LIS
Working Paper Series

No. 668

The Taxing Deed of Globalization:

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April 2016

Luxembourg Income Study (LIS), asbl

The Taxing Deed of Globalization*

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This draft: April 2016

Abstract

We examine the effects of globalization on the size and composition of tax revenues, worker-specific tax burdens, and effective average labor income tax rates using a unique international database on income tax calculators. We find that due to increasing mobility of firms and high-income workers, globalization led governments in OECD countries to seek tax revenues from alternative sources, specifically from employee-borne taxes paid by relatively less mobile middle-income workers. In 1994-2007, they experienced a globalization-induced rise in their personal income tax rate of around 1.5, whereas the top 1% of workers faced a reduction of approximately 1.5 percentage points.

Keywords: Globalization; Income taxes; Tax progressivity; International trade; Migration

JEL-codes: F1; F6; H2; H3.

*The authors would like to thank conference participants and discussants at the CESifo Conference on Public Sector Economics, IIPF, Royal Economic Society, European Trade Study Group, 8th FIW-Research Conference "International Economics", FIW-Workshop "Trade, Migration and Labor Market Outcomes", Villars Research Workshop on International Trade, and seminars at Yale University, the European Commission, Technical University Dresden, University of Lucerne, and the University of Bayreuth for their numerous comments. In particular, the authors are grateful to Josef Falkinger, Richard Baldwin, and Marcelo Olarreaga for helpful advice.

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Over the past decades, global integration of the world economy has risen dramatically – as has inequality across and within countries. That globalization may be a source of inequality is widely accepted by economists, but the exact channels of causation are still debated. We explore one of them: the influence of globalization on inequality through changes in personal income taxation systems around the globe. Using the largest existing database on income tax calculators, collected by the authors, this paper identifies the existence of a causal effect exerted by globalization, measured as goods trade and migration, on country-level tax outcomes and quantifies its magnitude.

Economies became increasingly integrated in the post-World-War-II era, which was characterized by falling barriers to cross-border flows of goods and production factors. While the consequences of vanishing barriers to trade and migration are complex, we focus on the effect of globalization on the behavior of tax authorities around the globe. On the one hand, measures of globalization are correlated with higher expenditures on public goods (see Rodrik, 1998; Epifani and Gancia, 2009).[1] On the other hand, raising the mobility of some factors – such as capital (see Persson and Tabellini, 1993; Devereux, Griffith, and Klemm, 2002; Devereux, Lockwood, and Redoano, 2008) or skilled and/or high-income workers (see Kleven, Landais, Saez, and Schultz, 2014) – in conjunction with liberalization of cross-border business transactions limits the opportunities of tax authorities to diversify the tax burden.[2] Hence, governments rely increasingly on fewer and relatively immobile tax bases to fulfill a growing demand for public goods. These tax bases are essentially three: (i) property and wealth, (ii) sales and consumption, and (iii) the personal income of relatively immobile workers.[3] This paper assesses the effects of globalization on the relative size of these tax bases and specifically focuses on worker-specific tax burdens and effective average labor income tax rates across the individual income distribution in an economy.

To identify the effect that globalization exerts on tax outcomes, we develop a novel instrument for trade and migration openness – *pure cross-border transaction costs* – based on insights from new quantitative trade and migration general-equilibrium models. We combine this instrument with data on taxation, specifically, data on personal income taxation, to derive several insights.[4] First, globalization made governments seek tax revenues from sources other than firm-borne taxes, which is consistent with economic theory suggesting a decreasing taxation of mobile and increasing taxation of immobile tax bases. Globalization increased the share of tax revenues that are collected via employee-borne taxes. Second, relative tax burdens on the broad middle class relative to the very-high-income and lowest-

[1] Leading explanations for the positive correlation between public spending and globalization include workers' increased demand for additional insurance against external shocks (Rodrik, 1998) and terms-of-trade externalities (Epifani and Gancia, 2009). For the link between globalization and the size of government spending, also see Cameron (1978) and Alesina and Wacziarg (1998).

[2] The literature on cross-border tax competition primarily documents a convergence of corporate income and consumption tax rates (see Devereux, Griffith, and Klemm, 2002; Onaran, Boesch, and Liebrecht, 2012), as well as of effective tax rates on labor income (see Onaran, Boesch, and Liebrecht, 2010).

[3] For the link between globalization and tax design, see Ganghof and Eccleston (2004) and Hines and Summers (2009).

[4] While revenues from personal income taxation are the most important source for developed countries, they are less important than value-added taxes in less developed economies.

income earners have increased, particularly in the industrialized part of the world. Third, this last change was induced inter alia through modifications of countries' income tax laws, which provided for a relatively more aggressive taxation of the middle class relative to the extremes of the income distribution. We find that middle-income earners faced a rise in their personal income tax rate of around 1.5 percentage points due to the rise in globalization between 1994 and 2007 alone. In the same time period, the top 1% of workers faced a globalization-induced reduction in their effective income tax rates of approximately 1.5 percentage points. These changes are confirmed in data sets on aggregate income distributions across countries, in microdata across countries from the Luxembourg Income Study (LIS), and, using interstate worker mobility in the United States, in microdata at the sub-national level.

Our findings are consistent with the literature on optimal non-linear taxation in closed (Saez, 2001) and open (Simula and Trannoy, 2010; Piketty and Saez, 2013; Lehmann, Simula, and Trannoy, 2014) economies.[5] This paper documents the global dimension of the causal impact of globalization on income tax systems, specifically, the personal income tax schedules over the last quarter of a century. In pursuit of this line of research, the present paper compiled the biggest existing data set on personal income tax calculators, covering 252 economies and territories around the globe at an annual level between the years 1980 and 2012 for 12 household archetypes (distinguished by the types of allowances and deductions granted across all the existing systems).[6] Many of the results are well aligned with the current public debate on globalization-induced inequality; however, thus far this debate has lacked the exact documentation of the phenomenon that the present paper generates.

The remainder of the paper is organized as follows: In the next section, we provide a few stylized facts on the link between globalization, the relative size and composition of tax revenues, and firm-borne versus individual-borne tax rates. In Section 3, we develop an instrument for globalization that is consistent with recent quantitative trade and migration models and elaborate on the theoretical causal link between openness and income inequality. In Section 4, we document the causal link between globalization and the size and composition of tax revenues for OECD and non-OECD countries and over the years 1980-2007. Section 5 is devoted to investigating the effect of globalization on worker-specific tax burdens and effective average tax rates. Section 6 illustrates the robustness of the findings and provides supporting evidence based on the link between state-to-state migration and state-level tax characteristics in the United States. The last section concludes.

[5] Saez (2001) examined optimal taxation with immobile labor whereas Simula and Trannoy (2010) and Lehmann, Simula, and Trannoy (2014) extended the analysis to consider migration in a canonical optimal taxation setting along the lines of Mirrlees (1971) and Diamond (1998). Earlier empirical work on the link between migration and personal income taxes exists for individual countries and location decisions of workers within countries (see Kirchgaessner and Pommerehne, 1996; Wagner, 2000; Schmidheiny, 2006). This literature documents a higher income tax sensitivity of more skilled (higher earning) and younger individuals than on average.

[6] See Egger and Strecker (2016) for more information on the data set.

2 Globalization, tax revenues, and personal income tax rates

The purpose of this section is to document stylized facts about the changes of what we refer to as globalization, of the composition of tax revenues across major bases, and of personal income tax rates across countries and years. The description of the sources and the generation of the data that are used throughout the paper are relegated to the Appendix. This paper's research agenda limits the scope of the analysis to 65 countries between 1980 and 2007 due to the need for additional data in our regressions such as income inequality and education.[7]

2.1 Globalization

It is well documented in the literature that trade grew substantially in all major regions of the world over the last decades, and that the liberalization of discriminatory and non-discriminatory trade policy measures is partly responsible for this pattern (see Baier and Bergstrand, 2001; Egger and Nigai, 2015). Important policy changes fostering this development were the GATT (General Agreement on Tariffs and Trade) and WTO (World Trade Organization) rounds, as well as the formation of what Baldwin (2006) called the "spaghetti bowl" of preferential trade agreements. At the same time, labor migration increased substantially and, in some OECD countries, became a major force to counteract plummeting fertility rates. In this context, it should be mentioned that the mobility of high-skilled workers – through migration – as well as international trade – through international, within-firm production process fragmentation – is fundamentally linked to the activity of multinational firms. Hence, the two measures of globalization should be expected to be highly correlated with multinational activity and each other.

Figure 1 illustrates the evolution of average imports (in percent of GDP), average inward FDI stocks (in percent of GDP), and average immigration stock (per capita) among the 65 biggest economies in the world. The figure suggests that, between 1980 and 2007, normalized imports, inward FDI stocks, and immigrant stocks rose by more than 16%, 272%, and 37%, respectively.[8]

Lower barriers to goods trade, capital mobility, and worker migration are generally associated with higher government spending for a variety of reasons, also illustrated in Figure 1, where tax revenues as a share of GDP increased by 16%. Rodrik (1997, 1998) argues that globalization exposes domestic workers to external shocks, which increases their demand for social insurance and the provision of public goods. This is consistent with trade liberalization being a source of higher inequality as suggested by Goldberg and Pavcnik (2004,

[7] While we compiled data on income tax calculators for 252 countries and territories for the period 1980-2012, the limiting factor to the analysis here are the additional regressors.

[8] While FDI rose most dramatically, its measurement is less precise than trade or immigration. This is due to differences in the definition of FDI across countries and differences in the thresholds imposed for accounting purposes imposed by the OECD or the UNCTAD FDI/TNC Database.

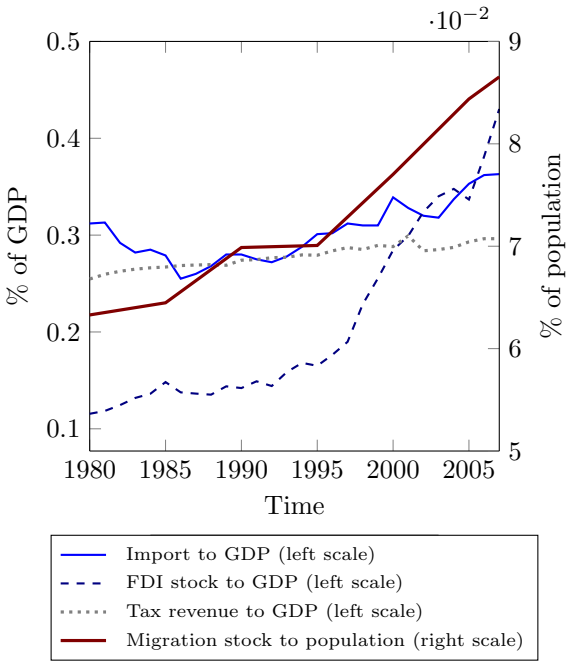

Figure 1: Openness, FDI, and Migration in 65 economies over 1980-2007

2007).[9] However, Epifani and Gancia (2009) point to the terms-of-trade effect, whereby open economies may raise public spending partly at the expense of foreign economies.

2.2 Tax revenue composition

Countries differ in terms of the composition of tax revenues. This composition may be influenced by globalization as well as other factors (e.g., see Hines and Summers, 2009) but there are systematic differences between OECD and non-OECD countries in the period between 1980 and 2007. While both country groups collect roughly one quarter of their total tax revenues from firm-borne taxes, they differ substantially in the relative importance of other sources.

We shed more light on the differences in the average composition of tax revenues in Figure 2. For the present purpose and to some extent for reasons of data availability, we distinguish between four sources of tax revenues: firm-based taxes (corporate taxes and employer-borne labor taxes, such as payroll and employer-borne social security contributions); personal

[9]Trade economists have put forth a number of theoretical explanations for the positive link between openness and inequality: (i) positive sorting of more productive workers to exporting firms (see Helpman, Itskhoki, and Redding, 2010; Burstein and Vogel, 2012; Harrigan and Reshef, 2013 among others), (ii) firm heterogeneity and a high profitability of exporters combined with wage bargaining (see Egger and Kreickemeier, 2009; Amiti and Davis, 2011; Egger, Egger, and Kreickemeier, 2013), (iii) offshoring of certain skill-specific stages of production (see Feenstra and Hanson, 1996, 1999, 2004; Zhu and Trefler, 2005), and lastly (iv), capital-skill complementarity and associated skill-premia (see Parro, 2014). For an empirical example, Autor, Dorn, Hanson, and Song (2014) use individual-level U.S. data and find that a higher exposure to imports from China has had a larger adverse effect on the demand for low-skilled workers relative to that of high-skilled workers, which suggests that globalization imposes heterogeneous costs on workers by skill and employment status. Autor, Dorn, and Hanson (2015), using local U.S. labor market data, find that rising import competition, depending on industry characteristics, may lead to wage polarization and/or rising unemployment.

income taxes on employees (including their social security contributions); taxes on goods and services following the International Monetary Fund's (IMF) definition;[10] and a remainder category, which contains all other sources of tax revenue. The figure suggests that the share of revenues collected from employee-borne income taxation is the most important source in the OECD group over the sample period, followed by taxes on goods and firm-based taxes. In contrast, non-OECD countries rely least heavily on employee-based taxes and most heavily on goods taxes. For these reasons, we devote much of our discussion in the main text to OECD member countries but provide all the results for non-OECD economies in the Appendix.

