Capital Taxation, Development, and Globalization: Evidence from a Macro-Historical Database*

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Abstract

This paper builds and analyzes a new global macro-historical database of effective tax rates on capital and labor in 154 countries. We establish a new stylized fact: while effective capital tax rates fell in developed countries between 1965 and 2018, they rose in developing countries since 1990. Multiple research designs at the country, sector and firm-level suggest that trade openness contributed to this rise, by increasing the share of output produced in corporations and larger firms, where effective capital taxation is higher. In contrast to a common view, globalization appears in many countries to have supported governments' ability to tax capital.

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1 Introduction

How has globalization affected the relative taxation of capital and labor? Has it uniformly eroded the amount of taxes paid by capital owners, shifting the burden to workers? Or have some countries managed to increase effective capital tax rates, and if so how? Answering these questions is critical to better understand the macroeconomic effects and social sustainability of globalization in uncertain times (Goldberg & Reed, 2023).

Based on a new long-run global database of effective tax rates on capital and labor, we document that in developing countries, effective capital tax rates have increased in the post-1990 era of hyper-globalization. Consistently across several research designs, we find that a significant share of this rise can be explained by trade openness. By expanding the share of economic activity occurring in the corporate sector, and within the corporate sector in larger firms, our results show that trade improves the effective collection of taxes, particularly corporate income taxes. Globalization has also had widely noted negative effects on capital taxation, due to international tax competition that applies downward pressure on corporate statutory tax rates. We find that the positive tax capacity effect of trade we uncover prevailed in developing economies, causing openness to increase overall government tax revenues (as a % of GDP). The revenue consequences of globalization have not been systematically investigated in developing countries due to limited data, and concerns over potential revenue losses have persisted as a key obstacle to further integration across borders (World Bank, 2020). In contrast to a common view, our findings show that globalization has not uniformly eroded governments' ability to raise revenue, and instead appears to have supported capital taxation in many countries.

To establish these results, this paper makes two contributions. The first is to build and analyze a macro-historical database of effective tax rates on capital (ETR_K) and labor (ETR_L) covering 154 countries, with over half starting in 1965, until 2018. Each ETR divides all taxes collected on the factor by the national income that accrues to it; by relying on actual taxes collected, ETRs capture the net past effect of all tax rules and, importantly for developing countries, tax evasion and avoidance. Complementary to existing ETR series that focus on developed countries, our data provides a global coverage by digitizing and harmonizing thousands of historical and recent public finance records in developing countries. The global database allows us to systematically characterize the evolution of effective tax rates in developing countries and compare trends across development levels.

A novel fact emerges from this database: the evolution of capital taxation has been asymmetric across development levels. In high-income countries, effective capital tax rates declined, from a high of 38-39% in the late 1960s to 32-33% in the late 2010s. By contrast, in developing countries, effective capital tax rates have been on a rising trend since the beginning of the 1990s, albeit starting from a low level. Effective capital tax rates rose from 10% in 1989 to 18% in 2018, with more pronounced increases in larger economies. For example, ETR_K rose from 6% to 24% in China, 5% to 12% in India, and 7% to 27% in Brazil. The positive trend in capital taxation is driven by the corporate sector: the average effective corporate tax rate rose from 12% in 1989 to 20% in 2018.

This rise of capital taxation in low- and middle-income countries had not been noted in the literature before, due to a lack of data on the evolution of taxation globally. The finding appears robust. It holds: when we exclude China and oil-rich countries; with other approaches to computing capital and labor income in unincorporated businesses (where factor shares are not directly observable); and with alternative ways of splitting personal income tax revenue between capital versus labor.

Our second contribution is to formulate and test a hypothesis that sheds light on the rise of capital taxation in developing countries. We hypothesize that openness exerts a positive effect on developing countries' capacity to tax, consistent with trade leading to the expansion of larger firms relative to smaller ones (Mrázová & Neary, 2018) and firm-level effective taxation rising with size, due to better enforcement and higher statutory tax burdens (Almunia & Lopez-Rodriguez, 2018; Best, Shah, & Waseem, 2021).[1] Our hypothesis is motivated by the observation that the rise in ETR_K coincides with trade liberalization. Since the beginning of the 1990s, many developing countries opened their markets and reduced tariffs, leading to a boom in international trade that reshaped the economies of Mexico, India, and China among others (Goldberg, 2023). By disproportionately benefiting larger firms, trade can increase the share of economic activity in corporations and more formal businesses, where effective taxation of capital (and labor) is higher.

To motivate the tax capacity hypothesis, Figure 1 shows that the share of domestic output from the corporate sector (profits and employee compensation) has grown over time in developing countries, at the expense of mixed-income (income of self-employed and unincorporated businesses). While the corporate sector accounted for 53% of domestic output in 1989, prior to the hyper-globalization era, it grew to 62% by 2018; mixed income fell from 32% to 20% over the same period. Thus, developing countries have experienced a relocation of activity from a hard-to-tax sector to a sector with stronger effective taxation.

[1]Higher effective taxation in the corporate sector stems both from stronger enforcement and higher statutory taxes than in the non-corporate sector. Our notion of tax capacity is that these co-determined forces jointly lead to higher ETR_K with firm size (where size is measured as firm output, in our case revenue).

We establish the second contribution in two steps. First, we study the impact of trade on taxation in developing countries, with a focus on ETR_K and corporate taxes. Second, we study mechanisms that link trade to taxation, with a focus on the tax capacity channel.

We implement three research designs to study how trade impacts taxation. First, we estimate the non-parametric association within a country over time between ETR and trade openness. Second, we analyze major trade liberalization events that occurred in seven large developing countries, including China's WTO accession in 2001, and caused sharp reductions in trade barriers (Brandt, Biesebroeck, Wang, & Zhang, 2017; Goldberg & Pavcnik, 2016). We use synthetic control methods and present event-study results. Third, we extend the trade instruments from Egger, Nigai, and Strecker (2019) to our sample.

All three designs show that, in developing countries, trade leads to a large increase in ETR_K, and a smaller increase in ETR_L. The effect is sizable: trade openness can account for 33% of the documented rise in ETR_K since 1989. Although studying macroeconomic outcomes presents identification challenges, the results are consistent across research designs, which differ in their identifying assumptions, and are robust to numerous sensitivity checks. Across the research designs, we also find that trade leads to an increase in total tax revenues (as a % of GDP). Reflecting trade's positive impact on ETR_K, over half of this increase comes from higher corporate income taxes (CIT), and a smaller share from personal income taxes and payroll. Indirect taxes (combining tariff revenues and domestic consumption taxes) slightly rise, but the coefficient is not significant.

We then turn to investigate mechanisms. In the IV and liberalization event-studies, we find that trade increases the share of domestic output produced in the corporate sector, relative to the unincorporated business sector (mixed-income).[2] Thus, output is expanded in the corporate sector where enforcement is stronger and effective taxation is higher (Slemrod & Velayudhan, 2018). Moreover, within the corporate sector we find that trade increases the average effective tax rate on capital, suggesting the expanded corporate output accrues to firms whose ETR_K increases with their output (our proxy for firm size). These two effects of trade are consistent with the tax capacity channel. Simultaneously, we find that trade reduces the statutory corporate tax rate, consistent with a tax competition channel where globalization pushes governments to reduce the statutory tax burden on capital. On net, the positive tax capacity impact outweighs the tax rate reduction in developing countries, causing trade to increase ETR_K at the country-level.

In contrast, we find no tax capacity effect of trade in developed countries, but a stronger decrease in statutory corporate tax rates. These results help reconcile the asymmetric evolution of capital taxation in developing and developed countries.

[2] Trade leads to a sharp rise in corporate profits and an insignificant change in employee compensation.

We sharpen our mechanism analysis by conducting a firm-level investigation of the tax capacity channel. We merge multiple administrative datasets in Rwanda, which allows us to observe each firm's integration into international trade and corporate tax payments. The integration measure accounts for the firm's indirect exposure to trade through its production network (Almunia, Hjort, Knebelmann, & Tian, 2023). Rwanda provides an interesting setting: starting from a relatively low share of domestic output, the corporate sector has grown significantly since the 1990s, in tandem with a rise in trade openness and tax collection. Using the shift-share design of Hummels, Jørgensen, Munch, and Xiang (2014) for identifying variation, we find that trade integration increases both a firm's ETR_K and its size. Though limited to a single country, these firm-level results provide micro-evidence for trade's positive impact on ETR_K, and support the tax capacity mechanism whereby trade's impact is mediated by a positive firm size-ETR_K gradient.

Finally, we study sources of heterogeneity in the pro-tax impact of trade. During our sample period, developing countries have invested in domestic tax enforcement, such as large taxpayer units (C. Basri, Felix, Hanna, & Olken, 2019). We find that trade's impacts on the tax capacity mechanism and on ETR_K hold in the absence of these enforcement policies and, more generally, outside of periods of significant fiscal pressure (Cagé & Gadenne, 2018). Thus, trade's pro-tax impact appears to be a broad feature of the globalization process which does not hinge on governments' initial enforcement and revenue needs. At the same time, we find that openness' pro-tax impact depends on the nature of the trade shock, in ways that are consistent with recent theoretical work on trade and formalization (Dix-Carneiro, Goldberg, Meghir, & Ulyssea, 2021).

Combining multiple empirical strategies, our results at the country, corporate sector, and firm-level consistently suggest that trade openness increases ETR_K and contributed to the newly documented rise of ETR_K in developing countries since the early 1990s. Based on a new global database, our findings show that globalization has supported effective capital taxation and overall revenue collection in many countries around the world.

Section 2 discusses related literature. Section 3 describes the methodology and data. Section 4 presents findings on the long-run evolution of ETR. Section 5 analyzes trade's impact on ETR and Section 6 investigates the mechanisms. Section 7 concludes.

2 Related Literature

Globalization and tax structure Our paper contributes to the macro literature on globalization and tax structure (Alesina & Wacziarg, 1998), reviewed in Adam, Kammas, and Rodriguez (2013). The "race to the bottom" hypothesis posits that governments reduce taxes on factors that become more mobile (e.g., capital) following trade liberalization (Slemrod, 2004). To achieve revenue neutrality, governments raise taxes on less mobile factors (e.g., labor).[3] The "social insurance" hypothesis postulates that governments raise revenue to insure workers displaced by international competition, often via social security and payroll taxes (Rodrik, 1998). These studies mainly focused on high-income countries. By expanding the scope to developing countries, we formulate and test a new mechanism, where trade increases ETR by expanding activity in firms with higher effective tax collection. Our results suggest that globalization has supported the ability of governments to tax capital in many countries.

Our results are based on a new global database of effective tax rates, which complements existing datasets (including Carey & Rabesona, 2004; Kostarakos & Varthalitis, 2020; McDaniel, 2007) by expanding coverage to developing countries (details in Section 3).[4] Our backward-looking ETR measure is complementary to the literature on forward-looking capital tax rates (including Devereux & Griffith, 1999), which models in detail the statutory tax burden a firm would face under different conditions. This literature finds that the statutory tax burden on capital has fallen in developed and developing countries, consistent with the 'race to bottom' mechanism (including Devereux, Griffith, & Klemm, 2002; R. Kumar & James, 2022; Steinmüller, Thunecke, & Wamser, 2019).

Effective taxation and trade in developing countries Our paper contributes to the micro-oriented literature on trade and public finance in developing countries. Many studies focus on *border taxes* and evasion (e.g., Fisman & Wei, 2004; Javorcik & Narciso, 2017; Sequeira, 2016) or cross-border income-shifting (e.g., Bilicka, 2019; Londoño-Vélez & Tortarolo, 2022; Wier, 2020). We focus instead on trade's impacts on the *domestic tax bases* of capital and labor and domestic economic structure.[5] Our results are intuitive when considering that the trade literature finds positive effects of openness on domestic outcomes including market shares (McCaig & Pavcnik, 2018), firm size (Alfaro-Ureña, Manelici, & Vasquez, 2022), and local development (Méndez & Van Patten, 2022), which the public finance literature has separately identified as determinants of effective taxation (Besley & Persson,

[3]Within labor in OECD countries, Egger et al. (2019) find that globalization in the post-1994 era led to a reduction in income taxes for the top 1% of workers and increased income taxes for middle-class workers.

[4]We complement other work in economic history on taxation (including Cogneau, Dupraz, Knebelmann, & Mesplé-Somps, 2021), by providing long-run measures of factor effective tax rates.

[5]The theoretical literature has focused on trade's impact on the optimal indirect tax mix between border and consumption taxes in developing countries (e.g. Emran and Stiglitz, 2005) and mainly abstracted from direct taxes. Benzarti and Tazhitdinova (2021) study the impact of indirect taxes on trade flows.

2014; Best et al., 2021).[6] We contribute by linking these two bodies of work and directly studying trade's impacts on domestic tax bases at the country, sector and firm level.

By incorporating domestic tax bases, we can comprehensively study the total tax revenue impacts of globalization. Previous studies on trade's revenue impact in developing countries have produced mixed findings, possibly due to differences in sample, methods and tax base focus (including Baunsgaard & Keen, 2009; Buettner & Madzharova, 2018; Cagé & Gadenne, 2018). We contribute by implementing multiple identification strategies in the largest sample to date and find that trade's impacts on domestic tax bases are sufficiently large that openness increases total tax revenue (as a % of GDP).

These impacts of trade are mediated by the tax capacity mechanism, which is rooted in two distinct insights from the trade and the public finance literatures. First, a large class of models predicts that trade leads to the expansion of large firms relative to small firms (Mrázová & Neary, 2018); for empirical evidence, see Bernard, Jensen, Redding, and Schott (2007). Second, in developing countries small firms are mainly informal, and effective taxation increases with firm size (measured as firm revenue)[7]; this positive gradient arises because effective tax collection is higher in larger firms and corporations due to their visibility, complex production structures, and employment of many workers (Almunia, Hjort, et al., 2023; Waseem, 2020). The resulting information trails improve enforcement (Naritomi, 2019; Pomeranz, 2015), though with limits (Carillo, Pomeranz, & Singhal, 2017).[8] The positive size-gradient also arises because the tax code in developing countries often leads to higher statutory tax burdens for larger firms and corporations (R. Kumar & James, 2022): Bachas, Brockmeyer, Dom, and Semelet (2023) find a positive size-statutory tax gradient among corporations in 15 countries. Our mechanism is motivated by Abbas and Klemm (2013), who hypothesize that the corporate sector expansion could explain why the reduction in statutory corporate tax burdens in developing countries has not led to a reduction in CIT revenue (% of GDP).[9] The mechanism also relates to studies in high-income countries that link CIT collection to the corporate sector's statutory burden, output-share and profitability (Clausing, 2007; Griffith & Miller, 2014; Sørensen, 2007).

We focus on a mechanism based on firm size, but many links between trade, firm structure, and taxation remain to be explored (Atkin & Khandelwal, 2020; Parenti, 2018).

[6]Our results, which focus on the corporate output-share, are compatible with findings from trade-formalization studies, which instead focus on the share of formal workers or firms (Section 6).

[7]See also Kopczuk and Slemrod (2006), Kleven, Knudsen, Kreiner, Pedersen, and Saez (2011), La Porta and Shleifer (2014), Bachas, Fattal, and Jensen (2019) and Best et al. (2021).

[8]In developed countries including the US, the large corporate sector is considered an important determinant of effective tax collection (Kleven, Kreiner, & Saez, 2016; Slemrod & Velayudhan, 2018).

[9]See also Quinn (1997), M. M. S. Kumar and Quinn (2012) and Abramovsky, Klemm, and Phillips (2014).

3 Construction of Effective Tax Rates

This section presents a new database of effective tax rates (ETR) on labor and capital, which covers 154 countries, starting in 1965 when possible, until 2018. We first outline the conceptual framework to build ETR, then present the data sources, and finally discuss the sample coverage. Further details are in Appendix B.

3.1 Methodology

Effective tax rates We compute macroeconomic effective tax rates following the methodology of Mendoza, Razin, and Tesar (1994). The effective tax rate on labor, denoted ETR_L, is the total amount of taxes effectively collected on labor divided by total labor income in the economy; similarly for capital, denoted ETR_K:

$$ETR_L = \frac{T_L}{Y_L} \quad \text{and} \quad ETR_K = \frac{T_K}{Y_K} \tag{1}$$

To construct the numerators, each type of tax revenue is assigned to labor or capital:

$$T_L = \sum_j \lambda_j \cdot \tau_j \quad \text{and} \quad T_K = \sum_j (1 - \lambda_j) \cdot \tau_j \tag{2}$$

where λ_j is the allocation to labor of each type j of tax τ_j. Types of taxes j follow the OECD Revenue classification. We allocate taxes as follows: (1) corporate income taxes, wealth taxes, and property taxes are allocated to capital; (2) payroll taxes and social security payments are allocated to labor; (3) personal income taxes (PIT) are allocated partly to labor and partly to capital, in a country-time specific manner (details below). Indirect taxes are neither assigned to labor nor to capital (but analyzed directly in Section 5.3). Table B2 provides a detailed allocation summary.

To construct the denominators, we decompose net domestic product as follows:

$$Y = Y_L + Y_K = \underbrace{CE + \phi \cdot OS_{PUE}}_{Y_L} + \underbrace{(1 - \phi) \cdot OS_{PUE} + OS_{CORP} + OS_{HH}}_{Y_K} \tag{3}$$

Labor income Y_L equals compensation of employees (CE) plus a share ϕ of mixed income (operating surplus of private unincorporated enterprises, OS_{PUE}). Capital income Y_K equals the remaining share $(1 - \phi)$ of mixed income, plus corporate firms' profits net of depreciation (operating surplus of corporations, OS_{CORP}), plus actual and imputed rental income (operating surplus of households, OS_{HH}).[10]

We also measure the effective tax rate on corporate profits, $\overline{ETR}_C^K$, as the ratio of corporate income taxes to corporate profits. This is an average effective tax rate at the corporate sector level; in Section 6, we analyze the firm-level corporate effective tax rate.

These macroeconomic ETRs rely on several conventions and assumptions (see Carey & Rabesona, 2004). First, as is done in the literature, they do not factor in economic incidence in that the economic cost of taxes is not "shifted" from one factor of production to another: all labor taxes are allocated to labor and all capital taxes are allocated to capital. Second, the tax revenue streams need to be comparable to their macroeconomic tax bases measured in national accounts. This generates two key challenges for our ETRs: (i) in the numerator, what share of personal income tax revenues to allocate to capital versus labor; and (ii) in the denominator, what share of mixed income to allocate to capital versus labor. We outline below our benchmark assumptions (detailed discussion is in Appendix B.2).

Allocation of personal income taxes (PIT) The main empirical difficulty in assigning taxes to labor and capital concerns the allocation of PIT. A naive procedure allocates 70% of the PIT to labor and 30% to capital, roughly matching the labor and capital shares of domestic product. In practice, however, recent work highlights that not all labor and capital income is subject to PIT, since not all individuals are required to file PIT, and exemptions apply to some income types (Jensen, 2022). Exemptions for capital (e.g., imputed housing rents, undistributed profits) are typically larger than for labor (e.g., pension contributions). Further, labor and capital income might not face the same tax rate: dual-income tax systems tax labor income with progressive rates but capital income with flat rates. In the US, Piketty, Saez, and Zucman (2018) use detailed tax and national accounts data to measure that 75% of labor income is subject to PIT, versus 33% of capital income. This suggests allocating 15% of PIT to capital and 85% to labor.[11]

Starting from this baseline where 15% of PIT revenues derive from capital, we perform two country-year adjustments: (i) we raise capital revenues for country-years with a high PIT exemption threshold in the income distribution (Jensen, 2022); (ii) we lower it in country-years where dividends face lower taxes than wages. The resulting capital share of PIT revenue varies between 7% and 32% across country-years. Over time, this share falls

[10]We decompose net domestic product (NDP), which subtracts consumption of fixed capital from gross domestic product (GDP). NDP is lower than GDP, by 10% on average. We exclude capital depreciation since it does not accrue to any factor of production and is usually tax-exempt. Factor incomes also exclude indirect taxes (which are also excluded in the numerator of ETR).

[11]If 75% of labor income is taxable and labor income is 70% of national income (resp. 33% and 30% for capital income), then $75\% \times 70\%/(75\% \times 70\% + 33\% \times 30\%) = 84\%$ of the PIT is labor income.

from a global average of 19% in 1965 to 14% in 2018, due to a reduction in PIT exemption thresholds and increased prevalence of dual tax systems.

In the absence of detailed tax records in every country and year, these adjustments provide an imperfect approximation of the true capital share of PIT. We therefore implement two simple robustness checks where the share allocated to capital is fixed over time at either 0% or 30%, representing low and high-end scenarios.

The labor share of mixed income The labor share of mixed income (unincorporated enterprises) is hard to measure.[12] For our benchmark series we assume $\phi = 75\%$, i.e., 25% of mixed income is considered capital income.[13] In the absence of a consensus over alternatives this assumption has the advantage of being transparent, though factor shares are unlikely in practice to everywhere be time and country-invariant. We therefore implement two robustness checks, which create time and year variation in ϕ. The first method, based on ILO (2019), uses micro-data to estimate the country-specific labor income of self-employed based on the observable characteristics of these workers and their comparison with employees.[14] Second, we assign to ϕ the observed country-year labor share of the corporate sector (as in Gollin, 2002).

The exact ETR formulas which include the above adjustments are in Appendix B.2.

Usefulness and limitations of ETR Since national account statistics are compiled following harmonized guidelines, ETRs are conceptually comparable over time and across countries, though the data limitations described above should be kept in mind. By relying on taxes actually collected, the ETRs incorporate tax avoidance and evasion behavior as well as the net past effects of all tax policies, including rates, exemptions and credits. This is particularly relevant in a development context, where due to widespread evasion, knowledge of statutory tax rules only provides a partial picture of effective tax burdens.

The ETRs are backward-looking measures that comprehensively capture how much capital and labor have effectively paid in taxes. They are helpful for three reasons. First, knowing how much revenues are effectively collected from each factor is important when governments face fiscal pressure (Besley & Persson, 2014): this is characteristic of most

[12]The UN's national accounts framework outlines the combination of multiple methods to overcome challenges of measuring the *level* of mixed income in economies with widespread informality. While information on the methods used is not available on a country-year basis, an inspection of the published frameworks suggests no change in methodologies for mixed income over time.

[13]This is below the 30% used in Distributional National Accounts (DINA) guidelines (Blanchet, Chancel, Flores, & Morgan, 2021), but since the global average of the corporate sector's capital share is 27%, assuming a lower capital share for unincorporated enterprises seems reasonable (see Guerriero, 2019).

[14]Details in Appendix B.2. A challenge with this method is that it can create implausibly large estimates of the level of mixed income compared to their values in national accounts. We implement an adjustment to help with this limitation, but for this reason we choose to use ILO (2019) only for robustness.

developing countries, where potential revenue losses or gains is a key policy determinant. Second, the level of the ETR and its deviation from a statutory rate is frequently an input into policy-making to understand the size of tax gaps (e.g. the recent focus on the firm-level ETR in the global minimum tax agreements). Finally, the tax burden levied on each factor is an important starting point to determine the economic incidence of a tax system.

A limitation of macroeconomic ETRs is that they are impacted by both the tax code and economic changes. Thus, studying ETRs is most helpfully done in combination with analyzing its mechanisms, which we focus on in Section 6. Related, we emphasize that the ETR should not be interpreted as a proxy for the statutory tax burden. An important complementary body of work carefully measures legal tax burdens (Devereux & Griffith, 1999), by constructing forward-looking average tax rates on capital based on the simulated present value of returns and costs of a new investment. Driven by differing objectives, the backward-looking and forward-looking measures are related, yet distinct.[15]

3.2 Data sources

3.2.1 National accounts

To measure factor incomes for 154 countries since 1965 when possible, we create a panel of national accounts using data from the System of National Accounts (SNA) produced by the United Nations. We first use the 2008 SNA online repository that has global coverage for recent decades. In turn, the UN Statistics Division provided us with access to the 1968 SNA offline data which covers historical data from the 1960s and 1970s. To the best of our knowledge, our paper is the first to harmonize and integrate the 2008-SNA and 1968-SNA datasets.[16] Estimating factor incomes requires information on all the components of national income (equation 3). Whenever we have national income for a country-year but information on a component is missing, we attempt to recover it with information from the second SNA dataset, as well as using national accounting identities with non-missing values for the other income components. In the remaining cases, we impute component values following DINA guidelines (Blanchet et al., 2021) (details in Appendix B.1).

3.2.2 Tax revenue

We construct a new tax revenue dataset that disaggregates taxes by type following the OECD Revenue Statistics classification of taxes. Our database includes all taxes—on per-

[15]This is particularly the case for $\overline{ETR}_C^K$: see supplementary appendix for a detailed discussion. Our measure of $\overline{ETR}_C^K$ also relates to the CIT-efficiency measure by IMF (2014). In the supp. apppendix we find that CIT-efficiency measured with our data in the relevant sample matches well the IMF (2014) series.

[16]Relative to recent work (including Guerriero, 2019; Karabarbounis & Neiman, 2014), our data expands coverage in space and time, mainly to developing countries, and systematically attempts to measure factor incomes for total domestic output (vs. only for the corporate sector).

sonal and corporate income, social security and payroll, property, wealth and inheritance, consumption and international trade—at all levels of government. We ensure a systematic separation of income taxes into personal and corporate income. We collect new archival data and integrate it with existing data sources.

When available, OECD Revenue Statistics data (link) is the preferred source, as it covers all types of tax revenues and goes back to 1965 for OECD countries. It accounts for 2,875 country-year observations (42.3% of the sample). Its drawback is its limited coverage of non-OECD countries, as it covers 93 countries in total and only covers developing countries more recently. We add data from ICTD (link). ICTD includes most developing countries, with coverage that starts in the 1980s. ICTD sometimes combines personal and corporate income taxes, and sometimes lacks social security. ICTD adds 1,246 country-year observations (18.3% of the sample).

To complement these existing sources, we conducted archival data collection to digitize records from government budgets and national statistical yearbooks. This adds 2,011 new country-year observations.[17] We supplemented these archival records with countries' online publications, and offline data from the IMF Government Finance Statistics (1972-1989). In total, this data collection adds 2,678 observations (39.4% of the sample).

Building a dataset based on newly digitized historical sources necessarily requires making a number of decisions. To increase the credibility of our data, we follow four guiding principles. First, we seek to build long historical time-series that overlap in years with existing sources. We aim to only use two data sources per country, but use the overlapping years between multiple sources to corroborate that they are comparable in levels of tax revenue and types of taxes in place.[18] For this reason, a switch in data source rarely leads to a significant change in trend. Second, for the historical periods without overlap with existing data, we corroborate the levels of tax to GDP with academic and policy studies. Third, we draw on historical studies to verify that large changes in revenues collected reflect policy, economic or political changes rather than data artifacts. Fourth, we aim to be conservative and exclude countries in time periods where concerns exist about data quality, due to the economic and political context.

