Arbeitskreis Quantitative Steuerlehre
Quantitative Research in Taxation – Discussion Papers

Jonas Knaisch, Carla Pöschel

Corporate Income Tax and Wages: A Meta-Regression Analysis

arqus Discussion Paper No. 262
March 2021

www.arqus.info
ISSN 1861-8944

Corporate Income Tax and Wages: A Meta-Regression Analysis[*]

Jonas Knaisch

Otto-von-Guericke-University Magdeburg

Carla Pöschel

Freie University Berlin

March 2021

Abstract

In this paper we apply meta-regression analysis to quantitatively review the growing empirical tax incidence literature that indicates a substantial burden of the corporate income tax falling on employees. While most studies report large negative wage elasticities to corporate taxes, our findings suggest that estimates with positive values are published less often than they should. After accounting for publication bias, we estimate an average wage elasticity to corporate taxes of -0.016. Moreover, methodological aspects (data coverage and temporal focus) drive the heterogeneity among estimates. Our consensus estimates suggest a long-term wage elasticity to corporate taxes between -0.105 and -0.141, depending on the underlying CIT burden variable and the type of data used.

Keywords: Tax incidence, wages, corporate income tax, wage elasticity to taxes, meta-regression analysis

[*] We thank Sebastian Eichfelder, Jochen Hundsdoerfer and Viktor Steiner for helpful comments and suggestions. All errors remain our own. Authors contact e-mail: jonas.knaisch@ovgu.de; carla.poeschel@fu-berlin.de.

I. Introduction

While the corporate income tax (CIT) is legally levied on firms, views on who ultimately bears the actual tax burden differ widely. One may assume that the entire CIT burden falls on capital owners. The tax burden, however, can also be passed on to consumers through higher prices for products or services and employees in form of lower wages. In its Final Report on Action 11, the Organization for Economic Cooperation and Development (OECD) concludes that the "*economic incidence, particularly of the CIT in a global economy, is still an unresolved issue for economists*" (OECD 2015, 116). This is an important issue since the distribution of the tax incidence among individuals is a key parameter for policy makers due to its implications for the tax progressivity and the distributive fairness of the tax system (Auerbach 2006).

The academic tax incidence discussion dates back at least to Harberger (1962). Given a set of restrictive assumptions (in particular, a closed economy with fixed labor and capital stocks), the CIT burden falls entirely on capital in the long-run. The simple Harberger (1962) model abstracts from several important determinants, such as imperfect competition or international capital flows (Auerbach 2006). Therefore, extensions assume an open economy where capital is perfectly mobile across countries, while labor is not (e.g., Harberger 1995; Harberger 2008a, 2008b; Gravelle and Smetters 2006; Randolph 2006). As a result, taxing capital induces capital flows abroad, a decline in the marginal labor productivity and, thus, lower wages, leading to labor bearing a substantial share of the CIT.

Building on these theoretical incidence models, a growing literature empirically assesses the incidence of the CIT on wage rates by using regression techniques. A first stream of literature provides either country or state level estimates of wage effects by using variations in CIT rates across countries or states over time. Those studies identify the 'indirect' incidence effect of corporate taxes through the adjustment of output prices or the capital allocation. The first empirical study in this vain of Hassett and Mathur (2006) uses aggregate wage data for 72 countries between 1981 and 2002. They regress five-year average manufacturing hourly wages on three measures of the CIT burden (i.e., statutory tax rate, effective marginal and average tax rate). They estimate an extremely large wage elasticity, as their findings imply that a 1% increase in the CIT rate is associated with a decrease in hourly wages of roughly 1%.[2]

An emerging second series of studies focuses on the ‘direct’ incidence of corporate taxes on wages. Arulampalam, Devereux and Maffini (2012) argue that firms and employees collectively bargain over the firms’ economic after-tax profits. The final distribution of the CIT burden is driven by the outside options and the bargaining power of both, the firm and the employees. The empirical strategy to measure the impact of corporate taxes on wages through wage bargaining or the ‘direct’ incidence channel is by controlling for labor productivity or the capital stock. Using firm-level data on 55,082 European firms from 9 countries for the years 1996–2003, Arulampalam, Devereux and Maffini (2012) estimate that a 1% increase in the CIT payment per worker results in a decrease of wages by 0.09% in the long-run.

A multitude of studies corroborates evidence for labor bearing a substantial share of the CIT, since estimates suggest a tax incidence of 30–100% falling on employees (e.g., Hassett and Mathur 2006; Felix 2007; Arulampalam, Devereux and Maffini 2012; Dwenger, Rattenhuber and Steiner 2017; Fuest, Peichl and Siegloch 2018). Thus, the precise magnitude of the tax incidence on wages still remains controversial (many studies point to this, see e.g., Gentry and College 2007, 13; Harris 2009, 2; Dwenger, Rattenhuber and Steiner 2017, 1). It is widely acknowledged among the reviews of the tax incidence literature that the inconsistent magnitude of the wage elasticity to taxes is driven by differences in design aspects of the studies (see, Gentry and Collage 2007; Gravelle 2011 and Clausing 2013). Given the diversity in findings

[2] The studies by Felix (2007), Gravelle and Hungerford (2007) and Clausing (2012) replicate the model specifications of Hassett and Mathur (2006) and estimate wage elasticities with magnitudes which are half as large. Gravelle and Hungerford (2007) note that their results are sensitive to alternative exchange rate conversions and the lag structure. More recent versions of the paper report smaller elasticity estimates (see, Hassett and Mathur 2010; Hassett and Mathur 2015).

and the vast amount of methodological choices, our paper contributes to the literature by quantitatively combining the empirical corporate tax incidence literature using meta-regression analysis (MRA). First, we test for the presence of publication bias in the underlying literature. Second, we compute how much of the CIT burden is borne by employees on average. Third, we investigate whether heterogeneous estimates are driven by differences in methodological aspects (e.g., datasets, specifications and estimation methods) across studies.

This paper extends earlier literature in several ways. We systematically review the latest empirical literature on the effect of corporate taxes on wages and provide an up-to-date review of the empirical studies. We go beyond a qualitative literature review and quantitatively combine the literature to derive an average wage elasticity with respect to corporate taxes. To the best of our knowledge, we provide the first MRA on the literature about the CIT incidence on wages. We find evidence for publication selection in favor of negative elasticity estimates. After accounting for the issue of publication bias, our results suggest an average true wage elasticity to taxes of -0.016, which is much smaller than the unweighted mean value of -0.21.

Moreover, in further MRA, we explain the variation in estimates by adding several moderator variables regarding the underlying tax burden measures, datasets, estimation methods and specifications. This allows us to detect significant sources of heterogeneity (or bias) in the primary literature. Our results reveal that the use of cross-country data instead of within-country data yields smaller (i.e., less negative) wage elasticities on average. Long-term effects seem to be larger than short-term or static effects, as the tax incidence effect occurs over time rather than immediately. Our MRA shows that the incidence of corporate taxes on wages trends upwards over time. This finding might be consistent with an increasing capital mobility and/or a better data availability during the last decades.

After accounting for heterogeneity in estimates and correcting for publication bias, we estimate a negative but small consensus wage elasticity to taxes. While Hassett and Mathur

(2006) report a wage elasticity of roughly -1.0, our results suggest that a 1% larger statutory tax rate depresses wages by only 0.108% (when using cross-country data) to 0.112% (when using within-country data) in the long-run. The average tax incidence on wages is even lower when studies use ex-post tax rates; our estimates yield a consensus long-term wage elasticity of -0.105 to -0.110, respectively. The consensus long-term wage elasticity to ex-ante tax rates ranges between -0.137 (cross-country data) and -0.141 (within-country data). These results can guide future empirical studies, as our MRA uncovers potential sources of heterogeneity in the underlying literature.

Our findings also contribute to recent debates about cutting the CIT rate and its implications for wages. Considering an allegedly conservative wage elasticity range of -0.16 to -0.33, the Council of Economic Advisers (CEA) forecasts that reducing the CIT rate to 20% would raise the average household income by more than $4,000 annually in the US (CEA 2017).[3] Our estimates indicate that the degree to which the CIT is shifted to employees is relatively low in comparison to prior findings of, for example, Hassett and Mathur (2006). Accordingly, the appealing argument of a large tax incidence effect on wages for advocates of lowering the CIT should be taken with care.

The remainder of this paper is structured as follows. Section II describes our literature selection approach and presents our meta-sample. Section III discusses our moderator variables. Section IV displays our MRA results. Finally, Section V concludes the paper.

[3] Summers (2017) and Furman (2017) have criticized the CEA's estimates as implausible because they imply an increase in wages of 3 to 5 times the tax revenue loss.

II. Meta-Sample

Wage Elasticity to Corporate Taxes

MRA results are only meaningful if the estimates are comparable across primary studies (Stanley 2001). Most incidence studies estimate the wage elasticity to corporate taxes according to the following baseline equation:

$$log(wage\ rate) = \alpha + \beta \log(CIT) + \gamma X + \varepsilon \quad (1)$$

where $wage\ rate$ is the wage rate, CIT denotes the CIT rate (see Section III for further descriptions), and the vector X typically contains various country-, individual- and/or firm-level controls.[4] ε is the error term. The main coefficient β (expected to be negative) captures the wage elasticity to taxes and is the outcome variable in our MRA. The wage elasticity determines the percentage change in wages when the CIT rate increases by 1%. An elasticity of β = -1.0 corresponds to the full shifting case, where employees bear 100% of the corporate income tax. Some studies use other versions of the baseline equation (1) than a log-log specification (e.g., linear or semi-log). As we focus solely on wage elasticities, we ensure comparability among studies by consistently transforming estimates into elasticities using the sample mean values of the CIT rate and wage rate.

