Statutory Incidence of Ad Valorem Taxes: Revisiting Classical Theory and Policy Implications

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Abstract

This paper revisits the canonical result that statutory tax incidence is theoretically irrelevant for economic outcomes in competitive equilibrium. We show that statutory incidence of ad valorem taxes changes the tax base and therefore effective tax rates. Shifting statutory incidence toward the demand side reduces the consumer price, raises the supplier price, and increases quantity. The effect on tax revenue is ambiguous. We derive empirically tractable incidence formulas and quantify them using simulations. Applying the framework to OECD payroll taxes, we find that accounting for statutory incidence is important since employer shares rise with total payroll taxes, offsetting nominal differences.

A canonical result in public finance holds that the economic incidence of a tax is independent of its statutory (or legal) incidence—absent frictions and in competitive equilibrium. This result is discussed extensively in public finance textbooks (e.g., Dalton, 1941; Salanié, 2003; Gruber, 2019) and handbook chapters (e.g., Kotlikoff and Summers, 1987; Fullerton and Metcalf, 2002):

> "[I]t is clear that the determination of the equilibrium quantity, the price paid by consumers, and the net of tax receipts of producers does not depend on which side of the market the tax is levied." (Kotlikoff and Summers, 1987)

This theoretical irrelevance has motivated a substantial empirical literature, which generally finds that statutory incidence affects economic outcomes (see Benzarti, 2025, for a recent review). For

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example, Jiménez et al. (2024) study a statutory shift of mortgage taxes in Spain—an ad valorem tax—from borrowers to banks without changing the tax rate, motivated by the "key principle [...] that (economic) tax incidence [...] is independent of on which agent taxes are levied [...] as price adjustments compensate such shift." In practice, however, statutory incidence can play a central role in tax design. In the case of payroll taxes, for instance, contributions are typically divided nominally between the employer and employee, consistent with a "traditional" policy view that who formally pays the tax (statutory incidence) also determines who economically bears it (economic incidence).

This paper reexamines the classical statutory irrelevance result in the frictionless, competitive benchmark economy for ad valorem taxes. We then apply these theoretical insights to payroll taxes among OECD countries and discuss their implications for recent payroll tax reforms. Ad valorem taxes are proportionate to the price per unit of the good, i.e., $(1+\tau)p$, and are ubiquitous in practice, including payroll, income, value-added, or sales taxes. In comparison, a per unit tax—also known as specific tax—is a constant amount per unit of the good irrespective of its price, i.e., $p+t$.

We first show that statutory incidence of ad valorem taxes is more nuanced than that of per unit taxes by introducing the concepts of strong and weak irrelevance. Statutory incidence is *strongly* irrelevant for economic incidence if shifting the statutory incidence at a constant tax rate does not affect the economic equilibrium and collected revenue. This reflects the classical notion of statutory irrelevance to date. In contrast, we define statutory incidence to be *weakly* irrelevant if shifting the statutory incidence maintains the economic equilibrium and collected revenue while allowing for simultaneous tax rate adjustments. While per unit taxes satisfy strong and weak irrelevance, we show that ad valorem taxes only satisfy weak irrelevance.

Figure 1a illustrates a stylized example of the classical view in the literature: per unit taxes satisfy both strong and weak irrelevance. Irrespective of whether the per unit tax is levied on the supplier, $p_S = p_D - t$, or whether it is levied on the buyer, $p_D = p_S + t$, the equilibrium is unchanged (p_S and p_D are the prices received and paid by the supply and demand side, respectively).

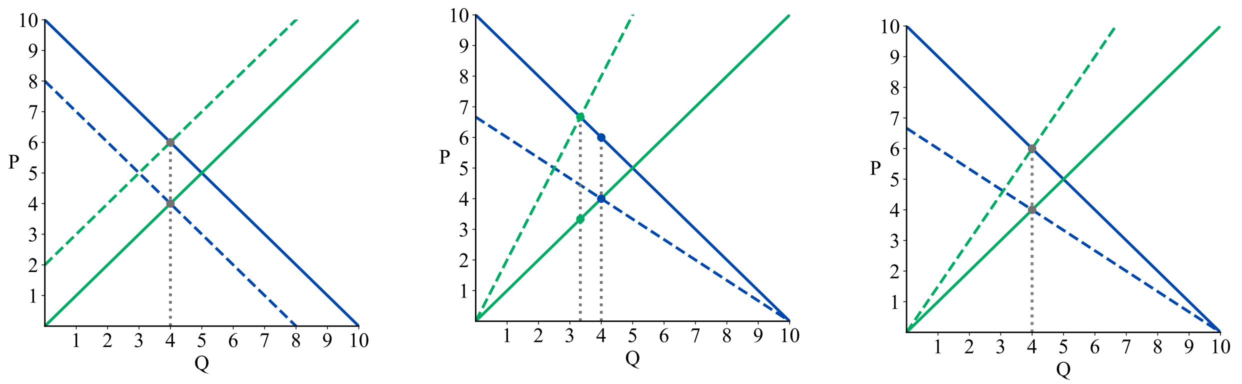
We demonstrate that strong irrelevance of statutory incidence is not satisfied for ad valorem taxes. Figure 1b provides a stylized example of this failure, which we generalize in section 3. Consider an ad valorem tax τ_0 fully levied on the demand side such that $p_D^0 = (1+\tau_0)p_S^0$. Suppose a reform shifts the statutory incidence from the demand to the supply side without changing the tax rate. The prices (p_D, p_S) will adjust in equilibrium to equate supply and demand at $p_S^1 = (1-\tau_0)p_D^1$. Unlike in the per unit tax case, however, the price adjustment does not neutralize the statutory incidence shift, leading to a change in the real economic allocation, tax incidence, and collected tax revenue.

We derive under general conditions—downward-sloping demand, upward-sloping supply—that statutory incidence shifts of a constant ad valorem tax rate toward the demand side increase the equilibrium quantity, raise buyer prices, and lower consumer prices. The effect on revenue depends on the demand and supply elasticity, but increases unambiguously for shifts toward the supply side when $|\varepsilon^D| < 1$.

Strong irrelevance fails for ad valorem taxes due to differences in the tax base. When the tax is levied on the demand side, the tax base is the supply price, p_S. This creates a wedge of $\tau_0 p_S$ between the

Figure 1: (Ir)relevance of statutory incidence for per unit vs. ad valorem taxes

(a) Irrelevance per unit tax $t_D = t_S$ | (b) Strong relevance ad valorem tax $\tau_D = \tau_S$ | (c) Weak irrelevance ad valorem tax $\tau_D = \tau_S/(1-\tau_S)$



Notes: This figure illustrates in classic price-quantity diagrams the (ir)relevance of statutory tax incidence for per unit and ad valorem taxes. Downward-sloping, solid blue lines correspond to inverse linear demand curves. Upward-sloping, solid green lines correspond to inverse linear supply curves. Dashed blue and green lines account for taxes when levied on the supply and demand side, respectively. Panel (a) shows that for a per unit tax ($t_D = t_S$), the statutory incidence does neither affect equilibrium quantity nor prices. Panel (b) demonstrates the economic relevance of statutory tax incidence for fixed ad valorem tax rates ($\tau_D = \tau_S$). Panel (c) illustrates the case where different ad valorem tax rates on the supply side and the demand side ($\tau_D = \tau_S/(1-\tau_S)$) lead to the same equilibrium (the case of weak irrelevance).

demand and supply curve. When the tax is levied on the supply side, the tax base is the demand price, p_D. This creates a wedge of $\tau_0 p_D$. Since $p_S \leq p_D$ for $\tau_0 \geq 0$, the distortion is smaller when τ_0 is levied on the demand side. An important implication is that an ad valorem tax of τ_0 levied on the supply side is economically different from an ad valorem tax of τ_0 on the demand side.

We derive empirically tractable formulas for the predicted price and economic incidence changes in response to tax reforms that shift the statutory incidence. These formulas closely mirror canonical economic incidence formulas for tax rate changes and depend on relative demand and supply elasticities, the tax rate, and the pre-reform statutory incidence. The close resemblance of tax incidence formulas is due to changes in statutory incidence for ad valorem taxes implicitly acting as effective tax rate changes. In addition, we derive general economic incidence formulas in response to tax rate changes that account for the statutory incidence. These formulas reinforce that accounting for the statutory incidence is important when considering tax rate changes.

Using these general formulas, we provide numerical examples in the payroll tax context that simulate statutory incidence shifts and tax rate changes. In line with the well-established intuition, these simulations emphasize the importance of relative demand and supply elasticities. However, they also reveal how the statutory incidence affects expected price changes. Shifts in statutory incidence at constant tax rates can lead to meaningful price changes for medium and large tax rates as are commonly observed for payroll taxes. This has implications for empirical research analyzing tax reforms, which must distinguish predicted price changes in the frictionless, competitive benchmark from the influence of other factors like salience or evasion.

To complete our theoretical discussions, we show how the statutory irrelevance of ad valorem taxes can be restored in the weak irrelevance sense. Conceptually, weak irrelevance asks: can we implement the same equilibrium outcome after a change in the statutory incidence at a different tax rate? Figure 1c illustrates a stylized example. For any tax rate $\tau_S < 1$ on the supply side, there is an equivalent tax rate on the demand side, $\tau_D = \frac{\tau_S}{1-\tau_S}$, leading to the same allocation. Implicitly, both tax rates lead to the same per unit tax, and they generate the same tax revenue. Thus, we consider these tax regimes as equivalent from a tax collection perspective. The important policy takeaway is that shifts in statutory incidence are only neutral when accompanied by corresponding tax rate adjustments.

Finally, we apply our theoretical insights to payroll taxes among OECD countries, focusing on social insurance contributions. We establish three new results. First, accounting for differences in statutory incidence is important for comparing payroll tax rates across countries. Second, total payroll taxes and employer shares are positively correlated, which implies more muted cross-country differences in effective than nominal payroll tax rates. Third, this relationship holds within types of payroll taxes or controlling for country and year fixed effects. This pattern can be explained by a "traditional" policymaker's intention to reduce the burden on workers by shifting the statutory incidence toward employers. According to our theoretical framework, this policy achieves the intended effect of lowering workers' tax burden; however, not mechanically through shifting the statutory incidence but indirectly through lowering effective tax rates on both sides. These results should be considered when policymakers design tax policies and when researchers evaluate their effects.

Related literature. We contribute to the extensive theoretical and empirical literature on tax incidence. We argue the conventional result of statutory irrelevance emerges from this prior work *also* for ad valorem taxes for two reasons. First, algebraic results from a per unit tax are transferred to ad valorem taxes without further proof (e.g., Dalton, 1941; Kotlikoff and Summers, 1987). Second, algebraic results for ad valorem taxes only consider the introduction of an infinitesimal tax at initial $\tau = 0$ (e.g., Fullerton and Metcalf, 2002; Salanié, 2003). As we show, the statutory incidence is indeed irrelevant when introducing an infinitesimal ad valorem tax at $\tau = 0$; the irrelevance fails, however, for any given non-zero ad valorem tax. Stiglitz and Rosengard (2015) demonstrate that per unit and ad valorem taxes can lead to the same equilibrium, but discuss neither the relevance of statutory incidence nor that ad valorem rates on the supply and demand side would differ. Pauwels and Schroyen (2024) form an exception in the theoretical literature showing—similar to this paper—the failure of the classical statutory irrelevance in a frictionless, competitive economy.

We deviate from the literature and Pauwels and Schroyen (2024) in several ways. First, we introduce the concepts of strong and weak irrelevance. Through this, we can clarify that ad valorem taxes fail strong irrelevance while satisfying weak irrelevance. Second, we derive new economic tax incidence formulas, which account for statutory incidence, generalize the commonly applied canonical expressions, and are empirically tractable. Using these formulas, we provide simulations quantifying the magnitude of the new statutory incidence channel. Applying our theoretical insights to payroll taxes in OECD countries, we document new facts on the relationship between payroll tax rates and employer-employee contribution shares, and interpret recent tax policy reforms through the lens of our framework.

This paper also relates to prior work showing statutory incidence matters for economic incidence outside of the frictionless, competitive benchmark. For instance, statutory incidence matters in the monopoly case (e.g., Stiglitz and Rosengard, 2015). The classical irrelevance further rests on the assumption that all information to determine tax liability is freely and universally observed (Slemrod, 2008), which fails in the presence of frictions such as tax salience (Chetty et al., 2009), differential evasion and enforcement (Kopczuk et al., 2016; Slemrod, 2019; Hargaden and Roantree, 2019; Bibler et al., 2021; Fox et al., 2022; Garriga and Tortarolo, 2024), price rigidities and norms (Saez et al., 2012), imperfect competition (Hansen et al., 2017), and bargaining power (Claussen et al., 2024; Jiménez et al., 2024). Benzarti (2025) discusses the empirical literature documenting various "tax anomalies" and outlines key shortcomings of the canonical incidence model. Saez and Zucman (2024) propose a new framework assigning the economic incidence of a tax by its base, e.g., assigning labor income taxes to workers irrespective of statutory incidence. This paper contributes to this literature by revisiting the classical tax incidence model, yielding theoretical results that align with the empirical evidence showing that statutory incidence affects economic incidence and that the relative magnitudes of demand and supply elasticities are not sufficient to determine tax incidence.

This article proceeds as follows. Section 1 introduces notation and defines strong and weak statutory irrelevance. Section 2 recalls the strong irrelevance of per unit taxes. Section 3 generalizes and discusses the failure of strong irrelevance of ad valorem taxes. Section 4 demonstrates how weak irrelevance of ad valorem taxes can be restored. Section 5 provides an application to payroll taxes in OECD countries. Section 6 concludes.

1 Notation and definitions

Let p denote the tax-exclusive price of some good. What matters for supply and demand are the effective, tax-inclusive prices. Let p_S denote the tax-inclusive price received by the suppliers after subtracting any legal tax obligation. Respectively, let p_D denote the tax-inclusive price for the demand side, which includes any possible formal tax liability. Denote $S(p_S)$ and $D(p_D)$ as aggregate supply and demand.

