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Evidence from Dutch administrative data

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Abstract

We analyse the effects of social security contributions (SSCs) by examining the distribution of earnings close to thresholds in the schedule in the Netherlands. The shape of the earnings distribution provides information on behavioural and incidence effects of SSC. We consider three earnings concepts, four types of contributions and five thresholds at which marginal rates change. The basic idea is that a discontinuity in the marginal SSC rate should cause a discontinuity in the distribution of at least one of three earnings concepts: labour costs, gross earnings and net earnings. We use a rich administrative dataset containing observed payments on most SSCs for the entire working population for the years 2006-2012. Our finding that the density of gross earnings is smooth is an indication of small behavioural responses and is consistent with the results in recent empirical studies that attribute this to the complexity of the tax system, small changes and non-salience. Smoothness of gross earnings challenges the standard incidence theory prediction of full shifting of SSCs to employees. New and more puzzling is the finding of a smooth distribution of both net earnings and labour costs. The smooth distribution of these earnings concepts renders the results on incidence inconclusive. This lack of 'deterministic' discontinuity can mainly be explained by measurement errors resulting from the complexity of the institutional system and the rather small changes in marginal rates. A general finding of this paper is that this kind of cross-sectional analysis requests high quality data on SSCs which are rare.

JEL Codes: H22, H24, H55

Keywords: social security contributions, bunching analysis, incidence

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1. Introduction

The welfare effects of taxation entail both behavioural and redistributive (incidence) effects. In sharp contrast to the large literature on income taxes, the literature on payroll taxes is less extensive (Saez et al., 2012).¹ This is remarkable in view of the large share of payroll taxes in most OECD countries. Total employee and employer payroll taxes amounted to 22.6% of total labour costs in the OECD in 2012 (OECD, 2013). The average Dutch share of 23.6% was slightly above the OECD average, and it exceeded 20% in more than half of the OECD countries.

The incidence² of payroll taxes might be different from the incidence of income taxes because of two main features (see e.g. OECD (1990) and Gruber (1997)). First, payroll taxes are formally shared between employees and employers. According to the standard Invariance of Incidence Proposition, this split is irrelevant for incidence and employment, at least in the long run (except in case of restrictions such as minimum wages). A second feature that determines the incidence is the degree of the tax/benefit linkage. Full shifting of payroll taxes to employees is more likely with stronger tax/benefit linkages; see Summers (1989) and Gruber (1997). However, the empirical literature has found mixed evidence on incidence of payroll taxes (see Saez et al., 2012).³

Recently, the bunching approach has been proposed to analyse behavioural responses to taxes (Saez, 2010). Identification of the effects relies on discontinuities in the tax systems. Resulting discontinuities in the corresponding earnings distribution encompass both behavioural responses as well as related incidence effects. In practice, separating the two is done by (implicit) reckoning of small behavioural/incidence responses. Most applications use the thresholds in the income tax schedule (e.g. Saez (2010) for US, Chetty et al. (2011) for Denmark, Kleven and Waseem (2013) for Pakistan) and focus on behavioural responses. Applications using thresholds found in payroll tax schemes have been carried out by Liebman and Saez (2006), Alvaredo and Saez (2007) and Müller and Neumann (2015). Our empirical approach is most related to the two latter studies which explicitly address incidence.

The basic idea of this approach is that understanding the incidence of payroll taxes requires analysing the distribution of three income concepts: labour costs, gross earnings (net of employer payroll taxes) and net earnings (net of employer and employee payroll taxes). The idea behind it is that a discontinuity in the marginal tax rate should cause a discontinuity in at least one of the three distributions of earnings since these are deterministically related. We name this "deterministic discontinuity". Under the assumption of a continuous distribution of (marginal) productivity and fixed labour supply, full incidence on employees is reflected by a smooth density of labour costs and a discontinuity at the threshold in the densities of gross and net earnings. The standard theory of

¹ The terms payroll taxes and social security contributions are interchangeable. Most European countries use the term payroll taxes because payments for social security are deducted at source by employers.

² Incidence identifies who ultimately bears the economic burden of taxes (Mirrlees et al., 2011).

³ A first strand of the literature uses cross-country macro-data to assess the relationship to the aggregate wage and labour income share. The survey of Giebel et al. (2014) concludes that the macro-studies find mixed results. A second strand exploits variation in payroll tax rates over individuals and over time by estimating earnings equations. Examples include Hamermesh (1979) for the US and Lehmann et al. (2013) for France. Finally, quasi-experimental studies are based on the exogenous variation in rates arising from a reform. Examples include Gruber (1994, 1997) and Saez et al. (2012).

incidence predicts full incidence on the employee, at least in the long run. The combination of a discontinuous density of labour costs and a smooth density of net earnings would suggest full incidence of payroll taxes on employers. The argumentation needs refinement when considering labour supply responses. With positive and homogeneous labour supply elasticity for all individuals, an optimising worker should never choose earnings before or at the threshold where marginal tax rates fall. In contrast, an optimising worker would locate before or at the threshold rather than after the threshold facing increasing marginal rates. Therefore, a discontinuity in the SSC rates turns into a gap (decrease in marginal rates) or bunching (increase in marginal rates) in the earnings distribution with densities equal to zero around the threshold and incidence cannot be inferred (Muller and Neumann, 2015). However, due to optimising errors and friction costs, the gap is smoothed out, rendering a pattern with a trough more likely (see Chetty et al., 2011).

This paper is the first to look at earnings responses to thresholds in the social security contributions (SSCs) schedule in the Netherlands. Our goal is to contribute to the knowledge of behavioural responses and incidence by explaining their implications and by empirically testing these. We consider four types of contributions covering unemployment insurance, disability insurance, health insurance, and occupational pensions. These schemes feature in total five thresholds, at which marginal rates change. We use a rich administrative dataset that contains detailed job-level and earnings variables for the entire working population for the years 2006-2012. As far as we know, we are the first to use the actual observed payments for most of the contributions for all workers. This is a main advantage since imputation of contributions by applying legislated rates creates mechanically gaps in the distributions and might lead to invalid conclusions on incidence.

The conclusions that can be drawn are mixed in our case. First, we find that the density of gross earnings is continuous around the thresholds. The absence of either a gap or trough in case of a concave kink point and the lack of bunching in case of a convex kink point indicate small behavioural responses either due to small labour supply elasticities or high adjustment costs. Other explanations point to the complexity of the tax system, too small changes in marginal tax rates and non-salience (Saez, 2010). Also questionable is the amount of (individual) wage adjustment. For this reason, the literature has mainly found bunching by special groups such as self-employed (Saez, 2010) or directors of closely-held companies (Adam et al., 2015).

The prediction of standard incidence theory that contributions are fully shifted to the employees (in the long run) would imply a discontinuous distribution of gross earnings. The contradicting finding of a smooth distribution of gross earnings is supported by recent empirical studies (Liebman and Saez 2006; Alvaredo and Saez 2007; Saez et al. 2012, Lehmann et al. 2013, Neumann, 2014, Müller and Neumann, 2015). We assess this as a compelling result since our gross earnings concept is measured with high precision and very likely without measurement errors which would be an alternative cause of smoothness.⁴

Second, we also find smooth distributions of both labour costs and net earnings which is puzzling in case of continuous gross earnings. This is can be taken as an indication of measurement error. An important source of measurement error is imputation. Although we have rich data we still had to impute information on pension contributions, which constitute an important part of labour costs in

⁴ Our measure of gross earnings is equal to the income concept used to determine social security contributions and no imputation is needed. It is provided by the employer to the tax authority.

the Netherlands. To overcome this problem we construct an alternative measure of labour costs that includes all relevant SSCs. Furthermore the exact split between employee and employer unemployment insurance contribution is not observed and therefore we used the statutory split. For net earnings we applied a tax-benefit calculator for the employee's expenditure on health insurance that is also not observed in the data. Simulation exercises suggest two further explanations for this lack of (deterministic) discontinuity. First, the changes in marginal rates are relatively small (e.g. in 2011, ranging from 4.2pp to 12.16pp) and therefore even small measurement error can blur the discontinuity. Second, the institutional system is complex due to the specification of (small) specific rates for groups that cannot be identified. As a consequence, even minor errors in the computation of labour costs are enough to mask any discontinuity.

Until now, only a few papers have looked at incidence following the approach established by Alvaredo and Saez (Neumann, 2014, Müller and Neumann, 2015). The approach demands for large, high-quality micro-level data containing information not only on earnings but also on social security contributions for all workers. Only recently such administrative data became accessible. The clear advantage of this approach is that it is an intuitive approach and that cross-section data suffices. Existing discontinuities in tax schedules provide the necessary variation in marginal tax rates needed for identification. However, not all assumptions underlying this approach are easily met. Obviously, an essential empirical requirement is the absence of significant measurement errors in earnings data and in the observed SSCs and calculation of SSC rates. Theoretical assumptions are flexible wages, perfect salience, negotiations at the individual level, and adjustment through the earnings concept under study (Müller and Neumann, 2015).

The outline of the paper is as follows. We start with a summary of the theoretical and empirical literature in the next section. The institutional setting is described in Section 3. After discussing the administrative dataset in detail in Section 4, the results are presented in Section 5. A simulation exercise will stress the importance of measurement errors in Section 6. Section 7 concludes.

2. Literature review

2.1 Incidence, discontinuity and bunching: conceptual framework

Incidence identifies who ultimately bears the economic burden of taxes. An individual bears the burden of a tax to the extent it makes him worse off (causes a loss of welfare) (Mirrlees, 2011). Legal incidence (statutory burden) of payroll taxation can differ from economic incidence (actual burden) for a number of reasons. First, in a standard neoclassical equilibrium the incidence of a tax on wages depends on demand and supply elasticities for that specific type of labour, or specific sector. Workers bear most of the burden if supply elasticity is low and demand elasticity is high. In the reverse case of high supply elasticity and low demand elasticity the burden can be shifted to consumers, or other workers in case of heterogeneous labour (Teulings, 1995). The distinction between statutory employer and employee contributions is not relevant in this context, nor the distinction between payroll taxes, and income taxes; only labour cost and net real wages matter. For social security contributions included in the pay roll tax only the implicit tax matters, that is, the marginal tax minus the marginal benefit for the individual.