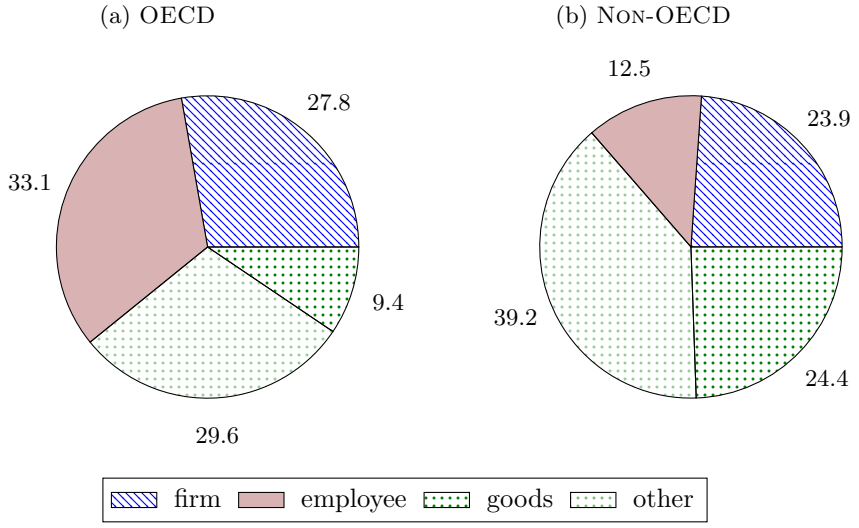

Figure 2: Tax-revenue composition in OECD and non-OECD countries

2.3 Corporate and personal income tax rates

Earlier evidence suggests that capital and high-mobility workers respond sensitively to lower tax rates, while low-mobility workers are less responsive. This is consistent with Figure 3, which summarizes the evolvement of the average corporate tax rate, the average top-1% personal income tax rate, and the average median-income tax rate in our sample between 1980 and 2007.[11] The figure suggests that tax rates levied on relatively mobile bases – corporate profits and high incomes – have declined, while taxes on the median personal income have, on average, increased in the recent past. Hence, the relative stability of personal income *tax revenues* over the same time span conceals the relatively strong changes in the structure of effective personal income *tax rates*. The fact that the reductions in both corporate profit and top personal income tax rates are concurrent with an increase in the median personal income tax rate suggests that the average economy reduced the burden on

[10] According to the IMF's Government Finance Statistics: goods and services taxes include taxes levied on the production, extraction, sale, transfer, leasing, and delivery of goods and services, but exclude taxes on imports, exports, and other cross-border transactions

[11] Personal income tax rates in this context include the worker-specific labor income tax rate and the employee-borne social security contributions. The computation of effective personal income tax rates requires information on the distribution of personal gross incomes within countries over time and on the personal income tax code per country and year. Details on both types of data are relegated to the Appendix.

mobile capital and high-income individuals at the expense of median-income earners. While evidence on this fact is interesting in itself, this paper is concerned with documenting the causal role of globalization in this process. This process, however, is not straightforward, as both trade and migration are affected by taxes on firms and workers. To circumvent this problem we develop an instrument for globalization using the insights from structural models of cross-border flows of goods and workers.

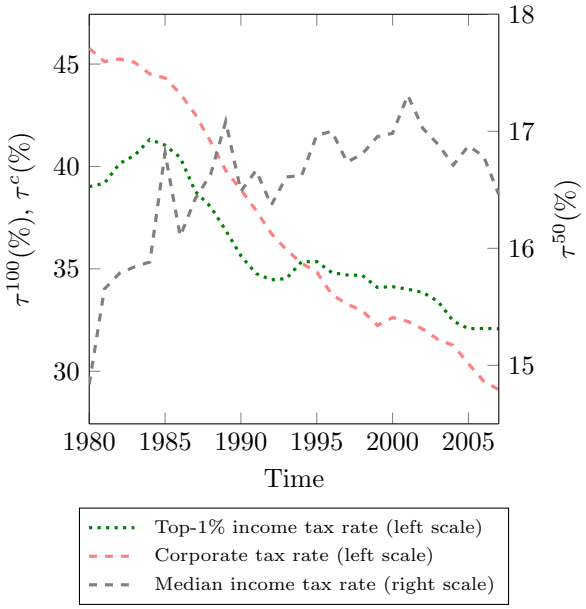

Figure 3: Corporate tax rates and personal income tax rates for top-1% and median workers in 65 economies over 1980-2007

3 An instrument for endogenous globalization

Identifying the effect of globalization on tax revenues and personal income tax schedules is challenging, because the production of goods depends on (gross-of-tax) factor returns, the consumption of goods depends on (net-of-tax) disposable income, and the location of factors (capital and workers) depends on expected net factor returns and the provision of public goods (which are themselves a function of tax revenue). Hence, an analysis of the effect of globalization on tax revenues and tax rates needs to guard against this intricate endogeneity problem.

This paper utilizes insights from from recent structural general equilibrium models of trade (see Eaton and Kortum, 2002; Anderson and van Wincoop, 2003; Arkolakis, Costinot, and Rodriguez-Clare, 2012) and migration (see Artuc, Chaudhuri, and McLaren, 2010; Anderson, 2011; Dix-Carneiro, 2014) to generate instruments for the two measures of globalization.

Let us use $\pi_{n,ijt}$, with $n = \{trade, mig\}$ to denote the expenditure share at time of importer country i on goods from j in the case of trade and the share of natives from j that have chosen to migrate to i in the case of migration, respectively. Then, for a set of N countries

we can specify bilateral trade and migration shares as:

$$\pi_{n,ijt} = \frac{c_{n,jt}\beta_{n,ijt}}{\sum_k c_{n,kt}\beta_{n,ikt}}, \tag{1}$$

where $c_{n,jt}$ is proportional to country j's supply potential and $\beta_{n,ijt}$ captures the influence of frictions to or preferences against acquiring goods or receiving migrants in country i from j at time t. With trade, $c_{n,jt}$ may be influenced by production costs and (gross-of-tax) factor income, while with migration it is a function of potential migrants' (net-of-tax) reservation wages in j, both being influenced by taxation. We follow Head and Ries (2001) in circumventing the problem by normalizing $\pi_{n,ijt}$ as:

$$\frac{\pi_{n,ijt}}{\pi_{n,iit}} = \frac{c_{n,jt}}{c_{n,it}}\beta_{n,ijt}, \tag{2}$$

and, following Eaton and Kortum (2002), Anderson and van Wincoop (2003) and many others, assume domestic trade costs to be zero for all i and t, whereby $\beta_{n,iit} = 1$. We then obtain:

$$\beta_{n,ijt}\beta_{n,jit} = \frac{\pi_{n,ijt}}{\pi_{n,iit}}\frac{\pi_{n,jit}}{\pi_{n,jjt}}. \tag{3}$$

With $\beta_{n,ijt}\beta_{n,jit}$ at hand, we can compute *average* costs of (inward and outward) trade or migration, which are denoted by $\beta_{n,it} = \sum_{j\neq i}\beta_{n,ijt}\beta_{n,jit}$. These costs are correlated with trade and migration, but they do not depend on gross- or net-of-tax factor incomes in exporting or importing countries, according to modern quantitative work in international economics.

Let us use $\pi_{n,it}$ to denote country-level average openness to trade (measured as the average of exports and imports to total absorption) and migration (measured as the average of immigrant and emigrant stock to native population).[12] Moreover, let λ_t^{π} and μ_i^{π} denote time and country fixed effects, respectively. We can then formulate a stochastic model of trade/immigrant openness that will serve as the first stage as:

$$\ln(\pi_{n,it}) = constant^{\pi_n} + \Gamma_n^{\pi} Z_{it} + \lambda_{n,t}^{\pi} + \mu_{n,i}^{\pi} + \delta\ln(\beta_{n,it}) + \upsilon_{n,it}, \tag{4}$$

where $constant^{\pi_n}$ is an intercept, Z_{it} is the matrix of additional controls and $\upsilon_{n,it}$ is a residual term. Using the data on trade and migration from the sources described in the Appendix, this regression obtains a coefficient estimate of $\widehat{\delta} = 0.114$ with a standard error of 0.005 when considering trade and $\widehat{\delta} = 0.447$ with a standard error of 0.008 when using migration. Both instruments have strong partial F-statistics of 433 and 2,785 for trade and migration, respectively.

[12] The results throughout this work are robust to using only outward or only inward measures of trade and migration openness instead of using total trade or total migration openness. These results are relegated to the online appendix.

4 The effect of globalization on the size and composition of tax revenues

The question of how globalization affects the overall level of tax revenues (relative to GDP) is closely related to the analysis of Rodrik (1997, 1998) and Epifani and Gancia (2009), who identified a positive relationship between government spending and openness. However, our analysis is different from theirs in two significant ways. First, we are interested not only in the size of overall tax revenue but also its composition. Second, we rely on the structural instrument of globalization as outlined in Section 3. We start identifying the effect of globalization on tax revenues and their composition by letting R^r, where $r = \{total, firm, employee, goods, other\}$, be the government tax revenues of type r denoting *total* tax revenues, revenues from *firm*-borne taxes, *employee*-borne taxes, sales, and value-added-type taxes on *goods* and services, and *other* tax revenues, respectively. We also denote the two proposed measures of globalization as $\pi_{n,it}$ for $n = \{trade, mig\}$. Then, we specify the following linear regression model:

$$100 \times \frac{R_i^r}{GDP_{it}} = const_n^r + \psi_n^r \ln(\pi_{n,it}) + \Gamma_n^r Z_{it} + \lambda_{n,t}^r + \mu_{n,i}^r + u_{n,it}^r, \tag{5}$$

where Z_{it} is a vector of controls, $u_{n,it}$ is the disturbance term, the scalars $const_n^r$ and γ_n^r and the vector Γ_n^r are regression parameters, and $\lambda_{n,t}$ and $\mu_{n,i}$ are fixed time and country effects, respectively. The vector Z_{it} includes the following nine control variables: (i) three regressors for the share of population with primary, secondary, and tertiary education, (ii) three binary indicator variables for democracy and either left- or right-wing majorities in the legislature, (iii) log population, log real GDP per capita, and the interaction term of the two.[13] We employ two different specifications of equation (5): (1) OLS where $\ln(\pi_{n,it})$ is treated as exogenous, and (2) instrumental-variable (IV)generalized method of moments where $\ln(\pi_{n,it})$ is treated as endogenous and we instrument $\ln(\pi_{n,it})$ with the derived instrument $\ln(\beta_{n,it})$ from Section 3. Among the two types of models, the IV estimator is the preferred one, since it avoids the endogeneity bias of the two openness measures by instrumenting and conditioning on observable determinants of government size. Owed to their correlation, we use the two measures of globalization in separate regressions, but the results are robust to including both of them at the same time.

Table 1: Revenue, Openness and Migration

	R_{it}^r	total		firm		employee		goods		other	
	Coef.	trade	mig	trade	mig	trade	mig	trade	mig	trade	mig
OLS	$\widehat{\psi}_n^r$	1.560	0.150	0.388	0.599	0.703	−0.082	0.333	0.162	0.433	−0.728
		(0.400)	(0.306)	(0.303)	(0.238)	(0.161)	(0.187)	(0.200)	(0.175)	(0.306)	(0.198)
	R^2	0.951	0.951	0.890	0.899	0.954	0.954	0.859	0.859	0.610	0.612
IV	$\widehat{\psi}_n^r$	2.441	1.013	−0.104	0.151	1.370	−0.124	1.947	1.118	−1.237	−0.658
		(0.575)	(0.423)	(0.407)	(0.272)	(0.216)	(0.303)	(0.399)	(0.242)	(0.473)	(0.236)
	R^2	0.951	0.950	0.889	0.899	0.954	0.954	0.852	0.856	0.594	0.612
	Obs	1,575	1,575	1,389	1,389	1,393	1,393	1,534	1,534	1,374	1,374

Standard errors in parentheses are robust to an unknown form of heteroskedasticity and autocorrelation. For brevity, the constant, time and country fixed effects and coefficients for education shares, democracy, left-and right-wing governments, log population, log real GDP per capita and the interaction between log population and log real GDP per capita are suppressed.

[13] All data sources are reported in the Appendix.

The regression results, summarized in Table 1, are consistent with the literature in indicating that openness is generally associated with larger government size relative to GDP. The coefficient is larger in the IV model with openness being instrumented in comparison to OLS, where it is not. Hansen-Sargan-C-tests confirm that the OLS estimates are subject to the aforementioned endogeneity bias. E.g., in the case of total revenues, the χ^2-test statistic is equal to 4.87 and is significant at 5%. Next to the results on total tax revenues in Table 1, we report the ones for the same models estimated on the remaining four tax revenue categories in r. These suggest that globalization has had important compositional effects on government revenues. Specifically, it raised the relative size of employee-borne tax revenues and ones on goods transactions, and reduced the relative size of the residual (other) tax revenues. The effect on the share of firm-borne tax revenues cannot be estimated precisely. The effects of trade and migration on the composition of tax revenues generally have the same sign and qualitatively differ only with regard to the statistical precision at which they are estimated.

