean marginal contribution rate (Table B.4), the mean average pension contribution rate (Table B.5), and the number of participants (Table B.6). All six variables exhibit an increasing trend as can be seen in the bottom row in each table.

The high variation in pension contribution rates over time, across pension funds and among individuals within the same pension fund is used in our identification of our empirical model, which is the focus of the next section.

Table 2: Descriptive statistics, characteristics participants

	Shares		Shares
Public sector	3.3%	Singles	20.2%
Banking sector	10.0%	Single parent	3.5%
Men	59.8%	Couple with children	59.8%
Average age (years)	39.5		
Age class 20-30	4.1%		
Age class 30-40	27.6%		
Age class 40-50	50.3%		
Age class 50+	18.1%		

Notes: The shares are weighted by the inverse of the size of the pension fund. Public sector refers to participants enrolled in a scheme of pension fund ABP. Banking sector refers to participants in the pension funds of ABN Amro, ING Group, and Rabobank. Below 50K represents employees earning less than 50,000 euro (discounted to 2006 euros).

Table 3: Descriptive statistics, pension schemes

	2008	2009	2010	2011	2012	Average
no. participants ($\times$ 1,000)	1069	1081	1091	1099	1104	1094
w ($\times$ € 1,000)	30.47	30.86	30.55	30.54	32.29	31.04
w/h ($\times$ € 1,000)	17.82	18.09	17.88	17.95	19.69	18.38
ρ (%)	13.00	13.72	13.61	14.30	15.06	14.16
ρ_e (%)	3.94	4.09	4.19	4.42	4.78	4.37
ρ_r (%)	9.06	9.63	9.42	9.88	10.27	9.80
τ (%)	16.79	17.85	17.77	18.41	19.44	18.36
τ_e (%)	5.03	5.25	5.41	5.64	6.11	5.60
τ_r (%)	11.80	12.60	12.35	12.77	13.33	12.76
lower limit ($\times$ € 1,000)	10.96	11.57	11.81	11.88	11.88	11.78

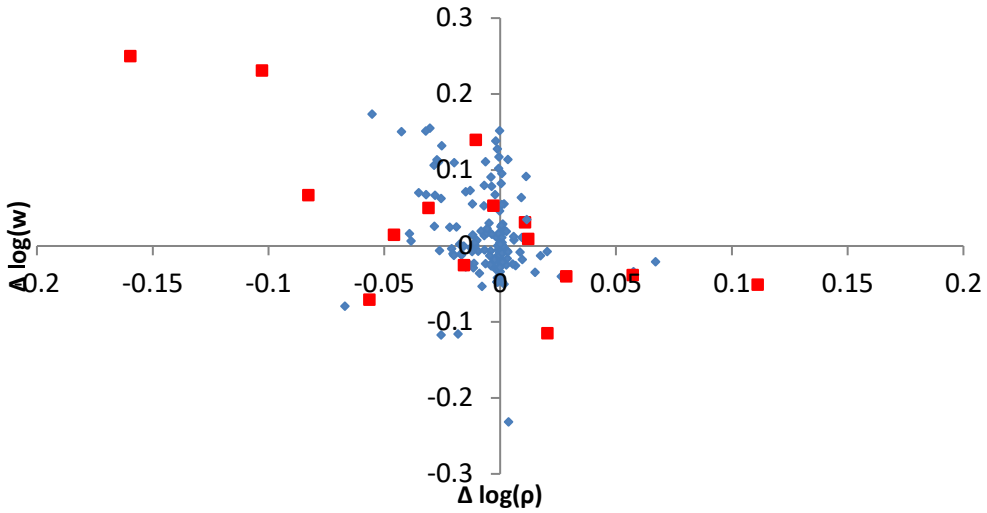
*N*otes: The pension contribution rates and amounts are weighted by the size of the pension fund.

7 Estimation results

7.1 Graphical evidence at pension fund level

Figure 8 depicts the two-year log change in labor cost ($\Delta \log(w)$) and in the average net-of-pension contribution rate ($\Delta \log(\rho)$). As a preliminary result for equation (1), a linear trend line across the full set of points has a slope coefficient of –1.13. This estimate is not significantly different from minus one, since the corresponding standard error equals 0.18. The pension funds at banks are potential outliers with a pronounced impact on the slope coefficient (Table B.7).[27] Dropping the banks from the sample yields a similar slope coefficient of –1.05 with standard error 0.29. This is a rough indication that the employer pays the majority of increases in pension contributions in the corresponding two years.

Figure 8: Two year log-change average net-of-pension contribution rate ρ and two year log-change labor cost w.



Notes: Annual changes at pension fund level. Red squares correspond to the three pension funds of banks, blue dots are from non-banks. Sample period 2006-2012.

The preliminary results are at the pension fund level. It does not exploit within pension fund variation (Figure B.1), nor does it allow for pension fund-specific effects in (1). For instance, certain participants may face a larger increase in wage rates than others within the same pension fund. In addition, some pension funds might adopt a different policy

[27] In Figure 8, the maximal value of Cook's distance is at most 0.27, due to the observation of ABN Amro 2010–2012. Although this maximal value seems reassuring, Cook's distance measure pertains to individual observations rather than a specific group of observations.

in setting pension contribution rates (e.g., accepting a low funding ratio or focusing on indexation in a so-called real pension contract) and the wage growth can differ between sectors (e.g., prosperous sectoral performance or prospects). This illustrates that the assumption of a pension fund-independent intercept can be violated. The analysis with individual employee level data in Section 7.2 resolves both issues. The First-stage results using changes at the individual level as instruments can be found in Table B.8. The coefficient is significant and positive (0.432) and the instrument is strong enough (F-test statistic is 245).

7.2 Main results

Table 4 documents the estimation results for equation (1) with labor cost. Six different specifications are reported. Column (1) is the baseline scenario. Full results are given in Table B.9. Column (2) differs from the baseline specification by omitting the weighting of participants based on the pension fund size. In column (3), participants of the public sector fund ABP are excluded since political pressure and signaling may affect their contribution rates, accrual rates, and the employee-employer incidence differently for a public sector pension fund than a private sector pension fund. Likewise, the results without the banking sector can differ from other sectors (column (4)). Pension funds for workers in the banking sector tend to charge higher and more volatile contribution rates (Table B.7 and Figure 8). Moreover, employee contributions tend to be low, mostly absent, in the banking sector. Column (5) shows the impact when including incomes above 50K. Column (6) reports the results with additional noise from social security contributions. The results are very robust across columns.

The coefficient of main interest – for the average net-of-pension contribution rate (β_ρ) – is negative and significant, and robust over all specifications. It shows that labor costs adjust for about 70% to a change in average pension contribution rates. The coefficient of the marginal net-of-pension contribution rate (β_τ) is small and insignificant in all specifications in Table 4.[28] With the exception of the somewhat more negative coefficient in column (5), the elasticity β_ρ differs in each specification significantly from minus one at the 10% level. This suggests that a smaller, yet significant, part of about 30% is paid by employees by means of a lower net wage.

The fact that marginal rates do not matter while average rates do, suggests that the standard demand and supply model is less relevant here, at least at this time horizon. Moreover, the 70-30 division between employers and workers is high compared to what

[28]The estimated residuals exhibit in none of the estimates significant positive serial correlation at a two-year lag.

is usually found on the basis of plausible demand supply elasticities. The elasticity β_ρ of about 70% is close to the average statutory incidence of 69%. At first sight, this suggests that the statutory incidence determines the economic incidence and gross wages are sticky. However, the result also remains when the employer-employee shares deviate substantially from 70-30, e.g., in the banking sector. Dropping the banking sector (column (4)) does not give a higher value for this coefficient. In our subgroup analysis we will investigate this further by looking at pension funds with different statutory employee-employer contribution shares (Table 8). Again, the 70-30 economic incidence cannot be rejected. For this reason, the similarity with the statutory incidence in the baseline model could be coincidence and one has to consider alternative explanations, e.g. the bargaining model instead of sticky wages.