We express per unit taxes by t and ad valorem taxes by τ. The statutory incidence of a given tax may be split across the demand and supply sides; we denote $\alpha \in [0, 1]$ as the statutory share of the tax falling on the demand side. Thus:

$$\begin{aligned} \text{per unit tax:} \quad & p_D = p + \alpha t \quad \text{and} \quad p_S = p - (1-\alpha)t \\ \text{ad valorem tax:} \quad & p_D = (1+\alpha\tau)p \quad \text{and} \quad p_S = [1-(1-\alpha)\tau]p, \end{aligned}$$

where the tax-exclusive price p adjusts in equilibrium to equate supply and demand.

Statutory incidence describes the side on which the tax is levied *de jure*. To isolate the role of statutory incidence, we abstract from remittance of the tax to the revenue authority, which can matter in practice (Slemrod, 2008).

Strong and weak statutory irrelevance

We define the statutory incidence of some tax to be *strongly irrelevant* for economic incidence whenever real economic outcomes are independent of the statutory incidence holding the tax rate constant (Definition 1). This formalizes the notion of statutory irrelevance in the literature to date. In contrast, we define the statutory incidence to be *weakly irrelevant* whenever the real economic outcomes are unaffected by the statutory incidence whilst allowing for a corresponding adjustment in the tax rate (Definition 2). Strong irrelevance implies weak irrelevance, but not vice versa.

Definition 1 (Strong irrelevance of statutory incidence)**.** *The statutory incidence of some tax regime* $T = \{\tau, \alpha\}$ *is strongly irrelevant if for all* $\alpha_0, \alpha_1 \in [0, 1]$ *and any* $\tau_0 \in \mathbb{R}$ *we have*

- *Constant prices:* $p_S(\tau_0, \alpha_0) = p_S(\tau_0, \alpha_1)$ *and* $p_D(\tau_0, \alpha_0) = p_D(\tau_0, \alpha_1)$
- *Constant quantity:* $Q(\tau_0, \alpha_0) = Q(\tau_0, \alpha_1)$
- *Constant revenue:* $R(\tau_0, \alpha_0) = R(\tau_0, \alpha_1)$

Definition 2 (Weak irrelevance of statutory incidence)**.** *The statutory incidence of some tax regime* $T = \{\tau, \alpha\}$ *is weakly irrelevant if for all* $\alpha_0, \alpha_1 \in [0, 1]$ *and any* $\tau_0 \in \mathbb{R}$ *there exists* $\tau_1 \in \mathbb{R}$ *such that*

- *Constant prices:* $p_S(\tau_0, \alpha_0) = p_S(\tau_1, \alpha_1)$ *and* $p_D(\tau_0, \alpha_0) = p_D(\tau_1, \alpha_1)$
- *Constant quantity:* $Q(\tau_0, \alpha_0) = Q(\tau_1, \alpha_1)$
- *Constant revenue:* $R(\tau_0, \alpha_0) = R(\tau_1, \alpha_1)$

As a corollary of Definition 1, under strong irrelevance, the economic incidence of a change in the tax rate is independent of its statutory incidence (**Corollary 1**).

We frequently express formulas in terms of the tax-inclusive price elasticities. Formally, these are defined as $\varepsilon^S := \frac{\partial S(p_S)}{\partial p_S} \frac{p_S}{S(p_S)}$ and $\varepsilon^D := \frac{\partial D(p_D)}{\partial p_D} \frac{p_D}{D(p_D)}$. Throughout, we assume $\varepsilon^S \geq 0$ and $\varepsilon^D \leq 0$.

2 Strong irrelevance of per unit taxes

To contrast ad valorem taxes, this section rederives the well-known insight that the statutory incidence of per unit taxes is irrelevant for economic incidence in a frictionless, competitive environment.

2.1 Strong irrelevance

Consider a per unit tax t for $\alpha \in (0, 1)$.[1] The tax-inclusive prices are $p_D = p + \alpha t$ and $p_S = p - (1 - \alpha)t$. The tax-exclusive price, p, is a function of t and α, and adjusts in equilibrium for markets to clear, i.e., $S(p - (1 - \alpha)t) = D(p + \alpha t)$. Proposition 1 establishes the strong statutory irrelevance of per unit taxes, implying economic incidence is independent of statutory incidence (Corollary 1).

Proposition 1. *Per unit taxes satisfy strong irrelevance of statutory incidence.*

Proof of proposition 1. Totally differentiating both sides of $S(p - (1 - \alpha)t) = D(p + \alpha t)$ with $d\alpha \neq 0$ and $dt = 0$, we obtain $\frac{\partial S}{\partial p_S} [dp + t d\alpha] = \frac{\partial D}{\partial p_D} [dp + t d\alpha]$, which is equivalent to $\left[\frac{\partial S}{\partial p_S} - \frac{\partial D}{\partial p_D}\right] [dp + t d\alpha] = 0$. Hence, unless $\frac{\partial S}{\partial p_S} = \frac{\partial D}{\partial p_D} = 0$, we must have $dp = -t d\alpha$.[2] From $dp_D = dp + t d\alpha$ and $dp_S = dp + t d\alpha$,

[1] All insights on statutory irrelevance hold for $\alpha = 0$ or $\alpha = 1$, respectively.

[2] Since $\frac{\partial S}{\partial p_S} \geq 0$ and $\frac{\partial D}{\partial p_D} \leq 0$ by assumption, the only possibility for $\left(\frac{\partial S}{\partial p_S} - \frac{\partial D}{\partial p_D}\right) = 0$ is that $\frac{\partial S}{\partial p_S} = 0$ and $\frac{\partial D}{\partial p_D} = 0$.

it follows $dp_S = dp_S = 0$. Finally, $dS = S'(p_S)dp_S$ and $dD = D'(p_D)dp_D$ imply $dQ^* = 0$ and $dR^* = dQ^*t + dtQ^* = 0$, satisfying Definition 1. □

2.2 Economic incidence formulas

The economic incidence of a tax is often expressed as the change in (tax-inclusive) prices in response to a change in the tax. Specifically, a per unit tax reform with $dt \neq 0$ and $d\alpha = 0$ for arbitrary $\alpha \in [0, 1]$ leads to the following price changes:

$$\frac{dp_S}{dt} = \frac{\varepsilon^D - \frac{\partial D}{\partial p_D}\frac{t}{D}}{\varepsilon^S - \varepsilon^D + \frac{\partial D}{\partial p_D}\frac{t}{D}} \tag{1}$$

$$\frac{dp_D}{dt} = \frac{\varepsilon^S}{\varepsilon^S - \varepsilon^D + \frac{\partial D}{\partial p_D}\frac{t}{D}}. \tag{2}$$

Online Appendix A.1 provides a detailed derivation of this result, which is obtained from totally differentiating $S(p - (1-\alpha)t) = D(p + \alpha t)$ with $d\alpha = 0$ and $dt \neq 0$ to obtain an expression for $\frac{dp}{dt}$, and then totally differentiating the expressions for p_S and p_D. The introduction of a small per unit tax, i.e., $t = 0$ and $dt \neq 0$, depicts the classical textbook formula:

$$\frac{dp_S}{dt} = \frac{\varepsilon^D}{\varepsilon^S - \varepsilon^D} \quad \text{and} \quad \frac{dp_D}{dt} = \frac{\varepsilon^S}{\varepsilon^S - \varepsilon^D}.$$

The strong irrelevance result implies prices are unaffected by shifts in the statutory incidence, i.e., $\frac{dp_S}{d\alpha} = 0$ and $\frac{dp_D}{d\alpha} = 0$. Accordingly, equations (1) and (2) remain valid for price changes in response to a small tax policy reform that changes both the statutory incidence and the tax rate.

3 Failure of strong irrelevance of ad valorem taxes

We now turn to the case of ad valorem taxes. Section 3.1 formally proves the failure of strong irrelevance. Section 3.2 provides intuition for this result. We then derive economic incidence formulas in section 3.3 for changes in the statutory incidence and tax rate, respectively. Section 3.4 provides numerical examples demonstrating the magnitude of the statutory incidence channel.

3.1 Formal proof

Proposition 2 shows that ad valorem taxes fail strong statutory irrelevance (Definition 1). In turn, the statutory incidence of a given ad valorem tax rate *is* relevant for real economic outcomes and the economic incidence of the tax.

Proposition 2. *Ad valorem taxes do not satisfy strong irrelevance of statutory incidence.*

Proof of proposition 2. Definition 1 requires $\frac{dp_S}{d\alpha} = \frac{dp_D}{d\alpha} = 0$. We will prove that $\frac{dp_S}{d\alpha} = 0$ and $\frac{dp_D}{d\alpha} = 0$ cannot hold simultaneously when $\tau \neq 0$. First, consider $p_S = [1 - (1-\alpha)\tau]p$. Totally differentiating both sides, and imposing $d\tau = 0$, $\frac{dp_S}{d\alpha} = [1 - (1-\alpha)\tau]\frac{dp}{d\alpha} + \tau p$. Postulating $\frac{dp_S}{d\alpha} = 0$, re-arrange to obtain $\frac{dp}{p} = -\tau d\alpha \frac{1}{1-(1-\alpha)\tau}$. Second, consider $p_D = (1 + \alpha\tau)p$. Totally differentiating and imposing

$d\tau = 0$, $\frac{dp_D}{d\alpha} = (1+\alpha\tau)dp + \tau p d\alpha$. Again, postulating $\frac{dp_D}{d\alpha} = 0$, re-arrange to obtain $\frac{dp}{p} = -\tau d\alpha \frac{1}{1+\alpha\tau}$. For these equations to hold simultaneously, we need $\tau = 0$. Thus, for any $\tau \neq 0$, Definition 1 is not satisfied, and the statutory incidence of an ad valorem tax matters for economic incidence. □

3.2 Intuition

The distortion of an ad valorem tax depends on the tax rate *multiplied* by its tax base—the tax-exclusive price p. Strong irrelevance fails for ad valorem taxes because a shift in the statutory incidence changes the *base* without adjusting the tax rate. While the tax base, p, does adjust to changes in the statutory incidence to maintain an equilibrium, it does not fully offset the shift in statutory incidence (unlike in the per unit tax case).

Consider a tax that is initially levied fully on the supply side and then shifted fully on the demand side. What happens in equilibrium?

1. Prior to the tax reform, $p_S^0 = (1-\tau_0)p_D^0$. The tax creates a wedge (distortion) equal to $\tau_0 p_D$.
2. The reform shifts the tax entirely on the demand side. Consider the (hypothetical) market immediately after the reform before the supplier adjusts the price. Then, $\tilde{p}_D = (1+\tau_0)p_S$. Since $p_S^0 < p_D^0$, the immediate wedge is smaller and consumers face a lower price $\tilde{p}_D < p_D^0$. At this point, there is excess demand: $D(\tilde{p}_D) > S(p_S^0)$.
3. The supplier raises the price until demand equals supply. At this new equilibrium, $p_D^1 = (1+\tau_0)p_S^1$ with $p_S^1 > p_S^0$. Since $p_S^1 \leq p_D^0$ for $\tau \geq 0$, the wedge is less distortive at $\tau_0 p_S^1 < \tau_0 p_D^0$.

The quantity increases as the tax is shifted onto the consumer. This result generalizes: for a given tax rate, τ_0, equilibrium quantity is maximized when τ_0 is levied fully on the demand side.

3.3 Economic incidence formulas

The canonical economic incidence analysis asks how the tax-inclusive prices adjust when the tax rate changes. Here, we extend this analysis to assessing price changes due to (i) changes in the statutory incidence at constant tax rate and (ii) changes in the tax rate at constant statutory incidence.[3] Online Appendix A.2 provides detailed derivations of these results.

Economic incidence of a change in statutory incidence

Suppose a tax reform shifts the statutory incidence by $d\alpha$ while keeping the tax rate unchanged. What are the effective changes in tax-inclusive prices p_S and p_D? Since the underlying tax-exclusive price, p, adjusts in equilibrium, result 1 first summarizes how p changes in response to the reform $d\alpha$.

Result 1 (Tax-exclusive price change due to statutory incidence shifts)**.** *Consider a tax-reform that shifts the statutory incidence by $d\alpha$ without altering the ad valorem tax rate, i.e., $d\tau = 0$. Then, the tax-exclusive price changes by*

$$\frac{dp}{p} = -\tau d\alpha \, \frac{\frac{\varepsilon^S}{1-(1-\alpha)\tau} - \frac{\varepsilon^D}{1+\alpha\tau}}{\varepsilon^S - \varepsilon^D}. \tag{3}$$

[3] The analysis considers small changes; thus, simultaneous variations in the tax rate and in statutory incidence are additively separable.

Result 1 follows from totally differentiating $S([1-(1-\alpha)\tau]p) = D((1+\alpha\tau)p)$ with $d\tau = 0$, using $S = D$, the definitions of ε^S and ε^D, and the relationships between p_S, p_D, and p.

To shed light on the economic incidence of the statutory incidence shift, we next express how the tax-inclusive prices p_S and p_D change in response to the $d\alpha$ reform. Result 2 describes these price changes. The expressions follow from totally differentiating $p_S = [1-(1-\alpha)\tau]p$ and $p_D = (1+\alpha\tau)p$, the result for $\frac{dp}{p}$, and setting $d\tau = 0$.