Naturally, the effect of openness on the size and composition of government revenues may differ across different time periods and country groups. To explore this issue, we divide the sample into four subcategories along country and time dimensions. First, following Rodrik (1998), we consider the OECD and non-OECD country groups separately (see the Appendix for definitions). This split is motivated by the fact that these two groups differ significantly in a range of underlying fundamentals, such as the levels of the social protection of workers and the quality of institutions, which may not be entirely captured by the control variables. According to Figure 2, these two country groups also differ significantly in the composition of their tax revenues. Second, we consider two different sub-periods, namely 1980-1993 and 1994-2007. Doing so naturally divides the sample into two equally-sized subsamples, while allowing the coefficients of interest to differ between them. The differences in the coefficients on the globalization variables around the early 1990s could be rooted in the deep liberalization steps of migration and trade policy that became effective around this time. Specifically, the Maastricht Treaty, which allowed European Union nationals free movement within the EU, started in 1992; the Schengen Agreement, which reduced border barriers between EU members, came into force in 1995; the North Atlantic Free Trade Agreement, which led to a tremendous increase in trade between Canada, Mexico, and the United States, became effective in 1994.[14] All these events suggest that examining the effect of openness on taxation across these two time periods separately could be fruitful.[15]

[14]For a quantitative discussion of the effect of NAFTA see Caliendo and Parro (2014).

[15]Formal structural break tests on a country by country basis also suggest that the hypothesis of no structural break is rejected at 5% and that the estimated break year is 1994 on average.

Table 2: Revenues, Trade and Migration - Subgroups

	R^r_{it}	total		firm		employee		goods		other	
	Coef.	trade	mig	trade	mig	trade	mig	trade	mig	trade	mig
	1980-1993										
OLS	$\hat{\psi}^r_n$	−0.385	−1.755	0.367	−1.233	1.902	0.107	0.563	−0.565	−0.379	0.039
		(0.554)	(0.629)	(0.788)	(0.508)	(0.738)	(0.520)	(0.411)	(0.381)	(0.303)	(0.215)
	R^2	0.974	0.974	0.971	0.971	0.962	0.961	0.948	0.948	0.930	0.930
IV	$\hat{\psi}^r_n$	1.221	−0.602	2.757	−1.050	1.984	−0.375	1.201	1.208	−0.973	0.194
		(1.013)	(1.318)	(1.239)	(0.654)	(1.148)	(0.616)	(0.666)	(0.628)	(0.448)	(0.287)
	R^2	0.973	0.974	0.970	0.971	0.962	0.961	0.947	0.944	0.929	0.930
	Obs	353	353	330	330	338	338	353	353	330	330
	1994-2007										
OLS	$\hat{\psi}^r_n$	4.715	0.482	1.999	−0.664	0.874	0.860	4.909	−0.263	−2.582	0.558
		(1.660)	(0.591)	(1.263)	(0.636)	(0.912)	(0.547)	(0.535)	(0.234)	(0.634)	(0.201)
	R^2	0.973	0.971	0.919	0.919	0.923	0.923	0.966	0.950	0.768	0.747
IV	$\hat{\psi}^r_n$	6.214	1.036	−1.107	0.062	5.404	−0.206	5.756	0.136	−3.328	0.799
		(1.924)	(0.959)	(1.336)	(0.883)	(1.317)	(0.948)	(0.657)	(0.407)	(0.814)	(0.401)
	R^2	0.972	0.971	0.917	0.918	0.918	0.922	0.965	0.950	0.765	0.746
	Obs	364	364	350	350	350	350	364	364	350	350

Standard errors in parentheses are robust to an unknown form of heteroskedasticity and autocorrelation. For brevity, the constant, time and country fixed effects and coefficients for education shares, democracy, left-and right-wing governments, log population, log real GDP per capita and the interaction between log population and log real GDP per capita are suppressed.

We utilize the associated results to quantify the effect of openness on the share of different tax revenue components across the two country groups and time periods and report the results for OECD countries in Table 2, whereas results for non-OECD countries are available in the Appendix. As we are left with two subsamples, the table consists of two panels, where the upper and lower panels pertain to the OECD-country sample in 1980-1993 and 1994-2007, respectively.

The results in the upper panel of Table 2 suggest that in the early (pre-liberalization) period the effect of globalization on the relative size of total tax revenues could not be precisely estimated for OECD countries. During this time, OECD countries responded to trade by raising additional revenues from taxes on firms, employees, and goods. On the other hand, higher migration was associated with lower firm-borne tax revenues and taxes on goods. Only migration seems to have stimulated revenues from taxes on goods and to have reduced taxes in the *other* category. By way of contrast, we find very strong effects of globalization on the total revenue-to-GDP ratio for OECD countries in the later (post-liberalization) period. The results in the lower panel of Table 2 suggest that trade openness, in particular, raised the relative magnitude of revenues collected from taxes on employees and goods transactions. For reasons that will be discussed in the next section, the effect of migration openness cannot be precisely estimated.

Overall, the results in Table 2 suggest two important insights. First, the effect of openness on the relative size of tax revenues became more pronounced during the more recent time period for OECD countries. This increase, however, was not compensated by increased taxes paid by firms but rather by employees. A signature feature of income tax systems in most countries, particularly developed ones, is their progressivity, whereby the tax burden more than proportionately rises with income. Hence, the question at hand is whether the change in the relative magnitude of tax revenues collected from employees was due to

inflation,[16] due to greater globalization-induced productivity growth for (low- and middle-) income earners in the progressive part of the tax schedule versus (high-income) earners in the non-progressive part, or due to a change in the tax schedule itself. The assessment of this question will be the subject of the next section, which will unveil the key insights of this paper.

5 The effects of globalization on personal income taxes

Measuring the effects of globalization – through trade and migration openness – in personal income taxes across as many countries and years as possible is at the heart of the present paper. For this, we focus on two personal income tax measures: the share of the relative tax burden borne by workers across different percentiles of the income distribution and effective personal income tax rates across those percentiles. The former reflects an outcome of both effective tax rates and gross income levels, while the latter focuses on effective tax rates only.

5.1 Globalization and the relative personal income tax burden across earners

For the respective analysis per earner type, we need to calculate personal income tax burdens for all percentiles of the income distribution for each country-year observation in our sample. This requires detailed information on the distribution of gross incomes and the country-year-specific tax calculators. Some countries are included in the Luxembourg Income Study, so that representative micro-level data on the personal income distribution are available. However, these data do not cover 65 countries over 28 years. Therefore, we must make use of otherwise available data on Gini coefficients and average wages, which can be obtained for the 65 economies of interest between 1980-2012 (see the Appendix for details). These measures permit portraying the distribution across centiles only upon adopting assumptions regarding the shape of the distribution. The Gini coefficient and the average wage are sufficient statistics for backing out all moments of the distribution with single-parameter-Pareto- or log-normally-distributed wages. We test and are able to confirm the validity of these necessary assumptions, having compared LIS microdata-based wage percentiles with imputed wage percentiles assuming Pareto versus log-normal distributions.[17] We feed the obtained country-year-specific average percentile wages into the tax calculator for that country and year to obtain the country-year-percentile-specific effective average tax rate.[18]

[16] This phenomenon is called cold progression, whereby a constant tax schedule leads to higher average effective personal income tax rates through inflation-driven cross-market increases in nominal wages.

[17] We describe the imputation procedure in detail in the Appendix.

[18] Here, we focus on single male earners. The effective tax rate depends on the marital and family status of a worker, the employment status of co-habiting partners and spouses, etc., in many countries. To that effect, the tax calculators cover 12 household types. However, not even the micro data in the Luxembourg Income Study are sufficiently detailed or the data sets sufficiently large to permit calculating proper weights for each household type. We therefore have to make the additional assumption on household type. This study does not want to address individual behavioral responses to changes in income prospects or structural tax changes. Rather, we implicitly hold behavior constant and assess how income prospects and particularly the tax calculator itself are affected by globalization. For this purpose, it is sufficient to consider effects for the single male earner archetype.

This analysis results in two measures of interest: the nominal wage paid to an average worker in percentile p, country i, and year t, w_{it}^p, and the associated effective employee-borne tax rate, which includes labor income taxes, and employee-borne social security contributions, τ_{it}^p. Based on these measures, we compute the percentage contributed by each percentile relative to total employee-born tax revenue under the aforementioned assumptions, $100 \times \frac{\tau_{it}^p w_{it}^p}{\sum_k \tau_{it}^k w_{it}^k}$, and determine the associated impact of globalization thereon by:

$$100 \times \frac{\tau_{it}^p w_{it}^p}{\sum_k \tau_{it}^k w_{it}^k} = const_n^p + \gamma_n^p \ln(\pi_{n,it}) + \Gamma_n^p Z_{it} + \lambda_{n,t}^p + \mu_{n,i}^p + u_{n,it}^p, \tag{6}$$

for $p = \{1, ..., 100\}$ and $n = \{trade, mig\}$. As before, we conduct the analysis separately for the OECD and non-OECD country groups and for the time periods 1980-1993 and 2004-2007. For the sake of brevity, we focus on IV regression results and on the parameter γ_n^p, and suppress the results for the non-OECD countries in this and the subsequent subsections and relegate them to the Appendix.

We summarize the findings by way of figures, since there are 100 (percentile-specific) regression coefficients for each sub-sample. In each figure, we report the estimates obtained for the contribution to total employee-borne tax revenue obtained under the Pareto and the log-normal parameterization, and we display point estimates along with 90% confidence bands. The estimated percentile-specific coefficients $\hat{\gamma}_n^p$ are displayed in Figures 4 and 5 for trade openness and migration openness, respectively. Each figure is organized horizontally in two panels, 1980-1993 on the left and 1994-2007 on the right.

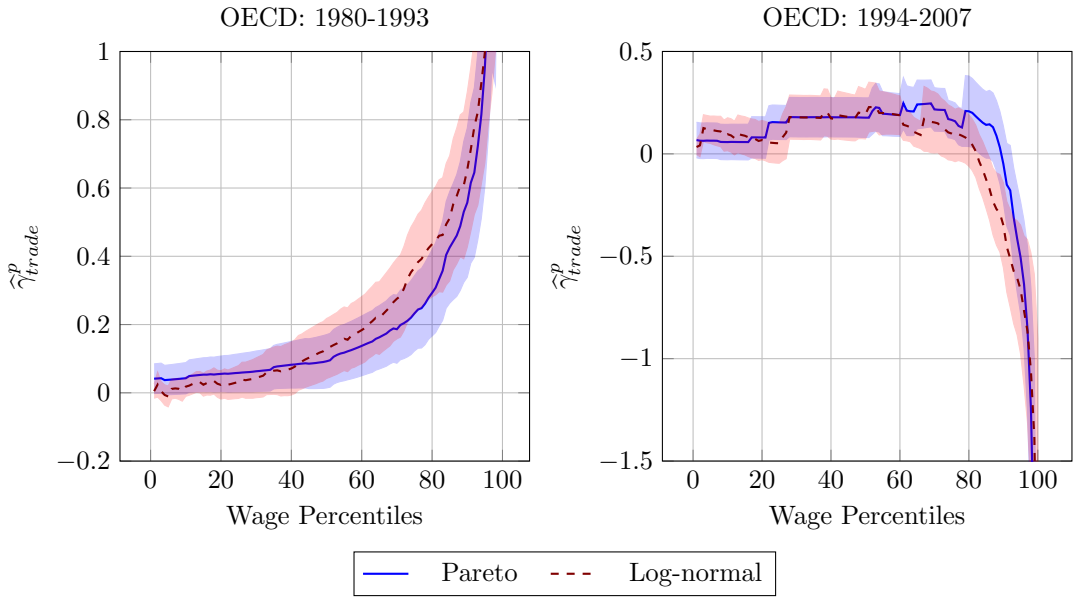

Figure 4: Regression coefficients IV-GMM: Trade openness and percentile-specific contributions to total employee-borne personal income tax revenues

Figure 4 provides the following insights. In the first half of the covered time span, OECD countries collected more-than-proportionately higher personal income tax revenues from

earners with higher, relative to earners with lower, incomes in response to greater trade openness, independent of how wages are imputed (Pareto or log-normally). The relationship was relatively flat and insignificantly different from zero for the lower half of the wage distribution. However, OECD countries leaned more heavily on above-median-income earners in response to greater trade openness. Under the Pareto assumption for wages, the respective coefficient $\hat{\gamma}^{trade}$ (with standard errors in parenthesis) is 0.21 (0.06), 0.49 (0.11), and 4.15 (1.95) for the 75^{th}, 90^{th}, and 100^{th} percentile, respectively. This pattern is consistent with two large strands of existing work. First, the recent trade literature predicts that lowering cross-border barriers to goods transactions raises the inequality of workers by benefiting highly-productive workers and workers in highly-productive firms relatively more (see Egger and Kreickemeier, 2009; Helpman, Itskhoki, and Redding, 2010; Nigai, 2015). If globalization shifted the wage schedule progressively, we expect to see the pattern of the left panel of Figure 4. Second, with limited cross-border mobility of labor, the optimal taxation literature (most exemplary, Saez, 2001) suggests that an increase in real income inequality should be countered by increasing taxes on the high-earning and redistributing across percentiles. Hence, greater globalization-induced progression of the wage distribution should be accompanied with greater progression of the income tax schedule. Again, this is consistent with Figure 4.