Table 4: Labor cost

	(1)	(2)	(3)	(4)	(5)	(6)
Marginal rate β_τ	-0.025	0.065	-0.03	-0.022	0.003	0.014
	(0.035)	(0.063)	(0.035)	(0.037)	(0.062)	(0.041)
Average rate β_ρ	-0.669***	-0.703***	-0.668***	-0.627***	-0.795***	-0.608***
	(0.182)	(0.179)	(0.182)	(0.234)	(0.164)	(0.181)
R^2 (%)	16.3	15.5	16.4	15.8	16.0	15.8
First-stage F (%)	245	243	245	512	85	245
Observations	3319343	3319343	2176345	3229304	3719184	3319343
Weighted by fund size	yes	no	yes	yes	yes	yes
Include public sector	yes	yes	no	yes	yes	yes
Include fin. employees	yes	yes	yes	no	yes	yes
Upper thr. 50K	yes	yes	yes	yes	no	yes
Excl. ssc	yes	yes	yes	yes	yes	no

Notes: Each specification is based on equation (1) as a 2SLS regression with (*i*) two-year changes, (*ii*) the labor cost as the dependent variable, (*iii*) the marginal pension contribution rate instrumented by the two-year lagged predicted rate, (*iv*) both year and pension fund dummies included in X_{t-2}, and (*v*) gender, age, marital status and having children are individual-specific control variates X_{t-2}. Income controls are ten-piece linear splines of level and annual change of log labor cost. Robust standard errors (in parentheses) are clustered at the pension fund level. *** Significant at the 1% level.

The impact on labor cost can be decomposed into the effect on hourly labor cost and on the number of hours worked per worker. The data on hourly labor cost are obtained

Table 5: Hourly labor cost

	(1)	(2)	(3)	(4)	(5)	(6)
Marginal rate β_τ	0.023	0.099*	0.019	0.028	0.025	0.06
	(0.040)	(0.054)	(0.040)	(0.041)	(0.056)	(0.046)
Average rate β_ρ	-0.842***	-0.72***	-0.841***	-0.673***	-0.847***	-0.775***
	(0.182)	(0.194)	(0.180)	(0.275)	(0.152)	(0.187)
R^2 (%)	33.6	29.5	33.8	32.8	32.5	33.3
Observations	3319342	3319342	2176344	3229303	3719183	3319342
Weighted by fund size	yes	no	yes	yes	yes	yes
Include public sector	yes	yes	no	yes	yes	yes
Include fin. employees	yes	yes	yes	no	yes	yes
Upper thr. 50K	yes	yes	yes	yes	no	yes
Excl. ssc	yes	yes	yes	yes	yes	no

Notes: All specifications are based on equation (2) as a 2SLS regression with (*i*) two-year changes, (*ii*) the hourly labor cost as the dependent variable, (*iii*) the marginal pension contribution rate is instrumented by the two-year lagged predicted rate, (*iv*) both year and pension fund dummies are included, and (*v*) gender, age, marital status and having children are individual-specific control variates. Income controls are ten-piece linear splines of level and annual change of log hourly labor cost. Robust standard errors (in parentheses) are clustered at the pension fund level. * Significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

by dividing total labor costs per worker by the observed number of hours worked per year. Table 5 gives the effects on hourly labor cost. The results are largely the same as for total labor cost. The effect of the marginal net-of-pension contribution is again insignificant; for the average rate the coefficient turns out to be slightly more negative (0.8) than for total labor cost. Thus, a 1%-point increase in pension contributions increases hourly labor costs by about 0.8%. This concurs with the insignificant effects found for the effects on labor supply, both for the marginal and average rates (Table 6).

Separating employer and employee pension contribution rates

Further insight into the roles of statutory rates can be found by testing for the impacts of employer and employee rates separately. According to the Invariance of Incidence Proposition (IIP) division of total contributions into employer and employee parts should be irrelevant. We attempt to study this using the variation in pension contributions paid by employees and employers in our data. The results of separating employee and

Table 6: Hours worked

	(1)	(2)	(3)	(4)	(5)
Marginal rate β_τ	0.008	0.067	0.008	0.01	0.034
	(0.025)	(0.052)	(0.025)	(0.029)	(0.030)
Average rate β_ρ	0.009	-0.292	0.01	-0.141	-0.055
	(0.074)	(0.209)	(0.073)	(0.131)	(0.049)
R^2 (%)	11.0	11.1	11.1	11.4	11.3
Observations	3319342	3319342	2176344	3229303	3719183
Weighted by fund size	yes	no	yes	yes	yes
Include public sector	yes	yes	no	yes	yes
Include fin. employees	yes	yes	yes	no	yes
Upper thr. 50K	yes	yes	yes	yes	no

Notes: All specifications are based on equation (3) as a 2SLS regression with (*i*) two-year changes, (*ii*) the hours as the dependent variable, (*iii*) the marginal pension contribution rate is instrumented by the two-year lagged predicted rate, (*iv*) both year and pension fund dummies are included, and (*v*) gender, age, marital status and having children are individual-specific control variates. Income controls are ten-piece linear splines of level and annual change of hours. Robust standard errors (in parentheses) are clustered at the pension fund level. * Significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

employer pension contribution rates (equation (4)) are presented in Table 7. The results are, however, rather unsatisfactory and further research is needed: While the signs for the impact of average contribution rates are again significantly negative, the finding that labor costs respond stronger to employee rates than to employer rates ($|\beta_{\rho e}| > |\beta_{\rho r}|$) is counter-intuitive, although the standard errors are large. We suggest the following three explanations for this finding.

First, the question is whether there is enough variation between employer and employee rates to derive significant results. As the correlation matrix shows (Table B.10), employer and employee rates are correlated (0.4) which may result in a lower power for the coefficients in equation (4). Overall, further research is needed on the isolated response to employee and employer contribution rates.

Second, the contribution rate shows an increasing trend in our sample (Table 3 and Table B.5). If employee rates are more salient than employer rates (Iturbe-Ormaetxe, 2015), an increase in the net wage rate is particularly desirable to compensate for an increase in employee contribution rates. This has an upward effect on $|\beta_{\rho e}|$. Notice that the year fixed effects in equation (4) will pick up the general trend, not the specific trend for employee contribution rates.

Third, the variance of average employee rates is about half of the variance for the average employer rate. Also the statutory rates for employees are about half of those for employers (Table B.7). This concurs with the 70-30 economic incidence (employer-employee) found in our analysis. The combination of a strong correlation and small changes in employee rates can inflate the coefficients of the average net-of-pension employee rate and the corresponding standard error. To gain more insight in this explanation, we run several sensitivity tests based on different ratios of employer and employee rates (see Table 8).

In Table 8 we separate our main sample into subsamples based on either the ratio of the employee-employer pension contribution rate in the base year, or on the two year change in the employee-employer share. Interestingly, we find that the coefficient of average net-of-tax contribution rate is not significantly different from -0.7 even though the statutory share in the subgroups is not equal to 70-30. The labor costs of pension funds with a high $\frac{\rho e}{\rho r}$ are more sensitive to the pension contributions. Since the difference between pension funds with high and low $\frac{\rho e}{\rho r}$ is insignificant, we conjecture that the 70%-30% is the dominant driver. Within the group of pension funds with a high employee share, the average net-of-rate coefficient is not significantly different from zero and one. This might be caused by a lack of variation between and within pension funds with low employee shares.