Result 2 (Tax-inclusive price changes due to statutory incidence shifts)**.** *Consider a tax-reform that shifts the statutory incidence by $d\alpha$ without altering the ad valorem tax rate, i.e., $d\tau = 0$. Then, the tax-inclusive prices change by*

$$\frac{dp_S}{p_S} = d\alpha \frac{\tau^2}{(1+\alpha\tau)[1-(1-\alpha)\tau]} \frac{-\varepsilon^D}{\varepsilon^S - \varepsilon^D} \tag{4}$$

$$\frac{dp_D}{p_D} = d\alpha \frac{\tau^2}{(1+\alpha\tau)[1-(1-\alpha)\tau]} \frac{-\varepsilon^S}{\varepsilon^S - \varepsilon^D}. \tag{5}$$

Result 2 has important economic implications. First, as is well-known for per unit taxes, the incidence is proportional to the relative elasticities, and falls more on the less elastic side. Second—which is worth stressing—the price change is non-zero since ad valorem taxes do not satisfy strong irrelevance of statutory incidence. Third, for $\alpha \neq 1$, a reform that only shifts the statutory incidence towards the demand side ($d\alpha > 0$ and $d\tau = 0$) increases the supplier price ($\frac{dp_S}{p_S} > 0$) and decreases the consumer price ($\frac{dp_D}{p_D} < 0$). A corollary of this is that—for a given tax rate τ_0—the equilibrium quantity (Q) is maximized when the statutory incidence falls fully on the demand side (**Corollary 2**).

Since tax revenue is $R = \tau p Q$, and p and Q move in opposite directions for changes in the statutory incidence, $d\alpha \neq 0$, the revenue-maximizing α at constant τ is ambiguous. However, for $\varepsilon^D \geq -1$, revenue is maximized when $\alpha = 0$, i.e., the tax falls fully on the supply side (**Corollary 3**).[4]

All results follow through for subsidies with $s = -\tau$ (**Corollary 4**). The frictionless framework can be easily extended by introducing behavioral terms on one market side, such as reduced tax salience.

Economic incidence of a change in the tax rate

Consider now a tax reform that changes the tax rate by $d\tau$ while keeping the statutory incidence unchanged. How will the tax-inclusive prices p_S and p_D change? As before, the tax-exclusive price, p, responds to maintain market clearing.

Result 3 (Tax-exclusive price change due to tax rate changes)**.** *Consider a tax-reform that changes the tax rate by $d\tau \neq 0$ while keeping the statutory incidence unchanged, i.e., $d\alpha = 0$. Then, the tax-exclusive price changes by*

$$\frac{dp}{d\tau}\frac{1}{p} = \frac{\frac{1-\alpha}{1-(1-\alpha)\tau}\varepsilon^S + \frac{\alpha}{1+\alpha\tau}\varepsilon^D}{(\varepsilon^S - \varepsilon^D)}. \tag{6}$$

Result 3 follows from totally differentiating the equilibrium condition $S([1-(1-\alpha)\tau]p) = D((1+\alpha\tau)p)$

[4] Totally differentiating $R = \tau p Q = \tau p D$ gives $\frac{dR}{R} = \frac{dp}{p} + \frac{dD}{D}$. This can be rewritten as $dR = (1+\varepsilon^D)\frac{dp}{p} + \frac{\tau}{1+\alpha\tau}\varepsilon^D d\alpha$.

with $d\tau \neq 0$ and $d\alpha = 0$. Result 4 describes the changes in tax-inclusive prices.

Result 4 (Tax-inclusive price changes due to tax rate changes)**.** *Consider a tax-reform that changes the tax rate by $d\tau \neq 0$ while keeping the statutory incidence unchanged, i.e., $d\alpha = 0$. Then, tax-inclusive prices change by*

$$\frac{dp_S}{p_S} = d\tau \frac{1}{[1-(1-\alpha)\tau]\,(1+\alpha\tau)} \frac{\varepsilon^D}{(\varepsilon^S - \varepsilon^D)} \tag{7}$$

$$\frac{dp_D}{p_D} = d\tau \frac{1}{[1-(1-\alpha)\tau]\,(1+\alpha\tau)} \frac{\varepsilon^S}{(\varepsilon^S - \varepsilon^D)}. \tag{8}$$

Equations (7) and (8) are similar to the well-established incidence formulas of per unit taxes expressed in equations (1) and (2). In both cases, the economic incidence is proportional to the relative elasticities. Unlike the per unit tax case, however, the statutory incidence (α) matters for the economic incidence through the term $\frac{1}{[1-(1-\alpha)\tau](1+\alpha\tau)}$; this term only drops out when $\tau = 0$ reflecting the *introduction* of a small ad valorem tax. A further distinction—given the proportionate nature of an ad valorem tax—is that the economic incidence is expressed as a relative change. Finally, the ratio of relative price changes, $\left[\frac{dp_S}{p_S}\right] / \left[\frac{dp_D}{p_D}\right] = \frac{\varepsilon^D}{\varepsilon^S}$, is constant and independent of the statutory incidence and the tax rate, but empirical researchers are typically more interested in examining the separate effects on supply and demand prices, e.g., the effect on total labor costs or take-home pay.

3.4 Numerical examples of economic incidence

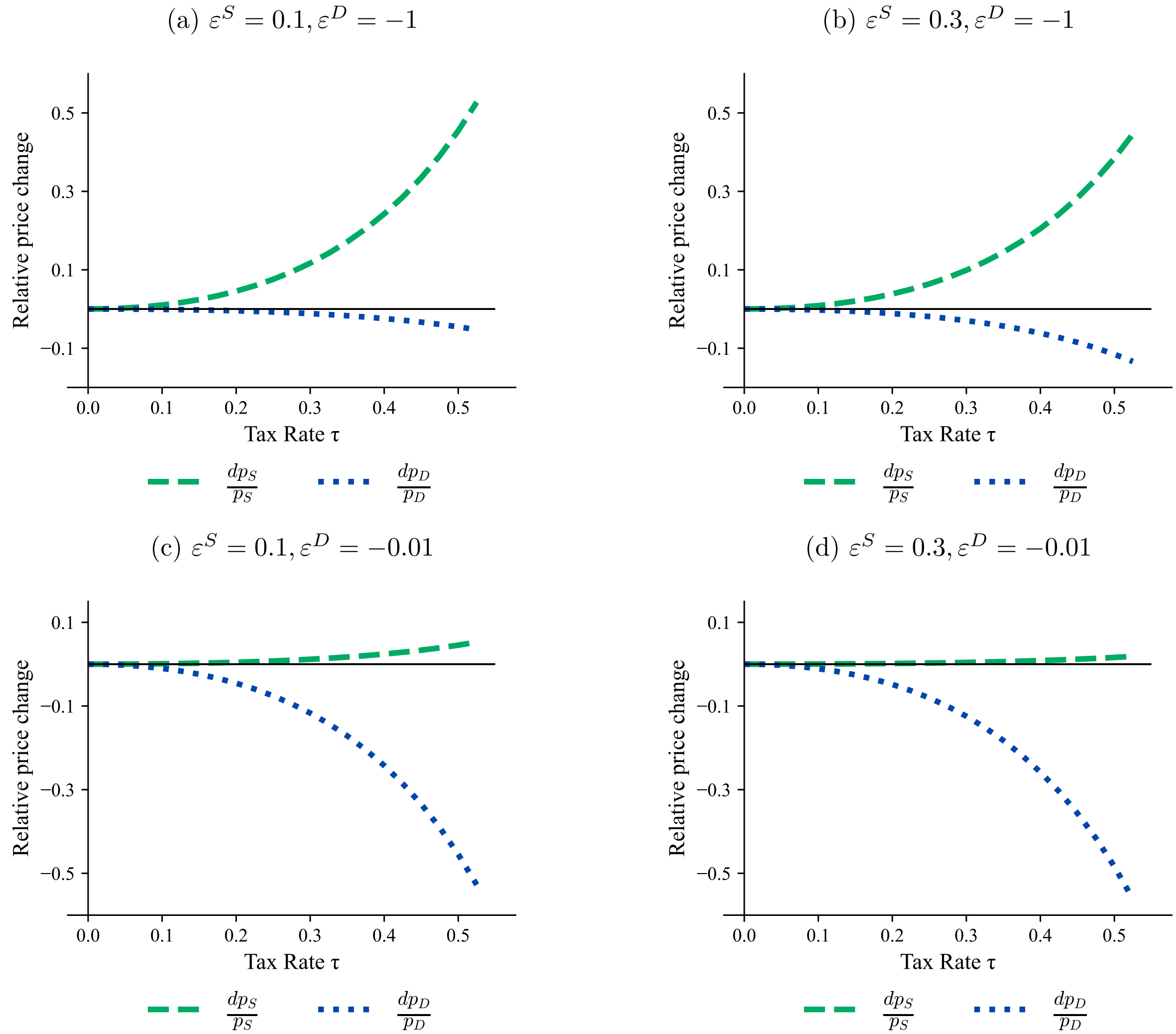
The previous section established two key results: (i) shifts in the statutory incidence while holding the tax rate constant will lead to changes in prices, and (ii) the statutory incidence matters for how prices change in response to changes in the tax rate. The following simulates the magnitude of these effects based on the incidence formulas derived in section 3.3.

While these simulations are general, we choose parameters to match the payroll tax context. In the payroll setting, p_S refers to the after-tax wage received by employees, and p_D refers to the per unit labor costs paid by employers. The only unknowns in the economic incidence formulas are the supply and demand elasticities, ε^S and ε^D, which we set based on the empirical literature: $\varepsilon^S \in [0.1, 0.3]$ (Chetty et al., 2011) and $\varepsilon^D \in [-1, -0.01]$ (Lichter et al., 2015).

Simulating economic incidence for a change in statutory incidence

Figure 2 shows price changes, $\frac{dp_S}{p_S}$ and $\frac{dp_D}{p_D}$, in response to a tax reform that shifts the statutory incidence from the supply side ($\alpha = 0$) to the demand side ($d\alpha = 1$) while keeping the tax rate constant (see result 2). To interpret these price changes, recall that a shift of the statutory incidence from the supply to the demand side, while keeping the nominal tax rate fixed, acts like a decrease in the tax rate under the initial statutory incidence. Panels 2a and 2b depict cases when supply is less elastic than demand. Consequently, the supply side bears a larger share of the economic incidence of the ad valorem tax. When the statutory incidence is shifted onto the demand side, the suppliers benefit proportionally more from the reduction in the effective tax rate. Panels 2c and 2d depict the opposite case when demand is less elastic than supply.

Figure 2: Effect of shifting the statutory incidence from the supply to the demand side



Notes: This figure shows numerical examples for the effect of changing the demand-side statutory incidence from $\alpha = 0$ to $\alpha = 1$ on relative price changes. Each panel shows the effect on the relative supply-side price change in blue and on the relative demand-side change in green for different levels of the tax rate τ. Panel (a) corresponds to a supply elasticity of 0.1 and a demand elasticity of -1. Panel (b) corresponds to a supply elasticity of 0.3 and a demand elasticity of -1. Panel (c) corresponds to a supply elasticity of 0.1 and a demand elasticity of -0.01. Panel (d) corresponds to a supply elasticity of 0.3 and a demand elasticity of -0.01.

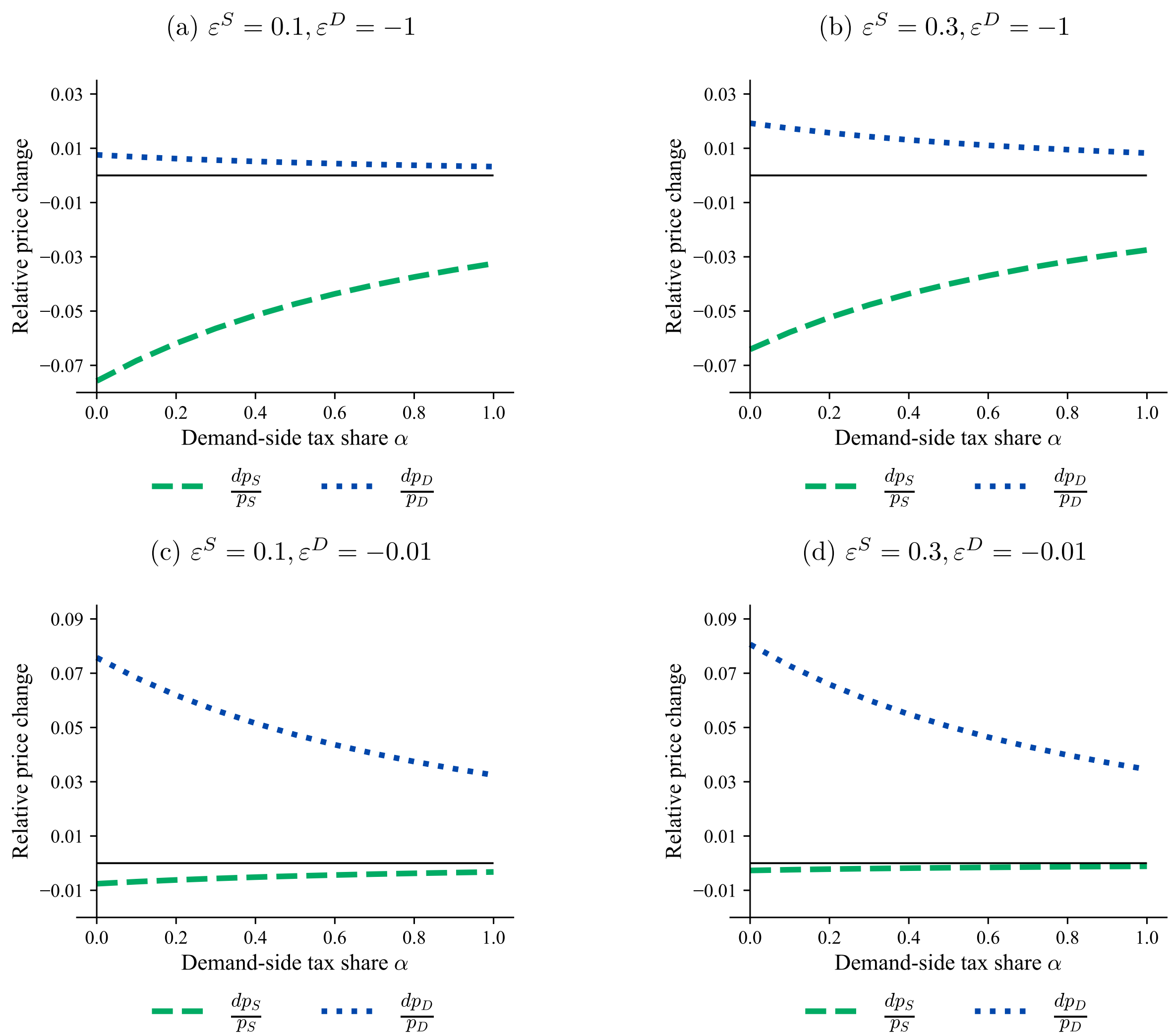
The proportional price changes are small for low tax rates. For medium-to-large tax rates, however, the price changes are non-negligible. This has important implications for empirical research: when analyzing a reform with a meaningful shift in the statutory incidence and a sizable tax rate, prices *are* expected to change even in the absence of any optimization frictions.

