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Appendix to

Does Tax-Benefit Linkage Matter for the Incidence of Payroll Taxes?

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This Appendix provides complements to the theoretical framework presented in Section 2 (Appendix A), perceptions of the reforms from press and labour union archives (Appendix B), information on the data sources (Appendix C), a meta-analysis of payroll tax incidence (Appendix D), robustness checks (Appendix E), and estimates of the effects of the reforms on employment outcomes (Appendix F).

A   Theory Appendix

This appendix derives general formulas for the pass-through to workers of employer payroll taxes with tax-benefit linkage. Section A.1 presents the general setup and specifies our definition of the tax-benefit linkage. Section A.2 derives the partial equilibrium pass-through formula in the standard competitive labour market model. Section A.3 extends the analysis to a a general equilibrium framework with two types of workers.

A.1 Setup and General Overview

Production function. We consider a representative firm that uses $n + 1$ factors of production: capital (denoted by K) and n types of labour inputs, which we denote by L_1 to L_n. In particular, the labour inputs include those of the treated and control workers that we consider in the empirical analysis, which are denoted by L_T and L_C, respectively. The firm's production function $F(K, L_1, ..., L_n)$ is assumed to be homogeneous of degree one and to exhibit positive and diminishing marginal products.

A potential caveat when linking the theory to our research design is that we empirically define treated and control workers based on their wage levels rather than on an exogenous measure of skills such as educational attainment. The models discussed in this appendix are used to study the market response to changes in payroll taxes, and the treatment and control groups are empirically defined as a function of wages *prior* to the reforms, which can be considered as exogenous to the payroll tax increases. Our approach, therefore, consists in defining workers with different pre-reform wage levels as different inputs in production, and to evaluate how their wages respond to changes in payroll taxes under alternative models.

For simplicity, we assume that all payroll taxes are nominally paid by the firm and we denote by w_k the posted wage of type-k workers. The corresponding labour cost to the firm is denoted by $z_k \equiv w_k(1 + \tau_k)$, where τ_k is the rate of payroll taxes that are nominally paid by the firm for a worker with posted wage w_k.

The firm's after-tax profit is given by

$$\Pi = pF(K, L_1, ..., L_n) - rK - \sum_k z_k L_k,$$

where p is the output price and r is the cost of capital. Corporate taxes are ignored for simplicity. When computing the pass-through formulas under the general competitive equilibrium, we will assume that there are only two types of inputs, which are the theoretical counterparts of the control (L_C) and treated (L_T) workers in our empirical analysis. We further normalize the output price p to be 1 without loss of generality.

Labour supply with tax-benefit linkage. On the supply side, we denote by $\tilde{w}_k \equiv w_k(1 + q\tau_k)$ the perceived wage of type-k workers, i.e. their posted wage augmented by the perceived benefits from employer payroll taxes. The tax-benefit linkage is modelled as a reduced-form parameter q whose value lies in the interval $[0, 1]$. This parameter, which is assumed to be constant across worker types, measures the extent to which workers value employer payroll taxes relative to cash income. It subsumes two dimensions of tax-benefit linkage that we do not model separately: (i) the actuarial fairness of payroll taxes, which determines the degree of linkage between these taxes and future benefit entitlements at the individual level, and (ii) the salience of this linkage to workers.

If one assumes perfect information (strong salience), the degree of tax-benefit linkage can be measured as the ratio between the expected flow of benefits accrued from additional payroll taxes paid, and the value of this flow if it had been instead saved at the market rate of return r. This purely actuarial approach neglects the fact that payroll taxes may force workers to over-save in comparison to their counterfactual savings in the absence of social insurance. It also ignores that forcing agents to save may be beneficial if they are too myopic to fully internalize the future benefits of their savings. Measuring the salience of tax-benefit linkage (the extent to which agents are informed of and understand the linkage) and its exact consequences on workers' utility is a challenging task. For these reasons, we simply model the linkage through a single reduced-form parameter q that enters the indirect utility function and represents the present value of the payroll taxes paid in monetary terms. This indirect utility may be seen as the result from the maximization of a utility function $U(C_k, L_k)$, which depends on consumption C_k and employment L_k, under the constraint $C_k \leq w_k(1 + q\tau_k)L_k + R_k$, where R_k denotes non-labour income. The case with $q = 1$ represents fully salient linkage, i.e. a situation akin to the *quid pro quo* tax described in the classic public finance literature (Musgrave, 1968). The opposite polar case with $q = 0$ means that there is no linkage or that there is linkage but that future benefits are not perceived by workers because of lack of salience.

We model the extensive margin of labour supply by assuming that type-k workers have an indirect utility function $V(\tilde{w}_k, R_k) = V(w_k(1 + q\tau_k), R_k)$, which is increasing in their perceived wage $\tilde{w}_k$ and non-labour income R_k. The labour supply of a type-k worker can then be expressed as

$$L_k^S = L_k^S(\tilde{w}_k, R_k) = L_k^S(w_k(1 + q\tau_k), R_k), \qquad k = 1, \ldots, n. \qquad (A.1)$$

Denoting η_k^S the labour supply elasticity of workers of type k, we have

$$\eta_k^S \equiv \frac{\mathrm{d} \ln L_k^S}{\mathrm{d} \ln w_k} = (1 + q\tau_k)w_k \frac{l_k^S}{L_k^S}, \qquad k = 1, \ldots, n, \qquad (A.2)$$

where we use $l_k^S \equiv \partial L_k^S / \partial \tilde{w}_k$ to denote the partial derivative of the labour supply of type-k workers with respect to the perceived wage $\tilde{w}_k$. Since non-labour income R_k is assumed to be independent of payroll taxes, it will be omitted in future notations.

Definition of payroll tax pass-through: individual versus firm level. In our setup, we consider two groups of workers: treated workers (L_T), for whom employer payroll taxes change as the result of the reform being studied, and control workers (L_C), whose employer payroll taxes are unchanged.

We define the pass-through of employer payroll taxes to workers at the individual level as the pass-through of payroll taxes to the wages of treated workers relative to control workers. This corresponds to the main empirical specification in the paper. Pass-through

is understood at the individual level since the individual wages of the treated workers are directly affected by the change in payroll taxes.

We define the pass-through of employer payroll taxes to workers at the firm level as the pass-through of employer payroll taxes to control workers, i.e. to workers in a firm affected by the change in employer payroll taxes but whose labour cost is nominally unchanged by the reform under study. This tax shifting can be understood as firm-level pass-through in the sense that individual-level pass-through can be zero (no change in the relative wages of treated and control workers) while employer payroll taxes are shifted to all workers in the firm, whether treated or control.

A.2 Partial Equilibrium with Market Clearing and Linkage

We start by deriving the simple partial equilibrium formula for the pass-through of payroll taxes with tax-benefit linkage (Kotlikoff and Summers, 1987; Gruber, 1997).

The labour supply of workers of type k is given by equation (A.1). On the demand side, the partial equilibrium approach ignores possible substitutions between inputs and assumes that the labour demand for type-k workers depends only on their labour cost, i.e.

$$L_k^D = L_k^D(z_k) = L_k^D\Big(w_k(1 + \tau_k)\Big), \qquad k = 1, \dots, n. \tag{A.3}$$

Denoting η_k^D the labour demand elasticity of type-k workers, we have

$$\eta_k^D \equiv \frac{\mathrm{d}\ln L_k^D}{\mathrm{d}\ln w_k} = (1 + \tau_k)w_k \frac{l_k^D}{L_k^D}, \qquad k = 1, \dots, n,$$

where $l_k^D \equiv \partial L_k^D / \partial z_k$ denotes the partial derivative of the labour demand of type-k workers with respect to the labour cost z_k.

Totally differentiating the labour supply and demand conditions (A.1) and (A.3) yields

$$\mathrm{d}\ln(L_k^S) = \eta_k^S\Big(\mathrm{d}\ln w_k + \mathrm{d}\ln(1 + q\tau_k)\Big), \qquad k = 1, \dots, n,$$

and

$$\mathrm{d}\ln(L_i^D) = \eta_k^D\Big(\mathrm{d}\ln w_k + \mathrm{d}\ln(1 + \tau_k)\Big), \qquad k = 1, \dots, n,$$

where η_k^S and η_k^D are the labour supply and labour demand elasticities for type-k workers.

Equating variations in supply and demand and rearranging terms, we obtain the following formula for the pass-through rate of payroll taxes to workers:

$$\frac{\mathrm{d}\ln w_k}{\mathrm{d}\ln(1 + \tau_k)} = -\frac{\eta_k^D - q\frac{1 + \tau_k}{1 + q\tau_k}\eta_k^S}{\eta_k^D - \eta_k^S}, \qquad k = 1, \dots, n. \tag{A.4}$$

In the absence of tax-benefit linkage ($q = 0$), this expression simplifies to the standard incidence formula in which the pass-through rate of payroll taxes to workers depends solely on the relative magnitude of the labour supply and labour demand elasticities: if $|\eta_k^D| \gg |\eta_k^S|$, payroll taxes are fully passed through to workers; if $|\eta_k^D| \ll |\eta_k^S|$, the pass-through to workers is zero. With full linkage ($q = 1$), payroll taxes are fully passed through to workers irrespective of the labour demand and supply elasticities.

A.3   General Equilibrium in Competitive Labour Markets

In this section, we adapt Feldstein (1974)'s general equilibrium model of tax incidence to incorporate tax-benefit linkage in the analysis of the pass-through of payroll taxes to workers.

We assume a one sector model in which the representative firms' output is produced using two labour inputs (L_T and L_C) with constant returns to scale:

$$Y = F(L_T, L_C). \tag{A.5}$$

The assumption of perfectly competitive markets implies that both types of workers are paid their marginal products. Denoting F_T (resp. F_C) the partial derivative of the production function F with respect to L_T (resp. L_C), we have

$$F_T = w_T(1 + \tau_T), \tag{A.6}$$
$$F_C = w_C(1 + \tau_C). \tag{A.7}$$

The system is completed by the two labour supply equations:

$$L_T^S = L_T^S(\tilde{w}_T) = L_T^S\big(w_T(1 + q\tau_T)\big), \tag{A.8}$$
$$L_C^S = L_C^S(\tilde{w}_C) = L_C^S\big(w_C(1 + q\tau_T)\big). \tag{A.9}$$

We consider a small change in the rate of payroll taxes that applies to treated workers, $\mathrm{d}\tau_T$. The effects of this tax change on the equilibrium wages of treated and control workers can be analysed by totally differentiating equations (A.5) through (A.9):

$$F_{TT} \cdot \mathrm{d}L_T + F_{CT} \cdot \mathrm{d}L_C = \mathrm{d}w_T(1 + \tau_T) + \mathrm{d}\tau_T \cdot w_T, \tag{A.10}$$
$$F_{CT} \cdot \mathrm{d}L_T + F_{CC} \cdot \mathrm{d}L_C = \mathrm{d}w_C(1 + \tau_C), \tag{A.11}$$
$$\mathrm{d}L_T = l_T^S \cdot [\mathrm{d}w_T(1 + q\tau_T) + q\mathrm{d}\tau_T \cdot w_T], \tag{A.12}$$
$$\mathrm{d}L_C = l_C^S \cdot [\mathrm{d}w_C(1 + q\tau_C)]. \tag{A.13}$$

