Globalization and Factor Income Taxation*

Pierre Bachas[†], Matthew Fisher-Post[‡], Anders Jensen[§], Gabriel Zucman[¶]

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Abstract

How has globalization affected the relative taxation of labor and capital, and why? To address this question we build and analyze a new database of effective macroeconomic tax rates covering 150 countries since 1965, constructed by combining national accounts data with government revenue statistics. We obtain four main findings: (1) The effective tax rates on labor and capital converged globally since the 1960s, due to a 10 percentage-point increase in labor taxation and a 5 percentage-point decline in capital taxation. (2) The decline in capital taxation is concentrated in high-income countries. By contrast, capital taxation increased in developing countries since the 1990s, albeit from a low base. (3) Consistently across a variety of research designs, we find that the rise in capital taxation in developing countries can be explained by a tax-capacity effect of international trade: Trade openness leads to a concentration of economic activity in formal corporate structures, where capital taxes are easier to impose. (4) At the same time, international economic integration reduces statutory tax rates, due to increased tax competition. In high-income countries, this negative tax competition effect of trade has dominated, while in developing countries the positive tax-capacity effect of international trade appears to have prevailed.

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[†]World Bank Research, pbachas@worldbank.org

[‡]Paris School of Economics, mfp@psemail.eu

[§]Harvard Kennedy School and NBER, anders_jensen@hks.harvard.edu

[¶]UC Berkeley and NBER, zucman@berkeley.edu

1 Introduction

How has globalization affected the relative taxation of labor and capital, and why? Has international economic integration eroded the amount of taxes effectively paid by capital owners, shifting tax burdens to workers? If so, which countries have been most affected by this process and through which mechanisms? Answering these questions is critical to better understand the macroeconomic effects and long-run social sustainability of globalization.

To address these questions, this paper builds and analyzes a database of effective tax rates on labor and capital covering more than 150 countries since 1965. Constructed following a common methodology, these series allow us to study trends in labor and capital taxation globally, comprehensively, and over a long period of time. Our database captures all taxes paid at all levels of government: corporate income taxes, individual income taxes, payroll taxes, property taxes, estate and inheritance taxes, consumption taxes, and other indirect taxes. This makes it possible to estimate total tax wedges—for instance the gap between what it costs to employ a worker and what the worker receives—and how these wedges vary internationally. Since capital income is always more concentrated than labor income, the relative taxation of the two factors of production is also closely linked to the progressivity of the tax system.

To maximize the time and geographical scope of this database, we conducted a large-scale digitization and harmonization of historical data published by national statistical offices, which we combine with existing (but limited in coverage) series published by the United Nations, the OECD, and the IMF. The construction of our effective tax rates proceeds in three steps. Using national accounts data we first compute total labor and capital income in each country. Using government revenue statistics we then classify all government revenue sources into either labor taxes, capital taxes, or indirect taxes. Combining these two inputs, we compute effective macroeconomic tax rates on labor and capital by dividing labor or capital taxes paid by the corresponding income flow.

From this database, we are able to make two main contributions. The first is to establish a set of facts on the evolution of factor income taxation. Taking a global perspective, we find that average effective labor and capital tax rates have converged globally since the 1960s,

due to a 10 percentage-point increase in labor taxation and 5 percentage-point decrease in capital taxation. This decline in capital taxation is driven by a collapse in the taxation of corporate profits, from close to 30% in the 1960s to less than 20% in the late 2010s. The rise in labor taxation owes primarily to the expansion of payroll taxes.

Our most striking findings involve the evolution of capital taxation. We uncover an asymmetric evolution of capital taxation across countries of different development levels. In high-income countries, effective capital tax rates collapsed, from close to 40% in the post-World War II decades to about 30% in 2018. For instance, in the United States, the average effective capital income tax rate fell from more than 40% in the 1960s to 25% in 2018. By contrast, in developing countries effective capital tax rates have been on a rising trend since the 1990s, albeit starting from a low level. Effective capital tax rates rose from about 10% in the 1990s to 20% in 2018, with the increase happening primarily in large economies. Between 1995 and 2018, for example, the effective capital tax rate rose from 10% to 30% in China, 18% to 28% in Brazil, 7% to 11% in India, and 5% to 10% in Mexico. This increase is one factor explaining the rise in the overall tax-to-GDP ratio of developing countries, along with the increase of indirect taxes and a slow but steady rise in labor taxation.

This rise of capital taxation in low- and middle-income countries had not been noted in the literature before, due to the lack of systematic data on the evolution of tax structures in developing countries. The finding appears to be robust. It holds when we exclude China and oil-rich countries; when we restrict the analysis to a balanced sample of countries; and under different weighting schemes. It holds with alternative approaches to computing capital and labor income in non-corporate businesses, where factor shares are not directly observable. It is also robust to alternative ways of assigning certain taxes to capital versus labor.

These findings present us with a puzzle: Why did effective tax rates on capital rise in developing countries while they fell in high-income countries in the era of hyper-globalization?

Our second main contribution is to formulate and test a hypothesis that sheds light on this puzzle. Our hypothesis is motivated by the observation that the increase in capital taxation in developing countries coincides with their trade liberalization. Between

the late 1980s and the early 2000s, many countries opened their markets and reduced tariffs. This policy revolution, combined with technological improvements (e.g., the rise of container shipping), led to a boom in international trade and reshaped the economy of countries such as Mexico, India, and China. We hypothesize that trade liberalization exerts a positive effect on developing countries' ability to raise tax revenue: by increasing the concentration of economic activity in formal corporate structures at the expense of smaller informal businesses, it facilitates the imposition of taxes, particularly of corporate taxes—a pro-tax-capacity effect.[1] Meanwhile globalization exacerbates tax competition and create new opportunities for tax avoidance, putting downward pressure on capital tax rates—a race-to-the-bottom effect. Our evidence suggests that in high-income countries the race-to-the-bottom effect has dominated, while in developing countries the tax-capacity effect appears to have prevailed since the mid-1990s.

To establish these results, we implement three research designs. First, we run non-parametric estimations of the five-year relation between changes in effective tax rates and changes in trade openness. Second, we analyze major trade liberalization events which occurred in seven large developing countries. These events are those that caused the largest and most sudden reduction in trade barriers, including for instance the often-discussed WTO accession of China in 2001 (Goldberg and Pavcnik, 2007; Goldberg and Pavcnik, 2016; Brandt et al., 2017). We use synthetic control methods to create counterfactuals for each country's event, and present event-study graphs. Last, we extend the two instruments for trade openness presented in Egger, Nigai, and Strecker (2019), to estimate the effect of trade on factor taxation.

In each case we find that trade openness leads to a large rise in effective capital taxation in developing countries, and a smaller increase in effective labor taxation. On the contrary, trade integration has a null or negative effect on capital taxation in high-income countries, but a positive effect on labor taxation. Although the sources of variation and identification

[1]Trade also encourages the adoption of modern accounting practices and leads to growth in firm size and the expansion of value chains. As large corporations are more visible and generate information trails (Kleven, Kreiner, and Saez, 2016; Basri et al., 2019), the literature is consistent with the hypothesis that trade-induced economic change could make the tax base more enforceable in low-tax-capacity states.

strategies involved are different in our three empirical specifications, our results are consistent across them and robust to a range of sensitivity checks.

To better understand these results, we study potential mechanisms using event studies and the instrumental variable research designs. Consistent with the tax-capacity hypothesis, we find that trade liberalization leads to a rise in the fraction of domestic product that originates from the corporate sector (at the expense of the non-corporate business sector) and to an increase in salaried employment (at the expense of self-employment). These changes lead to a growing fraction of output being produced and income being earned in sectors that are more visible and easier to tax. We also find that the positive impact of trade on capital taxation, in addition to being concentrated in developing countries, is stronger in populous countries and in countries with restrictions on capital flows. This finding is consistent with the notion that large countries and countries managing their capital accounts are less exposed to the race-to-the-bottom effect that has pushed capital taxation down in high-income countries. Last, trade liberalization is actually associated with a decline in statutory corporate tax rates across all countries, but more so in high-income countries. On net, the trade-induced increase in tax capacity dominates the statutory tax rate reduction in developing countries, and vice-versa in rich countries.

The rest of the paper proceeds as follows. In Section 2, we relate our work to the existing literature. Section 3 describes the methodology and data collection. Section 4 presents our findings on the evolution of effective tax rates over the long-run. In Section 5, we present graphical evidence on the association between trade openness and effective tax rates. Section 6 studies the impacts of major trade liberalization events. Section 7 presents instrumental variable estimates of the effect of trade liberalization and investigates heterogeneity and mechanisms. In Section 8 we analyse episodes of capital liberalization. Section 9 concludes.

2 Related literature

2.1 Globalization and taxation

Our paper first relates to the literature on globalization and taxation. Since Adam Smith (1776), economists have conjectured that increased openness pushes governments to reduce taxes on the most mobile factors of production (e.g., high-wage workers, capital) and recover the revenue shortfalls by increasing the taxation of less mobile factors (Bates, Da-Hsiang, and Lien, 1985; Rodrik, 1997). This effect is thought to be particularly strong for countries competing for capital (Wilson, 1999; Kanbur and Keen, 1993).

In an important contribution, Egger, Nigai, and Strecker (2019) show that globalization led to a decline in the progressivity of labor taxation in OECD countries since 1994 (namely, an increase in labor taxation for the middle class and a decline for the top 1 percent). Our approach, which focuses on the changing balance of labor vs. capital taxation in both OECD and non-OECD countries, is complementary. For OECD countries, our findings reinforce Egger, Nigai, and Strecker (2019): we show that in addition to reducing labor tax progressivity, globalization has been associated with a sharp decline in capital taxation. This decline reduces overall tax progressivity (above and beyond the decline due to falling labor tax progressivity) given the concentration of capital income at the top.

Our paper also adds to the macroeconomic literature on the link between trade and taxes. Due to the lack of systematic statistics on the evolution of tax structures in developing countries, this literature has focused on high-income countries or a single tax (e.g., the corporate income tax).[2] Our contribution to this literature is to build and analyse a new global dataset of effective tax rate, extending prior work which focused on developed countries (Mendoza, Razin, and Tesar, 1994; Carey and Rabesona, 2004; McDaniel, 2007). This allows us to uncover new trends (most importantly, the rise in capital taxation in

[2] Rodrik (1997) finds that trade openness is associated with a decline in effective capital tax rates and an increase in effective labor tax for 14 OECD countries with high levels of capital mobility, between 1965 and 1991. In a sample of 14 OECD countries between 1981 and 1995, Swank and Steinmo (2002) finds that trade is not associated with changes to effective tax rates, neither on capital nor on labor. Over the same period Slemrod (2004) finds that trade is not associated with changes to the statutory corporate income tax rate.

developing countries in the era of hyper-globalization) and to formulate an hypothesis that can explain this dynamic.

2.2 Tax capacity in developing countries

Our paper also relates to the growing literature on tax capacity in developing countries. This literature highlights a number of factors driving the rise of taxation over the path of development, including the rise of salaried employment (Jensen, 2021), growing capacity to observe income (Pomeranz, 2015), the threat of whistle-blowing in large firms (Kleven, Kreiner, and Saez, 2016), and investments in tax capacity (Besley and Persson, 2014). We complement these studies by investigating the role of a new channel, international trade. The increase in effective tax rates we document in response to trade liberalization is consistent with previous studies showing that trade has a positive effect on growth (e.g., Goldberg and Pavcnik, 2016) and growth is associated with higher tax rates (e.g., Besley and Persson, 2014). Our approach goes further by showing the direct role of trade openness and documenting mechanisms through which trade liberalization affects effective tax rates (namely an increase in the corporate share of domestic product and a transition from self-employment to salaried employment).[3]

Last, we add to a body of work in economic history documenting the long-run evolution of tax revenue and tax capacity (Cogneau, Dupraz, and Mesple-Somps, 2021; Cogneau, Dupraz, Knebelmann, et al., 2021; Albers, Jerven, and Suesse, 2020).[4] A strand of that literature studies the tax revenue effects of trade liberalization and the extent to which lost tariff revenues were compensated by other taxes, in particular the value-added tax (Baunsgaard and Keen, 2009; Cage and Gadenne, 2018; Buettner and Madzharova, 2018). Our paper complements this work by focusing on effective labor vs. capital tax rates in

[3] We also find that trade liberalization increases the effective tax rate on labor, suggesting that it raises labor formality. Recent work shows this is the case for the tradable sector (e.g., Dix-Carneiro, Goldberg, et al., 2021), but the evidence of the impact of trade on overall labor formality in developing countries is mixed (e.g., McCaig and Pavcnik, 2018; Dix-Carneiro and Kovak, 2017; Attanasio, Goldberg, and Pavcnik, 2004).

[4] These studies cover a century of tax revenue, dating from pre-independence, respectively for French colonial Africa, and all of Africa.

addition to total tax revenues, and by implementing several identification strategies to capture the causal effect of trade.[5]

3 Construction of factor shares and effective tax rates

This section describes the construction of our database of effective tax rates on labor and capital. The data covers the 150 most populous countries from 1965 to 2018, with exceptions only for pre-independence, civil war, and command economy eras. The database is available online at http://globaltaxation.world along with country-specific visualizations and notes. Here we focus on the general methodological principles.

3.1 Conceptual framework and methodology

3.1.1 Factor shares

We begin by decomposing each each country's output into a labor and capital component. Following standard national accounts definitions, net domestic output Y at factor prices (i.e., before indirect taxes) can be expressed as:

$$Y = CE + OS_{CORP} + OS_{HH} + OS_{PUE} \tag{1}$$

where CE is compensation of employees (wages, salaries, plus supplements to wages and salaries such as contributions to pensions); OS_{CORP} is the operating surplus of corporations (profits, net of depreciation); OS_{HH} is the operating surplus of households (actual and imputed rental income); and OS_{PUE} is the operating surplus of private unincorporated enterprises, or mixed income.

[5] Cage and Gadenne (2018) find that trade liberalization led to a decrease in overall tax revenue pre-1995. Our paper highlights positive revenue effects of trade liberalization but looking at different outcomes (effective capital and labor tax rates, as opposed to indirect tax revenues) and sample periods (the positive effects we obtain are concentrated after 1995). We also complement Buettner and Madzharova (2018) who shows that lost tariff revenue from WTO accession events in the 1990s were fully compensated.

The capital share of net domestic output, denoted α is computed as:

$$\alpha = \frac{Y_K}{Y} = \frac{OS_{CORP} + OS_{HH} + (1-\phi) \cdot OS_{PUE}}{CE + OS_{CORP} + OS_{HH} + OS_{PUE}} \tag{2}$$

where ϕ is the labor share of mixed income. The labor share of net domestic output, $1-\alpha$ equals compensation of employees plus a share ϕ of mixed income:

$$1 - \alpha = \frac{Y_L}{Y} = \frac{CE + \phi \cdot OS_{PUE}}{CE + OS_{CORP} + OS_{HH} + OS_{PUE}} \tag{3}$$

Four points are worth noting. First, our output measure is net domestic product, that is, operating surplus is measured net of capital depreciation. Throughout this paper we focus on net-of-depreciation output concepts, as in, e.g., Karabarbounis and Neiman (2014) and Guerriero (2019). Second, as is standard in the literature (see Browning, 1978; Saez and Zucman, 2019), we do not allocate indirect taxes to labor or capital; we instead compute factor shares of domestic product net of indirect taxes. Third, public-sector enterprises are usually included in the corporate sector (see Lequiller and Blades, 2014). Last, we compute factor shares of domestic output (as opposed to national income). This is the most logical thing to do for our purposes, since countries typically try to tax domestic output.[6]

The labor share of mixed income In the data we collected (discussed in Section 3.2), we observe all components of equations (3) and (2), except for the labor share of mixed income, ϕ. Measuring the labor component of self-employment and unincorporated enterprises' income is challenging, as discussed in Gollin (2002) and Karabarbounis and Neiman (2014). For our benchmark series we follow the literature in assuming that $\phi = 70\%$ (see Guerriero, 2019). To test for robustness, we also implement the method discussed in Young (1995), Gollin (2002), and Guerriero (2019) and developed further in Cette, Koehl, and Philippon (2020) and ILO (2019). This method imputes to the self-employed a labor income similar to the wage they would have earned in an employer-employee relation, based on observable characteristics. We extend the estimates in ILO (2019), using ILOSTAT (2021)

[6]For example, residents in Lesotho may earn labor income in South Africa, and corporations resident in France may book profits in Ireland. Wages earned in South Africa are included in Y_L for South Africa (not Lesotho); profits booked in Ireland are included in Y_K for Ireland (not France).

data on self-employment shares of the workforce, to all countries since 1991, and impute the series backwards to complete it. Details are in the data Appendix B.

3.1.2 Effective tax rates on capital and labor

We allocate each tax revenue source to labor, capital, or a mix of the two. Specifically, (1) Corporate income taxes, and wealth and property taxes are allocated to capital income. (2) Payroll taxes and social security payments are allocated to labor income. (3) Personal income taxes (PIT) are allocated between labor and capital, reflecting the fact that personal income is composed of salaries, capital income, and mixed income. (4) Indirect taxes are not assigned to a factor (if they were, they would be proportional). Table A1 summarizes our allocation.

PIT allocation to factors of production When the PIT includes both labor and capital income and the tax base covers a large share of the population, studies find that around 15% of PIT collection is from capital income.[7] We adjust this assumption in two ways, to account for countries with narrower PIT tax bases and/or dual tax schedules (one tax schedule for labor income, another for capital income). First, countries with a high PIT exemption threshold, and thus many exempted income taxpayers, have a larger share of capital income in their PIT, since richer taxpayers derive a larger share of their income from capital. We use data from Jensen (2021), which systematically documents the location of the PIT threshold across countries, to adjust for the share of capital income in the PIT at the country-year level. Second, some countries offer more favorable tax treatment to dividends than to labor income, thus lowering the share of capital taxed through the PIT. Using data from the OECD on whether dividends receive a lower tax rate, we compute the ratio of the statutory rate on dividends to that of the top rate on labor income, and adjust the capital share of PIT revenue down when this ratio is below one.

[7] This PIT revenue from capital income includes taxes on dividends, on the capital share of self-employment income (see above), and on capital gains. OECD (2020) revenue data reports the latter (PIT revenue from capital gains). From 2010-18, among 27 countries that report some capital gains tax revenue within PIT revenue, this revenue averages just under 4% of PIT revenue. In the US, that number is 7.5%. Of course, many countries do not tax capital gains as such, and most countries tax other forms of capital income within the PIT system.

These adjustments imply that the share of PIT revenue we allocate to capital depends on the location of the PIT exemption threshold, and on the relative tax treatment of capital and labor income in the PIT. The resulting share of PIT allocated to capital income varies between 7% and 35%, depending on countries and years. Over time, this share falls from a global average of 19% in 1965 to 14% in 2018, due to both a reduction in PIT exemption thresholds, and to the adoption of lower tax rates on dividends in some countries.

Effective Tax Rates The total tax revenue assigned to labor and capital is:

$$T_L = \sum [\lambda_{ic} \cdot \tau_i] \quad \text{and} \quad T_K = \sum [(1 - \lambda_{ic}) \cdot \tau_i] \tag{4}$$

where λ_{ic} is the allocation to labor of each type of tax τ_i in country c (see Table A1).

The effective tax rates on labor and on capital, ETR_L and ETR_K, are computed by dividing tax revenue collected by the size of the respective labor and capital tax bases:

$$ETR_L = \frac{T_L}{Y_L} \quad \text{and} \quad ETR_K = \frac{T_K}{Y_K} \tag{5}$$

These measures of macroeconomic effective taxation capture realized tax revenue, reflecting countries' historical tax rules and investment in capital and labor, building on the work of Mendoza, Razin, and Tesar (1994) and Carey and Rabesona (2004).[8] Compared to these pioneering estimates, our ETRs are global, cover over a half-century, and provide cohesion with national accounts by systematically integrating mixed income.

3.2 Data

3.2.1 National income components

Our novel factor shares database expands coverage beyond existing data—in both time and geography—with comprehensive estimates of disaggregated national income components. To estimate factor share statistics for 156 countries since the 1960s, we create a harmonized

[8]The measures of ETRs computed in (5) are called 'backward-looking' ETRs in the literature. A separate literature tries to model all statutory features of the tax system at a point in time in order to measure 'forward-looking' ETRs (see, e.g., King and Fullerton, 1984; Devereux, 2004). They model incentives at the margin and predict taxes on new investments, but are less adapted to study long-term global trends.

panel of national accounts which combines data from the UN System of National Accounts, the World Inequality Database, and other sources. We briefly describe these sources here.

From the World Inequality Database (WID, 2020), we retrieve United Nations System of National Accounts data that covers 4,000 country-years, from the production and income accounts of the online UN SNA (2008) 'Main Aggregates and Detailed Tables.' In addition, the UN Statistics Division provided us access to their archival data on the components of GDP, with over 2,000 country-year observations from the 1960s and 1970s, framed in the SNA1968 format (UN SNA, 1968). Since the UN SNA data does not explicitly tabulate the share of capital depreciation (consumption of fixed capital) in national income for all country-years, we obtain this statistic from the World Inequality Database (WID, 2020).

To our knowledge, this is the first factor shares dataset that harmonizes SNA2008 with SNA1968 data, and the two series match well when they overlap.[9] A limitation of the SNA1968 historical data is that it does not disaggregate 'mixed income' and 'operating surplus of the household sector', but subsumes the two. Therefore, we impute the split of mixed income vs. household operating surplus in SNA1968 data according to the split that occurs in SNA2008 data at the year of stitching.[10]

Our work expands the reference dataset in Karabarbounis and Neiman (2014) along two dimensions. First, the integration of the SNA1968 data extends coverage in time and space.[11] Second, our definition of factor shares goes a step further: whereas Karabarbounis and Neiman (2014) focuses primarily on factor shares in the corporate sector, we retrieve the total economy (and sector) estimates by including mixed income and rental income (actual and imputed) in the estimation procedure. Appendix B provides details.

[9]The overlap usually occurs in the 1970s, as countries transitioned from the historical SNA framework to the modern one. The SNA1968 data contains the 'compensation of employees' and 'operating surplus of corporations,' so we have reason to be confident in minimal mismeasurement across eras.

[10]We also follow the United Nations guidelines to stitch these series together (UN, 2018). When national income components are missing, we rely on accounting identities or make simple interpolations.

[11]Karabarbounis and Neiman (2014) restrict their sample to online UN SNA 2008 data, and to countries with at least 15 consecutive years of complete-case data.

3.2.2 Tax revenue data

Having expanded the coverage of factor shares, our new tax revenue dataset aims to achieve two similar objectives. First, to collect disaggregated tax revenue data by type of tax (separating personal income taxes from corporate income taxes, and measuring payroll and property taxes). Second, to obtain a global coverage, with a focus on integrating previously unused historical data from developing countries.

We first gather existing high-quality data from OECD (2020) and ICTD/UNU-WIDER (2020) for recent years, and from the IMF GFS (2005) for older years. Second, we retrieved thousands of country-year observations of historical revenue data from the Harvard University Library archives,[12] as well as online data from national statistical offices and finance ministries. Third, we assign to each revenue source a tax label, following the OECD's tax classification (see OECD, 2020). Table B1 details the data sources used.

When available, OECD tax revenue data is our preferred source. This is because it covers and classifies all types of revenue (including payroll tax and decentralized tax revenues), usually back to 1965 for OECD countries. OECD data accounts for 41% of the country-year observations in our dataset. Its drawback is its limited coverage of non-OECD countries: in total it covers 93 countries, and only over the past two decades.