Simulating economic incidence for a change in tax rate

Figure 3 shows expected price changes, $\frac{dp_S}{p_S}$ and $\frac{dp_D}{p_D}$, in response to a change in the tax rate. These price changes will depend on the statutory incidence, which we keep constant in the simulations (i.e., $d\alpha = 0$; see result 4). For illustrative purposes, we set $\tau_0 = 0.4$ and consider $d\tau = 0.05$.

An important insight of the above theory is that an ad valorem tax rate of τ_0 creates larger distortions when the statutory incidence falls on suppliers than when it falls on buyers. We show this across combinations of elasticities in Figure 3: price changes are smaller the larger the statutory incidence share of the demand side (α). The relative elasticities determine the degree to which suppliers or buyers bear the economic incidence. For instance, suppliers face larger price decreases than consumers face price increases when demand is relatively more elastic (Panels 3a and 3b).

Figure 3: Numerical Examples for Effect of a Change in Tax Rate on Relative Price Changes



Notes: This figure shows numerical examples for the effect of changing the tax rate from 0.4 to 0.45 on relative price changes. Each panel shows the effect on the relative supply-side price change in blue and on the relative demand-side change in green for different levels of the demand-side tax share α. Panel (a) corresponds to a supply elasticity of 0.1 and a demand elasticity of -1. Panel (b) corresponds to a supply elasticity of 0.3 and a demand elasticity of -1. Panel (c) corresponds to a supply elasticity of 0.1 and a demand elasticity of -0.01. Panel (d) corresponds to a supply elasticity of 0.3 and a demand elasticity of -0.01.

These simulations reveal that the economic incidence of a nominal change in the tax rate differs substantially between a statutory incidence of $\alpha = 0$ and of $\alpha = 1$. When considering a tax rate change of $d\tau$, it is thus important to account for the statutory incidence of the tax.

4 Restoring weak irrelevance of ad valorem taxes

Section 3 established that ad valorem taxes fail the strong irrelevance of statutory incidence (definition 1). One interpretation of this result is that an ad valorem tax of τ_0 levied fully on the supply side is not the same "tax" as an ad valorem tax of τ_0 levied fully on the demand side. From a policy perspective, arguably, what matters is (i) how the tax distorts allocations and (ii) how much revenue it generates. This is captured in the notion of weak statutory irrelevance (definition 2): for an ad valorem tax at rate τ_0 on the supply side, is there a rate τ_1 that achieves the exact same outcomes when levied on the demand side?

Proposition 3 demonstrates that ad valorem taxes satisfy weak statutory irrelevance. The intuition is based on the observation that changes in statutory incidence and tax rates can offset each other. For each combination of statutory incidence and tax rate, there exist other combinations of statutory incidence *and* tax rate that result in the same equilibrium prices, quantity, and tax revenue. These different (τ, α) combinations are therefore equivalent to the same per unit tax that leads to the corresponding equilibrium.

Proposition 3. *Ad valorem taxes satisfy weak irrelevance of statutory incidence.*

Proof of proposition 3. Consider tax schedules $\mathcal{T}_0 = (\tau_0, \alpha_0)$ and $\mathcal{T}_1 = (\tau_1, \alpha_1)$ with

$$(\tau_0, \alpha_0): \quad p_D^0 = (1 + \alpha_0 \tau_0) p^0 \text{ and } p_S^0 = [1 - (1 - \alpha_0)\tau_0] p^0$$
$$(\tau_1, \alpha_1): \quad p_D^1 = (1 + \alpha_1 \tau_1) p^1 \text{ and } p_S^1 = [1 - (1 - \alpha_1)\tau_1] p^1.$$

Suppose prices are equalized under both regimes, $p_S^0 = p_S^1$ and $p_D^0 = p_D^1$. If this holds, then $\mathcal{T}_0$ and $\mathcal{T}_1$ achieve equal equilibrium quantities. This condition is true for

$$\tau_1 = \frac{\tau_0}{1 + (\alpha_0 - \alpha_1)\tau_0} = \frac{\tau_0}{1 - d\alpha \; \tau_0}. \tag{9}$$

One can then show that (9) implies $R_0 = \tau_0 p^0 = \tau_1 p^1 = R_1$. □

For example, suppose τ_0 is fully levied on the supply side (i.e., $\tau_S = \tau_0$, $\alpha_0 = 0$). Shifting the tax fully onto the demand side ($d\alpha = 1$) results in the same quantities, prices, and tax revenue when $\tau_D = \frac{\tau_S}{1 - \tau_S}$, or equivalently $\tau_S = \frac{\tau_D}{1 + \tau_D}$.

Proposition 3 shows that any change in the statutory incidence can be offset by a change in the tax rate (in the frictionless benchmark). Analogously, any change in the tax rate can be offset by a change in the statutory incidence. This result extends policymakers options to implement policies that change or keep effective tax rates despite shifts in the statutory incidence.

5 Application to payroll taxes in OECD countries

This section characterizes implications of our theoretical insights for payroll taxes among OECD countries. Payroll taxes—or social insurance contributions—demonstrate the importance of statutory incidence in practice. Payroll taxes are taxes on the earnings of employees to fund various social insurance schemes, such as public pensions, health, or unemployment insurance. The statutory share of these taxes falling on the employer varies from 8% in Lithuania to 95% in Estonia among the OECD countries in our sample in 2024.

The following analyses combine data on payroll taxes we collected from OECD (2025), government websites, and consulting firms.[5] The design of payroll taxes differs widely across OECD countries both in terms of their level and coverage as well as the statutory split between employers and employees. We focus on OECD countries for which social contributions funded through payroll taxes cover at least pension, health, and unemployment insurance—the three most common components of social insurances. We exclude countries where these insurances are funded through general income taxes. This sample includes 23 out of the 38 OECD countries.

Fact I: Differences in statutory incidence affect payroll tax comparisons across countries, requiring a standardization of statutory incidences for more accurate comparisons

A key theoretical insight is that effective tax rates depend on the statutory incidence. Heterogeneity in statutory incidence across countries' payroll taxes thus renders cross-country comparisons of nominal tax rates inadequate. Instead, one should standardize tax rates by converting them to a common statutory incidence following equation (9). The OECD, for instance, reports the "tax wedge," corresponding to the employer-side standardization in our framework.[6]

Figure 4a shows two such revenue-equivalent conversions: one where the tax falls fully on the employer ($\alpha = 1$, black X) and one where the tax falls fully on the employee ($\alpha = 0$, red squares). Consistent with the notion of "effective tax rate," the revenue-equivalent tax rate is above the nominal rate when falling on the employer, and is below the nominal rate when falling on the employee. This adjustment meaningfully shifts country rankings. For instance, while France exhibits the highest nominal rate, its standardized rate is lower than that of Austria. Slovenia and Costa Rica have very similar statutory rates, but around 10pp different standardized rates.

Fact II: Total payroll tax rates and employer shares are positively correlated, implying more muted cross-country differences in effective payroll tax rates

Figure 4b shows the relationship between payroll tax rates and statutory incidences in 2024. Tax rates range from around $\tau = 0.15$ to almost $\tau = 0.5$. While the employer bears at least half of the statutory incidence in almost all countries, substantial variation remains. Overall, there is a positive association between the tax rate and the employer share.[7] This implies that differences in effective rates across countries are generally smaller than differences in nominal rates.

While the previous analysis provides a cross-country comparison for 2024, changes in the tax rate and in employers' shares between 2000 to 2024 are also positively correlated. This also holds in a

[5]We use average employer and employee payroll tax rates for full-time employees at 100% of the average wage.

[6]The OECD defines the tax wedge to be "the ratio between the amount of taxes paid by an average single worker [...] and the corresponding total labour cost for the employer."

[7]All of the results in Figure 4 and those mentioned in this section are robust to excluding Lithuania (an outlier with a low tax rate and statutory incidence) or in the subset of countries shown in Figure 4c.

regression with country and year fixed effects, where a 10 percentage-point increase in the tax rate is associated with a 2.1 percentage-point higher employer share ($p < 0.001$).

Fact III: The positive relationship between payroll tax rates and the employer share persists within types of payroll taxes

For better comparability and to identify specific patterns, Figure 4c decomposes payroll taxes into their specific components. We include the 16 countries that have individual rates on each of health insurance, pension, and unemployment insurance. The positive relationship between the tax rate and the employer share persists within each type. This suggests that the positive association for payroll taxes is a general phenomenon across types of payroll taxes and not just the result of aggregating various payroll taxes of different sizes and employer shares.

Interpreting the facts: A policymaker's view and its implications on effective tax rates

Under the classical view, statutory incidence is irrelevant for economic incidence, so one might not expect any systematic correlation. By contrast, a "traditional" view equates statutory and economic incidence, leading policymakers to increase employer shares to reduce workers' tax burden. Empirically, average employer shares are lower for health insurance (0.55) and pensions (0.57) than for unemployment insurance (0.67) and accident insurance (almost always 100%), consistent with the "traditional" view that employers bear greater responsibility for unemployment and workplace risks.

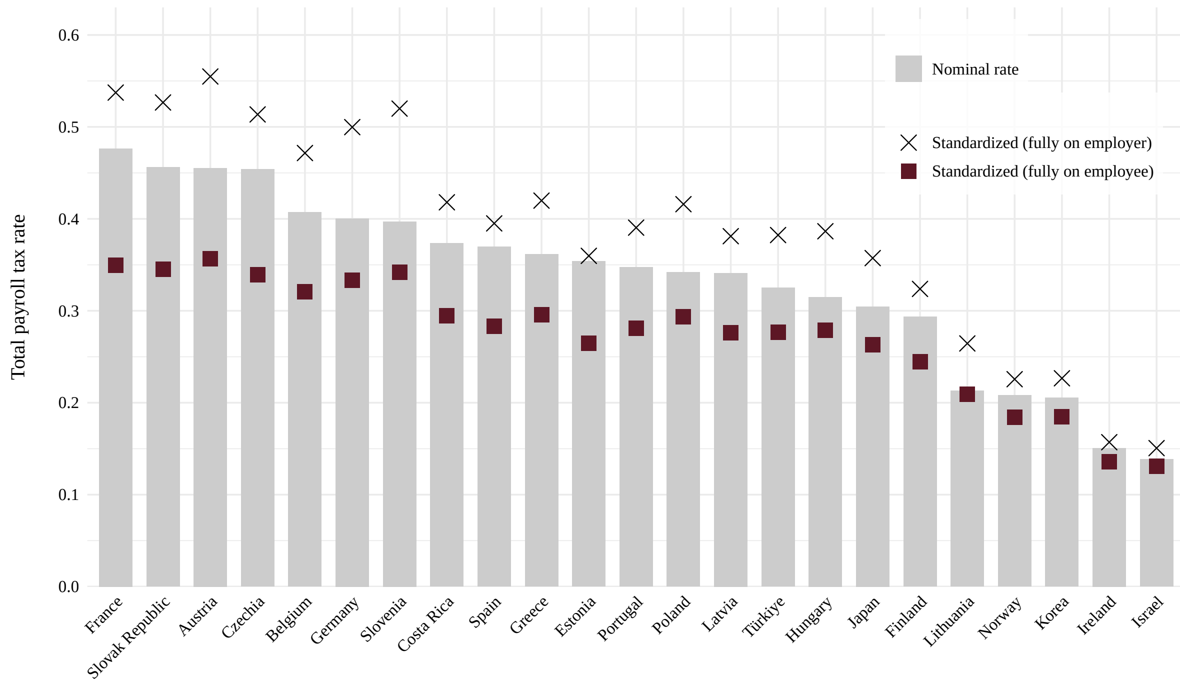
Recent payroll tax reforms illustrate this "traditional" view which links statutory and economic incidence. Germany's health insurance "add-on premium" was levied fully on employees before 2019, when it was split evenly between employers and employees without changing the nominal rate. The shift aimed at redistributing the economic burden.[8] In Finland, to reduce non-wage labor costs, unions and employers agreed to raise employees' pension contributions by 1.2pp between 2017 and 2020 and raise employees' unemployment insurance contributions by 0.85pp between 2017 and 2018 while lowering the employer shares by the respective amounts. Our theoretical insights imply that shifting the statutory incidence toward employers at constant rates reduces the overall economic burden (on both workers and firms) whereas shifts toward the employee increase effective rates. Thus, the German reform lowered the effective tax rate, whereas it increased in Finland.