Note that because $F(\cdot, \cdot)$ is homogeneous of degree 1, the marginal products F_T and F_C

are homogeneous of degree 0. By Euler's theorem, this implies

$$F_{CT} = \frac{F_{TT} \cdot F_{CC}}{F_{CT}}. \tag{A.14}$$

Pass-through to treated workers. Using equation (A.14) to substitute for F_{CT} in the system formed by equations (A.10) to (A.13), one obtains the following expression for the change in the wage rate of treated workers resulting from a one percent change in the rate of payroll taxes that are levied on their wage:

$$\frac{\mathrm{d}\ln w_T}{\mathrm{d}\ln(1+\tau_T)} = \frac{1+\tau_T}{w_T} \cdot \frac{\mathrm{d}w_T}{\mathrm{d}\tau_T} = -\frac{\left[F_{CC} \cdot l_C^S \left(\frac{1+q\tau_C}{1+\tau_C}\right) - 1\right] + qF_{TT} \cdot l_C^S}{\left[F_{CC} \cdot l_C^S \left(\frac{1+q\tau_C}{1+\tau_C}\right) - 1\right] + \left(\frac{1+q\tau_T}{1+\tau_T}\right)F_{TT} \cdot l_T^S}. \tag{A.15}$$

This expression can be rewritten as a function of economically meaningful parameters. Let $\alpha_T \equiv (1+\tau_T)w_T L_T/Y$ denote the labour share of treated workers. Using Euler's equations, the local elasticity of substitution between treated and control workers, which we denote by σ, can be shown to satisfy the following equations:[1]

$$\sigma = -\frac{(1+\tau_T)w_T(1-\alpha_T)}{F_{TT} \cdot L_T} \tag{A.16}$$

and

$$\sigma = -\frac{(1+\tau_C)w_C\alpha_T}{F_{CC} \cdot L_C}. \tag{A.17}$$

Using equation (A.2) to replace the labour supply elasticities of treated and control workers in the elasticity of substitution formulas (A.16) and (A.17) yields

$$F_{TT} \cdot l_T^S \left(\frac{1+q\tau_T}{1+\tau_T}\right) = -(1-\alpha_T)(\eta_T^S/\sigma) \tag{A.18}$$

and

$$F_{CC} \cdot l_C^S \left(\frac{1+q\tau_C}{1+\tau_C}\right) = -\alpha_T(\eta_C^S/\sigma). \tag{A.19}$$

Plugging equations (A.18) and (A.19) into (A.15) and rearranging terms yields the following formula for the pass-through rate of payroll taxes to treated workers:

$$\frac{\mathrm{d}\ln w_T}{\mathrm{d}\ln(1+\tau_T)} = -\frac{1+\alpha_T(\eta_C^S/\sigma) + q\left(\frac{1+\tau_T}{1+q\tau_T}\right)(1-\alpha_T)(\eta_T^S/\sigma)}{1+\alpha_T(\eta_C^S/\sigma) + (1-\alpha_T)(\eta_T^S/\sigma)}. \tag{A.20}$$

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[1]Note that the derivations do not require a constant labour share α_T (as would be the case for a Cobb-Douglas production function) nor a constant elasticity of substitution (as for a CES production function); these parameters are only used to describe a local property of the production function in the neighbourhood where the economy is operating when the tax change is introduced.

Full tax-benefit linkage ($q = 1$) implies that payroll taxes are entirely shifted to treated workers. In the absence of linkage ($q = 0$), the pass-through rate depends on the relative magnitudes of the labour supply elasticities of treated and control workers, η_T^S and η_C^S, and the elasticity of substitution between worker types, σ. If σ is very large relative to η_T^S and η_C^S, changes in payroll taxes are full passed through to treated workers. If, instead, $\eta_T^S \approx \eta_C^S \gg \sigma$, payroll taxes are passed through to treated workers in proportion of their share α_T in total output.

Pass-through to control workers. Using similar calculations as for the treated workers, we obtain the following formula for the pass-through of treated workers' payroll taxes to control workers:

$$\frac{\mathrm{d} \ln w_C}{\mathrm{d} \ln (1 + \tau_T)} = -\frac{\alpha_T (\eta_T^S / \sigma) \left(\frac{1-q}{1+q\tau_T} \right)}{1 + \alpha_T (\eta_C^S / \sigma) + (1 - \alpha_T)(\eta_T^S / \sigma)}. \tag{A.21}$$

Full tax-benefit linkage ($q = 1$) implies that control workers' wages are unaffected by changes in treated workers' payroll taxes. In the absence of linkage ($q = 0$), the pass-through to control workers depends on the relative magnitude of the labour supply elasticities of treated and control workers, η_T^S and η_C^S, and the elasticity of substitution between both types of workers, σ. If σ is very large relative to η_T^S, the wages of control workers are unaffected by changes in treated workers' payroll taxes. In the case where $\eta_T^S \approx \eta_C^S$, the pass-through to control workers simplifies to $\alpha_T / (1 + \sigma / \eta_T^S)$. In this case, when labour supply elasticities are large relatively to σ, treated workers' payroll taxes are shifted to control workers in proportion of the labour share of treated workers α_T in total output.

Individual-level pass-through (relative wages). Combining equations (A.20) and (A.21) yields the following formula for the pass-through of an increase in the payroll taxes of treated workers to the relative wages of treated and control workers, which is the parameter that we estimate in our empirical analysis:

$$\frac{\mathrm{d} \ln \left(\frac{w_T}{w_C} \right)}{\mathrm{d} \ln (1 + \tau_T)} = -\frac{1 + \alpha_T (\eta_C^S / \sigma) + \left(q \left(\frac{1+\tau_T}{1+q\tau_T} \right) - \alpha_T \right) (\eta_T^S / \sigma)}{1 + \alpha_T (\eta_C^S / \sigma) + (1 - \alpha_T)(\eta_T^S / \sigma)}. \tag{A.22}$$

Full tax-benefit linkage ($q = 1$) implies a 100% pass-through of treated workers' payroll taxes to the wage ratio between treated and control workers. In the absence of linkage ($q = 0$), the pass-through rate depends on the relative magnitudes of the labour supply elasticities of treated and control workers, η_T^S and η_C^S, and the elasticity of substitution between worker types, σ. If σ is very large, changes in treated workers' payroll taxes are fully passed through to the relative wages of treated workers. If $\eta_T^S \approx \eta_C^S \gg \sigma$, the relative wages of treated and control workers are unaffected by the tax change.

In the special case where the labour supply elasticities of treated and control workers are equal (i.e. $\eta_T^S = \eta_C^S = \eta^S$), the above pass-through formulas simplify to

$$\frac{d\ln w_T}{d\ln(1+\tau_T)} = -\frac{\sigma + \eta^S\left[\alpha_T + q\left(\frac{1+\tau_T}{1+q\tau_T}\right)(1-\alpha_T)\right]}{\sigma + \eta^S} \approx -\frac{\sigma + \eta^S\left[\alpha_T + q(1-\alpha_T)\right]}{\sigma + \eta^S}, \quad (A.23)$$

$$\frac{d\ln w_C}{d\ln(1+\tau_T)} = -\frac{\eta^S \cdot \alpha_T\left(\frac{1-q}{1+q\tau_T}\right)}{\sigma + \eta^S} \approx -\frac{\eta^S \cdot \alpha_T(1-q)}{\sigma + \eta^S}, \quad (A.24)$$

$$\frac{d\ln\left(\frac{w_T}{w_C}\right)}{d\ln(1+\tau_T)} = -\frac{\sigma + \eta^S \cdot q\left(\frac{1+\tau_T}{1+q\tau_T}\right)}{\sigma + \eta^S} \approx -\frac{\sigma + \eta^S \cdot q}{\sigma + \eta^S}, \quad (A.25)$$

where the approximations hold when the payroll tax rate τ_T is small. Equation (A.25) corresponds to equation (1) in the main text and clarifies the theoretical interpretation of our empirical estimates when a competitive labour market equilibrium is assumed (ignoring capital as well as interactions with the product market). Note that this relatively simple expression for the pass-through of employer payroll taxes to relative wages does not require a specific functional form for the production function as it holds for any function with constant returns to scale.

Quantity responses. The effects of a change in the payroll tax rate of treated workers on employment levels for both worker types can be derived from equations (A.12) and (A.13) using the above pass-through formulas. In the special case where labour supply elasticity is equal across worker types ($\eta_T^S = \eta_C^S = \eta^S$), the employment effects are given by:

$$\frac{d\ln L_T}{d\ln(1+\tau_T)} = -\frac{\eta^S\left(\frac{1-q}{1+q\tau_T}\right)(\sigma + \eta^S\alpha_T)}{\sigma + \eta^S} \approx -\frac{\eta^S(\sigma + \eta^S\alpha_T)(1-q)}{\sigma + \eta^S}, \quad (A.26)$$

$$\frac{d\ln L_C}{d\ln(1+\tau_T)} = -\frac{(\eta^S)^2\alpha_T\left(\frac{1-q}{1+q\tau_T}\right)}{\sigma + \eta^S} \approx -\frac{(\eta^S)^2\alpha_T(1-q)}{\sigma + \eta^S}, \quad (A.27)$$

$$\frac{d\ln\left(\frac{L_T}{L_C}\right)}{d\ln(1+\tau_T)} = -\frac{\sigma \cdot \eta^S\left(\frac{1-q}{1+q\tau_T}\right)}{\sigma + \eta^S} \approx -\frac{\sigma \cdot \eta^S(1-q)}{\sigma + \eta^S}. \quad (A.28)$$

Under full tax-benefit linkage ($q = 1$), changes in the payroll tax rate of treated workers have no impact on the employment levels of treated and control workers. In the absence of linkage ($q = 0$), employment effects depend on the relative magnitude of the labour supply elasticity, η^S, and the elasticity of substitution between worker types, σ. If $\sigma \gg \eta^S$, a 1% increase in the payroll tax rate or treated workers reduces the employment of treated workers by $\eta^S\%$, while the employment level of control workers remains unchanged. Conversely, if $\eta^S \gg \sigma$, the same 1% increase in the payroll tax rate of treated workers reduces their employment by $(\sigma + \eta^S\alpha_T)\%$ and that of control workers by $\eta^S\alpha_T\%$, implying a relative employment decline of $\sigma\%$ for treated workers relative to control workers.

Firm-level pass-through (impact on control workers). Firm-level shifting of payroll taxes with limited effects on the relative wages of treated and control workers cannot be easily rationalized within the standard competitive labour market model. To simplify the discussion, we consider the special case where the elasticity of labour supply is constant across worker types, i.e. $\eta_T^S = \eta_C^S = \eta^S$. It follows immediately from equation (A.24) that in the case of full tax-benefit linkage ($q = 1$), the wages of control workers are not affected by a change in the tax levied on treated workers.

Let us now assume no linkage ($q = 0$). Equation (A.24) shows that the extent to which a tax change for treated workers is passed through to control workers depends on the labour share of treated workers, α_T, and the relative magnitude of the elasticity of substitution, σ, and of the labour supply elasticity, η^S. The wage of control workers will respond only if the labour share of treated workers, α_T, is large enough and if σ is not too large relative to η^S. Assuming a labour supply elasticity of 0.5,[2] our pass-through estimates for Reforms NL1 (0.25), NL2 (0.44) and NL3 (-0.06) would imply implausibly low values of the elasticity of substitution between treated and control workers, between -0.03 and 0.39. As a matter of comparison, elasticities of substitution between skilled and unskilled workers (college and high-school equivalents) in the U.S. have been estimated to be around 1.5 (e.g. Autor et al., 2008) and to be even larger in France, with estimates ranging from 2 to almost 4 (Charnoz et al., 2011; Verdugo, 2014). Our treated and control workers are likely to be better substitutes than college and high-school equivalents in empirical studies of the skill premium. Indeed, the pre-reform gap between the average wages of these workers is around 25%, whereas the wage gap between college and high-school equivalents in France is around 50%. Based on equation (A.25), this observation leads us to conclude that the limited pass-through of employer payroll taxes to the relative wages of treated and control workers found in the cases of Reforms NL1, NL2, and NL3 is difficult to reconcile with the standard competitive model of the labour market—unless implausible assumptions are made regarding the elasticity of substitution between both types of workers. Similarly, our formula for the pass-through to control workers (equation A.24) makes a large pass-through to control workers hardly plausible in the context of the standard model.