To increase coverage, we augment the OECD data with the tax revenue data from the ICTD/UNU-WIDER (2020) (17% of observations). This remarkable dataset achieves near worldwide coverage but, for our purposes, faces limitations: it only starts in the 1980s; it does not follow the tax classification of the OECD; it sometimes mixes personal and corporate income taxes; and often lacks payroll taxes and decentralized taxes. To address these shortcomings, we collect historical public finance data from government reports, primarily digitized from the Harvard Library archives (30% of country-year observations) and with the IMF GFS (2005) offline historical database (10% of observations).[13]

To stitch together country-by-country time series of tax revenues, we follow three principles. First, we aim to only rely on a maximum of two data sources by country: the

[12] Lamont Library, Government Documents section.

[13] The ICTD/UNU-WIDER data draws principally from the IMF GFS online data, which covers well the past few decades. Our use of the IMF data is restricted to the offline historical dataset, which covers 1972-89 and fills gaps from the OECD and historical archives data. The ICTD does not report pre-1980 data.

OECD when it exists, and the alternative source with the best coverage over time and by tax type. Archival data is our second in priority since it often dis-aggregates revenue by source, and goes back to the 1960s. However our data hierarchy choice also depends on which source best matches the OECD data over their shared time frame. Second, we interpolate series with gaps, but only up to four years between two data points. Finally, we check country-specific policy reports and scholarly studies to triangulate across data sources and to identify events which may explain discordance across sources.

Tax revenues are disaggregated as finely as possible by source, according to the OECD tax classification (OECD, 2020). To measure taxes on capital and labor, we focus on three dimensions. First, we separate income taxes into personal and corporate income.[14] Second, we include payroll taxes, which requires at times to add new data sources (we digitized payroll taxes from the UN SNA and from Fisunoglu et al. (2011)). Third, we retrieve taxes on property (the main source of decentralized tax revenues), paying attention to countries with a federal tax system and substantial subnational government revenues.

3.2.3 Other datasets

International trade: We use UN COMTRADE (2020) to measure exports and imports.
Capital openness: We use data from Lane and Milesi-Ferreti (2017) to measure cross-border capital flows.
Statutory tax rates: Our data on statutory corporate tax rates comes from Vegh and Vuletin (2015) and Tax Foundation (2019).

4 Global trends in tax revenues, factor shares and effective tax rates

Data coverage Our new dataset achieves a substantial improvement in coverage of factor shares and factor taxation. Figure A1 shows that its coverage fluctuates from 86% of World

[14] In some cases, this split is not available in the headline, official income tax revenue aggregates, so we look to expert studies elsewhere, as above.

GDP in 1965 to 98% in 2015, as the number of countries grows from 78 to 156.[15] The main entrance event into the panel corresponds to the early 1990s transformation to market economies of the former communist countries. This includes Russia and China, for which a modern market-based tax system arguably appears in 1994 (World Bank, 2008).[16] Late decolonization and end of civil wars are other reasons to enter the panel later than 1965.

Thus 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 98% of World GDP. At their time of entry into the dataset, ex-communist countries account for 8% of World GDP (4.5% for China and 3.3% for Russia). We discuss how their entry impact the taxation patterns described below.

With this new dataset, we document the global evolution from 1965 to 2018 of tax revenues, factor shares, and effective taxation on capital and labor. Our objective is to show time series for each outcome which can be interpreted as the global value worldwide, in each year. For example, the global effective tax rate on capital equals worldwide capital tax revenue divided by worldwide capital income in the same year. Its interpretation is the expected tax rate that a unit of capital chosen at random across the world would face at that point in time.[17] For each outcome we first show the global trends, and then show separately high vs low and middle-income countries.

Tax revenues Figure 1 shows the time series of tax revenue as a share of net domestic product (NDP), separated into its main components: corporate income taxes, property and asset taxes, personal income taxes, payroll taxes, and indirect taxes (VAT and tariffs). Globally, tax revenue as a share of NDP increased from 26% to 32% between 1965 and 2015. This is driven by an increase in payroll and personal income taxes, which went from 11%

[15] Even in the most recent years we do not cover 100% of world GDP, as we did not try to collect data from countries with under 1 million inhabitants when these were not available through online sources.

[16] See Appendix B.3 for a case study of China's taxation leading to a modern tax system.

[17] Note that global figures depend on countries' changing shares of world GDP: Figure A2 shows how the weight of different countries evolved over time, highlighting the notable growth of China's weight in the past 20 years, and to a lesser extent that of other developing countries. The weight of China, in world GDP, was far less in the pre-1994 era during which it is excluded. Refer to Appendix B for further discussion.

to 16%. Indirect taxes slightly rose over the past 50 years from 8% to 9%, while revenues from taxes on capital (corporate and property) stagnated at around 6%.

We observe two striking differences in tax revenue patterns between high-income versus low- and middle-income countries. First, tax revenue as a share of NDP is currently much higher in rich countries than in developing countries (37% vs. 23%), as is already well documented. Second, in developing countries, all types of taxes increase their revenue collection over time (particularly from 1990 onward), including those on capital. By contrast, corporate income tax revenue decreased over time in high-income countries, and revenues from property taxes stagnated. Rising tax revenue in rich countries came primarily from the expansion of payroll taxes between 1965 and 1985.

Factor shares Figure 2 shows the capital share of net domestic product over time (solid line) and the capital share within the corporate sector (dotted line). The capital share of world income increased from 20% to 26%. This global trend is due to modest rises in the capital share of both rich countries (from 25% to 28%) and developing countries (from 36% to 38%) and to the increasingly large weight of developing countries in world income. The capital share within the corporate sector followed the same evolution as the aggregate capital share: it increased from around 19% in 1965 to 28% in 2015.

Effective tax rates Figure 3 shows our key time-series: the evolution of the effective tax rates on labor (red) and capital (blue); and, within capital income, the evolution of the effective tax rate on corporate profits (dashed blue).[18] Globally, the ETRs on labor and capital converged between 1965 and 2018. This is due to a large increase in labor taxation and a mild decrease in capital taxation. The global ETR_L increased from 16% to approximately 25%, while over that same period, the ETR_K decreased from an average of 32% in the mid-1960s to 27% in the late 2010s. Within the corporate sector, the global ETR on corporate profits saw a more pronounced decline, from 27% in 1965 to 18% in 2018.[19]

[18]The ETR on corporate profits is computed as the ratio of the revenue from the corporate income tax over the operating surplus of the corporate sector.

[19]Figure A4 shows the ETR series in a fully balanced panel of all countries since 1965, by way of imputation, to control for the changing sample composition over time (most importantly China and Russia missing pre-1994). Imputing missing values has limited impact on the global ETRs series, since the countries entering

These global trends mask important heterogeneity by development level. The decline in the ETR on capital is entirely concentrated in high-income countries, where it went from close to 40% in 1965 to about 30% by 2018. In contrast, the ETR_K doubled in developing countries from 10% to 20% over the long-run, following a steep acceleration after 1995. Despite this impressive convergence, the level of effective capital taxation is still significantly below that of rich countries. Over the past 50 years, the ETR_L did not converge: it increased by more in developed than in developing countries, even though the base was already much larger in rich countries (18%) than in poorer countries (6%) in 1965.

One of the most notable pattern of our data is the sizable increase in effective capital taxation within low- and middle-income countries, starting in 1990. The increase in ETR_K is a surprising and novel finding which is robust to a variety of sensitivity analyses. Figure 4 shows the evolution of ETRs in several subsamples of developing countries. The most sensitive subsample is the one which excludes China; the ETR_K only rises from 10% to 13% between 1995 and 2018. This highlights the importance of China's rising capital taxation, and its extraordinary growth (and thus global weight) over the past 25 years. While it appears to minimize the scope of our results, the next panel shows that excluding oil-rich countries (defined as deriving 7% or more of their GDP from oil) leads to a much stronger rise in ETR_K post 1990, which goes from 10% to 24%. We also observe that removing oil-rich countries leads to more stable series, and a flat effective capital taxation pre-1990. Given the specificity of corporate tax revenue of oil-dependent countries, we think that a fairer comparison to the benchmark series is one that excludes both ex-communist countries and oil-rich countries. The series for this subsample is shown in the mid-right panel, where we again observe a large rise in ETR_K.

Thus, the growth in ETR_K reflects more than China's rise. Figure A5 shows the evolution of ETRs in the most populated developing countries. In a majority of large countries ETR_K increased between 1990 and 2018: for example, India's rose from 6 to 11%, Indonesia's from 10 to 16%, and Brazil's from 10 to 28%. The bottom panels of Figure

in 1994 only represent 8% of global NDP at that time, and Russia's ETRs are close to the global average upon entry (but China's are lower, which explains the drop in adjusted ETR_K and ETR_L series pre-1994.). Focusing on developing countries only (1994 entrants now represent a third of total NDP), the imputation of missing country-years raises slightly the pre-1994 ETR on labor and on capital by 2 percentage points, due to Russia's higher levels, while China's ETRs match developing countries' average in 1994.

4 divide the sample between the 18 largest (non-oil rich) developing countries whose population exceeds 40 million, and the 55 countries with population under 40 million. The rise in ETR_K is much more pronounced in large countries, where it increases from approximately 10% to 25%, while the rise is modest in smaller countries (from 8% to 12%).

5 Correlation in trade and factor income taxation

5.1 Motivation

What are the determinants of the long-run trends in factor taxation? A natural starting point is the large literature which focuses on the role of globalization. Cross-border trade in goods and services has grown substantially (relative to GDP) in both developed and developing countries since the 1960s; this increased openness was driven in part by the rise of global value chains (Feenstra and Hanson, 2001), where the production process is fragmented across borders and firms rely on foreign subsidiaries and contractors. The literature argues that firms' ability to shift production processes across borders limits the governments' capacity to tax the productive factors. The long-run decline in ETR_K in rich countries is consistent with this hypothesis.[20] However, we saw that since the 1990s developing countries saw a rise in ETR_K at the onset of the hyper-globalization period.

Focusing on developing countries, we observe that the positive association between trade and capital taxation runs deeper: when we separate countries based on their initial level of trade in the pre-1995 period, early globalized countries saw trade and the ETR on capital rise in tandem prior to the 1990s, and stagnate thereafter (Figure A7). Developing countries which participated in the 'second wave' of globalization (after the early-1990s proliferation of trade agreements) saw an increase in their trade and capital taxation in the past 25 years. These heterogeneous trends motivate our systematic analysis of the impact of globalization on factor taxation in the remainder of the paper.

We note that both trade in goods and services, through the cross-border fragmentation of production processes, and capital flows, are important dimensions of globalization and

[20]The long-run decline in statutory corporate tax rates is also consistent with this hypothesis (Figure A6).

often correlate with each other.[21] However, internationally comparable data are more widely available for trade than for capital flows, and the literature focuses primarily on causal determinants of trade openness. For these reasons, we focus on trade as the main measure of globalization. We return to capital openness in Section 8.

5.2 Correlation over time

Our first empirical strategy simply presents the within-country association between trade and our outcomes of interest: factor shares and effective tax rates on labor and capital. We measure trade as the share of imports and exports relative to GDP. We create 5-year growth rates within-country in both the trade measure and the outcomes. To visualize these associations, we plot binned scatters of each outcome against trade, after residualizing all variables against year fixed effects. Each dot in the figure corresponds to a ventile (20 equal-sized bins) of the residualized trade openness distribution; we add back the mean of each variable to ease interpretation.

Figure 5 shows non-parametrically the medium-run within-country association, conditional on global time trends, but without any other controls or weights. We observe a positive association between the within-country growth in trade openness and ETR_K. Trade openness is also positively correlated with ETR_L, although the slope is smaller than for capital. We also observe a positive association between trade openness and the capital share of income; this association is almost twice as large for the corporate capital share. Trade may thus positively impact capital taxation in the economy, both through increasing capital's share of aggregate income and by raising ETR_K.[22]

[21] One might worry that total trade is a relatively crude measure, and prefer instead to measure specific types of trade separately, e.g., imports versus exports (see Goldberg and Pavcnik, 2016); or to disaggregate for a given product or industry or type of firm (as in McCaig and Pavcnik, 2018). However, we find that the export and import growth are strongly correlated; while the latter approach, although interesting, is less tractable at the aggregate country-year level of our analysis.

[22] The positive association between trade and the capital share contradicts classical trade models such as Heckscher-Ohlin (Ohlin, 1933), which predict that trade raises the country's abundant factor (labor in poor countries). Rather, it is consistent with bargaining models, in which opportunities to produce abroad improve capital owners bargaining position (Rodrik, 1998a; Harrison, 20050; Rodriguez and Ortega, 20060). It is also consistent with the global value chains (GVC) theory (Feenstra and Hanson, 2001): high-income countries focus on capital-intensive portions of the GVC and outsource labor-intensive processes to developing countries. Outsourced processes are still relatively capital-intensive for developing countries. Thus, trade integration benefits capital in both groups of countries, despite being the scarce resource in poorer ones.

Previous studies on ETRs and globalization mainly focus on rich countries. In Figure 6, we find that the association between trade and ETR_K differs between high- versus low- and middle-income countries: there is a mild negative slope between trade openness and ETR_K in high-income countries, compared to a steep positive slope in developing countries. While the negative slope in high-income countries is consistent with the cross-border mobility hypothesis (see Section 2), the opposite result in developing countries suggests that other channels, such as a pro-tax capacity effect of globalization, could determine how globalization impacts taxation differentially across development levels.

6 Event-studies around large trade liberalization events

6.1 Empirical design

In this section, we analyse trade liberalization events in key developing countries. To discern sharp breaks from trends in our outcomes, we search for events which caused large trade barriers reductions. Consequently, we focus on the six events studied in the review papers by Goldberg and Pavcnik (2007) and Goldberg and Pavcnik (2016), and add the often discussed China WTO accession event of 2001 (Brandt et al., 2017). The resulting events are Colombia in 1985; Mexico in 1985; Brazil in 1988; Argentina in 1989; India in 1991; Vietnam in 2001; and China in 2001. These events present two compelling features. First, they are characterized by large reductions in tariffs, the easiest trade barrier to measure. For instance, Brazil reduced average tariffs from 59% to 15% percent, India from 80% to 39%, and China from 48% to 20%. Second, these events have been studied exhaustively before; since trade liberalization events do not occur in a vacuum and are often accompanied by other reforms, we can rely on the existing in-depth narrative of the conditions surrounding trade reforms to gauge threats to identification and to our results' interpretation.[23] Appendix C.1 details all seven trade liberalization events.

[23]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.

For each event and outcome, we construct a synthetic control country following the methodology in Abadie, Diamond, and Hainmueller (2010).[24] The synthetic control is created as a weighted average over the donor pool of countries. To construct the weights, we match on the level of each outcome in the 10 years prior to the event, as to minimize the mean squared prediction error between the event-country and the synthetic control countries in pre-event years. We then create event-study graphs showing the average of the outcome variable for treated countries vs synthetic controls by relative time to the event.

We also implement the event-study in a regression setting, where we include country and calendar year fixed effects, using the seven treated countries and their synthetic controls in the 10 years before and after the events:

$$Y_{it} = \sum_{j=-10, j\neq -1}^{10} \beta_j * \mathbb{1}(j = t)_t * D_i + \theta_t + \kappa_i + \pi_{Year(it)} + \epsilon_{it} \tag{6}$$

where θ_t are event-time fixed effects, κ_i are country fixed effects, and $\pi_{Year(it)}$ are year fixed effects. The year fixed effects control for common shocks to factor shares and taxation which may be correlated with clusters of reforms. D_i is a dummy equal to one if country i is treated. Hence, β_j captures the difference between treated and synthetic control countries in event time j, relative to the pre-reform year $j = -1$ (omitted period). Since, statistical inference based on a small samples should be approached with caution (Abadie, Diamond, and Hainmueller, 2010), we plot 95% confidence bounds based on the wild bootstrap method (Cameron, Gelbach, and Miller, 2008), clustered at the country-event level.

We run two more specifications to attenuate potential issues with synthetic control event studies. First, in addition to the dynamic effects model, we estimate the simpler difference-in-differences (DiD) model, where the coefficient measures the average treatment effect over the first 10 years post-liberalization, and compute coefficients based on the imputation method of Borusyak, Jaravel, and Spiess (2021), which addresses estimation issues from two-way fixed effects and heterogeneous event-times (Chaisemartin and D'Haultfœuille, 2020). Second, we are interested in the impact of trade liberalization on several outcomes (trade,

[24]The use of synthetic controls has recently been used in the analysis of policy reforms, both at the national level (Jaeger, Noy, and Schoefer, 2021; Gruber, Jensen, and Kleven, 2021; Smith, 2015) and sub-national level (Havnes and Mogstad, 2015; Billmeier and Nannicini, 2013; Akcigit et al., 2021).

factor share, factor taxation). Our baseline approach creates a separate synthetic control for each event and each outcome, which increases the likelihood of obtaining similar pre-trends (Akcigit et al., 2021); but implies that for a given country-event, the synthetic control countries might differ across outcomes. In parallel, we implement a design where we simultaneously match on all outcomes of interest for each country-event (similar to Jaeger, Noy, and Schoefer, 2021). All methodological details are in Appendix C.2.

6.2 Results

Figure 7 shows the results for the main outcomes. The left-hand panels display the event-studies in levels, while the right-hand panels display the regression-based event-studies. The top panels show that for trade openness the synthetic control matches the average treated country closely during the 10 years prior to the event.[25] Trade openness increases in the year of the event and its trend changes in post-reform years, compared to the stable pre-trends. The absence of a dip in the immediate pre-reform years limits concerns about intertemporal substitution, although some liberalization events were predictable (especially in China and Mexico where the event is WTO accession). Overall, as expected, trade increases substantially when countries slash their import tariffs.

Turning to our outcomes, we see that trade liberalization events coincide with a positive break from trend in the capital share of domestic product. The synthetic control continues on its slight upward trend.[26] The impacts on factor taxation are displayed in the bottom set of panels of Figure 7. We observe that ETR_K sharply increase following the liberalization event. Both ETR_K and ETR_L break from the stable pre-trend at the time of liberalization, but the effect on capital taxation is about double that on labor. Despite the small sample size, the dynamic post-treatment effect coefficients are typically significant at the 5% level; and the p-value for the joint significance of all post-reform dummies are well below 0.05. Based on the difference-in-differences model, the liberalization events led to a 10 percentage

[25] Table C1 details the synthetic control matches for each event and outcome.

[26] The stability of these patterns helps alleviate concerns that the true counterfactual level would be overstated if trade flows and returns to capital were diverted away from countries in the synthetic control.

point rise in trade openness over 10 years and a 4.8 (2.0) percentage point increase in the effective tax rate on capital (labor) (Table A2).

6.3 Robustness, interpretation and limitations

To test for robustness of the event-study results, we conduct several checks. First, we jointly match on all four outcomes for each event to create synthetic controls, instead of creating outcome specific synthetic controls. Figure A8 shows that this leads to a small deterioration of the pre-trends, but to very similar point-estimates. Second, to check that one specific event does not drive the results, we remove one treated country at a time; Figure A9 shows robust dynamic treatment effects for all subsets of treated countries. Finally, the last row of Table A2 shows that the results are similar, when we re-estimate the DinD coefficient following the imputation method of Borusyak, Jaravel, and Spiess (2021) to attenuate issues with the two-way fixed effects estimation.

We recognize that our set of treated countries is small and that liberalization events do not occur in a vacuum. The timing of the events could coincide with unobservable changes in determinants of factor shares and factor taxation. Yet, the relatively stable trends in treated countries pre-liberalization imply that these confounding changes would have to sharply coincide with the events. The narrative analyses of the reforms, reproduced from past studies in Appendix C, do not highlight obvious confounding shocks.

Even if the events are primarily trade related, our interpretation of the dynamic coefficients depends on whether other reforms or confounding economic shocks occurred in post-reform years (Rodriguez and Rodrik, 2001). As discussed in Appendix C, some countries implemented further trade reforms following the initial liberalization event: Mexico joined NAFTA in 1994; Argentina and Brazil joined MERCOSUR in 1991. Some countries also liberalized cross-border capital flows (Mexico removed capital inflow restrictions in 1989; India liberalized foreign direct investment rules in 1993). These reforms often occurred several years after trade liberalization, but we observe sharp effects in the first few years. The short-run results showing a swift break from stable pre-trends are thus more likely to be directly attributable to trade liberalization; however, we caution

against attaching too much importance to the specific medium-run coefficients as those incorporate further cross-border liberalization reforms, general equilibrium impacts, and other systemic reforms (Goldberg and Pavcnik, 2007). [27]

Finally, we note that our results are based on a selected set of trade liberalization events characterized by sharp tariff cuts, in large developing countries with constraints on capital mobility (Chinn and Ito, 2006). The impacts of trade liberalization are more likely to carry over to countries with similar characteristics (see also Section 7.3).

7 Regressions with instrumental variables for trade

7.1 Empirical design

In this section, we study the impact of trade in a regression setting, which permits the study of mechanisms and of heterogeneity by income levels. We use instruments to alleviate endogeneity concerns. We estimate how trade impacts factor shares and factor taxation:

$$y_{ct} = \mu * trade_{ct} + \Theta * X_{ct} + \beta_c + \pi_t + \epsilon_{ct} \tag{7}$$

where y_{ct} is the outcome of interest in country c in year t, $trade_{ct}$ is the share of import and exports in net domestic product and μ_c and π_t are country and year fixed effects. We cluster the error term, ϵ_{ct}, at the country level. We also estimate models which include, in X_{ct}, proxies for confounding determinants of factor shares and factor taxation: the exchange rate, gross capital formation, log of population, log of GDP per capita, and capital openness (Rodrik, 1997; Harrison, 2005).

OLS estimation may be biased due to reverse causality and unobservable confounding factors which correlate with changes in trade. Since we are interested in uncovering causal effects, the challenge is to find exogenous trade variation. This leads us to focus on the two instruments in Egger, Nigai, and Strecker (2019). The first instrument relies on the general

[27] Wacziarg and Wallack (2004) study if trade liberalization events in developing countries coincide with domestic reforms. Out of our seven events, only Mexico has a confounding domestic privatization reform within the first five years of our event-year; Brazil (privatization) and Colombia (broad market-oriented reforms) had confounding reforms between 5 and 10 years after liberalization; and, the remaining four countries had no confounding reforms. The results are robust to excluding Mexico (Figure A9).

structure of quantitative general equilibrium models of trade (Eaton and Kortum, 2002; Arkolakis, Costinot, and Rodriguez-Clare, 2012). Under the standard gravity model assumptions, this instrument uses the average bilateral trade frictions between exporting and importing countries as the source of variation (aggregated to the country-year level).[28] In our context, this instrument is valid if the distribution (not the level) of trade costs among individual country-trading pairs is not influenced by the level of factor shares or factor taxation in the import or export country.

The second instrument exploits the time-series variation in global oil prices interacted with a country-specific measure of access to international markets. Specifically, access at the country-level is captured by the variance of distance from the three most populated cities to the closest maritime port. Intuitively, this time-invariant measure captures the internal geography of a country which is an important component of transportation costs. Following a global shock to oil prices, the transportation costs will be larger in countries with less concentrated access to maritime ports, leading to a larger drop in imports and exports.[29] Conceptually, both instruments aim to capture variation in trade costs driven by exogenous economic forces. They are detailed in Appendix D.