Other reforms illustrate the "traditional" view by simultaneously changing payroll tax rates and statutory incidence. Mexico, for instance, increased employer contributions for old-age support from 5.15% to 13.875% in 2020, raising employer shares with the goal of leaving workers' income unaffected.[9] Lithuania implemented a reform in 2019 in the opposite direction aimed at reducing the tax burden on labor and stabilizing the tax environment.[10] Employer rates were decreased from 30.5% to 1.46%, whereas employee rates increased from 9% to 20.96%. Similarly, Romania (a non-OECD country) shifted social contributions from the employer to the employee in 2018. Employee rates increased from 16.5% to 35.0%, while the employer rate fell from 22.75% to 2.25%. The reform was motivated by reducing the administrative burden on the employers and improving social contribution

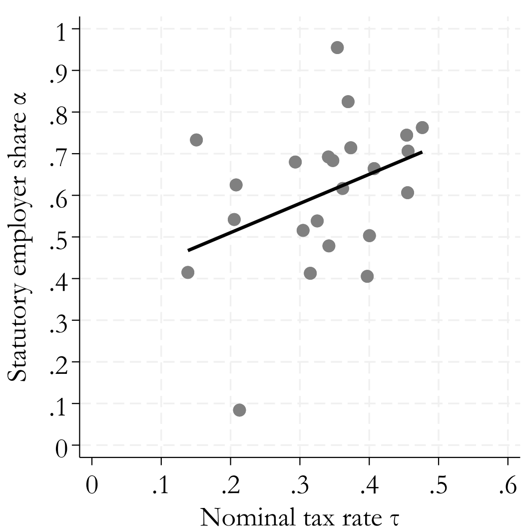
[8] Link to Federal Ministry of Health, accessed: 10/2025.
[9] Link to Ministry of Finance Mexico , accessed: 10/2025
[10] Link to Ministry of Finance Lithuania, accessed: 10/2025

Figure 4: Payroll taxes and statutory incidence across OECD countries

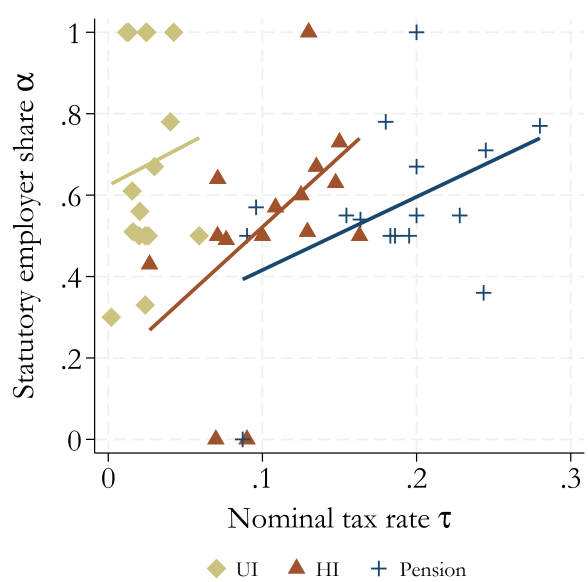
(a) Nominal and standardized payroll tax rates



(b) Correlation between τ and α



(c) Correlation between τ and α by type



Notes: This figure shows payroll tax rates and corresponding statutory incidences for OECD countries in 2024. In Panel (a), each gray bar corresponds to the total nominal tax rate. Each black X corresponds to the standardized tax rate when it falls completely on the employer ($\alpha = 1$). Each red square corresponds to the standardized tax rate when it falls completely on the employee ($\alpha = 0$). Panel (b) plots each country's nominal payroll tax rate against its statutory incidence. Panel (c) shows nominal unemployment (yellow diamonds), health (orange triangles), and pension (blue pluses) insurance tax rates and their respective statutory incidences.

collection.[11] While the effective payroll tax rate declined in Lithuania despite the increase in the employee share, the effective tax rate in Romania increased despite a lower nominal rate post-reform.

6 Conclusion

This paper reexamined the classical irrelevance of statutory incidence for ad valorem taxes. For tax incidence research, our results call for a better decomposition of observed price and quantity effects into a mechanic effect as expected in competitive equilibrium absent any frictions and additional effects due to optimization frictions or evasion opportunities. For policy, our results demonstrate that shifts in the statutory incidence imply effective tax rate changes. These insights can guide our understanding of how statutory incidence of ad valorem taxes affects economic incidence, and are important for building more elaborate theories to explain tax anomalies (Benzarti, 2025).

[11] Link to brief by the European Commission, accessed: 10/2025

References

Benzarti, Y. (2025). Tax Incidence Anomalies. *Annual Review of Economics*, 17:615–634.

Bibler, A. J., Teltser, K. F., and Tremblay, M. J. (2021). Inferring Tax Compliance from Pass-Through: Evidence from Airbnb Tax Enforcement Agreements. *The Review of Economics and Statistics*, 103(4):636–651.

Chetty, R., Guren, A., Manoli, D., and Weber, A. (2011). Are Micro and Macro Labor Supply Elasticities Consistent? A Review of Evidence on the Intensive and Extensive Margins. *American Economic Review*, 101(3):471–75.

Chetty, R., Looney, A., and Kroft, K. (2009). Salience and Taxation: Theory and Evidence. *American Economic Review*, 99(4):1145–1177.

Claussen, J., Streich, D., and Vlieg, K. (2024). Does Statutory Incidence Matter? Evidence from the German Real Estate Market. *SSRN WP 4860135*.

Dalton, H. (1941). *Principles of Public Finance*. London: Routledge and Kegan.

Fox, W. F., Hargaden, E. P., and Luna, L. (2022). Statutory Incidence and Sales Tax Compliance: Evidence from Wayfair. *Journal of Public Economics*, 213:104716.

Fullerton, D. and Metcalf, G. E. (2002). Tax Incidence. *Handbook of Public Economics*, 4:1787–1872.

Garriga, P. and Tortarolo, D. (2024). Firms as Tax Collectors. *Journal of Public Economics*, 233:105092.

Gruber, J. (2019). *Public Finance and Public Policy 6th Edition*. New York: Macmillan.

Hansen, B., Miller, K., and Weber, C. (2017). The Taxation of Recreational Marijuana: Evidence from Washington State. *NBER WP 23632*.

Hargaden, E. and Roantree, B. (2019). *Does Statutory Incidence Matter?: Earnings Responses to Social Security Contributions*. University of Oxford, Saïd Business School, Centre for Business Taxation.

Jiménez, G., Martinez-Miera, D., and Peydró, J.-L. (2024). Who Truly Bears (Bank) Taxes? Evidence from Only Shifting Statutory Incidence. *Journal of Public Economics*, 240:105173.

Kopczuk, W., Marion, J., Muehlegger, E., and Slemrod, J. (2016). Does Tax-Collection Invariance Hold? Evasion and the Pass-Through of State Diesel Taxes. *American Economic Journal: Economic Policy*, 8(2):251–286.

Kotlikoff, L. J. and Summers, L. H. (1987). Tax incidence. In *Handbook of Public Economics*, volume 2, pages 1043–1092. Elsevier.

Lichter, A., Peichl, A., and Siegloch, S. (2015). The Own-wage Elasticity of Labor Demand: A Meta-regression Analysis. *European Economic Review*, 80:94–119.

OECD (2025). *Taxing Wages 2025: Decomposition of Personal Income Taxes and the Role of Tax Reliefs*. OECD Publishing, Paris.

Pauwels, W. and Schroyen, F. (2024). The Legal Incidence of Ad Valorem Taxes Matters. *Journal of Economics*, pages 1–13.

Saez, E., Matsaganis, M., and Tsakloglou, P. (2012). Earnings Determination and Taxes: Evidence From a Cohort-Based Payroll Tax Reform in Greece. *The Quarterly Journal of Economics*, 127(1):493–533.

Saez, E. and Zucman, G. (2024). Distributional Tax Analysis in Theory and Practice: Harberger meets Diamond-Mirrlees. Working paper, NBER WP 31912.

Salanié, B. (2003). *The Economics of Taxation.* MIT Press, Cambridge, Mass.

Slemrod, J. (2008). Does It Matter Who Writes the Check to the Government? The Economics of Tax Remittance. *National Tax Journal*, 61(2):251–275.

Slemrod, J. (2019). Tax Compliance and Enforcement. *Journal of Economic Literature*, 57(4):904–954.

Stiglitz, J. E. and Rosengard, J. K. (2015). *Economics of the Public Sector - Fourth Edition.* WW Norton & Company.

Online Appendix

A Detailed derivations

A.1 Per unit taxes — detailed derivations

A.1.1 Economic incidence of per unit taxes

We consider the case $d\alpha = 0$ and $dt \neq 0$ for arbitrary $\alpha \in [0,1]$. We start by totally differentiating the equilibrium condition $S(p-(1-\alpha)t) = D(p+\alpha t)$ and using $p_S = p_D - t$, which results in

$$\begin{aligned}
\frac{\partial S}{\partial p_S}[dp-(1-\alpha)dt] &= \frac{\partial D}{\partial p_D}[dp+\alpha dt] \\
\Leftrightarrow \frac{dp}{dt}\left[\frac{\partial S}{\partial p_S} - \frac{\partial D}{\partial p_D}\right] &= \frac{\partial S}{\partial p_S}(1-\alpha) + \frac{\partial D}{\partial p_D}\alpha \\
\Leftrightarrow \frac{dp}{dt} &= \frac{(1-\alpha)\varepsilon^S + \alpha\varepsilon^D - \frac{\partial D}{\partial p_D}\frac{t}{D}}{\varepsilon^S - \varepsilon^D + \frac{\partial D}{\partial p_D}\frac{t}{D}}.
\end{aligned}$$

Setting $t = 0, \alpha = 1$, we derive the classical text book result:

$$\frac{dp}{dt} = \frac{\varepsilon^D}{\varepsilon^S - \varepsilon^D}.$$

However, the effects on p_S and p_D are independent of the statutory incidence: First, consider $p_S = p - (1-\alpha)t$. Totally differentiating both sides yields:

$$\begin{aligned}
dp_S &= dp - (1-\alpha)dt \\
\Leftrightarrow \frac{dps}{dt} &= \frac{\varepsilon^D - \frac{\partial D}{\partial p_D}\frac{t}{D}}{\varepsilon^S - \varepsilon^D + \frac{\partial D}{\partial p_D}\frac{t}{D}}.
\end{aligned}$$

Similarly, we totally differentiate $p_D = p_S + t$, yielding:

$$\frac{dp_D}{dt} = \frac{\varepsilon^S}{\varepsilon^S - \varepsilon^D + \frac{\partial D}{\partial p_D}\frac{t}{D}}.$$

Both yield the classical textbook result for $t = 0$.

A.1.2 Effect of simultaneous changes in tax rate and statutory incidence

We start by totally differentiating the equilibrium condition $S(p-(1-\alpha)t) = D(p+\alpha t)$ and using $p_S = p_D - t$, which results in

$$\begin{aligned}
\frac{\partial S}{\partial p_S}\left[dp-(1-\alpha)dt+td\alpha\right] &= \frac{\partial D}{\partial p_D}\left[dp+d\alpha t+\alpha dt\right] \\
\Leftrightarrow \frac{dp}{dt}\left[\frac{\partial S}{\partial p_S}-\frac{\partial D}{\partial p_D}\right]+\frac{d\alpha t}{dt}\left[\frac{\partial S}{\partial p_S}-\frac{\partial D}{\partial p_D}\right] &= \frac{\partial S}{\partial p_S}(1-\alpha)+\frac{\partial D}{\partial p_D}\alpha \\
\Leftrightarrow \frac{dp}{dt} &= -\frac{d\alpha t}{dt}+\frac{(1-\alpha)\varepsilon^S+\alpha\varepsilon^D-\frac{\partial D}{\partial p_D}\frac{t}{D}}{\varepsilon^S-\varepsilon^D+\frac{\partial D}{\partial p_D}\frac{t}{D}}.
\end{aligned}$$

Again, the effects on p_S and p_D are independent of the statutory incidence: First, consider $p_S = p-(1-\alpha)t$. Totally differentiating both sides yields:

$$\begin{aligned}
dp_S &= dp-(1-\alpha)dt+td\alpha \\
\Leftrightarrow \frac{dps}{dt} &= \frac{\varepsilon^D-\frac{\partial D}{\partial p_D}\frac{t}{D}}{\varepsilon^S-\varepsilon^D+\frac{\partial D}{\partial p_D}\frac{t}{D}}.
\end{aligned}$$

Similarly, we totally differentiate $p_D = p_S + t$, yielding:

$$\frac{dp_D}{dt} = \frac{\varepsilon^S}{\varepsilon^S-\varepsilon^D+\frac{\partial D}{\partial p_D}\frac{t}{D}}.$$

A.2 Ad valorem taxes — detailed derivations

A.2.1 Details on the effects of a change in statutory incidence only

Derivation of result 1. We start by totally differentiating the equilibrium condition $S([1-(1-\alpha)\tau]p) = D((1+\alpha\tau)p)$, which results in

$$\begin{aligned}
\frac{\partial S}{\partial p_S}\left[[1-(1-\alpha)\tau]dp+\tau p d\alpha\right] &= \frac{\partial D}{\partial p_D}\left[(1+\alpha\tau)dp+\tau p d\alpha\right] \\
\Leftrightarrow \frac{\partial S}{\partial p_S}\left[[1-(1-\alpha)\tau]\frac{dp}{d\alpha}+\tau p\right] &= \frac{\partial D}{\partial p_D}\left[(1+\alpha\tau)\frac{dp}{d\alpha}+\tau p\right] \\
\Leftrightarrow \frac{dp}{d\alpha}\left[[1-(1-\alpha)\tau]\frac{\partial S}{\partial p_S}-[1+\alpha\tau]\frac{\partial D}{\partial p_D}\right] &= -\tau\left[\frac{\partial S}{\partial p_S}p-\frac{\partial D}{\partial p_D}p\right].
\end{aligned}$$