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[2]Labour supply elasticity estimates are numerous and vary widely (Blundell and MaCurdy, 1999). The estimate of 0.5 is taken from the meta-analysis by Chetty (2012). For France, available estimates are lower, between 0.1 and 0.3 (Bourguignon and Magnac, 1990).

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B Perceptions of the Payroll Tax Reforms

In this appendix, we provide a comprehensive account of the information extracted from archives belonging to press outlets and unions concerning the reforms under investigation.

B.1 L1: Pension Payroll Tax Increase for Non-Executives (1996)

Press articles.   Reform L1 was decided in an agreement from 25 April 1996. It affected payroll taxes for the pension scheme of non-executives (ARRCO). The majority of press articles discussing this reform highlight the fact that it secured approval from a majority of labour unions, with the notable exception of the *Confédération Générale du Travail* (C.G.T.), historically affiliated with the French Communist Party. The agreement saw the endorsement of *Force Ouvrière* (F.O.), the *Confédération Française Démocratique du Travail* (C.F.D.T.), the *Confédération Générale des Cadres* (C.G.C.), the *Confédération Française des Travailleurs Chrétiens* (C.F.T.C.), and the employer federation *Conseil National du Patronat Français* (C.N.P.F.).[3] A prevailing theme in the press is that the agreement resulted in a reduction in to the rate of return for these schemes. For instance, an article from *Les Échos* stresses that "100 Francs of contribution are offering today (...) 8.94 Francs of pension, and the reform will lead to a reduction to 7.20 Francs of pension."[4]

Most newspaper articles suggest that the positive counterpart of the reduction in the returns to pension contribution was the planned increase in contributions for individuals with earnings above the Social Security threshold. For instance, an article from *Le Monde*

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[3]"Tous d'accord sauf la CGT sur les retraites complémentaires," *Libération*, April 27, 1996.

[4]"Retraites complémentaires: négociations pour un accord à l'arraché," *Les Échos*, 26 April 1996.

states that "the agreement also includes the provision that wage earners whose wage exceeds the Social Security threshold would be able to secure a better pension for themselves: The contribution rate is set to increase to 16% by 2005 for employees of existing firms, and as early as 2000 for firms established after 1 January 1997."[5]

Archives from the C.F.D.T. union. We were granted access to the archives of the C.F.D.T. union, where we had the opportunity to review all internal documents as well as materials such as documents, leaflets, or magazines directed towards C.F.D.T. members.

In a document specifically addressing pension benefits for union members,[6] the agreement on the complementary schemes AGIRC-ARRCO, dated 25 April 1996, is outlined under the title "Improving Pension Rights". The document further details the increase in payroll tax contributions as follows: "*Commencing from 1 January 2000, for existing firms and January 1, 1997, for new firms, the mandatory social security contribution rate will gradually rise to 16%, as opposed to the previous rate of 6%, applicable to the portion of the wage exceeding the Social Security threshold. **This measure will enable non-executives to increase their pension benefits above the threshold by a factor of 2.66.** Firms have the option to implement this measure immediately.*"

In one of the union's magazines, the agreement is advocated as a commendable compromise: "*The agreement is aimed at ensuring the financial balance of the schemes until the year 2005. It does not involve any reduction in pension rights already acquired or pension benefits already claimed. The reduction pertains to the volume of pension rights to be allocated in the future. The C.F.D.T. obtained a reduction of these cuts in pension rights and a more gradual implementation.*" The text proceeds to highlight the positive aspects of this compromise, particularly the increase in payroll tax rates above the threshold: "*The agreement also incorporates numerous positive elements that are significant in terms of additional pension rights for future retirees. For non-executives, this involves the implementation of a rate of 16% for wages above the Social Security threshold.*" When detailing the measures, the article underscores the enhancement in future pensions attributed to the advocacy of the C.F.D.T. union: "*From 1 January 1997, for new companies and from 1 January 2000, for existing companies, non-executive employees and their companies will gradually contribute 16% (instead of 6%) of the salary above the Social Security threshold. **This demand from the C.F.D.T. will allow non-executives to enhance their future pensions and will result in increased pay compensations for employers.***"[7]

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[5]"La baisse des retraites complémentaires est programmée," *Le Monde*, 27 April 1996.

[6]*Bulletin du Retraité CFDT*, No. 140, July August-September 1996.

[7]*Le retraité militant CFDT*, No. 96.06, June 1996, pp. 6–8.

B.2   L2: Pension Payroll Tax Increase for Executives (1988)

Reform L2, established in an agreement from 24 March 1988, raised the upper threshold for payroll taxation from 4 times the SST to 8 times the SST. As a result, previous voluntary complementary pensions schemes for those earning levels, specifically IRICASE, IRCASUP, and the *Caisse des cadres supérieurs du bâtiment et des travaux publics* (CCSBTP), were incorporated into the AGIRC scheme. Importantly, the capital funds from these previous schemes were transferred to the AGIRC fund.

There are few press articles covering this reform, which impacted a very small group of highly paid wage earners. The daily newspaper *Le Monde* portrayed the debate surrounding the reform primarily as a conflict within employer unions. The insurance industry, opposed to the reform, argued against it, while the rest of the employers favoured providing additional pensions to their top-paid executives. The insurance industry contended that mandating pension payroll taxes for high earners would diminish the incentives for saving through private pension funds, thereby reducing capital accumulation. Consequently, the head of the employer unions, who was also the CEO of a major insurance firm, resigned from his leadership role in the employer union.[8]

B.3   NL1: Increase in Family Payroll Tax (1989)

The announcement made by the French Prime Minister Michel Rocard in September 1988 to remove the cap on the employer payroll tax for family benefits was part of a broader policy initiative known as the "Plan Emploi," aimed at combating unemployment. The public debate pitted employer organisations and executives' unions, critical of the reform, against other labour unions that supported the idea of higher contributions for firms employing higher-paid workers.[9] We have come across press articles addressing the potential incidence or impact on the wages of workers earning above the Social Security threshold. However, the debate between employee unions (executives versus non-executives) suggests a concern that the reform might affect the wages of those in higher-paid positions.

B.4   NL2: Increase in Health Care Payroll Tax (1981)

On 12 November 1981, the newspaper *Le Monde* covered the political debate sparked by the French government's announcement to raise the health care payroll tax.[10] Alain Bocquet, a French MP from the Communist Party, expressed disapproval of the 1% increase in employee payroll taxes across all earnings. However, he endorsed the increase

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[8]"L'accord sur les retraites des cadres a été signé. Le président de la Fédération des assurances abandonne ses fonctions au CNPF", *Le Monde*, 3.26.1988.

[9]"Incertitudes autour de l'effet sur l'emploi du déplafonnement des cotisations familiales," *Le Monde*, 8.9.1988.

[10]"Solidarité nationale : M. Bocquet (P.C.) proteste contre l'augmentation des cotisations de la Sécurité sociale," *Le Monde*, 12.11.1981.

in employer payroll taxes, stating, "*Il faut faire payer les patrons!*" (You have to make the bosses pay!). In contrast, the centre-right opposition criticised the payroll tax hikes targeting firms, with one MP from the U.D.F. (centre-right party) remarking, "*On ne peut faire mieux en matière de politique anti-emploi*" (You can't do better in terms of anti-job policy). In another article, *Le Monde* reports on the negative reactions from most labour unions.[11] The majority of unions criticised the government's plans, particularly the increase in employee payroll taxes across all earnings. Employer organisations also strongly opposed the rise in employer payroll taxes. The article further highlights the inconsistency of uncapping employer payroll taxes during a period of high unemployment, pointing out the anticipated adverse effects on investment and employment decisions.

Following the announcement of the payroll tax increases, a contentious debate unfolded between the government and employer organisations. In an article from *Le Monde*, the minister in charge, Nicole Questiaux, is quoted as stating, "*The financial measures were chosen with the goal of combating unemployment. The decision to increase employers' payroll taxes exclusively above the Social Security threshold is justified by our intention to protect what are referred to as labour-intensive companies.*"[12]

B.5   NL3: Employer Tax Credit on Payroll Taxes (2013)

Reform NL3 was introduced following the release of a report commissioned by the French government from Louis Gallois, a former CEO of major industrial firms. The report, titled *Pacte pour la compétitivité de l'industrie française* (Pact for the Competitiveness of French Industry), was published in November 2012. It proposed various measures, including a recommendation to reduce payroll taxes by a total of 30 billion euros for wages up to 3.5 times the minimum wage. It also suggested shifting these contributions to other tax bases (such as VAT or the flat-rate income tax CSG) while simultaneously reducing public spending. Shortly after the report's publication, the government announced its intention to implement most of the recommended measures. This included the introduction of a tax credit calculated on the payroll of wage earners up to 2.5 times the minimum wage.

The debate surrounding the reform in the press focused less on employee and employer unions and more on political parties, as the National Assembly was responsible for discussing and voting on the reform. Within the left-leaning majority, many MPs expressed concerned about giving a "blank check" to firms without any counterparts.[13] On the other hand, right-leaning MPs, who opposed the government, were divided over whether to support this employer payroll tax cut.[14] Meanwhile, the main employer union emphasized the necessity of maintaining the tax credit up to 2.5 times the minimum wage without any

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[11]"Réactions hostiles du patronat et des syndicats. Les retombées amères de la solidarité," *Le Monde*, 12.11.1981.

[12]"La polémique se poursuit sur les charges des entreprises," *Le Monde*, 11.21.1981

[13]"Compétitivité: bronca dans les rangs socialistes sur le crédit d'impôt," *Le Monde*, 11.28.2012.

[14]"A l'Assemblée, la droite souligne les faiblesses du crédit d'impôt," *Le Monde*, 12.5.2012.

reduction.[15] The fact that the payroll tax cut was legislated as a tax credit strengthened the perception that it would not impact future benefits.

B.6 NL4: Increase in Flat-Rate Income Tax CSG (1997)

The introduction of Reform NL4 in 1997 was motivated by the need to increase tax revenues across a broad income base. As a result, the increase of the flat-rate income tax CSG impacted all forms of income, including labour and capital income, as well as most income types previously exempt from taxation (such as pensions, tax-free savings schemes, profit-sharing schemes). The combination of a reduction in employee payroll taxes and an increase in the CSG essentially resulted in a net increase in taxation, lowering the taxation of earnings subject to payroll taxes while raising it for all other income that was formerly taxed at a lower rate. Press reports from that period emphasized that this change would impact all individuals with either capital income or tax-free savings. In *Le Monde*, the reform's philosophy was described as "taxing less labour income and more capital income" and was noted for enjoying broad political support.[16]

C   Data Sources

C.1   Earnings Data

DADS panel data.   Our primary data source is the matched employer–employee DADS (*Déclaration Annuelle de Données Sociales*) Panel, developed by the French Institut National de la Statistique et des Études Économiques (INSEE). This panel is constructed from the mandatory annual declarations submitted by all employers for each of their employees.

The DADS Panel comprises a 1/25th sample of private sector employees born in October of even-numbered years, starting from 1976. In 2002, the sample size was doubled to represent 1/12th of all private sector workers. The dataset include approximately 1.1 million workers annually between 1976 and 2001, and 2.2 million workers from 2002 onwards. Some original data sources are currently unavailable for certain years (1981, 1983, and 1990), leading to missing data in the panel.