However, this pattern is lost entirely in the recent period 1994-2007, as illustrated in the right panel of Figure 4. Again, the results of the Pareto and log-normal wage imputations are very similar. In contrast to the earlier period, the later period suggests an inverse-U-shaped locus for the relationship between the relative personal income tax burden and wage percentiles in response to globalization. Clearly, this stark change in the relationship between the early and the later period cannot possibly be explained by a differential impact of globalization on the wages behind the percentiles, but must be related to a change in effective tax rates.[19] In the later half, we observe what we will refer to as the hollowing-out of the middle class: trade openness raised the tax burden on earners at the center of the wage distribution but not at the left and the right tails. The results suggest that the top decile of the income distribution in fact benefited from trade openness relative to other income groups, while the lowest quintile of the income distribution was not affected in relative terms. The coefficients (with standard errors in parentheses) that correspond to the 75^{th}, 90^{th} and 100^{th} percentiles under the assumptions of a Pareto distribution of wages are 0.20 (0.07), -0.06 (0.13), and -8.98 (3.20), respectively. These results are consistent with models in the optimal taxation literature, which assume high-income earners to also be highly mobile (see Simula and Trannoy, 2010; Lehmann, Simula, and Trannoy, 2014).

Figure 5 summarizes the corresponding results for the migration-based measure of openness. The figure suggests that the responses to migration-openness-induced changes in personal income tax burdens are qualitatively similar at the center of the distribution to those of trade-openness-induced changes. There are some differences in the tails. For instance, migration openness appears to have reduced effective tax burdens at the lower end of the income distribution between 1980-1993, increased them at incomes above the median, but

[19] Recall that this change could have two roots: a change in the nominal wage schedule at a given tax schedule and a change in the tax schedule.

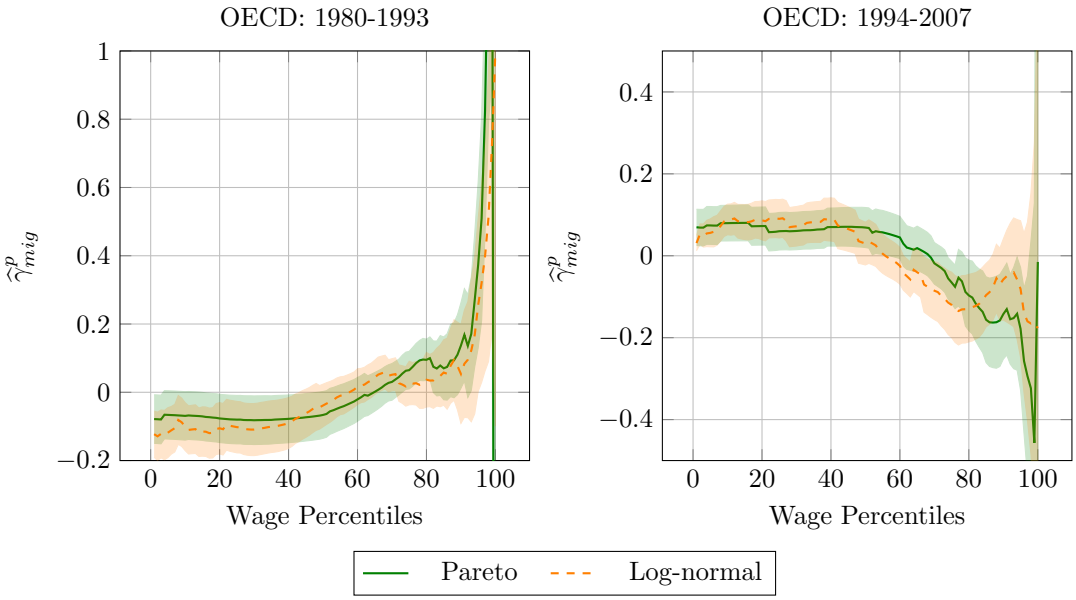

Figure 5: Regression coefficients IV-GMM: Migration openness and percentile-specific contributions to total employee-borne personal income tax revenues

produced no statistically significant response at the very top of the distribution (100^{th} percentile). In the more recent period, the figure suggests that migration openness led to higher relative tax burdens for incomes below the median and to a lower relative tax burden for incomes above the median. The effect on top incomes is again not precisely estimated.[20] However, the similarity in the qualitative shapes of the patterns between Figures 4 and 5 indicates the presence of a fundamental qualitative change in underlying tax policies.

We compare the above results based on imputed wages to relative tax burdens calculated from LIS microdata for the countries and years where such data are available. However, comparable and representative microdata are only available for 77 matching OECD country-year observations in the later half of the time span.[21] The purpose of using these data is to show that the results in Subsection 5.1 are consistent with the available microdata and are not an artifact of imputation. Moreover, these data may speak to the relative superiority of assuming Pareto- versus log-normally-distributed earnings.

[20] We attribute this to two shortcomings of the migration data: First, data on migration (whether stocks or flows) are generally sparse and missing for a large number of countries. To obtain a complete data set, we combine available data on stocks and flows across different sources, which may be subject to a high degree of imprecision. We describe the imputation procedure in detail in the Appendix. Second, the measure encompasses all types of migration (of high and low-skilled workers; politically and economically driven; etc.) which muddles the effect.

[21] The coverage of matching non-OECD countries is virtually nonexistent and only 61 OECD country-year matches can be made in the first half

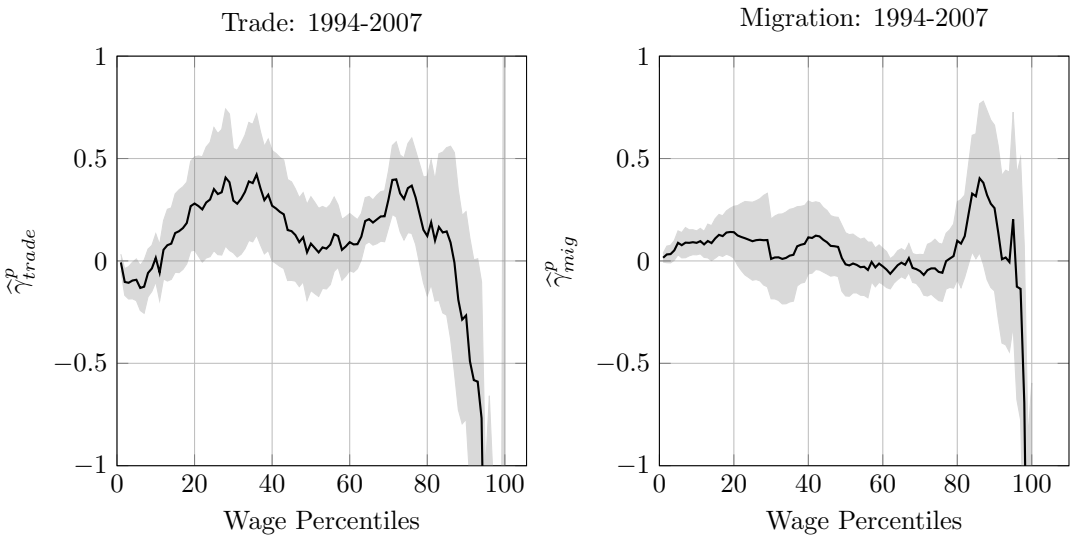

Figure 6: Regression coefficients IV-GMM: LIS for OECD Countries

For convenience, we repeat the above analysis using the limited LIS data in Figure 6, where the left and right panels present the effect of trade and migration openness measures on the relative tax burdens, respectively. Naturally, due to the small sample size, the estimated coefficients of openness based on LIS data are significantly more noisy than when using the imputed data. Further, LIS caps reported incomes, such that the top quantile(s) are likely underestimated. We do not view this as a problem since in that case we would underestimate (rather than overestimate) the effect of trade and migration openness on the tax burden for the very top quantile(s).[22] However, the general shape and magnitude of the results are consistent with previous effects. This suggests that the earlier results do not hinge upon the parametric assumptions on the shape of the income distribution and are in fact supported by available microdata.

5.2 Globalization and the effective average personal income tax rate

In this subsection, we investigate the extent to which changes in the labor tax burden were due to changes in effective tax rates versus wage changes. Here, we repeat the analysis of the previous subsection but now use the average effective tax rate of each percentile p as the dependent variable:

$$100 \times \tau^p_{it} = const^p_n + \xi^p_n \ln(\pi_{n,it}) + \Gamma^p_n Z_{it} + \lambda^p_{n,t} + \mu^p_{n,i} + u^p_{n,it}, \tag{7}$$

for $p = \{1, ..., 100\}$ and $n = \{trade, mig\}$. As before, we focus on IV-regression results on the parameter ξ^p, relegate results for non-OECD countries to the Appendix, and use figures to illustrate the findings.

[22] For some country-year observations, the samples are too small to impute 100 percentiles entirely. In those case, we linearly impute the internal missing percentiles and the lower bound, i.e., $w^{q-1}_{s,t}$ when top percentiles are missing.

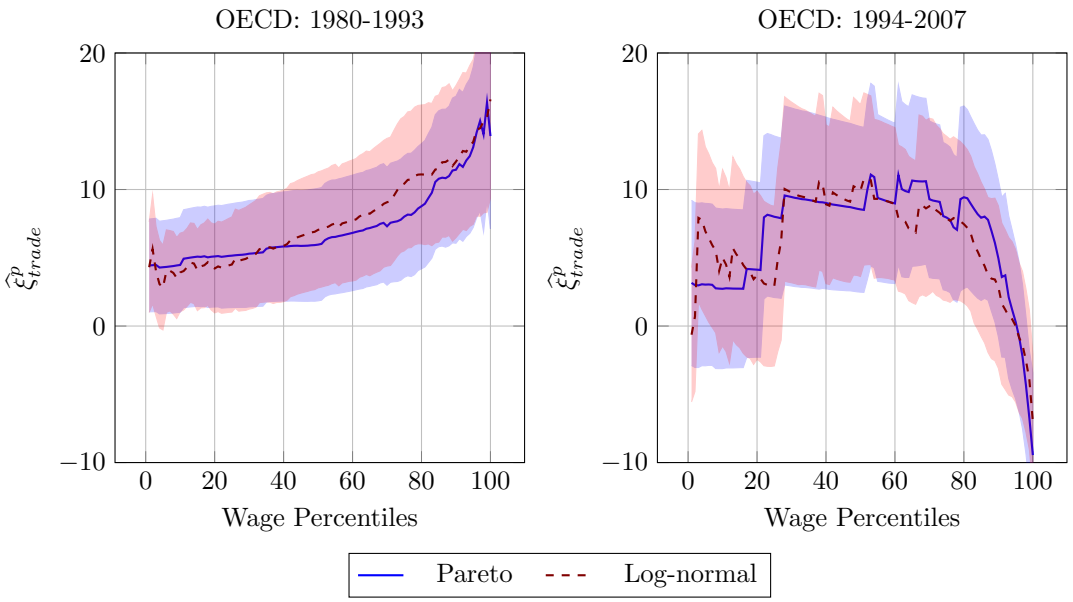

Figure 7: Regression coefficients IV-GMM: Trade openness and percentile-specific effective average tax rates

Figure 7 summarizes estimates of $\hat{\gamma}^p_n$ based on (7) when using instrumented trade openness as the measure of globalization, while Figure 8 does so when using instrumented migration openness instead. Figure 7 suggests that the trade-openness-induced changes in the progression of effective average tax rates across wage percentiles in both sub-periods feature a similar shape to the one of the tax burden in the previous subsection, only the confidence bounds are somewhat wider. Likewise, Figure 8 suggests that the migration-openness-induced changes in the progression of effective average tax rates across wage percentiles in both sub-periods are qualitatively similar to the ones of the tax burden in the previous subsection; however, the relationship is less pronounced. Both figures indicate a fundamental change in the effect of globalization on effective average personal income tax rates in the OECD, which is consistent with the fundamental change of the impact on the tax burden in the previous subsection.

In Figures 7 and 8, we identify changes in the effective average tax rates in response to higher openness with a certain amount of accuracy. However, it is also essential to study the cumulative magnitude of this response. We utilize the estimated coefficients and the observed data on openness to calculate the cumulative magnitude of the effects for the 100 different population groups in an average OECD country across the two periods. To calculate the effect of globalization exerted on the effective labor income tax rates in 1980-1993 and 1994-2007, we multiply the average change in (log) openness observed in the OECD group on the estimated (if different from zero at 10% significance level) coefficient in each period, respectively. For the cumulative effect between 1980 and 2007 we add the effects for the two periods. We plot the results for trade and migration in Figure 9.