Selection of Literature

We primarily used the IDEAS database and Google Scholar to locate appropriate studies. We employed the following keywords (and combinations of them): *tax incidence*, *wages*, *elasticity* and *corporate income tax*. Additionally, we scanned literature reviews (Gentry and

[4] The underlying studies use nominal or real wage rates, while these are measured either hourly, weekly, monthly or annually. Some studies also use average wage rates over the past five or three years. Due to correlation between various moderators, we cannot control for these differences in our MRA; Fuest, Peichl and Siegloch (2018) use the net-of-tax rate, we therefore multiply their elasticity estimates by -1.

College 2007; Gravelle 2011; Clausing 2013) and references of the identified studies. We completed our search process in December 2020.

We screened the abstracts of the studies and eliminated those not empirically investigating the association between the corporate income tax and wage rates. Our final meta-sample is determined by two selection criteria: First, the study must estimate the wage (semi-)elasticity of taxes according to the baseline equation (1) (inclusion criterion 1). Second, the study must provide standard errors or *t*-statistics and in some cases the sample mean values of the CIT rate and wage rate to be able to derive elasticity values (inclusion criterion 2).[5]

Since selecting a single estimate per primary study is quite subjective and results in a small sample size and less heterogeneity among the estimates, we include multiple estimates from each primary study, as long as there is a substantial difference regarding the variables, the specifications, the estimation strategy or the sample. We exclude estimates for specific subsamples of observations (e.g., for firm size, country size or union membership) from our meta-sample.[6] We only consider the latest version of a study to avoid autocorrelation among elasticity estimates.

Table 1 outlines the full meta-sample of studies with an overview of the underlying tax burden measures, data coverage and elasticities (i.e. number, mean, minimum, maximum and standard deviation). Our full meta-sample contains 15 primary studies comprising 115 estimates published between 2007 and 2018. The mean value of the wage elasticity of our full meta-sample equals -0.21, with a standard deviation of 0.23. Accordingly, the wage rate decreases by 0.21% if the CIT rate rises by 1% on average.

[5] Felix (2009) reports neither standard errors nor *t*-statistics and Gyourko and Tracy (1989) do not provide sample mean values of their variables.

[6] Felix and Hines (2009), for example, examine the incidence of the CIT on union wage rates by using interaction terms. As their regression equation is not comparable to the baseline equation (1), we exclude this study from our meta-sample.

The most extreme values (minimum and maximum) are -0.84 and 0.16 for Gravelle and Hungerford (2007) and Clausing (2012), respectively. The number of estimates from each primary study ranges from 2 (Goodspeed 2012; Liu and Altshuler 2013) to 15 (Hassett and Mathur 2015). The means of the estimates per primary study are negative (as expected) and range from -0.02 for Aus dem Moore (2014) to -0.57 for Hassett and Mathur (2015), indicating a substantial dispersion of estimates among the underlying primary studies. The paper of Hassett and Mathur (2015) reports more elasticity estimates than the average primary study (9.5 estimates). To address this, we exclude their estimates from our meta-sample as a robustness test. Finally, we drop two outliers from to the study of Ebrahimi and Vaillancourt (2016). As indicated by Figure 1, those estimates are far to the right of the remainder of the funnel plot due to their extreme low standard errors and, thus, can be seen as outliers (Stanley and Doucouliagous 2012). Since the meta-sample is rather small (115 estimates), our results are quite sensitive to these outliers.

III. Moderator Variables

The empirical studies vary considerably regarding the underlying datasets, tax rate variables and estimation methods. Therefore, it is not surprising that their findings are conflicting. MRA is a methodology for quantitatively combining a strand of literature and investigating heterogeneity among estimates across primary studies (Stanley 2001). We code several moderators which capture diverse study characteristics regarding the issue of publication bias and methodological choices (datasets, estimation methods and specifications). Table 2 summarizes the full set of moderator variables, along with a description and their summary statistics. At first glance, the summary statistics point to heterogeneous estimates as the means vary sharply between the moderators.

(insert Table 2 about here)

Publication Bias

A publication bias arises if statistically insignificant or supposedly counterintuitive estimates are not published in a journal or do not even appear in a working paper. To visually test for the presence of publication bias, a funnel plot is used to map the estimates (in our case, the wage elasticity to taxes) against their precision (the inverse of the standard error) (Egger et al. 1997). While imprecise estimates scatter widely at the bottom of the diagram, more precise estimates are distributed at the top of the diagram. In the absence of publication bias, the estimates should be symmetrically spread around the average true effect.

(insert Figure 1 about here)

The funnel plot of the wage elasticities in Figure 1 shows an elongated left tail with a missing right side, since the vast majority of the estimates vary between -0.8 and 0, while positive wage elasticities are almost absent. The peak of the funnel plot is composed of the most precise estimates, scattered around -0.05 and 0. The asymmetrical funnel plot is more consistent with the presence of a publication bias regarding the sign of the estimates than for statistical significance, because the funnel is thick rather than hollow (Havránek et al. 2018). Accordingly, elasticities with positive values are selected for publication less often than they should in the underlying literature. The scatter plot of the wage elasticities in Figure 2 illustrates this as well; most estimates range between -0.8 and 0, 66 estimates are statistically significant (at least at the 5% level) and 49 estimates are not statistically significant, while 109 estimates exert a negative sign and only 6 elasticity estimates are positive. Since positives wage elasticity estimates are contradictory to the theoretical arguments, authors may consider these positive estimates as signal of model misspecifications and adjust their models consequently.

(insert Figure 2 about here)

We address the issue of publication selection more formally by including the standard error (*Standard error*) of the corresponding estimate as an explanatory variable:

$$\hat{e}_{is} = \alpha + \beta \cdot \widehat{SE}_{is} + \gamma X_{is} + \varepsilon_{is} \text{ (2)},$$

where the dependent variable is the estimate $\hat{e}_{is}$ (*Wage elasticity to taxes*) and $\widehat{SE}_{is}$ is the standard error of regression $i = 1, \dots, I$ referring to primary study $s = 1, \dots, S$, X_{is} is a vector of the moderator variables (see the descriptions in the next subsections), α specifies the constant and ε_{is} is the error term.

The funnel asymmetry test of the coefficient on *Standard error*, β, indicates the presence of publication bias. The underlying intuition is simple: A correlation between the variables *Wage elasticity to taxes* and *Standard error* appears because of publication bias, i.e. under the given conditions (e.g., dataset and thus, standard error), authors may have to search longer for statistical significance by testing various methods and model specifications, resulting in larger magnitudes of estimates. The precision effect test on the constant (α) assesses whether there is an average 'true' effect beyond publication bias (Stanley 2008).

In MRA, the residuals are clearly heteroscedastic since the wage elasticity estimates exhibit different precisions, as shown by their different standard errors. To correct for heteroscedasticity, equation (2) is weighted by the inverse variances of the estimates ($\frac{1}{\widehat{SE}_{is}{}^2}$) as analytical weights (weighted least squares (WLS) meta-regression) (Stanley 2008). Beyond correcting for heteroscedasticity, weighting by the inverse variances corrects for low-quality estimates, since imprecise coefficients are given less weight in the MRA (Stanley and Doucouliagos 2012). We consider multiple estimates from each primary study in our meta-sample, which bears the risk of within-study dependency (i.e., autocorrelation). We allow for autocorrelation between estimates per primary study due to unobserved study-level heterogeneity and cluster standard errors at the study level (Stanley and Doucouliagos 2012).

Measuring the Corporate Income Tax Rate

The underlying studies use various measures of the tax burden to capture the impact of corporate taxes on wages:

- statutory corporate tax rates (STRs) or
- effective corporate tax rates, splitting into ex-ante ("forward-looking") and ex-post ("backward-looking") tax rates

Most studies in the meta-sample employ the top STR as the main explanatory variable (see Table 2). The STR is a relatively rough measure of the CIT that a firm actually pays as it neglects tax provisions concerning the determination of the tax base (such as tax deductions, income exemptions and tax incentives). Thus, using STRs to proxy for corporate taxes can be associated with a measurement error since the former tax code elements affect the CIT burden.

In order to overcome these issues, some studies apply ex-ante or ex-post effective corporate tax rates, which relate the statutory tax rate to the corresponding tax base. Generally, ex-ante rates assess the CIT burden on a prospective investment or the incentive to invest by assuming a mix of assets (e.g. intangibles, buildings, machinery, financial assets and inventories), financing sources (e.g. debt, equity or retained earnings) and fixed rates of interest, inflation, and depreciation. While effective marginal tax rates (EMTRs) reflect tax incentives for marginal investments (intensive margin response), effective average tax rates (EATRs) model tax incentives for profitable investments and thus, apply to discrete location decisions of firms (extensive margin response). Among the studies using effective corporate tax rates, 10 estimates refer to ex-ante rates (EMTRs or EATRs) along the lines of Devereux and Griffith (1999).[7] These tax rate variables, however, often rely on a set of simplifying assumptions and overlook corporate tax planning strategies or tax reliefs provided by tax authorities across countries.

[7] The two estimates of Liu and Altshuler (2013) refer to a different measurement.

Since many firms use tax planning activities to lower their tax liabilities (see, e.g. Dyreng, Hanlon and Maydew 2008 and Hanlon and Heitzman 2010), ex-ante tax variables do not solve all the issues of the STR, despite being a more reasonable approximation for investment tax incentives and tax base effects.

For this reason, a number of studies use ex-post average tax rates (ATRs) that correspond to the corporate taxes that are actually paid as a share of taxable income using either aggregate or micro data. These types of tax measures capture both, tax provisions and tax planning activities (e.g. nominal rates, depreciation allowances, treatment of losses, tax credits, profit shifting and tax reliefs). However, omitted variables and shocks may impact the profitability (and loss carryforwards) which in turn may affect ATRs as well as wage rates (Devereux and Griffith 1998).