Table 7: Labor costs: isolating employer and employee rates

	(1)	(2)	(3)	(4)	(5)	(6)
Marginal ee rate $\beta_{\tau e}$	-0.078	0.215	-0.079	-0.535	-0.138	-0.076
	(0.190)	(0.305)	(0.188)	(0.507)	(0.226)	(0.194)
Marginal er rate $\beta_{\tau r}$	-0.021	-0.025	-0.028	0.457	0.097	0.05
	(0.178)	(0.199)	(0.176)	(0.485)	(0.130)	(0.180)
Average rate $\beta_{\rho e}$	-1.668***	-1.661***	-1.671***	-0.927	-1.959**	-1.404**
	(0.614)	(0.590)	(0.613)	(0.743)	(0.921)	(0.605)
Average rate $\beta_{\rho r}$	-0.367	-0.379	-0.363	-0.802	-0.601***	-0.385*
	(0.233)	(0.268)	(0.235)	(0.585)	(0.242)	(0.222)
R^2 (%)	9.1	16.3	43.6	14.2	15.9	15.9
Observations	3319343	3319343	2176345	3229304	3719184	3319343
Weighted by fund size	yes	no	yes	yes	yes	yes
Include public sector	yes	yes	no	yes	yes	yes
Include fin. employ.	yes	yes	yes	no	yes	yes
Upper thr. 50K (2006)	yes	yes	yes	yes	no	yes
Excl. ssc	yes	yes	yes	yes	yes	no

Notes: All specifications are based on equation (4) as a 2SLS regression with (*i*) two-year changes, (*ii*) labor cost as the dependent variable, (*iii*) the marginal pension contribution rate is instrumented by the two-year lagged predicted rate, (*iv*) both year and pension fund dummies are included, and (*v*) gender, age, marital status and having children are individual-specific control variates. Income controls are ten-piece linear splines of level and annual change of log labor cost. Robust standard errors (in parentheses) are clustered at the pension fund level. * Significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

7.3 Robustness checks

Table 9 presents the results for labor cost testing for different lag lengths. The two-year difference baseline estimate is in column (1).

Notice that with a three-year difference and a growth spline, only three different years are effectively available, the years 2010-2012 when funding ratios were low and recovery plans were imposed on pension funds. The first observations in the three-year regressions are changes between 2007 and 2010 with the growth spline referring to the years 2006 and 2007. Overall, a longer sample period is required to evaluate whether the IIP holds in the long run.

The income level spline may correct for divergence in the income distribution. Table

Table 8: Labor costs: different subgroups

	(1) high ρ^e/ρ^r	(2) low ρ^e/ρ^r	(3) high $\Delta\rho^e/\rho^r$	(4) low $\Delta\rho^e/\rho^r$
Marginal rate β_τ	0.001	0.019	-0.039	0.062
	(0.045)	(0.070)	(0.036)	(0.057)
Average rate β_ρ	-0.528	-0.725***	-0.611***	-0.956***
	(0.408)	(0.247)	(0.216)	(0.221)
R^2 (%)	16.4	16.6	15.3	18.7
Observations	1671564	1576681	1671564	1576681

Notes: The table shows the results (Equation 1) for several subgroups.
Column (1)–(4) divide the sample in two equal parts according to the relative (change in) employee-employer shares. Column (1) is for individuals in pension funds with high $\frac{\rho e}{\rho r}$ (above the median), column (2) for individuals in pension funds with low $\frac{\rho e}{\rho r}$ (below the median), column (3) for high $\Delta\frac{\rho e}{\rho r}$ (above the median) and column (4) for low $\Delta\frac{\rho e}{\rho r}$ (below the median)

10 shows that this spline has some impact on the results (column (1) and (3)). The growth spline corrects for transitory income effects. Excluding the growth spline has only a minor impact on the coefficients (column (1) and (2)). The latter is in line with the findings in Kleven and Schultz (2014) who find that income splines are less important in countries with a stable income distribution such as Denmark and the Netherlands.

Table 11 shows that the 70%-30% incidence split is robust across different subsamples. The results do not vary by age. This is somewhat surprising given that defined benefit pension schemes tend to subsidize the accruals of older workers at the expense of younger workers (Bonenkamp, 2009). In other words, the results suggest that the tax-benefit linkage might be unimportant at the individual level, at least at this age difference. Then, following Disney (2004) the labor cost of women is indeed more sensitive to pension contributions than men. Somewhat surprisingly both the substitution and income effects are higher for women. Still, both for men and women, the income effects from the average net-of-contribution rates are not significantly different from 70%.

The finding that the statutory incidence ρ^e/ρ^r is insignificant in Table 12 confirms that the statutory incidence is not the dominant driver. Omitting the marginal net-of-tax rate τ has no effect on the coefficient of the average rate, β_ρ. When omitting the average rate, the marginal rate β_τ becomes significantly negative. A likely explanation is the high correlation between the marginal rate $\Delta\tau$ and the average rate $\Delta\bar{\rho}$ (Table B.10).

Table 9: Labor costs: different time lags and lags in splines.

	(1)	(2)	(3)	(4)	(5)
Marginal rate β_τ	-0.025	-0.047	-0.030	-0.017	-0.038
	(0.035)	(0.041)	(0.032)	(0.059)	(0.060)
Average rate β_ρ	-0.669***	-0.657***	-0.742***	-0.706***	-0.877***
	(0.182)	(0.183)	(0.138)	(0.215)	(0.181)
R^2 (%)	16.3	9.1	14.2	15.9	15.9
Observations	3314943	3319342	2497732	2500888	2465565
Difference (years)	2	1	1	2	3
Lag splines (years)	2	2	1	2	3
First year	2009	2009	2010	2010	2010

Notes: Weighted by inverse fund size, includes public sector, includes employees of financials, upper threshold labor costs at 50K (€, 2006). Specification (1) is the baseline specification in Table 4. Controls for gender, age, marital status, year and pension fund dummies.

We corrected for macro-economic trends by including year fixed effects in our specification. For instance, real wage changes are affected by sticky wages. Real wages in the Netherlands appear to exhibit a higher level of downward rigidity (Deelen and Verbeek, 2015). In our sample period the inflation rate varied between 1.2% and 2.5% which is moderate and above 0%. This suggests a minor impact of real wage rigidities. Still, real wages tend to fall in years with higher inflation rates, which is captured by the year fixed effects. In addition, we estimate the model for separate years. The results are given in Table 13. Though the variation over time is not a source of variation in Table 13, the elasticities for the average net-of-tax rates are in any of the considered years not significantly different from -0.7 and -1.

7.4 Discussion of the results

In this section we relate our empirical results in Tables 4, 5 and 6 to the theoretical predictions in Table 1. To sum up, we find no significant effect of the marginal net-of-pension contribution rate on labor cost, hourly labor cost or hours worked. We find a strong significant effect of the average pension contributions on labor cost ($\beta_\rho = -0.7$) and hourly labor cost ($\beta_\rho = -0.8$), and no discernible effect on hours worked. Since the average statutory employer rate equals 69%, the economic incidence of the average net-of-pension contribution is close to the statutory incidence, on average.

Table 10: Labor costs: different splines.