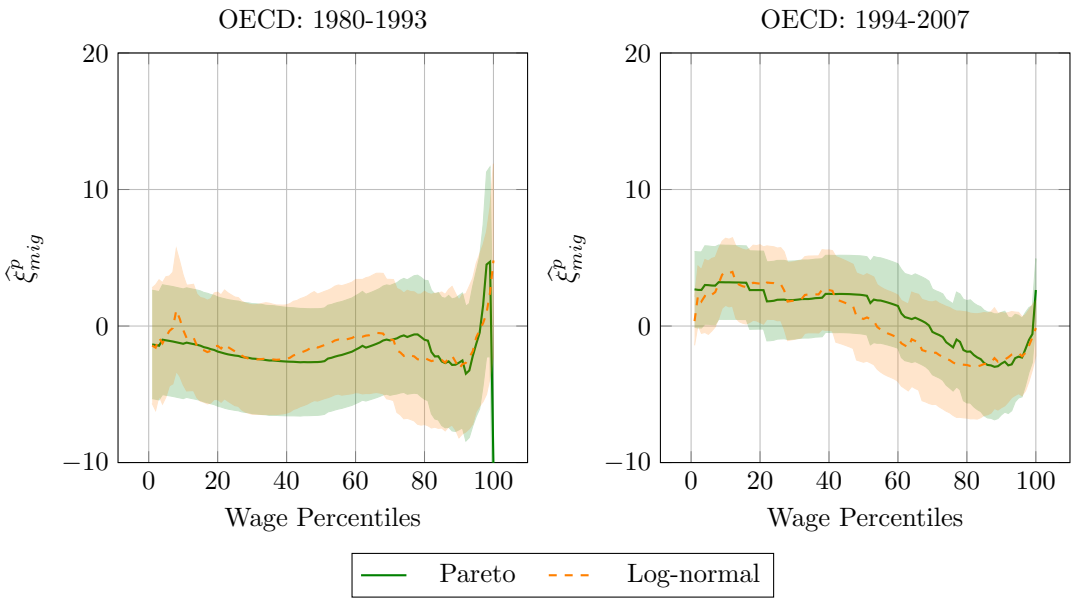

Figure 8: Regression coefficients IV-GMM: Migration openness and percentile-specific effective average tax rates

The magnitude of both period-specific effects and the total effect using trade openness is quite large. The poor (between the 1^{st} and 20^{th} percentile) experienced an increase in effective tax rates of around two percentage points in 1980-1993 but remained unaffected by the second wave of globalization. Workers in the lower-middle- and middle-income group experienced a similar increase in taxes (around 2 percentage points) in each period which amounted to roughly 4 percentage points in total. Workers located above the median but below the 70^{th} percentile faced a slightly larger increase in tax rates with the total effect being between 4 and 5 percentage points. Period-specific effects start diverging significantly for people above the 70^{th} percentile in the income distribution.

While in 1980-1993 the effect was progressive and higher percentiles saw their tax rates rising by relatively more such that labor tax rates were raised by around 6 percentage points for the top earners versus only 2.5 for workers in the 70^{th} percentile, in 1994-2007 the effect was regressive. In the later half of our sample period, the tax rate for the top earning *decreased* by more than 2 percentage points whereas it *increased* by more than 2 percentage points for workers in the middle and the upper-middle class as a consequence of globalization. These results are of significant magnitude compared to the conventional estimates to the gains from trade of moving from autarky to the observed, concurrent level of openness (see Arkolakis, Costinot, and Rodriguez-Clare, 2012). Therefore, the net effects of globalization for a household or earner depend substantively on the personal income tax redistribution scheme a government implements.

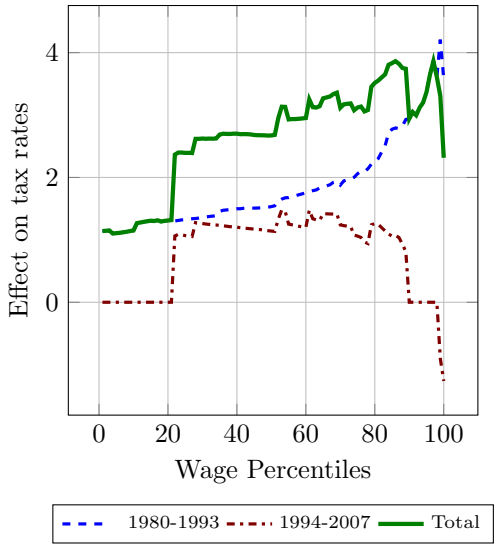

Figure 9: The effect of trade on tax rates for an average OECD country

In a progressive tax system, a general increase in the level of all wages would not preserve relative effective tax rates across different percentiles. Therefore, it is interesting to isolate pure policy (tax schedule) responses to globalization. As mentioned before, the relative tax burden and effective average tax rates are driven by changes in average wages, changes in the dispersion of wages, and changes in the tax schedule (i.e., tax policy in a narrow sense). Here, we are interested in fleshing out actual tax policy (i.e., tax schedule) changes. For this, note that the labor income of percentile p in country i in year t depends linearly on the average wage in country i in year t, $\overline{w}_{it}$, and a distribution parameter, s^p_{it}, such that $w^p_{it} = \overline{w}_{it} s^p_{it}$. Let us use the function $f_{it}(\cdot)$ to denote the tax code (or tax calculator) in country i and year t. Then, the effective average tax rate of percentile p may be defined as:

$$\tau^p_{it} \equiv f_{it}\left(\overline{w}_{it} s^p_{it}\right). \tag{8}$$

Naturally, globalization may affect average wages, $\overline{w}_{it}$, as well as wage inequality, s^p_{it}, a fact that is well supported by economic theory (see Feenstra and Hanson, 1996; Egger and Kreickemeier, 2009; Amiti and Davis, 2011) as well as by empirical evidence (see Goldberg and Pavcnik, 2004, 2007). However, it is less clear-cut whether globalization affects the tax calculator directly. To isolate changes in $f_{it}(\cdot)$, we produce counterfactual average wages and distribution parameters that are free of the effect of globalization. To this end, we first estimate the effect of globalization on average wages and percentile-specific distribution parameters using the following two regressions:

$$\begin{aligned} \ln\left(\overline{w}_{it}\right) &= const^w_n + \xi^w_n \ln(\pi_{n,it}) + \Gamma^w_n Z_{it} + \lambda^w_{n,t} + \mu^w_{n,i} + u^w_{n,it} \\ \ln\left(s^p_{it}\right) &= const^{s,p}_n + \xi^{s,p}_n \ln(\pi_{n,it}) + \Gamma^{s,p}_n Z_{it} + \lambda^{s,p}_{n,t} + \mu^{s,p}_{n,i} + u^{s,p}_{n,it}, \end{aligned} \tag{9}$$

for $n = \{trade, mig\}$ and $p = \{1, ..., 100\}$. Having estimated parameters on the openness variables, we produce percentile-specific counterfactual effective tax rates for each country

and year under the assumption that globalization had no effect on $\overline{w}_{it}$ and s^p_{it} as:

$$\widetilde{\tau}^p_{it} = f_{it}\left(e^{\ln(\overline{w}_{it}) - \widehat{\xi}^w_n[\ln(\pi_{n,it}) - \ln(\pi_{n,i1980})]} e^{\ln(s^p_{it}) - \widehat{\xi}^{s,p}_n[\ln(\pi_{n,it}) - \ln(\pi_{n,i1980})]}\right). \tag{10}$$

We re-run the regressions in (7) using these counterfactual effective average tax rates. We denote the estimated coefficient as $\widehat{\gamma}^{f(\cdot),p}_n$ and plot them in Figures 10 and 11.

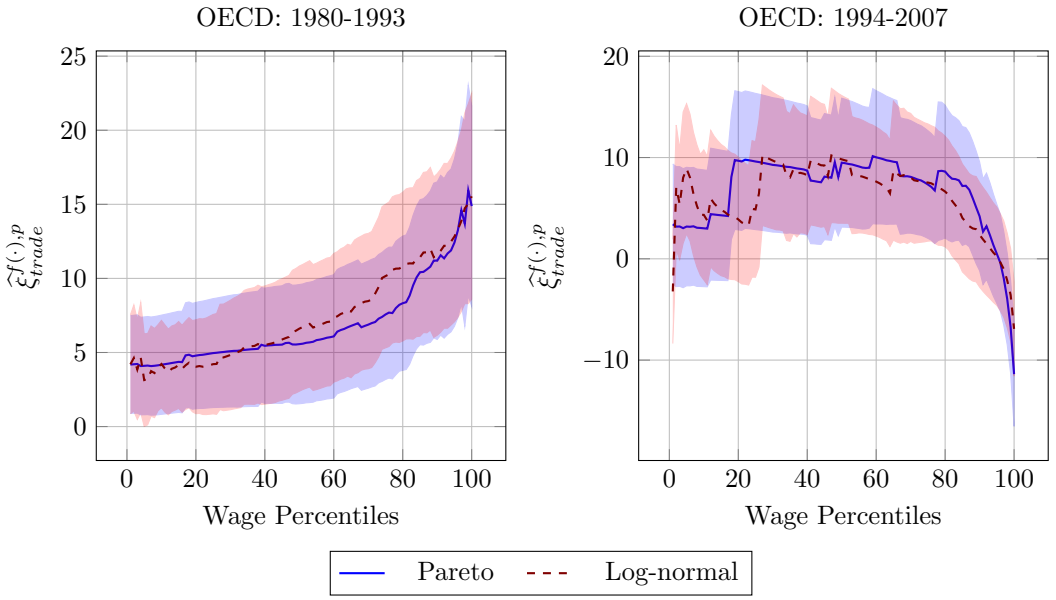

Figure 10: Regression coefficients IV-GMM: Isolated policy-response $f_{it}(\cdot)$ and Trade

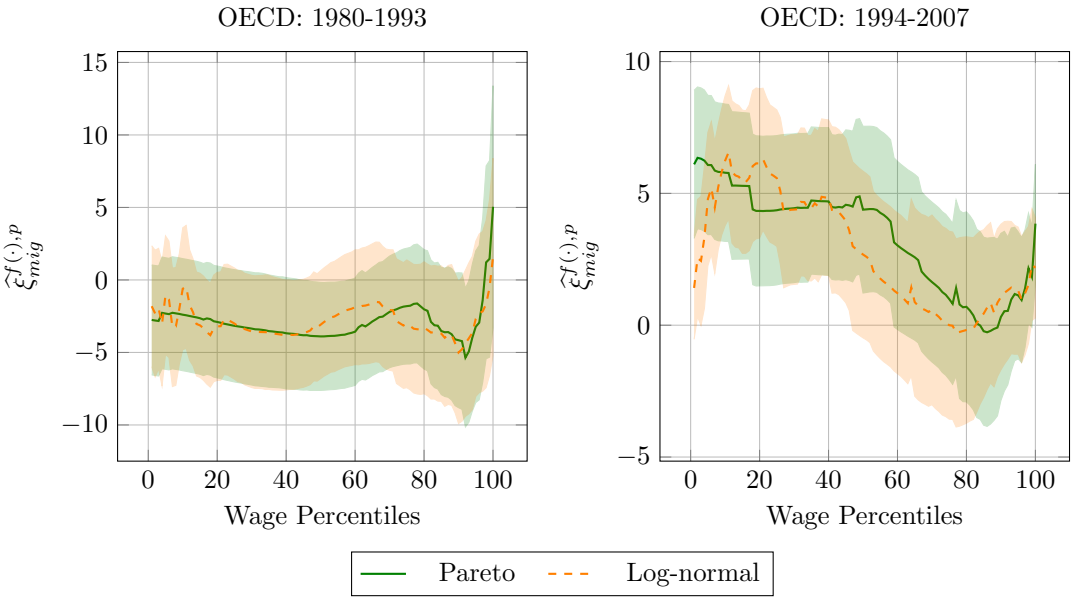

Figure 11: Regression coefficients IV-GMM: Isolated policy-response $f_{it}(\cdot)$ and Migration

First, when we use changes in tax calculators isolated from the effects of globalization on the level of wages and their dispersion (i.e., keeping the wages constant), the analysis obtains results that are nearly identical to those in Figures 7 and 8 across both time periods. Quantitatively, the pattern is somewhat less pronounced for the first 99 percentiles and more pronounced for the top percentile. This is reassuring as we can conclude that the findings mainly point to government responses, i.e., changes in the tax code, rather than on mechanical effects such as those induced by he cold progression only. Overall, these findings suggest that the effects of globalization on effective personal income tax rates are *mainly* (rather than *also*) driven by changes in the tax calculator.

6 Case study: Interstate migration and changes in effective taxation in the United States

Our results based on international data indicate that factor flows have heterogeneous effects on workers in terms of three tax outcomes: the relative tax burden, the effective average labor income tax rate, and the labor income tax calculator. We found that especially governments in developed countries reduced average taxes for high-income earners in response to trade and migration openness, while increasing them for earners in the middle and lower parts of the wage distribution to retain labor tax revenues. In this section, we examine whether similar mechanisms are observed at a sub-national level, using the example of the United States. This exercise will prove to be useful in two important respects. First, it will illustrate to which extent the main insights from the cross-country analysis are confirmed in sub-national data. Second, it will serve as an important validation based on much more complete microdata than the available internationally LIS microdata.

The taxation system of the United States provides an interesting case study, since goods trade is largely and migration is completely free within the country, and various levels of government influence the various levels of income taxes on individuals (and firms) within jurisdictions – federal, state, and in some cases local, sub-state levels. We use the variation across state income tax schedules to examine whether the mobility of high-skilled workers drives intra-national labor tax competition, akin to what we observed internationally.

One important feature of this case study is the high quality of the data involved. These data have several ingredients. First, we employ microdata from the Annual Social and Economic (ASEC) Supplement to the Current Population Survey (CPS) provided by the Integrated Public Use Microdata Series (IPUMS). These data include taxable income of each individual surveyed, as well as their paid federal and state-level taxes. Based on these data, we generate fifty taxable income quantiles and calculate the relative income tax burden and the effective average income tax rate for the state and federal level. Second, we complement these tax burdens with state-to-state migration flows provided by the Internal Revenue Service (IRS). The IRS records the location of each tax filer every year,[23] which we then use to compute overall state-to-state flows. We use the relative tax burden and the effective income tax

[23]Specifically, the IRS provides the total taxable income, the total number of returns and the total number of exemptions filed within states by the state in which they were filed in the year prior.

rates for single individuals with positive income (to match our international archetype as closely as possible) and measure migration flows in terms of the number of tax returns. We generate the instrument for interstate migration in the same way as before, using normalized state-to-state flows to compute relative mobility cost by state s for year t. We are only able to address migration openness, as interstate trade is assessed differently from international trade and assessed on a decennial basis only. We employ data on fifty states for eight years (2000-2007) which gives us 400 observations in comparable years to Section 5 and avoids the years of the Economic and Financial Crisis in 2008 and its years of recovery.