We extend the data coverage of these instruments to our full set of countries and time periods. Since the IV estimate of equation (7) recovers a local average treatment effect (LATE), it is important to understand the relevance of each instrument across our full sample. Figure A10 shows that each instrument is relevant in different subsamples: the oil-distance instrument has a strong first stage in recent decades and in high-income countries, while the gravity instrument has a stronger first-stage in earlier time periods and in lower-income countries.[30] This reveals that an IV estimate based on either of the individual instruments will be driven by first-stage compliers with characteristics that differ from the representative country in the full sample. But, restricting the analysis to

[28]Other studies which leverage the structure of the gravity model to create instruments for trade include Frankel and D. Romer (1999), Wacziarg (2001), and Anderson and Wincoop (2003).

[29]In the transport logistics literature, oil prices are a key determinant of transportation costs (Gross, Hayden, and Butz, 2012; Storeygard, 2016).

[30]Conceptually, the oil-distance instrument may be stronger in high-income countries if economic development is associated with improvements in domestic road networks (holding the physical distances from cities to maritime ports constant). We measure transportation networks in the latest year available; this introduces possible measurement error which weakens the instrument's relevance in earlier periods.

subsamples where an individual instrument has a strong first stage biases the IV estimates upwards (Abadie, Gu, and Shen, 2019). To guard against this, we combine the two instruments, which also raises statistical power (Mogstad, Torgovitsky, and Walter, 2020), and estimate a LATE that is representative across income levels and time periods. The LATE identified with multiple instruments retains an intuitive interpretation: it is a weighted combination of the instrument-specific LATEs using the instruments one at a time.[31]

Finally, an attractive feature of these instruments is that they impact cross-border trade in different ways: Table A3 shows that the gravity instrument causes on average an increase in trade, while the oil-distance instrument reduces trade. Moreover, both instruments have significant impacts on imports as well as exports. As such, our IV-estimate reflects the broad impacts of cross-border trade through its increases and decreases of goods and services in and out of the country.

7.2 Main results

Table 1 presents the OLS and IV estimation of equation (7) for our core outcomes. Panel A shows the OLS results, while Panels B through D show different IV specifications. The OLS and IV coefficients display the same sign, but the IV coefficients are always larger. In Panels B-D we estimate the IV model. Panel B shows the IV weighted by countries' yearly national domestic product (NDP), our benchmark to mirror the global trends shown in section 4. The 1st stage shows a strong F-statistic of 26.07. The IV estimation yields a positive impact of trade on the capital share, both in national income and in the corporate sector.[32]

Turning to the effective tax on factor shares, the IV-results indicate that trade leads to statistically significant increases in the effective tax rate of both capital and labor, but the effect on capital (0.375) is twice as large as the effect on labor (0.163). The IV-coefficient on ETR_L is more precise (p-value = 0.003) than that on ETR_K (p-value=0.081), which, as we will see later, masks large heterogeneity across income levels.

[31]The weights are a function of the strength of each instrument in the first-stage regression in the full sample (Angrist and Imbens, 1995). In our setting, a stronger weight is placed on the oil-distance instrument (see first-stage regressions in Table A7).

[32]The re-allocation towards capital inside the corporate sector implies that our results are not confounded by a positive impact of trade on the corporate share of national income. Moreover, we relate to the previous literature on global trends in factor incomes which focuses on shares within the corporate sector.

The IV estimates in Panel B are globally representative, since they include country weights, but Panel C shows that the results are robust to removing these weights: the 1st stage strength is reduced (F-statistic=8.415), but the results are broadly similar. In particular, trade's impact on the effective tax on capital (0.250, p-value=0.018) remains positive, and larger than that on labor taxation (0.133, p-value=0.013).

In Panel D, we include the set of country-year varying controls contained in X_{ct} in addition to the NDP weights. The inclusion of controls can help improve the precision of the estimates and could increase the likelihood that the exclusion restriction holds. Indeed, the controls lower the p-values and trade continues to have a positive impact on the capital factor share, and a larger positive impact on capital factor taxation than on labor taxation. Throughout the panels, we see in column 5 that the coefficients on the ETR on corporate profits mirror that of ETR_K, and are more precise.

The IV-results are robust to a battery of checks. First, we show that they hold with different measures of trade intensity (Table A4). Second, since one of the instruments relies on oil price variation, we allow oil-rich countries to be on a separate non-parametric time path; this addresses the concern that our estimating variation is correlated with trends in factor shares and effective taxation specific to oil-producing countries, and re-enforces the results (Table A5). Third, the results are broadly similar when we change our measurement assumptions to construct factor shares and ETRs (Table A6). The results are robust to the alternative assignment of taxes to capital versus labor proposed by Mendoza, Razin, and Tesar (1994); to changing the share of the PIT assigned to capital vs labor; and to using the ILO (2019) method to attribute mixed-income to labor vs capital, although the coefficients on ETR_K and ETR_L are now closer. Fourth, the results based on each individual instrument are comparable to the joint IV results (Table A7).

Finally, Table A3 directly reports the reduced-form impact of trade on our outcomes, leveraging the fact that the two instruments have opposite effects on trade. We find that the effects of globalization are symmetric: expanded openness increases both ETR_L and ETR_K, while reduced cross-border trade decreases the effective taxation of both factors.

7.3 Mechanisms and heterogeneity by income levels

These results re-enforce the findings of the previous sections, that trade raises effective tax rates, especially on capital. One conjecture to explain these results is that trade exerts a pro-tax capacity effect: trade openness changes the structure of labor markets and corporations by concentrating economic activity in large capital intensive firms; in turn this relaxes tax enforceability constraints.[33] Although the tax capacity channel has not been studied in-depth before, a wide literature argues that trade exacerbates tax competition and increases tax avoidance opportunities, thus exerting a downward pressure on capital tax rates in rich countries (a race-to-the-bottom effect).

To shed light on each of these mechanisms we look at how trade impacts outcomes which more directly relate to each hypothesis (self-employment shares for tax-capacity, statutory corporate tax rates for the race-to-the-bottom). We then revisit previous results to check for heterogeneous impacts across income levels, since we expect the tax capacity effect to mainly operate in low and middle-income countries.

Outcomes linked to mechanisms Table 2 repeats the benchmark IV specification but looks at additional outcomes. Panel A shows that trade leads to a reduction in the statutory corporate income tax rate, thus supporting a race-to-the-bottom effect.[34] At the same time, Panels B and C show that trade causes a reduction in the share of workers in self-employment, and an increase in the corporate share of GDP.[35] Thus, two countervailing forces appear to be at play: the growth in employee-employment and of the corporate

[33]The literature convincingly shows that third-party information trails are key for tax enforcement (Pomeranz, 2015; Naritomi, 2019). Activities with limited third-party data, such as self-employment, lead to high tax evasion rates (Kleven, Knudsen, et al., 2011), and the movement from self-employment to formal wage employment is associated with growth in tax enforcement capacity (Jensen, 2021).

[34]In Appendix Table A8, we verify that corporate income tax rate changes are significantly associated with changes in corporate income tax revenue (% of GDP) and with ETR_K. Consistent with past studies on the determinants of tax policies (C. Romer and D. Romer, 2010; Zidar, 2019), the outcome variable is the first-difference of the CIT rate: $\Delta CIT_{t,t-1}$. Results are robust to alternative outcomes, including: the level of the CIT rate while controlling for the lagged CIT rate; and a reform-tracker which changes value when the CIT rate changes. Results available upon request.

[35]Table A9 also shows that trade primarily causes a transition from agriculture to industry, with a small positive impact on services. Thus, in this empirical setting, trade induces a transition from a commonly identified 'hard-to-tax' sector (agriculture) to an 'easy-to-tax' sector (industry).

sector raises tax enforceability, while active government policies in the form of reductions of the statutory corporate tax rate lower the tax burden on capital.

Heterogeneity by development level Motivated by the contrasting long-run trends of ETR_K in high versus low and middle-income countries, we investigate if trade impacts taxation differentially across development levels. We estimate heterogeneous IV effects by interacting the trade variable with a high-income country dummy:[36]

$$y_{ct} = \mu * trade_{ct} + \kappa * trade_{ct} * \mathbb{1}(HighIncome) + \Theta * X_{ct} + \beta_c + \pi_t + \epsilon_{ct} \tag{8}$$

The results are presented in Table 3. In Column (1), we find that trade has a strong positive effect on ETR_K in developing countries, but a null effect in rich countries. Column (2) shows that trade increases ETR_L in both samples, but that this effect is stronger in high-income countries. Column (3) finds that trade decreases the statutory corporate tax rate in both samples, although by more so in rich countries. In contrast, Columns (4)-(6) show that the positive effect of trade on the employee-share and the corporate share is entirely concentrated in developing countries, with null effects in high income countries. These results point to heterogeneous mechanisms depending on countries' income levels: globalization might have limited capital taxation in rich countries by putting downward pressure on statutory corporate tax rates; while in developing countries although statutory rates also fell, they were more than counteracted by the expansion of the capital tax base which became more enforceable. On net this led to a rise in effective capital taxation in developing countries.

The trade liberalization events (Section 6) took place exclusively in developing countries. In Appendix Figure A11, we find that the trade-events led to growth in the corporate share but had no important impacts on corporate tax policy. These mechanism results are strongly consistent with the IV analysis, and reinforce the plausible role of enforceability in mediating trade's impact on capital taxation in developing countries.

[36]The two instruments leverage distinct variation; as such, interpreting heterogeneous IV-coefficients is challenged by the possibility that each instrument captures different LATEs (Mogstad, Torgovitsky, and Walter, 2020). However, as previously discussed, the IV-estimates based on using each instrument separately are in the range of the estimates based on using both instruments simultaneously (Table A7).

Heterogeneity by country size and mobility of capital Beyond the split by development level, we estimate additional sources of heterogeneity which mediate the impact of trade on taxation. Concerns related to capital flight are more pronounced in small-market economies (Wilson, 1999) and in countries with few restrictions on capital mobility (Rodrik, 1997; Chinn and Ito, 2006). We test for these mechanisms, by looking at heterogeneous treatment effects for statutory tax rates and effective tax rates using equation (8).

Table 4 shows the results. In Panel A, we find that increased trade openness leads to a reduction in the statutory CIT rate which is stronger in smaller countries and in countries with limited restrictions on capital mobility. Mirroring this result, panel B, shows that the positive effect of trade on ETR_K only occurs in large countries (population over 40 Million) and in countries with capital restrictions. These results support the conjecture that the pro-tax capacity effects of trade happen simultaneously with the race-to-the-bottom effects: only countries that can limit capital mobility and tax avoidance are able to increase ETR_K when they open to trade. A further hypothesis is that countries which collect less revenue from capital due to trade liberalization, compensate by taxing more the immobile factor, labor, to balance their budget (Rodrik, 1998b). In Panel C, we indeed find that the rise in ETR_L is qualitatively larger in small countries and in countries without capital restrictions.

7.4 Impacts on tax revenue

To further substantiate the tax capacity hypothesis, we look at the impact of trade on overall tax collection as a share of GDP, including capital, labor and indirect taxes.[37] Table 5 shows the impacts of trade on different taxes by development level. Column (1) shows that in developing countries, trade openness leads to a significant increase in overall tax to GDP as opposed to a null effect in rich countries. The positive result for developing countries re-enforces the hypothesis that trade produces an increase in overall tax capacity, while the null result for rich countries is expected given their already high tax capacity.

Further, Table 5 breaks down the impact of trade on different tax revenue sources. In developing countries, the increase in total tax revenue with trade is primarily due to the

[37] Looking directly at tax revenue also alleviates potential concerns of weak statistical capacity in developing countries, which could bias our measures of national income components and thus ETR_L and ETR_K.

significant rise in corporate income tax. All other tax sources slightly rise with trade, but no coefficient is significantly different from zero. In high income countries the effect of trade on CIT collection is slightly negative (but insignificant). Among taxes mainly assigned to labor, the PIT collection does not change with trade, as opposed to payroll taxes which increases significantly in high-income countries. These results on labor taxes echo the literature: Egger, Nigai, and Strecker (2019) shows that trade shifts the tax burden of the personal income tax away from the top earners and towards the median worker without changing overall collection. The increase in payroll tax revenues re-enforces Rodrik (1997)'s insurance argument: to protect themselves against the economic fluctuations brought by trade openness, workers demand more social protection financed by payroll taxes.

7.5 Quantitative importance of trade openness

How should we think of the quantitative importance of trade in accounting for the rise in capital taxation in developing countries? First, we note that although the IV and event-study estimations (Section 6) rely on entirely different identifying assumptions and methodologies, they yield comparable results in magnitude. Under the strong assumption that the trade liberalization events only impact factor taxation via trade, the event-study results imply an impact on ETR_K of 0.489, compared to the IV-coefficient of trade on ETR_K in developing countries of 0.44 (Table 3). Taken at face value, this means that increasing trade by 10 percentage points raises ETR_K by 4 to 5 percentage points. Second, we can combines our ETR_K coefficient with the change in trade openness in developing countries between 1965 and 2018: this back of the envelope calculation implies that trade accounts for a rise in ETR_K of 3 percentage points. This number should be taken with caution, but suggests that a third of the long-run rise in ETR_K is explained by trade globalization.[38]

[38]Concretely, the long-run increase in trade openness is 7.01 percentage points (Figure A7) and the trade-coefficient for ETR_K is 0.44 (Table 3), hence $7.01 * 0.44 = 3.08ppt$. The long-run increase in ETR_K is 10.1ppt (Figure 3), thus yielding $3.08/10.1 = 0.305$

8 Capital liberalization events

Until now, we have studied one key dimension of globalization, in the form of trade openness, and its impact on factor income taxation. Given our interest in the taxation of capital, another relevant dimension of globalization is capital openness. However, due to differences in countries' reporting requirements for capital flows, data on capital openness is not as internationally comparable and available than data on trade (Egger, Nigai, and Strecker, 2019). Further, to our knowledge, the literature has not identified a credible instrumental variable for capital openness (Magud, Reinhart, and Rogoff, 2011; Alfaro, Kalemli-Ozcan, and Volosovych, 2005). Notwithstanding, we provide here some evidence on the impact of capital liberalization based on an event-study design.

We rely on Chari, Henry, and Sasson (2012) who identified capital liberalization events in 25 developing countries corresponding to the date when foreign investment in the domestic stock market was first allowed.[39] The paper shows that these seemingly narrow events actually greatly expand foreign capital flows into the country, including foreign direct investment (FDI), and raise the import of capital goods.[40] Compared to other reforms aimed at lifting restrictions on FDI, opening the domestic stock market internationally occurs at a precise point in time (other policies are often less precise and staggered); is not marked by policy-reversal or by net capital outflow; and is unambiguously related to capital liberalization (Henry, 2007; Eichengreen, 2001).

We employ the same empirical design as in in Section 6, and create a synthetic control for each treated country and outcome of interest (see Appendix C.3 for details). We measure capital openness as the sum of foreign assets and liabilities, as a share of GDP (Lane and Milesi-Ferreti, 2017). Figure 8 reports the results.[41] Starting from a stable pre-trend, we observe a rise in capital openness, precisely at the time of the event, which keeps on

[39] Removing restrictions on the stock market constitute a liberalization of the capital account in relation to domestic financial markets. Lane and Milesi-Ferretti (2009) find that capital account liberalization and domestic financial development are strongly correlated with financial integration across countries

[40] FDI includes both green field investments (building of plants from scratch) and cross-border mergers and acquisitions; the latter is directly impacted by stock market liberalization and makes up 40-60% of FDI in recent times in developing countries. It is likely that the increased foreign ownership on the stock market subsequently triggers an increase in green field investments.

[41] In Appendix Figure A12, we show that the results are robust to creating synthetic controls that are based on simultaneously matching all outcomes for each treated country.

building over the post-event decade. The ETR_K also increases, but with a few years lag relative to the event: in the medium-run, the effect is precisely estimated and significant at the 5% level.[42] There is no discernible effect on ETR_L. The absence of an increase in the capital share is intriguing; we note that Chari, Henry, and Sasson (2012) find large wage effects, suggesting a proportionate (and high) growth of both factor incomes. Foreign inflow of capital, as well as any subsequent increase in capital goods import and aggregate investment, may positively impact ETR_K by contributing to the growth of large, complex firms with employees and thereby raising the tax-enforceable share of capital income (Section 7.3). Consistent with a role for tax capacity, we find that the capital liberalization events led to a decrease in the non-corporate sectors (Appendix Figure A13).

Qualitatively, these results are consistent with those from the previous sections, suggesting that the positive impact of globalization on effective capital taxation in low and middle income countries is robust to using capital instead of trade openness. However, given the inherent limitations with the measurement of capital flows, we consider that our results based on trade openness provide more meaningful and robust insights into globalization's impacts on factor taxation.

9 Concluding remarks and perspectives

In this paper, we combine a new global database with several empirical strategies to provide novel evidence on trends and causal effects of globalization on tax structures worldwide. Our starting point is the systematic harmonization of novel historical national accounts data and dis-aggregated government revenue statistics. This data collection permitted the construction of a new measures of effective tax rates on capital and labor in 156 countries between 1965 and 2018.

Using this database, we make two contributions. First, we establish new facts. Taking a global perspective, the average effective tax rates on labor and capital have converged, due to a increase in labor taxation and a fall in capital taxation. We find differences between

[42]Consistent with our result, Quinn (1997) finds a positive correlation between de-jure capital account openness and corporate taxation as a share of GDP. Note that the events considered here remove restrictions on capital *inflows*; it is possible that increased capital *outflows* may, conversely, reduce ETR_K.

developed and developing countries: while the effective tax rate on capital fell in OECD countries, it increased in the rest of the world (albeit starting from a very low level) in the post-1995 period of hyper-globalization.

Our second contribution is to formulate and test a new hypothesis that sheds light on these diverging global trends: that trade liberalization exerts a pro-tax-capacity effect, by increasing the concentration of economic activity in large, formal corporate structures. Using a verity of research designs, we show that trade leads to a higher effective taxation of capital, but only in developing countries. For these countries, the base expansion channel has been quantitatively large enough to offset the negative tax-competition effect of globalization. In high income countries, by contrast, the tax-competition effects has dominated, leading to a decline in capital taxation.

In this paper we have taken a global and macroeconomic perspective on tax systems and inequality, focusing on factor income shares and effective tax rates on labor and capital. In future research, our database (available online) could be used to study the effects of globalization on tax progressivity and inequality between groups of individuals. By combining our macroeconomic tax rates on labor and capital with estimates of the progressivity of labor and capital taxes (for instance using tax simulators, as in Egger, Nigai, and Strecker (2019)), one could estimate changes in the progressivity of the entire tax system. Moreoever, these changes in tax progressivity could be compared to the effects of globalization on the distribution of pre-tax income. This would make it possible to quantify the extent to which changes in taxation caused by globalization have curbed or exacerbated the unequalizing effects of international economic integration.

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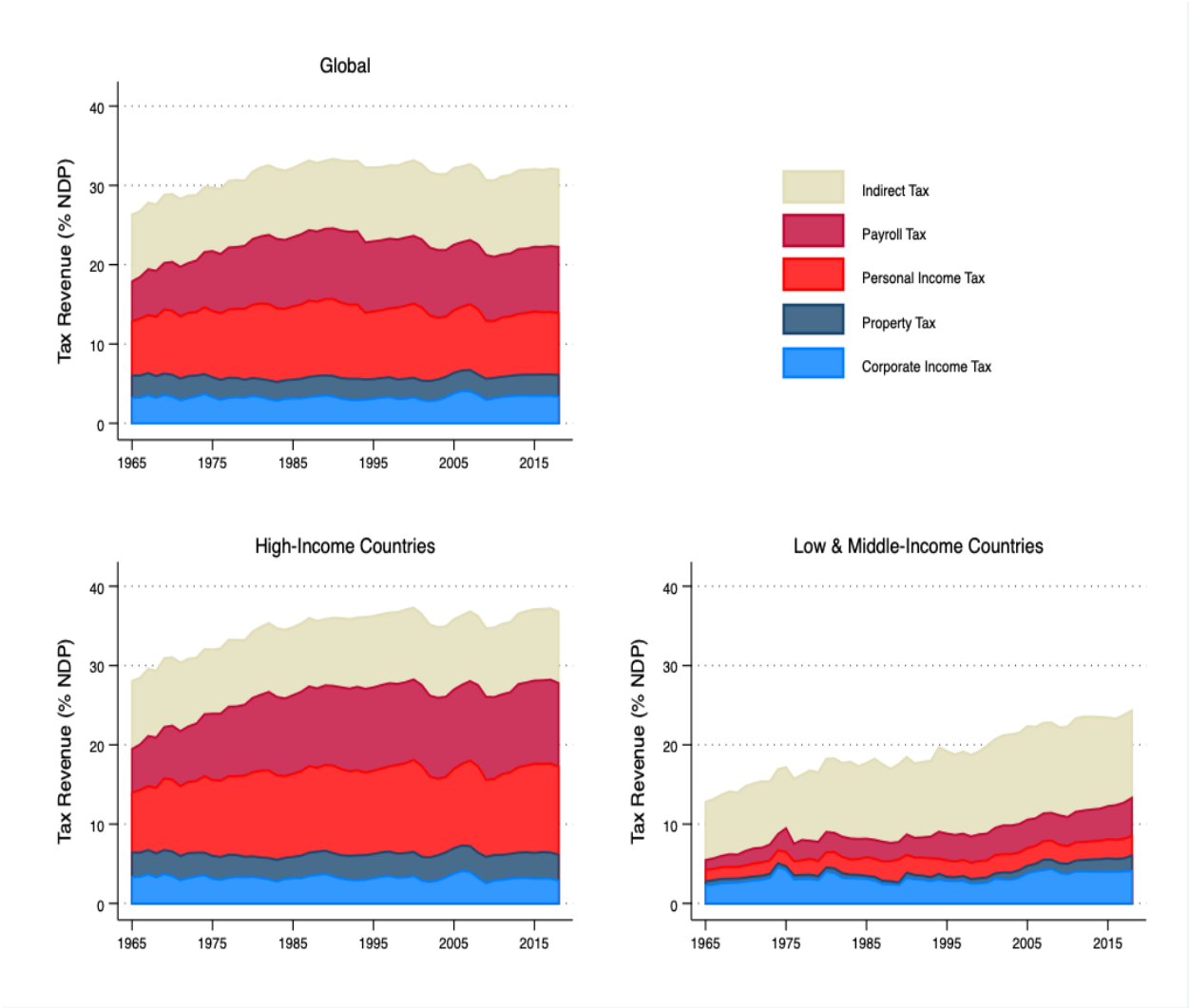
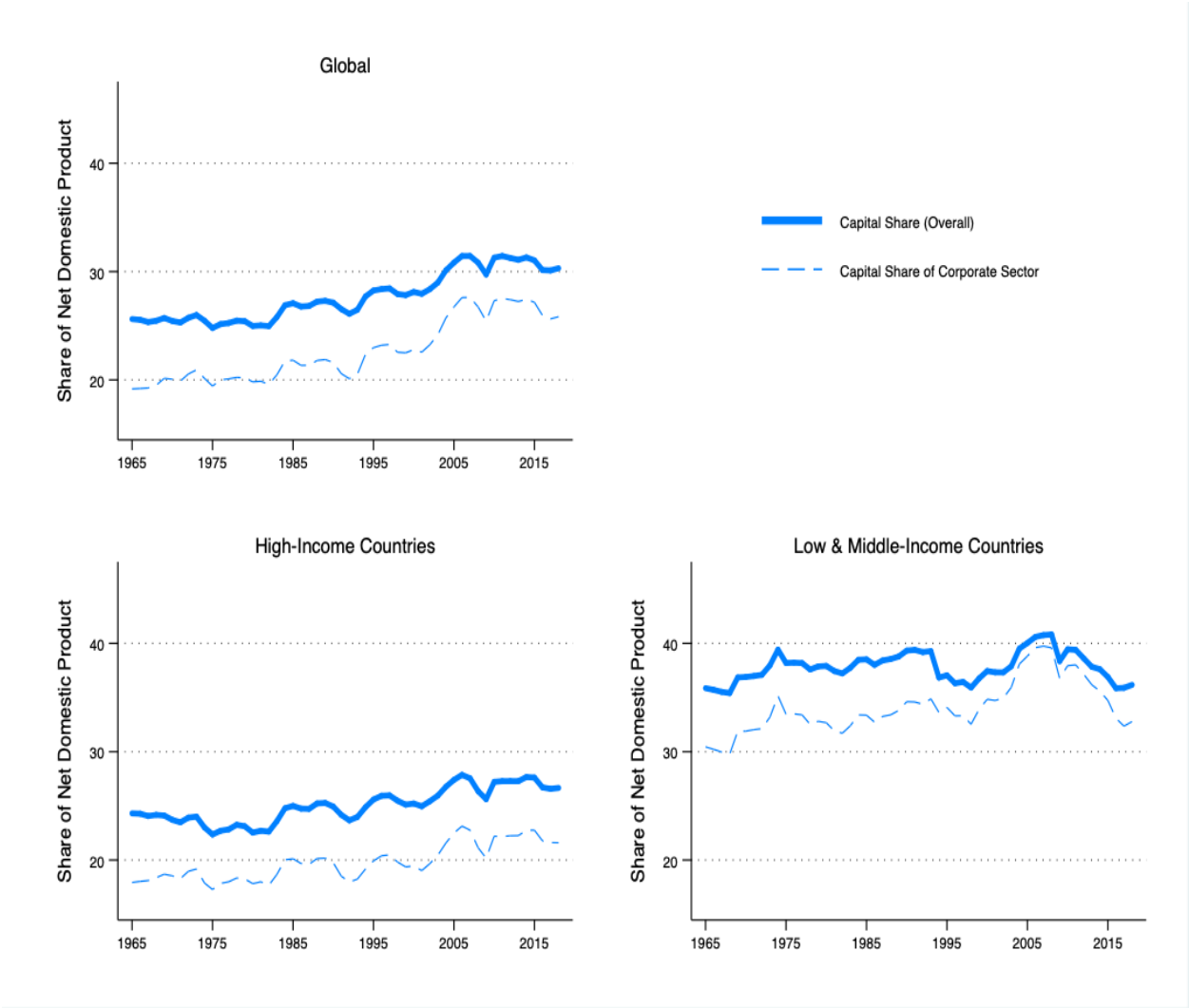
Figure 1: Tax Revenue as a Share of Domestic Product