Earnings definition.   The DADS Panel provides only one measure of annual earnings that remains consistent over the entire period: net taxable earnings, as reported to tax authorities by employers (variable SN). Net taxable earnings represent earnings after deduction of Social Security contributions but before deduction of the non-income-tax-deductible component of flat-rate contributions, namely the *Contribution sociale généralisée* (CSG) and the *Contribution au remboursement de la dette sociale* (CRDS).

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[15]"Le gouvernement peaufine son crédit d'impôt pour la compétitivité," *Les Echos*, 11.27.2012.

[16]"La contribution sociale généralisée bénéficie d'un consensus politique," *Le Monde*, 6.9.1997.

From 1993 onwards, the panel includes additional earnings variables: the CSG tax base for gross earnings (variable `SB`) and net earnings (variable `NETNET`). Before 1993, INSEE provides an estimate of gross earnings based on the reported net taxable earnings, but gross earnings for payroll tax purposes are not available in the data released by INSEE. Net earnings correspond to the amount effectively paid by firms to employees after deduction of specific employee contributions to restaurant vouchers or public transport passes, but before payment of the income tax.

As a result, we use the only raw information available throughout the entire period, i.e. net taxable earnings, and employ our microsimulation model to compute gross (posted) earnings, as well as labour costs inclusive of employer payroll taxes.

Multiple employers. The DADS data offers details on all job spells for each worker in the sample. For individuals with multiple employers, we calculate the total earnings by summing up earnings across all employers, as the payroll tax rate is determined based on the total annual earnings.

C.2 Micro-Simulation of Payroll Taxes

TAXIPP model. Microsimulation techniques are required to compute the individual-level labour cost based on the information available in the DADS Panel data. Our study relies on the TAXIPP model developed at the Institut des Politiques Publiques (IPP), specifically leveraging the payroll tax module. This model takes as input the payroll tax schedule as input, source from the IPP Tax and Benefit Tables,[17] and computes employee and employer payroll taxes, reductions in employer payroll taxes, flat-rate income tax (CSG and CRDS), and other payroll taxes. The TAXIPP model simulates the complexity of French payroll taxes in great detail, including local Social Security schemes such as the one in place in the Alsace-Moselle region.

Identification of private sector firms. We identify private sector firms based on the variable `ST` (i.e. status), which categorises firms according to their public or private ownership. However, a challenge arises from the waves of privatization and nationalizations experienced by several large firms in the 1980s. For instance, in 1986, the centre-right government executed a large-scale privatization of major state-owned companies, which was partly reversed in 1988, before another wave of privatization occurred in 1993. Consequently, some firms end up classified in the private sector while they were originally in the public sector (and vice versa). To address this issue, we restrict our sample to firms consistently identified as private sector entities throughout the entire period. This restriction ensures the exclusion of large utilities and certain publicly-owned firms that underwent privatization during the specified period.

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[17]http://www.ipp.eu/en/ipp-tax-and-benefit-tables/social-security-contributions/.

Identification of the applicable Social Security threshold.   The Social Security threshold (SST) is defined for the pay period and the number of hours worked as specified in the employment contract. However, because we lack information on the number of hours worked before 1993, determining the SST for individuals working part-time during that period is not feasible. To address this, we identify individuals working full-year based on the duration of the job spell (variable DP or *durée de paie*). Additionally, we identify full-time workers using the variable CE (or *condition d'emploi*), available throughout the entire period. From 1993 onwards, we leverage the effective number of hours worked (variable NBHEUR) to precisely determine the SST applicable to each worker, including those working part-time or less than a full year.

For individuals with multiple jobs, we aggregate earnings and job spells, as payroll taxes are calculated based on the total remuneration across all jobs.

Firms created after 1997.   For the implementation of Reform L1, the ARRCO agreement of April 1996 specified that firms created from 1997 onwards would experience a faster increase in the payroll tax rate compared to existing firms. Specifically, firms established after 1996 were subject to the maximum employer payroll tax rate of 12% as early as 2000, whereas pre-existing firms reached the maximum rate in 2005.

The phasing-in of Reform L1 means that we need to identify the date of firm creation to accurately apply the payroll tax schedule. We take advantage of another version of the DADS data, the DADS Postes, which is available since 1993 and covers the universe of all private sector employees and the firms in which they work. We construct a panel of firms using data from 1996 to 2008, which enables us to identify firms created from 1997 onwards. We then match this information with the DADS Panel data using each firm's unique identifier.

Identification of executives (*cadres*).   The DADS data do not explicitly indicate the complementary pension scheme to which the wage earner is affiliated (either ARRCO for non-executives or AGIRC for executives). We proxy each worker's status by relying on the information provided by the employer on the employee's occupation. In most instances, identification is straightforward, as the occupation label explicitly mentions the title "executive" (*cadre*). However, classification becomes more uncertain for certain occupation categories that could be interpreted either within or outside the executive group. To mitigate classification errors, we exclude from the sample workers with such ambiguous occupations. Additionally, apprentices and interns, who are not subject to regular payroll taxes, are also excluded from the sample.

The 35-hour week reform.   The DADS data lack specific information on the precise date when firms transitioned to the 35-hour week in the early 2000s, a factor influencing eligibility for certain payroll taxes reductions. To estimate this date, we rely on the

reported working hours for each firm. By calculating the share of the firm's employees declared as working 35 or 39 hours, we determine the highest share and assign each firm to the corresponding weekly working hours regime.

Validation of the labour cost simulation. To validate our labour cost simulation, we compared our simulated gross earnings (zh) with the exact variable used as the tax base for employee payroll taxes. This variable, introduced in the data in 1996, is available for later years but does not cover all our reforms. For this comparison, we used the 2017 data from the DADS panel, analysing the true gross earnings measure[18] against the gross earnings simulated with TAXIPP. The difference between the logarithm of the simulated earnings and the logarithm of true earnings is centred close to zero, with most deviations falling within a 2% margin of error.

Validating the accuracy of our simulation of employer payroll taxes (and, therefore, labour cost) is somewhat more intricate, as the linked employer–employee data never include them. However, we can assess the alignment of firm-level aggregates with what firms declare in their corporate income tax (CIT) returns (BIC-IS data source, DGFiP). To perform this comparison, we applied the TAXIPP micro-simulation model to the exhaustive linked employer–employee data (DADS Postes) for the year 2017. From the linked employer–employee data, we retain private sector employers and derive firm-level aggregates for gross earnings (exact) and labour costs (simulated), with employer payroll taxes calculated as the difference between these aggregates. In the CIT data, the exact wage bill and employer payroll taxes of each firm are recorded.

We select firms in the CIT data that are subject to the normal CIT regime, and whose fiscal exercise runs between the 1st of January and the 31st of December. While there are potential reasons for differences in total gross wages between the CIT data and the DADS data, such as the treatment of profit-sharing and amounts distributed in the context of incentive plans, we can still compare employer payroll taxes when total gross earnings align between both sources. This allows us to evaluate the accuracy of our simulation.

To ensure a meaningful comparison, we narrow our focus to firms with total gross earnings differing by less than 5 percentage points in the DADS and CIT data. The correlation between data sources for employer payroll taxes is 98%, with a rank-correlation also at 98%. To account for potential differences due to temporary workers from staffing agencies (not present in the DADS data), we further refine the sample to include only main positions (*emplois non annexes*) and repeat the comparison. Tn this refined sample the correlation increases to 99.4%, while the rank-correlation remains at 98%.

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[18]The corresponding variable is `BASCSG` in the DADS data.

D   Meta-Analysis of Payroll Tax Incidence

Table D1 – Meta-Analysis: Regression Estimates

| Estimates: | Dep. var.: estimated pass-through of payroll tax to workers | | | |
| | This paper | This paper + literature review | | |
	(1)	(2)	(3)	(4)
Panel A. Payroll taxes statutorily incident on employers				
Constant	0.253	0.070**	0.076**	−0.085
	(0.131)	(0.028)	(0.032)	(0.095)
Tax-benefit linkage				
None	ref.	ref.	ref.	ref.
Strong	0.760**	0.851***	0.738***	1.002***
	(0.132)	(0.100)	(0.228)	(0.101)
Uncertain		0.647***	0.514**	0.240
		(0.062)	(0.233)	(0.155)
Controls				
Time period FEs			Yes	Yes
Region FEs			Yes	Yes
Unit of observation				Yes
Macroeconomic conditions				Yes
Labour market conditions				Yes
N	5	26	26	26
Panel B. Payroll taxes and income taxes statutorily incident on employees				
Constant	0.887	0.850***	0.858***	
	(.)	(0.076)	(0.055)	
Tax-benefit linkage				
None	ref.	ref.	ref.	
Strong	0.119	0.156*	−0.164	
	(.)	(0.076)	(0.269)	
Controls				
Time period FEs			Yes	
Region FEs			Yes	
N	3	8	8	

Notes: This table reports the results of meta-regression analyses of the literature on payroll tax incidence. Column 1 uses only the pass-through estimates reported in this study, while Columns 2–4 additionally include estimates found in the literature and listed in Appendix Table D2. The models are linear regressions where the dependent variable is the study-specific pass-through estimate, and the observations are weighted by the inverse of the estimate's variance. The control variables include time period fixed effects, referring to the decade in which the analysed period begins (1970s, 1980s, 1990s, 2000s, 2010s), region fixed effects (U.S., Europe, Rest of the world), the unit of observation of the analysis (worker, firm, market level), the country's macroeconomic conditions (GDP growth and inflation rate) and its labour market conditions (unemployment rate, OECD indicator of strictness of employment protection legislation, union density, rate of collective bargaining coverage, and whether wage negotiations take place at the firm level). The control variables are computed as means over the post-reform years considered in each study, and all control variables are mean-centred. Robust standard errors are shown in parentheses. In Column 4, an arbitrary value is assigned to missing values for the OECD indicators of strictness of employment protection legislation and union density, and dummy variables are included to control for missing values. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Sources: The studies used in the meta-analysis are described in Appendix Table D2. The control variables are sourced from publicly available data. GDP growth and inflation rates are obtained from the World Bank database, while inflation rates for Argentina come from the Argentinean Central Bank. Data on the strictness of employment protection legislation, collective bargaining rates, firm-level wage negotiation, and union density are drawn from the OECD database. Unemployment rates are obtained from the OECD for Japan, Sweden, the U.K., and the U.S.; the World Bank for Argentina, Colombia, Finland, Greece, and Singapore; and INSEE for France.