Using the fact that $S = D$ in equilibrium, we can write

$$\frac{dp}{d\alpha}\left[[1-(1-\alpha)\tau]\frac{\partial S}{\partial p_S}\frac{p_S}{S}\frac{1}{p_S}-[1+\alpha\tau]\frac{\partial D}{\partial p_D}\frac{p_D}{D}\frac{1}{p_D}\right] = -\tau\left[\frac{\partial S}{\partial p_S}\frac{p_S}{S}\frac{1}{p_S}p-\frac{\partial D}{\partial p_D}\frac{p_D}{D}\frac{1}{p_D}p\right],$$

which given the definition of ε^S and ε^D simplifies to

$$\frac{dp}{d\alpha}\left[\frac{1-(1-\alpha)\tau}{p_S}\varepsilon^S - \frac{1+\alpha\tau}{p_D}\varepsilon^D\right] = -\tau\left[\varepsilon^S\frac{p}{p_S} - \varepsilon^D\frac{p}{p_D}\right].$$

Using the relationship between p_D, p_S and p, this further simplifies to

$$\frac{dp}{d\alpha}\frac{1}{p}\left(\varepsilon^S - \varepsilon^D\right) = -\tau\left[\frac{\varepsilon^S}{1-(1-\alpha)\tau} - \frac{\varepsilon^D}{1+\alpha\tau}\right].$$

Re-arranging gives result 1. □

Derivation of result 2. First, let us consider $p_S = [1-(1-\alpha)\tau]p$. Totally differentiating and holding τ constant, we obtain

$$\begin{aligned} dp_S &= [1-(1-\alpha)\tau]dp + \tau p d\alpha \\ \Leftrightarrow \frac{dp_S}{p_S} &= \frac{1-(1-\alpha)\tau}{p_S}dp + \tau\frac{p}{p_S}d\alpha \\ &= \frac{dp}{p} + \tau d\alpha\frac{1}{1-(1-\alpha)\tau}. \end{aligned}$$

Plugging in (3) for $\frac{dp}{p}$, we obtain

$$\begin{aligned} \frac{dp_S}{p_S} &= \tau d\alpha\left[\frac{-\frac{\varepsilon^S}{1-(1-\alpha)\tau} + \frac{\varepsilon^D}{1+\alpha\tau}}{\varepsilon^S - \varepsilon^D} + \frac{1}{1-(1-\alpha)\tau}\right] \\ &= \tau d\alpha\left[\frac{-\varepsilon^S + \frac{1-(1-\alpha)\tau}{1+\alpha\tau}\varepsilon^D + \varepsilon^S - \varepsilon^D}{[1-(1-\alpha)\tau](\varepsilon^S - \varepsilon^D)}\right]. \end{aligned}$$

Further simplifying gives (4).

Second, let us consider $p_D = (1+\alpha\tau)p$. Totally differentiating and holding τ constant, we obtain

$$\begin{aligned} dp_D &= (1+\alpha\tau)dp + \tau p d\alpha \\ \Leftrightarrow \frac{dp_D}{p_D} &= \frac{1+\alpha\tau}{p_D}dp + \tau\frac{p}{p_D}d\alpha \\ &= \frac{dp}{p} + \frac{1}{1+\alpha\tau}\tau d\alpha \\ &= -\tau d\alpha\left[\frac{\frac{\varepsilon^S}{1-(1-\alpha)\tau} - \frac{\varepsilon^D}{1+\alpha\tau}}{\varepsilon^S - \varepsilon^D} - \frac{1}{1+\alpha\tau}\right] \\ &= -\tau d\alpha\left[\frac{\frac{1+\alpha\tau}{1-(1-\alpha)\tau}\varepsilon^S - \varepsilon^D - \varepsilon^S + \varepsilon^D}{(1+\alpha\tau)(\varepsilon^S - \varepsilon^D)}\right]. \end{aligned}$$

Further simplifying gives (5). □

Extended proof of corollary 2. This proof uses a perturbation argument. Assume $\alpha \in [0,1)$ and consider a reform that shifts the incidence towards the demand side, i.e., $d\alpha > 0$. Equations (4) and (5) show that $\frac{dp_S}{p_S} \geq 0$ and $\frac{dp_D}{p_D} \leq 0$. Given upward sloping supply and downward sloping demand curves, this implies that the equilibrium quantity is increasing in α.

More formally, let us first totally differentiate $D((1+\alpha\tau)p)$, holding τ fixed and using (1),

$$\begin{aligned}
dD^* &= \frac{\partial D}{\partial p_D}\left[(1+\alpha\tau)dp + \tau p d\alpha\right] \\
&\propto \frac{\partial D}{\partial p_D}\left[(1+\alpha\tau)\frac{dp}{p} + \tau d\alpha\right] \\
&= \frac{\partial D}{\partial p_D}\left[\tau\alpha\left(1 - \frac{\frac{1+\alpha\tau}{1-(1-\alpha)\tau}\varepsilon^S - \varepsilon^D}{\varepsilon^S - \varepsilon^D}\right)\right] \\
&= d\alpha\left(-\frac{\partial D}{\partial p_D}\right)\frac{\tau^2}{1-(1-\alpha)\tau}\frac{-\varepsilon^S}{\varepsilon^S - \varepsilon^D} \\
&= d\alpha\frac{\tau}{(1+\alpha\tau)}\frac{\tau}{[1-(1-\alpha)\tau]}\frac{Q^*}{p}\frac{\varepsilon^S * (-\varepsilon^D)}{\varepsilon^S - \varepsilon^D} \\
&\geq 0.
\end{aligned}$$

Next, we consider $S([1-(1-\alpha)\tau]p)$, which gives

$$\begin{aligned}
dS^* &= \frac{\partial S}{\partial p_S}\left[[1-(1-\alpha)\tau]dp + \tau p d\alpha\right] \\
&\propto \frac{\partial S}{\partial p_S}\left[[1-(1-\alpha)\tau]\frac{dp}{p} + \tau d\alpha\right] \\
&= \frac{\partial S}{\partial p_S}\left[\tau d\alpha\left(1 - \frac{\varepsilon^S - \frac{1-(1-\alpha)\tau}{1+\alpha\tau}\varepsilon^D}{\varepsilon^S - \varepsilon^D}\right)\right] \\
&= \tau^2 d\alpha\frac{\partial S}{\partial p_S}\frac{1}{1+\alpha\tau}\frac{-\varepsilon^D}{\varepsilon^S - \varepsilon^D} \\
&= d\alpha\frac{\tau}{(1+\alpha\tau)}\frac{\tau}{[1-(1-\alpha)\tau]}\frac{Q^*}{p}\frac{\varepsilon^S * (-\varepsilon^D)}{\varepsilon^S - \varepsilon^D} \\
&\geq 0.
\end{aligned}$$

□

A.2.2 Details on change in tax rate only

Derivation of result 3. We start by totally differentiating the equilibrium condition $S([1-(1-\alpha)\tau]p) = D((1+\alpha\tau)p)$ with $d\alpha = 0$ & $d\tau \neq 0$, allowing for endogenous response in p (market clearing), which results in

$$
\begin{aligned}
\frac{\partial S}{\partial p_S}\left[1-(1-\alpha)\tau\right]dp-(1-\alpha)pd\tau] &= \frac{\partial D}{\partial p_D}\left[(1+\alpha\tau)dp+\alpha pd\tau\right] \\
\Leftrightarrow \frac{\partial S}{\partial p_S}\left[1-(1-\alpha)\tau]\frac{dp}{d\tau}-(1-\alpha)p\right] &= \frac{\partial D}{\partial p_D}\left[(1+\alpha\tau)\frac{dp}{d\tau}+\alpha p\right] \\
\Leftrightarrow \frac{\partial S}{\partial p_S}\left[\frac{p_S}{p}\frac{dp}{d\tau}-(1-\alpha)p\right] &= \frac{\partial D}{\partial p_D}\left[\frac{p_D}{p}\frac{dp}{d\tau}+\alpha p\right] \\
\Leftrightarrow \frac{dp}{p}\frac{1}{d\tau}\left[\frac{\partial S}{\partial p_S}p_S-\frac{\partial D}{\partial p_D}p_D\right] &= (1-\alpha)\frac{\partial S}{\partial p_S}p+\alpha\frac{\partial D}{\partial p_D}p.
\end{aligned}
$$

Using the fact that $S = D$ in equilibrium, and the definition of ε^S and ε^D simplifies to

$$
\frac{dp}{p}\frac{1}{d\tau}\left(\varepsilon^S-\varepsilon^D\right) = (1-\alpha)\varepsilon^S\frac{p}{p_S}+\alpha\varepsilon^D\frac{p}{p_D}.
$$

Using the relationship between p_D, p_S and p, this further simplifies to

$$
\frac{dp}{d\tau}\frac{1}{p} = \frac{\frac{1-\alpha}{1-(1-\alpha)\tau}\varepsilon^S+\frac{\alpha}{1+\alpha\tau}\varepsilon^D}{(\varepsilon^S-\varepsilon^D)}.
$$

□

Derivation of result 4. First, we derive the tax-inclusive prices. Let us consider $p_S = [1-(1-\alpha)\tau]p$. Totally differentiating and holding α constant, we obtain

$$
\begin{aligned}
dp_S &= [1-(1-\alpha)\tau]dp-(1-\alpha)pd\tau \\
\Leftrightarrow \frac{dp_S}{d\tau}\frac{1}{p_S} &= \frac{1-(1-\alpha)\tau}{p_S}\frac{dp}{d\tau}-(1-\alpha)\frac{p}{p_S} \\
&= \frac{dp}{d\tau}\frac{1}{p}-\frac{1-\alpha}{1-(1-\alpha)\tau} \\
&= \frac{\frac{1-\alpha}{1-(1-\alpha)\tau}\varepsilon^S+\frac{\alpha}{1+\alpha\tau}\varepsilon^D}{(\varepsilon^S-\varepsilon^D)}-\frac{1-\alpha}{1-(1-\alpha)\tau} \\
&= \frac{1}{[1-(1-\alpha)\tau]\,(1+\alpha\tau)}\frac{\varepsilon^D}{(\varepsilon^S-\varepsilon^D)}.
\end{aligned}
$$

Second, we consider $p_D = [1+\alpha\tau]p$. Totally differentiating and holding α constant, we obtain

$$
\begin{aligned}
dp_D &= [1+\alpha\tau]dp + \alpha p d\tau \\
\Leftrightarrow \frac{dp_D}{d\tau}\frac{1}{p_D} &= \frac{1D\alpha\tau}{p_D}\frac{dp}{d\tau} + \alpha\frac{p}{p_D} \\
&= \frac{dp}{d\tau}\frac{1}{p} + \frac{\alpha}{1+\alpha\tau} \\
&= \frac{\frac{1-\alpha}{1-(1-\alpha)\tau}\varepsilon^S + \frac{\alpha}{1+\alpha\tau}\varepsilon^D}{(\varepsilon^S - \varepsilon^D)} + \frac{\alpha}{1+\alpha\tau} \\
&= \frac{1}{[1-(1-\alpha)\tau]\,(1+\alpha\tau)}\frac{\varepsilon^S}{(\varepsilon^S-\varepsilon^D)}.
\end{aligned}
$$

□

A.2.3 Details on simultaneous changes in tax rate and statutory incidence of ad valorem taxes

Derivation. We consider the case $d\alpha = 0$ & $d\tau = 0$. We start by totally differentiating the equilibrium condition $S([1-(1-\alpha)\tau]p) = D((1+\alpha\tau)p)$, allowing for endogenous response in p (market clearing).

$$
\begin{aligned}
\frac{\partial S}{\partial p_S}&\left[[1-(1-\alpha)\tau]dp - (1-\alpha)pd\tau + \tau p d\alpha\right] = \frac{\partial D}{\partial p_D}\left[(1+\alpha\tau)dp + \alpha p d\tau + \tau p d\alpha\right] \\
\Leftrightarrow \frac{dp}{p}&\left[\frac{\partial S}{\partial p_S}[1-(1-\alpha)\tau] - \frac{\partial D}{\partial p_D}(1+\alpha\tau)\right] = \left[\frac{\partial D}{\partial p_D}\alpha + \frac{\partial S}{\partial p_S}(1-\alpha)\right]d\tau + \left[\frac{\partial D}{\partial p_D} - \frac{\partial S}{\partial p_S}\right]\tau d\alpha \\
\Leftrightarrow \frac{dp}{p}&\left[\frac{\partial S}{\partial p_S}\frac{p_S}{p} - \frac{\partial D}{\partial p_D}\frac{p_D}{p}\right] = \left[\frac{\partial D}{\partial p_D}\alpha + \frac{\partial S}{\partial p_S}(1-\alpha)\right]d\tau + \left[\frac{\partial D}{\partial p_D} - \frac{\partial S}{\partial p_S}\right]\tau d\alpha \\
\Leftrightarrow \frac{dp}{p}&\left[\varepsilon^S - \varepsilon^D\right] = \left[\frac{\partial D}{\partial p_D}\frac{p}{D}\alpha + \frac{\partial S}{\partial p_S}\frac{p}{S}(1-\alpha)\right]d\tau + \left[\frac{\partial D}{\partial p_D}\frac{p}{D} - \frac{\partial S}{\partial p_S}\frac{p}{S}\right]\tau d\alpha \\
\Leftrightarrow \frac{dp}{p}&\left[\varepsilon^S - \varepsilon^D\right] = \left[\frac{\alpha}{1+\alpha\tau}\varepsilon^D + \frac{1-\alpha}{1+(1-\alpha)\tau}\varepsilon^S\right]d\tau + \left[\frac{1}{1+\alpha\tau}\varepsilon^D + \frac{1}{1+(1-\alpha)\tau}\varepsilon^S\right]\tau
\end{aligned}
$$

$$
\frac{dp}{p} = \underbrace{\frac{\frac{\alpha}{1+\alpha\tau}\varepsilon^D + \frac{1-\alpha}{1+(1-\alpha)\tau}\varepsilon^S}{\varepsilon^S - \varepsilon^D}d\tau}_{\text{Effect when changing } \tau \text{ only}} - \underbrace{\frac{\frac{1}{1+(1-\alpha)\tau}\varepsilon^S - \frac{1}{1+\alpha\tau}\varepsilon^D}{\varepsilon^S - \varepsilon^D}\tau d\alpha}_{\text{Effect when changing } \alpha \text{ only}}
$$