The wage elasticity to taxes might be sensitive to the way of measuring the CIT rate due to the different implications of the latter. We group various rates and distinguish only between STRs (65 estimates), ex-ante (12 estimates) and ex-post effective tax rates (36 estimates) to ensure enough variation in each moderator variable instead of adding moderator variables for each type of tax measure. We code three moderator variables: *STR*, *Ex-ante tax rate* and *Ex-post tax rate*. We use the variable *STR* as the benchmark category, because most of the included estimates rely on the STR as the main explanatory variable.

(insert Figure 3 about here)

Figure 3 illustrates the association between the wage elasticities and their standard errors separately for each tax rate measure. The estimates that rely on the STR scatter much wider (-0.836 to 0.063) than those that use ex-ante rates (-0.643 to -0.061) or ex-post rates (-0.247 to 0.16); the latter estimates exhibit the lowest variability. Given this initial evidence for substantial variation of the estimates across tax rate measures, we perform subsample MRAs based on the tax rate measures in Section IV.

Data Coverage

Older studies commonly rely on aggregate wage data at the country level and exploit tax rate variations across countries. These primary studies cover a various number of countries, ranging from 9 to 72 (e.g., OECD countries only or worldwide). The tax incidence on wages may be driven by (unobservable) differences in economic, political, and regulatory characteristics between countries. The issue of endogenous tax rates due to, e.g. prevailing economic conditions or an extensive tax competition among countries (omitted variable bias) prevents a causal interpretation of the associations between CIT rates and wage rates. Carroll (2009) therefore employs aggregate data for 50 states within the US for the period 1970–2007 and finds that a 1% increase in the CIT rate decreases real wages by 0.014%, which is a rather small estimate in comparison to earlier findings. Fuest, Peichl and Siegloch (2018) exploit variations in local business tax rates across municipalities in Germany using establishment level data. Their results suggest that a 1% decrease in the net-of-business tax rate (reflecting an increase in the tax rate) reduces wages by 0.39%. As primary studies differ regarding the exploration of either cross-country (e.g., worldwide or across OECD countries) or within-country variation of CIT rates (e.g., across US states, Canadian provinces or German municipalities), we add the moderator variable *Cross-country data* to our MRA.

Estimation Methods

The majority of primary studies (69 estimates) exploits the panel structure of their datasets and estimates variations in wages over time, while controlling for unobserved but fixed heterogeneity between countries, states or individuals to address the former endogeneity issues (coded as *FE estimator*). We use *FE Estimator* as our base category and introduce two moderator variables indicating deviating methods: *OLS* and *GMM*.[8] We expect a bias for simple OLS estimates because of the influence of confounders in comparison to other estimates which rely, e.g., on IV, FE or GMM estimators.

Temporal Dynamics

Auerbach (2006) points to the importance of dynamics over time (i.e., the point in time at which the CIT burden is distributed among individuals): The incidence effect of the CIT on wages through the adjustment of factor prices and the capital allocation following a change in the CIT is likely to occur over time, rather than immediately. Accordingly, the long-term effect is likely to be larger. Most studies, however, provide single-point estimates by using static rather than dynamic models and are not able to cleanly separate long- and short-term effects. The exact distinction between short- and long-term effects is ambiguous in some studies. Therefore, we always designate an estimate based on a static model as *Static effect*, although studies sometimes use lags of the CIT rate.[9] We only mark an estimate as *Long-term effect* or *Short-term effect* when authors explicitly provide long-term or short-term elasticity estimates.

Theoretical Framework

The choice of the structural incidence model from which to derive the econometric specification impacts the variables used in the empirical analysis. By including (or excluding) control variables researchers can close (or open) paths along which the corporate income tax may affect wages. The literature points at two potential paths: the 'direct' and the 'indirect' tax incidence effect. Studies which adopt a wage bargaining framework try to isolate the 'direct' tax incidence effect. The rationale behind this is as follows: A rise in the CIT reduces the after-

[8] We omit the moderator variable *IV* due to collinearity with *Ex-ante rate* and the moderator variable *RE estimator* due to low variability (only 6 estimates).

[9] Hassett and Mathur (2015) justify their use of the five-year average wage by noting that the economic effects of CIT rate changes show up over longer time periods due to capital adjustment costs; even so, we label their estimates as *Static effect*.

tax rates of return on capital, thereby inducing an outflow of capital overseas and lower capital investments. This depresses labor productivity and wages since labor is far less mobile than capital. By controlling for value added or the capital stock, the 'indirect' tax effects on wage rates are controlled for and the remaining effect is the 'direct' incidence effect where higher corporate taxes reduce the quasi-rents that a firm and its employees can collectively bargain over (Arulampalam, Devereux & Maffini 2012).

As seen in Table 2, 85 (or 75%) of our estimates refer to the 'direct' incidence effect. Some of the primary studies do not directly address the channel they seek to consider: for example, Hassett and Mathur (2015) and Carroll (2009) claim that they focus on the whole general equilibrium effect, even though they control for labor productivity. Thus, they shut down the impact of variations in the capital intensity on wages and effectively measure the 'direct' incidence effect. To separate these 'direct' effects, we introduce the moderator variable *Total incidence effect* that is equal to one if a primary regression does not control for labor productivity (e.g., value added per worker or GDP per worker) or the capital stock, and zero otherwise.

Wage Effect over Time

The datasets of our primary studies cover more than 40 years (1970–2013). As the previous literature shows, the corporate tax incidence is driven by between-country (or state) effects (e.g. international capital mobility). Following the literature, we expect that the corporate tax incidence on wages trends upward over time due to an increasing mobility of capital relative to labor (see, e.g. Altshuler, Grubert and Newlon 2001; De Mooij and Ederveen 2008; Feld and Heckemeyer 2011; CEA 2017). We test this by coding the moderator *Average sample year*, which is normalized between zero and one by setting the oldest average sample year (1988.5) to zero and the latest (2005.5) to one. Moreover, as Clausing (2012, p. 467) notes, the growing importance of corporate tax avoidance may mitigate the increasing mobility effects, since corporate taxes deploy smaller effects when firms can shift profits to low-tax countries without corresponding real activity (e.g., capital and labor) movements. According to the findings of Arulampalam, Devereux and Maffini (2012), multinational enterprises (MNEs) shift a smaller share of the tax burden to employees than domestic firms. They explain their results by more outside options of MNEs and lower domestic profits over which to bargain due to a wider range of tax avoidance opportunities. Additionally, Dyreng et al. (2020) show empirically that firms with higher labor market power and a lower degree of tax avoidance pass more of the tax burden on to employees to maximize their after-tax profits (see also on this topic the OECD BEPS Final Report on Action 11 2015, Ch. 3.3.12).

IV. Meta-Regression Results

Testing Publication Bias

Table 3 reports our MRA results where the *Wage elasticity to taxes* is the dependent variable and the explanatory variable is its corresponding *Standard error*. In Panel A, we use the full meta-sample (without outliers). In Panel B, we perform subsample MRAs by splitting the full meta-sample (without outliers) according to the different types of the CIT rate (*STR*, *Ex-ante rate* and *Ex-post rate*).

(insert Table 3 about here)

Panel A of Table 3 presents alternative models to test whether the publication bias estimates are robust. While we estimate an Ordinary Least Squares (OLS) meta-regression in Model (1), we apply a WLS meta-regression to address heteroscedasticity in Model (2). As heterogeneous true effects among studies can be correlated with their precisions (e.g., some estimation methods may similarly affect the elasticity estimates' magnitude and its standard error), we use the inverse of the square root of the *Number of observations* as instrument for the *Standard* *error* in Model (3). The number of observations of the corresponding estimate relates to its *Standard error* but not to the underlying estimation method.

As seen in Panel A, the regression coefficients on *Standard error* are negative ($\beta < 0$) and statistically significant throughout our models; thus, researchers are likely to dismiss positive wage elasticities in favor of negative ones. Despite publication bias, however, we find evidence for a true negative wage elasticity of taxes in Models (2) and (3). According to our preferred Model (2), the true average wage elasticity to taxes is -0.016, which is much smaller than the unweighted mean value of -0.21.

Our subsample analysis in Panel B of Table 3 yields the following results: The issue of publication bias and the wage response appear to vary across our subsamples. While the average true wage elasticity to STRs seems to be close to or even zero as the constant is only weakly statistically significant in Model (1) of Panel B, the effects of ex-ante or ex-post rates range from -0.057 to -0.016. This finding is consistent with the discussion in the literature. The STR is often seen as an inaccurate indicator for the tax burden because of the omission of tax base effects (e.g. tax deductions, income exemptions, tax credits or formula apportionment).

Overall, the average true wage elasticity to taxes is likely to be very small beyond publication selection. Moreover, we observe that the magnitude is sensitive to the underlying definition of the CIT rate. Our results in Table 3, however, do not tell us if other methodological choices (e.g., dataset or estimation strategy) drive the magnitude of the underlying effect. Therefore, we further address the issue of heterogeneity in estimates in the next subsection.

Sources of Heterogeneity

Our MRA in Table 4 investigates the degree to which estimates vary with various methodological aspects and over time. We focus on the full meta-sample (without outliers) with *Wage elasticity to taxes* as the dependent variable. The explanatory variables are several characteristics within and between the underlying studies that are potentially driving the variation across estimates (see Section III for moderator variable descriptions). Instead of adding the full set of moderator variables simultaneously, we include them step by step to address multicollinearity concerns. The baseline Model (1) of Table 4 considers only two moderators which relate to the underlying corporate tax variable (*Ex-ante rate* and *Ex-post rate*) and the variable *Standard error* for the publication bias correction. The coefficients on the variables *Ex-ante rate* and *Ex-post rate* are both negative across most of the models and statistically significant in Models (1) and (2). The estimates become larger (i.e., more negative), when a primary study uses forward-looking (here: METR or MATR) or backward-looking rates (here: ATR) instead of the STR, confirming our previous results.