Table D2 – Summary of Empirical Studies of Payroll Tax Incidence using Micro Data

Study	Country	Payroll Tax/Reform	Tax-benefit linkage?	Method	Unit of observation	Estimated rate of pass-through to workers
Panel A. Payroll taxes statutorily incident on employers						
Gruber and Krueger (1991)	U.S.	Expansion of workers' compensation insurance programme between 1979 and 1988	Strong	DD: variation in workers' compensation rates across states and over time	Worker	0.865 (0.184) (Table 5, Column 7)
Gruber (1994)	U.S.	State and federal mandated maternity benefits between 1975 and 1979	Strong	DDD: variation in cost of mandate between different groups of workers across states and over time	Worker	1.56 (0.80) (Table 5, Column (iii))
Gruber (1997)	Chile	Reduction in employer payroll taxes after privatization of Social Security system in 1981	Strong	DDD: variation in payroll tax rates between white-collar and blue-collar workers across firms over time	Firm	1.022 (0.180) (Table 3, Column 1)
Anderson and Meyer (1997)	U.S.	Unemployment insurance between 1978 and 1984	Uncertain	DD: variation in unemployment insurance tax rates across firms over time	Firm	0.715 (0.292) (Table 3, Column 1)
Anderson and Meyer (2000)	U.S.	Adoption of experience-rated unemployment insurance by Washington State in 1985	Uncertain	DD: variation in unemployment insurance tax rates across firms over time	Worker	1.427 (1.191) (Table 3, Column 1)
Komamura and Yamada (2004)	Japan	Introduction of mandatory long-term care insurance in 2000	Yes (health insurance) No (long-term care)	DD: variation in employers' contribution rates to health insurance and long-term care insurance over time	Firm	Health insurance: 1.20 (0.2) Long-term care insurance: 0.2 (0.2) (Tables 1 and 2, FE model)
Baicker and Chandra (2006)	U.S.	Employer-provided health insurance between 1996 and 2002	Strong	IV: malpractice payments used as instrumental variable for health premiums	Worker	Covered workers: 1.00 (0.20) Non-covered workers: −0.15 (0.30) (based on Table 4, Columns 1 and 3)[a]
Murphy (2007)	U.S.	Unemployment insurance between 1992 and 2002	Uncertain	DD: variation in unemployment insurance tax rates across firms over time	Worker	0.23 (1.01) (Table 6, Panel A, Column 3)
Bennmarker, Mellander and Öckert (2009)	Sweden	Payroll tax reduction in Northern Sweden in 2002	None	DD: reform-induced variation in payroll taxes between target and control regions and over time	Firm	0.23 (0.08) (Table 4, Column 3)
Korkeamäki and Uusitalo (2009)	Finland	Payroll tax reduction in Northern Finland between 2003 and 2005	None	DD: reform-induced variation in payroll taxes between target and control regions and over time	Firm	0.49 (0.24) (based on Table 7, Column 2)[b]
Kugler and Kugler (2009)	Columbia	Sharp increase in payroll taxes for pensions and health following the 1993 Social Security reform	None	DD: variation in payroll tax rates across firms over time	Firm	0.2346 (0.0883) (Table 3, Column 1)
Cruces, Galiani and Kidyba (2010)	Argentina	Reform mandating new fully funded pension system in 1993	Strong	DD: variation in payroll taxes across geographical areas and over time	Area-level aggregates	0.501 (0.192) (Table 4, Column 2)
Saez, Matsaganis and Tsakloglou (2012)	Greece	Cohort-based payroll tax increase in 1992	None	RDD: based on date of entry in the labour force	Worker	0.295 (0.182) (based on Table 5, Column 1)[c]
Lehmann, Marical and Rioux (2013)	France	Reduction of payroll tax around the minimum wage between 2003 and 2006	None	IV: regression using predicted change in tax rates	Worker	0.134 (0.260) (based on Table 2, Column 3)[d]

Study	Country	Payroll Tax/Reform	Tax-benefit linkage?	Method	Unit of observation	Estimated rate of pass-through to workers
Panel A. Payroll taxes statutorily incident on employers (continued)						
Egebark and Kaunitz (2018)	Sweden	Payroll tax reduction for young workers (aged 26 or less) in 2009	None	DD: variation in payroll tax rates between age groups and over time	Worker	0.073 (0.022) (based on Table 6, Column 3)[e]
Adam, Phillips and Roantree (2019)	U.K.	Reforms of National Insurance Contributions between 1982 and 2015	None	IV regression using predicted change in tax rates	Worker	−0.009 (0.109) (based on Table 3, Column 6)[f]
Saez, Schoefer and Seim (2019)	Sweden	Payroll tax reduction for young workers (aged 26 or less) between 2007 and 2009	None	DD: variation in payroll tax rates between age groups and over time	Worker	Medium-run: −0.085 (0.046) (based on Table 1, Panel A)[g]
Benzarti and Harju (2021)	Finland	Different payroll tax rates across firms before 2010	None	RDD based on capital depreciation threshold	Firm	0.237 (0.427) (based on Table 2, Column 1)[h]
Kim, Kim and Koh (2022)	Singapore	Payroll tax reduction when workers turn 60	Strong	RDD: variation in payroll tax rates at age 60	Worker	Medium-run: 0.825 (0.35) (based on p. 11 and Table 4)[i]
Panel B. Payroll and income taxes statutorily incident on employees						
Bingley and Lanot (2002)	Denmark	Variation in income tax rates between municipalities during the period 1980–1991	None	IV: variation in local payroll taxes across workers in the same firm	Worker	0.643 (0.0592) (based on Table 2, Column 5)[j]
Kubik (2004)	U.S.	Tax Reform Act of 1986	None	DD: compare wages of workers before and after 1986 in occupations affected versus not affected	Occupation-year	0.898 (0.037) (based on Table 4, Column 3)[k]
Saez, Matsaganis and Tsakloglou (2012)	Greece	Cohort-based payroll tax increase in 1992	None	RDD based on date of entry in the labour force	Worker	1.382 (0.267) (based on Table 5, Column 1)[l]
Lehmann, Marical and Rioux (2013)	France	Reduction of payroll tax around the minimum wage between 2003 and 2006	None	IV: regression using predicted change in tax rates	Worker	0.560 (0.277) (based on Table 2, Column 3)[m]
Adam, Phillips and Roantree (2019)	U.K.	Reforms of National Insurance Contributions between 1982 and 2015	None	IV regression using predicted change in tax rates	Worker	1.253 (0.1414) (based on Table 3, Column 6)[n]

Notes: DD: differences-in-differences. DDD: triple differences. IV: instrumental variables. RDD: regression discontinuity design. Standard errors of point estimates are shown in parentheses. [a] The pass-through estimate in Baicker and Chandra (2006) is computed using the fact that health insurance premiums are about 20% of wage and salary income at the mean. [b] The pass-through estimate in Korkeamäki and Uusitalo (2009) is computed using the fact that the Finnish payroll tax experiment reduced payroll taxes by 4.1% on average. [c] The pass-through estimate for employer payroll taxes in Saez et al. (2012) is computed as (minus) the ratio between the estimated discontinuity in the log of posted earnings w and the estimated discontinuity in $\log(1 + \tau_R)$, where τ_R denotes the employer marginal payroll tax rate, and the standard error of the estimated pass-through rate is computed using the delta method. [d] The pass-through estimate for employer payroll taxes in Lehmann et al. (2013) is computed as one minus the estimated pass-through rates to employers (absolute value of coefficient β_ρ^P). [e] The pass-through estimate in Egebark and Kaunitz (2018) is computed using the fact that employer payroll tax rate was reduced from 32.42% to 15.52%. [f] The pass-through estimate in Adam et al. (2019) is computed as one minus the estimated pass-through rates to employers (absolute value of coefficient $\beta_{X,\rho}^{R,0}$). [g] The pass-through estimate in Saez et al. (2019) is computed as one minus the estimated pass-through rate to employers. [h] The pass-through estimate in Benzarti and Harju (2021) is computed using the fact that the employer payroll tax rate increases from approximately 22% to 24.6% at the capital depreciation threshold. [i] The pass-through estimate in Kim et al. (2022) is computed assuming the first stage is perfectly predictive. [j] The pass-through estimate in Bingley and Lanot (2002) is computed as one minus the estimated pass-through rates to employers (0.3570). [k] The pass-through estimate in Kubik (2004) is computed using the fact that the median marginal tax rate was 20.92% (Table 1, Column 1). [l] The pass-through estimate for employee payroll taxes in Saez et al. (2012) is computed as the ratio between the estimated discontinuity in the log of net earnings c and the estimated discontinuity in $\log(1 − \tau_R)$, where τ_E denotes the employee marginal payroll tax rate, and the standard error of the estimated pass-through rate is computed using the delta method. [m] The pass-through estimate for income taxes in Lehmann et al. (2013) is computed as one minus the estimated pass-through rates to employers (absolute value of coefficient β_ρ^I). [n] The pass-through estimate in Adam et al. (2019) is computed as one minus the estimated pass-through rates to employers (minus the value of coefficient $\beta_{X,\rho}^{E,0}$).

E   Robustness Checks

Reform L1: Increase in Pension Payroll Tax for Non-Executives (2000–5)

A. L1: DiD estimates

B. L1: Pass-through to workers (2SLS)

Reform L2: Increase in Pension Payroll Tax for Executives (1991)

C. L2: DiD estimates
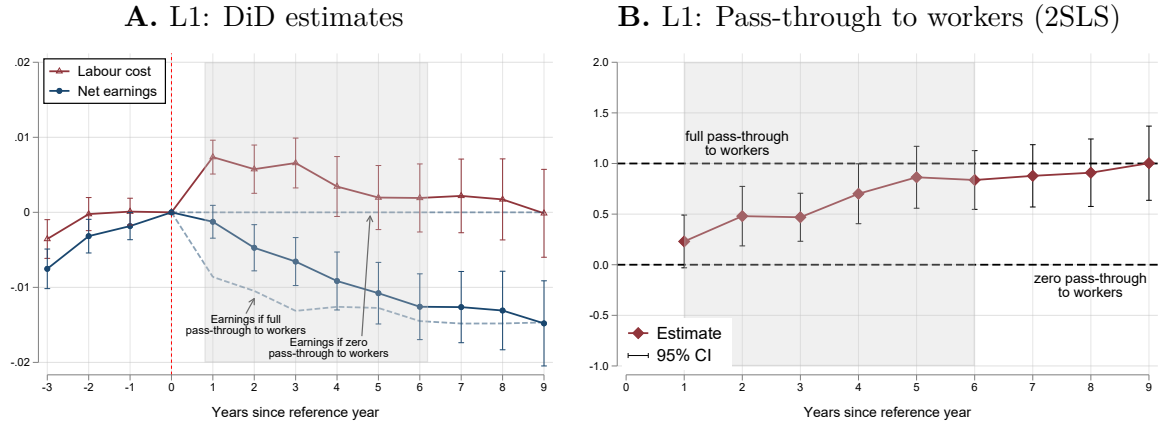
D. L2: Pass-through to workers (2SLS)

Figure E1 – Estimated Pass-Through to Workers for Payroll Tax Reforms with Linkage (Net Earnings)

Notes: (A) and (C) show the estimated log differences in average real net earnings (circle markers) and average real labour costs (triangle markers) between two groups of workers that were affected differently by reforms L1 and L2, while (B) and (D) show the estimated pass-through of the payroll tax increases to workers. For Reform L1 (A and B), the treatment (control) group consists of workers whose posted earnings in the reference year (1999) were between 1 and 1.4 (0.9 and 1) times the SST that year, using an unbalanced panel of workers who are observed in the reference year and at least another year. For Reform L2 (C and D), the treatment (control) group consists of workers whose posted earnings in the reference year (1989) were between 4 and 5.5 (2.5 and 4) times the SST that year, using a balanced panel of workers. In each panel, the shaded area indicates the reform's implementation period, while the vertical dotted line marks the reference year. In (A) and (C), the markers represent the differential growth in net earnings and labour costs between treated and control workers for both pre-reform and post-reform years, relative to the reference year. The vertical T-bars show the 95% confidence intervals around the point estimates, with standard errors clustered at the individual level. The dashed lines represent the predicted evolution of net earnings under the counterfactual scenarios of zero pass-through and full pass-through of the payroll tax change to workers. (B) and (D) present estimates of pass-through to workers, obtained from a 2SLS estimation of equation (6) in the main text, where $\log(1 + \tau)$ (τ: sum of employer and employee payroll taxes rates measured relative to net earnings) is instrumented by the interaction between the treatment group and year dummies. Diamond markers show the estimates while the vertical T-bars show the 95% confidence intervals (arrows indicate confidence intervals that extend beyond the y-axis range displayed). In the case of Reform L2, given the limited sample size, we aggregate years 2 and 3, as well as years 4 and 5.

Sources: DADS Panel; TAXIPP 0.4.