□

Derivation of tax-inclusive prices. Next, we derive the tax-inclusive prices. First, let us consider $p_S = [1-(1-\alpha)\tau]p$. Totally differentiating, we obtain

$$
\begin{aligned}
&dp_S = [1-(1-\alpha)\tau]dp - (1-\alpha)pd\tau + \tau pd\alpha \\
\Leftrightarrow\ &\frac{dp_S}{p_S} = \frac{dp}{p} - \frac{1-\alpha}{[1-(1-\alpha)\tau]}d\tau + \frac{\tau}{1-(1-\alpha)\tau}d\alpha \\
\Leftrightarrow\ &\frac{dp_S}{p_S} = \frac{1}{[1-(1-\alpha)\tau]\,(1+\alpha\tau)}\frac{\varepsilon^D}{(\varepsilon^S-\varepsilon^D)}d\tau + \frac{\tau^2}{(1+\alpha\tau)[1-(1-\alpha)\tau]}\frac{-\varepsilon^D}{(\varepsilon^S-\varepsilon^D)}d\alpha
\end{aligned}
$$

Second, we consider $p_D = [1+\alpha\tau]p$. Totally differentiating, we obtain

$$
\begin{aligned}
&dp_D = [1+\alpha\tau]dp + \alpha pd\tau + \tau pd\alpha \\
\Leftrightarrow\ &\frac{dp_D}{p_D} = \frac{dp}{p} + \frac{\alpha}{[1+\alpha\tau]}d\tau + \frac{\tau}{1+\alpha\tau}d\alpha \\
\Leftrightarrow\ &\frac{dp_D}{p_D} = \frac{1}{[1-(1-\alpha)\tau]\,(1+\alpha\tau)}\frac{\varepsilon^S}{(\varepsilon^S-\varepsilon^D)}d\tau - \frac{\tau^2}{(1+\alpha\tau)[1-(1-\alpha)\tau]}\frac{-\varepsilon^S}{(\varepsilon^S-\varepsilon^D)}d\alpha
\end{aligned}
$$

□

A.3 Closed form illustration of ad valorem relevance result

The previous derivations suggest post-tax wages for employees, $\tilde{w}$, are higher when the statutory incidence falls on the employer, while the employer's post-tax labor cost per unit, $\hat{w}$, are lower simultaneously. We illustrate this here for an economy with a unit mass of identical households and a representative firm, assuming simple functional forms for the households' utility and the firm's production function.

Optimization problems. Specifically, assume households solve the following optimization problem.

$$\max_l \tilde{w}l - \frac{l^{1+\frac{1}{\sigma}}}{1+\frac{1}{\sigma}}$$

This gives an aggregate labor supply of $L^S(\tilde{w}) = \tilde{w}^\sigma$. Further, assume the representative firm demands labor according to the following profit maximization problem.

$$\max_L L^{1-\beta} - \hat{w}L$$

This results in an aggregate labor demand of $L^D(\hat{w}) = (1-\beta)^{\frac{1}{\beta}}\hat{w}^{-\frac{1}{\beta}}$.

Statutory incidence on the employee. We first consider the case of $\alpha = 0$. Then, $\tilde{w} = (1-\tau)w$ and $\hat{w} = w$. In equilibrium, the wage rate w adjusts such that $L^D = L^S$. Solving for this, we obtain

$$\begin{aligned} w &= (1-\beta)^{\frac{1}{1+\sigma\beta}}(1-\tau)^{-\frac{\sigma\beta}{1+\sigma\beta}} \\ \tilde{w} &= (1-\beta)^{\frac{1}{1+\sigma\beta}}(1-\tau)^{\frac{1}{1+\sigma\beta}} \\ \hat{w} &= w \end{aligned}$$

Statutory incidence on the employer. Next, we consider the case of $\alpha = 1$. Then, $\tilde{w} = w$ and $\hat{w} = (1+\tau)w$. Again, the wage rate w adjusts such that $L^D = L^S$. Thus, we obtain

$$\begin{aligned} w &= (1-\beta)^{\frac{1}{1+\sigma\beta}}(1+\tau)^{-\frac{1}{1+\sigma\beta}} \\ \tilde{w} &= w \\ \hat{w} &= (1-\beta)^{\frac{1}{1+\sigma\beta}}(1+\tau)^{\frac{\sigma\beta}{1+\sigma\beta}} \end{aligned}$$

Comparison of statutory incidence regimes. Given the results above, we confirm that $\tilde{w}_{\alpha=0} < \tilde{w}_{\alpha=1}$ and $\hat{w}_{\alpha=0} > \hat{w}_{\alpha=1}$ for any $\tau > 0$ independent of σ and β. That is, workers earn more post-taxes per unit of labor supplied when the statutory incidence falls on the employer. Employers, on the other hand, face lower post-tax labor costs per unit when the statutory incidence falls on the employee. Moreover, since the amount of labor employed in equilibrium is increasing in $\tilde{w}$, employment and output are higher when the nominal incidence falls on the employer.

A.4 Ad valorem taxes extensions — detailed derivations

A.4.1 Details on change in statutory incidence of ad valorem subsidies

Derivation of corollary 4. We start by totally differentiating the equilibrium condition $S([1+(1-\alpha)\tau]p) = D((1-\alpha\tau)p)$, which results in

$$\begin{aligned}
\frac{\partial S}{\partial p_S}\left[[1+(1-\alpha)\tau]dp - \tau p d\alpha\right] &= \frac{\partial D}{\partial p_D}\left[(1-\alpha\tau)dp - \tau p d\alpha\right] \\
\Leftrightarrow \frac{\partial S}{\partial p_S}\left[[1+(1-\alpha)\tau]\frac{dp}{d\alpha} - \tau p\right] &= \frac{\partial D}{\partial p_D}\left[(1-\alpha\tau)\frac{dp}{d\alpha} - \tau p\right] \\
\Leftrightarrow \frac{dp}{d\alpha}\left[[1+(1-\alpha)\tau]\frac{\partial S}{\partial p_S} - (1-\alpha\tau)\frac{\partial D}{\partial p_D}\right] &= \tau\left[\frac{\partial S}{\partial p_S}p - \frac{\partial D}{\partial p_D}p\right].
\end{aligned}$$

Using the fact that $S = D$ in equilibrium, we can write

$$\frac{dp}{d\alpha}\left[[1+(1-\alpha)\tau]\frac{\partial S}{\partial p_S}\frac{p_S}{S}\frac{1}{p_S} - (1-\alpha\tau)\frac{\partial D}{\partial p_D}\frac{p_D}{D}\frac{1}{p_D}\right] = \tau\left[\frac{\partial S}{\partial p_S}\frac{p_S}{S}\frac{1}{p_S}p - \frac{\partial D}{\partial p_D}\frac{p_D}{D}\frac{1}{p_D}p\right],$$

which given the definition of ε^S and ε^D simplifies to

$$\frac{dp}{d\alpha}\left[\frac{1+(1-\alpha)\tau}{p_S}\varepsilon^S - \frac{1-\alpha\tau}{p_D}\varepsilon^D\right] = \tau\left[\varepsilon^S\frac{p}{p_S} - \varepsilon^D\frac{p}{p_D}\right].$$

Using the relationship between p_D, p_S and p, this further simplifies to

$$\begin{aligned}
\frac{dp}{d\alpha}\frac{1}{p}\left(\varepsilon^S - \varepsilon^D\right) &= \tau\left[\frac{\varepsilon^S}{1+(1-\alpha)\tau} - \frac{\varepsilon^D}{1-\alpha\tau}\right] \\
\Leftrightarrow \frac{dp}{p} &= d\alpha\frac{\tau\left[\frac{\varepsilon^S}{1+(1-\alpha)\tau} - \frac{\varepsilon^D}{1-\alpha\tau}\right]}{(\varepsilon^S - \varepsilon^D)}.
\end{aligned}$$

Next, let us consider $p_S = [1+(1-\alpha)\tau]p$. Totally differentiating and holding τ constant, we obtain

$$\begin{aligned}
dp_S &= [1+(1-\alpha)\tau]dp - \tau p d\alpha \\
\Leftrightarrow \frac{dp_S}{p_S} &= \frac{1+(1-\alpha)\tau}{p_S}dp - \tau\frac{p}{p_S}d\alpha \\
&= \frac{dp}{p} - \tau d\alpha\frac{1}{1+(1-\alpha)\tau}.
\end{aligned}$$

Plugging in for $\frac{dp}{p}$, we obtain

$$\begin{aligned}
\frac{dp_S}{p_S} &= \tau d\alpha\left[\frac{\frac{\varepsilon^S}{1+(1-\alpha)\tau} - \frac{\varepsilon^D}{1-\alpha\tau}}{\varepsilon^S - \varepsilon^D} - \frac{1}{1+(1-\alpha)\tau}\right] \\
&= \tau d\alpha\left[\frac{\varepsilon^S - \frac{1+(1-\alpha)\tau}{1-\alpha\tau}\varepsilon^D - \varepsilon^S + \varepsilon^D}{[1+(1-\alpha)\tau](\varepsilon^S - \varepsilon^D)}\right].
\end{aligned}$$

Further simplifying gives

$$\frac{dp_S}{p_S} = sd\alpha \frac{s}{(1-\alpha s)[1+(1-\alpha)s]} \frac{-\varepsilon^D}{\varepsilon^S - \varepsilon^D} \tag{10}$$

.

Next, let us consider $p_D = (1-\alpha\tau)p$. Totally differentiating and holding τ constant, we obtain

$$\begin{aligned}
dp_D &= (1-\alpha\tau)dp - \tau p d\alpha \\
\Leftrightarrow \frac{dp_D}{p_D} &= \frac{1-\alpha\tau}{p_D} dp - \tau \frac{p}{p_D} d\alpha \\
&= \frac{dp}{p} - \frac{1}{1-\alpha\tau} \tau d\alpha \\
&= \tau d\alpha \left[\frac{\frac{\varepsilon^S}{1+(1-\alpha)\tau} - \frac{\varepsilon^D}{1-\alpha\tau}}{\varepsilon^S - \varepsilon^D} - \frac{1}{1-\alpha\tau} \right] \\
&= \tau d\alpha \left[\frac{\frac{1-\alpha\tau}{1+(1-\alpha)\tau}\varepsilon^S - \varepsilon^D - \varepsilon^S + \varepsilon^D}{(1-\alpha\tau)(\varepsilon^S - \varepsilon^D)} \right].
\end{aligned}$$

Further simplifying gives

$$\frac{dp_D}{p_D} = sd\alpha \frac{s}{(1-\alpha s)[1+(1-\alpha)s]} \frac{-\varepsilon^S}{\varepsilon^S - \varepsilon^D}. \tag{11}$$

. □

A.4.2 Details on change in statutory incidence of ad valorem taxes with imperfect salience

Derivation. We start by totally differentiating the equilibrium condition $S([1-(1-\alpha)\tau]p) = D((1+\alpha\theta\tau)p)$, which results in

$$\begin{aligned}
\frac{\partial S}{\partial p_S} \left[[1-(1-\alpha)\tau]dp + \tau p d\alpha \right] &= \frac{\partial D}{\partial p_D} \left[(1+\alpha\theta\tau)dp + \theta\tau p d\alpha + \alpha\tau p d\theta \right] \\
\Leftrightarrow \frac{\partial S}{\partial p_S} \left[[1-(1-\alpha)\tau]\frac{dp}{d\alpha} + \tau p \right] &= \frac{\partial D}{\partial p_D} \left[(1+\alpha\theta\tau)\frac{dp}{d\alpha} + \theta\tau p + \alpha\tau p \frac{d\theta}{d\alpha} \right] \\
\Leftrightarrow \frac{dp}{d\alpha} \left[[1-(1-\alpha)\tau]\frac{\partial S}{\partial p_S} - [1+\alpha\theta\tau]\frac{\partial D}{\partial p_D} \right] &= -\tau \left[\frac{\partial S}{\partial p_S} p - \frac{\partial D}{\partial p_D} p \left(\theta + \alpha \frac{d\theta}{d\alpha} \right) \right].
\end{aligned}$$

Using the fact that $S = D$ in equilibrium, we can write

$$\frac{dp}{d\alpha} \left[[1-(1-\alpha)\tau]\frac{\partial S}{\partial p_S}\frac{p_S}{S}\frac{1}{p_S} - [1+\alpha\theta\tau]\frac{\partial D}{\partial p_D}\frac{p_D}{D}\frac{1}{p_D} \right] = -\tau \left[\frac{\partial S}{\partial p_S}\frac{p_S}{S}\frac{1}{p_S} p - \frac{\partial D}{\partial p_D}\frac{p_D}{D}\frac{1}{p_D} p \left(\theta + \alpha \frac{d\theta}{d\alpha} \right) \right],$$

which given the definition of ε^S and ε^D simplifies to

$$\frac{dp}{d\alpha}\left[\frac{1-(1-\alpha)\tau}{p_S}\varepsilon^S - \frac{1+\alpha\theta\tau}{p_D}\varepsilon^D\right] = -\tau\left[\varepsilon^S\frac{p}{p_S} - \varepsilon^D\frac{p}{p_D}\left(\theta + \alpha\frac{d\theta}{d\alpha}\right)\right].$$

Using the relationship between p_D, p_S and p, this further simplifies to

$$\begin{aligned}\frac{dp}{d\alpha}\frac{1}{p}\left(\varepsilon^S - \varepsilon^D\right) &= -\tau\left[\frac{\varepsilon^S}{1-(1-\alpha)\tau} - \frac{\varepsilon^D}{1+\alpha\theta\tau}\left(\theta + \alpha\frac{d\theta}{d\alpha}\right)\right] \\ \Leftrightarrow \frac{dp}{p} &= d\alpha\frac{-\tau\left[\frac{\varepsilon^S}{1-(1-\alpha)\tau} - \frac{\varepsilon^D}{1+\alpha\theta\tau}\left(\theta + \alpha\frac{d\theta}{d\alpha}\right)\right]}{(\varepsilon^S - \varepsilon^D)}.\end{aligned}$$