In a more general – disequilibrium - setting also employers may come into play as the tax burden is negotiated between employers and employees, or between individual workers and the pool of workers in case of heterogeneous labour. Here, also the distinction between employer and employee contributions may become relevant as the way wages are posted affects the bargaining; in particular wage schedules are known to be quite sticky in practice (Le Bihan et al., 2012; Barattieri et al., 2014). Finally, incidence may also be affected by tax evasion by employers or employees, for example, by underreporting income, or overreporting hours worked (in case taxes are convex in hourly wages).

Information on how payroll taxes affect the three relevant income concepts – labour cost, gross earnings (net of employer payroll taxes) and net earnings (net of employer and employee payroll taxes) – at the micro level of individual workers can provide insight into the incidence of these taxes and social security contributions. Furthermore, it is also possible to make a distinction between employer contributions –on top of gross wages - and employee contributions – deducted from gross wages.

In a novel approach, Alvaredo and Saez (2007) analyse the frequency distribution of these earnings concepts at the level of individual employees to infer information on incidence. Specifically, the way discontinuities in the tax schedule affect the distribution of income provides information on the incidence of taxation. For example, a convex threshold in taxes – that is, a discrete increase in marginal tax rates at some income level - raises the tax rate for workers just above this threshold in comparison with those just below the threshold. So, either labour cost are higher or net wages are lower for these workers. This causes a shift in the densities around this threshold for labour cost and net earnings, respectively. Therefore, by analysing the distribution for labour cost and net earnings one can find out who bears the burden of the higher rates. Assuming a smooth underlying distribution of abilities, a discontinuity in the tax rate should appear as a discontinuity in the density labour cost or of net earnings, respectively.

Furthermore, the frequency distributions can also reveal behavioral responses. If, for example, a higher tax beyond a threshold induces a negative labour response for the workers above this threshold, the density of incomes just below the threshold goes up. So both the direct effect of taxation as well as behavioral responses may cause discontinuities in the distribution of income for at least one of the income concepts. These two types of discontinuities are not always well distinguished in literature; generally, the 'bunching' literature focuses on the second type of discontinuity, that is discontinuity arising from behavioral responses. One should be careful, however, as these two causes of discontinuity are not always easy to disentangle in practice. We can work this out a bit deeper by analysing the relation between discontinuities in tax schedules and the distribution of income for the three income concepts distinguished here, starting with the case of 'deterministic' discontinuity first (no behavioral response), and then turning to the bunching case (with behavioral response). We use the term "deterministic" for the first case as a discontinuity in the tax rate should be reflected in at least one of the distributions, by definition. Which curve shifts depends on the incidence. In the latter case the behavioral response may involve both tax avoidance (adjusting labour supply) and tax evasion; both involve resource cost, whereas the first 'direct' discontinuity involves the distribution between employees and employers only.

2.2 Deterministic discontinuity: incidence

Let us consider the case of 'deterministic' discontinuity, first. In this case, behavioral responses are assumed to be absent. Under the assumption of a continuous distribution of abilities (productivity) the incidence of a change in the tax rate should be reflected in a discontinuity in the distribution of labour cost or net earnings. Consider a convex discontinuity of 35,000 in the tax schedule for gross earnings (i.e. the tax base). Let us assume that the payroll tax rate jumps up with 20 percentage points at this threshold. If all incidence is on the workers, this would show up as a discontinuity in net earnings at this threshold; beyond the threshold the higher tax rate – mechanically - compresses the income distribution, leading to higher densities just beyond the threshold which decline again for higher incomes. This is illustrated in Figure 1b, where the red line indicates the threshold. The distribution of labour costs is not affected by the tax rate and thus reflects the smooth distribution in marginal productivities, see Figure 1a. The combination of a discontinuity in the density of labour costs and a smooth density of net earnings would suggest full incidence of taxes on employers.

This similar exercise can be done for employer contributions vis-à-vis employee contributions. For example, if an increase in employer contributions shows up as a discontinuity in the distribution of gross earnings while labour cost is smooth, the incidence is on the workers, while the incidence is on the employers in the reverse case when gross earnings are smooth and labour costs feature a discontinuity. If the burden is shifted to employers the distribution of labour cost beyond the threshold becomes more dispersed, leading to lower densities initially beyond the threshold, and higher densities at the end of the distribution (see Figure 1c).

Absent any behavioural responses, the distribution of gross earnings is thus informative about the direction of incidence.





Figure 1 Direct discontinuity, increase in marginal tax rates at 35,000







(c) labour costs; incidence on employers

So far, all empirical papers - to our knowledge - find smooth distribution of gross earnings, suggesting that the employer contributions are borne by employers and employee contributions by workers (Liebman and Saez, 2006; Saez et al., 2012; Neumann, 2014). Unfortunately, data on labour costs are often not available, so that direct evidence of incidence on employers is lacking (Alvaredo and Saez, 2007). We have data on all three earnings concepts, which allows us to explore this issue in more detail.

2.3 Behavioral responses: bunching and dispersion

The argumentation above needs refinement when we allow for behavioral responses. A change in the marginal tax rate can be represented as a kink in the budget set of an individual. Standard economic theory makes clear predictions about the location of individuals in response to kink points in their budget set. If individual preferences are convex and smoothly distributed in the population, we should observe bunching of individuals at thresholds where marginal tax rates increase (i.e. convex kink point) (Saez, 2010). The higher marginal tax above the threshold induces people to reduce their effort. In the distribution of before tax income or gross earnings we would then observe a clustering or bunching of earnings at the kink point (see Figure 1 in Saez, 2010; and our Figures 2a and 2b).

The Dutch Social Security System (SSC) creates both convex and concave kink points. The lower earnings limits on pension and unemployment insurance contribution produce a convex kink point, whereas the SSC maximum creates a concave kink point. Faced with a concave kink point, where marginal tax rates fall, an individual worker would never locate at the kink point (see Figure 3a). In the distribution of before tax income we would then observe a gap (see Figure 3b). Rather than bunching of observations, we now observe a dispersion of observation around the kink point.









Before tax income z





Before tax income z

Both the concave and the convex case have in common that they result in discontinuities in the frequency distribution. In contrast to deterministic discontinuities, the bunching and dispersion now arise from behavourial responses. Note that these responses affect the distribution for each of the income concepts. So here, it is not the differences between the alternative income concepts that matters, but rather the clustering (or dispersion) of observations around kink points in each distribution.

In this paper we use a unique administrative data set on taxes and social security contributions to analyse frequency distributions for each of the three income concepts, labour cost, gross earnings and net earnings. We focus on payroll taxes and SSC rates. Using this comprehensive data set allows us to look into both incidence of different types of SSC rates as well as potential behavioural responses showing up in bunching or dispersion. For both purposes we focus on the detection of discontinuities in the frequency distributions around know kinks in SSC rates.

The advantage of this 'frequency distribution' method is that it provides insight into incidence of different type of taxes and social security contributions as well as into behavioural responses in a fairly simple framework. Moreover, being a static framework it is fairly insensitive to timing issues. Provided that the main features of the tax system are steady over time, the distribution for each of the income concept can be regarded as representing a steady state equilibrium. At the same time, at the individual level there may be significant noise due to idiosyncratic shocks in income. Therefore, people cannot always be assume to locate optimally. This can be due to unpredictable earnings, but also to collective bargaining, misperceive tax schedules (Liebman and Zeckhauser, 2005) and nonsalience of kink points.

2.4 Empirical literature on Incidence

Observed earnings are determined by both pre-tax hourly wages and hours and as such entail both incidence and behavioural effects. Most literature abstract from this and assume away incidence effects. The resulting earnings responses to changes in (payroll) taxes are attributed to behavioural responses (hours). In sharp contrast to the large literature on behavioural effects of income taxes, the literature on payroll taxes is less extensive. Only a small part of that literature focuses on the incidence effects of payroll taxes.

One of the first papers is the study by Alvaredo and Saez (2007). In their paper they examine the frequency distribution around the maximum cap that exists in the social security scheme in Spain. The marginal tax rate drops to zero for earnings above the cap. In contradiction to the prediction of standard theory, an eyeball test reveals that the distribution of gross earnings does not display a gap, or a trough, around the cap. However, the distribution of labour costs as well as of net earnings is discontinuous. These results are supported by an alternative analysis of annual growth rates of earnings. Under full incidence, growth rates of labour costs should not differ much between workers above and below the cap. As a consequence, gross earnings should increase more above the cap. Again, the reverse is found: the growth rate of labour costs falls discontinuously while the growth rate of gross earnings remains stable around the cap. The results on net earnings are inconclusive. They conclude that employee taxes fall on workers but that employer taxes are not fully shifted to workers.

In a similar way, Neumann (2014) and Müller and Neumann (2015) analyse the thresholds in the social security system in Germany. At a first cap, the marginal contribution rate of pension and unemployment insurance drops by 13pp for both employees and employers. The labour costs are calculated using legislated rates, which could result in mechanically created gaps that are not there. However, the German social security system is simple, uniform and salient and therefore the authors argue that risk of measurement errors is small. They estimate an insignificant discontinuity in the density of gross earnings at this cap, whereas the discontinuity in labour costs is significantly positive and the discontinuity in net earnings is significantly negative. The findings on shifting are similar for a

second, lower cap, where the marginal rate of health and long-term care insurance is reduced by 8pp. In a supplementary analysis, Neumann (2014) shows that the labour supply and demand elasticities are rather small close to both caps. Therefore, he concludes that the discontinuity found suggest that the SSC burden is equally shared between employees and employers.

Saez et al. (2012) analyse the effects of a unique reform in Greece on the same three earnings concepts, yielding the same incidence results as in the previous studies. The maximum cap for payroll taxes was increased (by 128%), but only for workers who started working in or after 1993. As a result, a worker in the new regime who is otherwise identical to a worker in the old regime has to pay permanently higher taxes (when earnings exceed the old cap). In contrast to previous papers this large and unique reform enables them to estimate a Regression Discontinuity Design model. Since the analysis does not find significant labour supply responses, tax incidence is inferred from the effects on average earnings. Again in contrast to the standard theory of incidence, average labour costs jump up, gross earnings are stable and net earnings jump down at the cut-off date. In sum, the employer bears the extra employer payroll tax and the employee bears the extra employee tax. Put differently, the SSC burden is shared according to statutory incidence.