	(1)	(2)	(3)	(4)
Marginal rate β_τ	-0.025	-0.013	(-0.127)**	(-0.138)**
	(0.035)	(0.037)	(0.057)	(0.063)
Average rate β_ρ	-0.669***	-0.682***	-0.533***	-0.49***
	(0.182)	(0.184)	(0.183)	(0.195)
R^2 (%)	16.3	12.8	12.1	6.7
Observations	3319343	3319343	3319343	3319343
Level spline	yes	yes	no	no
Growth spline	yes	no	yes	no

Notes: Weighted by inverse fund size, includes public sector, includes employees of financials, upper threshold labor costs at 50K (€, 2006). Specification (1) is the baseline specification (1) in Table 4. Controls for gender, age, marital status, year and pension fund dummies.

Table 11: Labor costs: different subgroups

	(1) $<$ 45 years	(2) $>$ 45 years	(3) men	(4) women
Marginal rate β_τ	-0.048	0.028	-0.070**	0.117**
	(0.036)	(0.040)	(0.035)	(0.057)
Average rate β_ρ	-0.666***	-0.687***	-0.607***	-0.903***
	(0.191)	(0.181)	(0.214)	(0.174)
R^2 (%)	16.1	18.0	21.7	12.7
Observations	2236582	1082761	1529222	1790121

Notes: The table shows the results (Equation 1) for several subgroups.
Column(1) are individuals younger than 45 years, column (2) individuals 45 years old and above, column (3) are men and column (4) are women.

Table 12: Labor costs: alternative measures of pension variables

	(1)	(2)	(3)	(4)
Marginal rate β_τ	-0.025	-0.024	-0.311***	
	(0.035)	(0.035)	(0.107)	
Average rate β_ρ	-0.669***	-0.671***		-0.701***
	(0.182)	(0.171)		(0.170)
Include $\frac{\rho e}{\rho r}$		0.029		
		(0.053)		
R^2 (%)	16.3	17.0	15.4	16.4
Observations	3319343	3317068	3319343	3319343

Notes: Column (1) is the baseline specification. Column (2) includes ratio, column (3) excludes the average tax rate and column (4) excludes the marginal tax rate.

Table 13: Labor cost, separate years

	(2009)	(2010)	(2011)	(2012)
Marginal rate β_τ	0.048	-0.001	-0.065	0.059**
	(0.057)	(0.036)	(0.059)	(0.029)
Average rate β_ρ	-1.712***	-1.561***	-1.198***	-1.386***
	(0.601)	(0.531)	(0.448)	(0.389)
R^2 (%)	19.4	17.5	12.0	9.9
Observations	818455	835789	854125	810974

Notes: Each specification is based on equation (1) as a 2SLS regression with (*i*) two-year changes, (*ii*) the labor cost as the dependent variable, (*iii*) the marginal pension contribution rate instrumented by the two-year lagged predicted rate, (*iv*) both year and pension fund dummies included in X_{t-2}, and (*v*) gender, age, marital status and having children are individual-specific control variates X_{t-2}. Income controls are ten-piece linear splines of level and annual change of log labor cost. Robust standard errors (in parentheses) are clustered at the pension fund level. *** Significant at the 1% level.

At first sight, this could suggest that economic incidence follows statutory incidence. However, a similar coefficient is found for sectors with deviating splits into employer and employee rates, in particular when excluding the bank sector where employee rates are virtually absent.

We compare our result of the average net-of-pension contribution rate on labor cost with the three theoretical models in Table 1. First, the standard demand and supply model of labor receives little support from our empirical findings. In contrast to the model marginal contribution rates turn out to be irrelevant for labor cost as well as for labor supply. Average rates do matter for incidence in our estimations, but they are considered as irrelevant in the standard model. Moreover, if average rates are taken into consideration in the standard model they would have an effect only through the income effect; this would, however, predict an opposite sign of the effect on hourly labor cost as a higher net-of-contribution rate would lead to less labor, thus increasing hourly labor cost rather than reducing it.

Second, the prominent role of average contribution rates matches better with the bargaining approach of wage determination. In the familiar search model workers and employers bargain over the quasi-rent from a successful match. Higher average pension contributions reduce the quasi-rent to be shared between employers and employees, and therefore leads to both higher labor costs and lower net wages. In principle, also marginal rates could have an effect on the wage bargain too, but not through its effect on the quasi-rent, but through the workers incentive on demanding high wages. Empirically, we find no significant effect of marginal rates on wages, however. With regard to labor supply both the average contribution rate (by the effect on wages) and the marginal contribution rate (by the bargaining incentive and the substitution effect) could affect the number of hours supplied by workers. Our empirical results, however, do not show discernible effects on hours supplied, both for the marginal and the average contribution rates. The low supply elasticity may have to do with institutional barriers for individual workers to adjust hours worked, indifference between pension accruals and other sources of labor income, or with non-salience of the significance of pension contributions (Brinch et al., 2017).

Third, the sticky wage hypothesis seems an attractive alternative explanation, at first sight too. In particular, the finding of average incidence of 70-30 in line with statutory incidence, may support the sticky wage hypothesis. This may be relevant in particular for the shorter time period of two or three years considered in our analysis. It corroborates earlier studies where employers were unable to shift employer payroll taxes to employees (e.g. Adam et al. (2018)). Having a closer look at the results, however, this explanation is less convincing though. The same 70-30 distribution in incidence is also found for

employees with different statutory shares in employee and employer rates. We therefore must conclude that from our results the bargaining model comes out as the most promising to explain incidence in the short and medium term.

8 Concluding remarks

This study contributes to the new empirical literature on incidence of payroll taxes such as social security contributions. Using a large unique Dutch administrative dataset we analyze the impact of pension contributions on wages, labor cost, and labor supply. Following Lehmann et al. (2013) and Adam et al. (2018) we make a distinction between average and marginal contribution rates as well as employer and employee shares in contributions rates. Since we also observe hours worked - unlike Lehmann et al. (2013), but like Adam et al. (2018) - we can separate the effect on labor cost into the effects on hourly labor costs and hours worked. This helps us to provide more insight into the behavioral effects underlying the incidence. Furthermore, we exploit both cross-sectional and within-variation in pension funds which enables us to separately estimate the marginal contribution rate and the average contribution rate.

Our main findings are as follows. First, the labor cost response to the average net-of-pension contribution rate is close to the statutory employer incidence of 70%. Second, the hours response to pension contribution rates is small. Consequently, a 1%- point change in the average pension contribution rate results in a 0.8% change in hourly labor cost, close to the 0.7% change for labor cost. Third, we find little effect of marginal contribution rates on hours worked. Fourth, although we can distinguish employee and employer rates we find unsatisfactory results, in particular that labor cost are more sensitive to employee rates than to employer rates. This should be the reverse if one believes in sticky wages, and it should be the same if the Invariance of Incidence Proposition (IIP) holds.

The incidence of 70 percent on employers is high compared to what is commonly assumed, often motivated by a high demand elasticity and low supply elasticity of labor. The meta analysis in Melguizo and González-Páramo (2013) indicates that between two thirds and 90% of the burden of a labor tax is borne by the employee rather than the employer. The high incidence on employers is all the more surprising as pension contributions go together with personal benefits in pensions received later in life. In theory, pension contributions can also be seen as a net benefit, if future pensions including the favorable tax treatment would be valued by workers. The high incidence on employers may therefore also be related to the complexity and the lack of trust in the Dutch defined benefit pension system.

The prominent role of average contribution rates and the insignificance of marginal rates are hard to align with the standard textbook model of incidence. Our findings are more in accordance with a bargaining model or a sticky wage model. This is not to say that the standard model is irrelevant to incidence. Over a longer time horizon it is well possible – and even plausible – that the more fundamental factors underlying demand and supply of labor become more decisive for the incidence of taxes and social security contributions relative to institutional rigidities and habits that may dominate in the short term. In that sense, one could argue that each model may be relevant: sticky wages for the short term, bargaining models for the medium term, and the standard supply and demand model for the long term. With the trend towards more flexible labor markets one can even conjecture that the standard model can be expected to become more relevant also at shorter horizons in the future. Future research may shed more light into these highly relevant issues.