To help assess our approach, the supplementary appendix provides additional material. We provide a table which outlines, in each of the 154 countries, the main considerations and our choices relating to the four guiding principles. The table emphasizes the uncertainty surrounding specific countries and time periods, and flags instances where

[17]The archives were accessed in the Government Section of the Lamont Library (website link).

[18]OECD is the preferred starting point and archival data is initially second in priority since it often disaggregates tax types and goes back far in time, but we revise this based on the source that best matches the OECD data. The supplementary appendix summarizes the data sources used for each country.

the data appears worthy of inclusion but should be interpreted with caution (all our main results are unchanged if we exclude these instances). Moreover, we provide in-depth country case-studies with direct links to the initial archival sources; the case-studies currently cover all countries with more than 15 million inhabitants but will ultimately expand to cover all 154 countries. We invite comments from researchers to help improve the accuracy of the series as we continuously update the data.

3.3 Data coverage of effective tax rates

The final ETR sample contains 6,799 country-year observations in 154 countries (Figure A1). The number of countries starts at 78 in 1965 and grows to 110 by 1975 (due to independence or country creation). The key jump in coverage —from 117 to 148 — corresponds to the entry of ex-communist countries in 1994, including China when it arguably built a modern tax system (Appendix B.1). The data is effectively composed of two quasi-balanced panels. The first covers 1965-1993 and excludes communist regimes, accounting for 85-90% of world GDP. The second covers 1994-2018 and includes former communist countries, accounting for 97-98% of world GDP. Figure A1 shows coverage by development level. We use the World Bank income classification in 2018, classifying low and middle-income countries (LMICs) as developing countries and high-income countries (HICs) as developed countries. We refer interchangeably to LMICs as developing countries and HICs as developed countries. Our sample contains 5,144 observations in LMICs and 1,655 observations in HICs.

Comparison with existing datasets Our database complements previous ETR series by expanding coverage to LMICs. Table B3 summarizes the coverage of existing ETR series, which focus on HICs (Carey & Rabesona, 2004; Kostarakos & Varthalitis, 2020; McDaniel, 2007; Mendoza et al., 1994). Our benchmark ETRs rely on specific choices: Table B3 summarizes the methodological differences with existing ETR series, which relate mainly to allocating capital to both mixed income and PIT.[19] The alternative choices are covered by the robustness checks of Section 3.1, which are implemented in Section 4.2.

4 Stylized Facts on Global Taxation Trends

4.1 Evolution of effective tax rates on capital and labor

Figure 2 documents the evolution of effective tax rates on capital and labor from 1965 to 2018. Aggregates are dollar-weighted, i.e., the global effective tax rate on capital equals worldwide capital tax revenues divided by worldwide capital income. These series can

[19] A comprehensive discussion of the methodological differences is provided in the supp. appendix.

thus be interpreted as the average tax rate on a dollar of capital income derived from owning an asset representative of the world's capital stock. The top panel shows global trends and the bottom panels separate HICs and LMICs.

Globally, effective tax rates on labor and capital converged between 1965 and 2018, due to a rise in labor taxation and a drop in capital taxation. The global ETR_L rose from 16% in the mid-1960s to 25% in the late 2010s, while ETR_K fell from 32% to 26%.

The global trends mask heterogeneity by development levels. While labor taxation rose everywhere, the decline in capital taxation only occurred in HICs: the effective capital tax rate fell from 38-39% to 32-33% between the late 1960s and late 2010s, fueled by a large reduction in effective corporate tax rates, which fell from 27% to 19%. In contrast, starting from a low level, ETR_K increased in LMICs, with the rise happening entirely since the beginning of the 1990s. ETR_K started at 10% in the mid-1960s and was at the same level in 1989; in between, there was a rise and decline in the late 1970s, but this temporary change was fully driven by resource-rich countries (Figure 4). From 10% in 1989, ETR_K saw a sustained increase over the next two decades which reached 18% in 2018. The rise in capital taxation is partly driven by higher effective taxation in the corporate sector: the effective corporate tax rate rose from 12% to 20% between 1989 and 2018 in LMICs.[20]

4.2 The rise of capital taxation in developing countries

The secular decline in ETR_K in HICs has been documented before (Dyreng, Hanlon, Maydew, & Thornock, 2017; Garcia-Bernardo, Janský, & Tørsløv, 2022), but the rise in ETR_K in LMICs starting at the beginning of the 1990s is novel. We therefore need to establish that this result is robust to the assumptions we used to construct the ETR series.

The ETR series depends on four main methodological decisions: (1) how to assign PIT revenue to capital vs labor; (2) how to allocate mixed income to capital vs labor; (3) balanced vs. unbalanced panel; (4) weights to aggregate countries. Our benchmark series: (1) assigns PIT to capital vs. labor for each country-year using data on PIT exemption thresholds and the tax treatment of dividends relative to wages; (2) allocates a fixed 25% of mixed income to capital; (3) consists of two quasi-balanced panels before and after 1994 (when China, Russia and other former command economies enter the sample); and (4) weighs countries by their share of worldwide factor income in each year. We assess how results change when varying one, several, or all of these choices at the same time.

[20] Figure A2 shows that both corporate tax revenues and corporate profits increased since 1989 but the former outpaced the latter, causing $\overline{ETR}_C^K$ to rise. Corporate profits and tax revenue are the largest components that determine changes in ETR_K. Smaller contributions to ETR_K's rise come from the decline in mixed-income, and the steady increase in property and wealth taxes, which outpaced income from rents, albeit starting from a very low level (0.3% of NDP in 1989).

Figure 3 investigates the robustness of the ETR_K trend in LMICs.[21] Panel (a) varies the allocation of personal income tax (PIT) revenue. Our benchmark follows a data-driven country-year assignment; instead we consider two simpler scenarios where the share allocated to capital is fixed, at either 0% or 30% (low and high-end scenarios). Due to high PIT exemption thresholds in LMICs, the benchmark country-specific assignment is closer in levels to the 30% than to the 0% scenario. Though the capital share allocated to PIT slightly changes over time (Section 3.1), the time-invariant robustness series track the trends in the benchmark series closely. This is because the PIT remains limited in LMICs, such that its split into labor versus capital is of minor consequence.

Panel (b) varies the assignment of factor shares in mixed income. We implement two robustness checks, creating mixed income labor shares that vary at the country-level based on the ILO (2019) method, and at the country-year level based on the observed corporate labor share. Both alternative series are very similar to the benchmark.

Panel (c) quantifies the effect of country entry into the panel. In our benchmark, China, Russia, and other former command economies enter in 1994. In this robustness, we balance the panel by imputing missing observations between 1965 and 1993; we use the observed ETR_K value for that country in 1994 and the trends in ETR_K observed for other LMICs in 1965-1993. The imputation raises ETR_K between 1965 and 1993, because Russia had both a high ETR_K and a high weight when entering the sample in 1994.

Panel (d) aggregates countries using net domestic product (NDP), instead of capital income weights. The NDP weights are either time-varying or fixed in 2010. These alternative weighting procedures suggest a slightly higher increase in ETR_K over time.

Finally, panel (e) plots all 54 combinations of the four methodological choices. The rise in ETR_K in LMICs between 1989 and 2018 is clearly apparent in each of the 54 series. How wide is the range of increases and how does our benchmark series compare? Computing the 1989-2018 change in the 54 series, we obtain a fairly tight range of ETR_K increases, between 6.4ppt and 10.3ppt. Our benchmark is at 8.7ppt, which is close to the mean increase of 9.2ppt; there are larger increases than our benchmark in 43 series and smaller increases in 10.[22] Our benchmark series corresponds to an 87% increase in the effective tax rate on capital in LMICs since 1989, reflecting both the strong growth and low baseline.

Comparison with previous studies Pre-existing ETR series mainly cover HICs, which limits the comparison to our sample. In HICs, our benchmark ETR trends are comparable

[21] The robustness for ETR_L in LMICs, and ETR_L and ETR_K in HICs are shown in the supp. appendix.

[22] Setting 1989 as the base year is partly arbitrary, but it allows us to fix a starting level for ETRs immediately before the period of strong trade liberalization in LMICs. If we instead compute the change in ETR_K between 2018 and the lowest point in a given series, the range of changes is 6.8-11.3ppt across the 54 series, with a mean at 9.6ppt and our benchmark at 9.4ppt.

to previous studies, but the levels differ by 16.5% on average (Figure B1). This difference is primarily due to methodological assumptions about the allocation of capital to mixed income and PIT (Table B3). However, the alternative methodologies from the pre-existing series are contained within the range of ETR trends produced by our robustness checks. In HICs, that range of ETR_K trends is indeed wide (due to the quantitative importance of the PIT; ETR series in supp. appendix). However, the range of ETR_K trends in LMICs is comparatively tighter (Figure 3); this is because the rise in ETR_K in LMICs is primarily driven by the corporate sector (Figure A2), which is not strongly affected by the methodological differences between our study and pre-existing studies.

4.3 Where has capital taxation risen?

Figure 4 shows the ETR_K series for subsamples of countries. Panel (a) plots ETR_K series for the most populous LMICs: Brazil, China, India and Indonesia. All display a marked ETR_K rise over time. Starting in 1989 (1994 for China) until 2018, ETR_K rose from 7% to 27% in Brazil, 6% to 24% in China, 5% to 12% in India, and 9% to 15% in Indonesia.

China's weight and fast-rising capital taxation imply that it plays a key role in the aggregate ETR_K trend in LMICs. Panel (b) shows that, when excluding China, the rise in ETR_K is half as large (from 10% to 15%) and a more significant part of the rise occurred earlier in the 1990s. Panel (c) shows that oil-rich countries, measured as deriving more than 7% of GDP in oil in 2018, have been on a completely distinct path. Reflecting the oil commodity shocks, their ETR_K rose in the 1970s but fell in the 1980s, and have stayed flat since. Excluding oil-rich countries yields a more pronounced ETR_K rise, from 9% in 1989 to 21% in 2018, and a flat ETR_K series from 1965 to 1989. If we exclude both China and oil-rich countries, we observe a rise in ETR_K from 9% in 1989 to 17% in 2018, which is similar in magnitude to the benchmark series.

Panel (d) reveals that, among non-oil-rich countries, the ETR_K rise is stronger in large LMICs, defined as the 19 countries with a population above 40 million in 2018. Even when excluding China, the ETR_K of the other 18 most populated countries rose from 9% to 18% between 1989 and 2018; in smaller countries, ETR_K rose from 10 to 14% over the same period. The ETR_K has risen by more than 5 percentage points in 13 of the 19 largest LMICs since 1989, and has only fallen in one country (Russia).[23]

In short, the rise in effective capital taxes is more pronounced in larger countries, including China, but is a general pattern in developing countries, except for oil-rich ones.

[23] The supplementary appendix shows the individual countries' ETR_K and ETR_L time series.

4.4 Suggestive evidence for the role of globalization

We saw that ETR_K fell in HICs but rose in LMICs. Importantly, the rise in LMICs starts in the early 1990s, which coincides with the onset of the "hyper-globalization" period that could a priori have made capital more mobile and harder to tax.[24] Instead, could trade globalization have caused ETR_K to rise in LMICs? Here we take a first pass at investigating this question. We create 5-year growth rates within countries in trade and ETRs. We plot binned scatters of ETR against trade openness (measured as the share of imports and exports in NDP), after residualizing all variables against year fixed effects. Figure 5 depicts these within-country associations, which condition on global time trends. Mirroring the heterogeneity in long-run trends, we observe differences by development level in the association between trade and ETR_K: openness is associated with increases in ETR_K in LMICs, but with decreases in ETR_K in HICs.[25] In sum, from a global and historical perspective, the correlational evidence suggests that trade may have contributed to the newly documented rise in ETR_K in developing countries.

Naturally, LMICs have undergone significant development since the 1960s and this growth is likely to also have contributed to the long-run rise in ETR_K. In the supplementary appendix, we find that the associations in Figure 5 hold in LMICs when controlling for GDP per capita growth. This correlational evidence, combined with the observation that while globalization is a major process in LMICs, its revenue impacts are still not established (Section 1), motivate us to investigate trade as a determinant of ETR and study its mechanisms.

5 Trade Globalization and Capital Taxation

In this section, we implement two distinct research designs to investigate the impact of trade openness on capital and labor taxation in developing countries.

5.1 Event-studies for trade liberalization

5.1.1 Empirical design

In the first design, we implement event studies of trade liberalization policy events in key developing countries. To discern sharp breaks from trends in our outcomes, our selection criteria was to select events that caused large trade barrier reductions and which

[24]Individual trends in the four largest LMICs (Figure 4) also suggest an association between liberalization episodes and an uptick in ETR_K (Brazil in 1988; China in 2001; India in 1991; Indonesia in the mid-1980s).

[25]The supplementary appendix further shows that early globalized LMICs saw trade and ETR_K rise in tandem prior to the 1990s and stagnate thereafter. By contrast, LMICs which participated in the second wave of globalization post-1990 saw a rise in trade and ETR_K in the 1990-2018 period.

have been studied in the literature. This led us to select the six events from the review papers by Goldberg and Pavcnik (2007, 2016) (Colombia in 1985, Mexico in 1985, Brazil in 1988, Argentina in 1989, India in 1991, Vietnam in 2001), and add the well-known event of China's accession to WTO in 2001 (Brandt et al., 2017). These liberalization events led to large reductions in tariffs: from 59% to 15% in Brazil; 80% to 39% in India; and, 48% to 20% in China. We can rely on pre-existing narrative analyses to discuss threats to identification and interpretation of results.[26] Appendix C.1 provides more details on our selection criteria and the liberalization events.

For each of the seven treated countries and outcomes, we construct a synthetic control country, as a weighted average over the donor pool of never-treated countries (Abadie, Diamond & Hainmueller, 2010).[27] We match on the level of each outcome in the 10 years prior to the event, while minimizing the mean squared prediction error between the event-country and the synthetic control.[28] We plot the average levels of the outcome for treated and synthetic control countries by relative time to the event. Moreover, we estimate the event-study model in 10 years both before and after the events:

$$y_{ct} = \sum_{e=-10, e\neq -1}^{10} \beta_e \cdot \mathbb{1}(e=t)_t \cdot D_c + \theta_t + \kappa_c + \pi_{Year(t)} + \epsilon_{ct} \tag{4}$$

where we include fixed effects for event-time, θ_t, country κ_c, and calendar year, $\pi_{Year(t)}$ (the latter control for shocks that correlate with events clustered in calendar time). D_c is a dummy equal to one if country c is treated. The coefficient β_e captures the difference between treated and synthetic control countries in event time e, relative to the pre-reform year $e = -1$ (omitted period). Since inference based on small samples is challenging, we plot 95% confidence bounds using the wild bootstrap, clustered at the country event level. In Table A1 we estimate the simple difference-in-differences, which captures the average treatment effect in the 10 years post-liberalization, and the imputed treatment effect based on Borusyak, Jaravel, and Spiess (2021), which addresses challenges from two-way fixed effects and heterogeneous event-times.

5.1.2 Event-study results

Figure 6 displays the event studies in levels (left-hand panels) and the dynamic regression coefficients (right-hand panels). The top panels show that, as expected, trade openness

[26] The reductions in trade barriers are sometimes implemented over several years. To be conservative, we focus on the earliest start year for each event as defined in published studies.

[27] For each country-event, we can include eventually-treated countries in the donor-pool (excluding those with treatment within 5 years of the event); the results, available upon request, are similar.

[28] The supp. appendix lists the countries included in the synthetic control for each event and each outcome.

rises in the years post-event by 10 percentage points, and its trend changes in post-reform years compared to pre-liberalization years.[29] The middle panels show that ETR_K followed stable pre-trends and sharply rises post-liberalization, by 4 to 5 percentage points. The bottom panels show ETR_L also rose, but only by 2 percentage points. Despite the small sample size, the dynamic post-treatment coefficients for each period are often significant at the 5% level. The p-values for the joint significance of all post-reform dummies are well below 5%. Table A1, Panel A, reports the DiD results, which are marginally more significant when estimated from imputed treatment effects. Panel B shows that results are comparable when we jointly match on all outcomes for each country-event.

The identifying assumption is that there are no changes in confounding determinants of ETR that coincide with the liberalization events. The breaks from stable pre-trends imply that confounding changes would have to sharply coincide with the event onset. Narrative analyses of the timing for each event (Appendix C.1) do not suggest obvious concurrent changes. Moreover, using data from Wacziarg and Wallack (2004), we verify that other cross-border reforms (e.g. capital liberalization) or domestic reforms (e.g. privatization) do not occur in the same year as the trade events.[30] However, reforms sometimes occur a few years after: for example, Mexico joined NAFTA and removed capital inflow restrictions, Argentina and Brazil joined MERCOSUR, and India liberalized its FDI rules (Appendix C.1). These reforms occurred several years post-trade liberalization, but ETRs sharply rise in the immediate post-event years. This discussion highlights that the causal interpretation of trade-centered macroeconomic reforms requires caution. A plausible interpretation is that the short-run rise in ETRs with sharp breaks from stable pre-trends reflects the impact of trade reforms, but that the medium-run coefficients also reflect the impacts of additional, mainly cross-border, reforms.

Our results are based on a (small) sample of liberalization events that satisfied specific criteria. In Appendix C.3, we study the robustness to using very different selection criteria for trade liberalization. Specifically, we re-estimate the event-study using the 68 liberalization events in LMICs from Wacziarg and Welch (2008). We find very similar impacts of trade on ETR using this alternative and expanded set of liberalization events.

We further probe the identification and robustness of our results. First, given the limited number of liberalization events, we investigate if the average effects are influenced by one particular event. Removing one treated country at a time, we find the dynamic treatment effects for all subsets of events are similar to the full sample (supp. appendix).

[29]The absence of a pre-reform dip limits concerns about inter-temporal substitution, although some of the liberalization events may have been predictable, including China's WTO accession.

[30]Only Mexico had a concurrent domestic reform, and results hold without it: see supp. appendix.

Second, Table A1 addresses concerns related to the control group. We find similar results when we remove from the donor pool each liberalizing country's 5 major export and import trading partners (measured in the immediate pre-event years), alleviating concerns of spillovers to countries in the control group.[31] Results are also comparable when the donor pool excludes countries that have already liberalized (based on Wacziarg & Welch, 2008), to guard against the concern that the trends in the synthetic control group reflect the longer-run effects of the treatment (liberalization). Finally, to lessen the concern that treated and control countries experience different unobservable shocks, we find similar results when the donor pool for each treated country is restricted to the same region (or to LMICs only).

5.2 Regressions with instrumental variables for trade

5.2.1 Empirical design

Our second design employs instrumental variables for trade. One attractive feature is that the IV provides causal estimates under different identifying assumptions than the event-study. We estimate the following model in developing countries:

$$y_{ct} = \mu \cdot trade_{ct} + \Theta \cdot X_{ct} + \pi_c + \pi_t + \epsilon_{ct} \tag{5}$$

where y_{ct} is the ETR (or another outcome) in country c in year t, $trade_{ct}$ is the share of imports and exports in NDP, and π_c and π_t are country and year fixed effects.[32] We cluster ϵ_{ct} at the country level. X_{ct} contains confounding determinants of ETR: the exchange rate, gross capital formation, log of population, and capital openness (Chinn & Ito, 2006 Rodrik, 1998). ETR time series are sometimes volatile (Figure 4), so we winsorize ETR at the 5%-95% level by year separately for LMICs and HICs.

OLS estimation of equation (5) may be biased due to reverse causality and unobservable confounding factors that correlate with trade. To try to address these issues, we use the two instruments for trade from Egger et al. (2019). The first instrument, denoted $Z^{gravity}$, relies on the structure of general equilibrium models of trade. Under the standard gravity model assumptions, it uses the average bilateral trade frictions between exporting and importing countries as variation (aggregated to the country-year level). This instrument

[31] We also verify that none of the main countries in the synthetic control (supp. appendix) had external or domestic reforms in the event-year or in the post-event periods (using the data in Wacziarg & Wallack, 2004). Consistent with this, the levels of the outcomes in the synthetic control are relatively stable throughout the event periods. Finally, note that if the spillovers correspond to coordination of policies, this would likely bias our estimation towards finding null effects.

[32] We include fixed effects for imputed and interpolated values, as well as for each tax and national account data source (Section 3.2), to ensure results are not driven by changes to data quality. Results also hold without imputed values and within each data source (Table A3).

is valid if the distribution (not the level) of trade costs among individual country-trading pairs is not influenced by ETRs in the import or export country. The second instrument, denoted $Z^{oil-distance}$, interacts time-series variation in global oil prices with a country-specific measure of access to international markets. Access is captured by the variance of distance to the closest maritime port for the three most populated cities. This time-invariant measure captures the internal geography of a country and impacts transportation costs: following a global shock to oil prices, transportation costs will be higher in countries with less concentrated access to ports, leading to a larger drop in imports and exports. This instrument is valid if the interaction between global oil prices and country-specific measures of spatial concentration is uncorrelated with changes in ETRs. Conceptually, both instruments capture variation in trade costs driven by economic forces that are plausibly exogenous to ETRs and their determinants (details in supp. appendix).

In LMICs, the 1^{st}-stage is stronger in the 2000s and at higher income levels for Z^{oil}, and in earlier periods and at lower income levels for $Z^{gravity}$ (supp. appendix). Restricting the analysis to sub-samples where one of the instruments has a strong first-stage introduces bias (Mogstad, Torgovistky, & Walters, 2021). Instead, we combine the two instruments to estimate a local average treatment effect that is representative of LMICs across income levels and time periods. Table A2 shows the 1^{st}-stage.[33]

5.2.2 Instrumental variable results

Table 1 presents the results in LMICs for ETR_K in Panel A, and ETR_L in Panel B.[34] In column (1), the OLS uncovers positive, significant associations between trade and both ETRs. In column (2), we employ the two instruments. The 1^{st}-stage Kleibergen-Paap F-statistic is 24.59. The IV shows that trade causes an increase in both effective tax rates, and the coefficient for ETR_K (0.151) is three times larger than for ETR_L (0.047). These magnitudes are economically meaningful: moving from the 25^{th} to the 75^{th} percentile of trade openness in LMICs would cause a 8.9 percentage points increase in ETR_K.

The remaining columns of Table 1 present three sets of robustness checks. In the first set (Columns 3 to 7), we modify the specification. The most notable difference is that the coefficient on ETR_K increases (to 0.211) when we weigh the regression using NDP (Column 4), putting thus more weight on the variation in larger developing countries. The results hardly change when we: use non-winsorized ETRs (Column 3); include

[33] Table D1 shows the instruments impact imports and exports, and trade in intermediate goods-services (G-S) and final G-S. Thus, our IV-estimates comprehensively reflect the impacts of trade through rises and falls in final and intermediate goods and services that flow both in and out of the country.

[34] Relative to ETR coverage, the sample size drops by 4.5% due to data-availability of instruments.

controls (Column 5);[35] allow oil-rich countries to be on a separate non-parametric time path (Column 6), which addresses the concern that the identifying variation for $Z^{oil-dist}$ is correlated with trends in ETRs specific to oil-rich countries (Figure 4); winsorize trade openness (Column 7).

In the second set of robustness checks, we implement the alternative capital and labor assignments to PIT and mixed-income, described in Section 4.2. In our benchmark, the capital share of mixed income is time-invariant, yet trade may cause factor shares to change. In columns (8)-(9), we allow factor shares to respond to trade by implementing the two methods which create country-year varying capital-shares of mixed income: the results are comparable. They also remain similar when we fix the capital share of PIT at 0% (column 10) or at 30% (column 11) in all countries over time. In the third robustness set (columns 12-13), we estimate IVs using each instrument separately. The 1^{st}-stage F-statistic is 45.13 for $Z^{gravity}$ and 10.75 for Z^{oil}. The IV estimates are comparable, though larger when based on Z^{oil}. Leveraging the opposite sign effects of the two instruments on trade, the reduced form results (Table A2) suggest that openness effects are symmetric: increased trade increases both ETR_L and ETR_K, while reduced trade decreases both ETRs.

Finally, our results are based on an unbalanced panel combining several data sources (Section 3.2- 3.3). Table A3 shows that the results are qualitatively similar within each data-source for taxes (newly digitized government records; OECD; ICTD) and national accounts (SNA1968; SNA2008), as well as in both quasi-balanced panels (pre and post-1994) and in a strongly balanced panel (1965-2018).[36]

Quantifying the role of trade How much of the ETR_K rise in LMICs since 1989 can be accounted for by rising trade? Between 1989 and 2018, the weighted ETR_K in LMICs rose by 8.7ppt (Section 4.2) and trade openness by 13.6ppt. The NDP-weighted IV for trade's impact (col.4 of Table 1) is arguably the most comparable, since the ETR_K trends in Section 4 are also weighted. Using this estimate would imply that trade openness accounts for 33% of the rise in ETR_K ($0.211 * 0.136/0.087 = 0.329$). Considering all estimates in Table 1 generates a range of 21-42%.[37]

5.3 Impacts of trade openness on total tax revenues

We find positive effects of trade on capital and labor taxation, but how does trade impact *overall* tax revenues, including indirect taxes? This is a relevant question, as trade-induced tax losses from liberalization remain an important concern for policymakers (Hallaert,

[35]Results also hold when controlling for GDP per capita (not shown).
[36]Variation between coefficients may reflect data quality or 1^{st}-stage and treatment heterogeneity.
[37]For reasons discussed in 5.1.2, we do not use the event-study estimates for this exercise.

2010; World Bank, 2020). Table 2 presents the OLS and the IV estimation of the effect of trade on total taxes (% of NDP), in LMICs, as well as on individual tax revenue streams. Total taxes include direct taxes on capital and labor, as well as indirect taxes (sum of taxes on trade and domestic consumption).[38]

The trade coefficient for total tax collection is positive and significant in both the OLS and the IV. The IV coefficient (0.101) is economically large: moving from the 25^{th} to the 75^{th} percentile of openness in LMICs would cause a 5.9ppt increase in total taxes (the unweighted average tax/NDP ratio in LMICs is 17.6%). This result is mainly driven by higher corporate income taxes, which account for just over half of the increase in total taxes, and to a lesser extent by social security and personal income taxes.[39] Trade has a positive, but statistically insignificant, effect on indirect taxes.

Trade's impact on total taxes is robust to using NDP-weights; including controls; winsorizing trade; and using each instrument separately (Table A4).

We can also study the impact of the trade liberalization events from Section 5.1 on total tax revenue. Using the event-study methodology, Figure A3 shows that the trade events led to an increase in overall tax collection, with a break from the stable pre-trend.

One limitation is that we do not separately study trade's impact on tariff revenues versus domestic consumption taxes, as our data does not contain a systematic breakdown between these two indirect taxes. This reflects our initial focus on direct capital and labor taxes, but additional data work would permit a separation of these indirect taxes.[40]

Both the event study and the IV indicate that trade leads to higher overall taxation in LMICs. This finding relates to the literature on the net impact of openness on tax revenues, which finds mixed results due to differences in sample, empirical strategy and definition of openness (Section 2);[41] moreover, some of these studies focus on the net impact of trade on indirect taxes and abstract from direct domestic taxes. We contribute by comprehensively studying the total tax impact of openness, based on implementing several identification strategies in the largest sample of developing countries to date.