In sum, all three papers conclude that in contrast to standard incidence theory the burden of employer payroll taxes is not fully shifted to employees. Surprisingly, all papers find a smooth distribution of gross earnings. As expected, the burden of employee payroll taxes is found to be borne by employees. These studies underline the necessity to have information on the distribution of all three income concepts. Comparing the distributions of gross earnings, labour costs as well as net earnings makes it possible to draw conclusions on incidence. Our research follows this approach closely and the distribution of gross earnings, labour costs and net earnings are scrutinized in Section 4.

3. Institutional Setting

3.1 The Social Security System in the Netherlands

The Dutch social security system is rather complex with a multitude of social security contributions, thresholds and tax base definitions. Social security contributions are always deducted at source by employers. Employer contributions are calculated on top of gross earnings, while employee contributions are deducted from gross earnings. The contributions are based on monthly earnings and apply only up to an upper threshold (cap). The health and disability insurance contributions are payable from the first euro earned. The unemployment and pension contributions also have a lower threshold, i.e., they are payable only on earnings above the lower threshold.

The payroll tax system distinguishes four types of contributions, featuring multiple discontinuous jumps in marginal rates. These thresholds apply to all earnings irrespective of type, that is, they are calculated by adding together earnings from regular pay, overtime, bonus, etc. earned in a given month. We first present a detailed overview of the payroll system in 2011 (Table 1).⁵

(*i*) The *unemployment* insurance contribution consists of two parts: a part that is paid to the general unemployment fund and a part that is paid to the branch fund. Employers pay 4.2% of the earnings between $\leq 16,965$ and $\leq 49,297$ for the general unemployment fund and an average contribution of 2.24% of the earnings below $\leq 49,297$ for the branch fund. Since 2009, employees do not pay for unemployment insurance (see Appendix Table A.1 for all rates 2006-2012). Actually, the branch part is quite variable. First of all, the legislated rate varies a lot across sectors. Second, it varies within sectors depending on whether the employer has chosen to bear the costs of the first six weeks of sickness (in this case, the employer needs to pay lower premium). Finally, in certain sectors the rates can vary by the type of contract or type of job (these sectors account for more than 2 million jobs).

(*ii*) The *disability* insurance contribution is paid only by employers and consists of two parts. Employers pay a uniform rate of 5.1% for workers up to 55 years of age and on earnings up to €49,297. In addition, the disability premium has a part with a differentiated rate (0.62% on average). The differentiated part can take a value of zero if the employer does not have public insurance, that is, in case the employer decides to bear the risk for claims. Publicly-insured 'small' employers (paying a total amount for the disability premium of less than €650,000) need to pay either a surcharge (a higher rate) or they get a discount (a lower rate) on the differentiated part of the disability premium. The surcharge/discount is sector-dependent.

(*iii*) For *health* insurance employees pay a nominal contribution of $\leq 1,210$ on average per year. Depending on the personal situation and household income, the government partially compensates employees for this contribution ('healthcare benefit'). Besides the nominal contribution, every employee is required to pay an income-related health insurance contribution of 7.75% of earnings. The income-related contribution is fully compensated by the employer and thus the rate of 7.75% actually applies to the health insurance contribution paid by the employer. However, the employee has to pay income tax on this compensation. The maximum base for the income-related health insurance contribution is $\leq 33,427$.

⁵ The structure of the SSC system was the same between 2006 (the first year for which we have detailed joblevel data on earnings and payroll taxes) and 2011. An overview of all the rates for 2006-2012 is given in Appendix A.

(*iv*) The *pension* system combines a basic state old-age pension (first pillar), occupational pension schemes (second pillar), and voluntary individual pension schemes (third pillar). The state old-age pension contribution is levied, combined with income tax, on income from work and owner-occupied housing. We focus on the second pillar, that is, on supplementary occupational pensions as an element of labour compensation. Although there is no statutory obligation for employers to offer a pension scheme to their employees, more than 95% of employees are covered. These second pillar schemes are therefore best thought of as quasi-mandatory. Occupational pension contributions are sector specific and sometimes even company specific. The contributions are usually paid into the pension funds when the wage exceeds a certain limit (*in Dutch*: franchise). The lower limit and the contributions rates differ significantly across pension funds (see Appendix Table A.5).

As is visible from Table 1 and Figure 4, the changes in marginal tax rates at the thresholds are rather small. The change at the lower threshold for the unemployment insurance contribution is 4.2pp; at the health insurance income threshold it is 7.75pp; at the upper threshold for the unemployment and disability insurance contributions it is, on average, 12.16pp.

Besides the different contributions and thresholds, the existence of four payroll tax bases adds to the complexity of the system (Table 2). The unemployment and disability contributions are levied on gross wage that is adjusted for pension contributions. The health insurance contribution is based on gross wage adjusted for pension contributions, unemployment contributions and private use of the company car. The unemployment contribution is deductible for the health insurance base (Table 2, footnote b). The feature that the base of one contribution depends on another contribution complicates the calculation. Pension contributions are paid on gross wage. The most complicated base applies to the income tax.

	Employer tax	Employee tax	Lower threshold (<i>tl</i>)	Upper threshold (<i>tu</i>)
Unemployment				
General unemployment fund	4.20%		€16,965	€49,297
Branch fund	2.24% ^a			€49,297
Disability				
Uniform rate	5.10%			€49,297
Differentiated rate	0.62% ^a			€49,297
Health	7.75% ^c	€1,210 ^b		€33,427 (th)
Pension ^d	14.28%	7.20%	€13,482	

Table 1The Dutch Social Security System (2011)

Notes: The numbers refer to the most common case. The figures on thresholds are annualized. Figures for other years are given in Section 3.

^a The numbers are average rates for the private sector.

^b Depending on the personal situation and gross household income, employees might obtain partial compensation of this amount.

^c Employees pay taxes on the insurance contribution paid by the employer.

^d The rates and the threshold for the pension contribution are averages for the private sector.



Table 2Base Social Security System (2011)

	Base	Part-time Threshold
Unemployment		
General unemployment fund	Gross adjusted earnings (GAE) ^a	no
Branch fund	Gross adjusted earnings	no
Disability		
Uniform rate	Gross adjusted earnings	no
Differentiated rate	Gross adjusted earnings	no
Health	Health Insurance tax base (HTB) ^b	no
Pension	Gross earnings (GE) ^c	yes
Income tax	Taxable income ^d	no

Notes:

^a Gross wage minus pension contribution paid by the employee.

^b = ^a minus unemployment insurance paid by the employee plus private use of company car.

^c Gross earnings is contractual earnings plus incidental earnings.

d = b plus health insurance paid by the employer minus personal exemptions.

3.2 Contributions when working part-time or part of the year

In the Netherlands part-time employment is very common. Half of all employees work part-time. On average the Dutch working week amounts to 32 hours, whereas the usual full-time working week is about 38 hours. Since 2006 the thresholds for unemployment, health and disability only depend on the pay period (Law on Financing Social Security, *in Dutch*: Wfsv). Since most employers pay on a monthly base the thresholds are also applied on the monthly wages. Working part-time makes no difference. For example, both a full-time worker and a worker working 32 hours per week start paying unemployment premium the moment their income exceeds 16,965/12 euro per month. The only exception is the pension contribution. Pension payments are deferred benefits: contributions

today generate benefits in the future. As a result of the part-time threshold, part-time workers also pay contributions and build up pension rights.

Although the statutory rules for social security contributions are straightforward, the actual calculation of the monthly payment by employers to the tax authority is more difficult (see Appendix B for an explanation). However, calculating annual payments will be correct in most of the cases. There are however exceptions and therefore we limit our sample to employees working full-year (either part-time or full-time) for a single employer⁶ (see Section 3.1).

3.3 Interaction with the Income Tax

In the Netherlands, general social security contributions are integrated in the income tax system (see Appendix Table B.1). These contributions cover old age income provision, widows and orphans pensions and exceptional medical expenses. The contributions for these general schemes are levied on the first and second tax bracket of income from work and owner-occupied housing.

These two tax brackets are close to thresholds in the social security system. The first tax bracket is close to the lower threshold for unemployment insurance contribution (the difference is 18,628 - 16,965 = 1663 euro). Although their base is different (see Table 2), for a worker with no personal exemptions adding the employer health contribution almost bridges the gap (16,965+7,75%). The increase in the income tax rate is 9%-point. This potential interaction should be kept in mind when analyzing discontinuities at the lower threshold. The second tax bracket coincides with the upper threshold for the health insurance contribution, but at this point the increase in the tax rate is only 0,05%-point and is therefore negligible.

⁶ Adjustments for multi-employer workers are done retroactively. We do not have data on these retroactive adjustments.

4. Data

4.1 Description of available datasets

It is crucial to use administrative data to detect discontinuities because there is usually too much measurement error in survey data (Saez, 2010). We use a rich administrative dataset that contains detailed job-level and earnings variables for the entire working population on a monthly basis starting from January 2006.⁷ In each of those monthly data sets, and for each job, we have the number of days of work, regular and overtime hours of work, and monthly earnings.⁸ Individuals with more than one job during the month have more than one job record. Earnings are reported in full with no cap and on forms directly filed by employers. The earnings variables are controlled by the fiscal administration and as such are reliable.

The data also include the actual amount of employer and employee payroll taxes paid out for the corresponding job. We observe most, but not all payroll taxes mentioned in Table 1. In particular, we have data on the total amount of the unemployment insurance contribution jointly paid by employer and employee (the latter existed before 2009). To be able to separate both contributions, we use the legislated rates. This procedure does not always lead to expected results and we exclude the workers for which the computed amounts using legislated rates deviate significantly from the reported amounts in the dataset (see Section 3.2). Furthermore, the data includes the employer contributions paid to the branch fund, to the disability insurance (both the uniform part and the differentiated part) and to health insurance.

Four components of the social security system are not in our data. The first component is the nominal health insurance contribution paid by the employee. Fortunately, competition between the health insurance companies resulted in a small deviation from the average amount of the nominal premium which is therefore used as a proxy. The second component is the partial compensation to low-income employees for paying this nominal contribution. The third component is the taxes employees have to pay on the health contribution paid by the employer. These calculations are not straightforward and for this purpose we employ an extensive tax-benefit calculator of the Netherlands Bureau for Economic Policy Analysis. The fourth component is the pension contribution paid by both the employer and the employee. Calculation of these contributions has proven very difficult. There are more than 400 pension funds with extremely differentiated rules, rates, and thresholds both across funds and over years. Since there was no database containing information on the pension contribution rates and thresholds covering our time period, we constructed it ourselves for the 40 major pension funds.⁹

For our analysis, we create data at the individual level. For individuals with multiple jobs, we aggregate the earnings and payroll taxes to reflect the annual figures. We also merge the job-level dataset with the municipal database (personal records). This procedure yields very detailed labour market and socio-demographic information on insured employees in the Netherlands.