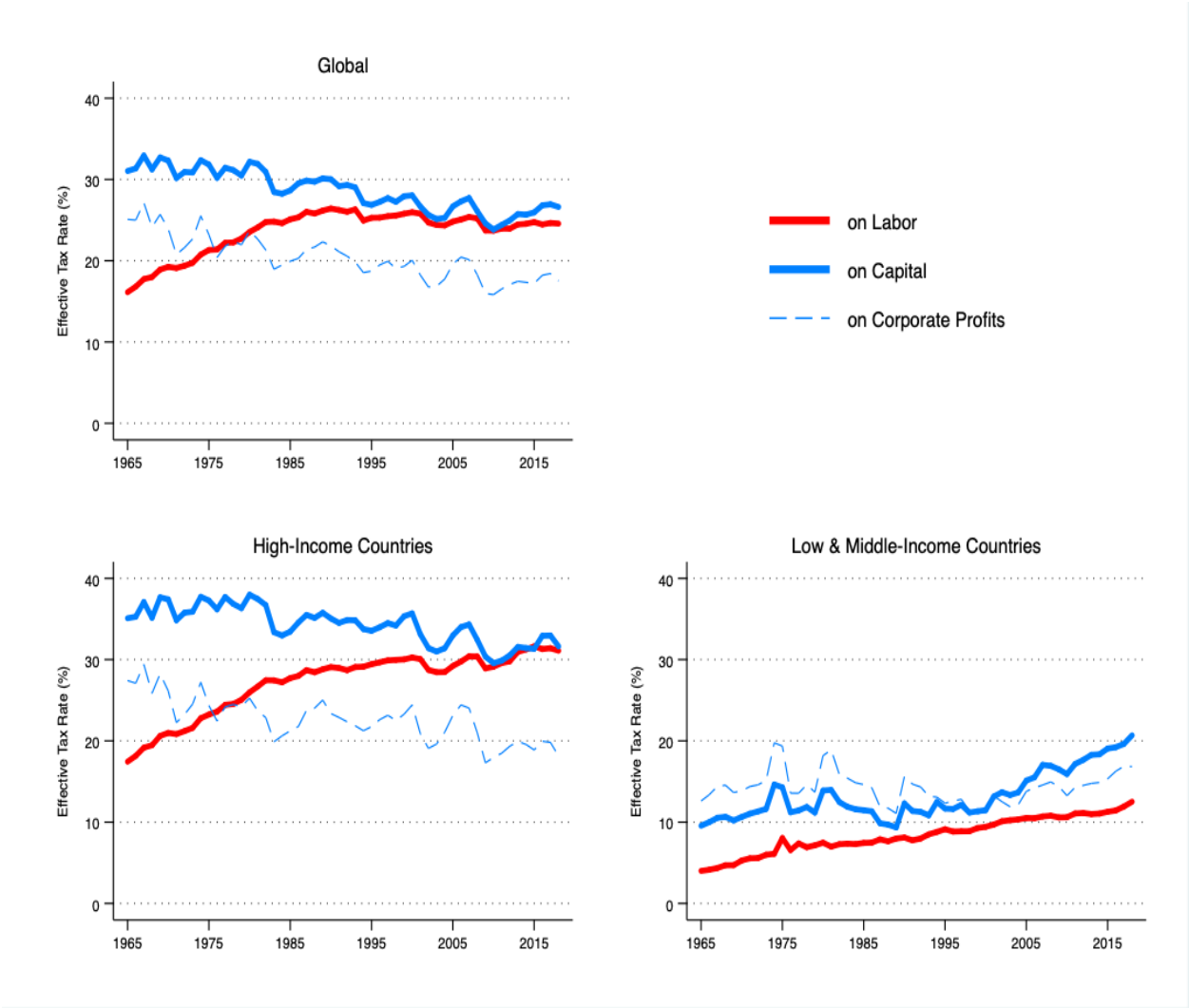
Notes: This figure plots the time series of tax revenue as a share of net domestic product (NDP), separated into five revenue sources. The top left panel corresponds to the global average, weighting country-year observations by their share in that year's total NDP, in constant 2019 USD (N=156). The bottom-left panel shows the results for high-income OECD countries (N=37), and the bottom right for low- and middle-income countries (N=119). We consider as high-income, all OECD countries that meet the World Bank's classification of high-income. Tax revenues are separated into five main categories: indirect taxes (including domestic consumption taxes, excises, and tariffs), payroll taxes, taxes on personal income, taxes on property and wealth, and taxes on corporate income. 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, and in particular China and Russia, and accounts for 98% of World GDP.

Figure 2: Capital Share of Domestic Product



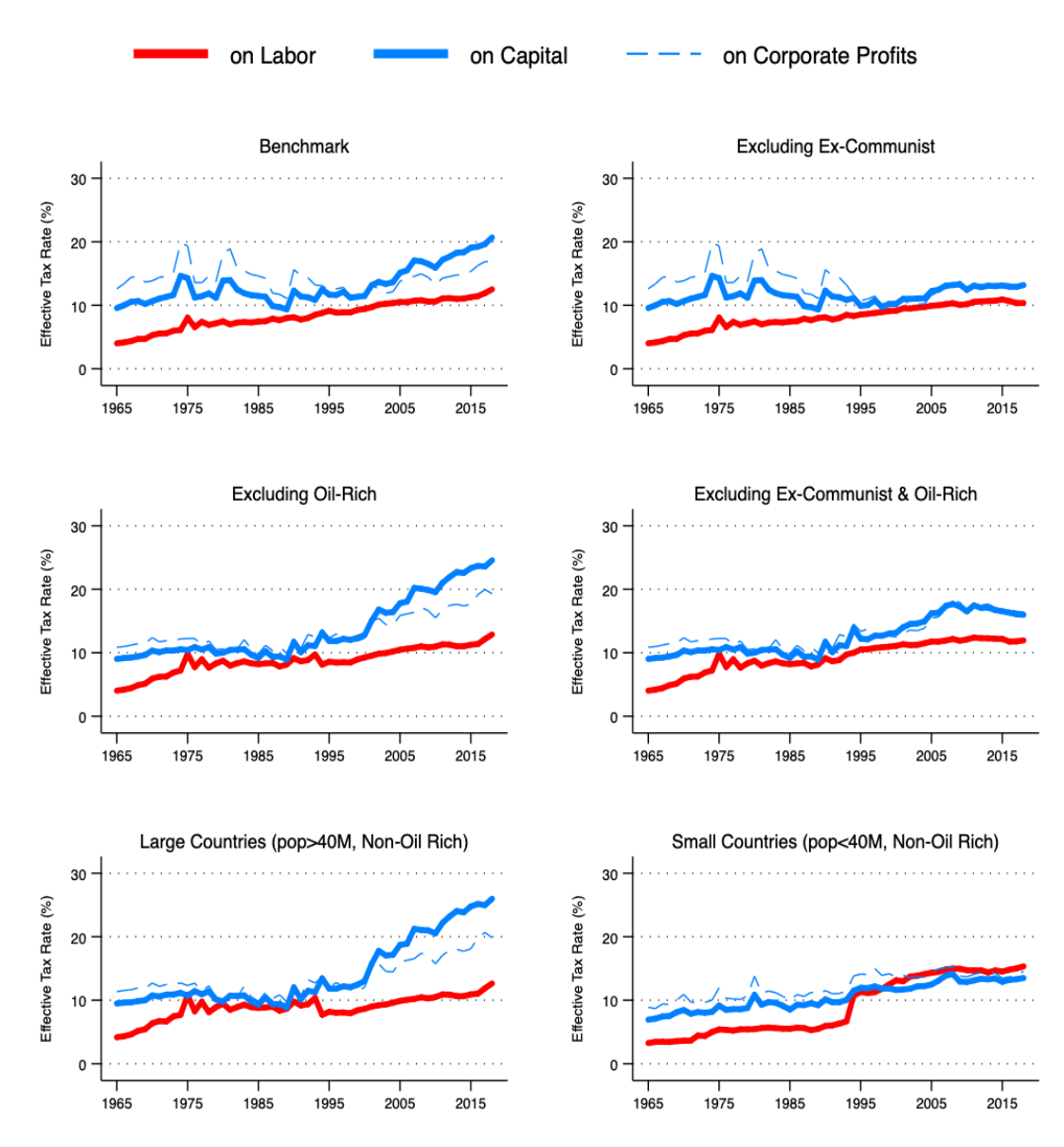
Notes: This figure plots the time series of the capital share as a percentage of net domestic product (NDP). The solid line corresponds to the overall capital share, and the dotted line to the capital share within the corporate sector. The top left panel corresponds to the global average, weighting country-year observations by their share in that year's total NDP, in constant 2019 USD (N=156). The bottom-left panel shows the results for high-income OECD countries (N=37), and the bottom right for low- and middle-income countries (N=119). We consider as high-income, all OECD countries that meet the World Bank's classification of high-income. 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, and in particular China and Russia, and accounts for 98% of World GDP.

Figure 3: Effective Taxation of Capital and Labor



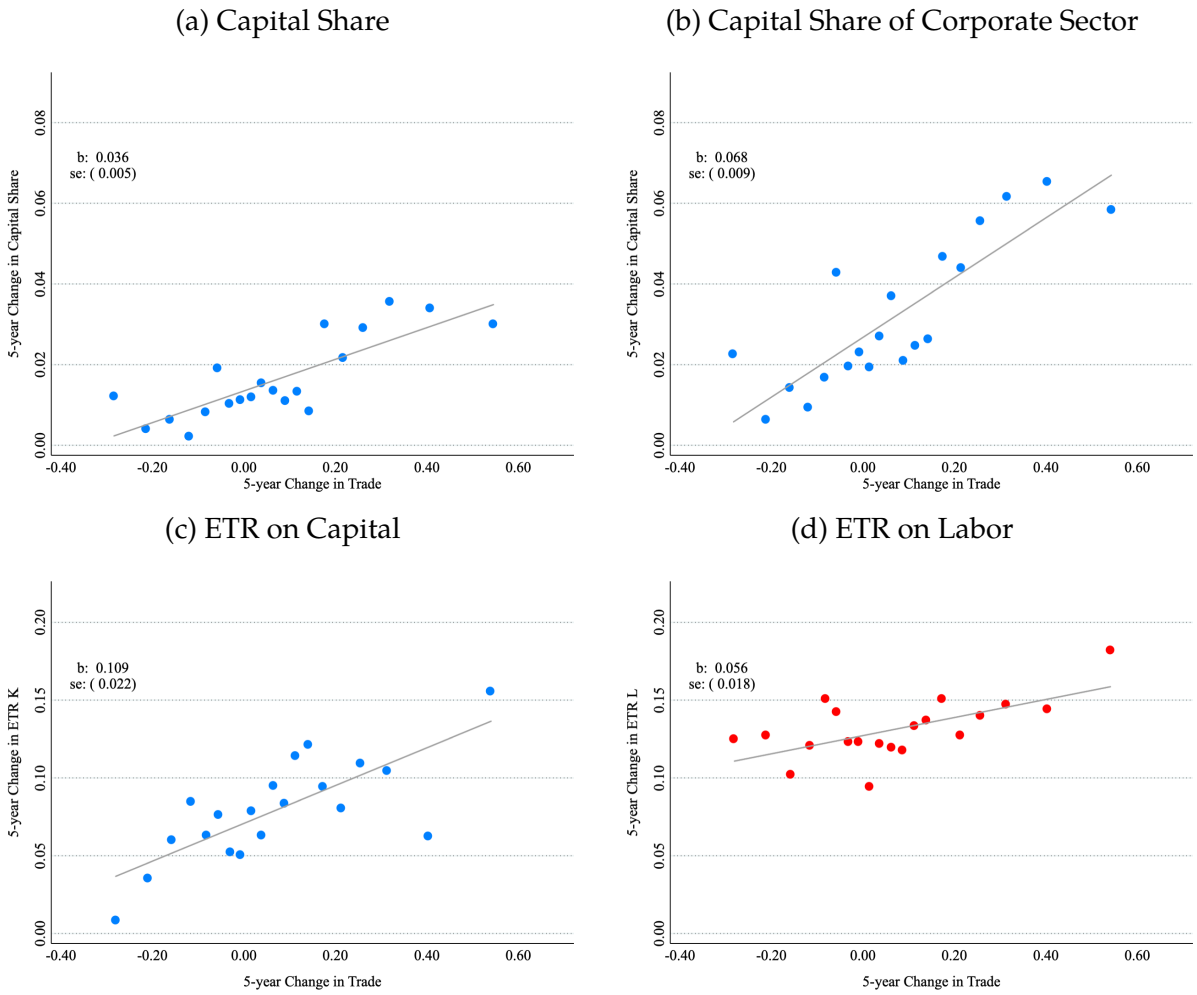
Notes: This figure plots the time series of average effective tax rates on labor (blue) and capital (red), as well as the effective tax rate on corporate profits (red dashed line). The top-left panel corresponds to the global average, weighting country-year observations by their share in that year's total NDP, in constant 2019 USD (N=156). The bottom-left panel shows the results for high-income OECD countries (N=37), and the bottom-right panel for low- and middle-income countries (N=119). High-income countries are OECD countries that meet the World Bank's income threshold of high-income. 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, and in particular China and Russia, and accounts for 98% of World GDP. Figure shows how the entry into our panel in 1994 of these countries impact the results, by imputing their pre-1994 data with a regression procedure.

Figure 4: Effective Taxation of Capital and Labor in Low- and Middle-Income Countries



Notes: This figure plots the time series of average effective tax rates on labor, capital, and corporate profits, in the 118 low- and middle-income countries. Compared to the full sample of 156 countries, it excludes OECD countries classified as high-income by the World Bank. The top-left panel is our benchmark result, taken from 3. The top-right panel excludes former communist countries, most notably China and Russia. The mid-left panel excludes oil-rich countries (the 33 countries where average oil production since 1990 has exceeded 6.5% of GDP, per Ross and Mahdavi (2015)). The mid-right panel excludes both ex-communist and oil-rich nations. Finally the bottom panels show the results separately for the 18 large (non-oil rich) countries to the left, and the 68 small (non-oil rich) countries to the right. Large (small) countries are defined as having a population above (below) 40 Million in 2018.

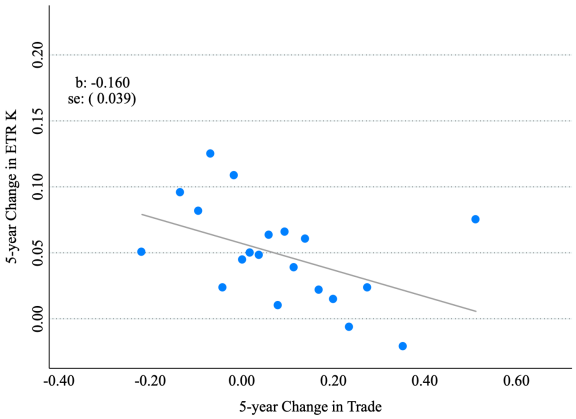
Figure 5: Change in Capital Shares and Factor Taxation vs. Change in Trade



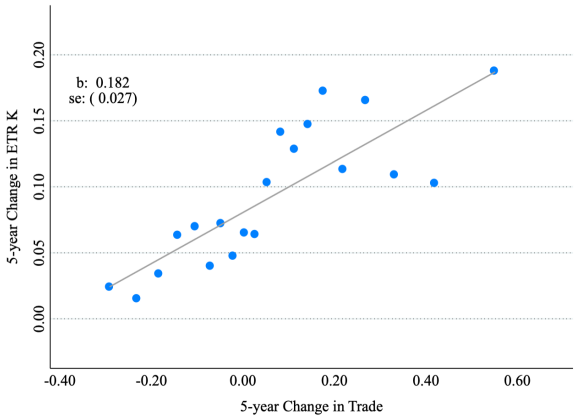
Notes: These figures show the relationship between trade and the capital share of domestic product (a); the capital share of the corporate sector (b); the effective tax rate on capital income (c); and the effective tax rate on labor income (d). Trade is measured as the sum of import and exports as a share of NDP. 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. For ease of interpretation, we add back the (non-residualized) mean of the given variable. Linear trend lines are unweighted, with year fixed effects, and are estimated based on the underlying country-year panel data. The corresponding slope and standard error are shown top-left in each panel.