6 Mechanisms

This section investigates mechanisms for trade's impact on taxes, especially ETR_K.

[38]Long-run trends in taxation by type and development level are in the supplementary appendix.

[39]CIT grew significantly, as a share of NDP, between 1989 and 2018: see Figure A2.

[40]While the sign of openness' impact on tariff revenue could in principle differ depending on whether the reduction in trade costs is initially due to economic forces (as in the IV) or policy changes (as in the event study), we find positive impacts in both cases on domestic capital and labor taxes, and on total taxes.

[41]An important study in this literature, Baunsgaard and Keen (2009) writes in the conclusion: "it is possible that indirect effects operating through higher levels of openness and income consequent upon trade reform have more than offset the direct loss of revenue identified here."

6.1 Outlining the tax capacity mechanism

The *tax capacity* mechanism combines two distinct insights from the trade and public finance literature (Section 2): first, trade expands activity in corporate structures and larger firms relative to smaller businesses and self-employment; second, effective taxation increases with firm size. To fix ideas, consider the following decomposition of ETR^K:

$$ETR^K = \int_{i \in C} ETR_i^K f(i)\, di + \int_{i \in NC} ETR_i^K f(i)\, di \tag{6}$$

$$= \mu_C^K \cdot \overline{ETR}_C^K + (1 - \mu_C^K) \cdot \overline{ETR}_{NC}^K \tag{7}$$

This decomposition shows that the effective tax rate on capital ETR^K is composed of two parts.[42] The first part captures capital taxation within the corporate sector. It is the product of the corporate sector's share of NDP, μ_C^K, and the average effective tax rate on capital in the corporate sector, $\overline{ETR}_C^K$. The former is directly measured in national accounts (employee compensation plus corporate profits net of depreciation), while the latter is computed as the ratio of corporate income tax revenue to corporate profits. In the second part, $\overline{ETR}_{NC}^K$ measures the effective tax rate on capital in the non-corporate sector; it is multiplied by the non-corporate sector's income share, $1 - \mu_C^K$, which includes mixed income of unincorporated enterprises and household surplus (rents and imputed rents).[43]

In LMICs, $\overline{ETR}_C^K$ is 50% larger than the overall ETR^K (19.9% versus 13.3%). This stems from both stronger enforcement and higher statutory tax burdens in the corporate sector.[44] Hence, the expansion of the corporate sector relative to the non-corporate sector (i.e. an increase in μ_C) could increase ETR^K.

The conjecture that trade exerts a tax capacity effect is rooted in the literature on trade and firm size (described in Dix-Carneiro et al., 2021). First, trade can lead to increased market opportunities that disproportionately benefit large exporters (Melitz, 2003). Second, trade can expand the availability of intermediate goods and lower their prices, which could disproportionately benefit initially larger firms (for example due to fixed costs as in Kugler & Verhoogen, 2009). Through these two channels, trade could expand the corporate sector's share of national income (μ_C), as larger firms are more likely to be incorporated. Moreover, by benefiting initially larger firms or leading to firm

[42] In this section, capital taxation is denoted with a K-superscript to accommodate additional notation.

[43] $\overline{ETR}_{NC}^K$ is measured as the ratio of tax revenue from property and wealth, self-employment, and the PIT assigned to capital, over capital mixed-income and the surplus of the household sector. It is thus composed of a mix of variables, which are arguably not as well measured as those from the corporate sector.

[44] The ability to levy higher tax rates is endogenous to enforcement (Bergeron, Tourek, & Weigel, 2024). Our notion of tax capacity is that these co-determined forces jointly contribute to effective taxation.

size growth within the corporate sector, trade could also increase the average effective corporate tax rate, $\overline{ETR}_C^K$. This effect would be driven by a positive firm size-ETR_i^K gradient, where size is measured as firm revenue. The positive gradient arises because compliance and enforcement increase with size.[45] It also arises because the tax code in LMICs often leads to higher statutory tax burdens for larger firms (R. Kumar & James, 2022): using administrative tax data, Bachas et al. (2023) find a positive association between firm size and the statutory effective tax rate for corporate firms in 15 LMICs.[46]

6.2 Results on mechanisms: Tax capacity and race to the bottom

We investigate mechanisms relating trade to ETR, focusing on the tax capacity and 'race to the bottom' channels. In the race to bottom, international tax competition leads governments to reduce statutory corporate tax rates, which would reduce $\overline{ETR}_C^K$ (Section 2). We study both mechanisms in LMICs with the empirical strategies of Section 5.

Table 3 shows the OLS (Panel A) and the IV (Panel B) from equation 5. Consistent with race-to-bottom, column (1) shows that trade causes a decrease in the statutory CIT rate (significant at 10%).[47] The CIT rate is an imperfect proxy of firms' tax incentives as it ignores the tax base (Abbas & Klemm, 2013), but it can be measured in our full sample.

In line with the tax capacity mechanism, trade raises the corporate share of domestic output (μ_C), and reduces mixed income by an equivalent magnitude.[48] This is consistent with the conjecture that trade disproportionately benefits larger firms, which are more likely to be incorporated. Trade also raises $\overline{ETR}_C^K$ (column 6), consistent with the trade-induced corporate output accruing to firms whose ETR^K-size gradient is positive.

How is the additional income of the corporate sector allocated between capital and labor? Columns (4)-(5) show that the corporate sector rise is entirely driven by higher corporate profits, while the change in employee compensation growth is small and sta-

[45]See studies cited in Section 2. For example, Best et al. (2021) uncover a negative size-evasion gradient using randomized audit data on firms in Pakistan, finding also that firm-size is the most significant predictor of evasion. Models of tax compliance provide micro-foundations for the negative size-evasion gradient (including Kleven et al., 2016; Kopczuk & Slemrod, 2006).

[46]The gradient is positive everywhere except at the very top of the size-distribution, where it becomes negative. The gradient is driven by preferential tax treatments that increase with firm size and with characteristics that correlate with size such as total profits. The gradient can also reflect avoidance behavior, if larger firms are on average less able to take actions that reduce their legal tax liability.

[47]The outcome is the first-differenced tax rate (Romer & Romer, 2010). Table A4 shows results with the level of the CIT rate. We combine data from Végh and Vuletin (2015), Egger et al. (2019), Tax Foundation (link) and country-specific sources. A next step could be to study trade's impact on the more detailed statutory measures (Section 2). The downward trend in CIT rates in LMICs (supp. appendix) is related to, but does not fully capture, changes over time in the detailed statutory measures.

[48]The quality of data-sources used by national statistics offices can affect the measurement of mixed income in LMICs, but we find no impact of trade on countries' statistical capacity (World Bank link).

tistically insignificant.[49] This, in turn, causes trade to expand the capital share, both of national income and of the corporate sector (columns 7-8).[50]

The mechanism IV-results are robust to several checks (Table A4): using NDP weights; including controls; winsorizing the trade variable; and, estimating IVs separately based on each instrument. The CIT rate result remains less robust than the tax capacity results.

Figure A3 studies the same mechanism-outcomes but using the event-study design (Section 5.1). The trade liberalization events led to a decrease in the CIT rate and raised both corporate income (μ_C) and the effective corporate tax rate ($\overline{ETR}_C^K$). Some individual event-time coefficients are less precisely estimated, but the post-event dummies are jointly statistically significant for all outcomes. Although they are based on different identifying variation in trade, the event-study and IV results are therefore both consistent with the existence of the tax-capacity and race-to-bottom mechanisms in developing countries.

6.3 Firm-level investigation of tax capacity mechanism

The tax capacity mechanism is based on a firm level channel, combining a positive impact of trade on firm size with a positive firm size-ETR^K gradient. While the macro-results on μ_C and $\overline{ETR}_C^K$ in the previous subsection are consistent with it, in this subsection we directly investigate the tax capacity mechanism at the firm level.

We conduct the analysis in Rwanda between 2015 and 2017, where we leverage multiple administrative datasets to observe each formal Rwandan firm's exposure to trade and domestic tax payments. To our knowledge, there is limited firm level evidence in LMICs on how trade impacts a firm's domestic effective tax rate. Rwanda is an interesting setting as the corporate sector, starting from a comparatively low output share, has grown significantly since the 1990s, in tandem with a rise in trade openness and tax revenues.

We use corporate income tax returns to measure each firm's effective tax rate ETR_i^K as the ratio of corporate taxes paid divided by reported net profit. Net profit is revenue minus material, labor, operational, depreciation and financial costs. In Rwanda, this firm-level ETR_i^K varies due to firm characteristics (including revenue, our proxy for size), reduced rates and exemptions (Mascagni, Monkam and Nell, 2016). This ETR_i^K can also vary due to tax avoidance but, since the denominator is based on tax returns, it will not capture

[49] There is also a null effect of trade on households' operating surplus OS_{HH} (result not shown).

[50] This could occur due to an increase in markups. De Loecker and Eeckhout (2021) find that markups have risen in most regions over the past 40 years. De Loecker, Goldberg, Khandelwal, and Pavcnik (2016) and Goldberg (2023) study the impact of trade on markups. Gupta (2023) and Atkin et al. (2015) find that markups increase with firm size, respectively in India and Pakistan. The rise in corporate profits and limited change in employee compensation may also arise if trade raises firms' labor market power (Felix, 2022). Finally, it may arise if trade benefits more capital-intensive production in developing countries, including through a reduction in CIT rates (Kaymak and Schott, 2023).

outright evasion.[51] The corporate ETR_i^K in Rwanda is everywhere positively associated with size (proxied by firm revenue), apart from in the top percentile (Bachas et al., 2023). Outside of the very top, an increase in firm i's size may cause ETR_i^K to rise.

We merge the CIT returns with customs data to record firms' direct exposure to trade. Following recent work (reviewed in Atkin and Khandelwal, 2020, Bernard & Moxnes, 2018), we measure a firm's total exposure to trade by also accounting for the firm's indirect exposure via its linkages to domestic suppliers that use traded goods in their production.[52] We merge administrative data that record transaction linkages between formal firms (details on data and sample in Appendix D.1). To measure a firm's total trade exposure in a network setting, we follow the methodology in Dhyne, Kikkawa, Mogstad, and Tintelnot (2021) that uses similar datasets to measure Belgian firms' exposure to trade. Specifically, we define firm i's total foreign input share as the share of inputs that it directly imports (s_{Fi}), plus the share of inputs that it buys from its domestic suppliers l (s_{li}), multiplied by the total import shares of those firms:

$$s_i^{Total} = s_{Fi} + \sum_{l \in V_i} s_{li} \cdot [s_{Fl} + \sum_{r \in V_l} s_{rl} \cdot (s_{Fr} + ...)] \tag{8}$$

where V_i is the set of domestic suppliers of firm i, and V_l is the set of domestic suppliers of firm l. The denominator of the input shares is the sum of imports and purchases from other firms. We limit the recursive calculation in (8) to inputs from a firm's immediate suppliers l and the suppliers to their suppliers r (adding more levels only marginally raises s_i^{Total}).[53] Inspecting s_i^{Total} and s_{Fi} reveals that while just under 30% of Rwandan formal firms import directly, 93% rely on trade directly or indirectly through suppliers which use foreign inputs in their production. Most firms are therefore dependent on foreign trade, but only a limited number show that dependence through the direct foreign inputs observed in customs data. The median total foreign input share is 48%.

We estimate regressions in the sample of corporate firms of the form:

$$ETR_{it}^K = \mu \cdot s_{it}^{Total} + \Theta \cdot X_{it} + \pi_t + \pi_i + \epsilon_{it} \tag{9}$$

[51] For this reason, $\overline{ETR}_C^K$ measured in national accounts differs from the (appropriately weighted) corporate ETR_i^K measured in tax returns. They also differ because of conceptual differences in the measurement of profits: see the supplementary appendix for a detailed discussion.

[52] Recent papers study domestic linkages in LMICs and their role in propagating trade shocks (including Almunia, Hjort, et al., 2023; Fieler, Eslava, & Xu, 2018; Javorcik, 2004).

[53] We focus on firms' exposure to imports through their supplier network; we find qualitatively similar results when we study firms' exposure to exports through their client network (results available).

where ETR^K_{it} and s^{Total}_{it} are the corporate effective tax rate and total trade exposure of firm i in year t, and π_t and π_i are year and firm fixed effects. X_{it} includes number of employees and number of clients and suppliers, and ϵ_{it} is clustered at the firm level.

In Table 4, the OLS estimation of (9) shows that a within-firm increase in trade exposure is associated with a higher corporate effective tax rate. This result holds with only year fixed effects π_t (column 1); with industry-geography fixed effects (column 2); with firm controls X_{it} (column 3); with firm fixed effects π_i (column 4).

In Table 4, column (5), we implement an IV that generates firm-level variation in trade exposure using the shift-share design from Hummels et al. (2014). The identifying variation is trade shocks from changes in the world export supply of specific country-product combinations in which a Rwandan firm had a previous import relationship. Specifically, the direct import trade shock for firm i in year t is:

$$logM^D_{it} = log \sum_{a,c} s^{a,M}_{ic,t-1} \cdot WES_{a,c,t} \tag{10}$$

where $s^{a,M}_{ic,t-1}$ is the share of imports of firm i in year $t-1$ that falls on product a from country c, and $WES_{a,c,t}$ is the world export supply (excluding sales to Rwanda) of country c for product a. Product a is measured at the detailed six-digit HS level. Rwandan firms import over 3,510 distinct products from 174 different countries of origin.

The shocks to Rwandan firms' trading environment are time-varying and specific to each partner-country $\times$ product being traded. They capture transportation costs and worldwide shocks to export supply for the relevant country $\times$ product, and contain granular variation across products and countries. The identification strategy rests on the joint hypotheses that these shocks are plausibly exogenous to Rwandan firms' trading environment and that they create varied impacts across firms because Rwandan importers have few imported inputs in common. Indeed, the customs data shows that the median number of unique importing firms in a given HS6 product $\times$ country and time period is 1; the 95^{th} percentile is 3. Hence, if only one Rwandan firm imports metal cored wires from Turkey, an idiosyncratic shock to Turkey's global export supply of those wires will affect just one firm in Rwanda. Note also that, to construct the trade shocks, we rely on prior information about importers' sourcing patterns, which removes concerns over contemporaneous shocks affecting both the choice of imported goods and firm outcomes.

We build the trade shocks for all firms. In turn, the 1^{st}-stage instruments are the firm's own trade shocks, as well as the trade shocks to its suppliers and to the suppliers of its suppliers. Specifically, the 1^{st}-stage regression is:

$$s^{Total}_{it} = \beta_1 \cdot logM^D_{it} + \beta_2 \cdot logM^S_{it} + \beta_3 \cdot logM^{SS}_{it} + \kappa_t + \kappa_i + \epsilon_{it} \tag{11}$$

where $logM^D_{it}$, $logM^S_{it}$, and $logM^{SS}_{it}$ are the trade shocks to firm i, to firm i's suppliers, and to the suppliers of firm i's suppliers. We construct weighted averages of trade shocks in the supplier network using the recursive formulation in (8) (details in Appendix D.1).

We find that both direct trade shocks to a firm's own imports and indirect shocks to a firm's network of suppliers cause significant changes to the firm's total exposure s^{Total}_{it}, generating a strong 1^{st}-stage (Kleibergen-Paap F-statistic of 18.17).

The IV specification shows that trade causes an increase in the individual firm's effective tax rate on capital (column 5). In Panel B, the IV reveals that trade causes an increase in firm size (proxied by revenue). Panel C shows a positive OLS association between firm size and ETR^K_i (we cannot use the IV in this panel due to the exclusion restriction).

In Appendix D.1, we find that the main results are robust to controlling for trade shocks to firm i's potential suppliers (firms that operate in the same industry and geographical area as i's current suppliers but are not currently supplying to i) and horizontal suppliers (firms that are suppliers to firm i's current clients). These results provide additional support for the exogeneity assumption.[54]

Though the analysis in Rwanda is based within a single country over a limited time range, it supplements the macro-level results in two ways. First, it provides firm-level identified evidence that trade exerts a positive impact on effective corporate taxation in a developing country, which complements the country-level results in LMICs. Second, by showing that trade increases firm size and that size is positively associated with ETR^K, it supports the tax capacity mechanism interpretation that trade's impact on ETR^K is mediated by a positive size-ETR^K gradient.

Discussion: Links to trade-formality literature At the firm, sector and country level, we find positive effects of trade on outcomes related to formalization. Recent studies focused on the number of formal versus informal firms or formal versus informal workers, and found mixed evidence that trade increases formality by these measures (reviews in Engel & Kokas, 2021; Ulyssea, 2020).[55] One way to reconcile our results with these studies is to note that our focus is on the share of output produced in larger and formal firms: output expansion in these firms may occur without changes to the number of formal or informal firms, and does not imply an increase in the number of formal workers, since informal workers may work in formal firms and contribute to their output (Ulyssea, 2018). In 6.4, we also show that openness' impact on our formal-outcomes depends on the nature of the trade shock, consistent with recent theoretical work in trade (Dix-Carneiro et al., 2021).

[54] In an extension, we find that increased *output* exposure to imports through the client network has positive effects on ETR^K, though this average effect could mask heterogeneity across firms.

[55] Goldberg and Pavcnik (2003), Bosch et al. (2012), Cruces et al. (2018), Dix-Carneiro and Kovak (2019).

6.4 Sources of heterogeneity in trade's pro-tax impacts

We return to the country-level IV (equation 5) to study sources of heterogeneity in trade's pro-tax impacts on the tax capacity mechanism and ETR.

Heterogeneity: Domestic enforcement reforms Over our sample period, LMICs have implemented tax enforcement policies. A challenge for the mechanism interpretation is that trade, potentially due to revenue concerns, may have prompted governments to implement these policies that increase ETR^K. To investigate this, we measure the year of adoption (if any) in LMICs of four policies that increase domestic tax enforcement: (i) large taxpayer unit; (ii) organizational integration of customs and domestic tax authorities; (iii) VAT; (iv) international accounting standards (IAS).[56] We estimate heterogeneous IV effects by including an interaction term between trade and the policy adoption variable in (5).[57] Table A5 shows a positive effect of trade on ETR^K without these policies, though the effect is larger following their adoption. Trade has a similar impact on the corporate income-share (μ_C) with and without the enforcement policies, but trade's positive impact on $\overline{ETR}_C^K$ is significantly amplified when enforcement policies are in place.[58] That is, the trade-induced expansion of the corporate sector seems to occur regardless of enforcement policies, but the extent to which the additional corporate output translates into higher effective corporate taxation is reinforced when such policies have been enacted.[59]

Governments in LMICs may have sought to raise domestic revenue, possibly in response to openness, through other channels apart from these specific enforcement policies. We investigate this in Table A6, finding that trade's positive impact on the tax capacity mechanism and ETR^K hold outside of periods of significant revenue loss, when defined in various ways including the episodes of trade revenue loss in Cagé and Gadenne (2018). Thus, trade's pro-tax impacts appear to be broadly present in the globalization process in LMICs, and do not hinge on government's revenue need or enforcement investments.

Heterogeneity: Nature of trade shock Trade theories highlight that the impacts of trade on formality-related outcomes depend on the nature of the trade shock. In Appendix D.2, we use both instruments and equation (5) in LMICs to investigate if the ETR and

[56]The enforcement focus on large firms increases collection (Almunia & Lopez-Rodriguez, 2018; M. C. Basri, Felix, Hanna, & Olken, 2021). The customs-tax unification improves domestic audit capacity (IMF, 2022). The VAT creates information trails (Almunia, Henning, Knebelmann, Nakyambadde, & Tian, 2023; Waseem, 2020). IAS deepen accounting requirements for tax reporting (Barth et al., 2008).

[57]The timing of adoption for each reform is endogenous; however, our focus is on the trade coefficients with and without these reforms in place, which are identified (Bun and Harrison, 2019).

[58]Only the VAT was adopted in all liberalizing countries by the time of the events studied in Section 5.1.

[59]Intuitively, the enforcement policies all disproportionately raise enforcement on larger firms, thereby further increasing the slope of the ETR^K-size gradient inside the corporate sector. Whether these enforcement policies are themselves driven by globalization is a topic for future research.

mechanism impacts differ along two dimensions (Dix-Carneiro et al., 2021): imports versus exports; and, trade in intermediate versus final goods and services (G-S). We find that *exports* increase ETR^K and the corporate income-share (μ_C), while *imports* decrease both outcomes. These results are consistent with 'Melitz-type' demand effects, whereby increased exports represent a pure positive demand shock for export-oriented firms, while increased imports may constitute a negative demand shock for domestic firms, disproportionately affecting larger ones. In additional IV regressions, trade in *intermediate G-S* increases ETR^K and μ_C, while trade in *final G-S* decreases both outcomes.[60] Results are similar for $\overline{ETR}_C^K$. These results are consistent with the increased availability of intermediate goods benefiting larger firms; by contrast, the increased availability of final goods may constitute a negative domestic demand shock, particularly for larger firms. These results suggest trade's pro-tax impacts depend on the nature of the trade shock.

Heterogeneity: Developing vs developed countries We investigate if trade's impacts on mechanisms and ETR differ across development levels, by expanding our sample to include HICs. We expect that the tax capacity mechanism is less likely to operate in HICs, where enforcement constraints on effective taxation are less binding and the corporate sector's size has been stable since the 1970s (Figure 1). On the other hand, the race-to-bottom is likely to be active in HICs, given previous research (Section 2). Table A7 reports heterogeneous IV effects by augmenting (5) with an interaction between trade and a dummy for high-income countries.[61] Trade only raises ETR^K in LMICs, but raises ETR^L everywhere. The negative race-to-bottom effect on the CIT rate is much stronger in HICs than in LMICs. The positive impact of trade on tax capacity outcomes (μ_C, $\overline{ETR}_C^K$) is limited to LMICs, with null effects in HICs.[62] These results suggest countervailing mechanisms that differ by development level, through which trade may have contributed to the diverging trends in ETR^K between HICs and LMICs documented in Figure 2.

We study additional country characteristics in the supplementary appendix. We find that trade's negative impact on the CIT rate is larger in countries that are smaller and with fewer capital restrictions – two settings where capital flight concerns are more pronounced (Hines, 2006). Mirroring this result, trade's positive impact on ETR^K occurs in larger countries and with more capital restrictions. The tax capacity and race-to-bottom mechanisms therefore appear to occur simultaneously: countries with larger markets and lower capital mobility reap more of the tax-capacity benefits of trade.

[60] Which suggests that imports of intermediate (final) G-S increases (decreases) ETR_K and μ_C.

[61] We note these results should be interpreted with caution, given the econometric challenges of estimating IV effects with multiple endogenous regressors (Andrews, Stock, & Sun, 2019).

[62] The IV-coefficients for developing countries differ qualitatively between Table A7 and Tables 1-3. This is because the two instruments' strength changes in the 1^{st}-stage regression (Table A2).

Extension: Capital openness We focused on trade openness but another relevant dimension of globalization is capital openness (Ilzetzki, Reinhart, & Rogoff, 2019; Van Patten, 2022). Due to differences in reporting requirements, data on capital openness is not as available and comparable as trade data, and finding credible exogenous variation for capital openness is challenging. Notwithstanding, we try to investigate the impacts of capital openness in Appendix E. We rely on capital inflow liberalization events for 25 developing countries from Chari, Henry, and Sasson (2012), which capture the first time that foreign investment in the domestic stock market is allowed. Employing the event-study design of Section 5.1, we find that capital liberalization events raise capital openness and positively impact ETR^K and the tax capacity mechanism (μ_C, $\overline{ETR}_C^K$). The pro-tax impacts of globalization in LMICs may be robust to using capital instead of trade openness.

7 Conclusion

This paper provides evidence on long-run trends in capital taxation and causal effects of globalization. Based on a new macro-historical database, we document that effective capital tax rates have increased in developing countries in the post-1990 era of hyper-globalization. By expanding the share of economic activity in incorporated and larger firms, we find that trade improves the effective collection of taxes, particularly corporate income taxes. We provide evidence on this tax capacity effect across multiple research designs and at the country, corporate sector and firm-level. Despite a simultaneous negative effect on corporate statutory tax rates induced by international tax competition, the positive tax capacity effect is sufficiently large that trade increases the effective tax rate on capital and overall government revenues (% of GDP) in developing countries.

Due to limited data, the revenue consequences of globalization in developing countries had not been systematically investigated and policy concerns over revenue losses have persisted in a context of uncertainty surrounding the future of globalization (Goldberg & Reed, 2023). We find that globalization has pro-tax impacts that have supported the effective taxation of capital and overall revenue collection in many countries.

Our results show that openness increased the share of market income going to corporations, profits, and capital. Simultaneously, trade's pro-tax impacts mean that developing countries raised more taxes from capital. As a result, openness is likely to have widened pre-tax income inequality, but its effect on post-tax income inequality is more nuanced. We adopted a macro focus, but a next step could be to combine the ETRs with individual-level estimates of the progressivity of capital (and labor) taxes. This would allow a comparison of the distributional effects of globalization on pre versus post-tax income, raising empirical questions for future research (Goldberg, 2023; Pavcnik, 2017).

References

Abbas, A., & Klemm, A. (2013). A partial race to the bottom: Corporate tax developments in developing economies. *International Tax and Public Finance*, *20*.

Abramovsky, L., Klemm, A., & Phillips, D. (2014). Corporate tax in developing countries: Current trends and design issues. *Fiscal Studies*, *35*(4), 559–588.

Adam, A., Kammas, P., & Rodriguez, A. L. (2013). The effect of globalization on capital taxation. *Journal of Macroeconomics*, *35*.

Alesina, A., & Wacziarg, R. (1998). Openness, country size and government. *Journal of Public Economics*, *69*.

Alfaro-Ureña, A., Manelici, I., & Vasquez, J. (2022). The effects of joining multinational supply chains. *Quarterly Journal of Economics*, *137*(3).

Almunia, M., Henning, D., Knebelmann, J., Nakyambadde, D., & Tian, L. (2023). Leveraging trading networks to improve tax compliance. *Working Paper*.

Almunia, M., Hjort, J., Knebelmann, J., & Tian, L. (2023). Strategic or confused firms? Evidence from missing transactions in Uganda. *Review of Economics and Statistics*.

Almunia, M., & Lopez-Rodriguez, D. (2018). Under the radar: The effects of monitoring firms on tax compliance. *American Economic Journal: Economic Policy*, *10*(1).

Andrews, I., Stock, J., & Sun, L. (2019). Weak instruments in IV regression: Theory and evidence. *Annual Review of Economics*, *11*.

Atkin, D., & Khandelwal, A. (2020). How distortions alter the impacts of international trade in developing countries. *Annual Review of Economics*, *12*.

Bachas, P., Fattal, R., & Jensen, A. (2019). Size-dependent tax enforcement and compliance. *Journal of Development Economics*, *140*, 203–222.

Bachas, P., Brockmeyer, A., Dom, R., & Semelet, C. (2023). Effective tax rates and firm size. *Working Paper*.