9 Appendix

A.1 Incidence of tax rates in a bargaining model

This appendix describes the incidence of taxes (i.e., SSC) in the familiar search model Mortensen and Pissarides (1999) using a simplified static version Boone and Bovenberg (2002). Employers decide how many vacancies v to create thereby balancing the expected gain (i.e. surplus in case of a successful match) with the marginal cost of a vacancy. On the supply side each individual worker decides how much effort to put in search given the search cost, the after-tax total wage per worker $wT(w)$ and the probability of a match depending on the tightness of the labor market v/s. We define taxes as a function of labor cost w, unlike Boone and Bovenberg (2002) who take taxes as a function of net wages. This is immaterial for the result of the model. The wage is determined in a one-shot bargaining game between the individual employer and workers with worker bargaining strength equal to θ. Assuming zero outside options for both workers and employers the quasi-rent of a successful match equals $hyT(w)$ where hy is the output per worker (= hours worked h times hourly productivity y), and $T(w)$ the amount of taxes per worker. The labor cost w that maximizes the Nash bargaining function $(w - T(w))^{\theta}(hy - w)^{1-\theta})$ is given by the first order condition

$$\theta(hy - w)(1 - T'(w)) - (1 - \theta)(w - T(w)) = 0$$

with $T'(w)$ indicating the marginal tax rate. Next, expressing the tax rates in "net-of-tax" terms we can write for the marginal net-of- tax rates: $\tau = 1 - T'(w)$ and $\rho = 1 - T(w)/w$ respectively. Substituting for these net-of-tax rates we find for the labor cost and for the net wage $w_n = \rho w$

$$w = \frac{hy}{1 + \frac{1-\theta}{\theta}\frac{\rho}{\tau}} \qquad\qquad w_n = \frac{hy}{\frac{1}{\rho} + \frac{1-\theta}{\theta}\frac{1}{\tau}}.$$

To start with the net wage for workers it can be seen that it increases with output per worker (hy) and bargaining power (θ). If average net-of-tax rates (ρ) increase workers benefit in their net wages as there is a larger surplus to be distributed between workers and employers. Also, a higher marginal tax rate τ increases net wages, but for a different reason: it increases the incentive for workers to negotiate for a higher wage as more is left from each additional unit of wages negotiated. The results for labor cost are similar except for the average net-of-tax rate (ρ). As the tax burden is shared between workers and employers, also employers benefit from a larger surplus that is left after taxation.

Given this net wage and labor cost the supply of vacancies by employers and the search intensity of workers together solve market equilibrium in terms of the tightness v/s. For a characterization of this equilibrium, see Boone and Bovenberg (2002).

In the usual search model labor supply per worker is taken as given. It can easily be extended to allow for endogenous supply of hours worked, for example, by assuming that workers decide on the hours worked (right to manage). If the hours decision is pre-set before bargaining the solution is simply similar to the above[29], with now the number of hours supplied depending on the net wage per hour; the hours decision of workers can then be written as depending on the before tax wage and the average tax, so $h(\rho w)$ with $h'(\rho w) > 0$. Then the above results change into

$$w = \frac{h(\rho w)y}{1 + \frac{1-\theta}{\theta}\frac{\rho}{\tau}} \qquad\qquad w_n = \frac{h(\rho w)y}{\frac{1}{\rho} + \frac{1-\theta}{\theta}\frac{1}{\tau}}.$$

The impact of the average net-of-tax rate ρ on labor costs per worker (w) is mitigated by the effect on number of hours worked. For a higher labor supply elasticity total labor cost may even increase, as long as output increases more than labor cost. For hourly labor

[29] If the hours supplied are not preset, an explicit solution for the wage is no longer possible. Yet the model remains quite straightforward then. A new element is, however, that the endogeneity of the hours supplied produces a disincentive for employers not to press wages too much down, as this will decrease hours supplied and thus reduce the surplus.

cost ($w/h(\rho w)$) the impact is still negative as it was in the case with exogenous labor supply. Workers benefit now from higher average net-of-tax rates as both hourly wages and labor supply increase.

Table B.1: Labor cost (× € 1,000), mean by pension fund and year.

	2009	2010	2011	2012	Total
ABN Amro financial services	46.7	46.7	51.4	58.0	50.4
Agriculture	32.7	33.1	34.4	39.0	34.8
Bakery	28.1	28.8	29.3	33.4	29.9
Catering industry	24.3	24.9	25.5	28.7	25.9
Cleaning and window cleaning business	18.6	18.8	19.4	22.0	19.7
Commercial transport	40.5	41.5	42.4	47.5	42.9
Construction industry	41.9	42.8	43.7	47.7	44.0
Fashion, interior, carpeting, textiles	35.3	36.0	37.3	41.4	37.5
Graphic arts industry	37.4	37.7	38.2	42.4	38.9
Groceries	22.6	23.1	23.5	26.7	24.0
Hairdressers	15.7	15.8	16.0	18.1	16.4
Health industry	29.9	30.7	31.4	36.0	32.0
Heineken brewing company	52.8	53.5	54.8	58.3	54.6
Hoogovens steel producer	53.4	52.2	54.9	60.6	55.0
House painters, finishers, and glaziers	41.8	42.9	44.0	49.3	44.5
Housing corporation industry	44.5	45.5	46.5	51.7	47.0
Housing industry	30.2	30.3	30.6	34.7	31.5
ING banking and insurance	52.3	50.7	55.0	59.8	53.7
KLM cabin crew	36.9	36.8	39.4	44.6	39.4
KLM Royal Dutch airlines	45.0	45.9	47.0	51.6	47.3
Meat, meat products, and convenience food industry	33.2	33.5	34.5	40.4	35.3
Metal and electronics industry	41.4	41.7	42.9	48.1	43.4
Metal and engineering industry	38.3	38.6	39.8	45.2	40.4
Pharmacy industry	25.4	26.3	26.9	31.4	27.5
Philips	53.4	56.4	59.1	60.4	57.1
Public sector	39.2	40.4	41.3	46.0	41.7
Rabobank	42.6	42.9	45.7	48.9	44.9
Railways	48.4	50.0	51.3	57.3	51.5
Retail business	21.6	21.9	22.2	25.3	22.7
Wholesale agriculture and food supply	35.2	36.1	36.5	40.7	37.1
Unweighted average	35.7	36.3	37.4	41.0	37.6

Table B.2: Lower limit (× € 1,000), mean by pension fund and year.