⁷ All datasets are provided by Statistics Netherlands and are accessed through a remote connection.

⁸ The monthly earnings are broken down into various types: regular earnings, overtime earnings, bonuses, and other forms of earnings. In this paper we add all earnings as this is the base for SSCs.

⁹ See documentation report on Pensiondatabase (in Dutch).

The analysis below is based on a sample of wage earners who are aged 18-65 years,¹⁰ work in the market sector, and have positive earnings. We exclude the public sector workers since their earnings are subject to a different tax payroll schedule.¹¹ To minimize the measurement error, we further exclude workers working for multiple employers simultaneously. Since we consider yearly earnings and yearly thresholds in our analysis, only workers working for the whole year are included. This procedure yields about two million observations per year for the period 2006-2011 (see Table 4).

	2006	2011
No. jobs	10,408,783	10,895,290
No. individuals	8,093,732	8,586,913
Selections		
- age 18-65	7,598,729	7,833,962
 private sector 	4,834,995	4,981,504
 single employer 	4,143,734	4,225,307
 working full year 	2,252,078	2,231,611

Table 4Sample size

4.2 A comparison of SSC rates

This section compares the observed SSC rates with the legislated SSC rates as this is important for the incidence analysis. Differences between observed and legislated SSC rates indicate measurement errors, rendering results about incidence of SSC inconclusive. Starting from 2006 we observe both the gross earnings concept that is the base for the SSCs as well as the actual SSC amounts in euros. Using this information we can calculate the observed SSC rates (ratio of SSC amount to income base) and compare those to the legislated SSC rates.

Two types of graphs are displayed.¹² The first type shows the observed marginal rates. We show that for most contributions the observed marginal rates correspond to the legislated rates which renders credibility to our data. The second graph type demonstrates the distribution of the observed marginal rates at thresholds. These graphs make clear that there is a discontinuity in the observed marginal rates at the relevant thresholds, which indicates that one could expect corresponding discontinuities in the earnings distributions.

Unemployment insurance rate. The legislated rate of the uniform part of the unemployment contribution is the same for every worker and is applied to gross earnings minus the employee pension contribution - the so-called gross adjusted earnings (GAE) - between a lower threshold (tl) and an upper threshold (tu) (Table 1). Figure 5 presents a histogram of the employer marginal contribution rates to the general unemployment fund calculated for gross adjusted earnings

¹⁰ The usual practice is to select individuals aged above 15 years. But we have some problems with the data for the category 15-18 years of age: more than 50% of these individuals are classified as employed workers even if they earned just a few euros from casual jobs, which creates big spikes at the lower end of the earnings distribution.

¹¹ About 100,000 workers in the private sector whose SSCs were paid to the public-sector scheme were also excluded.

¹² We show our findings for 2011 for the SSCs and for 2012 for the pension contributions. Findings for 2006 (the first year for which data are available) are available in a separate Appendix F.

between thresholds tl and tu.¹³ In general, the observed marginal rates correspond well to the legislated marginal rates presented in Table 5. We then focus our attention to the distribution of these rates at the tresholds tl and tu (Figure 6).¹⁴ The observed marginal rates are as expected and the figure show clear discontinuities around the thresholds. The discrepancies occur mainly for observations close to the thresholds which indicates that, at least in the case of the unemployment insurance contribution, employers might have difficulties to apply precisely the legislative rule for earnings in the neighbourhood of thresholds.

In addition to the contribution for unemployment insurance paid to the general unemployment fund, employers pay a contribution for unemployment insurance to the *branch fund*. The legislated rate of this unemployment contribution is variable and is applied to *GAE* below the upper threshold (*tu*). Figure 7 presents a histogram of the observed marginal contribution rates to the branch fund calculated for *GAE* below *tu*. It is evident that there is a lot of variation in this rate. This is due to several reasons. First of all, the legislated rate varies across sectors. Second, it varies within sectors depending on whether the employer has chosen to bear the costs of the first six weeks of sickness (in this case, the employer needs to pay lower premium). Finally, in certain sectors the rates can vary by the type of contract or type of job.¹⁵ Our data does not contain information on all these factors that contribute to the variability of this rate. This makes it impossible to compare the legislated to the observed marginal rates for this contribution. Importantly, measurement errors in these unemployment insurance rates will greatly complicate our analysis using labour costs as we will demonstrate later.

Health insurance rate. The legislated rate of the health insurance contribution is the same for every worker and is effectively paid by the employer. The base for this contribution differs from the base for the other SSCs (see Table 2). Let us denote this earnings concept as health insurance tax base (*HTB*). The health insurance contribution is paid on *HTB* up to an upper threshold (*th*).¹⁶ Figures 8 and 9 display the same message, that is the correspondence between the observed and the legislated rates at and below the threshold *th* is close to perfect.

Disability insurance rate. Analogue to the unemployment insurance, also the disability insurance consists of two parts: a uniform rate and a differentiated rate. Employers pay the disability contribution on *GAE* up to the upper threshold tu.¹⁷ We observe the amount of both the uniform and the differentiated part. Figure 10 and 11 present the distribution of marginal rates for the uniform part of the disability insurance contribution below threshold tu and on both sides of threshold tu. The figures indicate that the observed rates correspond well to the legislated rates.

¹³ In Appendix D we provide detailed explanation of the calculation of the marginal unemployment insurance rates using our dataset.

¹⁴ To construct these graphs, we first subtract the thresholds from gross adjusted earnings, so that thresholds are normalized to a value of 0. We then group workers in bins of €200 and plot the average marginal rate for each bin.

¹⁵ These sectors account for more than two million jobs.

¹⁶ In Appendix D we provide detailed explanation of the calculation of the marginal health insurance rates using our dataset.

¹⁷ For workers older than 55 years and newly-hired workers older than 50 years employers do not need to pay the uniform part of the disability insurance contribution. Thus when considering this contribution, we further limit the sample to workers younger than 50 years.

In contrast to the uniform disability rate, there is a lot of variation in the differentiated part. Figure 12 presents a histogram of the observed marginal rates for the differentiated part of the disability insurance contribution for *GAE* below *tu*. The rate can vary both between and within sectors for a variety of reasons on which we do not have data. Thus we cannot compare the legislated to the observed marginal rates for this contribution. Again, measurement errors in these disability rates will complicate our analysis using labour costs. But since these rates are very small (on average about 0.5%) the error is probably less severe.

Pension insurance rate. The occupational pension system is very heterogeneous; contribution rates and thresholds differ significantly across pension funds and from year to year. Since we do not want to base the analysis on average contribution rates and thresholds, we collected detailed data for the major pension funds. Table Appendix A.4 present information for the ten major pension funds in the private sector. As demonstrated in the tables, (employer and employee) contributions are usually paid into the pension funds when gross earnings exceed a certain lower threshold tlp_1 and up to a certain upper threshold tup_1 . Some pension funds stipulate a differentiated rate schedule coupled with additional thresholds, tlp_2 and tup_2 .

Figure 13 presents a histogram of the employer marginal contribution rates for pension insurance calculated for gross earnings between a lower threshold t/p_1 and an upper threshold tup_1 . Obviously, pension insurance rates vary the most across employees. For most of the workers this rate is between 10% and 20%, and thus the pension contribution usually accounts for the most significant part of labour costs.

There are important differences between the pension contribution and the other SSCs. First of all, the base for the pension contribution is different. The pension contribution rates are applied to gross earnings (including the employee pension premium) which we do not observe in our data. Second, unlike in the case of the other SSCs, the thresholds for the pension contribution need to be adjusted for workers that are working part-time. All these considerations lead to quite an involved procedure for calculating the pension contribution. The procedure is explained in detail in the Appendix E.













Gross adjusted earnings centered at tu, 2011





Note: The bins are equal to 0.2 percentage points.





Note: The bins are equal to 0.2 percentage points. The solid line indicates the legislated rate.

Figure 9 The employer marginal contribution rates for health insurance averaged over €200 bins of the health insurance base. The health insurance tax base is centered at threshold th.



Health insurance base centered at th, 2011





Note: The bins are equal to 0.2 percentage points. The solid line indicates the legislated rate.





Gross adjusted earnings centered at tu, 2011





Note: The bins are equal to 0.2 percentage points.

Figure 13 Distribution of the employer marginal contribution rates for pension insurance calculated over the range of gross earnings between a lower threshold t/p_1 and an upper threshold tup_1 .



Note: The bins are equal to 1 percentage point.

5. Results

Following recent bunching approaches to analyze behavioural response to marginal tax rates (e.g. Saez, 2010; Chetty et al., 2011), we explore potential discontinuities in the density of gross earnings at thresholds. The literature predicts bunching (troughs) at convex (concave) kink points. Provided some individuals are still located around the threshold we can examine incidence by comparing the densities of our earnings concepts. Incidence leads to shifts in the distribution (see Section 2). We follow the conceptual model in Alvaredo and Saez (2007) and define similar income concepts for labour costs, gross earnings and net earnings (see Table 5).

To detect any discontinuities at kink points, the simplest method consists of producing histograms of the earnings distribution with small bins, and checking whether the density at the threshold is discontinuous. If there is a gap or hole or bunching, we can interpret this as a behavioural response. Any other shifts of the distribution indicate incidence.

Since different SSCs have different bases, we explore densities of different gross earnings concepts depending on the base relevant for the threshold under consideration. At first, we perform a visual inspection, and then we apply a nonparametric test (McCrary, 2008). In each case, we first normalize the thresholds to a value of 0. We choose a bandwidth of 10,000 euros around the thresholds and a bin size of 200 euros.