Basri, C., Felix, M., Hanna, R., & Olken, B. (2019). Tax administration vs. tax rates. *NBER Working Paper*, (26150).

Basri, M. C., Felix, M., Hanna, R., & Olken, B. (2021). Tax administration versus tax rates. *American Economic Review*, *111*(12).

Baunsgaard, T., & Keen, M. (2009). Tax revenue and (or?) trade liberalization. *Journal of Public Economics*, *94*(9).

Benzarti, Y., & Tazhitdinova, A. (2021). Do value-added taxes affect international trade flows? *American Economic Journal: Economic Policy*, *13*(4), 469–89.

Bergeron, A., Tourek, G., & Weigel, J. (2024). The state capacity ceiling on tax rates. *Econometrica*, *Forthcoming*.

Bernard, A., Jensen, B., Redding, S., & Schott, P. (2007). Firms in international trade. *Journal of Economic Perspectives*, *21*(3).

Besley, T., & Persson, T. (2014). Why do developing countries tax so little? *Journal of Economic Perspectives*, *28*(4).

Best, M., Shah, J., & Waseem, M. (2021). Detection without deterrence. *Working Paper*.

Bilicka, K. A. (2019). Comparing UK tax returns of foreign multinationals to matched domestic firms. *American Economic Review*, *109*(8).

Blanchet, T., Chancel, L., Flores, I., & Morgan, M. (2021). *Distributional national accounts*.

Borusyak, K., Jaravel, X., & Spiess, J. (2021). Revisiting event study designs: Robust and efficient estimation. *Working Paper*.

Brandt, L., Biesebroeck, J. V., Wang, L., & Zhang, Y. (2017). WTO accession and performance of Chinese manufacturing firms. *American Economic Review*, *107*(9).

Buettner, T., & Madzharova, B. (2018). WTO membership and the shift to consumption taxes. *World Development*, *108*(1).

Cagé, J., & Gadenne, L. (2018). Tax revenues and the fiscal cost of trade liberalization, 1792-2006. *Explorations in Economic History*, *70*.

Carey, D., & Rabesona, J. (2004). Tax ratios on labor and capital income and on consumption. In P. B. Sørensen (Ed.), *Measuring the tax burden on capital and labor*.

Carillo, P., Pomeranz, D., & Singhal, M. (2017). Dodging the taxman: Firm misreporting and limits to tax enforcement. *American Economic Journal: Applied Economics*, *9*(2).

Chari, A., Henry, P., & Sasson, D. (2012). Capital market integration and wages. *American Economic Journal: Macroeconomics*, *4*(2).

Clausing, K. (2007). Corporate tax revenues in OECD countries. *International Tax and Public Finance*, *14*.

Cogneau, D., Dupraz, Y., Knebelmann, J., & Mesplé-Somps, S. (2021). Taxation in Africa from colonial times to present. *Working Paper*.

De Loecker, J., & Eeckhout, J. (2021). Global market power. *Working Paper*.

De Loecker, J., Goldberg, P., Khandelwal, A., & Pavcnik, N. (2016). Prices, markups and trade reform. *Econometrica*, *84*(2).

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

Devereux, M., Griffith, R., & Klemm, A. (2002). Corporate income tax: Reforms and tax competition. *Economic Policy*.

Dhyne, E., Kikkawa, A., Mogstad, M., & Tintelnot, F. (2021). Trade and domestic production networks. *Review of Economic Studies*, *88*(2).

Dix-Carneiro, R., Goldberg, P., Meghir, C., & Ulyssea, G. (2021). Trade and informality in the presence of labor market frictions and regulations. *NBER Working Paper*.

Dyreng, S. D., Hanlon, M., Maydew, E. L., & Thornock, J. R. (2017). Changes in corporate effective tax rates over 25 years. *Journal of Financial Economics*, *124*(3).

Egger, P., Nigai, S., & Strecker, N. (2019). The taxing deed of globalization. *American Economic Review*, *109*(2).

Engel, J., & Kokas, D. (2021). The distributional impacts of trade. *Working Paper*.

Felix, M. (2022). Trade, labor market concentration, and wages. *Working Paper*.

Fieler, A., Eslava, M., & Xu, D. (2018). Trade, quality upgrading and input linkages: Theory and evidence from Colombia. *American Economic Review*, *108*(1).

Fisman, R., & Wei, S.-J. (2004). Tax rates and tax evasion: Evidence from "missing imports" in China. *Journal of Political Economy*, *112*(2).

Fisunoglu, A., Kang, K., Arbetman-Rabinowitz, M., & Kugler, J. (2011). Relative political capacity dataset. Version 2.4. Harvard Dataverse.

Garcia-Bernardo, J., Janský, P., & Tørsløv, T. (2022). Decomposing multinational corporations declining effective tax rates. *IMF Economic Review*, *70*(2).

Goldberg, P. (2023). *The unequal effects of globalization*. MIT Press.

Goldberg, P., & Pavcnik, N. (2007). Distributional effects of globalization in developing countries. *Journal of Economic Literature*, *45*(1).

Goldberg, P., & Pavcnik, N. (2016). The effects of trade policy. *NBER Working Paper*.

Goldberg, P., & Reed, T. (2023). Is the global economy deglobalizing? *Brookings Paper on Economic Activity*.

Gollin, D. (2002). Getting income shares right. *Journal of Political Economy*, *110*(2).

Griffith, R., & Miller, H. (2014). Taxable corporate profits. *Fiscal Studies*, *35*.

Guerriero, M. (2019). Labor share of income around the world. *Working Paper*.

Gupta, A. (2023). Demand for quality, variable markups and misallocation: Evidence from India. *Working Paper*.

Hines, J. (2006). Corporate taxation and international competition. *Working Paper*.

Hummels, D., Jørgensen, R., Munch, J., & Xiang, C. (2014). The wage effects of offshoring. *American Economic Review*, *104*(6).

ILO. (2019). *The global labour income share and distribution*. Intl. Labor Organization.

Ilzetzki, E., Reinhart, C., & Rogoff, K. (2019). Exchange arrangements entering the twenty-first century. *Quarterly Journal of Economics*, *134*(2).

IMF. (2014). Spillovers in international corporate taxation. *IMF Staff Report*.

Javorcik, B. (2004). Does foreign direct investment increase the productivity of domestic firms? *American Economic Review*, *94*(3).

Javorcik, B., & Narciso, G. (2017). WTO accession and tariff evasion. *Journal of Development Economics*, *125*, 59–71.

Jensen, A. (2022). Employment structure and the rise of the modern tax system. *American Economic Review*, *112*(1).

Karabarbounis, L., & Neiman, B. (2014). The global decline of the labor share. *Quarterly Journal of Economics*, *129*(1).

Kleven, H., Kreiner, C., & Saez, E. (2016). Why can modern governments tax so much? *Economica*, *83*(330).

Kleven, H., Knudsen, M., Kreiner, C., Pedersen, S., & Saez, E. (2011). Unable or unwilling to cheat? Evidence from a tax audit experiment. *Econometrica*, *79*(3).

Kopczuk, W., & Slemrod, J. (2006). Putting firms into optimal tax theory. *American Economic Review*, *96*(2).

Kostarakos, I., & Varthalitis, P. (2020). Effective tax rates in the EU. *Working Paper*.

Kugler, M., & Verhoogen, E. (2009). Plants and imported inputs: New facts and an interpretation. *American Economic Review*, *99*(12).

Kumar, M. M. S., & Quinn, M. D. P. (2012). *Globalization and corporate taxation*. International Monetary Fund.

Kumar, R., & James, S. (2022). World Bank global marginal effective tax rate database report. *World Bank Technical Report*.

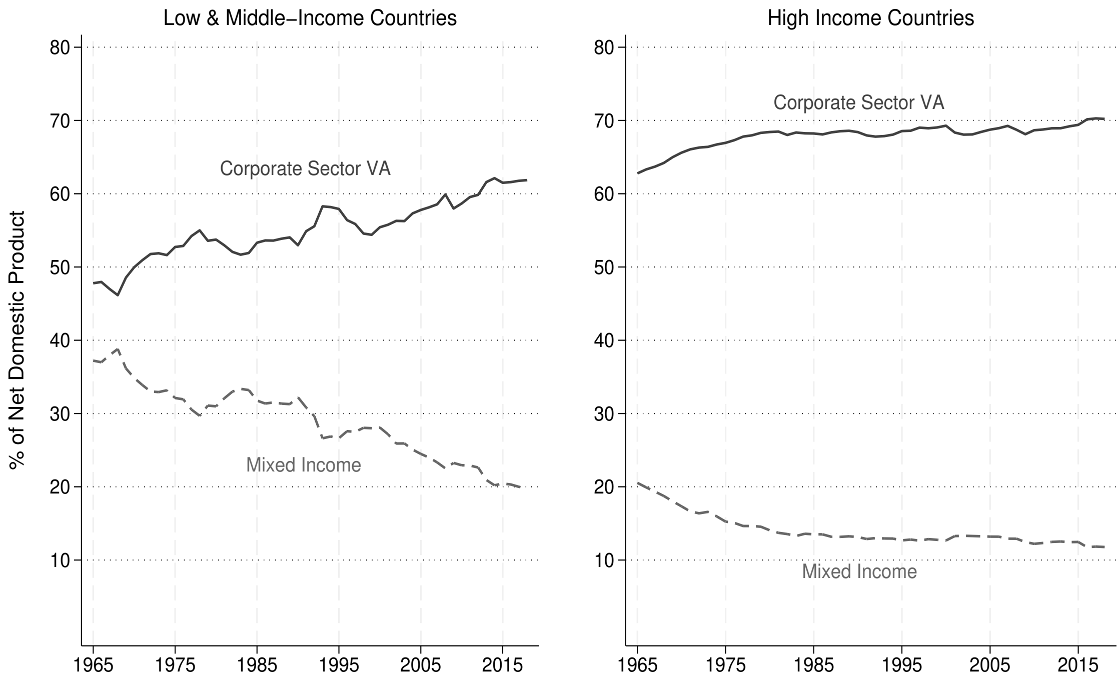
Londoño-Vélez, J., & Tortarolo, D. (2022). Revealing 21% of GDP in hidden assets: Evidence from Argentina's tax amnesties. *UNU WIDER Working Paper*, (103).

McCaig, B., & Pavcnik, N. (2018). Export markets and labor allocation in a low-income country. *American Economic Review*, *108*(7).

McDaniel, C. (2007). Average tax rates on consumption, investment, labor and capital in the OECD 1950-2003. *Working Paper*.

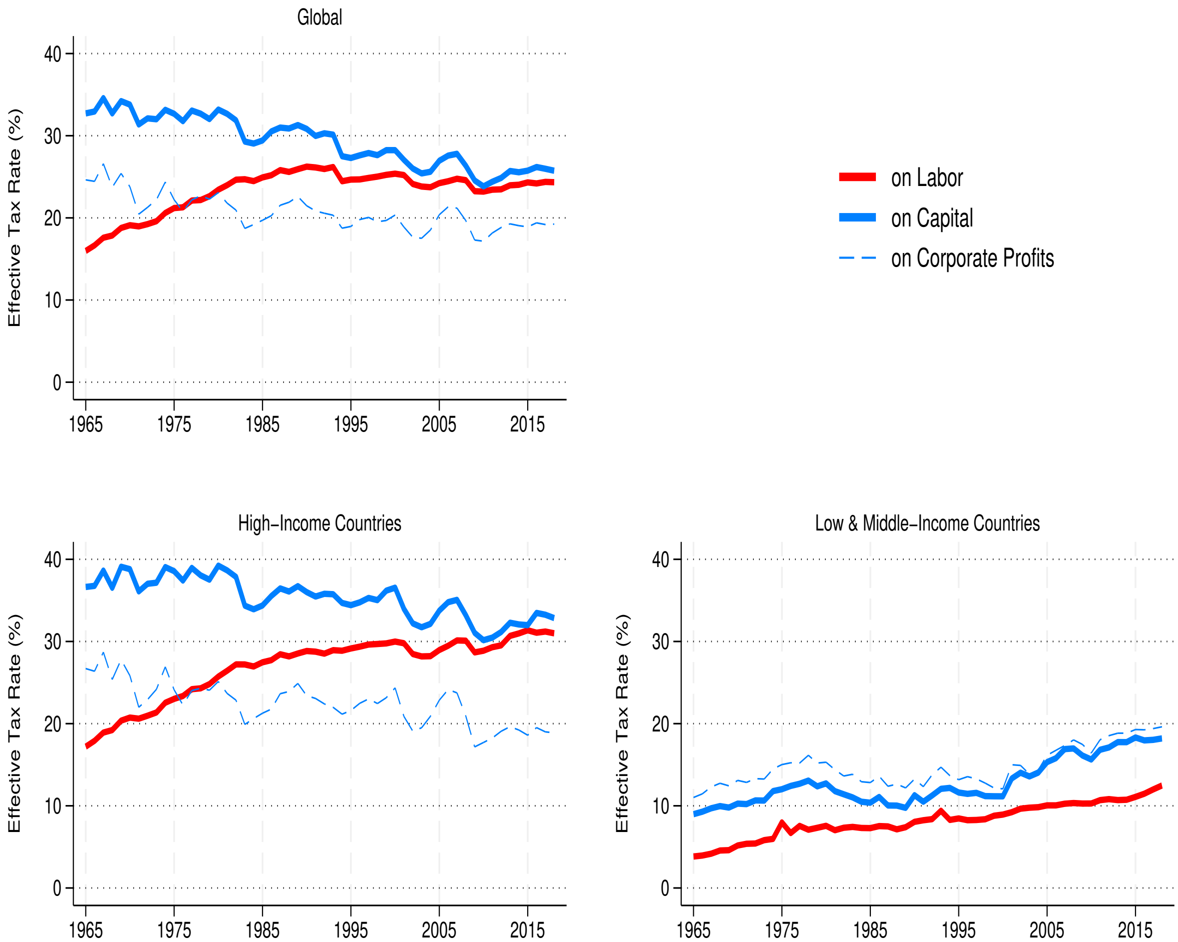
McDaniel, C. (2020). Average tax rates on consumption, investment, labor and capital in the OECD 1995-2018. *Working Paper*.
Méndez, E., & Van Patten, D. (2022). Multinationals, monopsony, and local development. *Econometrica*, *90*(6).
Mendoza, E. G., Razin, A., & Tesar, L. L. (1994). Effective tax rates in macroeconomics. *Journal of Monetary Economics*, *34*(3).
Mrázová, M., & Neary, P. (2018). Selection effects with heterogeneous firms. *Journal of European Economic Association*, *17*.
Naritomi, J. (2019). Consumers as tax auditors. *American Economic Review*, *109*(9).
Parenti, M. (2018). Large and small firms in a global market: David vs. Goliath. *Journal of International Economics*, *110*.
Pavcnik, N. (2017). The impact of trade on inequality in developing countries. *Proceedings of Jackson Hole Economic Symposium*.
Piketty, T., Saez, E., & Zucman, G. (2018). Distributional national accounts. *Quarterly Journal of Economics*, *133*(2).
Piketty, T., Yang, L., & Zucman, G. (2019). Capital accumulation, private property, and rising inequality in China. *American Economic Review*, *109*(7).
Pomeranz, D. (2015). No taxation without information. *American Economic Review*.
Quinn, D. (1997). The correlates of change in international financial regulation. *American Political Science Review*, *91*(3), 531–551.
Rodrik, D. (1998). Why do more open economies have bigger governments? *Journal of Political Economy*, *106*(5).
Sequeira, S. (2016). Corruption, trade costs, and gains from tariff liberalization: Evidence from Southern Africa. *American Economic Review*, *106*.
Slemrod, J. (2004). Are corporate tax rates, or countries, converging? *Journal of Public Economics*, *88*(6), 1169–1186.
Slemrod, J., & Velayudhan, T. (2018). Do firms remit at least 85% of tax everywhere? New evidence from India. *Journal of Tax Administration*, *4*(1).
Sørensen, P. (2007). Can capital income taxes survive? *CESifo Economic Studies*, *53*.
Steinmüller, E., Thunecke, G. U., & Wamser, G. (2019). Corporate income taxes around the world. *International Tax and Public Finance*, *26*, 418–456.
Ulyssea, G. (2018). Firms, informality, and development. *American Economic Review*.
Ulyssea, G. (2020). Informality: Causes and consequences for development. *Annual Review of Economics*, *12*.
Van Patten, D. (2022). The dismantling of capital controls after Bretton Woods and Latin American productivity. *AEA Papers and Proceedings*, *112*.
Wacziarg, R., & Wallack, J. (2004). Trade liberalization and intersectoral labor movements. *Journal of International Economics*, *64*.
Wacziarg, R., & Welch, K. H. (2008). Trade liberalization and growth: New evidence. *World Bank Economic Review*, *22*(2), 187–231.
Waseem, M. (2020). The role of withholding in the self-enforcement of a value-added tax. *Review of Economics and Statistics*, *104*(2).
Wier, L. (2020). Tax-motivated transfer mispricing. *Journal of Public Economics*.
World Bank. (2008). *Public finance in China* (J. Lou & S. Wang, Eds.). WB Group.
World Bank. (2020). *The African continental free trade area: Economic effects*. WB Group.

Figure 1: Corporate Sector Income and Mixed Income (1965-2018)



Notes: These panels plot the time series of corporate sector income and of mixed income between 1965 and 2018 by level of development, from national accounts statistics. Both outcomes are expressed as a percent of net domestic product and weighted by countries' net domestic product in constant 2010 USD. Corporate income is the sum of corporate profits and corporate employee compensation. Mixed income accounts for income from self-employed and unincorporated businesses. The left panel show the results for low and middle-income countries (N=117), and the right panel show the results for high income countries (N=37), based on the World Bank income classification in 2018.

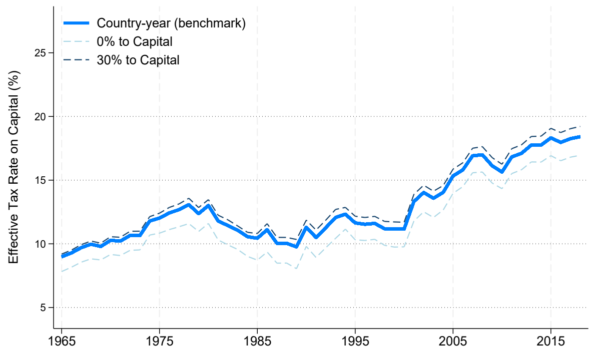
Figure 2: Effective Taxation of Capital and Labor (1965-2018)



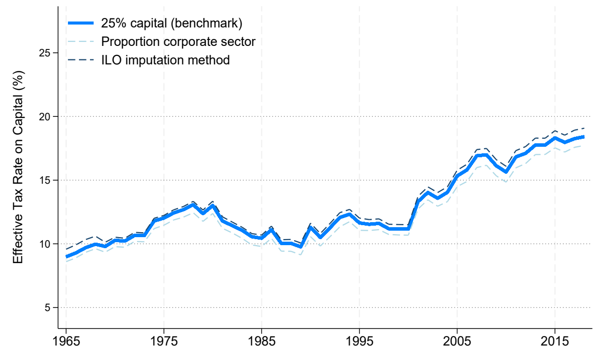
Notes: This figure plots the time series of average effective tax rates on labor (red) and capital (blue), as well as the average effective tax rate on corporate profits (blue dashed line). The top-left panel corresponds to the global average, weighting country-year observations by their share in that year's total factor income, in constant 2019 USD (N=154). The bottom-left panel shows the results for high-income countries (N=37), and the bottom-right panel for low- and middle-income countries (N=117). Income classification is based on the World Bank income groups in 2018. The dataset is composed of two quasi-balanced panels. The first covers the years 1965-1993 and excludes communist regimes. It accounts for 85-90% of world GDP during those years. The second covers 1994-2018 and integrates former communist countries, in particular China and Russia, and accounts for 97-98% of world GDP. This figure is discussed in Section 4.1.

Figure 3: Robustness of Effective Capital Taxation in Developing Countries

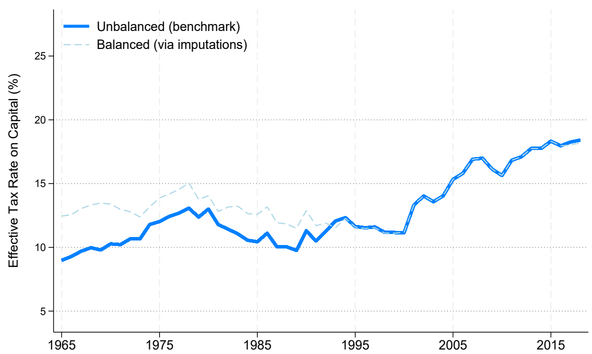
(a) PIT revenue allocation



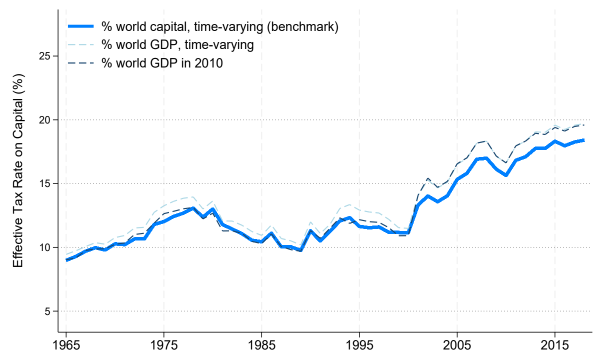
(b) Mixed-income allocation



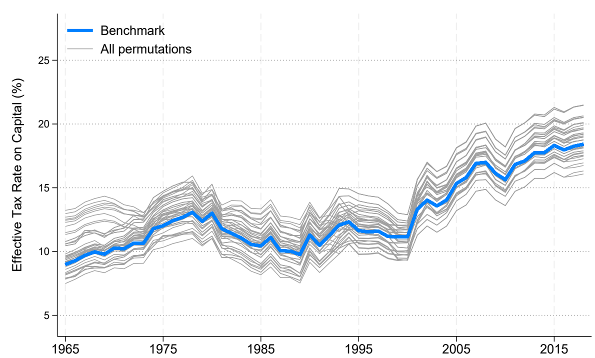
(c) Panel balancedness



(d) Weights for aggregation



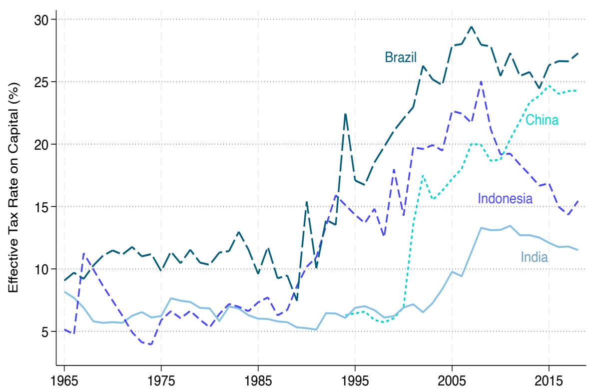
(e) All 54 combinations



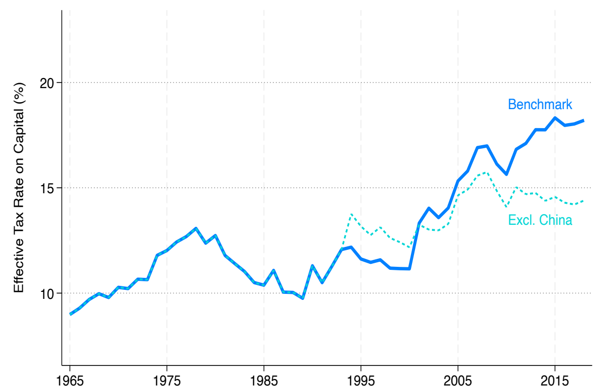
Notes: These panels show trends in the effective tax rate on capital in the 117 developing countries in our sample. The panels vary our four key methodological choices: the allocation of personal income tax revenue to capital vs labor (panel a); the allocation of mixed income to capital vs labor (panel b); presenting results for an unbalanced panel of countries vs a balanced panel via imputations (panel c); and, the use of weights to aggregate individual countries' time-series (panel d). Panel (e) shows all 54 possible combinations that can be constructed by combining these choices. In all panels, the blue line corresponds to our benchmark series. Developing countries are low and middle-income countries according to the World Bank income classification in 2018. This figure is discussed in Section 4.2.

Figure 4: Heterogeneity of Effective Capital Taxation in Developing Countries

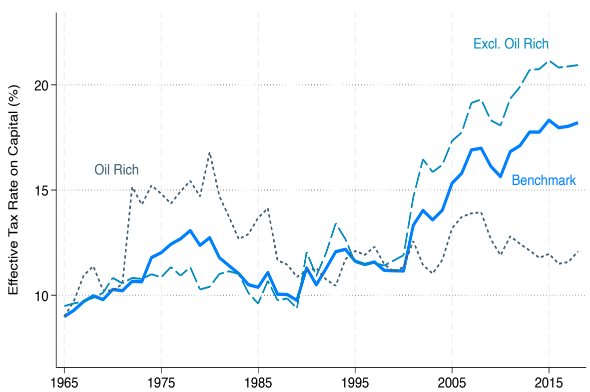
(a) Four largest countries



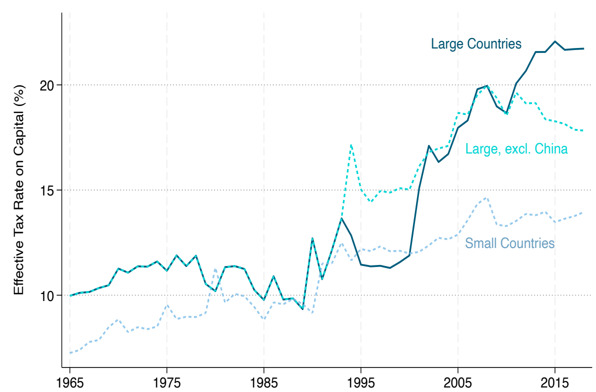
(b) Excluding China



(c) Oil Rich Countries



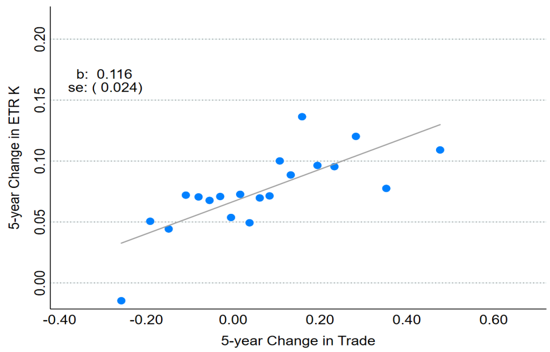
(d) Large vs small countries (non-oil rich)



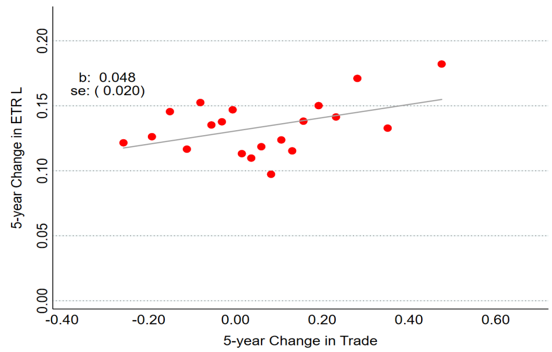
Notes: These panels show the evolution of the effective tax rate on capital, ETR_K, for major developing countries and sub-samples of developing countries. Developing countries are low and middle-income countries according to the World Bank income classification in 2018. Panel (a) plots the ETR_K series for the four largest (most populous) developing countries: Brazil, China, India, Indonesia. Panel (b) compares our benchmark series to the series that excludes China. Panel (c) plots the ETR_K series for a sample of oil-rich countries (countries with more than 7% of GDP from oil in 2018), and the benchmark ETR_K series without these countries. Within the sample of non-oil rich developing countries, panel (d) compares large countries to small countries. Large countries are defined as having a population above 40 million in 2018. This figure is discussed in Section 4.3.