Figure 6: Change in Factor Taxation vs. Change in Trade, by Income Level

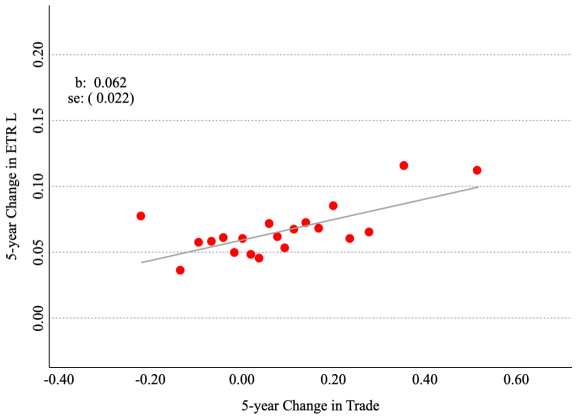
(a) ETR K: High-Income



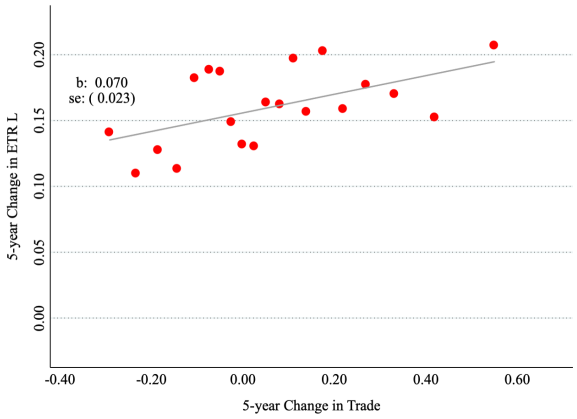
(b) ETR K: Low & Middle-Income



(c) ETR L: High-Income

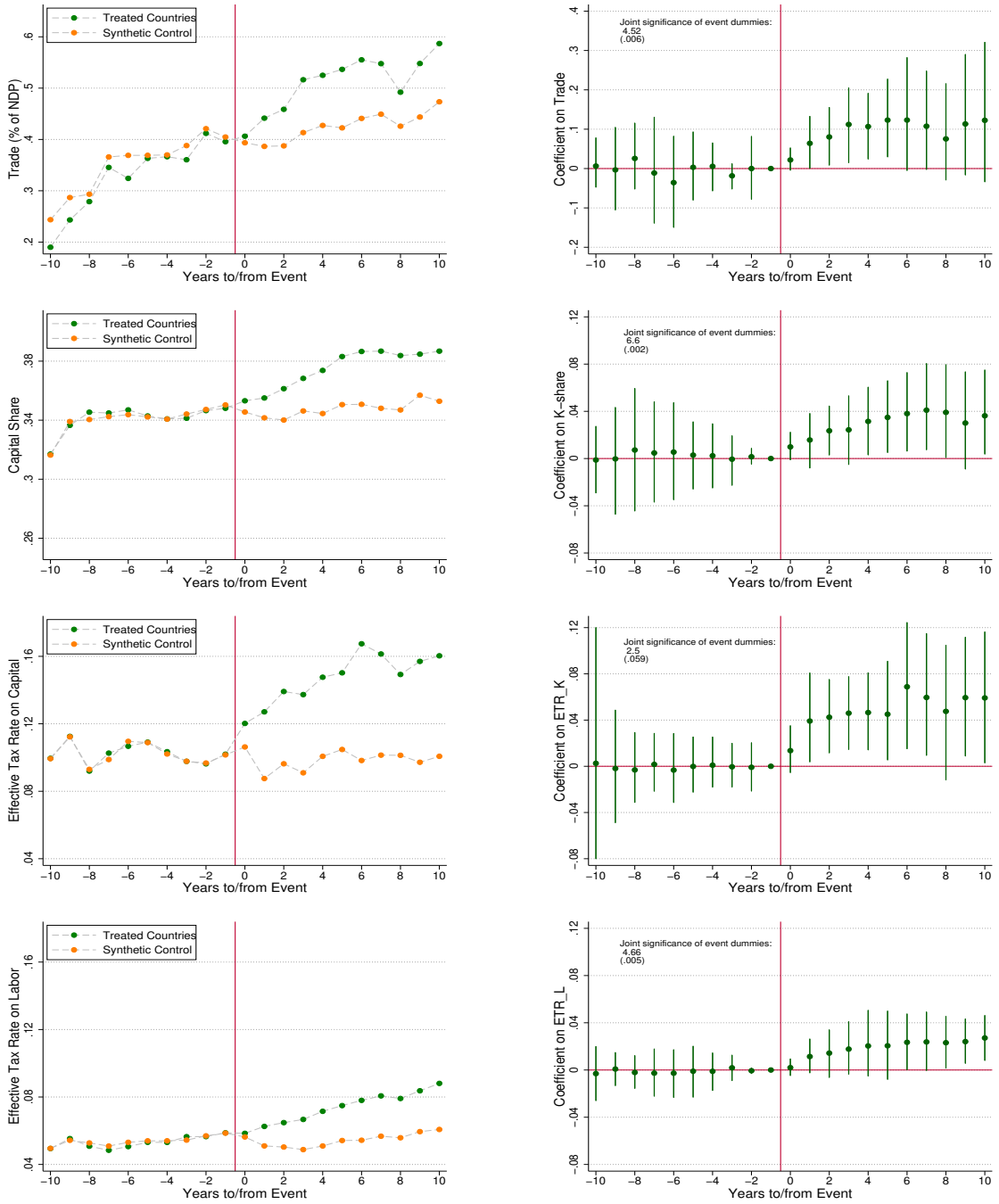


(d) ETR L: Low & Middle-Income



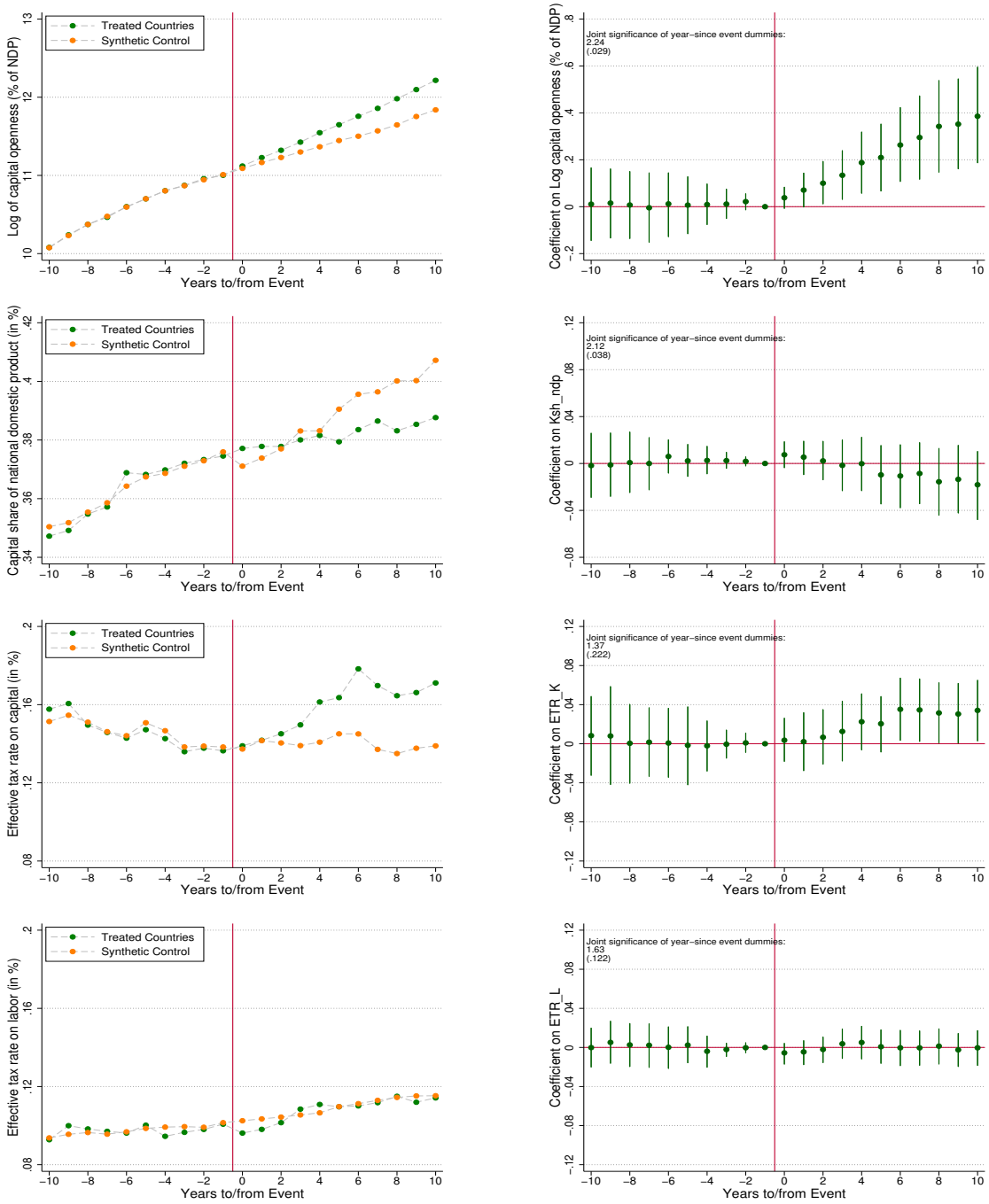
Notes: These figures show the association between changes in trade and changes in effective tax rates of capital (panels a and b) and labor (panels c and d), respectively for high income OECD countries and for low and middle income countries. Trade is measured as the sum of import and exports as a share of NDP. Both the x-axis and y-axis are measured as within-country percent changes over 5 years. Each graph plots binned scatter plots of the 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. For ease of interpretation, we add back the (non-residualized) mean of the given variable. Linear trend lines are unweighted, with year fixed effects, and are estimated based on the underlying country-year panel data. The corresponding slope and standard error are shown top-left in each panel.

Figure 7: 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; capital share; effective tax rate on capital, and on labor. The left-hand 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 coefficients on the 'to' ('since') dummies, in a regression with country fixed effects, year 'to' ('since') fixed effects, and calendar year fixed effects. The bars represent the 95% confidence intervals. Standard errors are clustered at the country-reform level and estimated with the wild bootstrap method. The top-left corners report the F-statistic on joint significance of the post-reform dummies, with the p-value in parentheses below. Details on methodology in Section 6.1 and Appendix C.2.

Figure 8: Event Study of Capital liberalization Reforms



Notes: These figures show event-studies for trade capital reforms in the 25 developing countries of Chari, Henry, and Sasson (2012). The panels correspond to different outcomes: capital openness; capital share; effective tax rate on capital, and on labor. Capital openness is the log of total foreign assets and liabilities as a % of GDP. The left-hand 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 coefficients on the 'to' ('since') dummies, in a regression with country fixed effects, year 'to' ('since') fixed effects, and calendar year fixed effects. The bars represent the 95% confidence intervals. Standard errors are clustered at the country-reform level and estimated with the wild bootstrap method. The top-left corners report the F-statistic on joint significance of the post-reform dummies, with the p-value in parentheses below. More details are in Section 8 and Appendix C.3.

Table 1: Trade Impacts on Factor Shares and Factor Taxation

	Capital Share		Effective Tax Rate		
	overall	corp. sector	labor	capital	corp. profits
Panel A: OLS					
Trade	0.0195*	0.0217	0.0246**	0.0168	0.0120
	(0.0109)	(0.0148)	(0.0101)	(0.0302)	(0.0220)
Panel B: IV estimate (NDP-weighted)					
Trade	0.151**	0.184**	0.163***	0.375*	0.342***
	(0.0698)	(0.0800)	(0.0538)	(0.213)	(0.121)
First-stage F-statistic	26.07	26.07	26.07	26.07	26.07
Panel C: IV estimate (unweighted)					
Trade	0.118*	0.122	0.133**	0.250**	0.359***
	(0.0681)	(0.0826)	(0.0526)	(0.105)	(0.0870)
First-stage F-statistic	8.42	8.42	8.42	8.42	8.42
Panel D: IV estimate (NDP-weighted, with controls)					
Trade	0.115**	0.142**	0.226***	0.400***	0.205*
	(0.0475)	(0.0546)	(0.0551)	(0.112)	(0.129)
First-stage F-statistic	19.02	19.02	19.02	19.02	19.02
N	*4518*	*4518*	*4518*	*4518*	*4518*

Notes: This table presents results from estimating the effect of trade on factor shares and factor taxation. In Panel A, we present results from estimating equation (7) using OLS, while Panels B and C and D present IV estimates—weighted by National Domestic Product (NDP); unweighted; and weighted with controls, respectively. Across columns, the outcome is the capital share of national domestic product and within the corporate sector, and the effective tax rate on labor, capital and corporate profits. Trade is measured as the sum of export and imports divided by NDP. IV estimates in panels B,C,D instrument for trade using the oil-price and the gravity-instruments from Egger, Nigai, and Strecker (2019). All estimates include country and year fixed effects and observations are weighted by net domestic product in constant 2019 USD at PPP (except in Panel C). The controls included in Panel C are: USD exchange rate; gross fixed capital formation (as a percentage of NDP); (log) population; (log) GDP per capita; and *de jure* capital accounts mobility. For more details, see Section 7. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table 2: Trade Impacts on Additional Outcomes

	OLS	IV		
		Weighted	Unweighted	Controls
	(1)	(2)	(3)	(4)
Panel A: Statutory Corporate Income Tax Rate				
CIT rate	-0.002	-0.064***	-0.051*	-0.061***
	(0.003)	(0.017)	(0.028)	(0.017)
Panel B: Self-Employment as a Share of the Workforce				
Self-employment	-0.0117	-0.220*	-0.185***	-0.174***
	(0.0145)	(0.126)	(0.0460)	(0.0560)
Panel C: National Income Components				
Corporate profits	0.0339***	0.175**	0.124***	0.206***
	(0.0128)	(0.0767)	(0.0321)	(0.0726)
Employee compensation	0.00848	-0.0749	-0.0964	0.0485
	(0.0175)	(0.0904)	(0.0669)	(0.0785)
Mixed income	-0.0231	-0.0685	-0.0391	-0.202**
	(0.0182)	(0.105)	(0.0301)	(0.0816)
Household operating surplus	0.0002	0.0145	0.0072	0.0171
	(0.0039)	(0.0146)	(0.0159)	(0.0137)
Corporate-sector value-added	0.0396*	0.164	0.0917***	0.274***
	(0.0210)	(0.109)	(0.0342)	(0.0943)
First-stage F-statistic		26.07	19.02	8.415
N	*4518*	*4518*	*4518*	*4518*

Notes: This table reports estimates of the impact of trade on additional outcomes. Each cell corresponds to a coefficient on trade from a regression model which varies in the outcome (across rows) and estimation model (across columns). Across columns, the coefficients are based on estimating equation 7 using, respectively: OLS; IV; IV without weights, IV with weights and controls. The controls included in column (4) are: USD exchange rate; gross fixed capital formation (as a percentage of NDP); (log) population; (log) gross domestic product per capita; and *de jure* capital accounts mobility. Weighted regressions are weighted by annual net domestic product in constant 2019 USD at PPP. Across panels, the outcome is: the statutory corporate income tax rate (Panel A); the self-employed share of the active workforce (Panel B); the share in national income of corporate profits, employee compensation, mixed income, household operating surplus, and the share of the corporate sector in the economy (Panel C). Trade is measured as the sum of export and imports divided by net domestic product. We instrument for trade using the oil-price and the gravity-instruments from Egger, Nigai, and Strecker (2019). All estimates include country and year fixed effects. For more details, see Section 7. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table 3: Heterogeneous Impacts of Trade by Development Level

	ETR_K	ETR_L	CIT rate	Capital share of income	Self employment	Mixed income	Corporate profits	Corporate value-added
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Trade	0.444**	0.145	-0.043*	0.182**	-0.252**	-0.124	0.219***	0.220***
	(0.181)	(0.093)	(0.024)	(0.077)	(0.107)	(0.097)	(0.063)	(0.083)
Trade∗𝟙(High-inc.)	-0.441	0.120	-0.032	-0.219	0.232	0.374*	-0.299**	-0.381**
	(0.347)	(0.194)	(0.047)	(0.137)	(0.209)	(0.205)	(0.146)	(0.176)
Implied coef. for	0.003	0.265**	-0.075***	-0.036	-0.021	0.250*	-0.080	-0.160
Trade∗𝟙(High-inc.)	(0.231)	(0.122)	(0.457)	(0.083)	(0.151)	(0.144)	(0.102)	(0.129)
N	*4518*	*4518*	*3810*	*4518*	*4518*	*4518*	*4518*	*4518*

Notes: This table presents results from the heterogeneous IV analysis based on estimating equation (8). The top row denotes the outcome variable: effective tax rate on capital; effective tax rate on labor; statutory corporate income tax rate; capital share of domestic product; self-employed share of workforce; mixed income as a share of domestic product; corporate profits; and share of the corporate sector in the economy. The regression coefficients for $Trade$ as well as the interaction with a dummy for high-income countries, $Trade * \mathbb{1}(High - income)$ are presented. The bottom row reports the coefficient for the linear combination of $Trade$ and the interaction term. Trade is measured as the sum of export and imports divided by net domestic product. We instrument for trade using the oil-price and the gravity-instruments from Egger, Nigai, and Strecker (2019). All estimates include country and year fixed effects and observations are weighted by net domestic product in constant 2019 USD at PPP. For more details, see Section 7. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table 4: Additional Heterogeneity Impacts of Trade

Heterogeneity H_c :	Small population	Capital openness
Panel A: CIT rate		
Trade	-0.053***	-0.063***
	(0.014)	(0.018)
Trade$*H_c$	-0.034	-0.034
	(0.054)	(0.079)
Coefficient on Trade in H_c	-0.088*	-0.094
	(0.049)	(0.072)
Panel B: ETR_K		
Trade	0.357**	0.617**
	(0.177)	(0.274)
Trade$*H_c$	-0.491	-0.483
	(0.544)	(0.456)
Coefficient on Trade in H_c	-0.134	0.133
	(0.456)	(0.224)
Panel C: ETR_L		
Trade	0.169***	0.144
	(0.061)	(0.158)
Trade$*H_c$	0.145	0.159
	(0.282)	(0.275)
Coefficient on Trade in H_c	0.314	0.304**
	(0.242)	(0.139)

Notes: This table presents results from the heterogeneous IV analysis based on estimating equation (8). The top row denotes the source of heterogeneity H_c, respectively across columns: a dummy for small population size (below 40 million); the Chinn-Ito index of capital account openness (Chinn and Ito, 2006), which is a continuous variable between 0 and 1; and, a dummy indicator for the post-1995 period. Across Panels, we estimate the effects of trade on the statutory corporate income tax rate (Panel A), the effective tax rate on capital (Panel B), and the effective tax rate of labor (Panel C). At the bottom of each panel, we report the coefficient on trade (and standard error) in the heterogeneity sub-sample as the linear combination of the coefficients on $Trade$ and $Trade * H_c$. Trade is measured as the sum of export and imports divided by net domestic product. We instrument for trade using the oil-price and the gravity-instruments from Egger, Nigai, and Strecker (2019). All estimates include country and year fixed effects and observations are weighted by net domestic product in constant 2019 USD at PPP. For more details, see Section 7. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table 5: Trade Impacts by Tax Source (% of GDP) and Development Levels

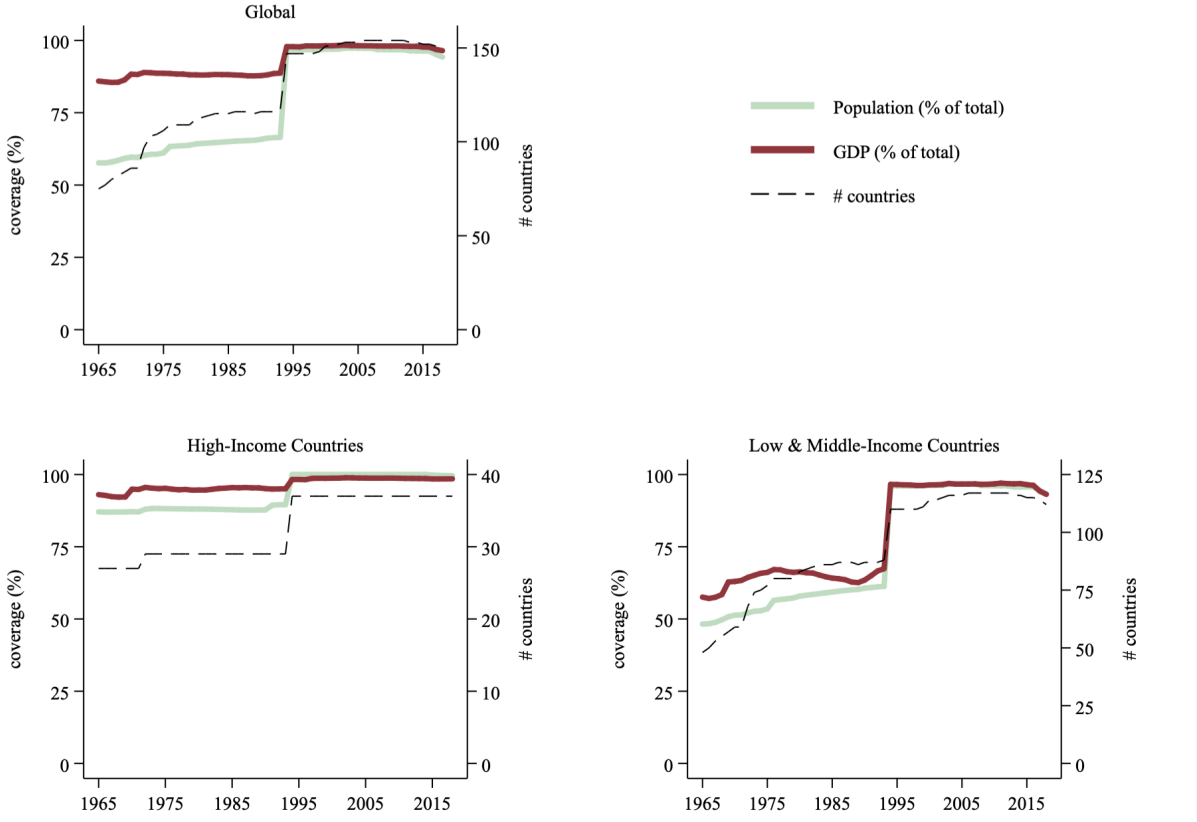
	total taxes (1)	indirect (2)	CIT (3)	property (4)	PIT (5)	payroll (6)
Trade	0.218*	0.002	0.102***	0.025	0.010	0.055
	(0.112)	(0.047)	(0.028)	(0.025)	(0.025)	(0.045)
Trade$*\mathbb{1}$(High-Inc)	-0.270	-0.146	-0.128**	-0.012	-0.061	0.090
	(0.251)	(0.132)	(0.061)	(0.042)	(0.062)	(0.093)
Implied coef. for Trade in High-Inc	-0.052	-0.144	-0.026	0.013	-0.0506	0.145**
	(0.188)	(0.105)	(0.036)	(0.026)	(0.042)	(0.056)
N	*4518*	*4518*	*4518*	*4518*	*4518*	*4518*

Notes: This table presents results for the impact of trade on different sources of taxation, estimated using the IV. Across columns, the outcome is the revenue collected by each tax as a percentage of NDP: total taxes, then indirect taxes, corporate income tax, property and wealth taxes, personal income tax, and social security taxes. The regression coefficients for $Trade$ as well as the interaction with a dummy for high-income countries, $Trade * \mathbb{1}$(High-income) are presented. The bottom row reports the coefficient for the linear combination of $Trade$ and the interaction term. Trade is measured as the sum of export and imports divided by GDP. We instrument for trade using the oil-price and the gravity-equation instruments from Egger, Nigai, and Strecker (2019). All estimates include country and year fixed effects and observations are weighted by net domestic product in constant 2019 USD at PPP. We use dummy variable controls for significantly interpolated revenue data (rare) or imputed factor share data (frequent) in all columns. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Appendices

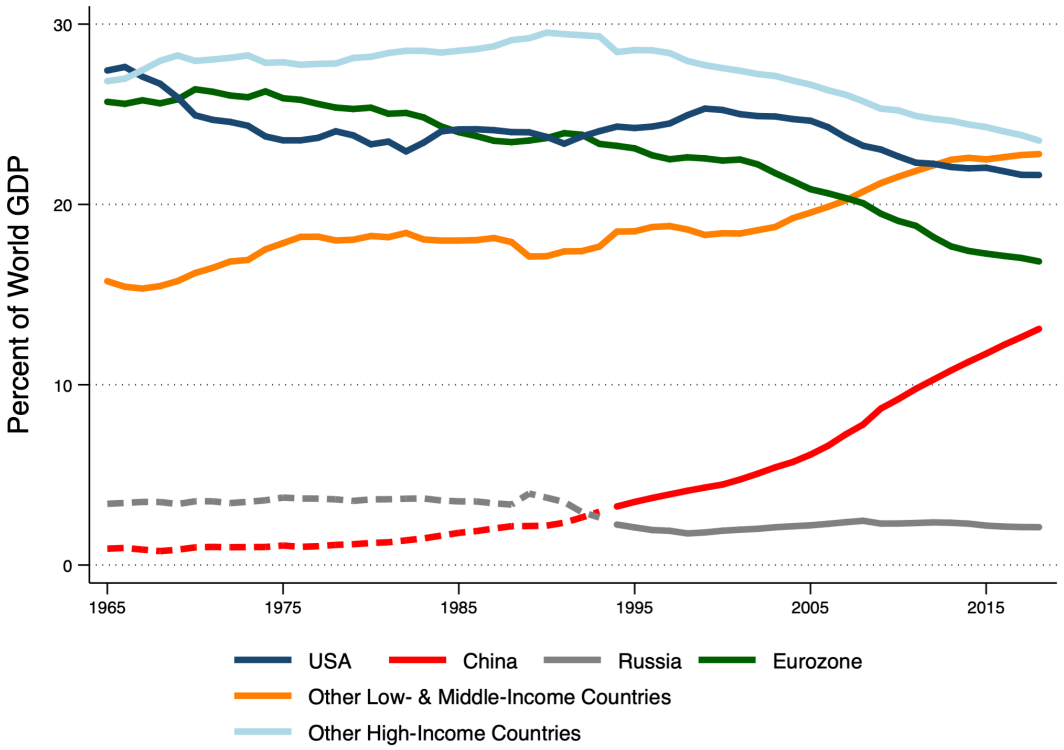
Appendix A Additional Figures and Tables

Figure A1: Data Coverage for Effective Tax Rates



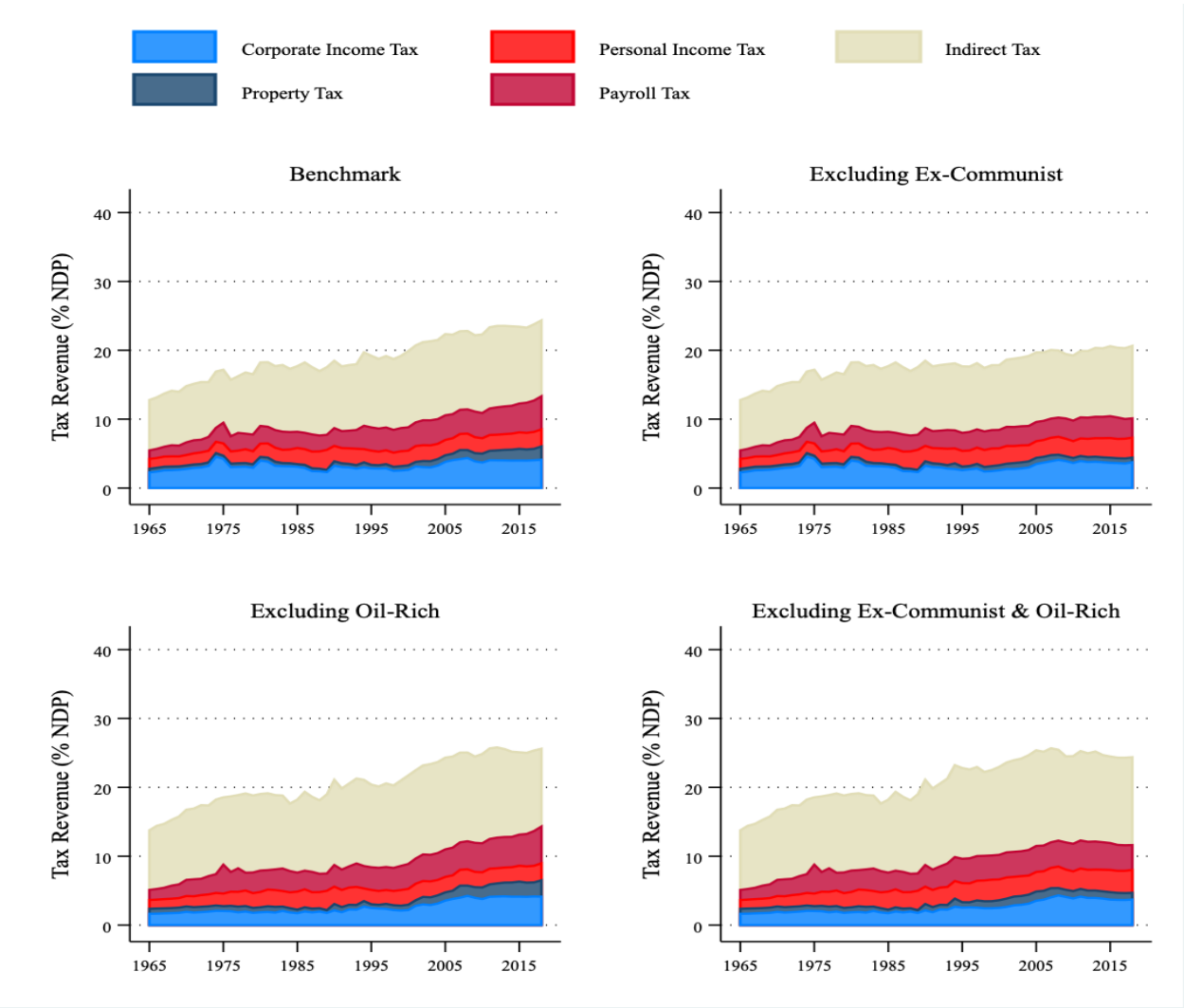
Notes: This figure shows the coverage of our effective tax rate data between 1965 and 2018, globally and for high vs. low- and middle-income countries. The solid lines plot the percentage of total population and GDP that is covered in our data (left axis). The dashed lines show the number of countries in the data (right axis). The missing 'missing' income (and population) prior to the 1990s corresponds to communist countries, particularly China, Russia and the ex-Soviet republics, and Vietnam. In addition to limited data on public revenue, communist country present a conceptual mismatch with our framework for factor income taxation (see Appendix B). Other missing country-years correspond to conflicts, independence post 1965, and in a few cases to missing data.