(insert Table 4 about here)

In Model (2) of Table 4, we add variables to control for the dataset and estimation methods. Regarding the variable *Cross-country data*, we obtain the following: The coefficients are positive and statistically significant throughout the models. The elasticity estimates are smaller when a primary study uses cross-country instead of within-country data on average. This may indicate that capital is more mobile between states, provinces and municipalities than across countries and thus, can escape the CIT burden more easily. Surprisingly, our results suggest that the estimation method is not a source of heterogeneity in estimates, since the coefficients on *OLS* and *GMM* are both negative but not statistically significant.

Model (3) of Table 4 includes the moderator variables *Long-term effect* and *Total incidence effect*. The estimates for *Long-term effect* confirm our prediction in Section III. On average, the long-term effect is larger (by -0.092% to -0.103%) than the short-term or static effect. One further aim of our MRA is to disentangle the ‘direct’ tax incidence effect on the wage rate. The regression coefficients on *Total incidence effect* are negative throughout our models but not statistically significant. We cannot infer a systematical difference between primary studies that control for labor productivity (e.g., value added per worker or GDP per worker) or the capital stock and studies that capture the total incidence effect. Considering the ambiguity of the theoretical justifications in some of the primary studies that designate their econometric specification as a total incidence framework although they control for labor productivity or the capital stock, our results further point to the difficulty to cleanly separate the two channels empirically.

Our most comprehensive Model (4) of Table 4 adds the variable *Average sample year*. The coefficient on *Average sample year* is negative and statistically significant at the 5% level. Accordingly, the magnitude of the reported wage elasticities tends to increase over time. There are two possible drivers: First, the larger wage responsiveness in later years can indicate a rising capital mobility from the 1990s onwards. Second, the increase over time may result from better data availability which produces more accurate estimates of the wage elasticity to taxes (see e.g., the significantly positive moderator *Cross-country data).*

The coefficients for the variable *Standard error* remain negative and statistically significant at the 1% level. Adding the full set of moderator variables in Model (4) depresses the magnitude of the coefficient on *Standard error* but the evidence on the publication bias survives. The true effect varies between -0.008 and -0.013, and is even insignificant in Model (1). The values of the constants in Table 4 are conditioned on the included moderator variables taking zero values and thus, cannot be interpreted as an average true effect. Therefore, in the next subsection, we derive our consensus estimates while accounting for the diverse study characteristics.

Consensus Estimations

The underlying tax effect is significantly driven by the data coverage, the temporal focus and the average sample year. We can now calculate a consensus wage elasticity to taxes, while accounting for these heterogeneity factors using our most comprehensive Model (4) of Table 4 (see Feld et al. 2013; Heckemeyer and Overesch 2017; Havranek et al. 2018). Our ideal study would estimate a long-term elasticity, as shifting of the CIT on employees takes time. Therefore, we set *Long-term effect* at the sample maxima (1.0). We multiply the three statistically insignificant moderators (*OLS*, *GMM* and *Total incidence effect*) and the *Average sample year* by their sample means. Moreover, we remove any source of publication bias by setting the moderator *Standard error* at its sample minima (0.001).

(insert Table 5 about here)

Table 5 provides our consensus estimates for the three alternative CIT variables segregated by cross-country and within-country data. When using the STR as the explanatory variable, our predicted wage elasticity to taxes is -0.108 for cross-country data and -0.112 for within-country data. Precisely, a 1% increase in the STR is associated with a reduction in wages between 0.108% and 0.112%. The cross-country incidence effect is slightly smaller than the within-country incidence effect, since the former effect considers international tax effects and therefore might capture corporate tax avoidance behavior more accurately. We observe an increase in the consensus estimates for ex-ante rate observations with corresponding values of -0.137 (cross-country data) and -0.141 (within-country data). The consensus wage elasticity with respect to ex-post tax rates ranges between -0.105 (cross-country data) and -0.110 (within country-data) and thus, is smaller than the consensus estimates for the two other CIT rate variables.

It is ambiguous in the literature which effective corporate tax rate is the most appropriate. Swenson (1994) proposes to apply ATRs since ex-ante tax rates do not capture tax law complexities and are sensitive to the underlying assumptions. However, ATRs give rise to possible endogeneity concerns (see, e.g. Devereux and Griffith 1998; Carroll 2009). Thus, we cannot infer from our analysis whether a certain tax rate measure is better or worse than the other conclusively. Considering our results and the described advantages and disadvantages of each CIT measure, it would be advisable for future empirical studies to conduct their analyses by using all possibilities (STRs, ex-ante and ex-post effective tax rates) to validate their results.

Extended Results and Robustness

We perform a set of robustness checks to evaluate the sensitivity of our MRA results in Model (4) of Table 4 to several model and meta-sample variations. Table 6 presents the results. The primary studies in our meta-sample are quite heterogeneous with regard to their geographical coverage (e.g., worldwide, OECD countries or single countries, like the US, Canada or Germany). In our first robustness test in Model (1) of Table 6, we include dummy variables for country groups (*worldwide* or *OECD countries*) instead of the variable *Cross-country data* to control for the composition of the countries within the sample. While our results on the covariates remain quantitatively and qualitatively stable, we observe that studies with OECD samples drive the smaller cross-country elasticity estimates. In our second robustness test in Model (2), we focus on within-country estimates by including dummy variables for the *US*, *Canada* and *Germany*. Controlling for country differences between estimates changes our results slightly; the sign and significance of the coefficient on *Total incidence effect* change, and the variable *Ex-ante rate* gains significance. The coefficients on *US* and *Canada* are strongly negative and statistically significant, indicating that the average true negative association between the CIT and wages is larger for US and Canadian estimates.

(insert Table 6 about here)

As the number of estimates per primary study varies widely from 2 to 15, we use the inverse square root of the number of estimates times the precision of estimates as an alternative weighting factor in Model (3) (Alinaghi and Reed 2020). This weighting scheme treats small and large studies equally und thus, corrects for the over- and under-representation of primary studies. Our results do not change qualitatively, except for the significance of the constant. The last robustness check in Model (4) examines the sensitivity of the main MRA results to changes in the meta-sample composition by excluding the estimates of Hassett and Mathur (2015). The results on the covariates are qualitatively and quantitatively robust.

V. Conclusion

A large theoretical literature on tax incidence is based on general equilibrium models to predict the distribution of the CIT among individuals. The CIT burden either falls on capital or labor depending on the underlying assumptions (in particular, a closed or an open economy). A multitude of empirical studies provide evidence for labor bearing a substantial share of the CIT. As these findings crucially hinge on the underlying study design, however, the exact magnitude of the tax incidence on employees through lower wages still remains inconclusive. This paper sets up a comprehensive meta-sample containing 115 estimates from 15 primary studies on the corporate tax incidence. We investigate: (1) How large is the corporate tax incidence falling on employees via lower wages? And (2) what are the sources of heterogeneity among estimates? We contribute to the literature by evaluating the impact of heterogeneity of diverse study characteristics using MRA and by providing an average estimate for the wage elasticity to corporate taxes.

The meta-sample mean of the wage elasticity corresponds to -0.21. We find evidence for publication selection for negative estimates rather than for statistical significance. After correcting for publication bias, our results suggest an average true wage elasticity of -0.016. Our findings shed light on the current policy debates about lowering the CIT rate. Considering our rather low estimates for the average true effect, the appealing argument of a large corporate tax incidence effect for advocates of lower corporate taxes should be taken with care.

Moreover, the reported size of the wage responses to the CIT depends on the data coverage, the temporal focus and the average sample year. The estimates are smaller (i.e., less negative) for cross-country studies than within-country studies. The degree of shifting is much larger in the long-run. We find a rising responsiveness of wage rates to corporate taxes over time. After accounting for heterogeneity in estimates and correcting for publication bias, we estimate a negative but small consensus wage elasticity. Our results suggest that a 1% larger STR depresses wages by 0.108% (cross-country data) to 0.112% (within-country data) in the long-run. The tax incidence effects on wages are slightly larger on average when studies use ex-ante rates and slightly lower when studies apply ex-post tax rates.

We acknowledge some limitations of our MRA. First, our meta-sample covers estimates from very different studies. As our meta-sample is rather small (115 estimates), we are not able to control for all study characteristics. Second, the mechanism underlying the tax incidence is very complex. The economic interactions of various factors, such as the size of an economy or the international tax competition, may have an impact on the degree of the tax incidence on wages (Auerbach 2006). Thus, a part of the conclusions of the literature remains unexplored in our MRA. Our results should be interpreted with conventional caution but are a good starting point for future empirical research.

References

Alinaghi, N. & Reed, W.R. (2020) Taxes and economic growth in OECD countries: A meta-analysis. *Public Finance Review 49*(1): 3–40.

Altshuler, R., Grubert, H. & Newlon, T.S. (2001) Has U.S. investment abroad become more sensitive to tax rates? NBER Working Paper Series No. 6383.

Arulampalam, W., Devereux, M.P. & Maffini G. (2012) The direct incidence of corporate income tax on wages. *European Economic Review, 56*(6): 1038–1054.

Auerbach, A.J. (2006) Who bears the corporate tax? A review of what we know. *Tax Policy and the Economy, 20*: 1–40.

Aus dem Moore, N. (2014) Shifting the burden of corporate taxes: heterogeneity in direct wage incidence. Ruhr Economic Papers No. 531.

Azémar, C. & Hubbard, R.G. (2015) Country characteristics and the incidence of capital income taxation on wages: An empirical assessment. *Canadian Journal of Economics, 48*(5): 1762–1802.

Bauer, T.K., Kasten, T. & Siemers, L.-H.R. (2017) Business taxation and wages: Redistribution and asymmetric effects. Joint Discussion Paper Series in Economics No. 32-2017.