Figure 5: Within-Country Associations between Effective Tax Rates and Trade

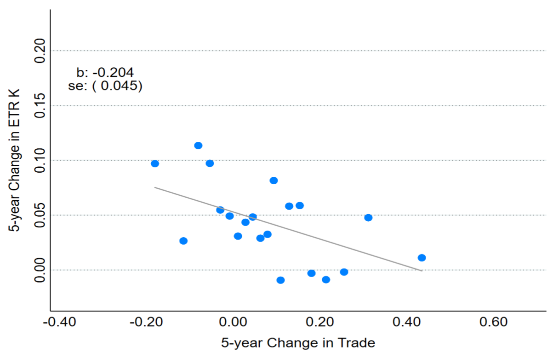
(a) ETR_K: All countries



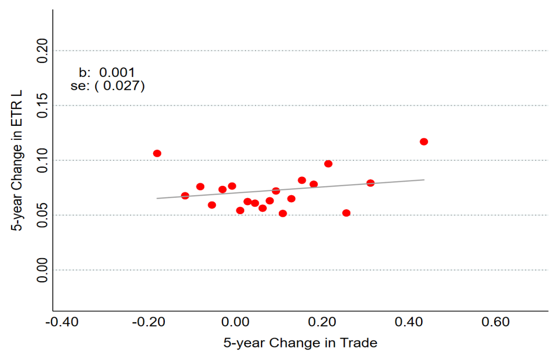
(b) ETR_L: All countries



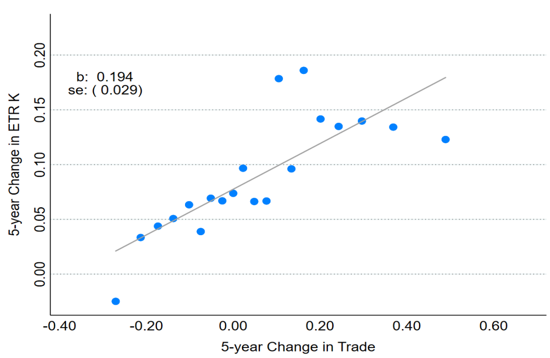
(c) ETR_K: High-income



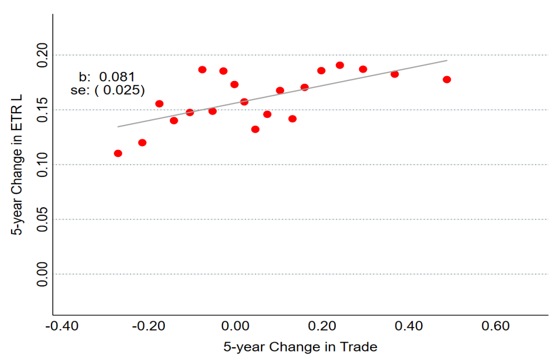
(d) ETR_L: High-income



(e) ETR_K: Low & middle-income

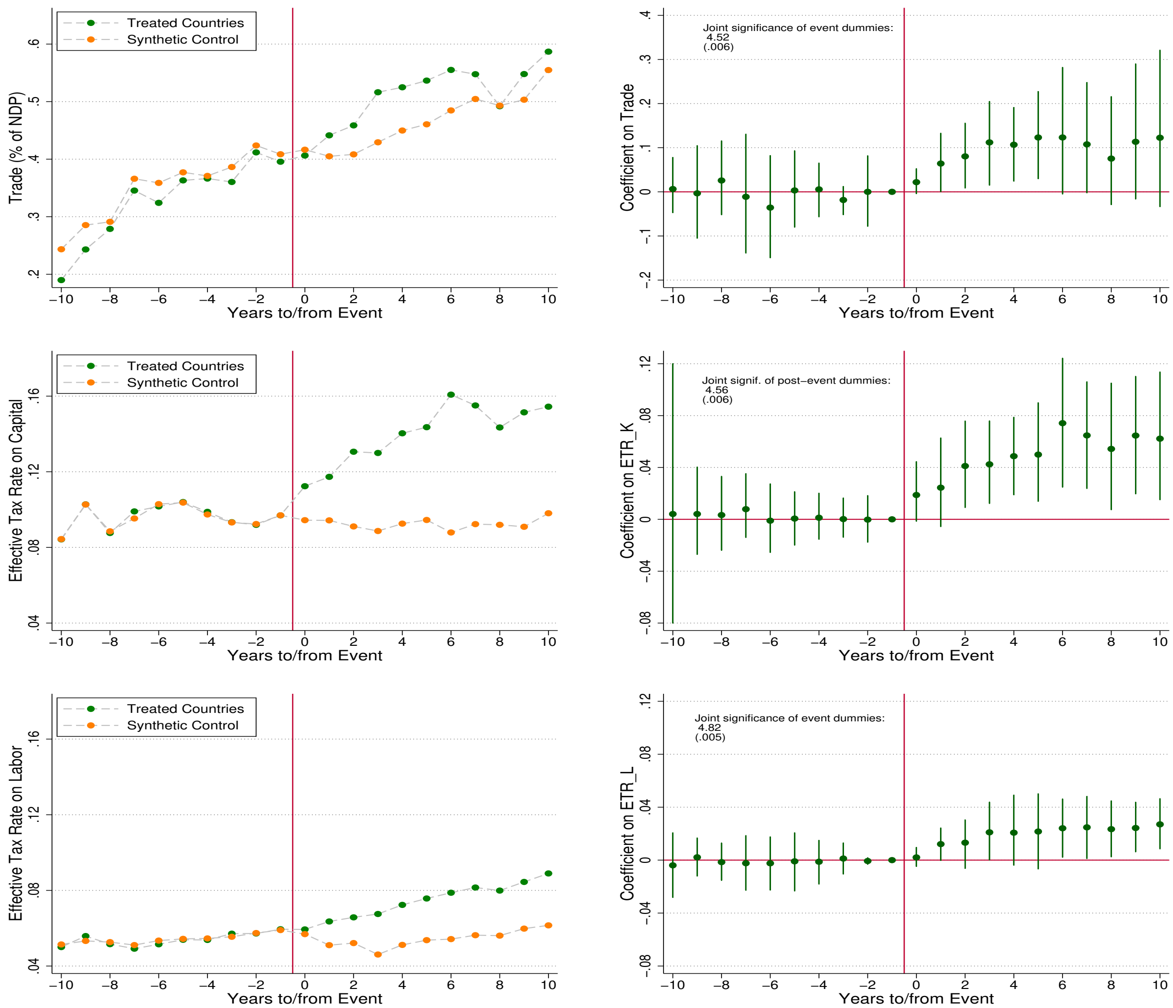


(f) ETR_L: Low & middle-income



Notes: These panels shows the association between trade and effective tax rates. The outcome is the effective tax rate on capital, ETR_K, and on labor, ETR_L, in the left-side and right-side panels, respectively. The top panels show the associations in all countries; the middle panels show the associations in high-income countries (based on World Bank income classification in 2018); the bottom panels show the associations in low and middle-income countries. Trade is measured as the sum of import and exports as a share of net domestic product. Both the x-axis and y-axis are measured as within-country percent changes over 5 years. Each graph shows binned scatter plots of each outcome against trade, after residualizing all variables against year-fixed effects. Each dot corresponds to a ventile (20 equal-sized bins) of the residualized trade variable, with average values of trade and ETR calculated by ventile. In each graph, the line represents the best linear fit based on the underlying country-year data, with the corresponding slope coefficient and standard error reported in the top-left corner. For more details, see Section 4.4.

Figure 6: Event Study of Trade Liberalization Reforms



Notes: These figures show event-studies for trade liberalization in seven large developing countries: Argentina, Brazil, China, Colombia, India, Mexico and Vietnam. The panels correspond to different outcomes: trade (top panels); effective tax rate on capital (middle panels); effective tax rate on labor (bottom panels). The left-side graphs show the average level of the outcome in every year to/since the event for the treated group and for the group of synthetic control countries. The right-hand graphs show the β_e coefficients on the to/since dummies, based on estimating the dynamic event-study regression in equation (4). The bars represent the 95% confidence intervals. Standard errors are clustered at the country-event level and estimated with the wild bootstrap method. The top-left corners report the F-statistic on the joint significance of the post-event dummies, with the p-value in parentheses. Details on methodology in Section 5.1.1.

Table 1: Trade Impacts on Effective Taxation of Capital and Labor in Developing Countries

	Benchmark		Robustness: Specification and covariates					Robustness: $K-L$ assignment to taxes and factor shares				Robustness: Individual instruments	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Panel A: ETR_K													
Trade	0.048***	0.151***	0.135***	0.211*	0.141**	0.136***	0.159***	0.161***	0.140***	0.147***	0.158***	0.148***	0.277***
	(0.013)	(0.047)	(0.037)	(0.121)	(0.055)	(0.044)	(0.046)	(0.052)	(0.045)	(0.045)	(0.047)	(0.047)	(0.095)
Panel B: ETR_L													
Trade	0.009*	0.047***	0.052***	0.059	0.037*	0.048***	0.049***	0.048***	0.051***	0.049***	0.042***	0.044***	0.214***
	(0.005)	(0.016)	(0.016)	(0.043)	(0.019)	(0.016)	(0.016)	(0.016)	(0.017)	(0.016)	(0.015)	(0.016)	(0.067)
Specification	OLS	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV	IV
1^{st} stage Kleibergen-Paap F-statistic		24.59	24.59	34.51	14.14	23.24	34.84	24.59	24.59	24.59	24.59	45.13	10.75
Modifications to IV in col. (2)			ETR winsorize	NDP weights	Include country-year controls	Include **1**(oil-rich)*year fixed effects	Winsorize trade	Assign based on ILO (2019)	Assign based on corp. K-share	Assign 0% of PIT to capital	Assign 30% of PIT to capital	Only use $Z^{gravity}$ instrument	Only use $Z^{Oil-Dist}$ instrument
N	4916	4916	4916	4916	3938	4916	4916	4916	4916	4916	4916	4916	4916

Notes: This table presents results from estimating the effect of trade on effective tax rates in developing countries. Developing countries are low and middle-income countries according to the World Bank income classification in 2018. The outcome is the effective tax rate on capital, ETR_K, in Panel A and the effective tax rate on labor, ETR_L, in Panel B. Trade is measured as the sum of exports and imports divided by net domestic product (NDP). Column (1) presents the OLS results from estimating equation (5). All other columns use IV; at the bottom of each column, we report the 1^{st}-stage Kleibergen-Paap F-statistic. The benchmark IV specification is in column (2), with the corresponding 1^{st}-stage regression reported in Table A2. The remaining columns modify the benchmark specification of column (2). In column (3), the outcome is non-winsorized, while in column (4) we include country-year NDP weights. In column (5), we include the country-year controls described in Section 5.2.1. In column (6), we include interactive fixed effects between a dummy for oil-rich countries and year dummies. Oil-rich countries derive more than 7% of GDP from oil in 2018. In column (7), we use the trade variable which is winsorized at the 5%-95% percentile on a yearly basis. In columns (8)-(9), we modify the assignment rule for mixed income's capital factor share, respectively by using the ILO (2019) method and by assigning the capital share in the corporate sector. In columns (10)-(11), we assign respectively 0% and 30% of personal income taxes (PIT) to capital taxes. In columns (12)-(13), we estimate the IV using the individual instruments $Z^{gravity}$ and $Z^{oil-distance}$, respectively. For more details, see Section 5.2. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table 2: Trade Impacts on Types of Taxes (% of NDP) in Developing Countries

	Total taxes (1)	CIT (2)	Property and Wealth (3)	PIT (4)	Social Security (5)	Indirect (6)
Panel A: OLS						
Trade	0.036***	0.021***	-0.001	0.003*	0.001	0.010
	(0.011)	(0.003)	(0.001)	(0.002)	(0.001)	(0.006)
Panel B: IV						
Trade	0.101***	0.053***	0.004	0.011**	0.013**	0.018
	(0.033)	(0.014)	(0.003)	(0.005)	(0.006)	(0.023)
1^{st}-stage Kleibergen-Papp F-statistic	24.59	24.59	24.59	24.59	24.59	24.59
N	4916	4916	4916	4916	4916	4916

Notes: This table shows the impacts of trade on collection of types of taxes, expressed as a percent of net domestic product (NDP), in developing countries. OLS results are in Panel A and IV results are in Panel B. Developing countries are low and middle-income countries according to the World Bank income classification in 2018. Trade is measured as the sum of exports and imports divided by NDP. All regressions in Panel B are based on the IV model described in Section 5.2. At the bottom of each column, we report the 1^{st}-stage Kleibergen-Paap F-statistic. The corresponding 1^{st}-stage regression is reported in Table A2. The outcome differs across columns: Column (1) is total taxes, which is the sum of direct taxes on capital and labor and indirect taxes on trade and domestic consumption; column (2) is corporate income taxes (CIT); column (3) is taxes on property, wealth and inheritance; column (4) is personal income taxes (PIT); column (5) is social security and payroll; column (6) is indirect taxes, which combines trade taxes and domestic consumption taxes. For more details on these types of taxes, see Table B2 and Appendix B.1. For more details on the IV, see Section 5.2. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table 3: Trade Impacts on Mechanism Outcomes in Developing Countries

		National income components					Factor shares	
	First-diff. CIT rate (1)	Corporate totl. income (2)	Household mixed income (3)	Corporate profits (4)	Employee compensation (5)	Corporate ETR_K (6)	Capital share natl. income (7)	Capital share corp. sector (8)
Panel A: OLS								
Trade	-0.003***	0.038***	-0.016	0.026***	0.006	0.074***	0.020**	0.029**
	(0.001)	(0.013)	(0.011)	(0.009)	(0.011)	(0.019)	(0.008)	(0.012)
Panel B: IV								
Trade	-0.012*	0.179***	-0.184***	0.176***	-0.014	0.163**	0.150***	0.192***
	(0.007)	(0.044)	(0.041)	(0.035)	(0.036)	(0.075)	(0.034)	(0.050)
1^{st} stage Kleibergen-Paap F-Statistic	24.59	24.59	24.59	24.59	24.59	24.59	24.59	24.59
N	4916	4916	4916	4916	4916	4916	4916	4916

Notes: This table presents results from estimating the effects of trade on mechanism outcomes in developing countries. Developing countries are low and middle-income countries according to the World Bank income classification in 2018. Trade is measured as the sum of exports and imports divided by net domestic product (NDP). Panel A presents OLS results and Panel B presents the IV results, based on the instruments described in Section 5.2. At the bottom of each column in Panel B, we report the 1^{st}-stage Kleibergen-Paap F-statistic. Across the columns, the outcome differs: column (1) is the first-differenced statutory corporate income tax (CIT) rate; column (2) is the corporate income share of net domestic product, where corporate income is the sum of corporate profits and corporate employee compensation; column (3) is the mixed income share of net domestic product; column (4) is the corporate profit share of net domestic product; column (5) is the employee compensation share of net domestic product; column (6) is the average effective tax rate on corporate profits; column (7) is the capital share of net domestic product; column (8) is the capital share of corporate income. For sake of space, we omit showing the insignificant impact of trade on OS_{HH}, the remaining component of national income. For more details on the outcomes, see Section 3.1 and Section 6.2. For more details on the instrumental variables, see Section 5.2. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table 4: Firm-Level Regressions in Rwanda: ETR^K, Trade and Size

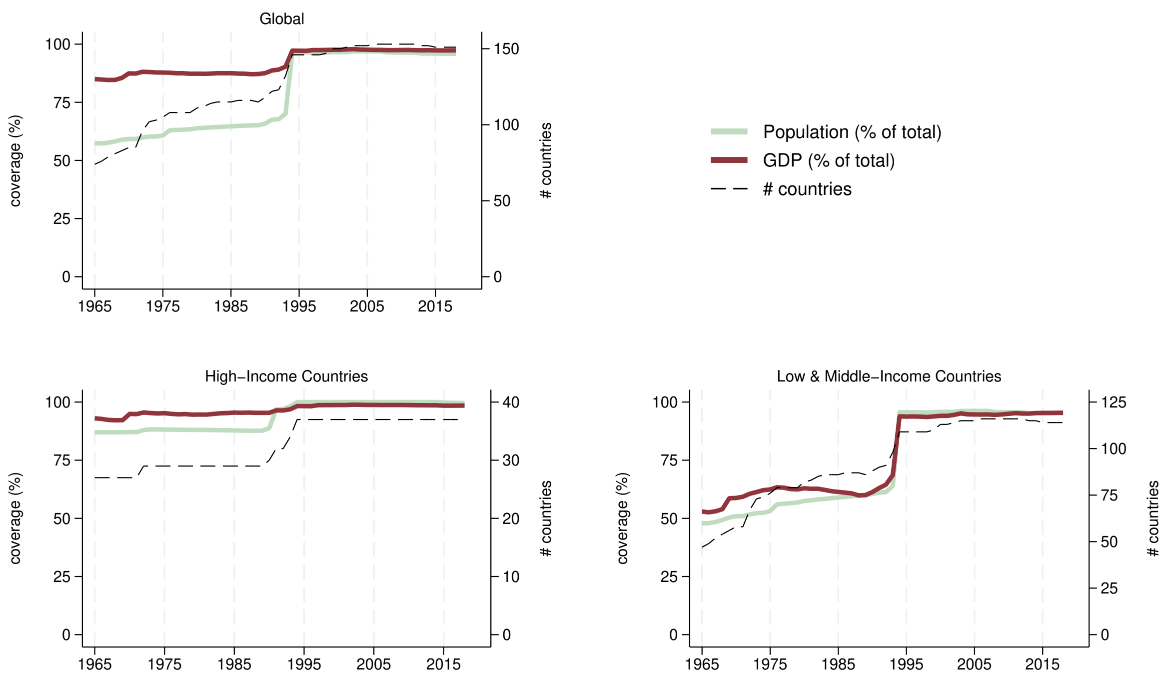
	(1)	(2)	(3)	(4)	(5)
Panel A outcome: ETR^K					
S^{Total}	0.100***	0.087***	0.075***	0.025*	0.133**
	(0.021)	(0.017)	(0.017)	(0.014)	(0.060)
Panel B outcome: Log revenue					
S^{Total}	1.362***	1.351**	1.078**	0.202*	1.444***
	(0.466)	(0.542)	(0.475)	(0.107)	(0.233)
Panel C outcome: ETR^K					
Log revenue	0.040*	0.092***	0.077**	0.029***	-
	(0.023)	(0.029)	(0.027)	(0.003)	-
Estimation	OLS	OLS	OLS	OLS	IV
1^{st}-stage Kleibergen-Paap F-statistic					18.17
Year FEs	Y	Y	Y	Y	Y
Industry-Geography FEs		Y	Y		
Firm controls			Y	Y	Y
Firm FEs				Y	Y
N	18478	18478	18478	18478	18478

Notes: This table presents firm-level regression results from corporate firms in Rwanda between 2015 and 2017. The outcome differs across panels: Panels A) and C) is the effective tax rate on corporate profits, ETR_i^K; Panel B) is log of annual revenue. In Panels A) and B), the reported regression coefficient is for total foreign input share, S^{Total}; in Panel C), it is for log annual revenue. Columns (1)-(4) present OLS results from estimating variations of equation (9): Column (1) includes year fixed effects; column (2) adds industry-geography fixed effects; column (3) adds firm-year controls (number of employees and total number of clients and suppliers); column (4) adds firm fixed effects. Column (5) is the IV estimation where the total foreign input share (S^{Total}) is instrumented with trade-shocks to firms and their supplier network based on the shift-share design of Hummels, Jørgensen, Munch, and Xiang (2014). The instruments are described in detail in Section 6.3 and Appendix D.1. In column (5), we also report the 1^{st}-stage Kleibergen-Paap F-statistic from estimating the 1^{st}-stage in equation (11). Details on the sample are provided in Appendix D.1. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the industry-geography level in columns (1)-(3), and at the firm-level in columns (4)-(5) (results are robust to clustering at firm-level in all columns).

Appendix

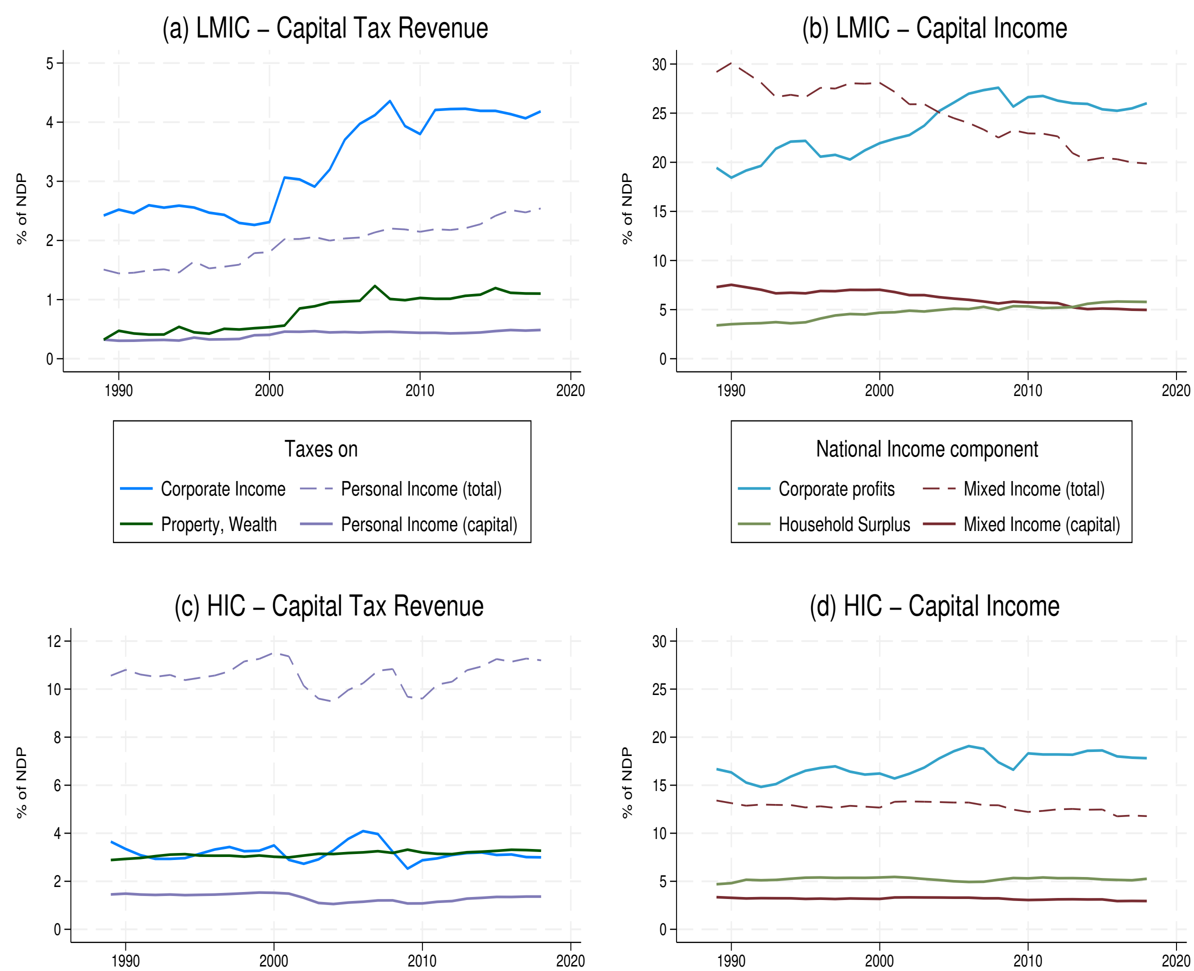
Appendix A Additional Figures and Tables

Figure A1: Data Coverage of Effective Tax Rates



Notes: These panels show the coverage of our effective tax rate data between 1965 and 2018 at the global level (top left panel), in high income countries (bottom left panel), and in low- and middle-income countries (bottom right panel). Low, middle and high-income countries are based on the World Bank income classification in 2018. The solid lines plot the percent of total population and GDP that are covered in our data (left axis). The dashed lines show the number of countries in the data (right axis). The dataset is composed of two quasi-balanced panels. The first covers the years 1965-1993 and excludes communist regimes. The second covers 1994-2018 and integrates former communist countries, in particular China and Russia. See Section 3.3 for more details.

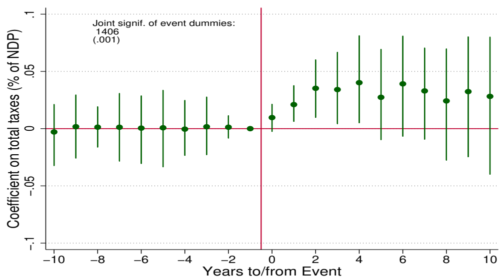
Figure A2: Evolution of ETR_K Components since 1989



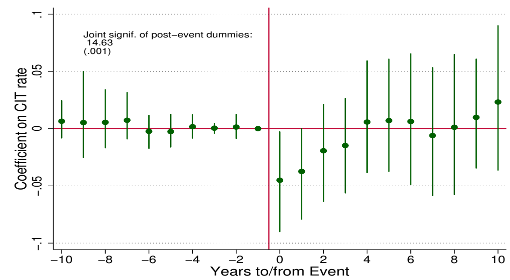
Notes: These panels show the evolution of the components of ETR_K between 1989 and 2018. This period is selected to match the period of rising ETR_K in low and middle-income countries (LMICs). The left-hand side panels correspond to the taxes on capital (numerator of ETR_K): corporate income taxes; taxes on property, wealth and inheritance; and the share of personal income taxes allocated to capital (including capital gains and dividends). The right-hand side panels correspond to the national income components attributed to capital (denominator of ETR_K): corporate profits; operating surplus of households (rents); and the share of mixed-income attributed to capital. The top panels are for LMICs, while the bottom panels are shown, as comparison, for high-income countries (HICs). Series are weighted by countries' national domestic product in 2010. The tax revenue data between 1989-1993 for former command economies (e.g. China, Russia) is missing, and is imputed by assigning the 1994 values 5 years backward. LMICs and HICs are defined according to the World Bank income classification in 2018. This figure is discussed in Section 4.1.