Next, let us consider $p_S = [1-(1-\alpha)\tau]p$. Totally differentiating and holding τ constant, we obtain

$$\begin{aligned}dp_S &= [1-(1-\alpha)\tau]dp + \tau p d\alpha \\ \Leftrightarrow \frac{dp_S}{p_S} &= \frac{1-(1-\alpha)\tau}{p_S}dp + \tau\frac{p}{p_S}d\alpha \\ &= \frac{dp}{p} + \tau d\alpha\frac{1}{1-(1-\alpha)\tau}.\end{aligned}$$

Plugging in for $\frac{dp}{p}$, we obtain

$$\begin{aligned}\frac{dp_S}{d\alpha}\frac{1}{p_S} &= \tau\left[\frac{-\frac{\varepsilon^S}{1-(1-\alpha)\tau} + \frac{\varepsilon^D}{1+\alpha\theta\tau}\left(\theta + \alpha\frac{d\theta}{d\alpha}\right)}{\varepsilon^S - \varepsilon^D} + \frac{1}{1-(1-\alpha)\tau}\right] \\ &= \tau\left[\frac{-\varepsilon^S + \frac{1-(1-\alpha)\tau}{1+\alpha\theta\tau}\varepsilon^D\left(\theta + \alpha\frac{d\theta}{d\alpha}\right) + \varepsilon^S - \varepsilon^D}{[1-(1-\alpha)\tau](\varepsilon^S - \varepsilon^D)}\right].\end{aligned}$$

Next, let us consider $p_D = (1+\alpha\theta\tau)p$. Totally differentiating and holding τ constant, we obtain

$$\begin{aligned}dp_D &= (1+\alpha\theta\tau)dp + \theta\tau p d\alpha + \alpha\tau p d\theta \\ \Leftrightarrow \frac{dp_D}{p_D} &= \frac{1+\alpha\theta\tau}{p_D}dp + \theta\tau\frac{p}{p_D}d\alpha + \alpha\tau\frac{p}{p_D}d\theta \\ \Leftrightarrow \frac{dp_D}{d\alpha}\frac{1}{p_D} &= \frac{dp}{d\alpha}\frac{1}{p} + \frac{1}{1+\alpha\theta\tau}\theta\tau + \alpha\tau\frac{1}{1+\alpha\theta\tau}\frac{d\theta}{d\alpha} \\ &= -\tau\left[\frac{\frac{\varepsilon^S}{1-(1-\alpha)\tau} - \frac{\varepsilon^D}{1+\alpha\theta\tau}\left(\theta + \alpha\frac{d\theta}{d\alpha}\right)}{\varepsilon^S - \varepsilon^D} - \frac{1}{1+\alpha\theta\tau}\left(\theta + \alpha\frac{d\theta}{d\alpha}\right)\right] \\ &= -\tau\left[\frac{\frac{1+\alpha\theta\tau}{1-(1-\alpha)\tau}\varepsilon^S - \varepsilon^S\left(\theta + \alpha\frac{d\theta}{d\alpha}\right)}{(1+\alpha\theta\tau)(\varepsilon^S - \varepsilon^D)}\right].\end{aligned}$$

Under full salience ($\theta = 1$ and $\frac{d\theta}{d\alpha} = 0$), we obtain result (5). □

B Testable Predictions

Our results yield empirically testable predictions. Taking our derivations seriously, and letting t index time, Appendix section A.2.3 implies the following empirical specification of a shift in the statutory incidence

$$\left(\frac{dp_S}{p_S}\right)_t = \beta_1^S x_{1t} + \beta_2^S x_{2t} \tag{12}$$

$$\left(\frac{dp_D}{p_D}\right)_t = \beta_1^D x_{1t} + \beta_2^D x_{2t}, \tag{13}$$

where

$$\left(\frac{dP}{P}\right)_t = \frac{P_t - P_{t-1}}{P_{t-1}}$$
$$x_{1t} = \frac{1}{[1-(1-\alpha_{t-1}\tau_{t-1})](1+\alpha_{t-1}\tau_{t-1})} d\tau_t$$
$$x_{2t} = \frac{\tau_{t-1}^2}{[1-(1-\alpha_{t-1}\tau_{t-1})](1+\alpha_{t-1}\tau_{t-1})} d\alpha_t.$$

The simple theoretical framework above would imply

1. $\beta_1^S = -\beta_2^S = \frac{\varepsilon^D}{\varepsilon^S+\varepsilon^D}$
2. $\beta_1^D = -\beta_2^D = \frac{\varepsilon^S}{\varepsilon^S+\varepsilon^D}$
3. and the derived elasticities $\hat{\varepsilon}^S$ and $\hat{\varepsilon}^D$ are identical when inferred from estimating equation (12) or (13).

In contrast, the classical view of statutory irrelevance would suggest $\beta_2^S = \beta_2^D = 0$.

In practice, however, there are numerous reasons why the derived relationships may not hold. First, policy changes, $d\tau_t$ and $d\alpha_t$, are likely endogenous and may correlate with other factors that shift demand and thus p_S and p_D, like optimization frictions like tax salience, or evasion. Second, we do no model a contribution-benefit linkage, which exists for many payroll taxes like pension contributions. This is different however for some payroll taxes. Health insurance benefits are independent of an individual's payroll tax contributions in many countries. Third, changes in statutory incidence, in the absence behavioral, informational, or market frictions, are often implemented across entire populations in empirical settings. An example is nationwide adjustments to statutory incidence and payroll tax rates in OECD countries, described in Section 5.

C Payroll taxes in OECD countries

Figure C.1: Payroll tax rates of employer and employee in OECD countries

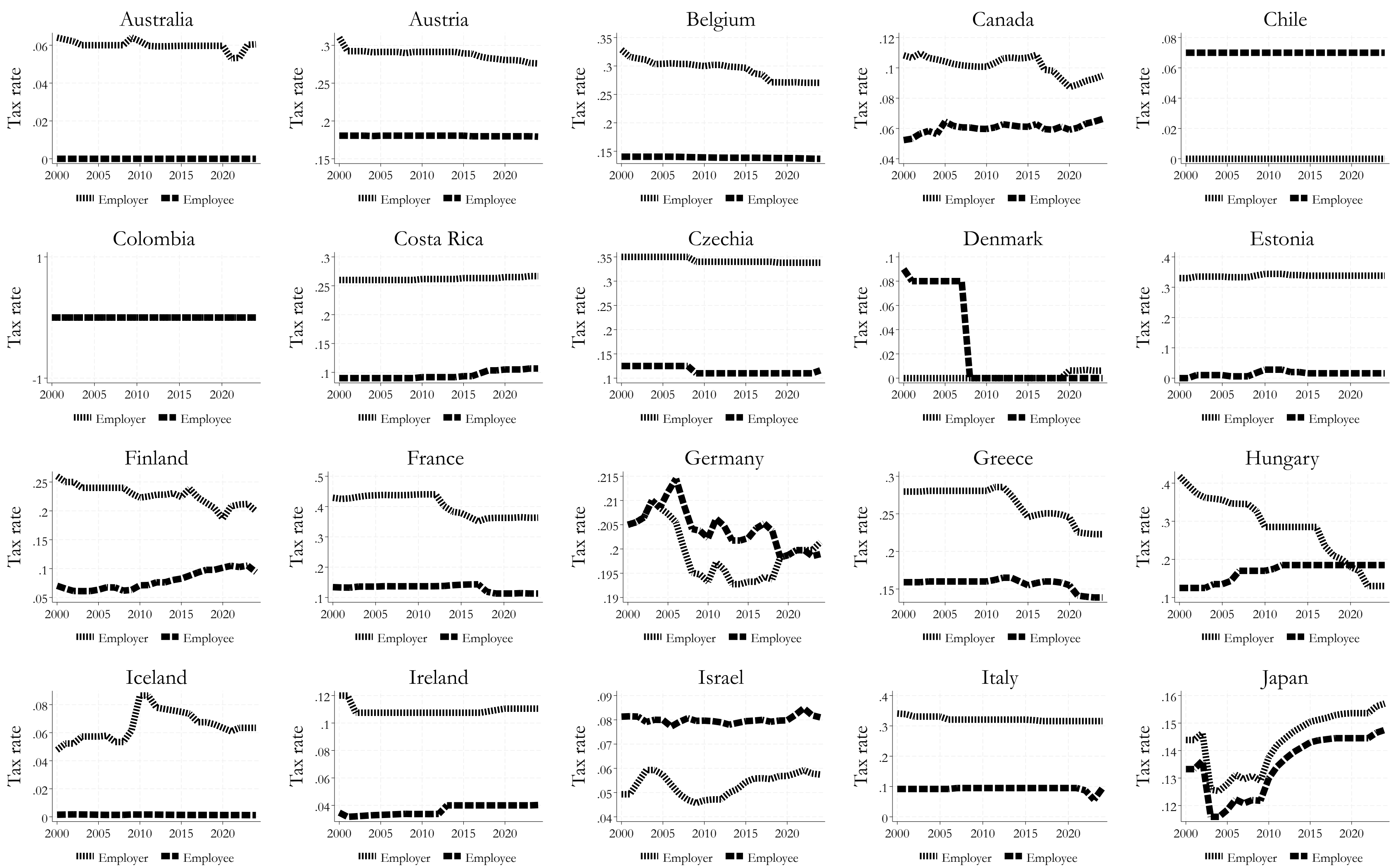
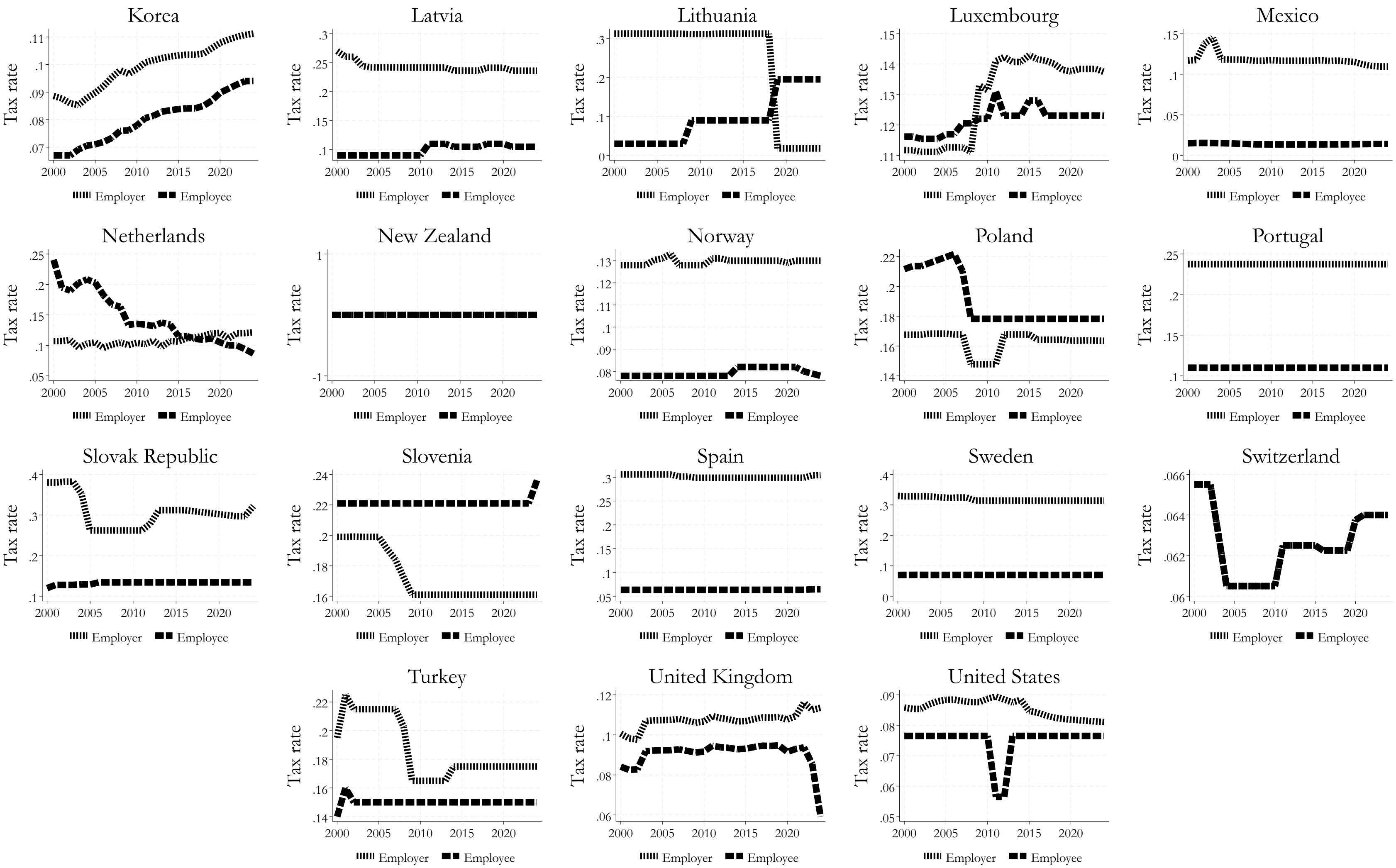


Figure C.1: Payroll tax rates of employer and employee in OECD countries



Notes: This figure shows the evolution of statutory employer and employee tax rates from 2000 to 2024 by all 38 OECD countries. The vertically dashed line corresponds to the employer side. The squared dashed line corresponds to the employee side. Based on *OECD Taxing Wages* data.