Carroll, R. (2009) Corporate taxes and wages: Evidence from the 50 sates. Tax Foundation Working Paper No. 8.

CEA (Council of Economic Advisers) (2017) Corporate tax reform and wages: Theory and Evidence (October). Washington.

Clausing, K.A. (2012) In search of corporate tax incidence. *Tax Law Review, 65*: 433–472.

Clausing, K.A. (2013) Who pays the corporate tax in a global economy? *National Tax Journal, 66*(1): 151–184.

De Mooij, R.A. & Ederveen, S. (2008) Corporate tax elasticities: A reader's guide to empirical findings. *Oxford Review of Economic Policy, 24*(4): 680–697.

Devereux, M.P. & Griffith, R. (1998) Taxes and the location of production: Evidence from a panel of US multinationals. *Journal of Public Economics*, *68*(3): 335–367.

Devereux, M.P. & Griffith, R. (1999) The taxation of discrete investment choices. The Institute for Financial Studies Working Paper Series No. W98/16.

Dwenger, N., Rattenhuber, P. & Steiner, V (2017) Sharing the burden: Empirical evidence on corporate tax incidence. *German Economic Review, 20*(4): 1–34.

Dyreng, S.D., Hanlon, M. & Maydew, E.L. (2008) Long-run corporate tax avoidance. *The Accounting Review, 83*(1): 61–82.

Dyreng, S.D., Jacob, M., Jiang, X. & Müller, M.A. (2020) Tax incidence and tax avoidance. SSRN Working Paper 3070239.

Ebrahimi, P. & Vaillancourt, F. (2016) The effect of corporate income and payroll taxes. Fraser Institute Working Paper.

Egger, M., Smith, G.D., Schneider, M. & Minder, C. (1997) Bias in meta-analysis detected by a simple, graphical test. *British Medical Journal, 315*(7109): 629–634.

Exbrayat, N. & Geys, B. (2016) Economic integration, corporate tax incidence and fiscal compensation. *The World Economy, 39*(11): 1792–1811.

Feld, L.P. & Heckemeyer, J.H. (2011) FDI and taxation: A meta-study. *Journal of Economic Surveys, 25*(2): 233–272.

Feld, L.P., Heckemeyer, J.H. & Overesch, M. (2013) Capital structure choice and company taxation: A meta-study. *Journal of Banking & Finance, 37*(8): 2850–2866.

Felix, R.A. & Hines, J. (2009) Corporate taxes and union wages in the United States. National Bureau of Economic Research Working Paper Series No 15263.

Felix, R.A. (2007) Passing the burden: Corporate tax incidence in open economies. LIS Working Paper Series No. 468.

Felix, R.A. (2009) Do state corporate income taxes reduce wages? *Economic Review, 94*(2):

77–102.
Fuest, C., Peichl, A. & Siegloch, S. (2018) Do higher corporate taxes reduce wages? Micro evidence from Germany. *American Economic Review*, *108*(2): 393–418.
Furman, J. (2018) No, the GOP Tax Plan Won't Give You a $9,000 Raise. *Wall Street Journal*, October 22, 2017.
Gentry, W.M. & College, W. (2007) A review of the evidence on the incidence of the corporate income tax. US Department of the Treasury OTA Paper 101.
Goodspeed, T. (2012) The Incidence of Bank Regulations and Taxes on Wages: Evidence from US States. CESifo Working Paper No. 4026.
Gravelle, J.C. (2011) Corporate tax incidence: A review of empirical estimates and analysis. Congressional Budget Office Working Paper Series 2011-01. Washington, D.C: Congressional Budget Office.
Gravelle, J.C. (2013) Corporate tax incidence: Review of general equilibrium estimates and analysis. *National Tax Journal*, *66*(1): 185–214.
Gravelle, J.G & Hungerford, T. L. (2007) Corporate tax reform: Issues for congress. Congressional Research Service Order Code RL34229.
Gravelle, J.G. & Smetters, K. (2006) Does the open economy assumption really mean that labor bears the burden of a capital income tax? *The B.E. Journal of Economic Analysis & Policy*, *6*(1): 1–44.
Gyourko, J. & Tracy, J. (1989) The importance of local fiscal conditions in analyzing local labor markets. *Journal of Political economy*, *97*(5): 1208-1231.
Hanlon, M. & Heitzman, S. (2010) A review of tax research. *Journal of Accounting and Economics*, *50:* 127–178.
Harberger, A.C. (1962) The incidence of the corporation income tax. *The Journal of Political Economy*, *70*(3): 215–240.
Harberger, A.C. (1995) The ABCs of corporation tax incidence: Insights into the open-economy case. In *Tax Policy and Economic Growth* (pp. 51–73). Washington: American Council for Capital Formation.
Harberger, A.C. (2008a) Corporation tax incidence: Reflections on what is known, unknown and unknowable. In Diamond, J.W. & Zodrow, G.R. (eds.) *Fundamental Tax Reform: Issues, Choices, and Implications* (pp. 283–307). Cambridge: The MIT Press.
Harberger, A.C. (2008b) The incidence of the corporation income tax revisited. *National Tax Journal*, *61*(2): 303–312.
Harris, B.H. (2009) Corporate tax incidence and its implication for progressivity. Tax Policy Center, Urban Institute and Brooking Institution Working Paper.
Hassett, K.A. & Mathur, A. (2006) Taxes and wages. American Enterprise Institute Working Paper No. 128.
Hassett, K.A. & Mathur, A. (2010) Spatial tax competition and domestic wages. *Working Paper*, Available at SSRN 2212975.
Hassett, K.A. & Mathur, A. (2015) A spatial model of corporate tax incidence. *Applied Economics*, *47*(13): 1350–1365.
Havránek, T., Irsova, Z., Zeynalova, O. (2018) Tuition fees and university enrolment: a meta-regression analysis. *Oxford Bulletin of Economics and Statistics 80*(6): 1145-1184.
Heckemeyer, J.H. & Overesch, M. (2017) Multinationals' profit response to tax differentials: Effect size and shifting channels. *Canadian Economics Association*, *50*(4): 965–994.
Liu, L. & Altshuler, R. (2013) Measuring the burden of the corporate income tax under imperfect competition. *National Tax Journal*, *66*(1): 215–238.
OECD (2015) Measuring and Monitoring BEPS, Action 11 – 2015 Final Report. OECD/G20 Base Erosion and Profit Shifting Project. Retrieved from *https://www.oecd.org/ctp/measuring-and-monitoring-beps-action-11-2015-final-report-9789264241343-en.htm*.

Randolph, W.C. (2006) International burdens of the corporate income tax. Congressional Budget Office Working Paper Series No. 2006-09. Washington, DC: Congressional Budget Office.

Stanley, T. (2001) Wheat from chaff: Meta-analysis as quantitative literature review. *Journal of Economic Perspectives 15*(3): 131–150.

Stanley, T.D. & Doucouliagos, H. (2012) *Meta-Regression Analysis in Economics and Business.* Abingdon: Routledge.

Stanley, T.D. (2008) Meta-regression methods for detecting and estimating empirical effects in the presence of publication selection. *Oxford Bulletin of Economics and Statistics 70*(1): 103–127.

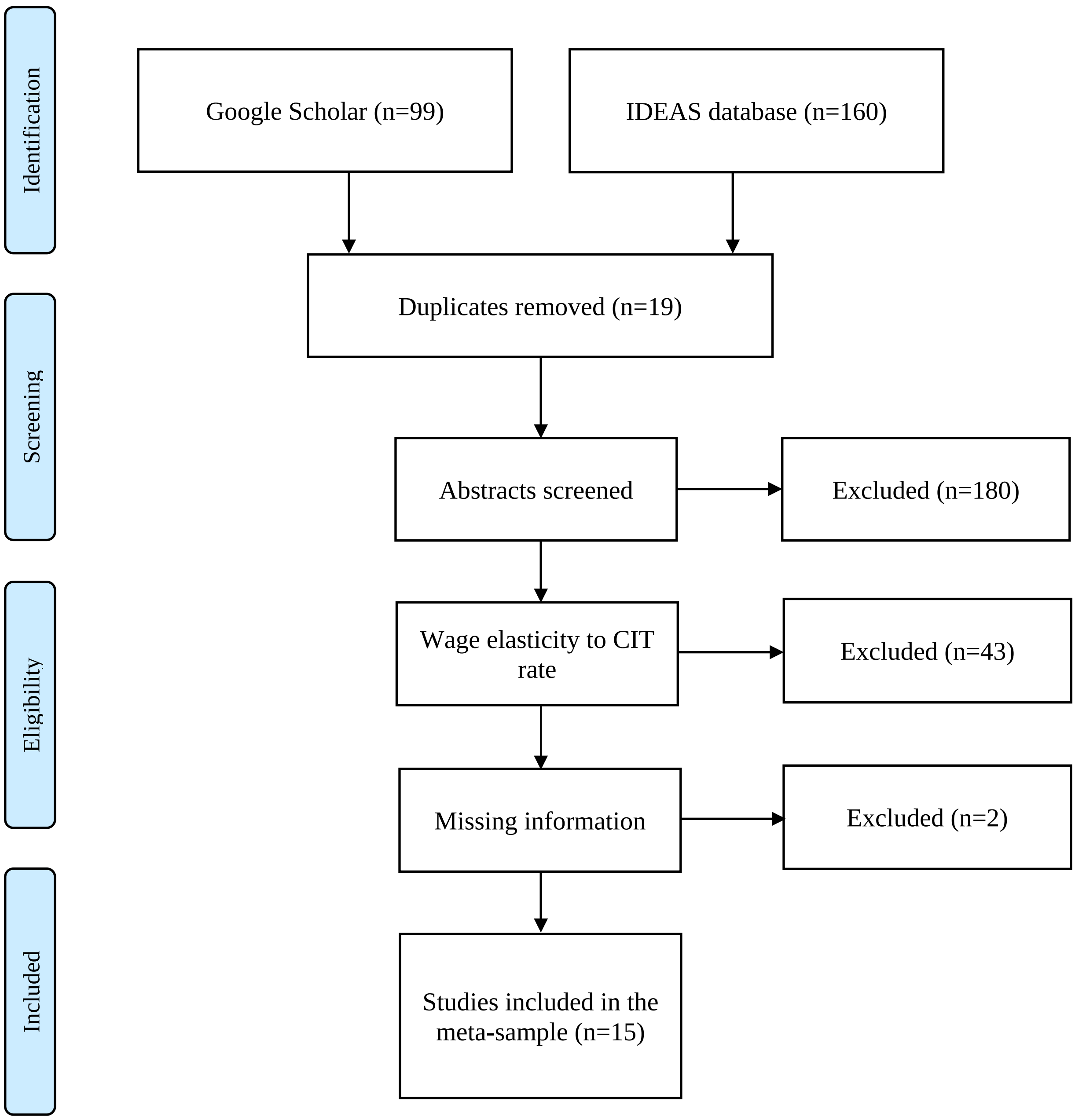
Summers, L. (2017) Trump's top economist's tax analysis isn't just wrong, it's dishonest. *Washington Post*, October 17, 2017.