Figure A3: Mechanism Impacts in Trade Liberalization Event Studies

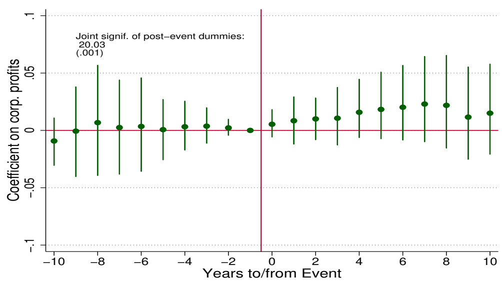
(a) Total taxes (% of NDP)



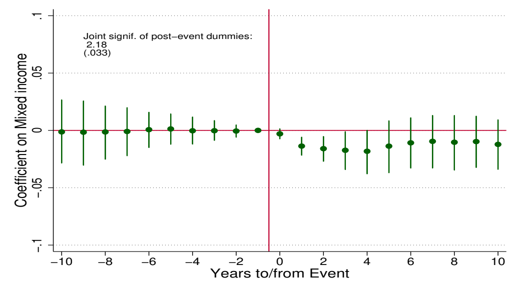
(b) Corp. income tax rate (first-diff.)



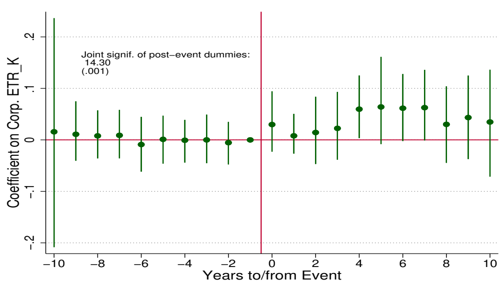
(c) Corporate income (% of NDP)



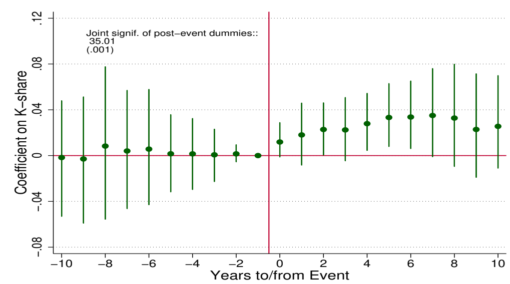
(d) Mixed income (% of NDP)



(e) Corporate ETR_K



(f) Capital income (% of NDP)



Notes: These panels show the impacts of the trade liberalization events on total taxes collected and mechanism outcomes. The panels are constructed using the method in Section 5.1, and similarly to Figure 6. Across panels, the outcome differs: panel a) is total tax revenue, as a percent of net domestic product (NDP); panel b) is the first-differenced statutory corporate income tax rate; panel c) is the corporate income share of net domestic product, where corporate income is the sum of corporate profits and employee compensation; panel d) is the mixed income share of net domestic product; panel e) is the average effective tax rate on corporate profits; panel f) is the capital share of net domestic product. In each panel, the top-left corner reports the F-statistic for the joint significance of post-event dummies, with the p-value reported in parentheses.

Table A1: Synthetic Difference-in-Difference of Trade Liberalization

	Trade	ETR_K	ETR_L
	(1)	(2)	(3)
Panel A: *Synthetic control for each outcome separately*			
Post*Treat	0.064	0.045***	0.020**
	(0.047)	(0.015)	(0.009)
Imputed treatment effect	0.070*	0.047***	0.020***
	(0.039)	(0.009)	(0.005)
Panel B: *Synthetic control for all outcomes jointly*			
Post*Treat	0.092*	0.033*	0.012
	(0.044)	(0.016)	(0.008)
Imputed treatment effect	0.101***	0.033***	0.012***
	(0.028)	(0.006)	(0.004)
Panel C: *Donor pool excluding major trading partners*			
Post*Treat	0.073	0.047***	0.018**
	(0.055)	(0.015)	(0.008)
Imputed treatment effect	0.082**	0.048***	0.018***
	(0.035)	(0.009)	(0.004)
Panel D: *Donor pool restricted to not-yet liberalized*			
Post*Treat	0.054	0.054***	0.013
	(0.058)	(0.014)	(0.008)
Imputed treatment effect	0.062*	0.054***	0.013***
	(0.034)	(0.009)	(0.005)
Panel E: *Donor pool restricted to same region*			
Post*Treat	0.049	0.034*	0.007
	(0.060)	(0.019)	(0.008)
Imputed treatment effect	0.058*	0.035***	0.017***
	(0.031)	(0.012)	(0.005)
Panel F: *Donor pool restricted to LMICs*			
Post*Treat	0.076	0.040**	0.016*
	(0.052)	(0.016)	(0.009)
Imputed treatment effect	0.085**	0.041***	0.016***
	(0.034)	(0.008)	(0.005)
N	294	294	294

Notes: This table shows the results from estimating the difference-in-difference effect and the imputed treatment effect - see Appendix C.2 for details. In Panel A, the synthetic control is created separately for each outcome (trade, ETR_K, ETR_L) and each liberalization country-event. In Panel B, the synthetic control is created for all three outcomes jointly for each country-event. In Panel C, the donor pool for each country-event excludes the 5 major import and export trading partners of the country, measured in terms of total volume of trade in the year immediately preceding liberalization. In Panel D, the donor pool excludes all countries that have already liberalized by the time of the event (based on Wacziarg & Welch, 2008). In Panel E, the donor pool is restricted to countries in the same region. In Panel F, the donor pool is all low and middle-income countries (LMICs), based on the World Bank income classification in 2018.* p<0.10 ** p<0.05 *** p<0.01.

Table A2: First-Stage and Reduced Form Regressions

	1^{st}-stage	Reduced form		1^{st}-stage		Reduced form	
	Trade	ETR_K	ETR_L	Trade	Trade$*\mathbb{1}$(High-inc.)	ETR_K	ETR_L
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$Z^{gravity}$	0.069***	0.010***	0.003***	0.014	0.040***	0.014*	0.002
	(0.010)	(0.002)	(0.001)	(0.019)	(0.014)	(0.008)	(0.004)
$Z^{oil-distance}$	-0.116***	-0.033***	-0.020**	-0.088***	-0.021	-0.022***	-0.015***
	(0.036)	(0.009)	(0.005)	(0.015)	(0.014)	(0.007)	(0.003)
1^{st}-stage F-statistic	24.59			22.82	11.75		
1^{st}-stage Sanderson-Windmeijer Weak Instruments F-statistic	24.59			41.93	26.60		
1^{st}-stage Kleibergen-Paap F-statistic	24.59			15.34			
Sample	Developing countries only			Developing and developed countries			
N	4916	4916	4916	6489	6489	6489	6489

Notes: This regression table shows the first stage and the reduced form results. The sample is developing countries ($N = 49160$) in cols. (1)-(3), and developing and developed countries ($N = 6489$) in columns (4)-(7). Trade is exports and imports divided by net domestic product. Column (1) corresponds to the first-stage in developing countries, used in Tables 1-2-3. Columns (4)-(5) correspond to the first-stage in the full sample, which estimates heterogeneous effects by development level, and which is used in Table A7. We report several 1^{st}-stage statistics: the F-statistic of excluded instruments; the Sanderson-Windmeijer multivariate F-test of excluded instruments; and, the Kleibergen-Paap F-statistic. When there is only one endogenous regressor (column 1), these three F-statistics are equivalent. Note in columns (4)-(5) that there is only one Kleibergen-Paap F-statistic, which evaluates the overall strength of the first-stage, even though there are two first-stage regressions. Columns (2)-(3) and (6)-(7) report the reduced form regressions of the instruments on the effective tax rates for capital, ETR_K, and labor, ETR_L. Developing (developed) countries are low and middle-income countries (high-income countries) according to the World Bank income classification in 2018. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table A3: Trade Impacts on Effective Tax Rates in Different Samples

	Sample changes related to tax revenue data				Sample changes related to System National Accounts data			Sample changes related to time-periods and balancedness		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: ETR_K										
Trade	0.157***	0.133***	0.215**	0.206***	0.162**	0.138**	0.183***	0.110*	0.205**	0.150***
	(0.054)	(0.049)	(0.098)	(0.068)	(0.064)	(0.062)	(0.052)	(0.060)	(0.098)	(0.052)
Panel B: ETR_L										
Trade	0.051***	0.029***	0.093*	0.028	0.039**	0.037*	0.041**	0.041**	0.056**	0.067***
	(0.017)	(0.011)	(0.049)	(0.022)	(0.018)	(0.018)	(0.020)	(0.015)	(0.021)	(0.020)
Modifications to benchmark sample in Table 1	Remove interpolated tax revenue	Only use HA tax data	Only use ICTD tax data	Only use OECD tax data	Remove composite SNA data	Only use SNA1968 data	Only use SNA2008 data	Only use pre-1994 years	Only use post-1994 years	Fully balanced panel 1965-2018
N	4563	2268	1004	1644	2752	983	1769	2122	2794	2879

Notes: This table presents results from estimating the effect of trade on effective tax rates in different samples across developing countries. The estimation is identical to the benchmark IV model in column (2) of Table 1; across columns, the sample differs from that benchmark sample. Developing countries are low and middle-income countries according to the World Bank income classification in 2018. The outcome is the effective tax rate on capital, ETR_K, in Panel A and the effective tax rate on labor, ETR_L, in Panel B. Trade is measured as the sum of exports and imports divided by net domestic product (NDP). In the first four columns, sample-changes are made to the tax revenue data: interpolated values are dropped in column 1; the only data-source is historical archives (HA) in column 2; the only data-source is ICTD in column 3; the only data-source is OECD in column 4. In the next three columns, sample-changes are made to the system of national accounts (SNA) data: in column (5), the composite SNA values are removed; in column (6), only data from SNA1968 are used; in column (7), only data from SNA2008 are used. In the final three columns, sample-changes are made regarding balancedness: in column (8), the quasi-panel between 1965 and 1993 is used; in column (9), the quasi-panel between 1994 and 2018 is used; in column (10), the fully balanced panel of countries between 1965 and 2018 is used. For more details on the interpolations, imputations and data-sources, see Section 3 and Appendix B.

Table A4: Robustness of Results for Total Taxes and Mechanisms

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Total taxes (% of NDP)						
Trade	0.105*	0.092**	0.097***	0.106***	0.099***	0.170**
	(0.060)	(0.039)	(0.031)	(0.032)	(0.032)	(0.073)
1^{st} stage K-P F-stat	34.51	14.14	23.09	34.84	45.17	10.75
N	4916	3938	4916	4916	4916	4916
Panel B: CIT rate (first-diff.)						
Trade	0.004	-0.007	-0.011*	-0.013*	-0.012*	-0.030*
	(0.011)	(0.009)	(0.006)	(0.007)	(0.007)	(0.016)
1^{st} stage K-P F-stat	34.51	14.14	23.24	34.84	45.13	10.75
N	4916	3938	4916	4916	4916	4916
Panel C: $log(1+\text{CIT rate})$						
Trade	-0.009*	-0.006	-0.009*	-0.010*	-0.009*	-0.026*
	(0.005)	(0.007)	(0.005)	(0.005)	(0.005)	(0.014)
1^{st} stage K-P F-stat	34.51	14.14	23.24	34.84	45.13	10.75
N	4916	3938	4916	4916	4916	4916
Panel D: Corp. income (% of NDP)						
Trade	0.188***	0.197***	0.173***	0.189***	0.179***	0.211**
	(0.051)	(0.047)	(0.044)	(0.046)	(0.045)	(0.104)
1^{st} stage K-P F-stat	34.51	14.14	23.24	34.84	45.13	10.75
N	4916	3938	4916	4916	4916	4916
Panel E: Mixed income (% of NDP)						
Trade	-0.203***	-0.162***	-0.184***	-0.194***	-0.185***	-0.137
	(0.053)	(0.040)	(0.040)	(0.038)	(0.041)	(0.112)
1^{st} stage K-P F-stat	34.51	14.14	23.24	34.84	45.13	10.75
N	4916	3938	4916	4916	4916	4916
Panel F: Capital share of NDP						
Trade	0.102*	0.112**	0.145***	0.158***	0.152***	0.107**
	(0.052)	(0.044)	(0.032)	(0.033)	(0.035)	(0.052)
1^{st} stage K-P F-stat	34.51	14.14	23.24	34.84	45.13	10.75
N	4916	3938	4916	4916	4916	4916
Panel G: Corp. ETR_K						
Trade	0.238*	0.189*	0.148**	0.172**	0.160**	0.385**
	(0.156)	(0.096)	(0.074)	(0.077)	(0.076)	(0.183)
1^{st} stage K-P F-stat	34.51	14.14	23.24	34.84	45.13	10.75
N	4916	3938	4916	4916	4916	4916
Modifications to IV in Panel B of Table 3	NDP weights	Include country-year controls	Include **1**(oil-rich)*year fixed effects	Winsorize trade at 5%-95%	Only use $Z^{gravity}$ instrument	Only use $Z^{Oil-Dist}$ instrument

Notes: This table presents robustness checks for trade's impacts on several outcomes in developing countries. Developing countries are low and middle-income countries according to the World Bank income classification in 2018. Trade is the sum of exports and imports divided by net domestic product (NDP). The outcome differs across panels, and the specification differs across columns: each cell is the coefficient from a separate IV regression. We report the 1^{st}-stage Kleibergen-Paap F-statistic separately for each IV regression. Panel A is total taxes as a % of NDP. Panel B is the first-differenced corporate income tax (CIT) rate. Panel C is the percent change from log of $(1 + \text{CIT rate})$. Panel D is the corporate income share of NDP. Panel E is the mixed income share of NDP. Panel F is the capital share of NDP. Panel G is the average effective tax rate on corporate profits. The different specifications across columns are the same as in Table 1 - please refer to that table for more details. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table A5: Impacts of Trade in LMICs, Heterogeneity by Enforcement Policy

	ETR_K (1)	ETR_L (2)	Corp. income (3)	Corp. ETR_K (4)
Panel A: Large Taxpayer Unit				
Trade	0.116*	0.013	0.171***	0.117*
	(0.066)	(0.029)	(0.057)	(0.068)
Trade∗𝟙(LTU)	0.089	0.084**	0.019	0.113
	(0.077)	(0.040)	(0.051)	(0.131)
Implied coef. for	0.205***	0.098***	0.190***	0.230**
Trade with LTU	(0.062)	(0.029)	(0.042)	(0.097)
Panel B: Customs-Tax Integration				
Trade	0.121*	0.018	0.172***	0.160*
	(0.064)	(0.038)	(0.052)	(0.094)
Trade∗𝟙(Customs-Tax)	0.208	0.198*	0.046	0.183
	(0.185)	(0.109)	(0.112)	(0.249)
Implied coef. for	0.330**	0.217**	0.219**	0.344*
Trade with Customs-Tax	(0.153)	(0.090)	(0.089)	(0.202)
Panel C: Value-Added Tax				
Trade	0.116**	0.015	0.171***	0.156*
	(0.058)	(0.025)	(0.054)	(0.089)
Trade∗𝟙(VAT)	0.101	0.096**	0.022	0.085
	(0.081)	(0.043)	(0.054)	(0.115)
Implied coef. for	0.218***	0.111***	0.194***	0.241***
Trade with VAT	(0.064)	(0.032)	(0.045)	(0.087)
Panel D: International Accounting Standards				
Trade	0.132**	0.023	0.160***	0.183**
	(0.054)	(0.022)	(0.051)	(0.088)
Trade∗𝟙(IAS)	0.122	0.111**	0.017	0.124
	(0.087)	(0.042)	(0.055)	(0.135)
Implied coef. for	0.255**	0.134***	0.177***	0.307***
Trade with IAS	(0.077)	(0.036)	(0.050)	(0.110)
N	4916	4916	4916	4916

Notes: This table estimates heterogeneous IV effects of trade in developing countries (low and middle-income countries according to the World Bank income classification in 2018). Trade is the sum of exports and imports divided by net domestic product (NDP). Outcomes differ across columns: column (1) is the effective tax rate on capital, ETR_K; column (2) is the effective tax rate on labor, ETR_L; column (3) is the corporate income share of NDP; column (4) is the average effective tax rate on corporate profits. We estimate

$$y_{ct} = \mu \cdot trade_{ct} + \kappa \cdot trade_{ct} \cdot \mathbb{1}(A)_{ct} + \theta \cdot \mathbb{1}(A)_{ct} + \pi_c + \pi_t + \epsilon_{ct}$$

where $\mathbb{1}(A)_{ct}$ is an indicator variable which takes a value of 1 in all years after the administrative reform has been implemented. We instrument for $trade_{ct}$ and $trade_{ct} \cdot \mathbb{1}(A)_{ct}$ using the two instruments (Section 5.2). The coefficient on $\mathbb{1}(A)_{ct}$ is also estimated, but is not reported in the table. In Panel A, the administrative reform is the existence of a large taxpayer unit (LTU); this variable is coded based on the USAID's 'Collecting Taxes Database' (website link) and country-sources. In Panel B, the administrative reform is the integration of the customs authority and the domestic tax authority in a single revenue agency; this variable is coded based on USAID's 'Collecting Taxes Database' (website link), the OECD Tax Administration Comparative Series (website link), and country-sources. In Panel C, the administrative reform is the implementation of a value-added tax (VAT); this variable is coded based on Keen and Lockwood (2010) and country-sources. In Panel D, the administrative reform is the adoption of international accounting standards (IAS); this variable is coded based on the IAS country-profiles (website link). At the bottom of each column and panel, we report the implied coefficient and estimated standard error based on the linear combination of the $trade_{ct}$ and $trade_{ct} \cdot \mathbb{1}(A)_{ct}$ coefficients. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table A6: Impacts of Trade Outside of Periods of Tax Revenue Loss

	ETR_K (1)	ETR_L (2)	Corp. income (3)	Corp. ETR_K (4)
Panel A: Excluding Trade-Induced Tariff Revenue Loss Periods (based on Cage and Gadenne, 2018)				
Trade	0.151***	0.047**	0.183***	0.203**
	(0.056)	(0.020)	(0.045)	(0.089)
N	3954	3954	3954	3954
Panel B: Excluding Periods of Indirect Tax Revenue Loss				
Trade	0.189***	0.053***	0.197***	0.225***
	(0.051)	(0.016)	(0.044)	(0.083)
N	3011	3011	3011	3011
Panel C: Excluding Periods of Total Tax Revenue Loss				
Trade	0.174***	0.048***	0.174***	0.203**
	(0.050)	(0.015)	(0.042)	(0.081)
N	3016	3016	3016	3016

Notes: This IV specification is the same as column (2) in Table 1, but modifications are made to the sample of developing countries. In Panel A, we exclude all country-year observations which belong to an episode of trade revenue loss, based on Cagé and Gadenne (2018). In a dataset of 130 countries between 1792 and 2006, the authors define such an episode by a fall in trade tax revenues as a percentage of GDP of at least 1 percentage point from a local yearly maximum to the next local yearly minimum that is accompanied by a non-decrease in the volume of imports as a share of GDP. In Panels B and C, we consider alternative definitions of revenue loss periods. In Panel B, we calculate the within-country yearly change in indirect taxes collected as a share of net domestic product (NDP), and take the three-year moving average. We then create terciles of this variable, separately for each country. We define periods of indirect tax revenue loss to be the observations which lie in the bottom tercile of this distribution, and exclude these country-year observations from the sample. In Panel C, we calculate the same revenue-loss variable, but based on changes in total taxes collected rather than indirect taxes collected. Trade is the sum of exports and imports divided by NDP. The outcome differs across columns: column (1) is the effective tax rate on capital, ETR_K; column (2) is the effective tax rate on labor, ETR_L; column (3) is the corporate income share of NDP; column (4) is the average effective tax rate on corporate profits. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table A7: Heterogeneous Impacts of Trade by Development Level

	ETR_K	ETR_L	First-diff. CIT Rate	Corp. Totl. Income	Mixed Income	Corp. Profits	Employee Comp.	Corp. ETR_K	Natl. K-Share	Corp. K-Share
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Trade	0.253**	0.116**	-0.020	0.279**	-0.183*	0.176***	0.056	0.445**	0.131**	0.158**
	(0.127)	(0.051)	(0.021)	(0.119)	(0.106)	(0.049)	(0.104)	(0.193)	(0.054)	(0.064)
Trade$*\mathbb{1}$(High-inc.)	-0.293	0.014	-0.064*	-0.502**	0.340**	-0.312***	-0.214**	-0.289	-0.197**	-0.239**
	(0.215)	(0.110)	(0.033)	(0.218)	(0.138)	(0.099)	(0.114)	(0.320)	(0.086)	(0.110)
Implied coef. for Trade in High-inc.	-0.040	0.130	-0.084***	-0.223	0.160	-0.135*	-0.158	0.156	-0.066	-0.081
	(0.127)	(0.095)	(0.020)	(0.154)	(0.135)	(0.072)	(0.117)	(0.173)	(0.056)	(0.081)
1^{st}-stage Kleibergen-Papp F-statistic	15.34	15.34	15.34	15.34	15.34	15.34	15.34	15.34	15.34	15.34
N	6489	6489	6489	6489	6489	6489	6489	6489	6489	6489

Notes: This table presents IV results from estimating the effects of trade on ETR and mechanism outcomes in the full sample of developing and developed countries. Trade is measured as the sum of exports and imports divided by net domestic product (NDP). We run the following IV regression: $y_{ct} = \mu \cdot trade_{ct} + \kappa \cdot trade_{ct} \cdot \mathbb{1}(HighIncome)_c + \Theta \cdot X_{ct} + \pi_c + \pi_t + \epsilon_{ct}$ The first-stage regression is reported in Table A2. At the bottom of each column, we report the implied coefficient and estimated standard error based on the linear combination of the $Trade$ and the $Trade * \mathbb{1}$(High-inc.) coefficients. High-income is based on the World Bank income classification in 2018. We also report the 1^{st}-stage Kleibergen-Paap F-statistic. Each column is a different outcome: column (1) is the effective tax rate on capital; column (2) is the effective tax rate on labor; column (3) is the first-differenced statutory corporate income tax rate; column (4) is the corporate income share of net domestic product, where corporate income is the sum of corporate profits and corporate employee compensation; column (5) is the mixed income share of net domestic product; column (6) is the corporate profit share of net domestic product; column (7) is the employee compensation share of net domestic product; column (8) is the average effective tax rate on corporate profits; column (9) is the capital share of net domestic product; column (10) is the capital share of corporate income. For more details on outcomes, see Section 3.1 and Section 6.2. For more details on the instrumental variables, see Section 5.2. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Appendix B Data & Construction of Effective Tax Rates

This appendix section provides an overview of the data sources used to create our tax revenue and national income series (Section B.1). Additionally, we discuss the methodology to measure effective tax rates (Section B.2).

B.1 Data sources

Tax revenue data Our tax revenue data draws from three key sources:

(i) **OECD Government Revenue Statistics** (website link): OECD revenue statistics take precedence in our data hierarchy as it contains all types of tax revenues already arranged in the OECD taxonomy of taxes. While it covers all OECD countries, it only covers a subset of developing countries which typically start in the early 2000s.

(ii) **ICTD Government Revenue Dataset** (website link): ICTD data covers many developing countries, but only begins in the 1980s. ICTD at times does not separate income taxes into personal vs. corporate taxes and often does not contain social security contributions.

(iii) **Archival data**: The main archival data collection corresponds to the digitization of the Government Documents section in the Lamont Library at Harvard University (website link). For each country, we scanned, tabulated and harmonized official data from the public budget and national statistical yearbooks, to retrieve official tax revenue statistics. The supplementary appendix lists the main historical documents used in each country's time-series. In the case where the document is a statistical yearbook, the initial listed source is always a report produced by the finance ministry or the national tax authority. To complement hard-copy archival data, we retrieved countries' online reports, usually published by their national statistical office or finance ministry. We also used complementary sources, including offline archival Government Finance Statistics data from the IMF which covers the period 1972-1989. For social security contributions, we relied on two additional sources: the 'D61' statistic on social contributions in the household sector in SNA-1968 and SNA-2008, and data from Fisunoglu, Kang, Arbetman-Rabinowitz, and Kugler (2011).

To increase the credibility of the tax revenue series based on newly digitized historical documents, we base our approach on the following four guiding rules:

1. We seek to build long time-series from the archival records in order to overlap with pre-existing sources (OECD, ICTD, IMF). We use the overlapping years to inspect that the different sources provide similar estimates of the overall levels of taxes collected and to verify that they report the same set of taxes in place. If discrepancies exist when data sources overlap, we inspect the accuracy of each source with additional information. For this reason, switches in data-source rarely lead to a significant change in trend.

2. In historical time-periods where no overlap exists with pre-existing sources, we find academic publications and policy reports to compare the estimated overall levels of

tax/GDP. When discrepancies exist, we investigate its causes (e.g. inclusion of non-tax revenues, differences in estimated GDP numbers).

3. We take note of instances where the overall tax take, or individual tax types, see sudden and large changes. We use additional sources to try to determine the proximate causes as they relate to policy changes, political transitions or economic shocks. We flag cases where we cannot find the proximate cause or where the political or economic events induce very significant volatility in the time-series.

4. We aim to be conservative in our inclusion of countries and time-periods. Specifically, we exclude countries in time-periods where data exists but where significant concerns remain about its reliability (and where it proves difficult to find corroborating sources). These instances are often in periods of significant political or economic change. For example, we exclude Afghanistan in the late 1970s and early 1980s; Cambodia in the late 1980s and early 1990s; Dominican Republic in the early 1960s; and, Namibia in 1990.

The supplementary appendix contains a table which summarizes our decisions as they relate to these four guiding rules in each country in our sample. The table emphasizes the uncertainty that exists for specific countries in specific time periods and we flag instances where we assess the data to be worthy of inclusion but where it should still be interpreted with caution and additional investigations would be helpful. We confirm that none of our main results change if we exclude these flagged instances. Moreover, the supplementary appendix provides case-studies with additional details on our decisions and direct links to the initial historical documents for each country. The case studies are currently limited to 67 countries but will ultimately cover the entire sample.[63]

Equipped with the historical time series, we have to construct long-run panels across sources. Below, we outline the instructions used to harmonize across sources and to improve data quality for the measurement of each type of tax. We flag instances where we consider the series to be legitimate, but where harmonization proved more challenging due to coinciding economic or political changes. For each country, the main decisions related to harmonization and data-quality are provided in the supplementary appendix.

1. We first rely on OECD data whenever it exists. Archival data is initially second in priority, but we revise this based on whether ICTD data provides a long time series and separates personal from corporate income taxes. We also study if ICTD has the better match in overlapping time-periods with OECD data. When possible, we aim to use no more than two data sources per country.

2. We exclude country-years for communist/command economies. This implies that our panel size jumps in 1994, including when China and Russia first appear. The year 1994 is a few years removed from the dissolution of the Soviet Union but, as discussed below, arguably corresponds to China's establishment of a modern tax system (World Bank, 2008).