We start our analysis with analyzing the impact of mobility on the relative tax burden in each of the fifty states for different workers:

$$100 \times \frac{\tau_{st}^q w_{st}^q}{\sum_k \tau_{st}^k w_{st}^k} = const_{mig}^q + \gamma_{mig}^q \ln(\pi_{mig,st}) + \Gamma_{mig}^q Z_{st} + \lambda_{mig,t}^q + \mu_{mig,s}^q + u_{mig,st}^q, \quad (11)$$

for $q = \{1, ..., 50\}$, where we include the matching state s (as opposed to country i) controls in vector Z_{st}. We report the data sources in the Appendix. There are minor differences to the approach in Section 5. First, we produce fifty rather than hundred quantiles based on taxable income to ensure that we calculate as many quantiles as possible while maintaining a high level of disaggregation. Hence, each q captures two percentiles of state s's population. Second, we are unable to differentiate between taxes on labor versus other forms of personal income, w_{st}^p therefore denotes total taxable income. Finally, as before with LIS data, due to the anonymity requirement, IPUMS caps reported incomes, such that we are likely underestimating taxable income for the very top quantile(s) in some states/years. We do not view this as a problem since in that case we would underestimate (rather than overestimate) the effect of migration on tax outcomes for the very top quantile.[24]

We report the results for the relative tax burden in the left panel of Figure 12, where for the ease of exposition we again plot the estimated coefficients against quantiles q along with 90% confidence bands. In qualitative terms, the shape of the estimated response curve is strikingly similar to what we saw in Section 5 for the OECD countries in the 1994-2007 period. The middle and upper-middle classes experienced an increase in their relative tax burden in response to higher interstate mobility, whereas earners in the top six percentiles experienced significant decreases in their relative tax burden. The estimated coefficients suggest that a one-percent increase in interstate earner mobility (into and out of) a state leads to a 0.15-percentage-point decline in the relative tax burden of the top-income percentile. This is in line with our findings on top incomes in the right panel of Figure 5.

[24] For some states/years, the state-year samples are too small to produce the top quantile(s). In those cases, we impute missing observations by taking the lower bound, i.e., w_{st}^{q-1}.

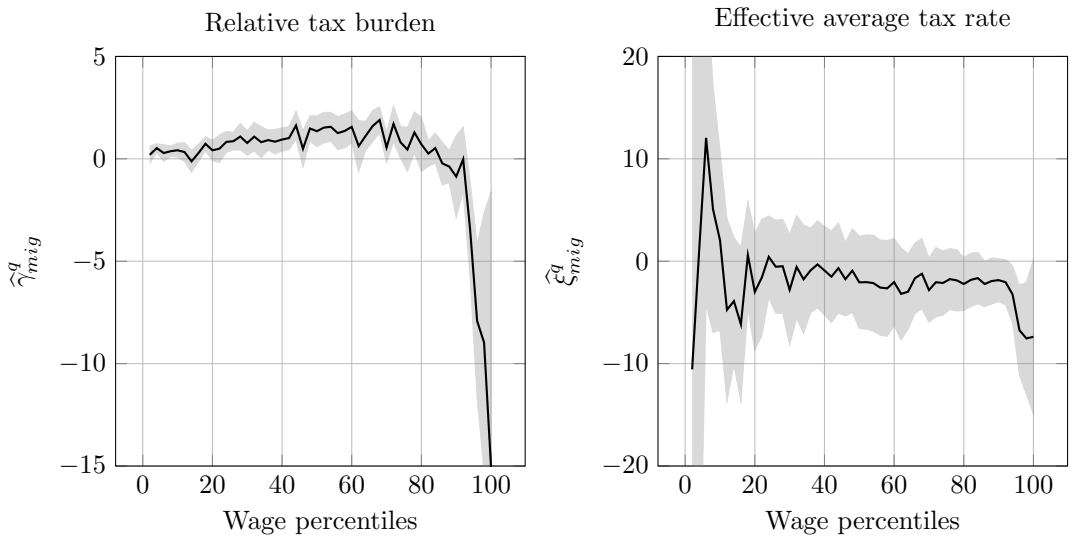

Figure 12: Regression coefficients IV-GMM: State-to-state migration and quantile-specific state-level personal income tax outcomes

Next, we examine the effect of interstate migration openness on the effective average state-level income tax rate by running the following regression:

$$100 \times \tau^q_{st} = const^q_{mig} + \xi^q_{mig} \ln(\pi_{mig,st}) + \Gamma^q_{mig} Z_{st} + \lambda^q_{mig,t} + \mu^q_{mig,s} + u^q_{mig,st}, \qquad (12)$$

for $q = \{1, ..., 50\}$ and where τ^q_{st} is the average effective tax rate applied by state s in year t to quantile q. We report the results in the right panel of Figure 12. Here, taxes decreased in response to rising migration openness for the top six percentiles, while the rest of the distribution remained unchanged. This suggests that state-level governments do engage in tax competition for mobile top-earners and lower the income tax rates accordingly. The estimates imply that, on average, a one-percent increase in interstate migration openness reduced the effective average state-level personal income tax rate by roughly 0.07 percentage points – a non-negligible increase given the overall size of state taxes.

Even though state governments set their own state-level income taxes, each individual is subject to the federal income taxation as well, irrespective of their resident state. Hence, the federal government of the United States superimposes an additional tax layer which cannot be avoided by relocating within the country. This would suggest that the impact of interstate mobility on the overall tax burden and tax rates is less pronounced relative to state-level component. To assess this hypothesis, we calculate the total relative tax burden and the total effective average tax rate (state plus federal personal income taxes) for each quantile of the income distribution and rerun the regressions in (11) and (12). The results are reported in Figure 13.

The left panel of Figure 13 portrays the estimated effect of state-to-state migration on the overall tax burden of individuals in each state and suggests that higher interstate mobility does not have a significant impact on the overall personal income tax burden apart from the

two highest income percentiles of the population. The coefficients are largely insignificant and become negative only at the very right tail of the income distribution. The same applies to the effective average federal-plus-state-level personal income tax rate shown in the right panel of Figure 13. This panel illustrates that the top two percentiles of the income distribution enjoyed lower tax rates due to higher mobility, while others experienced no significant effects. Figure 13 suggests that the federal tax layer functions as a tax policy coordination device in labor taxation, which mitigates or dampens the effect of increasing mobility on state tax policy.

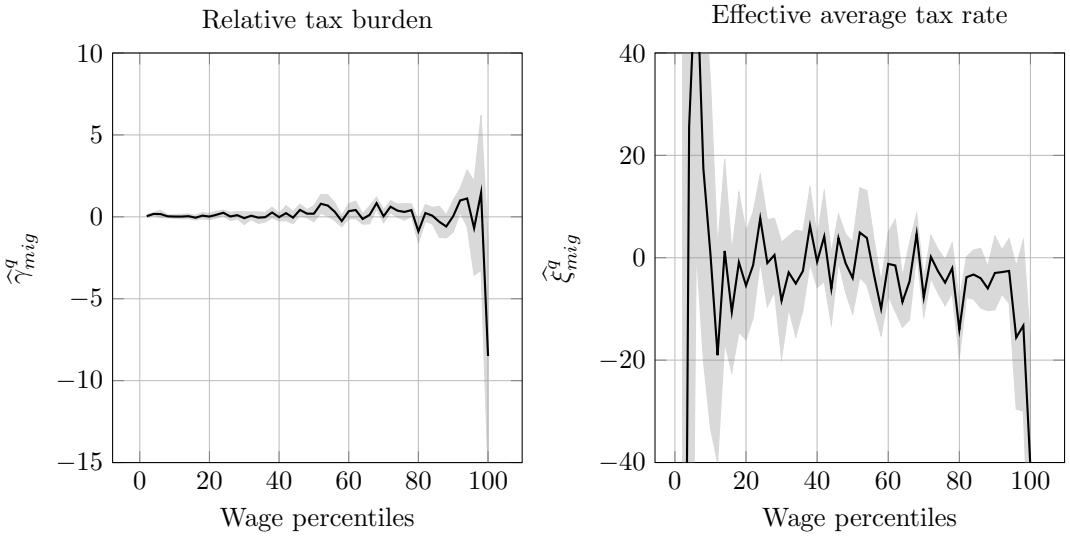

Figure 13: Regression coefficients IV-GMM: State-to-state migration and quantile-specific total personal income tax outcomes

7 Conclusions

This paper estimates the impact of globalization on tax revenues and its compositions across different country groups, time periods, and population segments. To this end, we have developed a novel instrument based on modern quantitative trade and migration theory. We apply this instrument in unique data set on relative personal income tax burdens and effective average income tax rates in the 65 biggest economies between 1980-2007.

We establish a new set of results based on the link between globalization and various tax outcomes. First, we find that globalization increased pressure on governments in OECD countries to raise additional tax revenues. These were raised mainly via increased labor income taxes. Second, we find that, while between 1980-1993, the response to globalization involved increasing the progressivity of the relative tax burden and the average effective labor income tax schedule, between 1994-2007 increased globalization led to increases in the tax rates and tax burdens on the middle and the upper-middle classes and to reductions for the top earners. We argue that this was partly due to high-skilled/high-income workers' cross-border migration and partly due to intensifying tax competition between governments

for the same workers. We also identify the same mechanism in a within-country setting looking at state-level personal income taxation in the United States. There, we also find that increasing migration openness led to lower tax burdens and lower tax rates for the top income percentiles.

Our results are significant in several other dimensions. First, we suggest that competition to attract and retain high-skilled workers may have a non-trivial impact on the effective income tax schedule, which has to be taken into consideration as immobile residents are likely to bear the additional burden of such tax competition. Second, we provide an additional link between globalization and rising income inequality, which directly relates to governments' policy responses rather than pure market forces. Quantifying the effect of globalization-induced policy responses on inequality in a general equilibrium framework may be fruitful for a quantification of the overall effect and we leave this for future research.

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Appendix

Appendix A: List of countries and data sources

List of countries

OECD: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United States.

Non-OECD: Argentina, Bangladesh, Barbados, Bolivia, Cameroon, Chile, China, Colombia, Costa Rica, Cyprus, Ecuador, Fiji, Ghana, Guatemala, Honduras, India, Indonesia, Israel, Jamaica, Jordan, Kenya, Kuwait, Malaysia, Malta, Mauritius, Morocco, Nepal, Pakistan, Peru, Philippines, Senegal, Singapore, South Africa, Sri Lanka, Thailand, Trinidad, Tunisia, Uruguay, Venezuela.

Data sources: International

In this section, we describe data sources of the variables used in the analysis. For the ease of introduction, we categorize them in four main groups: (i) tax revenues, (ii) wages, (iii) tax rates, and (iv) control variables.

(i) Tax revenues

The components of interest are total tax revenue, $total_{it}$, firm-borne tax revenue, $firm_{it}$, employee-borne tax revenue, $employee_{it}$, revenue from taxes on goods and services, $goods_{it}$, and all other taxes, $other_{it}$. We combine data from the IMF's Government Finance Statistics and the OECD's Tax Statistics to collect the respective variables. Since the two databases have different definitions of taxes that fall under the *goods* category, we use the IMF's

definition (taxes levied on the production, extraction, sale, transfer, leasing, and delivery of goods and services) as our benchmark and harmonize the OECD data by excluding the taxes on imports, exports, and cross-border transactions. In addition, for some country/year combinations separate data on employer- and employee-borne social security contributions are not available. We use our own estimates based on country-specific tax codes to predict the employer and employee shares of total social security contributions and apply these to the data on the latter.

(ii) Gross wages

For the analysis, we need percentile-specific measures of nominal labor income for a panel of countries. Unfortunately, micro-data sources only cover a handful of countries for a bare minimum number of years. To overcome these limitations, we parameterize wage income distributions using the moments observed in the data and produce country-year-percentile specific gross wages. We employ two alternative assumptions about the underlying income distribution – Pareto and log-normal. Although it would theoretically be possible to use a mixture distribution where the left tail is modelled as log-normally and the right tail as Pareto distributed, this mixture requires information on at least three moments of the distribution, which are unavailable for the majority of countries used in this study. Therefore, in order to calibrate the parameters of the distributions, we use data on two moments: the gross wage Gini coefficient, $Gini_{it}$, and the average gross wage, $\bar{w}_{it}$.[25]

With the single shape parameter Pareto distribution, the shape (ϕ_{it}) and the scale parameter ($\underline{w}_{it}$) can be identified from the following two moment conditions:

$$\bar{w}_{it} = \frac{\phi_{it}}{\phi_{it} - 1}\underline{w}_{it}; \qquad Gini_{it} = \frac{1}{2\phi_{it} - 1}. \tag{12}$$

In the case of the log-normal distribution with location parameter (μ_{it}) and scale (φ_{it}), the two moment conditions are:

$$\bar{w}_{it} = \exp\left(\mu_{it} + \sigma_{it}^2/2\right); \qquad Gini_{it} = 2\Phi(\varphi_{it}/\sqrt{2}) - 1, \tag{12}$$

where $\Phi(\cdot)$ is the cumulative distribution function for the standard normal distribution. Once we have calibrated the parameters of the income distributions, we calculate an average income within each of the hundred percentiles per country and year. Average labor income levels are obtained/calculated from the International Labor Organization's LABORSTA database and, for a number of countries, domestic statistical sources. The data on gross wage Gini coefficients are from the ILOstat database. Where specific years or countries were not available, we imputed missing gross wage Gini coefficients via linear regressions using gross income Ginis from the Standardized World Income Inequality Database (SWIID), the average wage, the distribution of education levels in the population, and total capital stock as predictors.