Swenson, D.L. (1994) The impact of U.S. tax reform on foreign direct investment in the United States. *Journal of Public Economics, 54*(2): 243–266.

Appendices

Appendix A

Figure 1A: Selection of literature and inclusion criteria



Appendix B

Table 1B: Correlation matrix of moderator variables

Moderator variables	*Standard error*	*STR*	*Ex-ante rate*	*Ex-post rate*	*Cross-country data*	*Within-country data*	*OLS*	*IV*	*GMM*	*FE estimator*	*RE estimator*	*Long-term effect*	*Short-term effect*	*Static effect*	*Direct incidence effect*	*Total incidence effect*	*Average sample year*
Standard error	1.000																
STR	0.149	1.000															
Ex-ante rate	-0.006	-0.020	1.000														
Ex-post rate	0.935	-0.041	-0.028	1.000													
Cross-country data	0.544	-0.009	-0.021	0.441	1.000												
Within-country data	0.768	0.041	-0.018	0.879	-0.033	1.000											
OLS	0.439	-0.000	-0.020	0.309	0.446	0.110	1.000										
IV	-0.021	-0.022	0.912	-0.042	-0.031	-0.029	-0.030	1.000									
GMM	-0.014	-0.044	-0.031	-0.054	-0.039	-0.043	-0.044	-0.046	1.000								
FE estimator	0.836	0.034	-0.024	0.937	0.303	0.888	-0.034	-0.036	-0.052	1.000							
RE estimator	-0.086	-0.036	-0.025	-0.051	-0.037	-0.040	-0.036	-0.037	-0.055	-0.043	1.000						
Long-term effect	-0.083	-0.043	-0.030	-0.060	-0.044	-0.047	-0.042	0.077	-0.065	-0.051	-0.053	1.000					
Short-term effect	0.922	-0.038	-0.027	0.998	0.443	0.876	0.311	-0.040	-0.050	0.934	-0.048	-0.057	1.000				
Static effect	0.231	0.726	0.004	-0.019	-0.034	0.055	-0.026	-0.008	-0.073	0.046	-0.059	-0.071	-0.063	1.000			
Direct incidence effect	0.943	0.033	-0.030	0.997	0.441	0.882	0.309	-0.043	-0.057	0.939	-0.053	-0.063	0.996	0.025	1.000		
Total incidence effect	0.071	-0.018	0.104	-0.001	-0.023	0.010	-0.022	0.088	-0.034	0.006	-0.027	-0.018	-0.029	0.285	-0.032	1.000	
Average sample year	0.915	-0.033	-0.026	0.997	0.400	0.898	0.295	-0.039	-0.051	0.939	-0.048	-0.056	0.999	-0.059	0.995	-0.029	1.000

Notes: This matrix shows the correlation of moderator variables using the full meta-sample without the two outliers of Ebrahimi and Vaillancourt (2016). The moderator variables are weighted by the inverse of squared *Standard error*.