A. Reform L1: Increase in Pension Payroll Taxes for Non-Executives

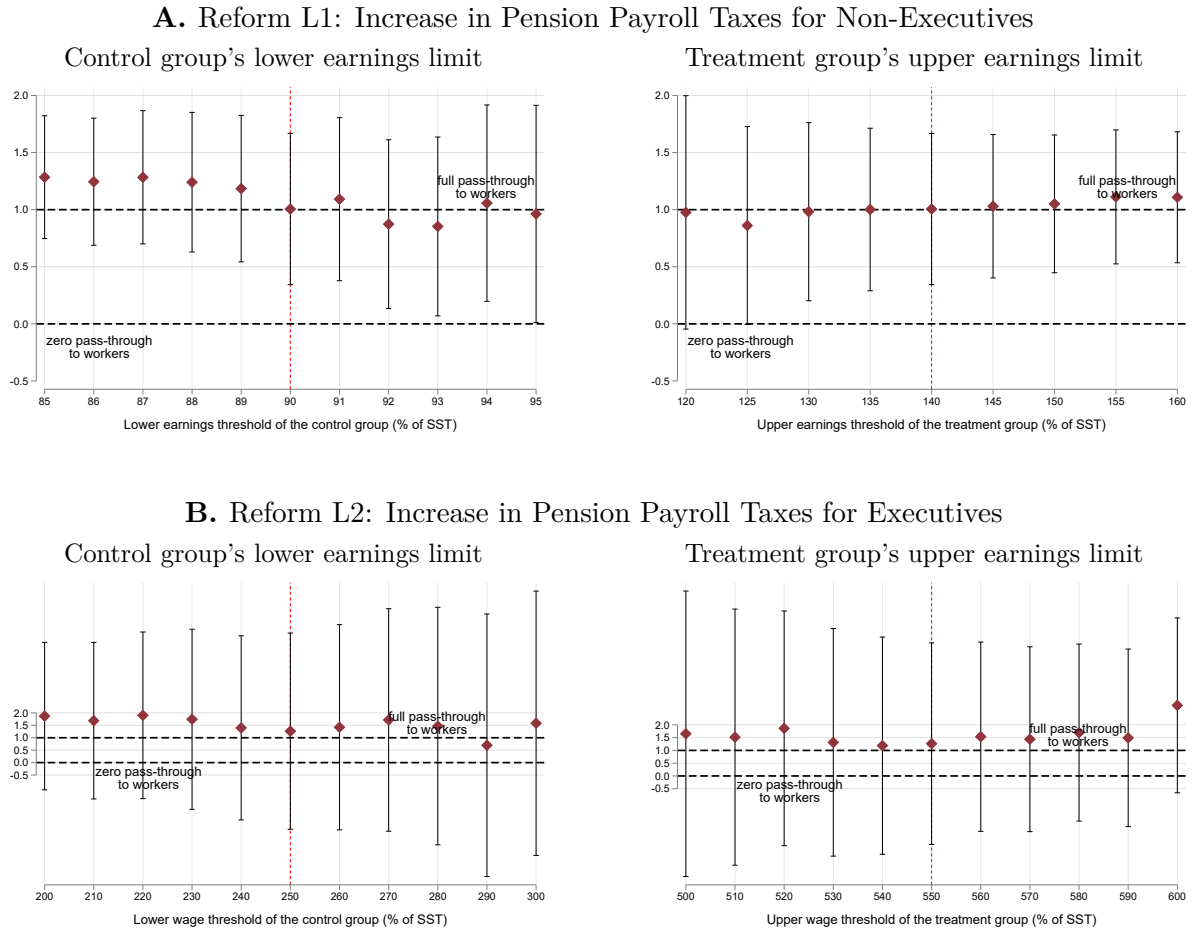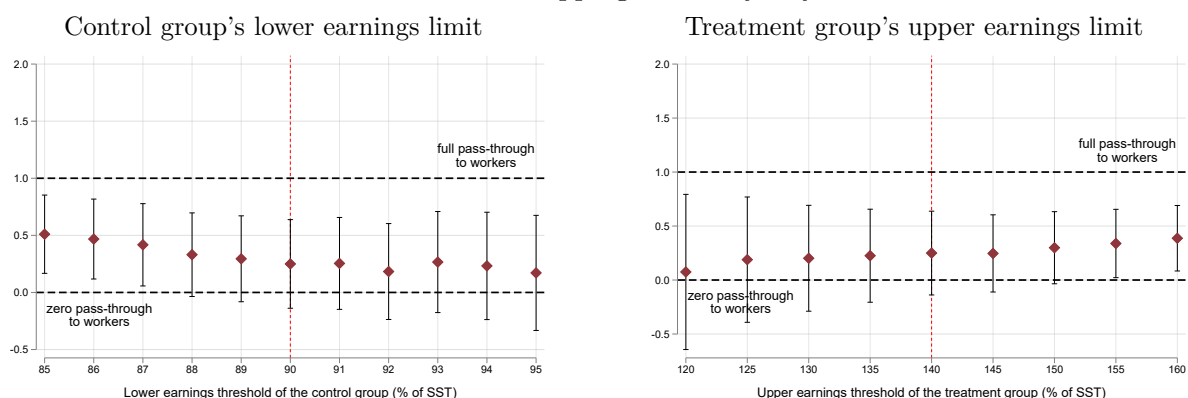**B.** Reform L2: Increase in Pension Payroll Taxes for Executives

Figure E2 – Estimated Pass-Through to Workers for Reforms with Linkage: Sensitivity to Lower and Upper Earnings Limits of the Treatment and Control Groups
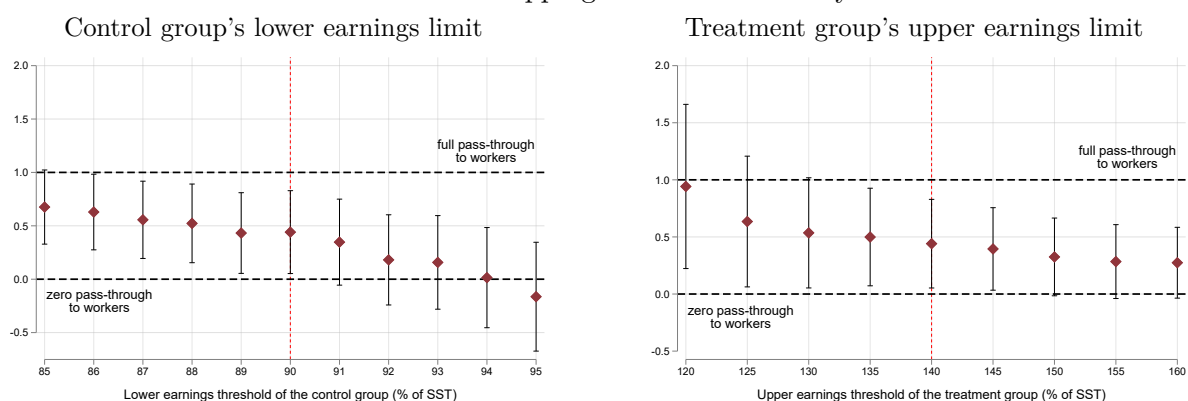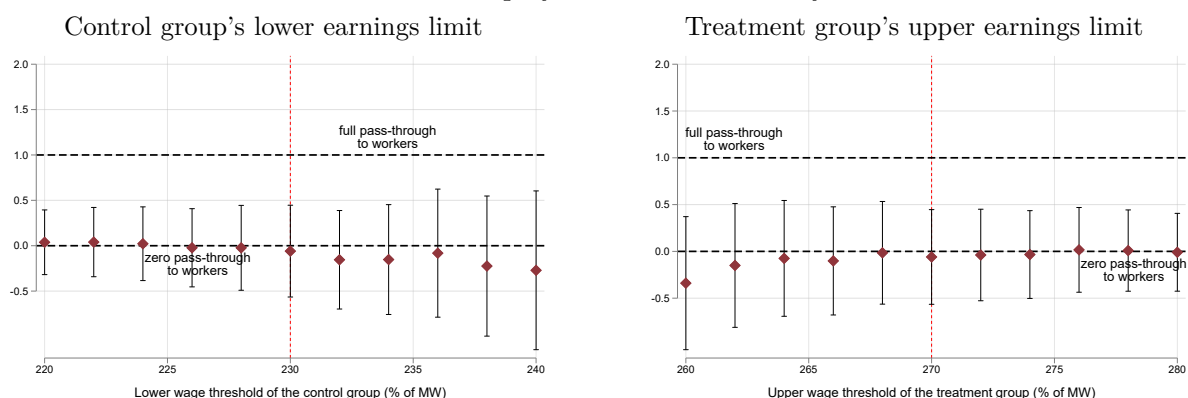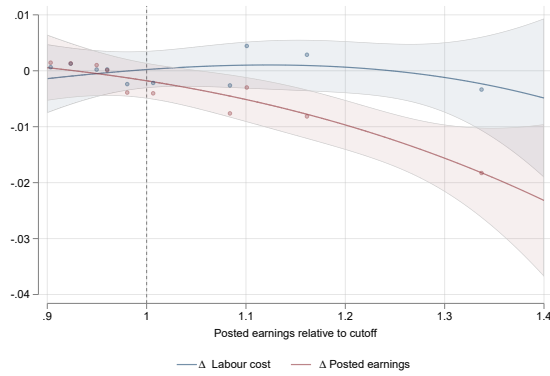
Notes: The pass-through estimates shown in this figure are evaluated in the last year of the estimation sample for each reform, and are based on a specification that does not include worker-specific linear time trends. The left panels show the estimates obtained for various choices of the control group's lower earnings limit (expressed in percentage of the Social Security threshold or SST) while keeping fixed the upper limit of the treatment group. The right panels show the estimates when varying the treatment group's upper earnings limit (expressed in percentage of the Social Security threshold) while keeping fixed the lower limit of the control group. The vertical dotted lines show the limit that are used in the baseline specification. The markers represent the estimated pass-through of employer payroll taxes to workers. The vertical T-bars show the 95% confidence intervals around the point estimates, with standard errors clustered at the individual level.
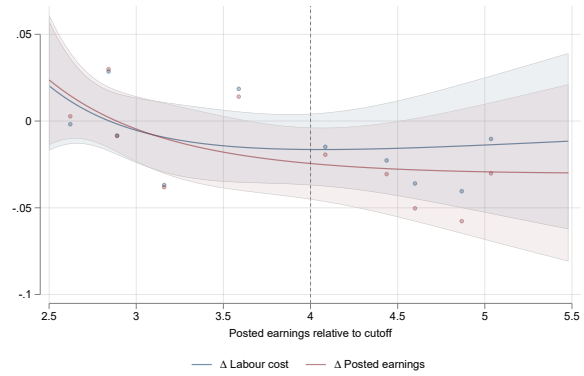*Sources:* DADS Panel; TAXIPP 0.4.