[25] That household incomes and wealth follow Pareto-type power-laws was the very insight provided by Pareto (1896) himself. Recent evidence by among others Felbermayr, Hauptmann, and Schmerer (2014) and Egger, Egger, and Kreickemeier (2013) for worker data supports this fact.

(iii) Tax rates

We calculate the final tax rate for each income percentile by aggregating all labor taxes, all employee-based social security contributions, and all other taxes payable on income by employees and subtracting all relevant deductions and credits for a percentile's income level. This final tax must include social security, as the decision to alter the structure of the income tax schedule is co-determined with the structure of the social security schedule.[26] The final data set covers the years from 1980 to 2007 for 65 countries in the world. The data on income tax codes were collected by the authors and are described in greater detail in Egger and Strecker (2016).

(iv) Endogenous control variables

In our analysis, we employ a vector of endogenous control variables, which are the following:

a *Trade:* As previously stated, we associate openness with the share of imports in total consumption of manufacturing goods, which we calculate using aggregate volume of manufacturing imports and total absorption of manufacturing goods. These data are taken from the World Bank's World Integrated Trade Solution Database. We classify manufacturing goods according to the SITC 1 classification. The domestic sales shares are calculated using data on manufacturing production from the OECD's Structural Analysis Database and United Nations Industrial Development Organization's Industrial Statistics Database when available. Otherwise, we predict production log-linearly using manufacturing value added.

b *Migration*: To compute the measure of migration openness we combine several data sets starting with the one from the World Bank's Global Bilateral Migration Database available for 1980, 1990, and 2000. We complement these data with ones from Adsera and Pytlikova (2015). Next, we use data on migration flows when available from several sources (EUROSTAT, United Nations Global Migration Database and International Labor Organization) to compute annual migration stocks. When flow data were unavailable we assumed zero flows and kept migration stock constant relative to the previous year.

(v) Exogenous control variables

In our analysis, we employ a vector of exogenous control variables, which are the following:

a *Primary, Secondary, and Tertiary education*: The shares of the population with primary, secondary and tertiary education are based on Barro and Lee's (2010) data on educational attainment between the years 1970 and 2000 in 5-year intervals. Intermittent observations were interpolated via regression on a polynomial of the year variable.

[26]The components of social security contributions vary by country, but generally include old age pension provisions, insurance against unemployment, invalidity, sickness, accidents, as well as the necessary contributions towards family allowances, payable by employees, employers or both.

b *Democracy, Left-wing, and Right-wing legislative majorities*: We include a democracy index as a binary indicator (as opposed to autocratic regimes), as well as binary indicator variables for left- and right-wing majorities in the legislature (center being the excluded variable) from the *The Quality of Government Basic Dataset*.

c *Population, real GDP per capita, interaction term*: We control for country size, level of development, and the interaction between the two by including these three normalized measures in logs obtained from the World Bank's WDI database.

Data Source: United States case study

(i) Endogenous control variable

In our U.S. case study, we employ a similar vector of control variables, which are the following:

a *Migration*: We use the number of migrated tax returns (inflows and outflows) from the *IRS's U.S. Population Migration Data* for the years 2000-2007.

(ii) Exogenous control variables

In our U.S. case study, we employ a similar vector of control variables, which are the following:

a *Primary, Secondary, and Tertiary education*: The shares of the population with primary, secondary and tertiary education are based on the *U.S. Census Current Population Survey*'s data on educational attainment between the years 1990 and 2010, where missing observations were interpolated via regression on a polynomial of the year variable.

b *Democracy, Left-wing, and Right-wing legislative majorities*: We include concurrent binary indicators for left- and right-wing majorities of the state legislature from the *National Conference on State Legislatures*'s timelines of state partisan composition.

c *Population, real GDP per capita, interaction term*: We control for state size, level of development and the interaction by including these three normalized measures obtained from the *Bureau of Economic Analysis* database on Regional Economic Accounts.

Appendix B: Imputation comparisons to available data

Imputed employee-borne tax revenues vs. data

To check whether the estimates square well with other out-of-sample data, we compare the observed size of total employee-borne revenues with the implied employee-borne tax revenues based on the imputed data. As we have percentile-specific income data, as well

as their respective tax rates (discussed below), we can calculate total employee-borne tax revenues as:

$$R_{it}^{employee} = \frac{lforce_{it}}{100} \times \sum_k \tau_{it}^k w_{it}^k, \tag{12}$$

where $lforce_{it}$ is total labor force in country i at time t obtained from the World Bank's World Development Indicators, with missing years interpolated using a polynomial regression on time. We compare the imputed and the actual data on employee-borne tax revenues in Figure 14.

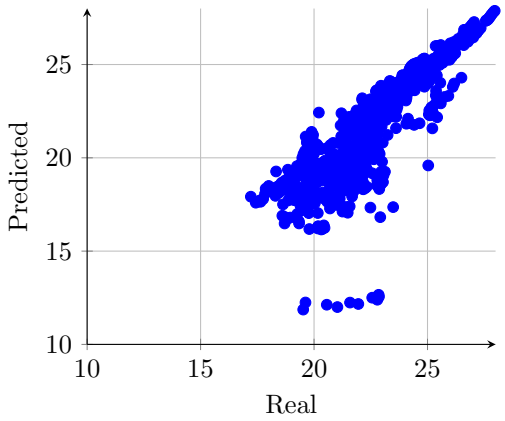

Figure 14: Employee-borne tax revenues in logs: Actual v. Prediction

While the predicted values of total labor tax revenues compare well with the data, the fit is better for OECD than for non-OECD countries. This can be explained by imperfect measurement of the active labor force and/or problems with tax collection in those countries. The overall correlation coefficients between the predicted and actual values (in logs) of $R_{it}^{employee}$ is 0.986 for the whole sample of tax revenues.

Imputed wages vs. Luxembourg Income Study micro-data

The best available cross-country source of micro-data on personal incomes is the Luxembourg Income Study (LIS), which are based on income surveys administered nationally and gathered and disseminated by the LIS Cross-National Data Center in Luxembourg. However, LIS data cover only 138 country-year observations that match our 65 countries between 1980 and 2007. Those matches are neither consecutive within-country nor available for a reasonable cross-section of countries in a given year.

To check the soundness of the imputed wage distributions based on Ginis and average wages, we compare the predictions with the available LIS data. We calculate percentile wages for single adult males with employment income based on their reported labor incomes and present the LIS and imputed percentile incomes for the year 2007 in Figure 15. It is apparent that the imputed percentiles match the data very well. Further, we report the country-year-specific correlation coefficients between the imputed and observed percentile wages in Table 3, which suggest that the imputed incomes match higher moments of the micro-data well.

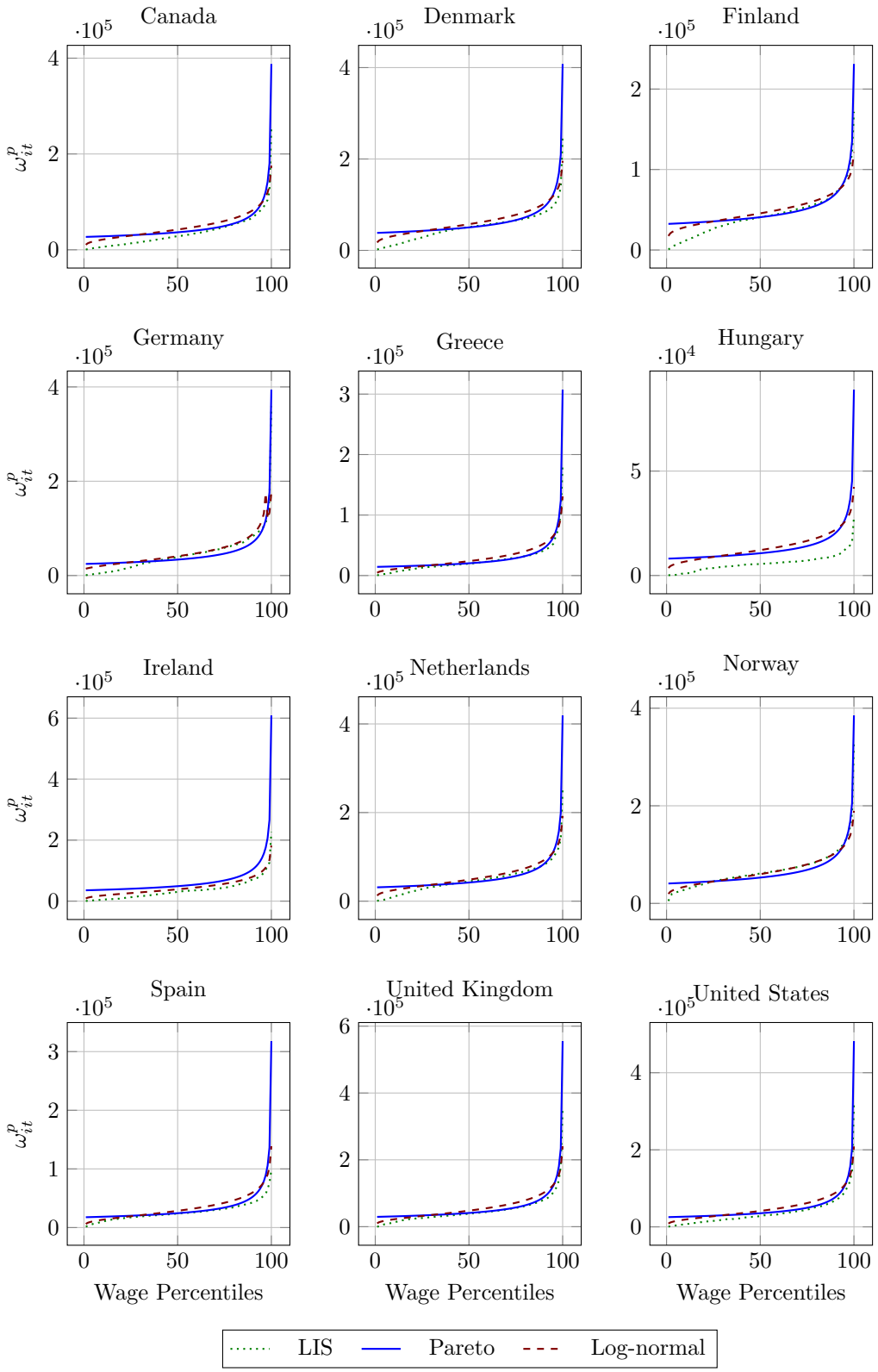

Figure 15: LIS and Imputed income percentiles: 2007

Table 3: LIS Country-Year Matches

Country	Type	1994	1995	1996	1997	1998	1999	2000	2001	2004	2005	2006	2007
Australia	Pareto		0.910						0.916				
	Log-normal		0.987						0.981				
Austria	Pareto	0.870			0.884			0.980		0.945			
	Log-normal	0.981			0.986			0.854		0.977			
Belgium	Pareto		0.904		0.920			0.963					
	Log-normal		0.971		0.982			0.782					
Canada	Pareto	0.848			0.890	0.900		0.912		0.941			0.948
	Log-normal	0.992			0.990	0.993		0.989		0.974			0.970
Denmark	Pareto		0.895					0.874		0.884			0.906
	Log-normal		0.988					0.982		0.982			0.971
Finland	Pareto		0.879					0.944		0.942			0.914
	Log-normal		0.994					0.974		0.973			0.988
France	Pareto	0.963						0.950			0.940		
	Log-normal	0.956						0.972			0.974		
Germany	Pareto	0.852						0.948		0.923			0.957
	Log-normal	0.990						0.968		0.979			0.948
Greece	Pareto		0.875					0.961		0.950			0.957
	Log-normal		0.981					0.946		0.963			0.963
Hungary	Pareto	0.875					0.964				0.977		0.908
	Log-normal	0.989					0.943				0.913		0.977
Ireland	Pareto	0.792	0.789	0.925				0.981		0.915			0.922
	Log-normal	0.973	0.969	0.974				0.857		0.989			0.986
Italy	Pareto		0.863			0.966		0.960		0.988			
	Log-normal		0.975			0.937		0.948		0.855			
Mexico	Pareto	0.979		0.917		0.998		0.976		0.993			
	Log-normal	0.935		0.988		0.847		0.947		0.903			
Netherlands	Pareto						0.816			0.897			0.911
	Log-normal						0.981			0.980			0.981
Norway	Pareto		0.885					0.942		0.957			0.962
	Log-normal		0.980					0.966		0.951			0.959
Spain	Pareto		0.799					0.920		0.875			0.847
	Log-normal		0.987					0.980		0.989			0.994
Sweden	Pareto		0.837					0.953			0.891		
	Log-normal		0.976					0.933			0.983		
United Kingdom	Pareto	0.951	0.832				0.973			0.982			0.969
	Log-normal	0.963	0.997				0.927			0.932			0.950
United States	Pareto	0.964			0.987			0.987		0.982			0.972
	Log-normal	0.960			0.903			0.884		0.925			0.951
Observations	138	0.895 0.915											

Missing percentiles in the LIS data were linearly interpolated. We are able to match 138 country-year-pairs, with 77 observations entering regressions in Figure 6

Appendix C: Non-OECD results

In this appendix, we provide results for non-OECD countries that mirror those presented in the main text for OECD members. As we have mentioned, non-OECD countries rely on employee-based taxes to a much lesser extent; hence, the results that we obtain for this group are generally much less pronounced.