Income concept	Abbreviation	Definition
Gross earnings	GE	Contractual earnings plus incidental
		earnings
Gross earnings adjusted	GAE	Gross earnings minus pension contribution
(variable in our dataset)		employee
Labour costs	LC	GAE plus employer SSCs plus pension
		contribution employer and employee
Labour costs adjusted	LCA	GAE plus employer SSCs
Net earnings	NE	GAE minus unemployment insurance
		employee (before 2009)

Table 5Earnings concepts

5.1 Gross earnings

Visual inspection

Lower threshold tl. The first threshold is generated by the unemployment insurance premium. It is a convex kink point in the payroll tax schedule: for earnings above this threshold both the employer and the employee need to pay contribution to the general unemployment fund (the marginal rate jumps up by 4.2% in 2011; Table A.1). According to the literature, behavioural responses at convex kinks should produce bunching in the density distribution of the relevant earnings concept. Since the gross adjusted earnings (*GAE*) are the base for the unemployment contribution, we explore the density of this earnings concept around *tl* (*lower threshold*). Figure 14a shows a histogram of *GAE*

around tl, with tl normalized to a value of 0. The distribution do not seem to exhibit any bunching around tl.

Upper threshold th. The second threshold is related to the health insurance contribution. This is a concave kink in the payroll tax schedule: for earnings above this threshold the marginal rate of the employer contribution for health insurance drops to zero (the maximum reduction equals 7.75% in 2011; Table 6). According to the literature, behavioural responses at concave kinks should produce troughs in the density distribution of the relevant earnings concept. This health insurance tax base (*HTB*) is the earnings concept relevant for threshold *th (upper threshold health insurance)*. Figure 14b shows a histogram of *HTB* around *th*, with *th* normalized to a value of 0. We cannot detect any visible troughs in the distribution of *HTB* around *th*.

Upper threshold tu. The third threshold is the upper limit in the social security scheme. This is a concave kink in the payroll tax schedule: for earnings above this threshold the marginal rates of the contributions for unemployment and disability insurance drop to zero. The combined uniform rate of the unemployment and disability insurance contributions drops by 9.3% in 2011 (Tables 5 and 7). In addition, the sum of both differentiated rates falls by 2.86% on average. We should expect a trough in the density distribution of the gross adjusted earnings (*GAE*), which is the base for the unemployment and disability contributions. Figure 14c shows a histogram of *GAE* around *tu*, with *tu* normalized to a value of 0. Again, the distribution do not seem to exhibit any discontinuities around *tu*.

Pension thresholds tlp₁ and tup₁. The fourth and fifth thresholds are created by the pension system. Most of the pension funds feature a single rate schedule with an employer rate erp_1 % and an employee rate eep_1 % applied to *GE* (gross earnings) above a lower threshold tlp_1 and below an upper threshold tup_1 (Table 8). Since the base for the pension contribution are the gross earnings, we explore the density of this earnings concept around tlp_1 and tup_1 .¹⁸ Given that tlp_1 and tup_1 differ across workers depending on the pension funds to which they belong to, we apply the following procedure to normalize tlp_1 and tup_1 to a value of 0. We first calculate for each individual the percentage difference between their *GE* and the relevant threshold (e.g., to normalize tlp_1 , we calculate (*GE* - tlp_1)/ tlp_1). We then group workers into 2-percentage point bins and count the number of workers in each bin. Figure 15 presents the *GE* densities centered at tlp_1 and tup_1 . We could not detect visually any discontinuity.

¹⁸ Detailed explanation of the *GE* calculation is given in Appendix D.

Figure 14a Distribution of gross adjusted earnings around threshold *tl*. The gross adjusted earnings are centered at threshold *tl*.







Health insurance base centered at th, 2011

Figure 14c Distribution of gross adjusted earnings around threshold *tu*. The gross adjusted earnings are centered at threshold *tu*.



Note: The bins are equal to €200.



Figure 15 Distribution of gross earnings around thresholds tlp_1 and tup_1 (%-deviation from the thresholds).

Note: The bins are equal to 2 percentage points.

Nonparametric tests

The most straightforward way to check for discontinuities is visual examination of a histogram of earnings to see if observations are clustered together immediately before or after a kink point. It is also possible to perform nonparametric tests, outlined by McCrary (2008) and summarized by Lee and Lemieux (2010), that assignment to one side of a threshold or the other is as good as random. Tables 9 and 10 present results of McCrary tests¹⁹ of discontinuities in *GAE* at the lower (*tl*), middle (*th*) and higher threshold (*tu*) for two specifications: (i) bin size = €200 and bandwidth = €5,000, and (ii) default bin size and bandwidth. The discontinuity is expressed as the log difference between the estimated densities before and after the threshold. Table 9 shows estimated log discontinuity of 2.7 percent at the higher threshold in 2006 when using our preferred specification (bin size = €200; bandwidth = €5,000). However this finding is not supported by the default specification. Table 10 shows that the test detects further significant discontinuities at the lower threshold of the unemployment contribution in 2011, but again the results are sensitive to the choice of bin size and

¹⁹ We prefer to show results of the tables instead of the accompanying graphs because the table is more illustrative of the sensitivity of the McCrary test.

bandwidth. Our preferred specification yields a positive and statistically significant estimate of log discontinuity of 3.2 percent, while the default specification results in negative and statistically significant estimate of -6.1 percent in log discontinuity. It is also surprising that the discontinuity at *tl* is insignificant in 2006 and significant in 2011, while the increase in the marginal tax rate is smaller in 2011. In addition, the default bin size of 15 euro is unattractive relative to the threshold of almost 17,000 euro. Additional sensitivity checks show that the conflicting results are driven by the different choice of bandwidth.

Similarly, Table 11 and 12 present results of McCrary tests of discontinuities in *GE* at tlp_1 and tup_1 for two specifications: (i) bin size = 2% and bandwidth = 30%, and (ii) default bin size and bandwidth. In this case the tests detect significant discontinuities at both tlp_1 and tup_1 . One should keep in mind though that we have calculated the *GE* and the pension contributions ourselves. Thus the discontinuities detected by the tests in Table 11 and 12 could be purely a mechanical result of our calculation, rather than discontinuities that would have been detected in case we observed the pension contributions.

	t/	th	tu
Estimate	-0.0156	-0.0004	0.0272
Bin size = €200, Bandwidth = €5000	(0.0097)	(0.0049)	(0.0079)
Sample size	250,113	741,634	316,216
Default estimate	-0.0069	-0.0034	0.0078
	(0.0129)	(0.0078)	(0.0111)
Default bin size (in euro)	12.70	9.32	13.94
Default bandwidth (in euro)	2,775	2,008	2,508
Sample size	125,811	312,338	155,178

Table 9McCrary tests of discontinuities in GAE, 2006

The coefficients are estimates of discontinuity measured as a log difference in height of the distribution on either side of a threshold.

Table 10McCrary tests of discontinuities in GAE, 2011

	tl	th	tu
Estimate	0.0321	0.0016	-0.0036
Bin size = €200, Bandwidth = €5000	(0.0100)	(0.0053)	(0.0085)
Sample size	227,559	639,977	271,029
Default estimate	-0.0609	0.0109	-0.0105
	(0.0147)	(0.0077)	(0.0102)
Default bin size (in euro)	14.80	10.65	14.94
Default bandwidth (in euro)	2,386	2,420	3,426
Sample size	100,362	319,256	184,233

The coefficients are estimates of discontinuity measured as a log difference in height of the distribution on either side of a threshold.

Table 11	McCrary tests o	f discontinuities	in GE, 2006
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	tlp1	tup ₁
Estimate	-0.0832	0.0695
Bin size = 2%, Bandwidth = 30%	(0.0145)	(0.0086)
Sample size	94,748	337,539
Default estimate	-0.0605	0.0609
	(0.0227)	(0.0163)
Default bin size (in %)	0.13	0.05
Default bandwidth (in %)	11.96	7.75
Sample size	37,120	73,365

The coefficients are estimates of discontinuity measured as a log difference in height of the distribution on either side of a threshold.

Table 12 McCrary tests of discontinuities in GE, 2012

	tlp1	tup ₁
Estimate	-0.0979	0.1676
Bin size = 2%, Bandwidth = 30%	(0.0122)	(0.0082)
Sample size	118,425	385,400
Default estimate	-0.0069	0.1025
	(0.0192)	(0.0164)
Default bin size (in %)	0.13	0.04
Default bandwidth (in %)	12.00	6.91
Sample size	50,216	71,975

The coefficients are estimates of discontinuity measured as a log difference in height of the distribution on either side of a threshold.

Behavioural responses

In general, densities of different gross earnings concepts seem to be continuous around thresholds. We can offer several potential explanations for the lack of bunching and gaps in the densities. First of all, the Dutch payroll tax schedule is associated with relatively small kinks. The change in the marginal tax rates is 4.2pp at the lower threshold, at the health insurance threshold it is 7.75pp and at the upper threshold it is 12.16pp (see Section 2). Unlike big kinks and notches²⁰, small kinks do not seem to create strong distortions and therefore do not induce large behavioural responses. Indeed, the received literature using bunching around kinks to identify behavioural responses (Saez 2010; Chetty et al. 2011) finds that only very *large and salient* kinks create any bunching at all,²¹ and even there the response is modest. The likely explanation is that the utility gain of bunching in response to jumps in marginal tax rates is not very large. This would suggest that wage earners are actually unresponsive to the marginal payroll tax rates.

²⁰ A notch is an change in average tax rate, whereas a kink is a change in marginal tax rate.

²¹ E.g., Saez (2010) finds that bunching arises only at the threshold of the first income tax bracket where the marginal tax rate jumps to 20 percent. He finds no evidence of bunching at any other kink point where the change in marginal tax rates is smaller.

Another possibility is the presence of optimization frictions such as switching and attention costs. Chetty et al. (2011) and Kleven and Waseem (2013) provide an extensive discussion of optimization frictions including imperfect information, inattention, inertia, adjustment costs and hours constraints.²² It is also possible that a portion of earnings are random so that wage earners cannot optimize perfectly or they might have little short-term control over their earnings.

Yet another possibility is that payroll taxes are considered by wage earners as deferred benefits. The most obvious example would be the pension contribution since the level of pension received depends on both the level and duration of contributions. Unemployment insurance also exhibits this deferred-benefit property to some extent: in the event of job loss, the maximum duration of unemployment benefits depends on the duration of contributions.

Although inconsistent with the standard labour supply model, our finding of smooth distribution of gross earnings is consistent with results in other empirical studies (Liebman and Saez 2006; Alvaredo and Saez 2007; Lehmann et al. 2013). We are not aware of a study that finds discontinuity in the distribution of gross earnings in the context of a tax system featuring (small) kinks.