Figure A2: Share of Worldwide GDP by Country



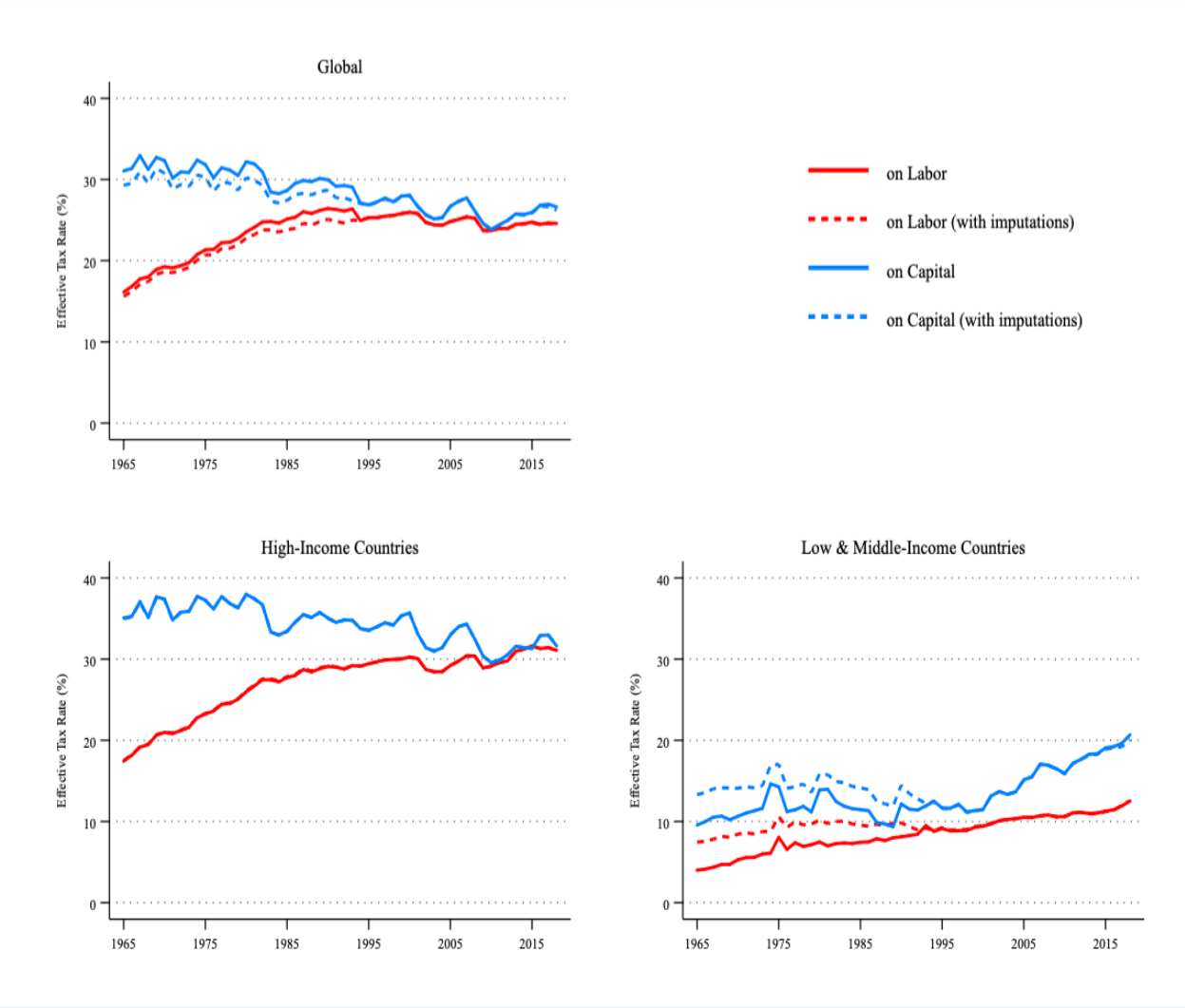
Notes: This figure plots the relative weight in world GDP of important countries. The countries are the USA, Eurozone 19, China, Russia, the remaining high-income countries and the remaining low and middle-income countries (less China and Russia). By construction these lines add to 100% of world GDP in each year. The dotted lines for China and Russia highlight that we do not have data on effective tax rates for these countries pre-1994, as discussed in Appendix B and Figure A1, but we know for every year their contribution to world GDP.

Figure A3: Tax Revenue in Low- & Middle-Income Countries



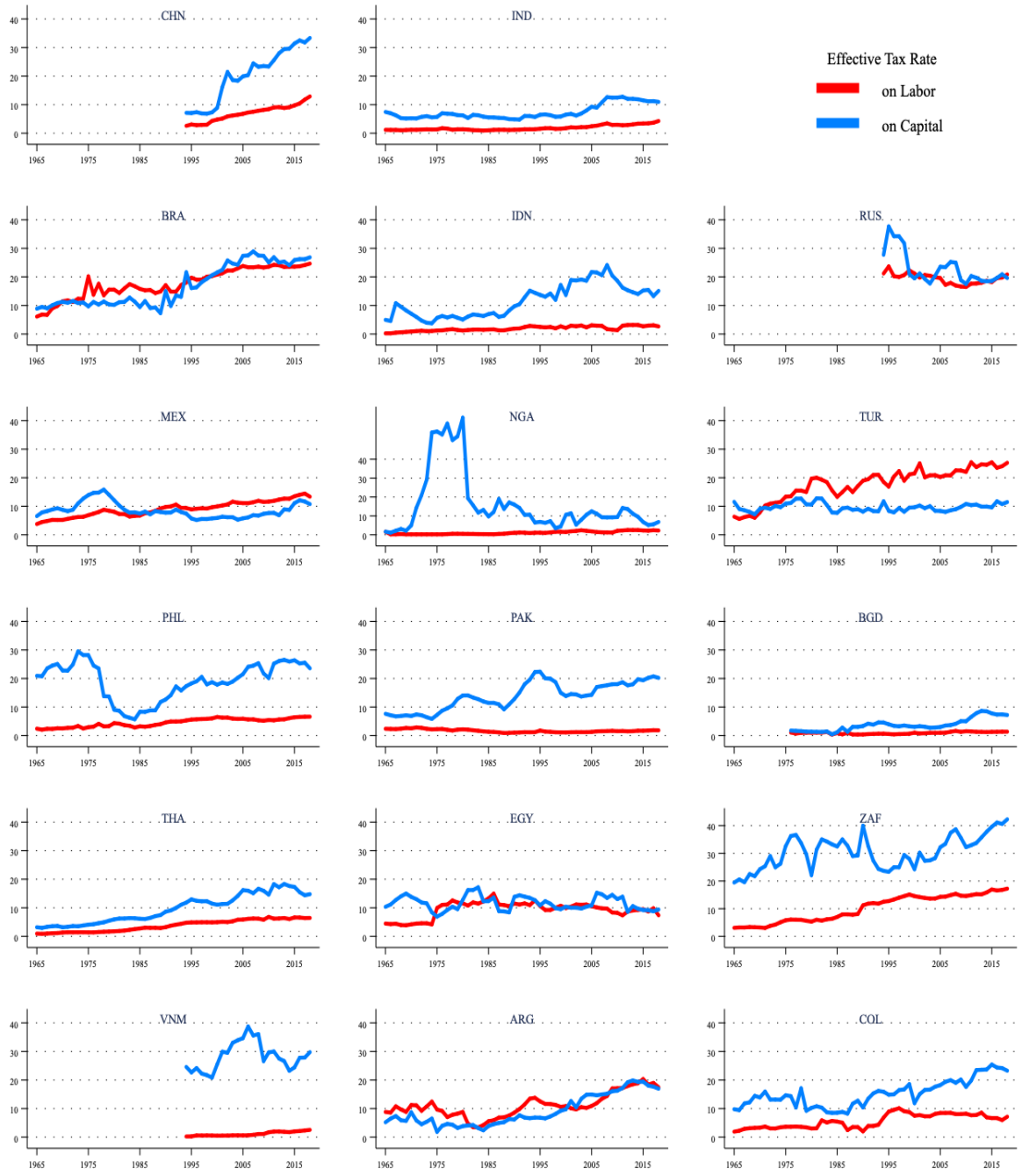
Notes: This figure plots the time series of tax revenue as a share of net domestic product (NDP), separated by revenue source, for the 119 low- and middle-income countries (sample countries that are not high-income OECD countries), weighting country-year observations by their share in that year's total NDP, in constant 2019 USD. The top left-panel repeats the benchmark figure for low and middle income countries. The top-right panel excludes former communist countries, most notably China and Russia. The mid-left panel excludes oil-rich countries (the 33 countries where average oil production since 1990 has exceeded 6.5% of GDP, per Ross and Mahdavi (2015)). The mid-right panel excludes both ex-communist and oil-rich nations.

Figure A4: Impact of Imputations on Effective Tax Rates



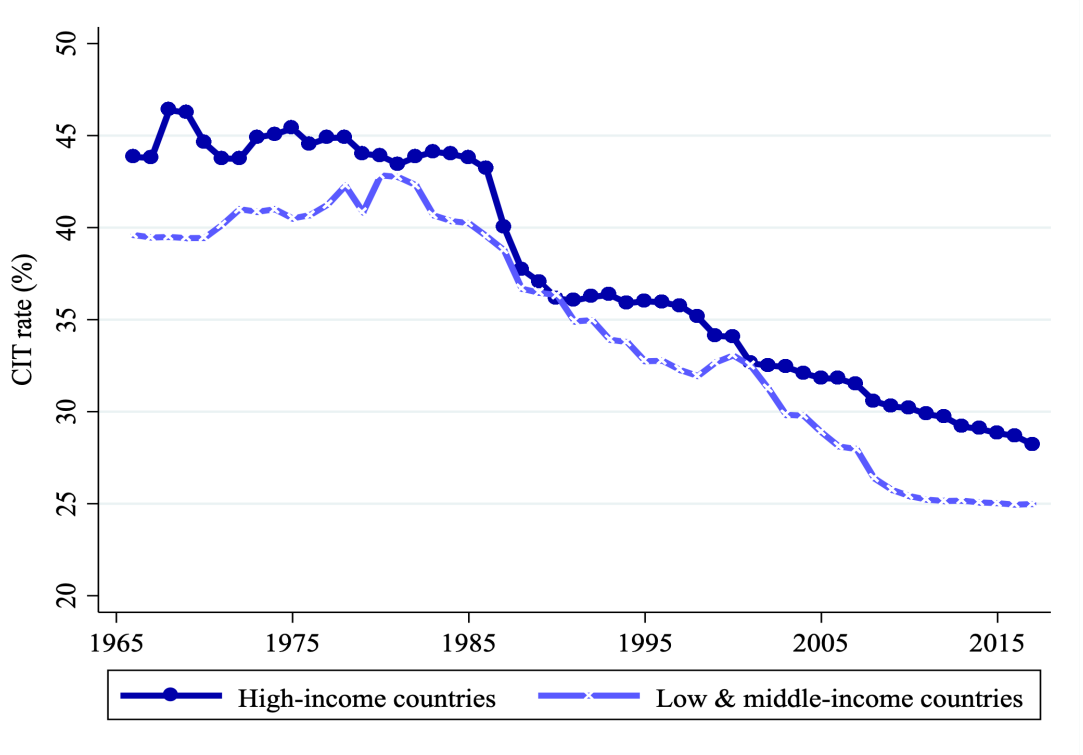
Notes: This figure plots the time series of effective tax rates for labor and capital series with and without imputations for missing country-years. This allows us to control for the sample composition changing over time and shows the plausible impact that having a balanced panel might have had on the time-series of ETRs. The solid lines correspond to the ETR series as shown in the paper and are derived from the unbalanced panel of countries, where ex-communist countries enter in 1994, including China and Russia. The dotted lines show the results of imputing values for the missing country-years in the pre-1994 data, as to have a fully balanced panel. We impute ETR values of the missing years based on a simple prediction model, which extends the trends observed in the data to the missing observation. Concretely, we decompose the ETR on capital and on labor into year and country fixed effects, separately for high versus low and middle-income countries: $ETR_{i,t} = \beta_t + \beta_i + \epsilon_{i,t}$, where β_t and β_i are year and country fixed effects. Each country-year is weighted by its share of worldwide income (in constant 2019 USD). We impute missing data by adding, to the first year of available data for a given country, the difference between the year fixed-effect of a missing year and that of the first available year in the country's time series. For example, the imputed 1993 value of ETR_K for China (whose series begins in 1994) is constructed as $ETR^K_{CHN,1993} = ETR^K_{CHN,1994} + \hat{\beta}_{1993} - \hat{\beta}_{1994}$.

Figure A5: Effective Tax Rates in Large Developing Countries



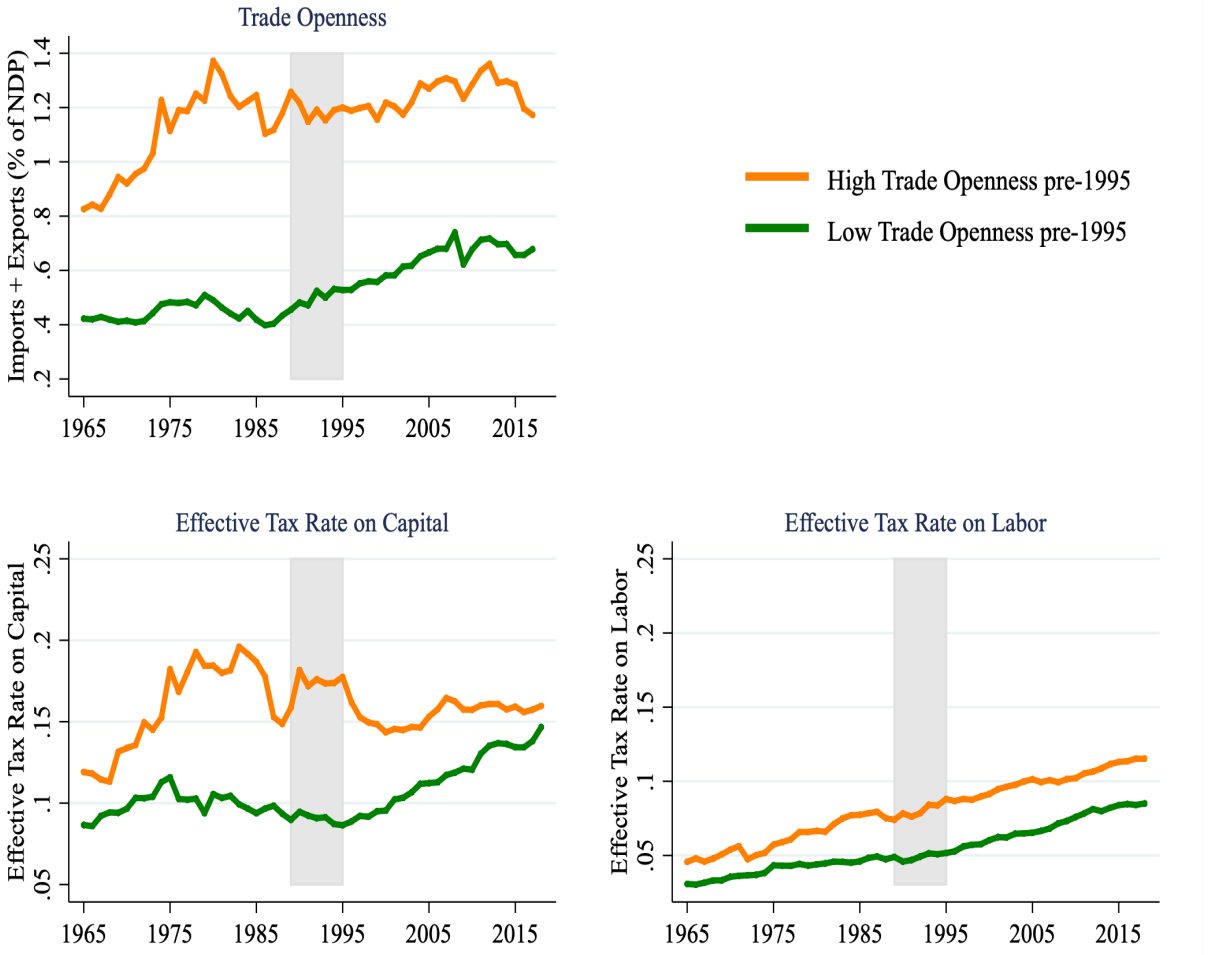
Notes: This figure shows the evolution of effective tax rates on labor and capital for the 17 largest low and middle income countries. Countries are displayed when they rank in the top 20 both in terms of population and GDP, in 2018.

Figure A6: Trends in statutory corporate income tax rates by development level



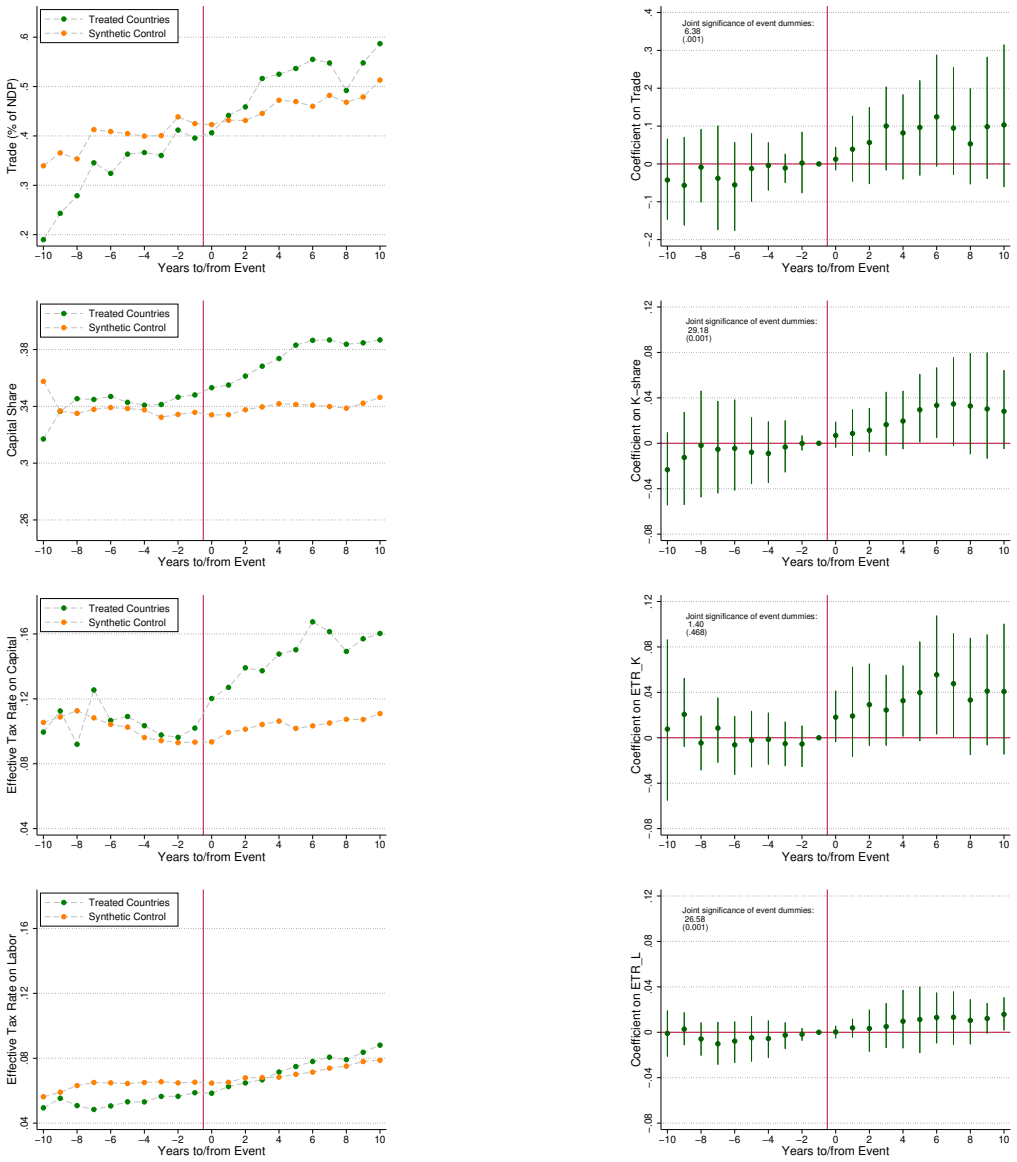
Notes: This figure plot the time series of statutory corporate income tax rates by level of development: the light blue X-line is for middle and low income countries, while the dark blue circle-line is for high income countries. Each line plots the year fixed effects from an unweighted OLS regression, in the relevant sub-sample of countries, on country and year fixed effects. The inclusion of country fixed effects eliminates the influence of countries entering and leaving the sample. The fixed effects are normalized to equal the level of the outcome variable in the relevant sub-sample in 1965.