[63]We invite comments from researchers to improve the accuracy of the series as we build the case studies and expand the data to recent years.

3. When none of the data sources separate PIT from CIT, we use academic sources and tax legislation to assign values.

4. To guard against omitting significant values of decentralized tax revenues, we use the OECD database on subnational government finance (link) to find the countries with significant state and local taxes, and we attempt to collect further data for these countries if necessary.

5. We linearly interpolate data when a given tax type is missing, but for no more than 4 years in a time-series and without extrapolation. We check for significant socio-economic changes that could cast doubt on the continuity of the tax revenue series and do not interpolate in such years.

6. We only use actual amounts of taxes collected, and do not rely on estimated values.

China's establishment of a modern tax system in 1994

In our benchmark setting, we only include formerly communist economies into our data starting in 1994. Given China's weight in the global economy, it is worth reviewing the reason for that choice. The tax revenue data for China covers most of our sample period although its quality improves markedly in the 1980s. Official statistics are available online: link here.

Prior to the 1980s, China had a command economy model of 'profit delivery,' in which the state directly received the revenues of profitable SOEs, and subsidized unprofitable ones. A corporate income tax first appears in China in 1983-84, but the majority of the base continues to be state-owned enterprises. In 1985, the tax system was further reformed into a 'fiscal contracting' system whereby firms negotiated a fixed lump-sum payment (regardless of economic outcomes), which cannot be split into labor versus capital taxes (nor into consumption taxes). We therefore exclude the 'pseudo'-CIT revenue dating from 1985 through 1993.

Rather, we consider that China's modern tax system began in 1994. The World Bank (2008) shows that, in 1994, China established for the first time a central tax administration; reformed the 'fiscal contracting' system; unified the PIT; created a VAT; and reduced 'extra budgetary' (non-tax) revenues. Thus from 1994 onward we can categorize tax revenue precisely by type, assign them to capital or labor, and estimate our ETRs.

National accounts data To compute factor incomes of net domestic product, we combine two main datasets from the United Nations Statistics Division. The first is the 2008 System of National Accounts (SNA) online data repository. The second is the 1968 SNA archival material. The 2008 and 1968 SNAs initially have different reporting classifications; to the best of our knowledge, our project is the first to harmonize national accounts across these two sources.

To estimate capital and labor factor incomes requires information on the 4 main sub-components that make up net domestic product (see equation 3). However, in some country-years where we have information on domestic product from an SNA dataset, there may not be data on all four sub-components at the same time. This is more frequently the case for the 1968 SNA than for the 2008 SNA and it is most frequent for mixed income (OS_{PUE}). In these cases, we first attempt to recover the value of the missing component using data from the other SNA dataset and national accounting identities with non-missing values for other components within the same country-year. For the remaining cases after applying this process, we impute values for the component. All of the regressions in Sections 5-6 include dummy variables for these composite cases; our main results also hold without the imputed values (Table A3). For the imputation, we follow the procedure from Blanchet et al. (2021). The World Inequality Database uses this procedure to impute consumption of fixed capital (depreciation) when it is missing in countries' series. For example, applying this procedure in our setting means that we model OS_{PUE} as a function of log national income per capita, a fixed country characteristic, and an AR(1) persistence term.

Table B1 summarizes the national accounts coverage in our dataset. The 'Complete SNA2008' row refers to country-years where all components of net domestic product are extracted from the 2008 SNA; similarly for the 'Complete SNA1968' row. The 'Composite' row counts instances where one component (or more) of net domestic product is initially missing from an SNA dataset and is retrieved from the other SNA dataset, is calculated via accounting identities, or is imputed.

Table B1: Main Data Sources

	Country-year obs.	%
Panel A: Tax revenue data		
OECD	2875	42.3%
Archives	2678	39.4%
ICTD	1246	18.3%
N	*6799*	*100%*
Panel B: Factor income data		
Complete SNA2008	2455	36.1%
Complete SNA1968	1360	20.0%
Composite	2984	43.9%
N	*6799*	*100%*

Notes: See Section B.1 for more details on the data-sources for tax revenue and factor income.

B.2 Construction of ETR

By combining data on disaggregated tax revenues and national income components, we construct effective tax rates on capital and labor (equations 1 and 2 in Section 3.1). Here we provide further details on the definitions of ETR. Computing ETR_L and ETR_K requires the following information for country c in year t:

$$ETR_{L,ct} = \frac{T_{L,ct}}{Y_{L,ct}} = \frac{\lambda_{PIT,ct} \cdot T_{1100,ct} + \lambda_{socsec,ct} \cdot T_{2000,ct}}{CE_{ct} + \phi_{ct} \cdot OS_{PUE,ct}}$$

$$ETR_{K,ct} = \frac{T_{K,ct}}{Y_{K,ct}} = \frac{(1-\lambda_{PIT,ct}) \cdot T_{1100,ct} + (1-\lambda_{CIT,ct}) \cdot T_{1200,ct} + (1-\lambda_{assets,ct}) \cdot T_{4000,ct}}{(1-\phi_{ct}) \cdot OS_{PUE,ct} + OS_{CORP,ct} + OS_{HH,ct}}$$

For each type of tax j, there is a $\lambda_{j,ct}$ allocation of the tax to labor which may vary by country-year (and $1-\lambda_{j,ct}$ is the allocation to capital). The allocation for each type of tax is described in Table B2, where the types of taxes follow the OECD classification. In our benchmark assignment, these allocations are time- and country-invariant for all types of taxes, except for personal income taxes ($\lambda_{PIT,ct}$) which we discuss in detail below. Further, in our benchmark assumption, we assume that the labor share of mixed income, ϕ_{ct}, is fixed at 75% in all country-years ($\phi_{ct} = 0.75$). In robustness checks, we let ϕ_{ct} vary at the country-level, based on ILO (2019), or at the country-year level by using the labor share in the corporate sector. In our benchmark assignment, replacing the invariant parameters with their fixed numerical values, we therefore have:

$$ETR_{L,ct} = \frac{T_{L,ct}}{Y_{L,ct}} = \frac{\lambda_{PIT,ct} \cdot T_{1100,ct} + T_{2000,ct}}{CE_{ct} + 0.75 \cdot OS_{PUE,ct}}$$

$$ETR_{K,ct} = \frac{T_{K,ct}}{Y_{K,ct}} = \frac{(1-\lambda_{PIT,ct}) \cdot T_{1100,ct} + T_{1200,ct} + T_{4000,ct}}{0.25 \cdot OS_{PUE,ct} + OS_{CORP,ct} + OS_{HH,ct}}$$

The parameter values are described in Table B2, both for the tax revenue numerator and the national income denominator. We now provide more details on λ_{PIT} and ϕ.

Labor share of personal income taxes: λ_{PIT} As discussed in Section 3.1, the level of personal income tax (PIT) that derives from capital versus labor income is rarely directly observed.[64] Thus, within PIT, an important parameter is the share of revenue assigned to labor, denoted λ_{PIT}. In the United States, Piketty et al. (2018) find that approximately 85% of PIT revenue is from labor and 15% from capital. To construct country-year specific $\lambda_{PIT,ct}$, we start from the US benchmark ($\lambda_{PIT} = 85\%$) and make two adjustments:

(a) First, the location of the PIT exemption threshold in the income distribution impacts λ_{PIT}, since the capital income share is higher for richer individuals. We retrieve PIT exemption thresholds from Jensen (2022). We assume countries with a higher PIT exemption threshold have a higher λ_{PIT}. Since the US has a low exemption threshold

[64] PIT revenue from capital income includes taxes on dividends and capital gains and on the capital share of self-employment income. OECD revenue data occasionally reports tax revenue from capital gains, which was on average 4% of PIT in the period 2010-2018 (7.5% in the US).

with $\lambda_{PIT} = 85\%$, we assign 85% of PIT to labor in countries where the PIT at least half of the workforce (mainly high-income countries). For countries where the PIT covers 1% or less of the workforce (lowest-income countries), we assign a maximum PIT capital share of 30%. For PIT thresholds with a coverage between 1% to 50% of the workforce, we linearly assign λ_{PIT} between 70% and 85%.

(b) Second, we assume that countries where a dual PIT system is in place have a larger λ_{PIT}. Dual PIT systems set capital income taxation to a lower—often flat—rate, while labor income is taxed with progressive marginal tax rates. We compute the measure of the percent difference between the tax rate on dividends and the top marginal tax rate on labor income. Data on dividend vs wage income tax rates are taken from OECD Revenue Statistics and country-specific tax code documents. Since we only have dividend rates, we assume that 50% of capital income in PIT benefits from the lower rate (e.g., capital gains might not benefit). For this 50%, we multiply λ_{PIT} by the percent difference in dividend versus top marginal tax rates.

Labor share of mixed income: ϕ Section 3.1 noted the difficulty of estimating the labor share of mixed income (unincorporated enterprises). We assume a benchmark measure of $\phi = 75\%$. The implied capital share is lower than the 30% used in Distributional National Accounts guidelines (Blanchet et al., 2021). However, since the global average corporate capital share is 27%, assuming that the capital share of unincorporated enterprises is slightly lower appears reasonable (see Guerriero, 2019).

We implement two robustness checks. First, we set the labor share of mixed income equal to that of the corporate sector at the country-year level; specifically, $\phi_{ct} = \frac{CE_{ct}}{CE_{ct}+OS_{CORP,ct}}$. This procedure follows Gollin (2002).

Second, we implement the ILO (2019) method which relies on harmonized household surveys and labor force surveys in developing countries between 2004 and 2017. Estimation of the relative labor income of self-employed is based on the observable characteristics of those workers and their comparison with employees. Relevant variables, including industry, occupation, education level and age, are used in a regression to uncover the determinants of labor income of employees. Given the estimated relationship between employee labor income and the explanatory variables, labor income is extrapolated to self-employed, generating a coefficient of relative earnings to employees, denoted γ_q. The method estimates a separate γ_q for different groups q of self-employed: self-employed workers; own-account workers; and, contributing family members. A correction procedure is implemented to reduce the bias from selection into self-employment. Total labor income in a given country-year is then determined as $Y_L^{ILO} = CE + \sum_q w_{emp} \cdot \gamma_q \cdot b_q$, where CE is the total compensation of employees in SNA, w_{emp} is the average employee wage (which relates CE to the total employee workforce), b_q is self-employed group q's count in the workforce, and γ_q is the q-specific earnings coefficient relative to the average employee wage. Equipped with the Y_L^{ILO} estimate, we calculate the 'implicit' labor mixed income ($OSPUE_L$) as the difference between Y_L^{ILO} and the value of compensation for employees CE observed in the national accounts. Then, we compute the mixed income share allocated to labor. Specifically, ϕ^{ILO} is computed as follows: $\phi^{ILO} = \frac{(Y_L^{ILO} - CE)}{OSPUE} = \frac{OSPUE_L^{ILO}}{OSPUE}$

Finally, we compute the average ϕ^{ILO} for each country during 2004-2017 and assign this value to all years. We assign a country-specific but time-invariant value for two reasons. First, prior to 2004, the ILO lacks the required data to compute Y_L^{ILO} on a country-year basis. Second, when measured at the country-year level during the 2004-2017 period, ϕ^{ILO} varies little within country across years. Assigning a country-specific but time-invariant mixed income factor share may therefore be reasonable.

The main challenge is that the estimation framework for γ_q is not disciplined by the country's actual values in SNA. In particular, nothing prevents $\sum_q w_{emp} \cdot \gamma_q \cdot b_q > OS_{PUE}$ - such that estimated labor mixed income is larger than the SNA actually observed entire mixed income. This would, implausibly, imply that $\phi^{ILO} > 100\%$. To remedy this concern, we winsorize ϕ^{ILO} at 100%. In cases where γ_q and b_q are not from ILO (2019), we also winsorize ϕ^{ILO} from below with the lowest observed country value in ILO (2019), which is 36%. While the ILO (2019) method generates important country-level variation, the global average value for ϕ^{ILO}, at 80%, does not differ much from our benchmark value $\phi = 75\%$.

Mixed income in China and the US We make mixed-income adjustment to the benchmark series for China and the United States. For China, Piketty, Yang, and Zucman (2019) (PYZ) show that Chinese national accounts systematically underestimate mixed income and overestimate other factor incomes: for example, the income of self-employed agricultural workers is attributed to employee compensation in the SNA 2008 data and not to mixed income (as in other countries). We base our mixed income series on PYZ.

Following PYZ, we define mixed income as the sum of the income attributed to self-employed workers from agriculture and individual businesses. PYZ covers the period 1992-2014. For years before and after, we extend the series as follows:

(a) For agriculture, relevant data is available dating back to 1952. We extend the series back to 1965 relying on the price deflator available at World Inequality Database. For more recent years (2014-2018), we predict the trend based on sources used in PYZ (National Bureau of Statistics, link).

(b) For individual businesses, PYZ computes the income of this sector by combining several data sources. Unfortunately, a crucial part of it is not available prior to 1992, namely the 'flow of funds' data. Instead, our assumption is that, prior to 1980, Chinese individual businesses accounted for a negligible share of the economy. This observation is consistent with facts on self-employment structure in China at the micro and macro levels, and the trends presented in PYZ for the 1990s.[65] For recent years (2014-2018), we predict the trend based on sources used in PYZ (National Bureau of Statistics, link).

The estimated series of mixed income in China follows the same trend as for the rest of LMICs, although it starts from a slightly higher initial level.

For the US, we use the factor shares from Piketty et al. (2018), which (i) assumes a higher capital share of income for partnerships vs. other non-corporate businesses; and (ii) accounts for the rising capital intensity of partnerships since the 1980s.

[65] At the micro level, self-employed workers represent less than 2% of workforce in the 1980s, but had similar income per capita as wage earners (Gustafsson & Zhang, 2022). At the macro level, very small-scale industries represented 0.4% of industry output in the 1970s, reaching 7% only in 1989 (Yusuf, 1994).

Table B2: Main Tax Revenue and National Accounts Concepts

Panel A: Tax Revenue

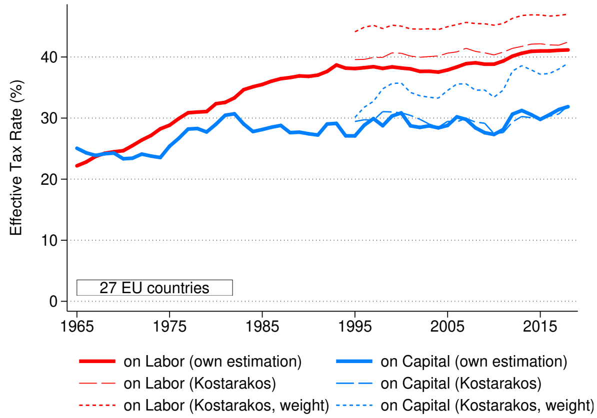
OECD revenue classification	**type of tax j**	**incidence λ_j on labor**	**notes**
1100	personal income tax (PIT)	$68\% \leq \lambda_{PIT} \leq 93\%$	Taxes on individuals (wages, capital income, capital gains). $\lambda_{PIT,ct}$ varies by country and year: see Section B.2 for details
1200	corporate income tax (CIT)	$\lambda_{CIT} = 0\%$	Taxes on corporate profits. Unallocable income taxes (OECD category *1300*) are split between PIT and CIT based on information from additional sources (see supplementary appendix)
2000 / 3000	social security & payroll	$\lambda_{soc.sec.} = 100\%$	Includes all social security contributions as well as payroll taxes
4000	property & wealth taxes	$\lambda_{assets} = 0\%$	Includes property, wealth and financial transaction taxes
5000	indirect taxes	excluded	Includes trade taxes, value-added taxes and other sales taxes and excise taxes. We consider these taxes as prior to factor income returns, such that they can be excluded from factor income taxation (Browning, 1978; Saez and Zucman, 2019).
6000	other taxes	excluded	Rare in occurrence and often quantitatively small
7000	non-tax revenue	excluded	Does not meet definition of taxation, can be quantitatively significant

Panel B: National Accounts

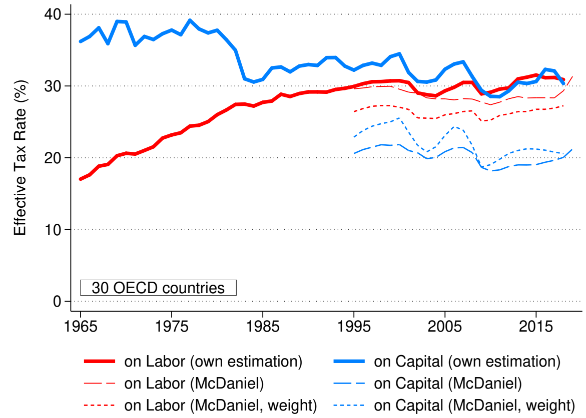
Natl. accounts acronym	**national income component**	**benchmark allocation**	**notes**
CE	compensation of employees	labor	Includes wages and salaries, employer and employee social contributions, and all payments from employers to their employees
OS_{PUE}	mixed income	$\phi = 75\%$ labor	'Operating surplus of private unincorporated enterprises' includes income from self-employment, household business owners, and informal or unincorporated enterprises
OS_{HH}	imputed rent	capital	'Operating surplus of households' is imputed rental income accruing to homeowners who live in their own home
OS_{CORP}	corporate profits	capital	'Operating surplus of corporations' includes all corporate income after paying employees and expenses, and can be thought of as corporate-sector capital income
OS_{GOV}	government operating surplus	—	$OS_{GOV} = 0$, by construction in national accounts
NIT	net indirect taxes	excluded	'indirect taxes, net of subsidies' usually comprise 8-15% of national income.
NFI	net foreign income	—	We treat domestic income without balancing the accounts to foreign earned income: many countries tax income earned domestically, regardless of citizenship, whereas net foreign income is taxed only with difficulty
CFC	depreciation	excluded	Factor income and our ETR are expressed net of 'consumption of fixed capital'

Figure B1: Comparing ETR Evolution in Our Data and Existing Studies

(a) Kostarakos and Varthalitis (2020)



(b) McDaniel (2020)



Notes: These graphs provide a comparison of our ETR estimations with the recent literature. The left-hand graph compares our estimations with Kostarakos and Varthalitis (2020), based on EU-27 members from 1995 to 2019. The right-hand graph compares our estimations with the updated dataset in McDaniel (2020) that includes 30 OECD countries from 1995 to 2018. This extension is based on McDaniel (2007) (Table B3), and covers the largest OECD countries, including the US, as well as Mexico and Turkey. The solid line represents the results using our ETR measures and weights, but based on the exact country samples in the respective studies. The long-dash line replicates the ETR measures from the two studies. The short-dash line extends their ETR series but using our country-year weights. For a discussion of the differences between series, see Section 4.2, Table B3 and the supplementary appendix.

Table B3: Effective Tax Rates: Existing Databases

Paper	**Time**	**Countries**	**Source**	**Notes on methodological differences with our approach**
Mendoza et al (1994)	1965-1988	G7 members	OECD	Difference: All mixed income is allocated to capital income. Difference: Labor and capital in the PIT are taxed at the same rate
Carey and Rabesona (2004)	1975-2000	25 OECD biggest members	OECD	Difference: Mixed income allocation where self-employed pay themselves the annual salary earned by the average employee. Similarity: Labor and capital in PIT are not taxed at same rate, measure preferential tax treatment of pension funds and dividends. Difference: Social security contributions deducted from household income.
McDaniel (2007) (McDaniel 2020)	1950-2003 (updated: 1995-2018)	15 OECD biggest members (updated 30 OECD biggest members)	OECD	Difference: Mixed income imputed to capital based on rest-of-economy share. Difference: Labor and capital in PIT are taxed at the same rate
Kostarakos and Varthalitis (2020)	1995-2019	EU-27 members	Eurostat	Follows Carey and Rabesona (2004)

Appendix C Trade Liberalization Event Studies

C.1 Description of liberalization events

Our selection of trade events is determined by three criteria. First, the event is related to measurable policy reforms; this improves the transparency of the event-study design which is based on a well-defined policy event. Second, the policy reforms induced large changes in trade barriers; this increases the likelihood of observing sharp breaks in macroeconomic outcomes around the event-time. Third, the event has been studied in academic publications; this allows us to rely on events for which the positive effects on openness have previously been established.

These criteria led us to focus on the six trade liberalization events referenced in review articles by Goldberg and Pavcnik (2007, 2016) to which we add China's WTO accession event (studied in Brandt et al., 2017). Most of these selected events feature reductions in tariff rates: many of the countries did not participate in the early GATT/WTO negotiation rounds, making reductions in tariffs an available policy lever. The tariff reductions were large: Brazil cut tariff rates from 59% to 15%, India from 80% to 39% percent, and China from 48% to 20%. Mexico reduced tariff rates from 24% to 12% and import license requirements went from covering 93% of national production to 25%; Colombia's tariffs were reduced from 27% to 10% and import requirements dropped from 72% of national production coverage to 1%. In the selected countries, "tariff reductions constitute a big part of the globalization process" (Goldberg & Pavcnik, 2016). The timing of the events and academic references are provided in the supplementary appendix.

Below are narrative analyses for some of the events:

- **Brazil** The liberalization event of 1988 is detailed in Dix-Carneiro and Kovak (2017). The authors note: "In an effort to increase transparency in trade policy, the government reduced tariff redundancy by cutting nominal tariffs... Liberalization effectively began when the newly elected administration suddenly and unexpectedly abolished the list of suspended import licenses and removed nearly all special customs regimes."

- **Colombia** Similarly to Brazil, tariff reductions in Colombia in 1985 were driven by the country's decision to impose uniform rates across products and industries under the negotiation commitments to the WTO. Goldberg and Pavcnik (2007) note that this reform objective makes "the endogeneity of trade policy changes less pronounced here [in Colombia] than in other studies."

- **China** Brandt et al. (2017) note that trade openness reforms had gradually been implemented in China prior to the country's WTO accession in 2001, but that the tariff reductions implemented upon accession were large, "less voluntary" and largely complied with the pre-specified WTO accession agreements. Importantly, the potential accession to WTO contributed to the timing of privatization initiatives, in which the Chinese government restructured and reduced its ownership in state-owned enterprises. While the privatization efforts began in 1995 and were incremental, it is possible that additional sell-offs in the post-WTO years contribute to the observed medium-run trends in our outcomes.

- **India** The 1991 event in India occurred as a result of an IMF intervention that dictated the pace and scope of the liberalization reforms. Under the IMF program, tariff rates had to be harmonized across industries, which, like in Brazil and Colombia, led to a large average reduction in tariffs. Topalova and Khandelwal (2011) argue the Indian reform "came as a surprise" and "was unanticipated by firms in India." The reforms were implemented quickly "as a sort of shock therapy with little debate or analysis." The IMF program was in response to a set of events including "the drop in remittances from Indian workers in the Middle East, the increase in oil prices due to the Gulf War, and political uncertainty following the assassination of Rajiv Gandhi".

- **Vietnam** The 2001 reform was implemented as a broad trade agreement that did not involve negotiations over specific tariffs (McCaig & Pavcnik, 2018). The reform was driven by the American government's decision to reclassify Vietnam from 'Column 2' of the US tariff schedule to 'Normal Trade Relations'. Column 2 was designed in the early 1950s for the 21 communist countries, including Vietnam, with whom the US did not have normal trading relations.

These descriptions of reform timing do not suggest that the liberalization events were directly triggered by changes in domestic taxation or factor incomes.

Goldberg and Pavcnik (2007) note other cross-border reforms that occurred during post-years of the liberalization events. Argentina's 1989 event and Brazil's 1988 event were followed by accession to Mercosur in 1991; India's 1991 event was followed by foreign direct investment liberalization in 1993; and Mexico's 1985 WTO accession was followed by a removal of capital inflow restrictions in 1989. These reforms occurred with some lag to the trade liberalization events.

C.2 Event study methodology

Our sample is constructed by applying a synthetic matching procedure to every treated country for each outcome of interest. The donor pool has to be fully balanced in all pre-event periods. To estimate the event study in equation (4) for a given outcome, the sample pools the seven treated countries and their synthetic control countries for 10 years before and after the events (yielding 294 observations). We estimate the event-study in equation 4 and the DiD model: $y_{ct} = \beta^{DiD} \cdot \mathbb{1}(e \geq 0)_t \cdot D_c + \theta_t + \kappa_c + \pi_{Year(t)} + \epsilon_{ct}$. The DiD model uses the same notation as equation (4). Moreover, we use the imputation method by Borusyak et al. (2021) to report average treatment effects comparable to β^{DiD} with a technique that deals with issues with two-way fixed effects and heterogeneous event timing. Details are provided in the supplementary appendix. All the DiD average treatment effects are reported in Table A1. We test if our results hold with a more restrictive synthetic control, by using our three main outcomes—trade, ETR_K and ETR_L— to construct one synthetic control group per treated country. The results are reported in Panel B of Table A1.

C.3 Alternative trade liberalization event study

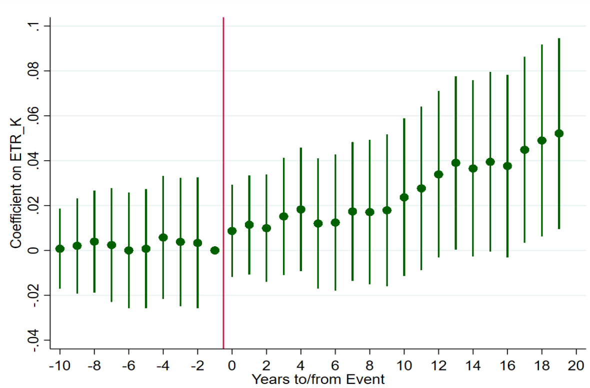
We present results based on an alternative measure of trade liberalization events. We use the events from Wacziarg and Welch (2008), which cover 141 countries at all levels of development between the 1950s and 1998. When merged with our data, the sample covers

68 liberalization events that occurred between 1965 and 1998 in developing countries. A trade liberalization event is defined to occur when all five of the following conditions no longer hold: (i) average tariff rates are above 40%; (ii) non-tariff barriers cover at least 40% of trade; (iii) the black market exchange rate is at least 20% lower than the official exchange rate; (iv) there is a state monopoly on major exports; (v) there is a socialistic system in place. These conditions are broader than our main liberalization event criteria (Section 5.1 and C.1). At the same time, our main events are covered in this expanded event sample (with the exception of China and Vietnam, whose events are after the end of the sample period); this occurs because the reduction in tariff rates, one of our main event criteria, was the remaining event-condition to be satisfied in Wacziarg and Welch (2008). We estimate the effects of the liberalization events using the DiD model: $y_{ct} = \beta^{DiD} \cdot E_{ct} + \theta_t + \theta_c + \epsilon_{ct}$. y_{ct} is the outcome of interest in country c in year t, E_{ct} is the event indicator which takes on a value of 1 in all periods after a country has a liberalization event (and 0 otherwise), and θ_t and θ_c are year and country fixed effects, respectively. ϵ_{ct} is clustered at the country level. Estimation issues arising from heterogeneous treatment-timing may be important; for this reason, we focus on the imputed treatment effects based on Borusyak et al. (2021). We restrict the sample to developing countries between 1965 and 2008.