Figures and Tables

Figure 1: Funnel plot of the wage elasticities to taxes

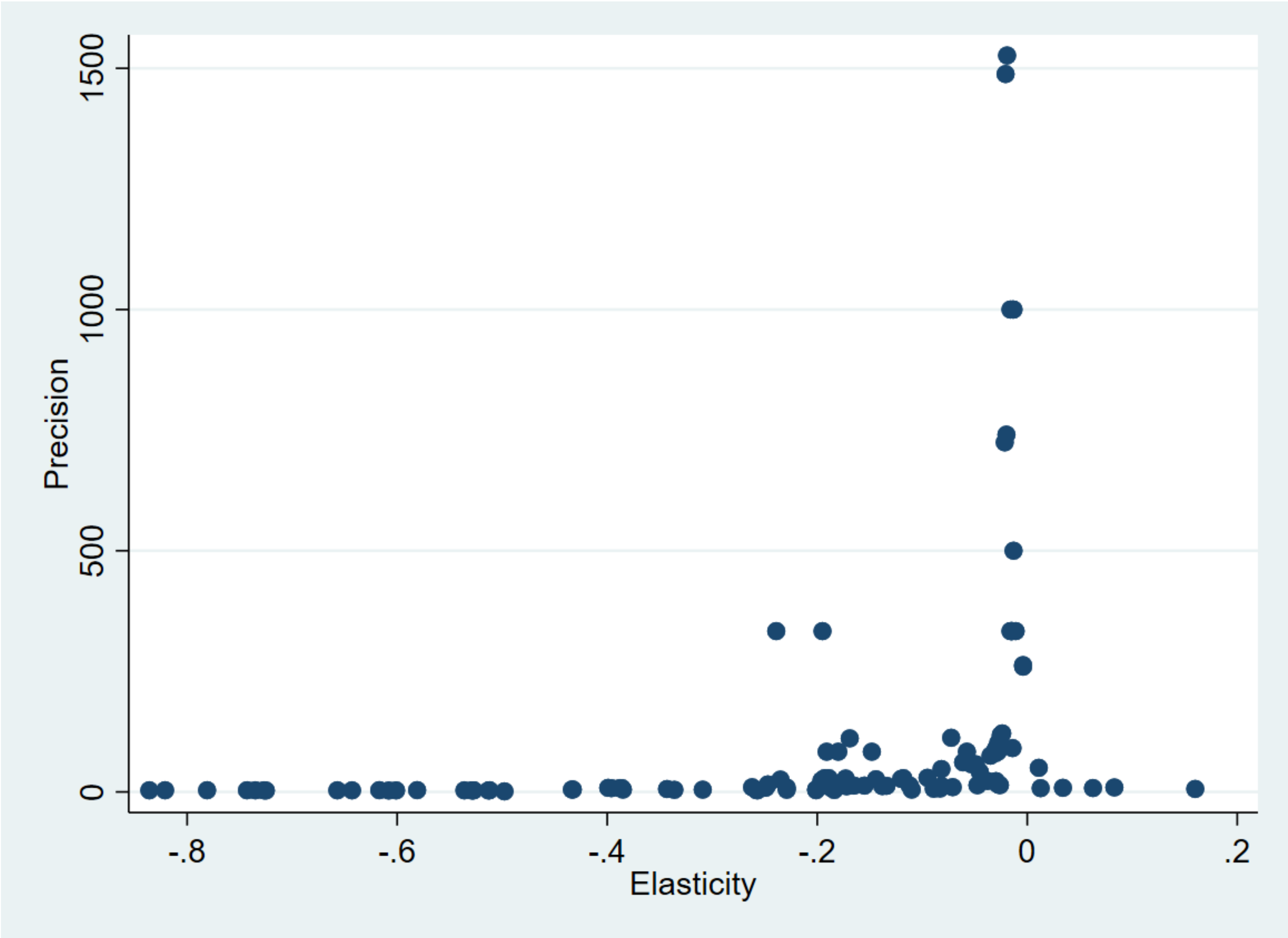


Figure 2: Scatter plot of the wage elasticities to taxes by significance

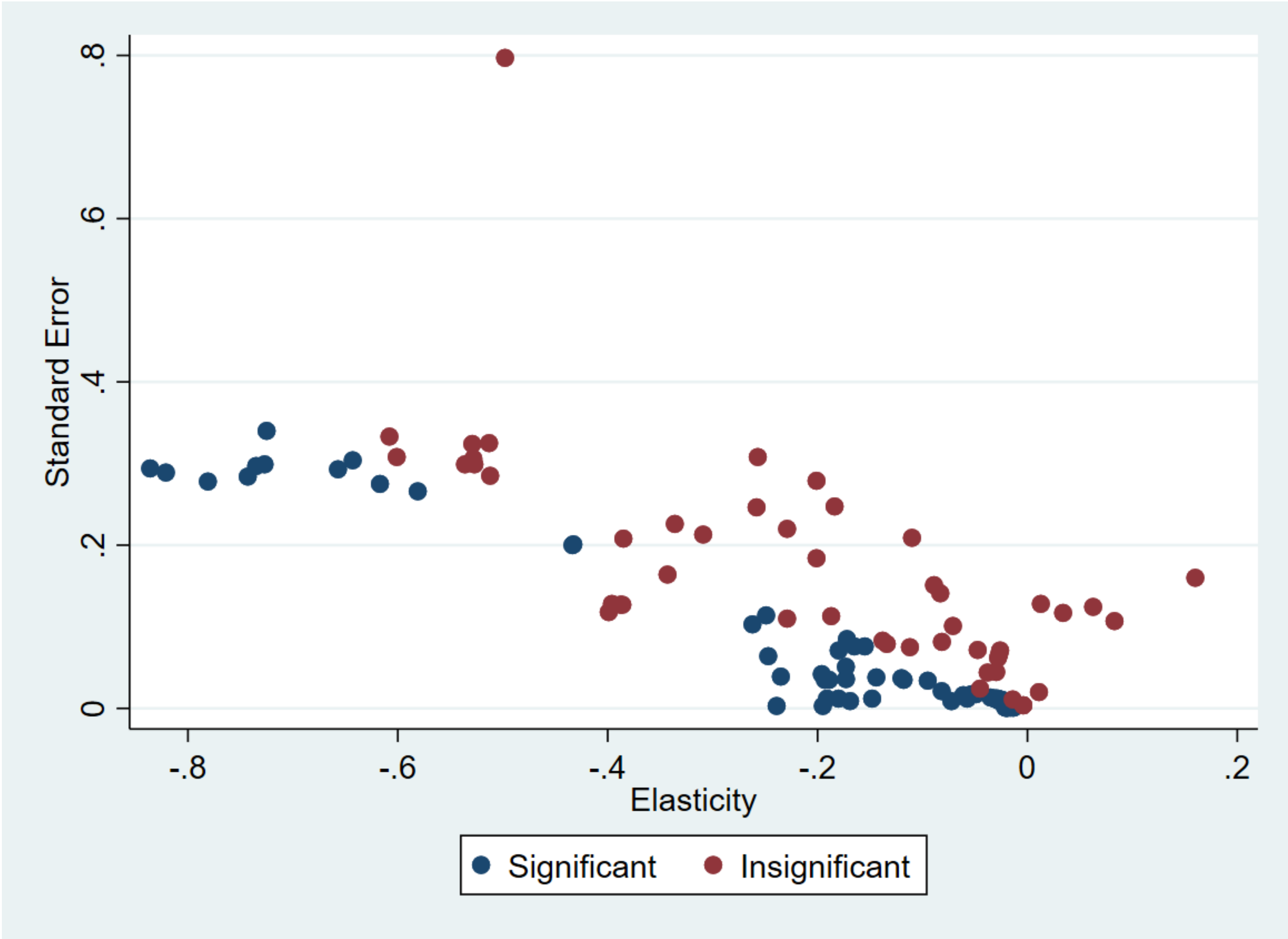


Figure 3: Scatter plot of the wage elasticities to taxes by the underlying CIT rate

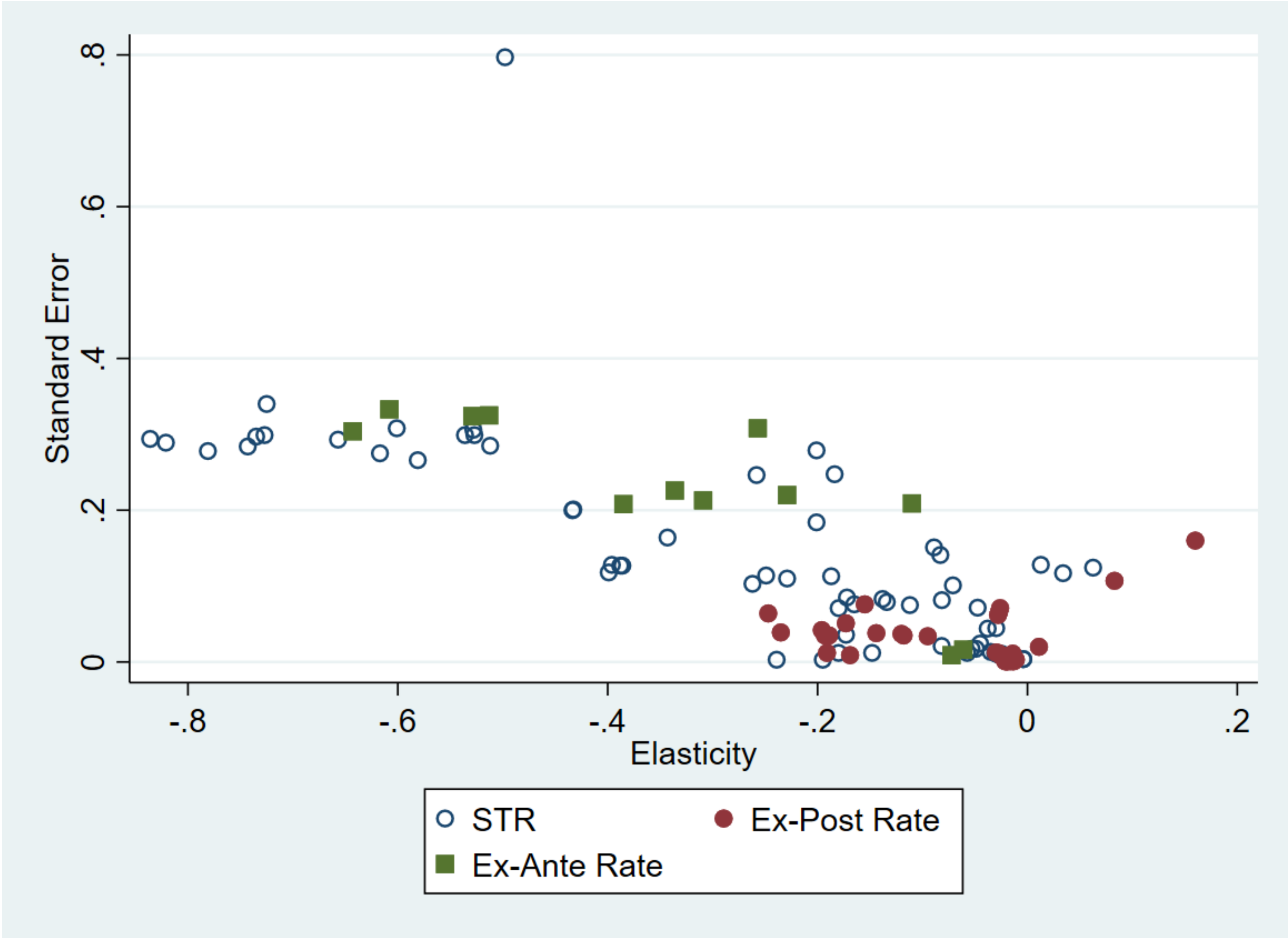


Table 1: Primary studies on the tax incidence on wages

#	Authors and publication year	CIT rate	Period	Dataset	Wage elasticity to taxes				Std.
					N	Mean	Min	Max	Dev.
1	Arulampalam, Devereux and Maffini (2012)	ATR	1996-2005	disaggregate cross-country	10	-0.07	-0.19	0.01	0.07
2	Aus dem Moore (2014)	ATR	1994-2010	disaggregate within-country	8	-0.02	-0.03	-0.02	0.00
3	Azémar and Hubbard (2015)	STR	1980-2004	aggregate cross-country	7	-0.04	-0.18	0.06	0.07
4	Bauer, Kasten and Siemers (2017)	STR	1995-2004	disaggregate within-country	10	-0.05	-0.17	-0.02	0.05
5	Carroll (2009)	STR, ATR	1970-2007	aggregate within-country	12	-0.07	-0.17	-0.01	0.07
6	Clausing (2012)	STR, ATR	1981-2009	aggregate cross-country	12	-0.15	-0.72	0.16	0.30
7	Dwenger, Rattenhuber and Steiner (2017)	ATR	1998-2006	disaggregate within-country	8	-0.19	-0.25	-0.14	0.04
8	Ebrahimi and Vaillancourt (2016)	STR	1998-2013	disaggregate within-country	4	-0.19	-0.24	-0.15	0.04
9	Exbrayat and Geys (2016)	STR	1982-2007	aggregate cross-country	3	-0.02	-0.06	-0.00	0.03
10	Felix (2007)	STR	1979-2002	aggregate cross-country	6	-0.33	-0.50	-0.18	0.14
11	Fuest, Peichl and Siegloch (2018)	STR	1989-2008	disaggregate within-country	6	-0.36	-0.40	-0.23	0.07
12	Goodspeed (2012)	STR	2003	disaggregate within-country	2	-0.05	-0.05	-0.05	0.00
13	Gravelle and Hungerford (2007)	STR, METR, AETR	1981-2002	aggregate cross-country	10	-0.44	-0.84	-0.11	0.25
14	Hassett and Mathur (2015)	STR, METR, AETR	1981-2005	aggregate cross-country	15	-0.57	-0.82	-0.25	0.17
15	Liu and Altshuler (2013)	METR	1982-1997	disaggregate within-country	2	-0.07	-0.07	-0.06	0.01
	Full meta-sample	-	1970-2013	-	115	-0.21	-0.84	0.16	0.23

Notes: The estimates of Fuest, Peichl and Siegloch (2018) are multiplied by -1 (net-of-tax rate estimates).