Figure A7: Trends in Factor Taxation by Initial Trade Openness, in Developing Countries



Notes: This figure plot the time series of trade openness (top-left panel), average effective tax rates on capital (top-right panel) and labor (bottom-left panel). The sample is limited to low- and middle-income countries. Within each panel, the green line (orange line) traces the evolution of the group of developing countries which had relatively high (low) trade openness prior to 1995. Specifically, high (low) trade openness is defined as having average yearly trade openness which lies above (below) the global yearly average between 1965 and 1995. Trade openness is measured as the share of imports and exports in national domestic product; note that this share can exceed a value of 1.Each line plots the year fixed effects from an unweighted OLS regression, in the relevant sub-sample of the outcome, on country and year fixed effects. The inclusion of country fixed effects eliminates the influence of countries entering and leaving the sample. The fixed effects are normalized to equal the level of the outcome variable in the relevant sub-sample in 1965. The shaded area highlights the notable 1990-1995 period, which marks the beginning of the 'second wave' of globalization, featuring a proliferation of bilateral and multilateral trade agreements (Egger, Nigai, and Strecker, 2019).

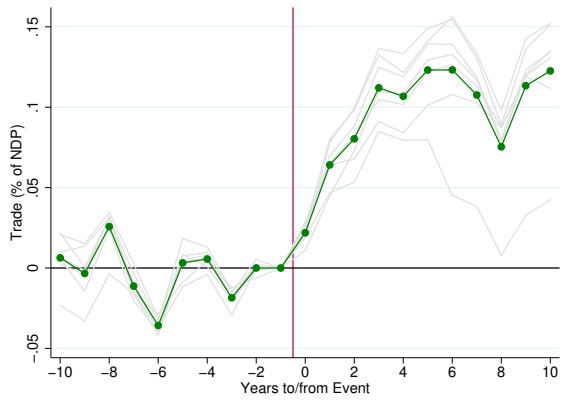
Figure A8: Event Studies of Trade Liberalization, Simultaneous Matching on Outcomes



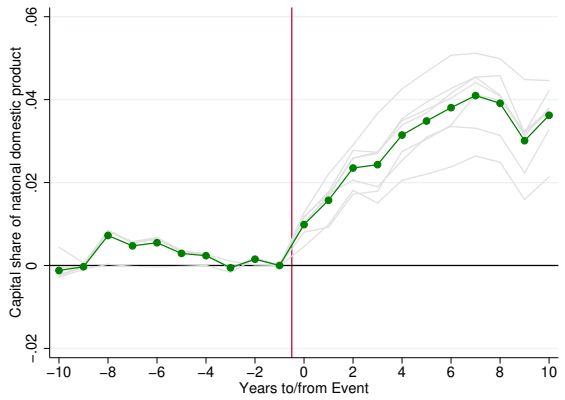
Notes: These figures show event-studies for trade liberalization reforms in seven countries, over four outcomes: trade (as a percentage of domestic product); capital shares; and effective tax rates (on capital and labor). The left-hand graphs show the average level of the outcome in every year relative to the event, for the treated group and for the group of synthetic controls. The right-hand graphs show the coefficients on the 'to' ('since') dummies, in a regression model with country fixed effects; year 'to' ('since') fixed effects; and calendar-year fixed effects. The bars represent the 95% confidence intervals for 'to' ('since') reform coefficients, while standard errors are clustered at the country-reform level and estimated using the wild bootstrap method. In the top-left corner, we report the F-statistic on joint significance of the post-reform dummies, with the p-value in parentheses below. These graphs are constructed similar to Figure 7, with the exception that the synthetic control for each event-country is based on matching simultaneously on all outcomes.

Figure A9: Robustness of Trade Liberalization to Changing Sample of Event Countries

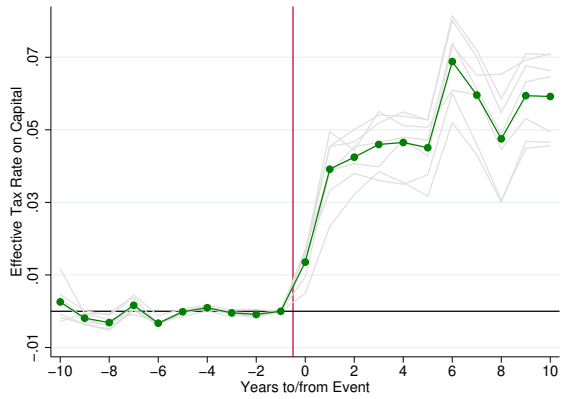
(a) Trade as % of NDP



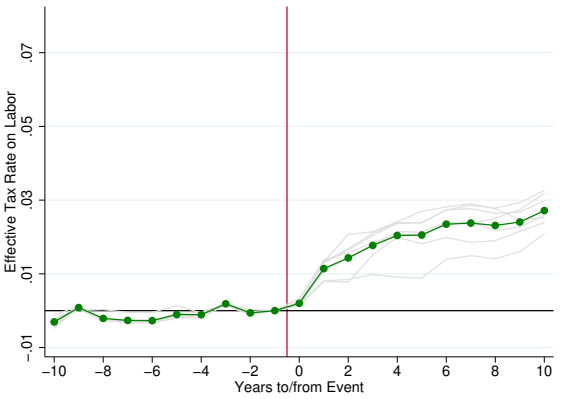
(b) Capital Share of NDP



(c) Effective Tax Rate on Capital



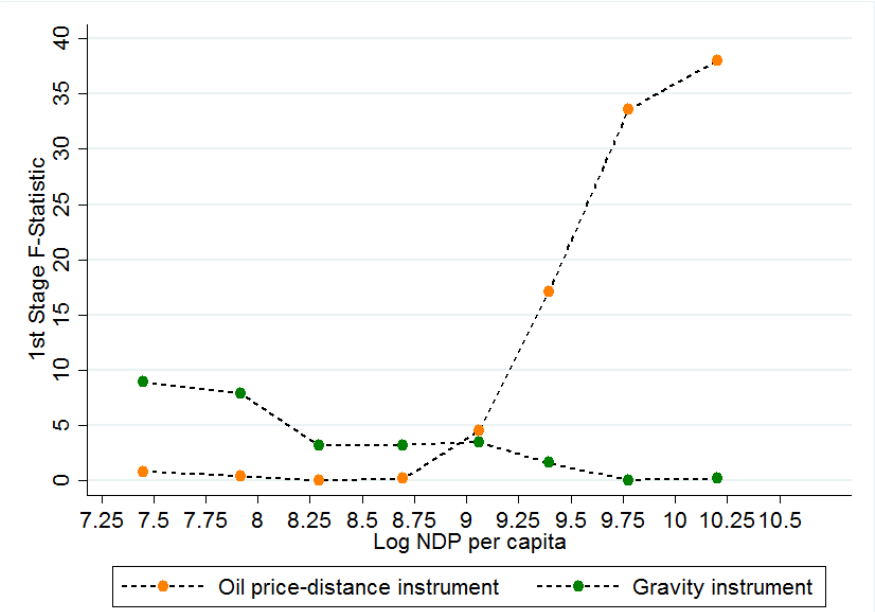
(d) Effective Tax Rate on Labor



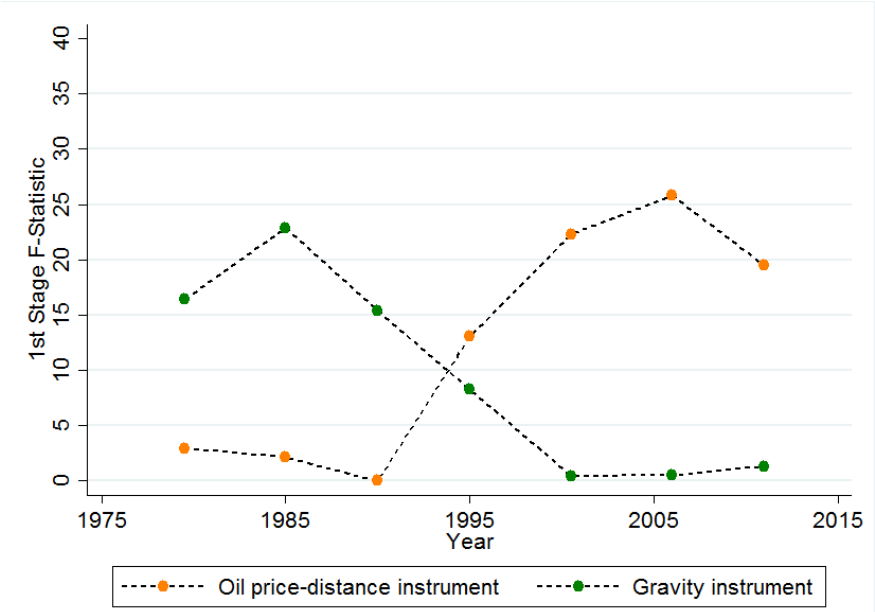
Notes: These figures show event studies for trade liberalization reforms in seven countries, over four outcomes: trade (as a percentage of domestic product); capital share (as a percentage of domestic product); and effective tax rates on capital and labor. In each figure, the solid green line displays the estimated coefficients for the interaction between a treatment dummy and a year 'to' ('since') dummy [note the omitted period is $t-1$], corresponding to the graphs displayed in the right column of Figure 7. Each lightly-shaded gray line repeats the estimation procedure based on a sample that removes one of the seven treated countries, one at a time. All the gray lines thus represent the dynamic treatment effects but for different subsets of the treated countries. More details can be found in Appendix C.2.

Figure A10: Strength of Individual Instruments Across Subsamples

(a) Sub-samples of NDP per capita

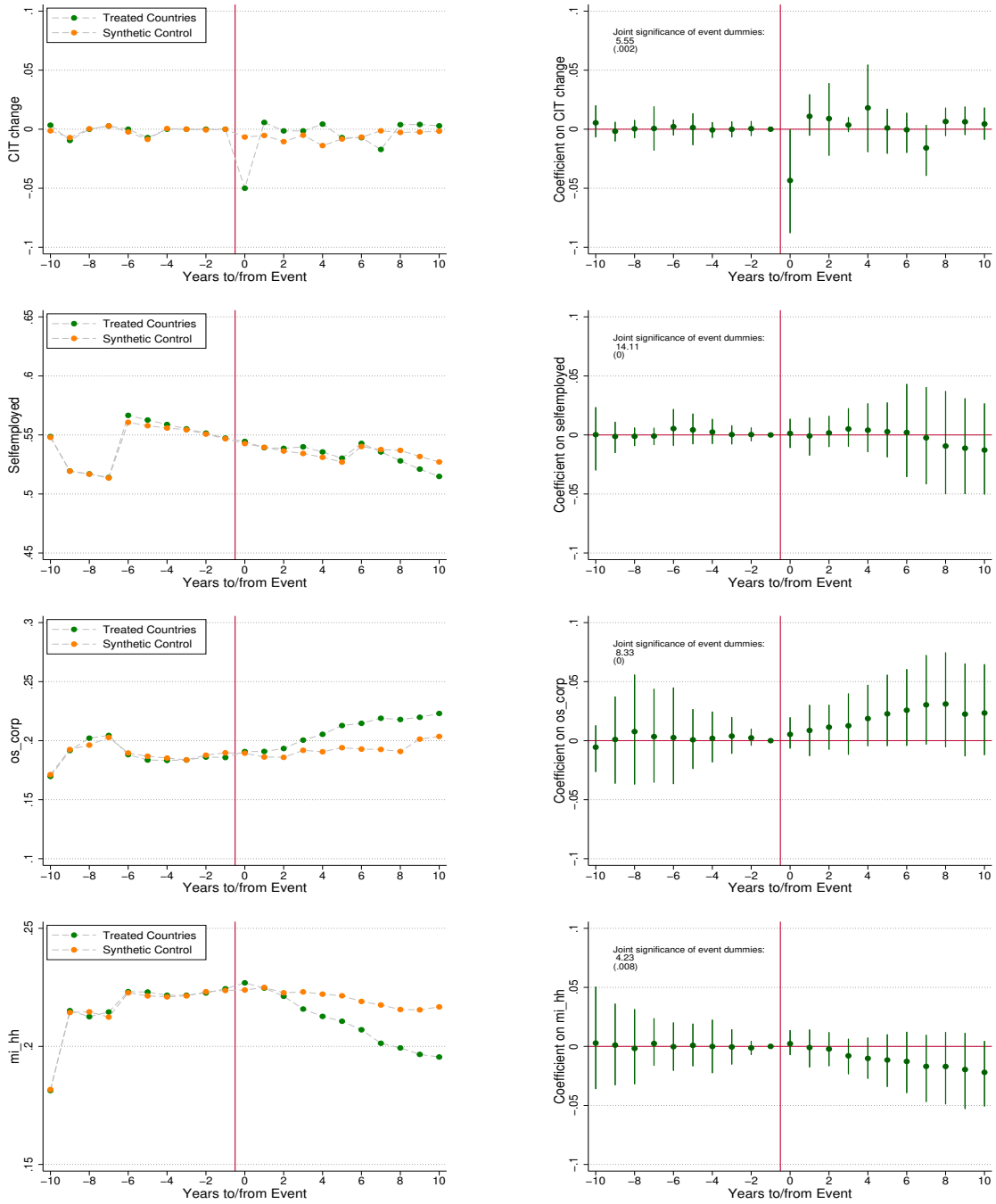


(b) Sub-samples of time-periods



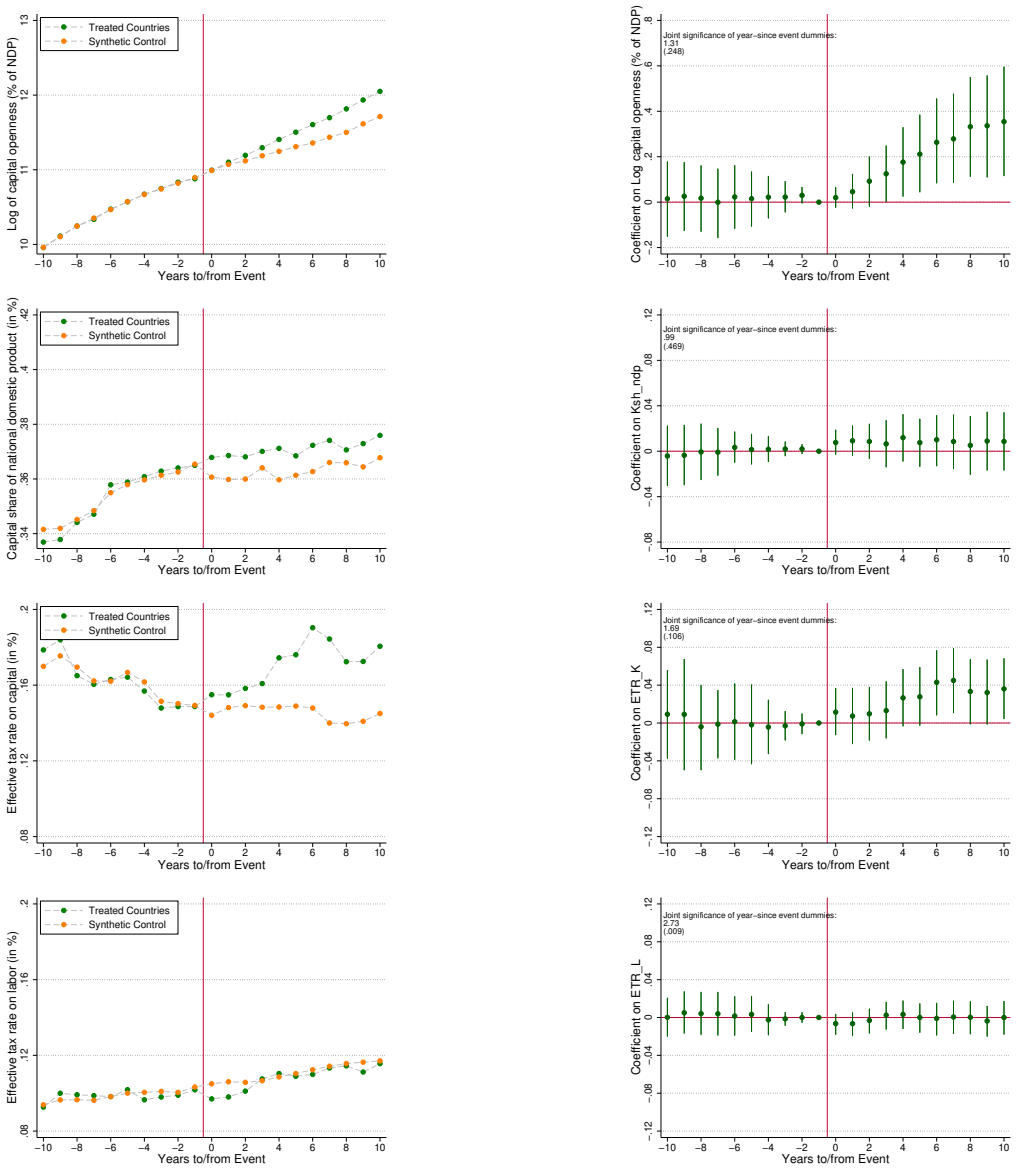
Notes: These figures show the individual statistical strength of the two instruments, denoted 'oil-distance' and 'gravity'. The outcome is the first-stage F-statistic from a regression of trade openness on the individual instruments (see Section 7). The outcome is shown across subsamples of log GDP per capita (Panel A) and years (Panel B). To construct each figure, the x-axis is first partitioned into ten deciles (ten bins of equal size). The first-stage F-statistic is then separately estimated in samples centered on each decile. The estimation is done in increments of one decile, and the bandwidth uses one decile of data on either side of the decile-center. To maintain an equal size in all estimation samples, estimation centered on the first and the tenth decile are therefore dropped. The value on the x-axis is the average value of the partitioning variable in each estimation sample.

Figure A11: Event Study of Trade Liberalization – Mechanism Outcomes



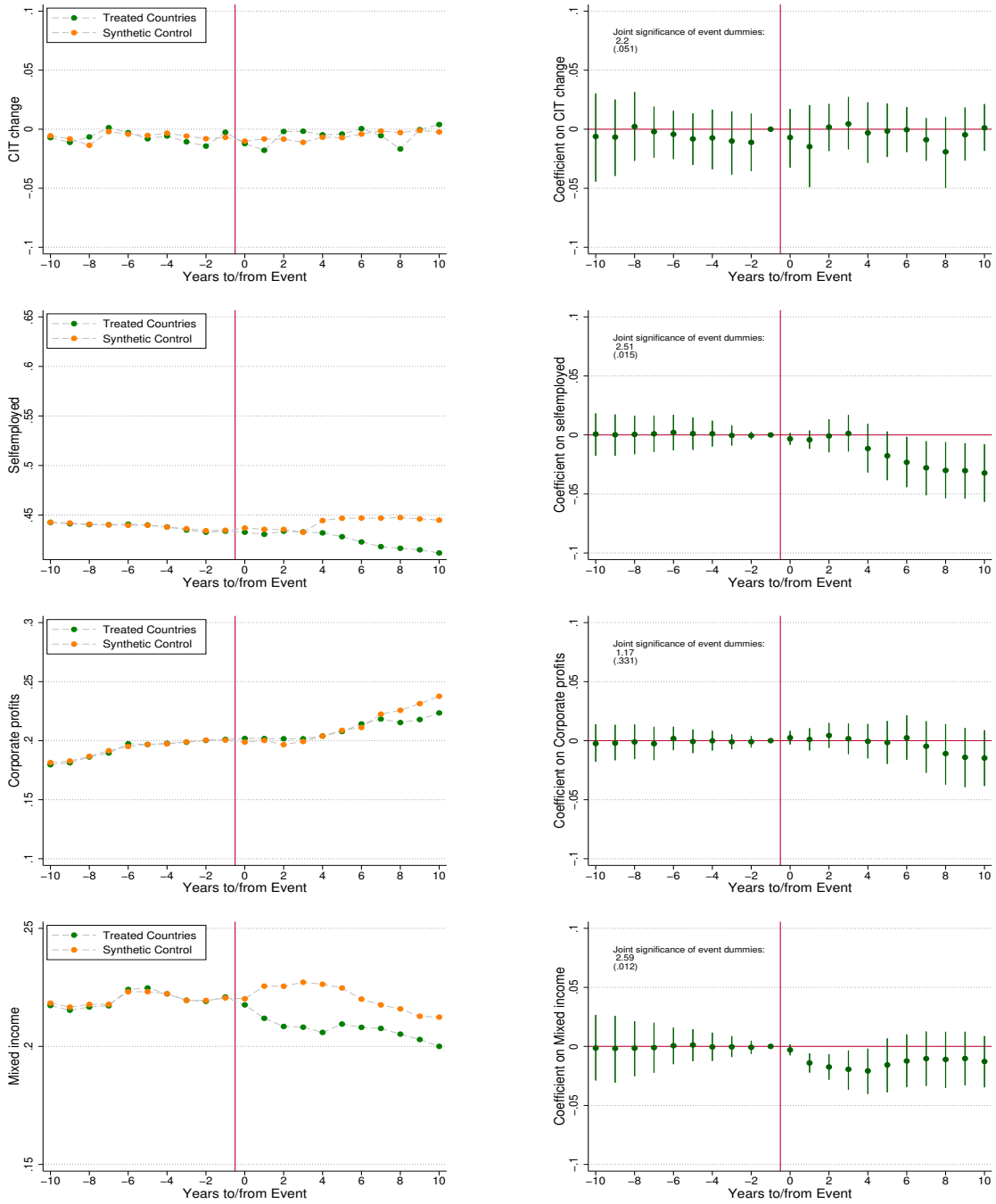
Notes: These figures show event-studies for trade liberalization in seven large developing countries: Argentina, Brazil, China, Colombia, India, Mexico and Vietnam. The panels correspond to different outcomes: corporate income tax rate; self-employed share of workforce; corporate profits share of national income; household mixed income share of national income. The left-hand 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 coefficients on the 'to' ('since') dummies, in a regression with country fixed effects, year 'to' ('since') fixed effects, and calendar year fixed effects. The bars represent the 95% confidence intervals. Standard errors are clustered at the country-reform level and estimated with the wild bootstrap method. The top-left corners report the F-statistic on joint significance of the post-reform dummies, with the p-value in parentheses below. Details on methodology in Section 6.1 and Appendix C.2.

Figure A12: Event Study of Capital Liberalization – Simultaneous Matching on Outcomes



Notes: These figures show event-studies for capital liberalization reforms over four outcomes: capital openness; capital shares; and effective tax rates (on capital and labor). The left-hand graphs show the average level of the outcome in every year relative to the event, for the treated group and for the group of synthetic controls. These graphs are constructed similar to Figure 8, with the exception that the synthetic control for each event-country is based on matching simultaneously on the four outcomes. The right-hand graphs show the coefficients on the 'to' ('since') dummies, in a regression model with country fixed effects; year 'to' ('since') fixed effects; and calendar-year fixed effects. The bars represent the 95% confidence intervals for 'to' ('since') reform coefficients, while standard errors are clustered at the country-reform level and estimated using the wild bootstrap method. In the top-left corner, we report the F-statistic on joint significance of the post-reform dummies, with the p-value in parentheses below.

Figure A13: Event Study of Capital Liberalization – Mechanism Outcomes



Notes: These figures show event-studies for trade capital reforms in the 25 developing countries of Chari, Henry, and Sasson (2012). The panels correspond to different outcomes: corporate income tax rate; self-employed share of workforce; corporate profits share of national income; household mixed income share of national income. The left-hand 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 coefficients on the 'to' ('since') dummies, in a regression with country fixed effects, year 'to' ('since') fixed effects, and calendar year fixed effects. The bars represent the 95% confidence intervals. Standard errors are clustered at the country-reform level and estimated with the wild bootstrap method. The top-left corners report the F-statistic on joint significance of the post-reform dummies, with the p-value in parentheses below. More details are in Section 8 and Appendix C.3.