	2009	2010	2011	2012	Total
ABN Amro financial services	11.4	11.6	11.8	12.0	11.7
Agriculture	12.0	12.2	12.3	12.7	12.3
Bakery	0.0	0.0	0.0	0.0	0.0
Catering industry	10.3	10.5	10.7	10.8	10.6
Cleaning and window cleaning business	10.5	10.5	10.7	10.9	10.6
Commercial transport	10.4	10.6	10.8	10.9	10.7
Construction industry	12.5	12.7	12.9	13.1	12.8
Fashion, interior, carpeting, textiles	13.5	13.9	14.0	14.1	13.9
Graphic arts industry	13.6	14.0	13.8	14.0	13.9
Groceries	13.4	14.3	14.3	14.4	14.1
Hairdressers	0.0	0.0	0.0	0.0	0.0
Health industry	10.3	10.5	10.7	10.8	10.6
Heineken brewing company	11.6	11.8	12.0	12.2	11.9
Hoogovens steel producer	15.0	15.3	15.5	14.7	15.1
House painters, finishers, and glaziers	12.4	12.7	12.7	13.0	12.7
Housing corporation industry	12.5	12.7	12.9	13.1	12.8
Housing industry	9.7	9.8	9.9	10.1	9.9
ING banking and insurance	18.3	19.0	19.0	19.6	18.9
KLM cabin crew	12.5	12.7	12.9	13.1	12.8
KLM Royal Dutch airlines	12.7	12.8	12.9	13.3	12.9
Meat, meat products, and convenience food industry	10.9	11.0	11.2	11.3	11.1
Metal and electronics industry	14.8	15.1	15.3	15.6	15.2
Metal and engineering industry	15.0	15.3	15.3	15.6	15.3
Pharmacy industry	11.6	11.9	12.1	12.1	11.9
Philips	15.3	15.3	12.1	12.2	13.9
Public sector	10.4	10.5	10.7	10.9	10.6
Rabobank	14.6	14.6	14.8	15.0	14.8
Railways	12.5	12.7	12.9	13.1	12.8
Retail business	12.0	12.1	12.2	12.4	12.2
Wholesale agriculture and food supply	15.2	15.5	15.7	15.9	15.6
Unweighted average	11.6	11.8	11.9	11.9	11.8

Table B.3: Upper limit (× € 1,000, if existent), mean by pension fund and year.

	2009	2010	2011	2012	Total
ABN Amro financial services					
Agriculture	47.8	48.7	49.3	50.1	49.0
Bakery	48.7	48.7	50.0	51.1	49.6
Catering industry	32.4	33.2	33.4	33.9	33.2
Cleaning and window cleaning business	47.8	48.7	49.3	50.1	49.0
Commercial transport	47.6	48.5	49.3	50.1	48.9
Construction industry	50.6	53.5	54.1	54.4	53.1
Fashion, interior, carpeting, textiles	145.1	149.4	150.2	152.0	149.1
Graphic arts industry	47.8	48.7	49.3	50.1	49.0
Groceries	47.8	48.7	49.3	50.1	49.0
Hairdressers	47.8	48.7	49.3	50.1	49.0
Health industry					
Heineken brewing company					
Hoogovens steel producer	253.9	255.2	258.4	262.9	257.4
House painters, finishers, and glaziers	44.3	45.1	45.4	46.3	45.3
Housing corporation industry					
Housing industry	47.8	48.7	49.3	50.1	49.0
ING banking and insurance	82.3	85.6	85.6	88.2	85.1
KLM cabin crew					
KLM Royal Dutch airlines					
Meat, meat products, and convenience food industry	57.7	58.5	59.1	60.0	58.8
Metal and electronics industry	64.1	65.2	66.3	67.7	65.8
Metal and engineering industry	73.3	75.5	75.5	77.4	75.4
Pharmacy industry					
Philips					
Public sector					
Rabobank	47.8	48.7	49.3	50.1	48.9
Railways					
Retail business	47.8	48.7	49.3	50.1	49.0
Wholesale agriculture and food supply	32.5	33.3	33.6	34.0	33.3
Unweighted average					

Table B.4: Marginal pension contribution rate (employee and employer contribution as % of gross wage), mean individual rate by pension fund and year.

	2009	2010	2011	2012	Total
ABN Amro financial services	25.9	24.2	33.3	37.8	30.0
Agriculture	12.0	12.1	14.4	15.7	13.6
Bakery	10.8	11.2	10.8	11.7	11.1
Catering industry	10.0	10.0	10.5	11.5	10.5
Cleaning and window cleaning business	16.9	17.4	17.4	19.3	17.7
Commercial transport	19.9	20.8	20.3	21.5	20.6
Construction industry	15.1	17.0	17.6	18.4	17.1
Fashion, interior, carpeting, textiles	20.0	20.0	22.2	22.2	21.1
Graphic arts industry	14.2	14.4	14.4	14.8	14.4
Groceries	16.7	16.7	16.7	17.0	16.8
Hairdressers	6.2	6.2	6.9	8.2	6.9
Health industry	20.2	20.7	20.9	21.3	20.8
Heineken brewing company	26.4	27.7	27.7	27.7	27.4
Hoogovens steel producer	23.3	23.3	23.3	25.7	23.8
House painters, finishers, and glaziers	12.3	12.1	11.7	12.2	12.1
Housing corporation industry	28.2	28.3	28.0	28.0	28.1
Housing industry	14.8	14.9	14.9	18.0	15.6
ING banking and insurance	30.8	25.7	31.2	34.9	30.2
KLM cabin crew	25.4	21.8	24.9	27.1	24.8
KLM Royal Dutch airlines	19.9	19.9	19.9	19.8	19.9
Meat, meat products, and convenience food industry	15.8	15.7	15.4	20.8	16.9
Metal and electronics industry	24.2	22.9	22.0	22.9	23.0
Metal and engineering industry	23.9	25.0	26.2	27.7	25.7
Pharmacy industry	21.1	21.1	21.1	23.9	21.8
Philips	15.5	16.0	17.3	18.2	16.6
Public sector	17.9	18.2	19.1	20.9	19.0
Rabobank	22.0	20.2	21.0	21.2	21.1
Railways	16.7	16.7	16.7	16.7	16.7
Retail business	14.4	14.3	14.3	16.1	14.8
Wholesale agriculture and food supply	6.8	6.9	7.0	6.9	6.9
Unweighted average	17.9	17.8	18.4	19.4	18.4

Table B.5: Average pension contribution rate (employee and employer contribution as % of labor cost), mean individual rate by pension fund and year.

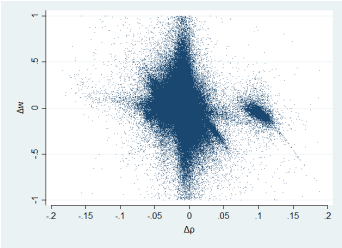
	2009	2010	2011	2012	Total
ABN Amro financial services	20.3	18.9	26.6	30.5	23.8
Agriculture	8.3	8.3	10.2	10.9	9.4
Bakery	11.2	11.6	11.2	12.0	11.5
Catering industry	7.9	8.0	8.4	9.3	8.4
Cleaning and window cleaning business	10.4	11.0	10.7	12.1	11.1
Commercial transport	17.4	17.5	17.5	18.1	17.6
Construction industry	11.8	13.0	13.5	13.5	13.0
Fashion, interior, carpeting, textiles	13.1	13.1	14.6	14.6	13.8
Graphic arts industry	11.1	11.0	11.1	11.2	11.1
Groceries	9.9	9.6	9.7	10.0	9.8
Hairdressers	6.2	6.2	6.9	8.2	6.9
Health industry	14.8	15.3	15.5	15.8	15.3
Heineken brewing company	20.8	21.8	21.9	21.7	21.6
Hoogovens steel producer	16.8	16.5	16.7	18.7	17.1
House painters, finishers, and glaziers	20.8	20.9	21.6	23.4	21.7
Housing corporation industry	21.9	22.1	21.8	21.8	21.9
Housing industry	10.8	10.8	10.8	12.9	11.3
ING banking and insurance	21.2	17.3	21.7	24.7	20.8
KLM cabin crew	20.0	17.1	19.8	21.6	19.6
KLM Royal Dutch airlines	14.7	14.7	14.8	14.6	14.7
Meat, meat products, and convenience food industry	10.8	10.8	10.7	14.6	11.7
Metal and electronics industry	15.3	14.4	13.9	14.5	14.5
Metal and engineering industry	14.7	15.1	16.2	17.1	15.7
Pharmacy industry	14.3	14.4	14.4	16.8	15.0
Philips	11.4	12.0	14.4	15.0	13.0
Public sector	13.8	14.1	14.9	16.2	14.7
Rabobank	22.0	20.5	22.8	21.6	21.7
Railways	12.4	12.5	12.5	12.5	12.5
Retail business	8.1	8.2	8.2	9.3	8.5
Wholesale agriculture and food supply	7.9	8.0	8.0	8.1	8.0
Unweighted average	13.7	13.6	14.3	15.1	14.2

Table B.6: Number of participants (× 1,000) by pension fund and year.