Incidence

Given the small behavioural responses, examining the gross earnings distribution close to the thresholds provides some information on incidence. Standard incidence theory predicts that contributions are fully shifted to the employees (in the long run) resulting in a discontinuous gross earnings distribution because the distribution of labour costs is smooth stemming from smooth labour productivity. Our finding challenges this prediction. We assess this as a compelling result since our gross earnings concept is measured with high precision and very likely without measurement errors which would be an alternative cause of smoothness.²³ However, measurement errors cannot be ruled out completely. In the next sections we will combine this finding for gross earnings with two other income concepts, labour costs and net earnings. Since they are deterministically related, a discontinuity in the SSC system should appear in one of the three earning concepts and as such should provide information on who actually pays the contributions.

²² Kleven and Waseem (2013) also develop a method to estimate these frictions in the presence of notches in the tax schedule.

²³ Our measure of gross earnings is equal to the income concept used to determine social security contributions and no imputation is needed. It is provided by the employer to the tax authority.

5.2 Labour costs

The next relevant earnings concept to further explore incidence are the labour costs (*LC*). The standard theory of incidence would imply a continuous distribution of labour costs and a discontinuous distribution of gross earnings. In that case, the incidence is on the employee. However, as our distribution of gross earnings is found to be smooth, there has to be a deterministic discontinuity in labour costs. This would indicate that the incidence is on the employer. Labour costs are earnings inclusive of employee and employer SSCs. These costs can be interpreted as the total cost of employing a given worker. Since we observe the actual amounts of SSCs (except of the pension contributions), we begin by examining the so-called labour costs adjusted (*LCA*) defined as the sum of observed *GAE* and observed employer SSCs: the unemployment contribution, the health contribution, and the disability contribution.

We can compute the (observed) employer payroll tax rates as: $tr_A = (LCA-GAE)/GAE$. Since the unemployment and the disability contributions have differentiated parts, tr_A differs across workers. Figure 16 illustrates the variability of tr_A over the range of *GAE* between thresholds tl and th. Histograms at other ranges of earnings show similar variability. Thus, while the gross earnings thresholds are the same for all individuals, this is not the case for the labour costs thresholds. As discussed above, employer payroll taxes depend on many additional factors including the firm size, the type of work, and whether or not the employer decides to bear part of the risk. Unfortunately, we do not observe all of these factors. Hence, any discontinuity they generate could be expected to be smoothed out in the aggregate even with small measurement errors. We return to this issue below when interpreting the results of our analysis.

To examine the distribution of *LCA*, we first need to calculate the corresponding thresholds for the *LCA* distribution. We do this by multiplying the thresholds tl, th, and tu by the corresponding rate (1 + tr_A) for each worker: tl_lc , th_lc , and tu_lc . We then normalize the *LCA* thresholds by calculating for each individual the percentage difference between their *LCA* and the relevant threshold (e.g., to normalize tl_lc , we calculate (*LCA* - tl_lc)/ tl_lc). We then count the number of workers in each 2-percentage point bin. Figure 17 presents the *LCA* densities centered at thresholds tl_lc , th_lc , and tu_lc . As in the case of gross earnings, no major discontinuities are visible in the graphs.

We also examine the distribution of labour costs including the employer pension contribution since they constitute a large part of the costs. We follow the same procedure of computing and normalizing the *LC* thresholds, and counting the number of workers in each 2-percentage point bin. Figure 18 presents the *LC* densities centered at thresholds tl_tp_1 and tl_tup_1 . Again, no major discontinuities are visible in the graphs.

To put this finding in perspective, we can compare it to other results. The evidence about the distribution of labour costs around kinks is scant and not that unanimous. Alvaredo and Saez (2007) and Saez et al. (2012) observe continuous distribution of gross earnings, but discontinuities in the distribution of labour costs. Both studies interpret this finding as incidence of payroll taxes primarily on employers. In contrast, Lehmann et al. (2013) find that the distributions of both gross earnings and labour costs are continuous. Neumann (2014) observes discontinuity in the distribution of labour cost combined with a smaller discontinuity in the distribution of gross earnings and interprets this as equal sharing of the burden between employers and employees.

In any case, smoothness of the distribution of both gross earnings and labour costs at kinks in our case could be taken as an indication of measurement errors in at least one of the income concepts and does not allow us to draw conclusions about incidence of payroll taxes.²⁴





Note: The bins are equal to 0.5 percentage points.

²⁴ The finding of continuous gross earnings and labour costs turned out to be very robust, even when we restricted our sample to very homogeneous groups of workers of the same sex, similar household composition and working in the same industry.

Figure 17 Distribution of labour costs adjusted (*LCA*) around thresholds *tl_lc*, *th_lc* and *tu_lc* (%-deviation from the thresholds).



Labour costs centered at *tu_lc*, 2011

Note: The bins are equal to 2 percentage points.



Figure 18 Distribution of labour costs (*LC*) around threshold tlp_1_lc and tup_1_lc (%-deviation from the thresholds).

Note: The bins are equal to 2 percentage points.

5.3 Net earnings

The final earnings concept that we examine are the net earnings (*NE*). According to the definition in Alvaredo and Saez (2007), net earnings are equal to gross earnings minus the employee SSCs. The standard theory of incidence would imply a discontinuous distribution of net earnings if gross earnings are smooth. In that case, the incidence is on the employee. In the Netherlands, employees do not pay any disability insurance contributions and since 2009 they do not pay for unemployment insurance either. They do pay for health insurance which we calculate by using a tax-benefit calculator (Appendix D). To calculate *NE*, we subtract the calculated health contribution from the observed gross adjusted earnings (*GAE*).²⁵ Next we compute the employee payroll tax rates as: te = (GAE-NE)/GAE. Since the employee health insurance contribution has components that depend on household income and household composition, *te* differs across workers. Our dataset includes all the relevant information to do so. Again, as in the case of the labour cost thresholds, the net earnings thresholds will not be located uniformly across wage earners in our sample. Analogue to the analysis of labour costs, we normalize the distance to the threshold.

Figure 19 presents the *NE* densities centered at thresholds *tl_ne*, *th_ne*, and *tu_ne*. As in the case of gross earnings and labour costs, no discontinuities are visible in the graphs. Equivalent to the results on labour costs, this finding of both continuous gross earnings and net earnings indicates the presence of measurement errors. Even though our net income variable is observed with high precision, we could introduce measurement errors because we had to calculate the employee health insurance contribution.

²⁵ Before 2009, we also subtract the unemployment insurance contribution paid by the employee.

Figure 19 Distribution of net earnings (*NE*) around thresholds *tl_ne*, *th_ne* and *tu_ne* (%-deviation from the thresholds).



Note: The bins are equal to 2 percentage points.

6. A Simulation Exercise

As discussed earlier, our finding of smooth distribution of gross earnings is consistent with results in recent empirical studies. However, continuous distribution of *both* gross earnings and labour costs is at best puzzling and points to the presence of measurement error in at least one of these income concepts. As shown by Alvaredo and Saez (2007), a discontinuity in the tax rate should be reflected in a discontinuity in at least one of these earning concepts as they are deterministically related. The relevant question is then what are the relevant factors that could mask deterministic discontinuities in earnings densities. We have already outlined several potential candidates, including small kinks and measurement errors. Next we explore the effect of these factors by simple simulation exercises.

One of the most obvious factors that could mask a discontinuity in the density of earnings is the presence of measurement error. This error could be both random (e.g., mistakes in the forms filled in by employers that are made by chance) or systematic (e.g., tendency to under-report earnings from certain activities such as over-time work or bonuses). Since we are using administrative data that employers have to provide to the tax authorities, our data should presumably contain little random or systematic error in our observed GAE and SSCs.

Nevertheless, it could be argued that the complexity of the institutional system could result in errors in the calculation. This could be particularly in the case of the labour costs which are calculated by adding different observed SSCs to gross earnings. Even if the SSC amounts are observed without error, the calculation of the individual threshold requires perfect information not only on the SSC amounts, but also on the marginal SSC rates. Since the unemployment and disability insurance rates vary over characteristics we do not observe (see Figures 4 and 9), our calculation of the individual threshold is likely to contain some error.

In an ideal world with perfect information on both uniform-rate SSC and variable-rate SSC, calculation of an individual labour cost threshold is straightforward. Suppose a uniform SSC rate r_u and a variable SSC rate r_v , which are both known. Then we could plot the observed labour costs *LCA* around the calculated labour costs thresholds t_c

- Observed labour costs: LCA = observed GAE + observed SSCs
- Calculated individual labour cost threshold: $t_lc = (1 + r_u + r_v)^* GAE_$ threshold; this threshold will vary across individuals since r_v varies across individuals.

Since the legislated r_v is unknown to us, we perform simulations.

Simulation 1: Legislated SSC rates

We first simulate labour costs by applying the legislated SSC rates to the observed GAE.

- Simulated labour costs: $LC_sim = observed GAE^*(1 + r_u + r_v)$
- Calculated individual labour cost thresholds: $t_lc = (1 + r_u + r_v)^* GAE_$ threshold; this threshold is the same for all individuals.

In that way it is easier to look at the distribution since the threshold is the same for everyone. We abstract from the complicating influence of the varying and partly unknown SSC rate. For the uniform-rate SSC we simply apply the legislated rates, r_u , while for the variable-rate SSC we apply the

average rates for the market sector, r_v . Unlike in the case of observed labour costs, in this simulation exercise the labour cost thresholds are the same for all individuals. Mechanically created gaps are expected to emerge in Figure 20. Interestingly, while the density of simulated labour costs continues to be smooth around threshold tl_lc which features a small kink, we observe discontinuities at thresholds th_lc and tu_lc which feature relatively larger kinks. Obviously, the size of the kink matters. The resulting mechanically created discontinuity turns out to be significant for two out of three kinks (see the results of the McCrary test in Table 13).,

Simulation 2: Partial labour costs and observed rates

To investigate the role of the complexity of the institutional system, we perform an additional simulation exercise where we abstract from the variable rates.

- Observed partial labour costs: LCP = observed GAE + observed uniform-rate SSCs
- Calculated individual labour cost thresholds: $t_lc = (1 + r_u)^* GAE_threshold$; this threshold is the same for all individuals.