Figure E3 – Estimated Pass-Through to Workers for Reforms without Linkage: Sensitivity to the Lower and Upper Earnings Limits of the Treatment and Control Groups

Notes: The pass-through estimates shown in this figure are evaluated in the last year of the estimation sample for each reform, and are based on a specification that does not include worker-specific linear time trends. The left panels show the estimates obtained for various choices of the control group's lower earnings limit (expressed in percentage of the Social Security threshold, or the minimum wage in the case of NL3) while keeping fixed the upper limit of the treatment group. The right panels show the estimates when varying the treatment group's upper earnings limit (expressed in percentage of the Social Security threshold, or the minimum wage in the case of NL1) while keeping fixed the lower limit of the control group. The vertical dotted lines show the limit that are used in the baseline specification. The markers represent the estimated pass-through of employer payroll taxes to workers. The vertical T-bars show the 95% confidence intervals around the point estimates, with standard errors clustered at the individual level.
Sources: DADS Panel; TAXIPP 0.4.
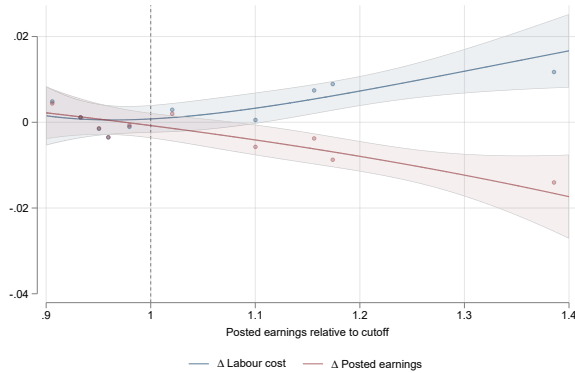
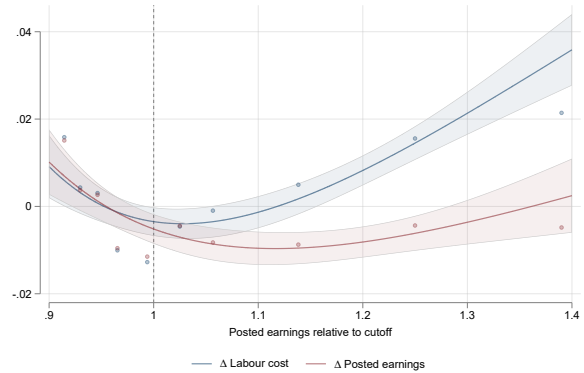## Payroll Tax Reforms with Linkage

A. Reform L1

B. Reform L2

Payroll Tax Reforms without Linkage

C. Reform NL1

D. Reform NL2

Tax Reform without Linkage
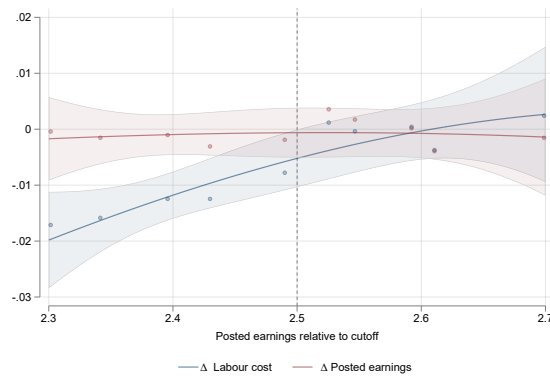
E. Reform NL3

Figure E4 – Non-Parametric Visualization of Treatment Effects

Notes: Each figure compares the growth rate (demeaned) of posted earnings (red) and labour costs (blue) depending on workers' posted earnings in the reference year. The y-axis shows the log-differences in posted earnings and labour cost between the last year in the estimation window and the reference year, averaged by bins of posted earnings (relative to the reform's earnings threshold) in the reference year (x-axis). The vertical dotted bars indicate the earnings threshold separating the treatment group from the control group in the reference year. Circles represent binned averages, with a total of 5 bins on each side of the threshold. Panels A and B show the results for reforms with tax-benefit linkage (L1 and L2, respectively), while Panels C to E show the results for reforms without linkage (NL1, NL2, and NL3, respectively). Lines are polynomial fits, shaded areas represent 95% confidence intervals.
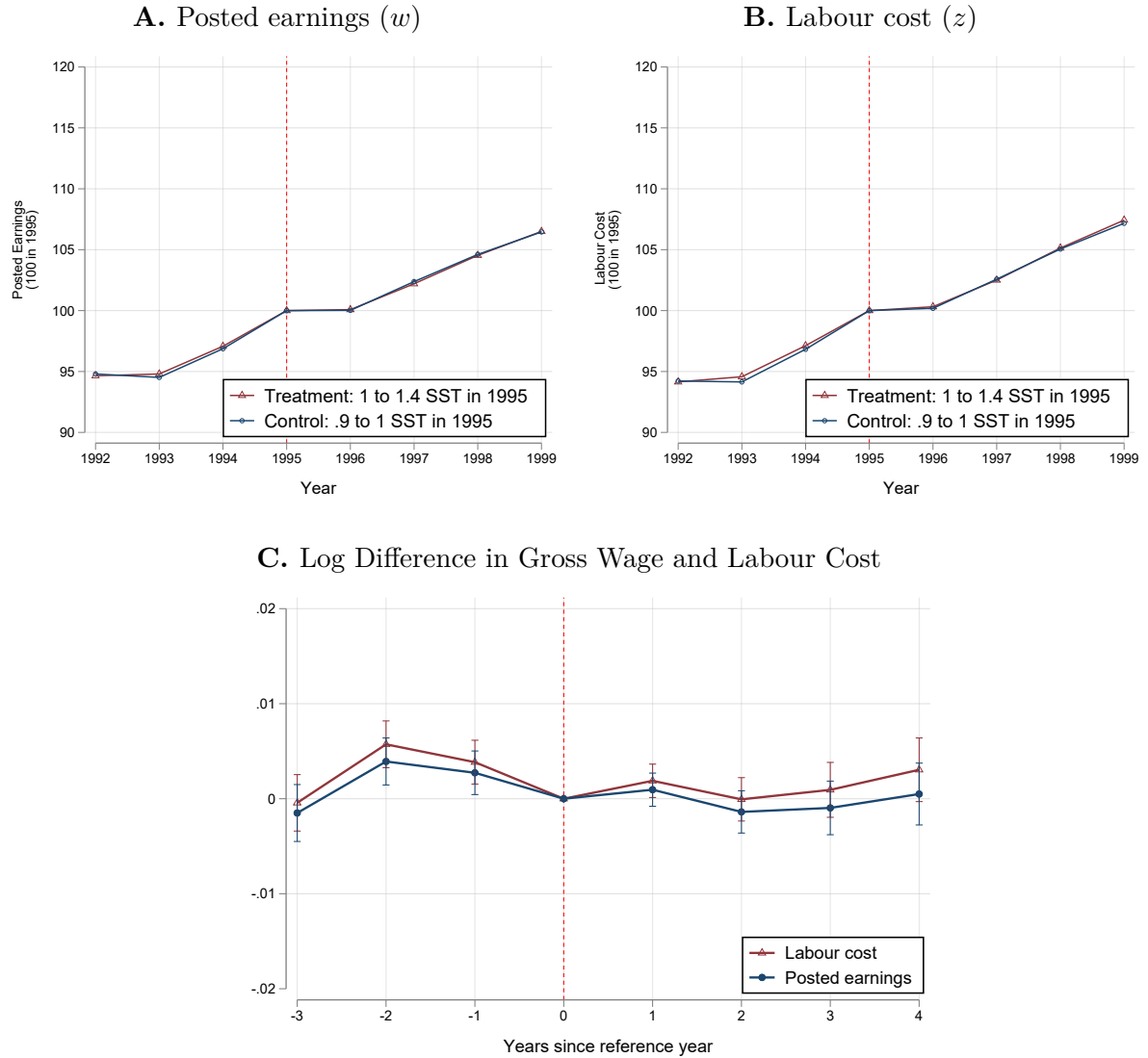*Sources:* DADS Panel; TAXIPP 0.4.

A. Posted earnings (w)

B. Labour cost (z)

C. Log Difference in Gross Wage and Labour Cost

Figure E5 – Placebo Reform (1996): Graphical Evidence on Earnings Responses

Notes: The top panels of the figure show the evolution of average real gross earnings (A) and of average real labour cost (B) between 1992 and 1999 for two groups of workers around a placebo reform which is set to take place in 1996 at the posted earnings cutoff of 1 SST. The difference-in-differences estimation is performed on an unbalanced panel of workers who are observed in the last pre-reform year (denoted by a vertical dotted line) and at least another year. Earnings levels are normalized to 100 for both groups in the placebo reference year (1995). The treatment group includes workers whose gross earnings in 1995 were 1 to 1.4 times the SST that year. The control group includes individuals whose gross earnings in 1995 were 0.9 to 1 times the SST that year. (C) shows the estimated log differences between the average real gross earnings (circle markers) and the average real labour cost (triangle markers) of the two groups of workers. The markers represent the parameter estimates on the interaction between the treatment group and year dummies, which is normalized to zero in the placebo reference year (1995). The vertical T-bars show the 95% confidence intervals around the point estimates, with standard errors clustered at the individual level.
Sources: DADS Panel; TAXIPP 0.4.

Table E1 – Incidence of Payroll and Income Tax Reforms: Alternative Specifications

	Reforms with linkage		Reforms without linkage		
	Payroll tax reforms				Income tax reform
Reform:	L1 Increase in pension payroll tax for non-executives	L2 Increase in pension payroll tax for executives	NL1 Uncapping of family payroll tax	NL2 Uncapping of health care payroll tax	NL3 Employer tax credit on payroll taxes
Reference year (t_0):	1999	1989	1988	1980	2012
Final year (t_{max}):	2008	1995	1997	1988	2018
	(1)	(2)	(3)	(4)	(5)
Panel A. Baseline specification					
Without worker-specific trends					
Last year	1.01***	1.26	0.25	0.44**	−0.06
	(0.34)	(2.01)	(0.20)	(0.20)	(0.26)
Final years	0.88***	0.74	−0.02	0.41***	−0.05
	(0.28)	(1.46)	(0.18)	(0.13)	(0.14)
With worker-specific trends					
Last year	1.27***		0.07	0.23	0.06
	(0.34)		(0.25)	(0.15)	(0.44)
Final years	1.21***		0.00	0.24*	0.02
	(0.31)		(0.24)	(0.13)	(0.26)
N	496,039	13,240	594,632	642,289	275,307
Panel B. Removing workers close to threshold ("doughnut hole")					
Without worker-specific trends					
Last year	0.97***	−0.48	0.34*	0.82***	0.04
	(0.33)	(1.96)	(0.21)	(0.21)	(0.25)
Final years	0.83***	0.12	−0.05	0.62***	0.05
	(0.27)	(1.44)	(0.19)	(0.14)	(0.14)
With worker-specific trends					
Last year	1.47***		0.22	0.26	0.30
	(0.35)		(0.27)	(0.17)	(0.43)
Final years	1.35***		0.11	0.26*	0.20
	(0.32)		(0.25)	(0.15)	(0.26)
N	342,423	11,944	419,719	458,947	208,839

Notes: See notes of Table 2 and Table 4 in the main text. The different columns correspond to different payroll tax or income tax reforms. The pass-through estimates reported in Panel A are obtained from the baseline specification (equation 6) and the augmented specification that controls for worker-specific trends (equation 7) using the same samples as in Tables 3 and 4. The estimates reported in Panel B are obtained using the same specifications as in Panel A but removing workers with earnings close to the earnings threshold in the reference year. We exclude workers with posted earnings between 0.95 and 1.05 times the SST in the reference year for reforms L1, NL2, NL3, workers between 2.25 and 2.75 times the minimum wage MW for Reform NL1, and workers between 3.75 and 4.25 times the SST for Reform L2. This restriction is not applicable to NL4 as treatment is not defined based on an earnings threshold for this reform. Standard errors clustered at the individual level are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Sources: DADS Panel; TAXIPP 0.4.