Revenue regressions

We start with running the following regression:

$$100 \times \frac{R^r_{it}}{GDP_{it}} = const^r_n + \psi^r_n \ln(\pi_{n,it}) + Z_{it}\Gamma^r_n + \lambda^r_{n,t} + \mu^r_{n,i} + u^r_{n,it},$$

where Z_{it} is a vector of controls, $u_{n,it}$ is the disturbance term, the scalars $const^r_n, \gamma^r_n$, and the vector Γ^r_n are regression parameters, and $\lambda_{n,t}$ and $\mu_{n,i}$ are fixed time and country effects, respectively. We report the results in Table 4.

The upper panel provides results for the non-OECD group in the 1980-1993 and the lower panel in the 1994-2007 periods. In the former period, we do not observe significant changes in the composition of the tax revenues due to openness. However, the results suggest that in the latter period, governments in non-OECD countries responded to higher openness by reducing the relative size of revenues raised with employer-based social security contributions and taxes in the *other* category. Hence, non-OECD countries did not respond to globalization by raising the relative size of tax revenue to GDP but rather by changing the composition thereof via lower revenues from firm-based and *other* taxes.

Table 4: Revenues, Trade and Migration - Non-OECD subgroup

R^r_{it}		total		firm		employee		goods		other	
	Coef.	trade	mig	trade	mig	trade	mig	trade	mig	trade	mig
1980-1993											
OLS	$\widehat{\psi}_n$	0.272	−0.470	0.907	3.540	−0.592	0.319	−0.666	0.591	1.228	−4.057
		(0.675)	(0.688)	(0.429)	(0.709)	(0.213)	(0.327)	(0.280)	(0.333)	(0.624)	(1.005)
	R^2	0.907	0.907	0.853	0.862	0.956	0.955	0.914	0.914	0.741	0.752
IV	$\widehat{\psi}_n$	0.892	−3.761	0.372	1.155	0.227	−0.488	0.523	1.869	−0.895	−6.860
		(0.850)	(1.644)	(0.533)	(1.048)	(0.276)	(0.472)	(0.402)	(0.621)	(0.809)	(1.905)
	R^2	0.906	0.902	0.849	0.855	0.953	0.954	0.907	0.905	0.704	0.724
	Obs	385	385	312	312	316	316	366	366	311	311
1994-2007											
OLS	$\widehat{\psi}_n$	0.670	1.314	0.694	0.152	0.500	−0.011	0.139	0.327	−0.960	−0.193
		(0.457)	(0.488)	(0.351)	(0.264)	(0.186)	(0.179)	(0.332)	(0.344)	(0.302)	(0.370)
	R^2	0.935	0.936	0.869	0.867	0.954	0.953	0.832	0.833	0.854	0.850
IV	$\widehat{\psi}_n$	1.406	−0.691	0.412	0.294	0.743	−0.049	0.865	−0.861	−1.315	−0.387
		(0.641)	(0.554)	(0.504)	(0.345)	(0.249)	(0.218)	(0.594)	(0.351)	(0.518)	(0.415)
	R^2	0.934	0.932	0.868	0.867	0.954	0.953	0.830	0.826	0.854	0.850
	Obs	473	473	397	397	389	389	451	451	383	383

Standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. Standard errors are robust to an unknown form of heteroskedasticity and autocorrelation. For brevity, the constant, time and country fixed effects and coefficients for education shares, democracy, left-and right-wing governments, log population, log real GDP per capita and the interaction between log population and log real GDP per capita are suppressed.

Relative tax burden regressions

Next, we report the effect of globalization on the relative tax burdens in Figures 16 and 17. The figures suggest that in 1980-1993 trade openness did not lead to lower burdens for the top earners in the non-OECD economies, which is different from the results for OECD countries. In terms of the other time periods and measures of globalization, results are qualitatively similar to the ones in the main text. For example, migration openness had a larger effect on workers in the right tail of the earnings distribution in 1980-1993, whereas they enjoyed lower tax burdens due to globalization in 1994-2007.

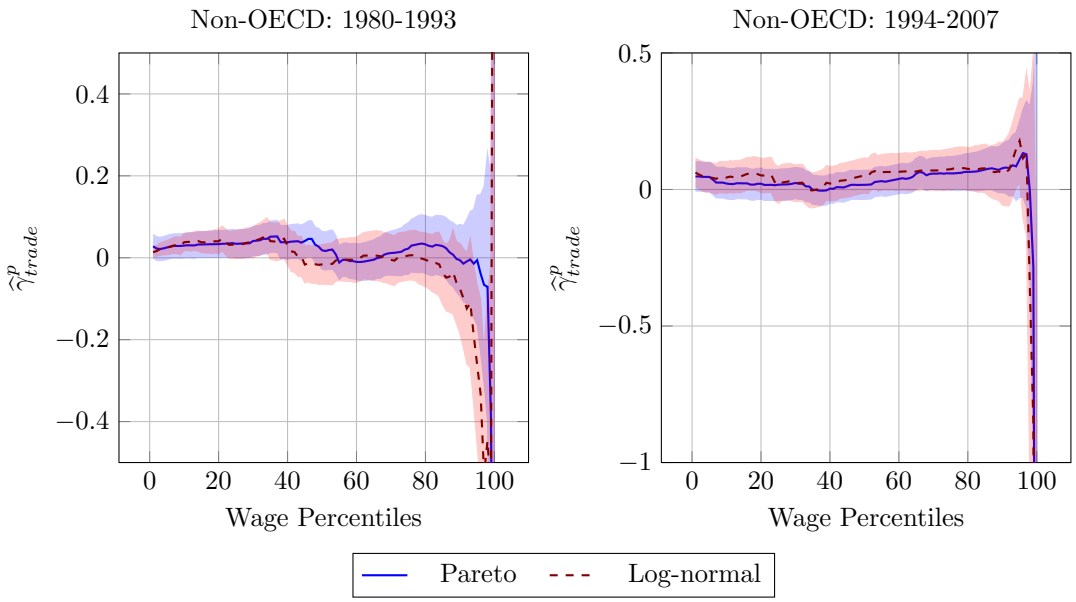

Figure 16: Regression Coefficients IV-GMM: Trade and Percentile-specific Contribution to Total Employee-borne Tax Revenue

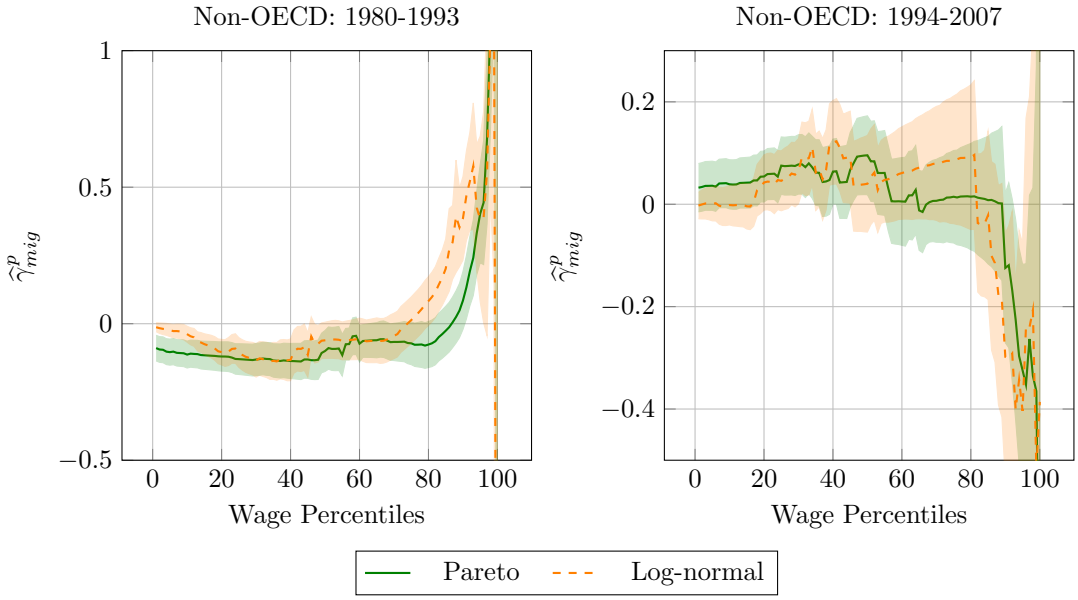

Figure 17: Regression Coefficients IV-GMM: Migration and Percentile-specific Contribution to Total Employee-borne Tax Revenue

Effective average income tax rate regressions

Finally, we report the effects of globalization on the average effective tax rates across different workers in non-OECD countries in Figure 18 and 19. When we measure globalization using trade openness, we cannot detect any significant effects, though qualitatively the results look similar to those for OECD countries. The same generally holds when considering migration:

in 1980-1994 workers in the right tail of the wage distribution faced higher tax rates but enjoyed relatively lower rates in 1995-2007 due to globalization.

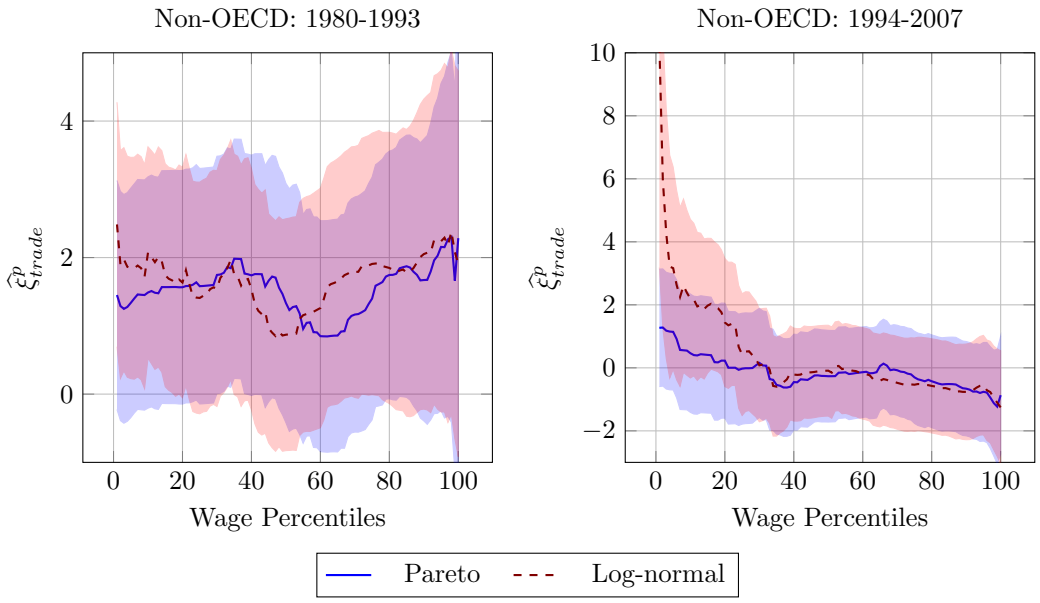

Figure 18: Regression Coefficients IV-GMM: Trade and Percentile-specific Tax Rates

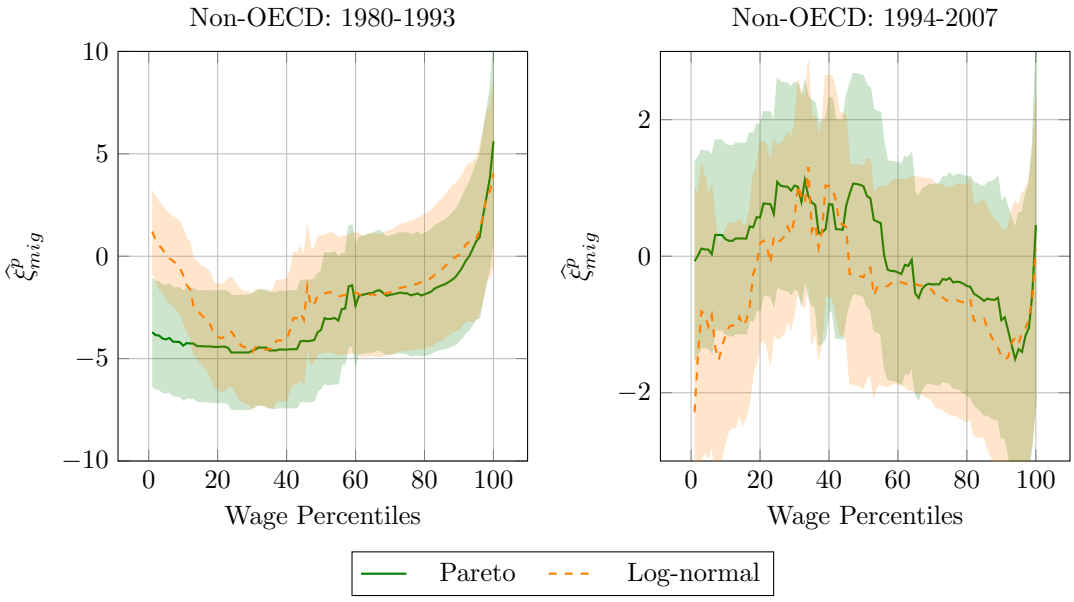

Figure 19: Regression Coefficients IV-GMM: Migration and Percentile-specific Tax Rates