The complexity of the system is mainly related to the existence of variable-rate SSCs which vary among individuals for multitude of reasons. Therefore, we focus only on the uniform-rate SSCs. As shown in Section 3.2, the uniform rates seem to be applied with precision by employers. To check this further, we compute the so-called partial labour costs, *LCP*, by adding only the uniform-rate observed SSCs to the gross earnings. As in the previous exercise, the labour cost thresholds are the same for all individuals. Findings in Figure 18 demonstrate again discontinuities of partial labour costs at thresholds th_lc and tu_lc . The discontinuity estimates are statistically significant at thresholds th_lc and tu_lc (see the results of the McCrary tests in Table 14). This indicates that the presence of variable-rate SSCs, though relatively small in size, is enough to mask discontinuities in labour costs.

Simulation 3: Partial labour costs and legislated rates

We also performed a simulation in which we simulated the partial labour costs by applying the unified SSC rate with perfect precision instead of the observed unified SSCs as in simulation 2.

- Simulated partial labour costs: LCP_sim = observed GAE*(1 + r_u)
- Calculated individual labour cost thresholds: $t_lc = (1 + r_u)^* GAE_$ threshold; this threshold is the same for all individuals.

The idea behind this simulation is to be able to exclude that part of the measurement error that is due to incomplete information. The uniform rate is the same for all employers irrespective of size firm, sector, etc. so differences between observed SSCs and calculated SSCs would not be due to incomplete information but due to wrong application of the legislated rates. Results were qualitatively similar to those shown in Figure 21.

Our simulations suggest that a measurement error for the contributions we observe does not seem to play a large role for the smooth earning densities. While we cannot exclude the presence of all above-mentioned factors that could mask discontinuities in gross (adjusted) earnings densities in Figures 14 and 15, our simulation exercises point mainly to the role of the size of the kinks and the complexity of the institutional system. These factors necessitate the calculation of individual

thresholds instead of a single threshold and therefore even small measurement errors in calculated rates are enough to mask any discontinuity.

Figure 20 Distribution of simulated labour costs adjusted (*LCA*) around thresholds *tl_lc*, *th_lc* and *tu_lc* (%-deviation from the thresholds).



Note: The bins are equal to 2 percentage points.

Figure 21 Distribution of simulated partial labour costs adjusted (*LCA*) around thresholds tl_{lc} , th_{lc} and tu_{lc} (%-deviation from the thresholds).



Note: The bins are equal to 2 percentage points.

Table 13McCrary tests of discontinuities in simulated LCA, 2011

	t/	th	tu
Estimate	-0.0025	0.0442	0.1401
Bin size = 2%, Bandwidth = 30%	(0.0100)	(0.0037)	(0.0049)
Sample size	225,190	1,155,062	989,656

The coefficients are estimates of discontinuity measured as a log difference in height of the distribution on either side of a threshold.

Table 14McCrary tests of discontinuities in simulated partial LCA, 2011

	tl	th	tu
Estimate	0.0039	0.0387	0.1136
Bin size = 2%, Bandwidth = 30%	(0.0100)	(0.0037)	(0.0049)
Sample size	225,969	1,157,612	981,219

The coefficients are estimates of discontinuity measured as a log difference in height of the distribution on either side of a threshold.

7. Conclusions

In this paper we examine distribution of earnings to analyse the behavioural and incidence effects of payroll taxation. We look carefully at the distribution of three earnings concepts at thresholds in the social security scheme in the Netherlands where marginal tax rates jump up or down. A rich administrative dataset for the years 2006-2012 is employed that contains detailed information on actual payments for most of the contributions. This has a clear advantage that gaps are not mechanically introduced by imputing payments.

Our findings are mixed and twofold. First, we find a continuous distribution of gross earnings indicating small behavioural responses. Confronted with a change in marginal tax rates, individuals are not able or willing to relocate. The finding of a smooth distribution of gross earnings is in line with results in recent empirical studies. Several explanations are given for this. The bunching approach could provide more definite answers in a tax system with large kinks or notches. It seems also important that the rules are simple and the same for everyone. At the same time, a continuous distribution makes it possible to look at incidence. Our finding of a smooth distribution contradicts the prediction of the standard incidence theory that contributions are fully shifted to the employees. We assess this as a compelling result since our gross earnings concept is measured with large precision and very likely without measurement errors which would be an alternative cause of smoothness.

Second, we also find a continuous distribution of both net earnings and labour costs. This lack of deterministic discontinuity is a clear indication of measurement errors in at least one of the earnings concepts. The rather small changes in marginal rates and the complexity of the institutional system provide the main explanation for this finding. This approach requires high-quality data on both earnings and contributions and even minor measurement errors can mask any discontinuity.

Our analysis stresses the importance of observing actual payments and avoiding imputing payments. In the latter, gaps are mechanically introduced resulting in an invalid conclusion on incidence. Since high-quality data combining information on earnings and contributions are sparse and so far very little discontinuity is found in practice, an alternative method would be to look at reforms that lead to a large change in marginal tax rates. A comparison of results obtained with Danish tax data suggests that reform-based estimates are potentially more revealing of (long-run) behaviour than bunching-based estimates (Kleven and Schultz, 2014). For future research we plan to apply panel estimation exploiting the large variation in pension contribution rates.

In general, the current literature shows that the finding of behavioural responses with the bunching method is more promising in a tax system with large and salient kinks or notches, such as provided by the personal income tax system. This seems a promising route for further research.

References

Adam, S., Browne, J., Phillips, D., and B. Roantree (2015), Adjustment costs and labour supply: evidence from bunching at tax thresholds in the UK, working paper.

Alvaredo, F. and E. Saez (2007), The effects of payroll taxes on earnings: evidence from Spanish administrative earnings data, mimeo

Barattieri, A., Basu, S. and P Gottschalk, 2014, Some Evidence on the Importance of Sticky Wages, American Economic Journal: Macroeconomics 6(1): 70-101.

Le Bihan, H., Montornes, J, and T. Heckel, 2012, Sticky Wages: Evidence from Quarterly Microeconomic Data, American Economic Journal: Macroeconomics 4(3): 1-32.

Chetty, R., J.N. Friedman, T. Olsen, and L. Pistaferri (2011), Adjustment costs, firm responses, and micro vs. macro labor supply elasticities: Evidence from Danish tax records, The Quarterly Journal of Economics 126 (2), 749-804

Geibel, F., M. Neumann, M. Tenand, L. Bettendorf, A. Bozio and T. Breda (2014), Who bears the economic burden of social security contributions? Lessons learned from macro cross-country studies, mimeo, forthcoming

Gruber, J. (1994), The incidence of mandated maternity benefits, American Economic Review 84 (3), 622–41

Gruber J. (1997), The Incidence of payroll taxation: Evidence from Chile, Journal of Labor Economics 15 (3), 72-101

Hamermesh, D. S. (1979), New estimates of the incidence of the payroll tax, Southern Economic Journal 45 (4), 1208-1219

Kleven, H. and Schultz, E. (2014), Estimating taxable income responses using Danish tax reforms. American Economic Journal: Economic Policy, forthcoming

Kleven, H.J. and M. Waseem (2013), Using notches to uncover optimization frictions and structural elasticities: Theory and evidence from Pakistan, The Quarterly Journal of Economics 128 (2), 669-723

Lee, D.S. and T. Lemieux (2010), Regression Discontinuity Designs in Economics, Journal of Economic Literature 48, pp. 281–355.

Liebman, J. and R. Zeckhauser, 2005, Schmeduling, Harvard University Working Paper.

Lehmann, E., F. Marical and L. Rioux (2013), Labor income responds differently to income-tax and payroll-tax reforms, Journal of Public Economics 99, 66-84

Liebman, J. and E. Saez (2006), Earning Responses to Increases in Payroll Taxes, NBER Retirement Research Center Paper No. NB 04-06

McCrary, J. (2008). Manipulation of the running variable in the regression discontinuity design: A density test. Journal of Econometrics, 142(2):698-714

Neumann, M. (2014), Earnings responses to social security contributions: Evidence from two German administrative data sets, mimeo, DIW Berlin

Mirrlees, J., Adam, S., Besley, T., Blundell, R., Bond, S., Chote, R., Gammie , M., Johnson , P., Myles, G. and J. Poterba , 2011, Tax by Design, Oxford University Press

Muller, K. and M. Neumann (2015), How reliable are incidence estimates based on cross-sectional distributions? Evidence from simulations and linked employer-employee data, mimeo, DIW Berlin

OECD (1990), Employer versus employee taxation: the impact on employment, Chapter 6 in Employment Outlook, Paris

OECD (2013), Taxing wages, Paris

Saez, E. (2010), Do taxpayers bunch at kink points?, American Economic Journal: Economic Policy 2 (3), 180-212

Saez, E., M. Matsaganis and P. Tsakloglou (2012), Earnings determination and taxes: Evidence from a cohort-based payroll tax reform in Greece, The Quarterly Journal of Economics 127 (1), 493-533

Summers, L.H. (1989), Some simple economics of mandated benefits, American Economic Review 79 (2), 177-83

Teulings, C., 1995, The Wage Distribution in a Model of the Assignment of Skills to Jobs, Journal of Political Economy, Vol. 103, No. 2, pp. 280-315.