Table 2: Description and summary statistics of moderator variables

Moderator variables	Description	Summary statistics		
		Estimates	**Mean**	**Std. Dev.**
Publication bias				
Standard error	Standard errors of the wage elasticities	-	0.116	0.128
CIT rate				
STR	= 1 if the wage elasticity relies on the STR as the explanatory variable, and 0 otherwise	65	0.575	0.497
Ex-ante rate	= 1 if the wage elasticity relies on the METR or AETR as the explanatory variable, and 0 otherwise	12	0.106	0.309
Ex-post rate	= 1 if the wage elasticity relies on the ATR as the explanatory variable, and 0 otherwise	36	0.319	0.468
Dataset				
Cross-country data	= 1 if the wage elasticity relies on cross-country data, and zero otherwise	63	0.558	0.499
Within-country data	= 1 if the wage elasticity relies on within-country data, and zero otherwise	50	0.442	0.499
Estimation method				
OLS	= 1 if the wage elasticity relies on a (pooled) OLS estimator, and 0 otherwise	14	0.124	0.331
IV	= 1 if the wage elasticity relies on a IV, and 0 otherwise	13	0.115	0.320
GMM	= 1 if the wage elasticity relies on a GMM estimator, and 0 otherwise	11	0.097	0.298
FE estimator	= 1 if the wage elasticity relies on a fixed effects estimator, and 0 otherwise	69	0.611	0.490
RE estimator	= 1 if the wage elasticity relies on a random effects estimator, and 0 otherwise	6	0.053	0.225
Temporal dynamics				
Long-term effect	= 1 if a long-term wage elasticity, and 0 otherwise	8	0.071	0.258
Short-term effect	= 1 if a short-term wage elasticity, and 0 otherwise	23	0.204	0.404
Static effect	= 1 if a static wage elasticity, and 0 otherwise	82	0.726	0.448
Control variables				
Direct incidence effect	= 1 if the wage elasticity relies on a regression controlling for labor productivity or the capital stock, and 0 otherwise	85	0.752	0.434
Total incidence effect	= 1 if the wage elasticity relies on a regression not controlling for labor productivity or the capital stock, and 0 otherwise	28	0.248	0.434
Effect over time				

Average sample year	= average sample year of the respective wage elasticity, normalized between 0 and 1	-	0.436	0.304

Notes: We drop two outliers of Ebrahimi and Vaillancourt (2016).

Table 3: Testing publication bias

Panel A: Full meta-sample

Moderator variables	Full meta-sample		
	OLS	*WLS*	*IV*
	(1)	(2)	(3)
Publication bias			
Standard error	-1.415***	-1.994***	-1.244***
	(0.369)	(0.475)	(0.412)
Constant (true effect)	-0.045	-0.016***	-0.061**
	(0.034)	(0.002)	(0.026)
Number of observations	113	113	103
Number of primary studies	15	15	15
Adj. R-squared	0.596	0.277	0.577
VIF	1	1	1

Notes: We drop two outliers of Ebrahimi and Vaillancourt (2016). The dependent variable is the *Wage elasticity to taxes*. We use ordinary least squares (OLS) meta-regression in Model (1), weighted least squares (WLS) meta-regression with the inverse of the squared *Standard error* as analytical weights in Model (2), and the inverse of the square root of the *Number of observations* as an instrument for the *Standard error* in Model (3). ***, **, and * indicate significance levels of 0.01, 0.05, and 0.1, respectively. Standard errors are in parentheses and clustered at the study level to control for autocorrelation (within-study dependency).

Panel B: Subsample analysis

Moderator variables	Subsample analysis		
	STR	*Ex-ante rate*	*Ex-post rate*
	(1)	(2)	(3)
Publication bias			
Standard error	-2.069***	-1.168**	-2.419
	(0.370)	(0.234)	(1.372)
Constant (true effect)	-0.009*	-0.057***	-0.016***
	(0.005)	(0.002)	(0.003)
Number of observations	65	12	36
Number of primary studies	11	3	5
Adj. R-squared	0.398	0.760	0.174

VIF	1	1	1

Notes: We drop two outliers of Ebrahimi and Vaillancourt (2016). The dependent variable is the *Wage elasticity to taxes*. We use weighted least squares (WLS) meta-regression with the inverse of the squared *Standard error* as analytical weights. ***, **, and * indicate significance levels of 0.01, 0.05, and 0.1, respectively. Standard errors are in parentheses and clustered at the study level to control for autocorrelation (within-study dependency).

Table 4: Sources of heterogeneity

Moderator variables	(1)	(2)	(3)	(4)
CIT rate				
Ex-ante rate	-0.037***	-0.037***	-0.034	-0.029
	(0.007)	(0.007)	(0.024)	(0.020)
Ex-post rate	-0.007	-0.006	-0.005	0.003
	(0.005)	(0.005)	(0.004)	(0.007)
Dataset				
Cross-country data		0.005***	0.005***	0.004***
		(0.001)	(0.001)	(0.001)
Estimation method				
OLS		-0.000	-0.001	0.000
		(0.001)	(0.001)	(0.001)
GMM		-0.030	-0.032	-0.031
		(0.034)	(0.035)	(0.035)
Temporal dynamics				
Long-term effect			-0.103***	-0.092***
			(0.025)	(0.023)
Control variables				
Total incidence effect			-0.006	-0.014
			(0.020)	(0.020)
Wage effect over time				
Average sample year				-0.017**
				(0.008)
Publication bias				
Standard error	-2.073***	-1.834***	-1.554***	-1.605***
	(0.474)	(0.398)	(0.270)	(0.277)
Constant	-0.009	-0.012**	-0.013***	-0.008*
	(0.005)	(0.005)	(0.004)	(0.004)
Number of observations	113	113	113	113
Number of primary studies	15	15	15	15
Adj. R-squared	0.293	0.361	0.388	0.458

VIF	1.09	1.10	1.15	1.24

Notes: We drop two outliers of Ebrahimi and Vaillancourt (2016). The dependent variable is the *Wage elasticity to taxes*. All moderator variables are coded as binary dummy variables, except for *Average sample year* and *Standard error*. We use weighted least squares (WLS) meta-regression with the inverse of the squared *Standard error* as analytical weights. ***, **, and * indicate significance levels of 0.01, 0.05, and 0.1, respectively. Standard errors are in parentheses and clustered at the study level to control for autocorrelation (within-study dependency).

Table 5: Consensus estimations

		Mean	**95% confidence interval**	
Cross-country data	*STR*	-0.108	-0.150	-0.066
	Ex-ante rate	-0.137	-0.217	-0.057
	Ex-post rate	-0.105	-0.154	-0.056
Within-country data	*STR*	-0.112	-0.155	-0.070
	Ex-ante rate	-0.141	-0.222	-0.060
	Ex-post rate	-0.110	-0.159	-0.060

Notes: Consensus estimations rely on Model (4) of Table 4. The variable *Long-term effect* is set at the sample maxima, the variables *Standard error* are set at their sample minima, the statistically insignificant variables *OLS*, *GMM* and *Total incidence effect* and the *Average sample year* are set at their sample means.

Table 6: Extended Results and Robustness

Moderator variables	Country groups	Single country	Weighting scheme	Without Hassett & Mathur
	(1)	(2)	(3)	(4)
CIT rate				
Ex-ante rate	-0.029	-0.045***	-0.023	-0.029
	(0.021)	(0.003)	(0.024)	(0.021)
Ex-post rate	0.003	-0.001	0.003	0.003
	(0.007)	(0.001)	(0.007)	(0.007)
Dataset				
Cross-country data		0.002***	0.005***	0.004***
		(0.001)	(0.001)	(0.001)
Country groups				
worldwide	-0.053			
	(0.099)			
OECD Countries	0.004***			
	(0.001)			
Single country				
US		-0.019***		
		(0.004)		
Canada		-0.125***		
		(0.004)		
Germany		-0.003		
		(0.003)		
Estimation method				
OLS	0.000	-0.000	0.001	0.000
	(0.001)	(0.001)	(0.002)	(0.001)
GMM	-0.032	-0.032	-0.028	-0.032
	(0.036)	(0.036)	(0.034)	(0.036)
Temporal dynamics				
Long-term effect	-0.095***	-0.110***	-0.083***	-0.096***
	(0.025)	(0.008)	(0.027)	(0.024)
Control variables				
Total incidence effect	-0.014	0.003**	-0.021	-0.014

	(0.021)	(0.001)	(0.026)	(0.021)
Wage effect over time				
Average sample year	-0.017**	-0.034***	-0.020*	-0.017**
	(0.008)	(0.005)	(0.009)	(0.008)
Publication bias				
Standard error	-1.526***	-1.509***	-1.645***	-1.491***
	(0.367)	(0.260)	(0.297)	(0.315)
Constant	-0.009*	0.009**	-0.006	-0.009*
	(0.004)	(0.004)	(0.006)	(0.004)
Number of observations	113	113	113	98
Number of primary studies	15	15	15	14
Adj. R-squared	0.454	0.610	0.478	0.429
VIF	1.34	6.08	1.30	1.26

Notes: We drop two outliers of Ebrahimi and Vaillancourt (2016). The dependent variable is the *Wage elasticity to taxes*. All moderator variables are coded as binary dummy variables, except for *Average sample year* and *Standard error*. We use weighted least squares (WLS) meta-regression with the inverse of the squared *Standard error* as analytical weights in Models (1), (2) and (4) and the inverse of the squared *Standard error* times the square root of the *Number of estimates* as analytical weights in Model (3). ***, **, and * indicate significance levels of 0.01, 0.05, and 0.1, respectively. Standard errors are in parentheses and clustered at the study level to control for autocorrelation (within-study dependency).

Impressum:
Arbeitskreis Quantitative Steuerlehre, arqus, e.V.
Vorstand: Prof. Dr. Ralf Maiterth (Vorsitzender),
Prof. Dr. Kay Blaufus, Prof. Dr. Dr. Andreas Löffler
Sitz des Vereins: Berlin

Herausgeber: Kay Blaufus, Jochen Hundsdoerfer,
Martin Jacob, Dirk Kiesewetter, Rolf J. König,
Lutz Kruschwitz, Andreas Löffler, Ralf Maiterth,
Heiko Müller, Jens Müller, Rainer Niemann,
Deborah Schanz, Sebastian Schanz, Caren Sureth-
Sloane, Corinna Treisch

Kontaktadresse:
Prof. Dr. Caren Sureth-Sloane, Universität Paderborn,
Fakultät für Wirtschaftswissenschaften,
Warburger Str. 100, 33098 Paderborn,
www.arqus.info, Email: info@arqus.info

ISSN 1861-8944