F   Effects on Employment Outcomes

One way in which adjustments might have occurred in response to employer payroll tax changes that were not passed through to workers is through a reduction in the employment prospects of treated workers relative to control ones.
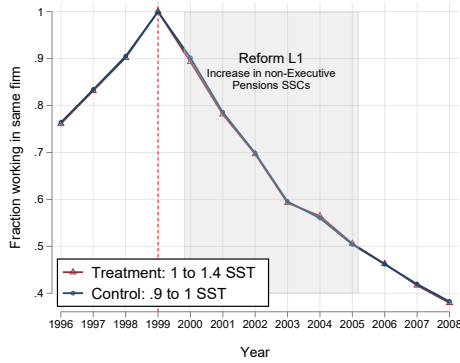
Our identification strategy, which defines groups based on posted earnings in the reference year, implies that both treated an control workers are all employed in the reference year. Differences in the baseline employment probabilities between the two groups of workers will, therefore, induce differential pre-trends when analysing the evolution of their employment probabilities before and after the reforms. To address this issue, we adopt an approach similar to Saez et al. (2019) by using propensity score reweighting to correct for differential trends in employment probabilities between the treatment and control groups. To compute these propensity weights, we use information on age, gender, *département* of residence, 2-digit occupation, the number of years the worker has been employed pre-reform, 2-digit industry code (which varies across reforms), and firm size. We then use these propensity scores to reweight workers in the graphical and regression analyses.

We focus on two employment outcomes. Our main outcome is the probability of remaining employed in the same firm as in the reference year. If workers in the treatment group, whose labour cost has increased relative to the control group, have experienced a reduction in their employment probabilities, it should be be reflected in the differential retention rates between the two groups of workers. Second, we examine the probability of having a non-zero wage in our data, which corresponds to the probability of being employed in the private sector in a given year.
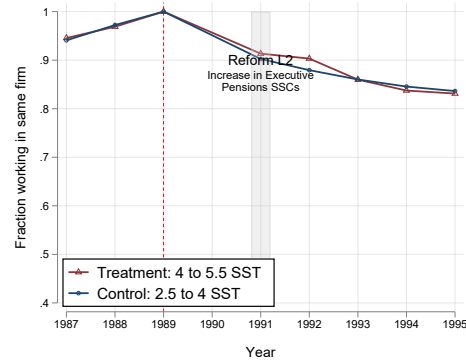
The evolution of the employment probabilities for both treated and control workers around the reform years are shown in Figure F1 (probability of being employed in the same firm as in the reference year) and Figure F2 (probability of being employed in the private sector). The corresponding difference-in-difference estimates are reported in Table F1. The estimates in Panel A are obtained from a baseline specification similar to equation (5) in the main text, while the estimates in Panel B additionally control for worker-specific trends.

Payroll Tax Reforms with Linkage

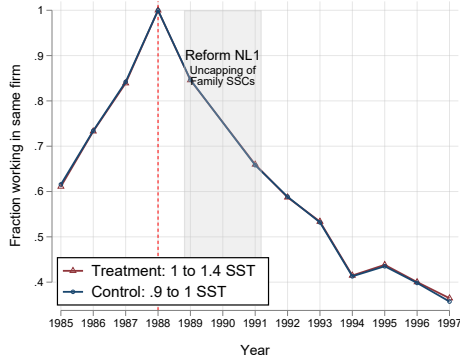**A.** L1: Increase in pension payroll tax for non-executives
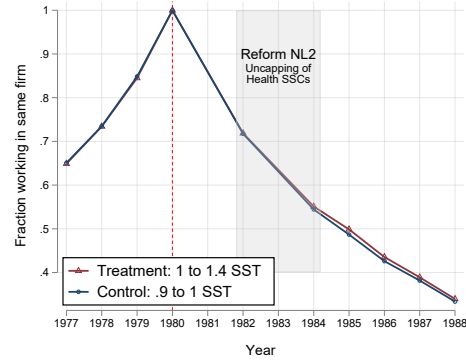
B. L2: Increase in pension payroll tax for executives

Payroll Tax Reforms without Linkage

C. NL1: Increase in family payroll tax

D. NL2: Increase in health care payroll tax

Income Tax Reform without Linkage

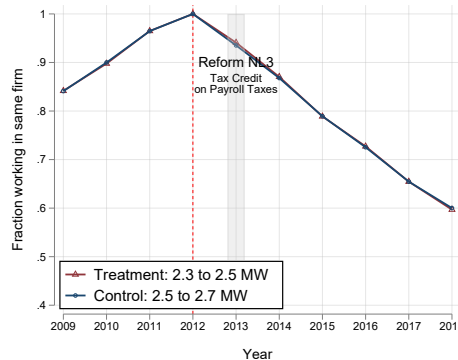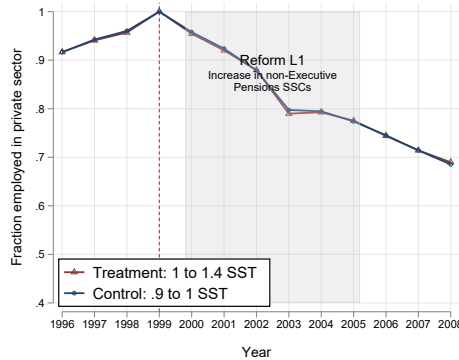**E.** NL3: Employer tax credit on payroll taxes

Figure F1 – Probability of Being Employed in Same Firm as in the Reference Year

Notes: For each reform, the figure shows the evolution of the probability to be employed in the same firm as in the reference year for the treated and control workers separately. For the definitions of the treatment and control groups, see notes of Tables 3 and 4. In each panel, the shaded area indicates the reform's implementation period, while the vertical dotted line marks the reference year. Observations are reweighted using inverse propensity score weights based on worker characteristics (age, gender, *département* of residence, two-digit occupation, and number of years employed pre-reform) and firm characteristics (two-digit industry code and firm size) in the reference year (see methododology described in Appendix F).
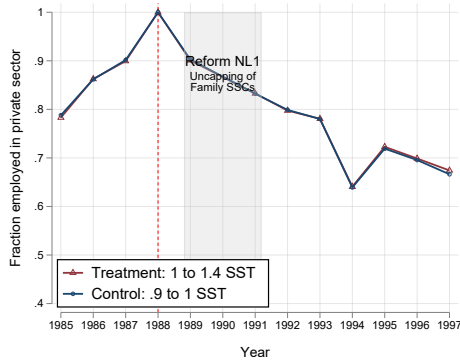*Sources:* DADS Panel; TAXIPP 0.4.

Payroll Tax Reform with Linkage

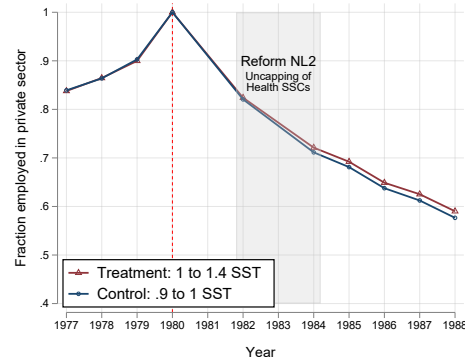### A. L1: Increase in pension payroll tax for non-executives

Payroll Tax Reforms without Linkage

B. NL1: Increase in family payroll tax

C. NL2: Increase in health care payroll tax

Income Tax Reform without Linkage

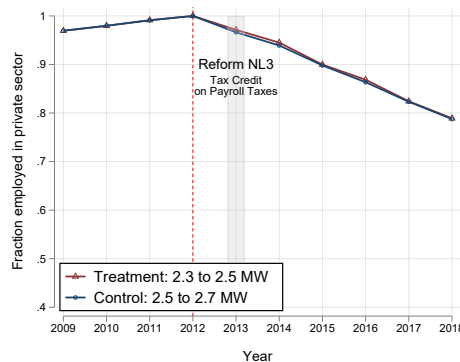### D. NL3: Employer tax credit on payroll taxes

Figure F2 – Probability of Being Employed in the Private Sector

Notes: For each reform, the figure shows the evolution of the probability of being employed in the private sector for the treated and control workers separately. For the definitions of the treatment and control groups, see notes of Tables 3 and 4. Reform L2 is not included since the sample used to analyse this reform is restricted to workers employed every year. The shaded area indicates the reform's implementation period, while the vertical dotted lines mark the reference years. Observations are reweighted using inverse propensity score weights based on worker characteristics (age, gender, *département* of residence, 2-digit occupation, and number of years employed pre-reform) and firm characteristics (2-digit industry code and firm size) in the reference year (see methodology described in Appendix F). Estimates for Reform L2 are not provided because the sample utilized for analysing this reform is restricted to workers observed every year in the data.

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Table F1 – Employment Outcomes: Difference-in-Differences Estimates

	Reforms with linkage		Reforms without linkage		
	Payroll tax reforms				Income tax reform
Reform:	L1 Increase in pension payroll tax for non-executives	L2 Increase in pension payroll tax for executives	NL1 Uncapping of family payroll tax	NL2 Uncapping of health care payroll tax	NL3 Employer tax credit on payroll taxes
Reference year (t_0):	1999	1989	1988	1980	2012
Final year ($t_{\max}$):	2008	1995	1997	1988	2018
	(1)	(2)	(3)	(4)	(5)

Panel A. Baseline specification

Dep. var.: Probability of remaining employed in the same firm

Last year	−0.0032	−0.0056	0.0073*	0.0060*	−0.0032
	(0.0047)	(0.0147)	(0.0041)	(0.0034)	(0.0055)

Dep. var.: Probability of remaining employed in the private sector

Last year	0.0044		0.0078**	0.0136***	0.0015
	(0.0044)		(0.0040)	(0.0035)	(0.0046)

Panel B. Controlling for worker-specific trends

Dep. var.: Probability of remaining employed in the same firm

Last year	−0.0085	−0.0034	−0.0033	0.0051	−0.0035
	(0.0146)	(0.0091)	(0.0145)	(0.0111)	(0.0114)

Dep. var.: Probability of remaining employed in the private sector

Last year	0.0085		−0.0029	0.0142	0.0003
	(0.0101)		(0.0122)	(0.0089)	(0.0066)
N	691,366	13,088	846,048	930,940	338,120

Notes: The different columns correspond to different payroll tax or income tax reforms. The coefficients reported in each column are difference-in-differences estimates of the effects of the reform on two employment outcomes: (i) the probability of remaining employed in the same firm as in the reference year and (ii) the probability of remaining employed in the private sector. For Reform L1 (Column 1), the treatment (control) group consists of workers whose posted earnings in the reference year (1999) were between 1 and 1.4 (0.9 and 1) times the SST that year, using an unbalanced panel of workers who are observed in the reference year and at least another year. For Reform L2 (Column 2), the treatment (control) group consists of workers whose posted earnings in the reference year (1989) were between 4 and 5.5 (2.5 and 4) times the SST that year, using a balanced panel of workers. For Reforms NL1 and NL2 (Columns 3 and 4), the treatment (control) group consists of workers whose posted earnings in the reference year (1988 for NL1 and 1980 for NL2) were between 1 and 1.4 (0.9 and 1) times the SST that year, using an unbalanced panel of workers who are observed in the reference year and at least another year. For Reform NL3 (Column 5), the treatment (control) group consists of workers whose posted earnings in the reference year (2012) were between 2.3 and 2.5 (2.5 and 2.7) times the minimum wage (MW) that year, using an unbalanced panel of workers who are observed in the reference year and at least another year. The estimates in Panel A are obtained from a baseline specification similar to equation (5) in the main text. The estimates in Panel B additionally control for worker-specific trends. Observations are reweighted using inverse propensity score weights based on worker characteristics (age, gender, *département* of residence, 2-digit occupation, and number of years employed pre-reform) and firm characteristics (2-digit industry code and firm size) in the reference year (see methodology described in Appendix F). Estimates for the probability of being employed in the private sector are not reported for Reform L2 because the sample being used to analyse this reform is restricted to workers observed every year in the data. Standard errors clustered at the individual level are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Sources: DADS Panel; TAXIPP 0.4.