Appendix A: Social security rates over time

Year	Lower threshold t/ (€)	Upper threshold tu (€)	Uniform Employer rate (%)	Uniform Employee rate (%)	Average differentiated employer rate (%)
2006	15,138	43,848	3.45	5.20	1.48
2007	15,660	45,017	4.40	3.85	1.27
2008	15,921	46,205	4.75	3.50	1.36
2009	16,443	47,802	4.15	0	1.41
2010	16,704	48,716	4.20	0	1.82
2011	16,965	49,297	4.20	0	2.24
2012	17,229	50,064	4.55	0	2.77

Table A.1 Unemployment insurance contribution to the general and branch fund

Table A.2Health insurance contributio	n
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Year	Upper threshold th (€)	Employer rate (%)
2006	30,015	6.50
2007	30,623	6.50
2008	31,231	7.20
2009	32,369	6.90
2010	33,189	7.05
2011	33,427	7.75
2012	50,064	7.10

Table A.3

Disability insurance contribution: uniform and differentiated rate

Year	Upper threshold <i>tu</i> (€)	Uniform Employer rate (%)	Average differentiated employer rate (%)
2006	43,848	5.40	0.98
2007	45,017	5.15	1.23
2008	46,205	5.65	0.72
2009	47,802	5.70	0.62
2010	48,716	5.70	0.66
2011	49,297	5.10	0.62
2012	50,064	5.05	0.55

Table A.4

Pension contribution, 10 largest private-sector pension funds, 2012

Pension fund	tlp1	tup ₁	erp ₁ %	eep ₁ %	tlp ₂	tup ₂	erp₂%	eep ₂ %
Health sector	10,802	-	11.90	11.90	-	-	-	-
Metal-technic	15,632	77,388	16.15	16.15	77,388	-	11.25	11.25
Retail	12,415	50,064	13.62	4.88	-	-	-	-
Construction	13,062	54,398	13.44	8.46	-	-	-	-
Food services	10,802	33,850	8.4	8.4	-	-	-	-
Transportation	10,802	50,064	19.34	9.90	-	-	-	-
Cleaning services	10,861	50,064	10.50	10.50	0	50,064	0.90	-
Metal-electro	15,563	67,738	14.50	12.00	-	-	-	-
Agriculture	12,711	50,064	15.29	4.21	-	-	-	-
Food production	14,415	50,064	13.16	5.34	0	50,064	0.88	0.53

Appendix B: Example of the cumulative calculation rule

Monthly payments have to be calculated in practice using a so-called cumulative calculation rule. An example of this rule is given in Table B.1. Three pay periods are considered: January, February and March. Earnings exceed the lower threshold (€1262) in every month but earnings only exceed the

upper threshold (€3654) in the first month. As a consequence, the actual base in January equals the difference between the thresholds (€2393). The untaxed amount above the upper threshold (€346) is carried forward to the base in February. Without this spillover, the base in February would equal €1938 (= 3200 - 1262); the actual base (€2284) is obtained after adding the previously untaxed amount. The actual base in the last month remains the amount above the lower threshold (€1938). The sum over the bases equals €6614. This sum can be calculated directly on an annual basis. Since total earnings (€10,400) are between both cumulative thresholds, the annual base equals the amount of earnings above the cumulative lower threshold (= 10,400 - 3786). The cumulative threshold equals the number of working months times the corresponding monthly threshold. This example shows that the computation of the contributions on a yearly base will be correct in most of the cases.

Table B.1	Example	of	cumulative	calcu	lation	rule
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Рау	Wage ^a	Cum.	Cum. low	Cum. up.	Min. Cum.	Cum.	Base actual
period		Wage [♭]	threshold	threshold ^d	Wage ^e	Base ^f	g =∆f
January	4000	4000	1262	3654	3654	2392	2392
February	3200	7200	2524	7308	7200	4676	2284
March	3200	10400	3786	10962	10400	6614	1938
Total	10,400						6614

Notes: For this employee the earnings in January exceed the upper threshold.

^a Wage is gross wage adjusted.

^b Cum. wage is sum of wages from January onwards.

^c Cum. lower threshold; lower threshold = 1262 euro per month

^d Cum. upper threshold; upper threshold = 3654 euro per month

 $e^{f} = min(b,d)$ $f^{f} = e^{-c}$

Appendix C: Personal income tax schedule

Ta	hla	1	
Ia	DIG		

The Dutch Tax Schedule (2011)

Taxable income (EUR)	Tax rate $(9/)$	General social security contributions			
	Tax Tale (%)	< 65 years	≥ 65 years		
0 - 18,628	1.85	31.15	13.25		
18,628 - 33,436	10.80	31.15	13.25		
33,436 - 55,694	42.00	-	-		
55,694 and over	52.00	-	-		

Appendix D: Calculation of Marginal Contribution Rates

Our dataset contains the total amount of the unemployment contribution paid by both the employer and the employee ($UI \in$). Thus for the period 2006-2008 we need to calculate the employer contribution ($ER_UI \in$) and the employee contribution ($EE_UI \in$) separately. For instance, in 2006 the legislated employer and employee rates were 3.45% and 5.2%, respectively, and the two contributions are calculated in the following way:

 $ER_UI \in = UI \in * 0.0345/(0.0345+0.052)$

EE_UI€ = *UI*€ * 0.052/(0.0345+0.052)

The next step is to calculate the observed marginal unemployment contribution rates and compare these rates to the legislated rates in Table 5. The marginal rates for the employer ($er_ui\%$) and the employee ($ee_ui\%$) are computed in the following way:

i) GAE below *tl* $er_ui\% = ER_Ul \in / GAE * 100$ $ee_ui\% = EE_Ul \in / GAE * 100$ ii) GAE between *tl* and *tu* $er_ui\% = ER_Ul \in / (GAE - tl) * 100$ $ee_ui\% = EE_Ul \in / (GAE - tl) * 100$ iii) GAE above *tu* $er_ui\% = (ER_Ul \in - (tu - tl) * 0.0345)) / (tu - tl) * 100$ $ee_ui\% = (EE_Ul \in - (tu - tl) * 0.052)) / (tu - tl) * 100$

The next step is to calculate the marginal health contribution rates and compare these rates to the legislated rates in Table Using the observed amount of the health insurance contribution ($ER_HI \in$) in our data, the marginal employer contribution rates ($er_hi\%$) for 2006 are computed in the following way:

i) *HTB* below th: er_hi % = ER_HI € / *HTB* * 100

ii) *HTB* above *th*: *er_hi*% = (*ER_HI*€ - *th* * 0.065) / *th* * 100

The calculation of the employee health insurance contribution requires calculation of three components:

- The employee pays nominal health insurance contribution that could vary based on the health insurance company to which the contribution is paid. However, due to competition among the

insurance companies this premium does not vary too much and we take the average of this contribution.

- Employees need to pay tax on the health insurance contribution paid by the employer. In order to calculate this tax we use a CPB-based micro tax simulator
- Employees with lower incomes receive health subsidy (so-called *zorgtoeslag*) which depends on the family income. To calculate this component we use again the CPB-based micro tax simulator.

The employee health insurance contribution is calculated as the sum of the nominal contribution and the tax on the health insurance contribution paid by the employer, minus the health subsidy received by the employee.

Appendix E: Calculation of Gross Earnings and Pension Contributions

Our dataset contains information on gross earnings minus the employee pension premium - socalled gross adjusted earnings (*GAE*). We do not have data on the pension contribution. In order to calculate the pension contribution, we first need a measure of gross earnings (*GE*) including the pension contribution, since the tax base for the pension contribution are the gross earnings.

Our dataset contains information on the collective labour agreement (CLA) to which a worker belongs. We identified the major CLAs and used this information to find out the pension funds with which these CLAs are associated as well as the rules to compute the pension contribution for workers that belong to these CLAs. Most of the pension funds feature a single rate schedule with an employer rate erp_1 % and an employee rate eep_1 % applied to *GE* above a lower threshold tlp_1 and below an upper threshold tup_1 . There are also pension funds that stipulate a differentiated rates schedule with a second set of employer and employee rates - erp_2 % and eep_2 % - that are applied to *GE* above a lower threshold tlp_2 and below an upper threshold tup_2 . Most of the pension funds stipulate a minimum age for the pension contribution. In addition, there are usually different rules for workers older than 55 years.

Since the pensions thresholds depend on whether a worker works full-time or part-time, we first adjust the thresholds for each worker taking into account their working hours relative to the hours specified in the CLA for a full-time worker.²⁶ We limit the sample to workers younger than 55 years. Based on the rules that we could identify from the CLAs, we calculate gross earnings (*GE*), employee pension contribution (*PenEE*) and employer pension contribution (*PenER*) following the procedure described below. Since *PenEE* and *PenER* are calculated in the same way, we illustrate the procedure only for *PenEE*.

1) A single lower threshold tlp_1

i) $GAE \le tlp_1$ GE = GAE PenEE = 0ii) $GE > tlp_1$ $GE = (GAE - tlp_1 * eep_1\%) / (1 - eep_1\%)$ $PenEE = (GE - tlp_1) * eep_1\%.$

²⁶ The definition of full-time work differs across the CLAs.

2) A lower threshold t/p_1 and an upper threshold tup_1

```
i) GAE \le tlp_1

GE = GAE

PenEE = 0

ii) tlp_1 < GE \le tup_1

GE = (GAE - tlp_1 * eep_1\%) / (1 - eep_1\%)

PenEE = (GE - tlp_1) * eep_1\%

iii) GE > tpu_1

GE = GAE + (tup_1 - tlp_1) * eep_1\%

PenEE = (tup_1 - tlp_1) * eep_1\%
```

3) A differentiated rate schedule with two lower thresholds; $tlp_1 = 0$ and $tlp_2 > 0$

$$PenEE = GE * eep_1\% + (GE - tlp_2) * eep_2\%$$

4) A differentiated rate schedule with two lower thresholds; $t/p_1 > 0$ and $t/p_2 = 0$

```
i) GAE \le tlp_1

GE = GAE /(1 - eep_2\%).

PenEE = GE * eep_2\%

ii) GE > tlp_1

GE = (GAE - tlp_1 * eep_1\%)/(1 - eep_1\% - eep_2\%)

PenEE = GE * eep_2\% + (GE - tlp_1) * eep_1\%
```

5) A differentiated rate schedule with two lower thresholds and one upper threshold; $t/p_1 > 0$, $t/p_2 > 0$, and $tpl_2 = tup_1$

```
i) GAE \le tlp_1

GE = GAE

PenEE = 0

ii) tlp_1 < GE \le tup_1

GE = (GAE - tlp_1 * eep_1\%) / (1 - eep_1\%)
```

$$PenEE = (GE - tlp_1) * eep_1\%$$

iii) $GAE > tup_1$
 $GE = (GAE + (tup_1 - tlp_1) * eep_1\% - tlp_2 * eep_2\%)/(1 - eep_2\%)$
 $PenEE = (tup_1 - tlp_1) * eep_1\% + (GE - tlp_2) * eep_2\%$

6) A differentiated rate schedule with two lower thresholds and two upper thresholds; $t/p_1 > 0$, $t/p_2 =$

and
$$tup_1 = tup_2$$

i) $GAE \le tlp_1$
 $GE = GAE/(1 - eep_2\%)$.
 $PenEE = GE * eep_2\%$
ii) $tlp_1 < GE \le tup_1$

GE = (GAE - tlp1* eep1%)/(1 - eep1% - eep2%)

 $PenEE = GE * eep_2\% + (GE - tlp_1) * eep_1\%$

iii) $GE > tup_1$

0,

 $GE = GAE + (tup_1 - tlp_1) * eep_1\% + (tup_2 - tlp_2) * eep_2\%$ $PenEE = (tup_1 - tlp_1) * eep_1\% + (tup_2 - tlp_2) * eep_2\%$

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