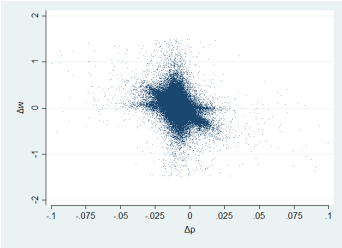
	2009	2010	2011	2012	Total
ABN Amro financial services	4.9	5.0	4.8	4.3	18.9
Agriculture	16.2	16.7	17.3	17.2	67.5
Bakery	6.8	7.0	7.1	7.1	28.1
Catering industry	21.3	22.0	22.6	22.6	88.5
Cleaning and window cleaning business	17.3	17.3	17.5	17.4	69.5
Commercial transport	33.9	34.8	35.6	35.0	139.2
Construction industry	37.0	38.3	39.5	38.3	153.1
Fashion, interior, carpeting, textiles	2.6	2.6	2.6	2.5	10.3
Graphic arts industry	8.1	8.3	8.4	8.0	32.8
Groceries	17.0	17.6	18.2	18.2	71.1
Hairdressers	5.8	6.1	6.5	7.0	25.3
Health industry	165.2	167.5	171.5	168.4	672.6
Heineken brewing company	0.7	0.8	0.8	0.6	2.9
Hoogovens steel producer	2.8	3.1	2.9	2.4	11.2
House painters, finishers, and glaziers	5.4	5.5	5.7	5.6	22.2
Housing corporation industry	8.3	8.4	8.6	7.8	33.0
Housing industry	5.9	6.0	6.2	6.1	24.2
ING banking and insurance	6.0	5.4	5.5	3.1	20.0
KLM cabin crew	3.4	3.5	3.6	3.4	13.9
KLM Royal Dutch airlines	6.1	6.2	6.1	5.6	24.0
Meat, meat products, and convenience food industry	4.1	4.1	4.2	4.0	16.5
Metal and electronics industry	33.1	33.8	33.6	30.1	130.6
Metal and engineering industry	73.0	76.1	77.7	75.0	301.8
Pharmacy industry	8.0	8.1	8.3	8.3	32.7
Philips	0.7	0.9	0.9	0.5	3.0
Public sector	284.5	289.4	296.5	272.6	1143.0
Rabobank	13.0	13.2	13.2	11.7	51.1
Railways	2.5	2.5	2.5	2.1	9.7
Retail business	21.5	22.0	22.5	22.7	88.7
Wholesale agriculture and food supply	3.4	3.5	3.6	3.4	13.8
Total	818.5	835.8	854.1	811.0	3319.3

Figure B.1: Scatterplots of all participants (a) and several pension funds (b-k), 2010.

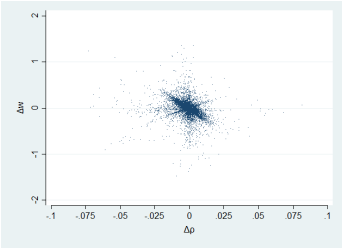
(a) Full sample



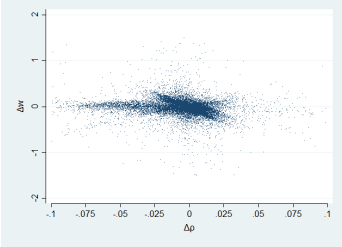
(b) Public sector



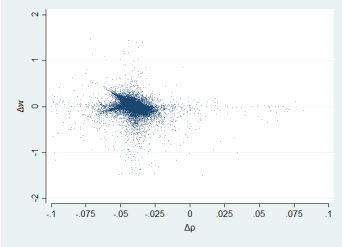
(c) Agriculture



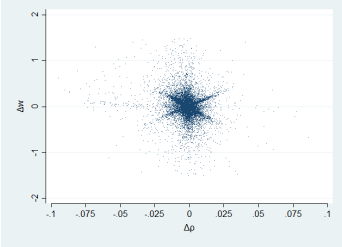
(d) Commercial transport



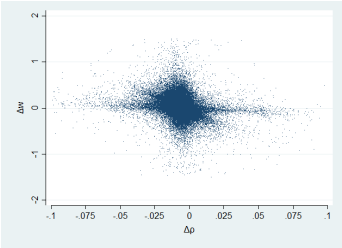
(e) Construction industry



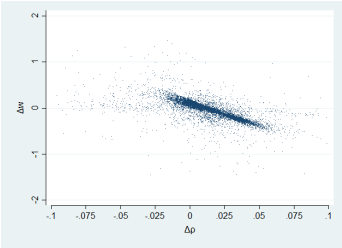
(f) Catering industry



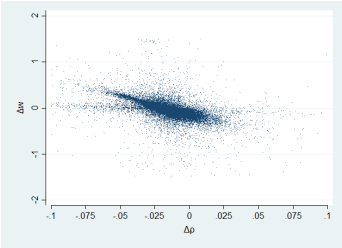
(g) Health industry



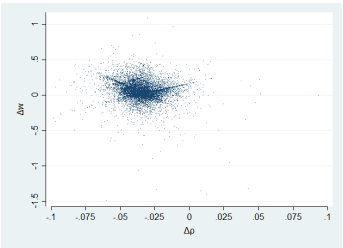
(h) Metal and electronics industry



(i) Metal and eng. industry



(j) Rabobank



(k) Retail business

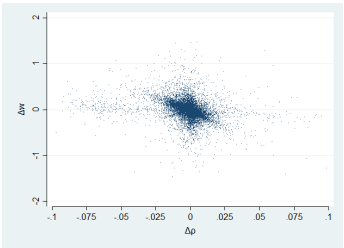


Table B.7: Employee and employer contributions (% labor cost) by pension fund industry and year.

	2009	2010	2011	2012	Total
Employee contribution rate (% labor cost)					
ABN Amro Bank	0.0	0.0	5.2	5.2	1.5
ING financial services	0.0	1.7	1.7	1.8	1.1
Rabobank	0.0	0.0	0.0	0.0	0.0
Other	5.6	5.7	5.8	6.3	5.8
Weighted average	5.3	5.4	5.6	6.1	5.6
Employer contribution rate (% labor cost)					
ABN Amro Bank	26.9	24.6	31.3	39.3	27.1
ING financial services	28.5	20.0	26.8	32.9	29.4
Rabobank	20.7	18.5	21.5	19.5	19.4
Other	11.6	11.7	11.9	12.4	11.9
Weighted average	12.6	12.4	12.8	13.3	12.8