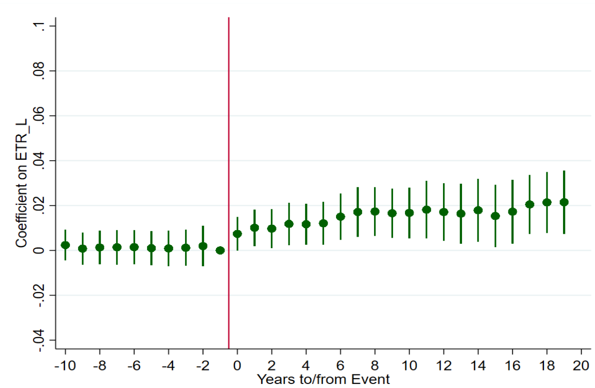
Panel A of Table C1 reports the β^{DiD} impacts on trade, ETR_K and ETR_L. Despite being based on broader criteria, the trade liberalization events produce qualitatively similar results to the main event-study (Section 5.1), with positive impacts on openness and both ETRs, and a larger magnitude-impact on ETR_K than ETR_L. Figure C1 estimates the dynamic event-study. Liberalized and control countries are on parallel trends until the event onset; both ETRs start to increase in the immediate post-event years. Panel B shows that the results are robust to estimating the effects in a fully balanced panel 10-years post-reform. In Panel C, the results hold when the control group is formed within-region. Panel D shows the results are robust to excluding countries which have cross-border capital liberalization events at any point during the sample-period (Bekaert, Harvey and Lundblad, 2000). Finally, Panel E shows the results hold when we exclude countries with concurrent domestic reforms (Wacziarg & Wallack, 2004).

Figure C1: Event-Study of Trade Liberalization Based on Wacziarg & Welch (2008)

(a) Effective tax rate on capital



(b) Effective tax rate on labor



Notes: These graphs show event-study impacts of the trade liberalization events from Wacziarg and Welch (2008) on ETR_K (left panel) and ETR_L (right panel).

Table C1: Trade Liberalization Event-Study Based on Wacziarg & Welch (2008)

	Trade	ETR_K	ETR_L
	(1)	(2)	(3)
Panel A: *Benchmark*			
Post*Treat	0.030	0.021	0.006
	(0.048)	(0.017)	(0.006)
Imputed treatment effect	0.090*	0.043**	0.021***
	(0.049)	(0.016)	(0.005)
N	4032	4032	4032
Panel B: *Fully balanced panel, 10-year post-reform*			
Imputed treatment effect	0.110**	0.031**	0.018***
	(0.054)	(0.014)	(0.005)
N	3082	3082	3082
Panel C: *With region-year fixed effects*			
Imputed treatment effect	0.084**	0.042**	0.021***
	(0.041)	(0.016)	(0.005)
N	4032	4032	4032
Panel D: *Excluding countries with capital liberalization*			
Imputed treatment effect	0.101*	0.028*	0.014**
	(0.057)	(0.017)	(0.006)
N	2651	2651	2651
Panel E: *Excluding countries with domestic reforms*			
Imputed treatment effect	0.056	0.040**	0.015***
	(0.051)	(0.016)	(0.005)
N	3551	3551	3551

Notes: This table shows the results from estimating the difference-in-difference regression and the imputed treatment effect of the 68 trade liberalization events from Wacziarg and Welch (2008), between 1965 and 2008. The sample is low and middle-income countries, based on the World Bank income classification in 2018. In Panel A, the post*treat coefficient corresponds to the β^{DiD} based on estimating the equation in Section C.3. The imputed treatment effect is based on the method in Borusyak, Jaravel, and Spiess (2021). In Panel B, the sample is restricted to the fully balanced set of countries in the 10 years after the liberalization event. In Panel C, the estimation is augmented with region-by-year interactive fixed effects. In Panel D, the sample excludes all countries that have a capital liberalization reform at any point during the sample-period, based on Bekaert, Harvey and Lundblad (2000). In Panel E, the sample excludes all countries with domestic reforms which coincide in timing with their trade liberalization event, based on Wacziarg and Wallack (2004). Standard errors are clustered at the country level. For more details on the liberalization events, see Appendix C.3. * p<0.10 ** p<0.05 *** p<0.01.

Appendix D Results on Tax Capacity Mechanism

D.1 Firm-level analysis in Rwanda

Data-sources and sample Our analysis draws on three administrative datasets from the Rwanda Revenue Authority (RRA), for the years 2015-2017. These data sources can be linked through unique tax identifiers for each firm, assigned by the RRA for the purpose of collecting customs, corporate income and value-added taxes. The first data source is the customs records, which contain information on international trade transactions made in each year by each firm. We use this data to measure each firm's direct imports. The second data is the firms' corporate income tax (CIT) declarations merged with the firm registry. These data contain detailed annual information on firms' profits, revenue and costs. We use these data to measure each firm's effective tax rate. The third data source is the business-to-business transactions database. These data are retrieved through the electronic billing machines (EBM) that all firms registered for VAT are legally required to use (Eissa and Zeitlin, 2014). For a given seller, EBMs record the transactions to each buyer identified by the tax firm-ID. We use this data to measure buyer-seller relationships.

When combined, these data allow us to construct the buyer-supplier relationships of the Rwandan formal economy and document firms' total trade exposure. Importantly, since the network data is based on tax-IDs, we cannot observe transaction linkages with informal, non-registered firms. This sample selection on formal firms also features in most recent network studies, by virtue of relying on administrative data, including in Chile (Huneeus, 2020); Costa Rica (Alfaro-Ureña et al.); Ecuador (Adao et al., 2022); India (Gadenne et al., 2022); Turkey (Demir et al., 2021); and Uganda (Almunia et al., 2023).

Our sample is the set of firms that are registered for CIT and that report positive income during the years 2015-2017. Note that only a small number of firms are registered for CIT or VAT but not both, meaning that the overlap with the EBM transactions data is strong. However, restricting the sample to positive income is consequential, as a significant number of registered CIT firms are 'nil filers' that report zero income ('nil filers' are common in developing countries: Keen, 2012). We measure each firm i's yearly effective tax rate on corporate profits, corresponding to corporate ETR_i^K in equation (6), as the ratio of corporate taxes paid divided by net profit. Net profit is revenue minus material, labor, operational, depreciation and financial costs.

The EBM data is meant to improve the enforcement of corporate taxes and VAT, and the reporting of linkages is more comprehensive for the relatively larger firms that are registered for these tax bases. For smaller incorporated firms that are instead registered to simplified tax bases (flat-amount or turnover), only a few of them are registered for VAT. Consequently, these firms are most likely to be recorded in the EBM data as clients in a particular transaction, making the coverage of their linkages less comprehensive. It is in principle also possible to measure ETR_i^K amongst these smaller, incorporated firms. However, the information on their tax returns regarding cost items is less detailed and additional assumptions on the relationship between turnover and profit are required, which makes the profit measure in the denominator of ETR_i^K less precise. With these data-challenges in mind, we can include these additional tax-registered firms in the analysis; we find qualitatively similar results (available upon request).

Exposure to trade To measure a firm's total exposure to trade, we follow Dhyne et al. (2021) who use similar administrative datasets as ours to measure trade exposure of Belgian firms. We define firm i's total foreign input share as the share of inputs that it directly imports (s_{Fi}), plus the share of inputs that it buys from its domestic suppliers l (s_{li}), multiplied by the total import shares of those firms:

$$s_i^{Total} = s_{Fi} + \sum_{l \in V_i} s_{li} \cdot [s_{Fl} + \sum_{r \in V_l} s_{rl} \cdot (s_{Fr} + ...)]$$

where V_i is the set of domestic suppliers of firm i, and V_l is the set of domestic suppliers of firm l. The denominator of the input shares is the sum of purchases from other firms and imports. Note that s_i^{Total} is recursive: a firm's total foreign input share is the sum of its direct foreign input share and the share of its inputs from other firms, multiplied by those firms' total foreign input shares. We limit the calculation to the inputs from a firm's immediate suppliers l as well as the suppliers to their suppliers r (adding more network-levels only marginally increases s_i^{Total}). s_i^{Total} reflects the direct import share of firm i's suppliers and the suppliers' suppliers, each weighted by the share of inputs that each firm buys from other domestic firms. We focus on firms' exposure to imports through their supplier network; in an extension, we find qualitatively similar results when studying firms' exposure to exports through their client network (results available).

Figure D1 displays a histogram of s_i^{Total} and s_{Fi} for all formal Rwandan firms. While just under 30% of firms import directly, 93% rely on trade either directly or indirectly through their suppliers. In the median firm, the total foreign input share is 48% (it is 39% for the median Belgian firm in Dhyne et al., 2021).

Impacts of trade exposure on ETR^K and size To visualize the association between trade exposure (s_i^{Total}) and ETR_i^K, we plot binned scatters of the variables against each other, after residualizing both against year fixed effects. In Figure D2, the dots correspond to equal-sized bins of the residualized trade variable. The line corresponds to the best linear fit regression on the underlying firm-level data ($N = 18478$). Figure D2 reveals a positive and strongly significant association: firms that are more exposed to international trade, both through direct imports and through links to importers in the supply network, have higher effective tax rates on corporate profits.

We investigate this association in a regression form in Table 4, deploying both OLS and IV. The IV applies the design in Dhyne et al. (2021) that extends the shift-share approach of Hummels et al. (2014) to a setting with shock pass-through via network linkages. The empirical strategies and the main results are described in Section 6.3.

In additional regressions (not shown but available), we find that the results are robust to controlling for trade shocks to firm i's potential suppliers (firms that operate in the same industry and geographical area as i's current suppliers but are not currently supplying to i) and firm i's horizontal suppliers (firms that are suppliers to firm i's current clients).

We focus on firms' exposure to imports through their supply network, but firms may also be impacted by imports through their clients. In an extension, we find that increased output exposure to imports through the client network has positive effects on ETR^K (results available), though this average effect could mask heterogeneity across firms depending on the complementarity between imports and domestic inputs.

Because the estimation is within the corporate sector, this exercise cannot speak to the magnitude of trade's net impact on sector-level $\overline{ETR}_C^K$. These firm-level results on corporate ETR_i^K are therefore complementary to the country-level results on $\overline{ETR}_C^K$. An additional limitation is that the network linkage measures are derived from administrative data which, by construction, only exist for tax registered firms (Atkin & Khandelwal, 2020). This sample restriction implies that this firm-level regression is not suited to study the impacts of trade on the size of informal firms.

D.2 Type of trade analysis

We investigate whether trade has differential impacts on ETR and mechanism outcomes depending on the nature of the trade variation (Section 6.4). We use our two instruments to investigate the impacts of: (i) imports versus exports (of trade in both intermediate G-S and final G-S); (ii) trade in intermediate G-S versus final G-S (summed across imports and exports). We use UN's Broad Economic Categories (Rev. 5) to classify final versus intermediate goods-services (G-S), combining capital goods with the latter. For the imports versus exports IV, the two 1^{st}-stage regressions are

$$log(imp_{ct}) = \beta_1 \cdot Z_{ct}^{gravity} + \beta_2 \cdot Z_{ct}^{oil-dist} + \mu_c + \mu_t + \epsilon_{ct}$$
$$log(exp_{ct}) = \pi_1 \cdot Z_{ct}^{gravity} + \pi_2 \cdot Z_{ct}^{oil-dist} + \eta_c + \eta_t + \iota_{ct}$$

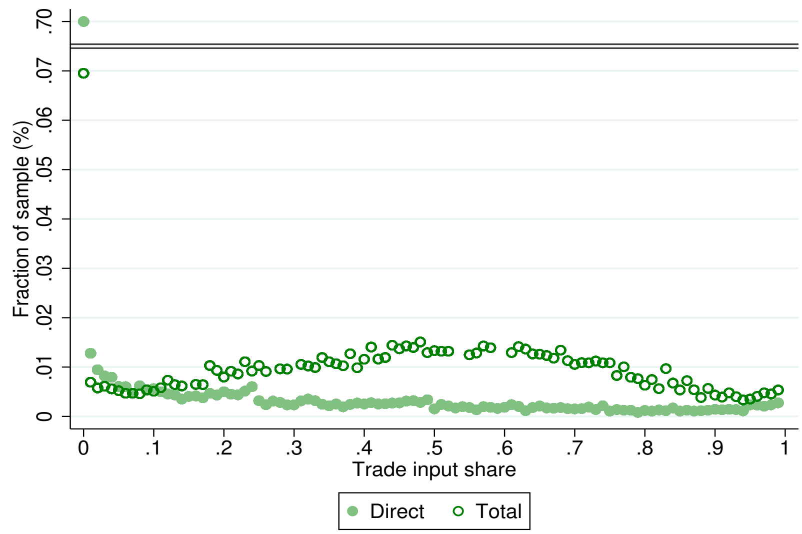
where $log(imp_{ct})$ and $log(exp_{ct})$ are the logs of total imports to NDP and total exports to NDP, respectively, in country c in year t. The log-transformation improves the 1^{st}-stage (results without logs are qualitatively similar). The 2^{nd}-stage is

$$y_{ct} = \theta_1 \cdot log(imp_{ct}) + \theta_2 \cdot log(exp_{ct}) + \kappa_c + \kappa_t + \phi_{ct}$$

The set-up is similar for the second IV (intermediate G-S vs final G-S) where we replace $log(imp_{ct})$ and $log(exp_{ct})$ with the log of total trade in intermediate G-S to NDP and the log of total trade in final G-S to NDP. IV results for developing countries are in Panel A of Table D1, with 1^{st}-stage regressions in Panel B. Note that it is ex ante unclear if the two instruments generate a strong overall first-stage. We gauge this by inspecting the Kleibergen-Paap F-statistics, which are not well above conventional threshold levels (13.56 and 8.21). Given this challenge, we limit our scope to studying whether the coefficient signs for the different types of trade are consistent with our simplified predictions (and whether they statistically differ from each other). The exclusion restriction requires that the regressors add up to total trade openness. For this reason, we cannot implement an IV which focuses on the impacts of final versus intermediate G-S for, say, imports only. This also implies that, for a given outcome, the hypotheses in our two IVs (final versus intermediate G-S; imports versus exports) will be correlated. We accordingly adjust the p-values for multiple hypotheses testing using the Romano-Wolf method.

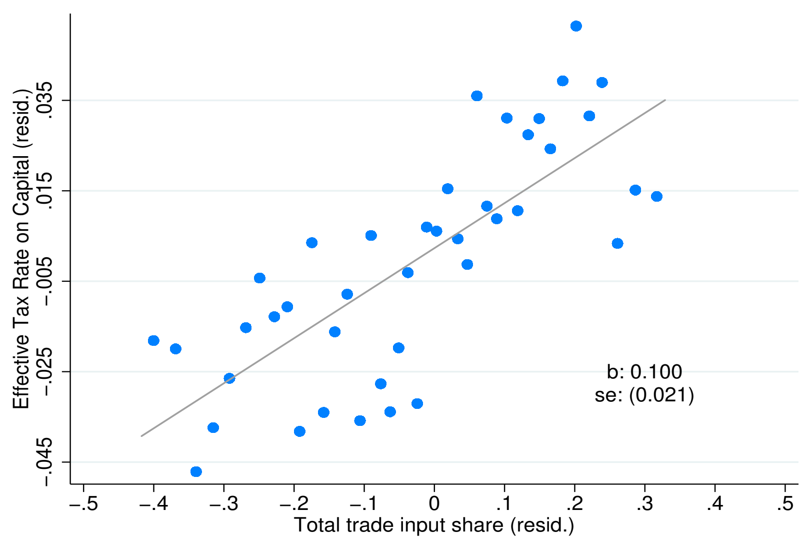
The results are described in Section 6.4. Since we only have 2 instruments, we cannot decisively conclude on the impacts for the 4 types of trade (imports of intermediate G-S, exports of intermediate G-S, imports of final G-S, exports of final G-S). Notwithstanding, the estimated IV coefficients are consistent with imports of final G-S decreasing ETR_K and mechanism outcomes (μ_C,$\overline{ETR}_C^K$), and imports of intermediate G-S increasing them.

Figure D1: Rwandan Firms' Direct and Total Exposure to Trade in Imports



Notes: This figure shows the distribution of direct foreign input share, s_{Fi}, and total foreign input share, s_i^{Total}, for all corporate firms in Rwanda between 2015 and 2017. The measures are calculated annually, and the figure pools all firm-year observations. The horizontal line represents a scale break in the vertical axis. More details are in Section D.1.

Figure D2: Rwandan Firms' Trade Exposure and Corporate Effective Tax Rate



Notes: This figure shows the firm-level association between total foreign input share, s_i^{Total}, and the corporate effective tax rate for all corporate firms in Rwanda between 2015 and 2017. The graph plots binned scatters of the variables against each other, after residualizing both variables against year-fixed effects. The dots correspond to equal-sized bins of the residualized trade exposure variable. The line corresponds to the best linear fit regression on the underlying firm-level data ($N = 18478$), which is also reported in column (1) of Table 4.

Table D1: Type of Trade Analysis in Developing Countries

Panel A: IV	ETR_K		ETR_L		Corporate Income		Mixed Income		Corporate ETR_K	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Export of G-S	0.487*		0.225**		0.214*		-0.159*		0.611*	
	(0.263)		(0.096)		(0.123)		(0.091)		(0.339)	
	[0.066]		[0.019]		[0.039]		[0.119]		[0.076]	
Import of G-S	-0.358***		-0.184***		-0.126*		0.069		-0.442***	
	(0.126)		(0.044)		(0.074)		(0.049)		(0.158)	
	[0.059]		[0.013]		[0.045]		[0.145]		[0.033]	
Intermediate G-S		0.303***		0.133***		0.147**		-0.119***		0.385***
		(0.095)		(0.038)		(0.070)		(0.045)		(0.122)
		[0.053]		[0.012]		[0.033]		[0.048]		[0.031]
Final G-S		-0.245***		-0.125***		-0.089**		0.050**		-0.302***
		(0.051)		(0.023)		(0.044)		(0.024)		(0.056)
		[0.013]		[0.006]		[0.019]		[0.119]		[0.006]
F-test: Equality of coefficients [p-value]	4.82 [0.030]	14.78 [0.004]	8.55 [0.004]	19.06 [0.001]	2.73 [0.096]	4.33 [0.039]	2.55 [0.113]	5.98 [0.016]	4.60 [0.034]	15.35 [0.000]
N	4572	4572	4572	4572	4572	4572	4572	4572	4572	4572

Panel B: 1^{st}-stage	Import of G-S (1)	Export of G-S (2)	Intermediate G-S (3)	Final G-S (4)
$Z^{gravity}$	0.287***	0.252***	0.282***	0.268***
	(0.034)	(0.060)	(0.034)	(0.052)
$Z^{oil-distance}$	-0.077***	0.003	0.008	-0.116***
	(0.011)	(0.018)	(0.013)	(0.019)
1^{st}-stage F-statistic	134.47	15.75	54.76	75.85
1^{st}-stage Sanderson-Windmeijer Weak Instrument F-statistic	36.49	34.02	65.33	70.59
1^{st}-stage Kleibergen-Papp F statistic	8.21		13.56	
N	4572	4572	4572	4572

Notes: The sample is developing countries, which are low and middle-income countries according to the World Bank income classification in 2018. Panel A presents IV results, while Panel B presents 1^{st}-stage results. In Panel A's odd-numbered columns, imports and exports are the regressors while in even-numbered columns it is trade in intermediate goods and services (G-S) and trade in final G-S. Outcomes differ across columns in Panel A: in cols. (1)-(2), effective tax rate on capital, ETR_K; in cols. (3)-(4), effective tax rate on labor, ETR_L; in cols. (5)-(6), corporate income share of net domestic product; in cols. (7)-(8), mixed income share of net domestic product; in cols. (9)-(10), average effective tax rate on corporate profits. For details on the outcomes and the instruments, see Table 1 and 3. Relative to those tables, the drop in sample size in this table is due to availability of the type of trade classification. For each coefficient, we report in brackets the p-values which correct for multiple hypotheses testing, using the Romano-Wolf method. Multiple hypothesis testing is accounted for within each outcome between the two IV estimations (exports and imports; final G-S and intermediate G-S). At the bottom of each column in Panel A, we report the F-test for the equality of coefficients. In Panel B, cols. (1)-(2) correspond to the first-stage regression that instruments simultaneously for imports and exports; cols. (3)-(4) is the first-stage regression which instruments simultaneously for intermediate G-S and final G-S. In Panel B, we report the F-statistic of excluded instruments; the Sanderson-Windmeer multivariate F-test of excluded instruments; and, the Kleibergen-Papp F-statistic. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level. For more details, see Section D.2.

Appendix E Capital Liberalization Events

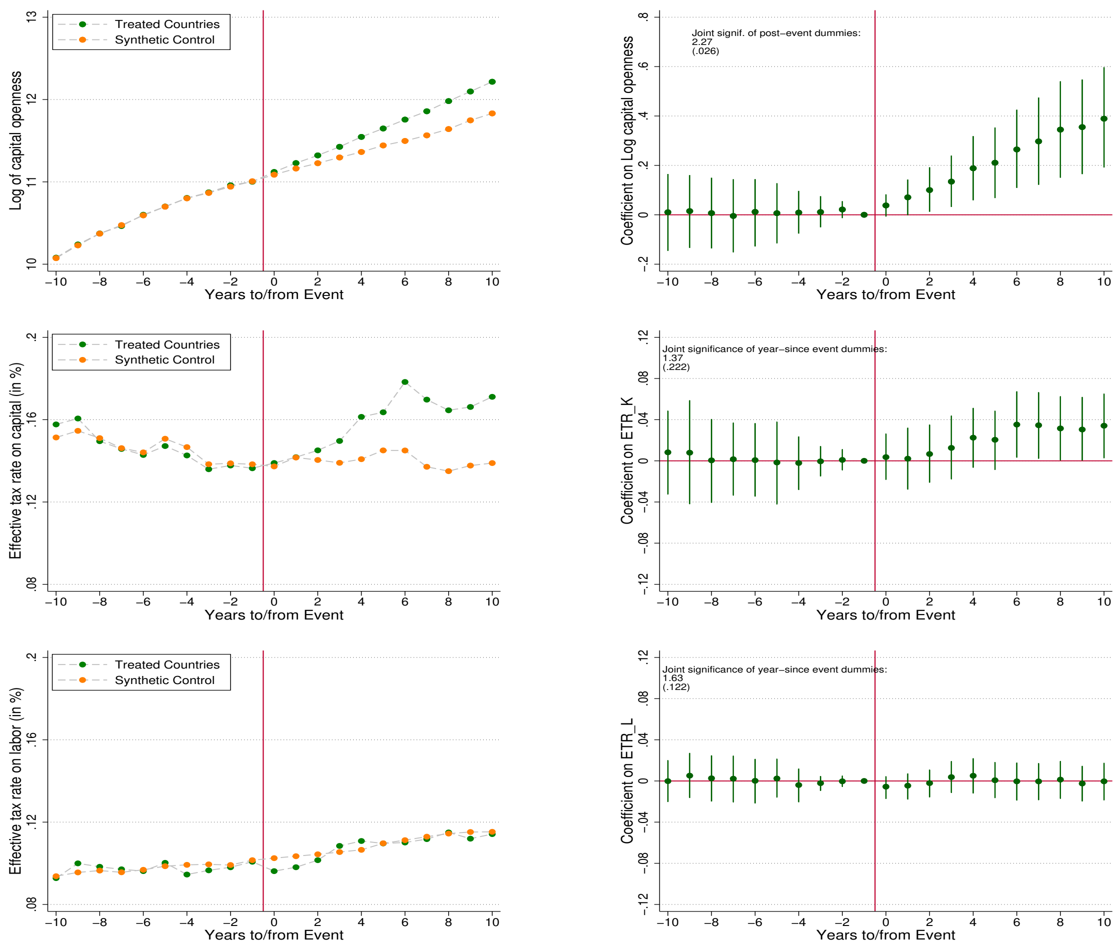
To attempt to investigate the impact of capital liberalization on effective tax rates, we draw on Chari et al. (2012). The authors measure capital liberalization events in 25 developing countries as the date when foreign investment in the domestic stock market was first allowed. They show that these events significantly increase foreign capital inflows, including foreign direct investment (FDI) and import of capital goods.[66] Compared to other policies aimed at lifting FDI restrictions, liberalizing the domestic stock market occurs at a precise point in time, is not marked by policy-reversal or net capital outflow, and is unambiguously related to capital liberalization (Eichengreen, 2001). We employ the empirical design of Section 5.1 and create a synthetic control country for each of the 25 treated countries and for each outcome. We measure capital openness as the total sum of the stocks of foreign assets and liabilities (Gygli et al., 2019). We find similar results when using alternative measures of capital openness, including portfolio equity assets and liabilities and the KOF financial globalization index (Gygli et al., 2019).

Figure E1 reports the event-study results. Relative to a stable pre-trend, we observe a sustained rise in capital openness precisely at the time of the event. ETR_K also increases, with a small lag to the timing of the capital liberalization event; in the medium-run, the positive effect on ETR_K is significant at the 5% level. There is no discernible effect on ETR_L. Similar to the reasoning for the trade tax-capacity mechanism, the inflow of foreign capital, as well as any subsequent increase in capital goods imports and aggregate investment, may positively impact ETR_K by contributing to general growth of firms or by causing an expansion of initially larger firms. Consistent with this interpretation, we find that the capital liberalization events led to increases in the corporate output share and the average corporate effective tax rate (results not shown but available).

One important limitation is that the events considered here remove restrictions on capital *inflows* and are not informative of the impacts of increased capital *outflows*. In general, more work is needed to understand the determinants of policies that impact cross-border capital flows in developing countries and their effects on ETRs.

[66]FDI includes green field investments (building plants from scratch) and cross-border mergers and acquisitions (M&A). Chari et al. (2012) note that M&A is impacted by stock market liberalization, makes up to 40-60% of FDI in developing countries, and can trigger subsequent green field investments.

Figure E1: Event Study of Capital Liberalization Reforms



Notes: These panels show event-studies for capital liberalization reforms in the 25 developing countries of Chari, Henry, and Sasson (2012). The panels correspond to different outcomes: capital openness (top panels); effective tax rate on capital (middle panels); effective tax rate on labor (bottom panels). Capital openness is the total sum of the stocks of foreign assets and liabilities, in constant USD. We use the log transformation for this outcome; results where the total sum is expressed as a percent of GDP are similar. The left-hand graphs show the average level of the outcome in every year to/since the event, for treated countries and for synthetic control countries. The right-hand graphs show the estimated β_e coefficients on the to/since dummies, based on equation (4) but where the trade liberalization events are replaced with capital liberalization events. The bars represent the 95% confidence intervals. Standard errors are clustered at the country level and estimated with the wild bootstrap method. The top-left corners report the F-statistic on joint significance of the post-event dummies, with the p-value in parentheses. Details are in Appendix E.