Table B.8: First-stage regression results

Instrument $(\log \bar{\tau}_{it} - \log \tau_{i,t-2})$	0.432***	w_{t-2}spl7	-0.041
	(0.028)		(0.040)
Instrument $(\log \bar{\rho}_{it} - \log \rho_{i,t-2})$	0.715***	w_{t-2}spl8	0.009
	(0.081)		(0.026)
Men	0.000	w_{t-2}spl9	-0.015
	(0.000)		(0.017)
Married. no children	0.001	w_{t-2}spl10	-0.027
	(0.000)		(0.024)
Married. children	0.001	$[w_{t-2} - w_{t-3}]$spl1	0.002**
	(0.000)		(0.001)
Single parent	0.001	$[w_{t-2} - w_{t-3}]$spl2	-0.006
	(0.000)		(0.010)
Age	0.000	$[w_{t-2} - w_{t-3}]$spl3	0.027
	(0.000)		(0.020)
2010	-0.003***	$[w_{t-2} - w_{t-3}]$spl4	-0.035
	(0.001)		(0.028)
2011	-0.001	$[w_{t-2} - w_{t-3}]$spl5	0.013
	(0.001)		(0.013)
2012	0.000	$[w_{t-2} - w_{t-3}]$spl6	0.000
	(0.001)		(0.016)
w_{t-2}spl1	0.001	$[w_{t-2} - w_{t-3}]$spl7	-0.017
	(0.000)		(0.018)
w_{t-2}spl2	-0.001	$[w_{t-2} - w_{t-3}]$spl8	0.009
	(0.003)		(0.014)
w_{t-2}spl3	0.005*	$[w_{t-2} - w_{t-3}]$spl9	-0.019
	(0.003)		(0.015)
w_{t-2}spl4	0.025**	$[w_{t-2} - w_{t-3}]$spl10	-0.002**
	(0.011)		(0.001)
w_{t-2}spl5	-0.045	Constant	-0.003
	(0.038)		(0.005)
w_{t-2}spl6	0.072*		
	(0.039)		
Fixed effect pension fund	yes		
F-test (1,29)	244.67		
Observations	3319343		

Notes: First-stage results (Equation 6) with two-year change in marginal pension contributions as the dependent variable. Reference year is 2009 and reference group are singles. Robust standard errors (in parentheses) are clustered at the pension fund level. *** Significant at the 1% level, ** significant at the 5% level, * significant at the 10% level.

Table B.9: Labor cost - full results

	(1)		
Marginal rate β_τ	-0.025	w_{t-2}spl7	-0.076***
	(0.035)		(0.019)
Marginal rate β_ρ	-0.669***	w_{t-2}spl8	-0.068***
	(0.182)		(0.027)
Men	0.029***	w_{t-2}spl9	-0.159***
	(0.003)		(0.058)
Married. no children	0.005***	w_{t-2}spl10	-1.090***
	(0.002)		(0.111)
Married. children	-0.003	$[w_{t-2} - w_{t-3}]$spl1	-0.535***
	(0.003)		(0.028)
Single parent	0.013***	$[w_{t-2} - w_{t-3}]$spl2	0.972***
	(0.002)		(0.140)
Age	-0.001	$[w_{t-2} - w_{t-3}]$spl3	-0.646***
	(0.000)		(0.051)
2010	0.003	$[w_{t-2} - w_{t-3}]$spl4	0.056
	(0.004)		(0.099)
2011	0.008**	$[w_{t-2} - w_{t-3}]$spl5	0.096
	(0.004)		(0.125)
2012	0.106***	$[w_{t-2} - w_{t-3}]$spl6	0.173*
	(0.006)		(0.100)
w_{t-2}spl1	-0.107***	$[w_{t-2} - w_{t-3}]$spl7	-0.037
	(0.006)		(0.077)
w_{t-2}spl2	0.006	$[w_{t-2} - w_{t-3}]$spl8	-0.117
	(0.020)		(0.141)
w_{t-2}spl3	-0.065***	$[w_{t-2} - w_{t-3}]$spl9	-0.086
	(0.015)		(0.075)
w_{t-2}spl4	-0.031	$[w_{t-2} - w_{t-3}]$spl10	0.078***
	(0.023)		(0.026)
w_{t-2}spl5	-0.074***	Constant	0.915***
	(0.019)		(0.058)
w_{t-2}spl6	-0.026		
	(0.017)		
Fixed effect pension fund	yes		
R^2 (%)	16,3		
Observations	3319343		

Notes: Full results Table 4 (column (1)) based on equation (1) which is a 2SLS regression with two-year change in labor cost as the dependent variable. Reference year is 2009 and reference group are singles. Robust standard errors (in parentheses) are clustered at the pension fund level.

*** Significant at the 1% level, ** significant at the 5% level, ** significant at the 10% level.

Table B.10: Correlation matrix.

Two year changes weighted by inverse of pension fund size in after-change year.

	Δw	$\Delta\tau$	$\Delta\bar{\tau}$	$\Delta\tau_e$	$\Delta\bar{\tau}_e$	$\Delta\tau_r$	$\Delta\bar{\tau}_r$	$\Delta\rho$	$\Delta\bar{\rho}$	$\Delta\rho_e$	$\Delta\bar{\rho}_e$	$\Delta\rho_r$	$\Delta\bar{\rho}_r$
Δw	1												
$\Delta\tau$	–0.02	1											
$\Delta\bar{\tau}$	–0.07	0.54	1										
$\Delta\tau_e$	–0.02	0.88	0.40	1									
$\Delta\bar{\tau}_e$	–0.07	0.39	0.82	0.49	1								
$\Delta\tau_r$	–0.02	0.96	0.56	0.70	0.28	1							
$\Delta\bar{\tau}_r$	–0.06	0.53	0.94	0.27	0.58	0.63	1						
$\Delta\rho$	–0.23	0.53	0.63	0.37	0.41	0.56	0.66	1					
$\Delta\bar{\rho}$	–0.11	0.52	0.71	0.34	0.44	0.58	0.75	0.90	1				
$\Delta\rho_e$	–0.22	0.39	0.42	0.49	0.55	0.28	0.28	0.76	0.62	1			
$\Delta\bar{\rho}_e$	–0.12	0.38	0.50	0.48	0.63	0.27	0.34	0.67	0.72	0.89	1		
$\Delta\rho_r$	–0.20	0.51	0.63	0.25	0.27	0.61	0.74	0.95	0.89	0.52	0.45	1	
$\Delta\bar{\rho}_r$	–0.09	0.50	0.68	0.21	0.28	0.61	0.80	0.84	0.95	0.38	0.46	0.93	1

Table B.11: Descriptives for each robustness check.

All specifications are based on (2) as a 2SLS regression with (*i*) two-year changes, (*ii*) the hourly labor cost as the dependent variable, (*iii*) the marginal pension contribution rate is instrumented by the two-year lagged predicted rate, (*iv*) both year and pension fund dummies are included, and (*v*) gender, age, marital status and having children are individual-specific control variates. Income controls are ten-piece linear splines of level and annual change of log hourly labor cost. Robust standard errors (in parentheses) are clustered at the pension fund level. * Significant at the 5% level.

	(1)	(2)	(3)	(4)	(5)
Observations	3,319,343	3,319,343	2,176,345	3,229,304	3,719,184
no. participants ($\times$ 1,000)	1094	1094	1094	1094	1094
w ($\times$ € 1,000)	31.04	31.14	30.92	30.32	38.75
w/h (€)	18.38	19.16	18.26	17.77	21.90
ρ (%)	14.16	14.51	14.14	13.55	14.75
ρ_e (%)	4.37	5.40	4.36	4.53	4.20
ρ_r (%)	9.80	9.10	9.78	9.02	10.55
τ (%)	18.36	19.59	18.33	17.73	18.09
τ_e (%)	5.60	7.39	5.59	5.84	5.19
τ_r (%)	12.76	12.21	12.74	11.89	12.91
lower limit ($\times$ € 1,000)	11.78	11.57	11.83	11.57	12.09

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