Table A1: Allocation of Taxes to Factor Incomes, by Type of Tax (Benchmark Estimates)

Type of tax	Series	Allocation to labor (λ_τ)
Panel A: Direct Taxes		
Personal income tax (PIT)	1100	Share λ [70,100%] to L (See 3.1.2)
Corporate income tax (CIT)	1200	0% to L $\Rightarrow$ all CIT to K
Other (unallocable) income tax	1300	50% to L, 50% to K; rare
Social security & payroll taxes	2000	100% to L
Property & wealth taxes	4000	0% to L $\Rightarrow$ all asset taxes to K
Panel B: Indirect Taxes & Other Revenue		
Indirect taxes	5000	excluded, assumed proportional
Other taxes	6000	excluded ; minor
Non-tax revenue	7000	excluded; non-tax

Notes: This table shows our benchmark assignment of statutory tax incidence λ_τ on labor (where the assignment to capital is $1 - \lambda_\tau$), for each of the types of taxes in our modified OECD (2020) classification. For the purposes of assigning tax incidence onto factor incomes (see 3.1), we consider here only direct taxes, and implicitly assume that indirect taxation falls proportionally onto labor and capital factor incomes (cf. Browning, 1978; Saez and Zucman, 2019). We treat 'other taxes' similarly (these are rare and insignificant), and ignore non-tax revenue. For income tax revenues whose provenance cannot be understood as either personal income tax (PIT) or corporate income tax (CIT), we assign them as a 50-50% split between the two; these 'unallocable' income tax revenues are rare in occurrence and small in magnitude. Taxes in the 4000 series (largely property taxes) also include wealth and financial transaction taxes.

Table A2: Synthetic Difference-in-Difference of Trade Liberalization

	Trade	Capital Share of Income	Capital Share Corp. Income	ETR Capital	ETR Labor
Panel A Synthetic control for each outcome separately					
Post*Treat	0.0992**	0.0271*	0.0283	0.0485**	0.0199*
	(0.0530)	(0.0165)	(0.0202)	(0.0230)	(0.0111)
Imputed treatment effect	0.107***	0.0269**	0.0284**	0.0490***	0.0198***
	(0.0291)	(0.0115)	(0.0142)	(0.0146)	(0.00512)
Panel B Synthetic control for all outcomes jointly					
Post*Treat	0.0994*	0.0292***	0.0335***	0.0339*	0.0127
	(0.0561)	(0.00697)	(0.0106)	(0.0201)	(0.00974)
Imputed treatment effect	0.109***	0.0272***	0.0311***	0.0341***	0.0121***
	(0.0292)	(0.00455)	(0.00661)	(0.00647)	(0.00430)
N	284	290	292	282	290

Notes: This table shows the result from the difference in difference regression of our outcomes on interest in event countries (treated), compared to synthetic control countries. Panel A shows the results when the synthetic control matching is done for each event-country and outcome separately. Panel B shows the results when the synthetic control matching is done jointly on all outcomes (but still separately for each event-country). In practice we run the following regression: $Y_{it} = \beta^{DiD} * \mathbb{1}(j \geq 0)_t * D_i + \theta_t + \kappa_i + \pi_{Year(it)} + \epsilon_{it}$ Where, the β^{DiD} coefficient is the difference-in-difference estimate, representing the average treatment effect from period 0 through 10 post the trade liberalization event. We also present an additional difference-on-difference estimate proposed by Borusyak, Jaravel, and Spiess (2021). This estimate is imputed by first estimating country and time fixed effects, using non-treated countries as well as treated countries before their respective event. Those unit and year specific estimates are then used to impute the treatment effect for every treated country, and the imputed coefficient is then the average of the individual treatment effects. Due to the small sample size, we present wild bootstrap standard errors in parentheses (Cameron, Gelbach, and Miller, 2008), except for the imputed treatment effect according to Borusyak, Jaravel, and Spiess (2021), where we report the default standard errors produced by the Stata command *did_imputation*. * p<0.10 ** p<0.05 *** p<0.01.

Table A3: Reduced Form Regressions

	Trade (1)	Imports (2)	Exports (3)	ETR_K (4)	ETR_L (5)
$Z^{Gravity}$	0.040**	0.034***	0.023***	0.012**	0.005**
	(.017)	(.009)	(0.007)	(0.004)	(0.002)
$Z^{Oil-Distance}$	-0.012***	-0.005***	-.004***	-0.002***	-.001***
	(0.003)	(0.001)	(0.001)	(0.000)	(0.000)
N	*4518*	*4518*	*4518*	*4518*	*4518*

Notes: This table shows additional impacts of the two instruments $Z^{Gravity}$ and $Z^{Oil-Distance}$. Both the gravity and the oil-distance instrument is from Egger, Nigai, and Strecker (2019). For ease of comparison, in this table we use standardized transformations of each instrument. Across columns, we regress both instruments simultaneously on: trade, measured as the sum of imports and exports (% of GDP); imports (% of GDP); exports (% of GDP); the effective tax rate on capital, ETR_K; and, the effective tax rate on labor, ETR_L. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table A4: Robustness of IV Results to Changing the Measurement of Trade

	Capital Share		Effective Tax Rate	
	overall	corp. sector	on capital	on labor
Trade in G&S (%NDP)	0.151**	0.184**	0.375*	0.163***
	(0.0698)	(0.0800)	(0.213)	(0.0538)
First-stage F-statistic	26.07	26.07	26.07	26.07
Trade in G&S (%NDP), winsorized	0.145**	0.178**	0.366*	0.168***
	(0.0666)	(0.0764)	(0.207)	(0.0515)
First-stage F-statistic	29.05	29.05	29.05	29.05
Trade in G&S (log levels)	0.0328***	0.0380**	0.0699*	0.00607
	(0.0124)	(0.0156)	(0.0393)	(0.0166)
First-stage F-statistic	9.025	9.025	9.025	9.025
Trade in Goods Only (%NDP)	0.196**	0.236**	0.469*	0.165**
	(0.0975)	(0.112)	(0.276)	(0.0814)
First-stage F-statistic	21.14	21.14	21.14	21.14
N	*4518*	*4518*	*4518*	*4518*

Notes: This table shows the robustness of the main IV results to changing the measure of trade. Across columns, the outcomes of interest are: capital share of net domestic product (NDP, column 1); capital share within the corporate sector (2); the effective tax rate on capital income (3); and the effective tax rate on labor income (4). Across panels, the measurement of trade varies as follows: trade in goods and services (G&S), expressed as a percentage of NDP; then the same, but winsorized at the 95th percentile; then log of the value of trade in G&S, expressed in constant 2019 USD; and finally trade in goods only, expressed as a percentage of NDP. At the bottom of each panel, we report the first-stage F-statistic. All estimates include country and year fixed effects, with errors clustered at country level. We use dummy variable controls for significantly interpolated revenue data or imputed factor share data. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses.

Table A5: Robustness to Controls & Oil-Rich*Time Fixed Effects

	Capital Share		Effective Tax Rate	
	overall	corp. sector	on capital	on labor
IV: without controls	0.151**	0.184**	0.375*	0.163***
	(0.0698)	(0.0800)	(0.213)	(0.0538)
First-stage F-statistic	26.07	26.07	26.07	26.07
IV: with controls	0.115**	0.142**	0.400***	0.226***
	(0.0475)	(0.0546)	(0.112)	(0.0551)
First-stage F-statistic	19.02	19.02	19.02	19.02
IV: with controls & oil-rich time FE	0.261**	0.275**	0.573**	0.386**
	(0.121)	(0.131)	(0.232)	(0.151)
First-stage F-statistic	3.896	3.896	3.896	3.896
N	*4518*	*4518*	*4518*	*4518*

Notes: This table shows the robustness of the main IV results to including controls and then additional time fixed effects for countries in which oil is an important part of the domestic product, exceeding 6.5% of GDP (Ross and Mahdavi, 2015; Mahdavi, 2020). Across columns, the outcomes of interest are: capital share of net domestic product (NDP, column 1); capital share within the corporate sector (2); the effective tax rate on capital income (3); and the effective tax rate on labor income (4). Across panels, the first set of results show our benchmark specification from Table 1, then to a vector of control variables, then adding additional time fixed effects for the oil-rich countries. The control variables are as follows: USD exchange rate; gross fixed capital formation (as a percentage of NDP); (log) population; (log) gross domestic product per capita; and *de jure* capital accounts mobility (Chinn and Ito, 2006). In these IV specifications, we instrument for trade (in goods and services, expresses as a percentage of net domestic product) with both price-distance and gravity instruments (as discussed in Section 7). Estimates are weighted by net domestic product in constant 2019 USD at PPP. All estimates include country and year fixed effects, with errors clustered at country level. We use dummy variable controls for significantly interpolated revenue data or imputed factor share data. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses.

Table A6: Robustness to Alternative Measurements of Effective Tax Rates

	OLS (1)		IV (2)		IV: with controls (3)		IV: unweighted (4)	
	ETR_K	ETR_L	ETR_K	ETR_L	ETR_K	ETR_L	ETR_K	ETR_L
Mendoza et al. (1994)	-0.00287	0.0125	0.261	0.138**	0.288***	0.183***	0.155**	0.0741
	(0.0185)	(0.00899)	(0.158)	(0.0527)	(0.0889)	(0.0457)	(0.0676)	(0.0451)
PIT = 0% on capital	0.00830	0.0285***	0.387*	0.158***	0.408***	0.222***	0.272**	0.123**
	(0.0249)	(0.0108)	(0.198)	(0.0559)	(0.107)	(0.0565)	(0.107)	(0.0532)
PIT = 15% on capital	0.00817	0.0265**	0.390*	0.158***	0.419***	0.218***	0.267**	0.125**
	(0.0282)	(0.0103)	(0.214)	(0.0540)	(0.116)	(0.0538)	(0.108)	(0.0515)
PIT = 30% on capital	0.00685	0.0245**	0.394*	0.157***	0.430***	0.214***	0.260**	0.126**
	(0.0317)	(0.00979)	(0.231)	(0.0524)	(0.127)	(0.0513)	(0.111)	(0.0501)
ILO factor shares	0.00126	0.0214**	0.231*	0.194***	0.237**	0.264***	0.234*	0.0865
	(0.0332)	(0.0103)	(0.137)	(0.0652)	(0.0990)	(0.0622)	(0.126)	(0.0591)
First-stage F-statistic			26.07	26.07	19.02	19.02	8.415	8.415
N	*4518*	*4518*	*4518*	*4518*	*4518*	*4518*	*4518*	*4518*

Notes: This table shows the robustness of the main results to three alternative measures of effective tax rates: (1) with the Mendoza, Razin, and Tesar (1994) ETR definition. (2) with the capital share of PIT revenues bounded at levels that are either unrealistically low (0%), at an intermediate fixed parameter of (15%), or unrealistically high (30%). Finally, with the ILO (2019) factor share method, which adjusts the labor share of mixed-income a based on observable characteristics of the self-employed. Specification (1) presents the OLS estimate. We present the benchmark IV specification in column (2), and then either add controls in (3) or remove NDP weights in (4). Specifications (1)-(3) are weighted by NDP in constant 2019 USD at PPP. The additional control variables in (3) include: USD exchange rate; gross fixed capital formation (as a % of NDP); (log) population; (log) GDP per capita; and *de jure* capital accounts mobility (Chinn and Ito, 2006). All estimates include country and year fixed effects, with errors clustered at country level. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses.

Table A7: Individual Instruments vs. Both Instruments

	First Stage			IV	
	(1)	(2)	(3)	ETR_K	ETR_L
Panel A: Both Instruments Together					
$Z^{Gravity}$ and $Z^{Oil-Distance}$				0.250**	0.133**
				(0.105)	(0.0526)
First-stage F-statistic				8.415	8.415
Panel B: Each Instrument Separately					
$Z^{Gravity}$	0.00769**	0.00749**		0.294*	0.134*
	(0.00332)	(0.00332)		(0.163)	(0.0767)
First-stage F-statistic				5.101	5.101
$Z^{Oil-Distance}$	-0.118***		-0.111***	0.151**	0.131***
	(0.0333)		(0.0319)	(0.0645)	(0.0283)
First-stage F-statistic				12.14	12.14
N	*4518*	*4518*	*4518*	*4518*	*4518*

Notes: This table shows the main results for both instruments together (Panel A), and then for each instrument separately (Panel B). In column (1), however, we show OLS estimates of trade (in goods and services, expressed as a percentage of NDP) regressed on both instruments together. Then columns (2) and (3) show OLS estimates of trade on each instrument separately. In the columns to the right, we present IV estimates for the effective tax rate on capital income ETR_K and on labor income ETR_L. See Section 7 and Appendix D for further discussion of these instruments. For ease of interpretation, these estimates are unweighted (therefore, these estimates match Panel B of Table 1 as well as Table **??**). The price-distance instrument $Z^{Oil-Distance}$ has been multiplied by 10^{10}, for ease of interpretation. All estimates include country and year fixed effects, with errors clustered at country level. We use dummy variable controls for significantly interpolated revenue data or imputed factor share data. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses.

Table A8: Association between statutory CIT rate and capital tax collection

	ETR_K			CIT revenue (% GDP)		
	All	High inc	Mid-low inc	All	High-inc	Mid-low inc
CIT rate	0.201***	0.216**	0.188***	0.037**	.036*	.038*
	(0.055)	(0.097)	(0.067)	(0.016)	(0.020)	(.022)
N	*3653*	*1225*	*2428*	*3653*	*1225*	*2428*

Notes: This table presents results from estimating the association between the corporate statutory tax rate and the effective tax rate on capital, ETR_K, as well as the share of corporate income tax revenue in GDP. For both outcomes, the association is estimated for all countries, then separately for high income countries, and for middle and low-income countries. All regressions include country and year fixed effects. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses are clustered at the country level.

Table A9: Impacts of trade on sectoral composition

	Industry (1)	Services (2)	Agriculture (3)
Panel A: OLS	0.041**	-0.018	-0.007
	(0.016)	(0.014)	(0.012)
Panel B: IV weighted	0.152**	0.089	-0.189
	(0.064)	(0.102)	(0.181)
First-stage F-statistic	33.40	33.40	33.40
Panel C: IV with controls	0.094***	0.069	-0.104
	(0.032)	(0.063)	(0.093)
First-stage F-statistic	22.86	22.86	22.86
Panel D: IV unweighted	0.012	0.088	-0.074
	(0.095)	(0.094)	(0.075)
First-stage F-statistic	7.75	7.75	7.75
N	*3849*	*3849*	*3849*

Notes: This table shows the impacts of trade on sectoral composition. Across columns, the outcome variable is (expressed as a % of national value-added): industry (manufacturing and non-manufacturing); services; agriculture. Across panels, we present: OLS estimates (Panel A); benchmark IV (Panel B); IV with controls (Panel C); IV without weights (Panel D). The weights used in all panels except D are net domestic product in constant 2019 USD at PPP. In Panel C, the additional control variables include: USD exchange rate; gross fixed capital formation (as a percentage of NDP); net foreign direct investment; (log) population; (log) gross domestic product per capita; and *de jure* capital accounts mobility (Chinn and Ito, 2006). In all IV specifications, we instrument for trade (in goods and services, expressed as a percentage of NDP) with both price-distance and gravity instruments (as discussed in Section 7). At the bottom of each panel, we report the 1st stage F-statistic on the joint significance of the two instruments. All estimates include country and year fixed effects, with errors clustered at country level. * p<0.10 ** p<0.05 *** p<0.01. Standard errors in parentheses.

Appendix B Data construction

B.1 National income data

Data sources We used two datasets to compute factor shares of net domestic product. Both come from the United Nations Statistics Division. The first is the SNA2008 (UN SNA, 2008) online data repository.[43] The second is SNA1968 archival material (UN SNA, 1968). While the SNA2008 data has extensive coverage, we were able to extend further its coverage using SNA1968 observations. As shown in Table B1, we nearly double our 'complete' coverage observations by adding the historical data. What we describe as 'complete' observations are those that include a split of basic factor income concepts, including the compensation of employees in the household sector and operating surplus in the corporate sector. We briefly describe these national income accounting concepts here, and how we attribute them to labor or capital factors of production, before returning to discuss missing data and coverage.

Income Concepts Net domestic product at factor prices is (equation (1) in text):

$$Y = CE + OS_{CORP} + OS_{HH} + OS_{PUE}$$

We detail below the national accounting concepts

- 'Compensation of employees' (CE) refers to formal labor income. It includes wages and salaries, employer and employee social contributions, and all payments from employers in a current or deferred income stream to their employees.
- The 'operating surplus of corporations' (OS_{CORP}) includes all corporate income after paying employees and expenses, and after depreciation, and can also be thought of as formal-sector capital income.
- The 'operating surplus of private unincorporated enterprises' (OS_{PUE}), or mixed income, includes income from self-employment, unincorporated professionals, house-

[43] We accessed this data via the World Inequality Database (WID, 2020).

hold business owners, and the owners of private unincorporated enterprises (often informal enterprise, in developing countries). This income usually represents a return to both labor and capital.

– 'Household operating surplus' (OS_{HH}) is essentially the imputed rental income accruing to homeowners who live in their own home (so that a country entirely of homeowners would not appear to have a lower national income than a country where landlords earn rental income on all homes).

All operating surpluses—of corporations, of unincorporated enterprises, and of the household sector—are estimated net of depreciation (consumption of fixed capital, CFC). This explains why we obtain factor shares of Net Domestic Product instead of Gross Domestic Product (below we provide further detail on the data on depreciation).

These concepts are sufficient for the decomposition of factor income into labor and capital income flows, and our definition of factor shares follows that in most of the literature. For completeness, we explain some of the other concepts that do not figure in our calculations. We explain here why we decided not to include them and the role they would play if included.

(1) *net indirect taxes* (indirect taxes net of subsidies, NIT) are excluded from consideration. In our data these comprise 8-15% of national income. These indirect taxes are assumed to be factor-neutral, i.e., levied on the returns to capital and labor proportional to each factor's share in the affected production process. (2) net foreign income—the net flow of labor and capital incomes (usually compensation of employees or corporate profits) from abroad— is ignored. One could move from 'net domestic product' to 'net national income' as our total income concept. In practice, this seems to be a less relevant concept for our purposes (most countries tax income earned domestically regardless of citizenship, whereas net foreign income is taxed only with difficulty), but, this adjustment is minor for most countries. In national accounting concepts following the 'income approach' to domestic product,

government surplus is zero by construction and thus does need to be distributed to labor or capital.[44] Nonprofit institutions are included in the household sector.[45] (3

Missing data and imputations When values are still missing after we have appended the two UN data sources, we follow a simple a transparent imputation procedure. In the description here, we focus on mixed income, as this is the concept whose values are most frequently missing in UN SNA data—in both UN SNA (2008) and especially UN SNA (1968)—but the same procedure applies to other income concepts whose values are occasionally missing in UN SNA data, as well.

We follow the imputation procedure from Blanchet and Chancel (2016), which presents a simple and transparent method to impute consumption of fixed capital (depreciation), used in the World Inequality Database (WID) series on national income (contrarily to us the WID does not systematically decompose income into factor shares). To explain our imputation of mixed income OS_{PUE}, we present the following stylized facts:

1. Mixed income (OS_{PUE}) represents a lower share of national income in rich countries. This is due to the outsized role of the informal economy and household enterprises in developing countries.

2. Some countries have structurally high (or low) levels of mixed income as a share of national income. These specific long-term country effects represent either (i) a 'real' economic trend (e.g., the informal economy, as above, or the role of certain industries that that are characterized by self-employment); or (ii) a specific tendency or practice in the national statistical office (e.g., in some countries many household enterprises are closely followed by tax authorities and therefore mapped by statisticians into the corporate sector; or vice-versa for countries where some quasi-corporations are poorly accounted for).

[44] Public sector enterprises that operate on the market are included in the corporate sector.

[45] Their employees earn labor income compensation, while the institutions themselves (especially trusts and institutions with significant endowments) do earn imputed rent from land ownership. In national accounts parlance, these non-governmental organizations are referred to as 'non-profit institutions *serving households*' (emphasis added).

3. Mixed income as a share of national income is persistent and path-dependent, such that the value in year t will be closely correlated to the value in year $t+1$. Exogenous shocks that affect OS_{PUE} without similarly affecting total income per capita are rare, so its decrease is a slow process as income per capita increases.

Therefore, we can model OS_{PUE} as a function of log national income per capita (at PPP), with a random effect to capture constant country characteristics:

$$OS_{PUE_{it}} = \beta_0 + \beta_1 NNIpc_{it} + u_i + \varepsilon_{it}$$

where there is a random effect term u for each country i, and ε is the error term for each country-year it. To account for persistence in OS_{PUE} we model the error term ε_{it} as an AR(1) process:

$$\varepsilon_{it} = \rho \varepsilon_{i,t-1} + \eta_{it}$$

where η_{it} is i.i.d. white noise. As in Blanchet and Chancel (2016), when we know part of the OS_{PUE} series for a given country (observing it in later years), we can estimate the country's random effect u_i and use that in the imputation. When no later value of OS_{PUE} is observed, we assume $u_i = 0$. OS_{PUE} returns to its expected long-run value at a rate of ρ^t.

While mixed income OS_{PUE} is the most frequently missing national income component, others are occasionally missing, as well. When additional national income components are missing, we run the same imputation procedure for those. Therefore, we are able to generate an estimate of factor shares for every country-year in which we have data on total-economy net national income per capita. The global coverage of factor share data, by source and including imputed values, is shown in Table B1.

Mixed Income Adjustment As a robustness check (discussed above in Section 3.1, with results in Appendix Table A6), we implement the method developed in Guerriero (2019) and ILO (2019), to adjust for the share of labor income in mixed income. For each of the three classes of self-employed workers for which data is available in ILO labor force survey data (*viz.* self-employed employers, 'own-account' workers, and 'contributing

family members'),[46] we estimate a country-year coefficient, computed as the ratio of the average employee's wage to that of the self-employed worker.

Total labor income for a given country-year is retrieved as follows:

$$Y'_L = CE + \sum \frac{CE}{s_{emp}} \cdot \gamma_i s_i$$

where CE is the total compensation of employees in national accounts; s_{emp} is the share of employees in the workforce (whose collective earnings equal CE), such that $\frac{CE}{s_{emp}}$ is the average employee wage; and s_i denotes the share in the workforce of each type of self-employed worker. Each self-employment category i corresponds to a specific earnings coefficient γ_i relative to the average employee compensation.[47] Capital income Y'_K is $Y - Y'_L$.

Note, in Appendix Table A6, that the results from this robustness check do not affect our estimates, as the factor shares estimated from this method do not systematically differ from the factor shares calculated with a benchmark $\phi = 70\%$ labor share of mixed income.

B.2 Tax revenue data

Data As described in Table B1, our tax revenue data draws from four types of sources:

- OECD online Government Revenue Statistics (OECD, 2020)
- ICTD/UNU-WIDER Government Revenue Dataset (ICTD/UNU-WIDER, 2020)
- Historical archive work, principally from the Harvard Lamont Library.
- IMF Government Finance Statistics (IMF GFS, 2005)

While our use of the first three is more or less self-explanatory, and we retrieve off-the-shelf data from these international organizations,[48] the fourth fountainhead is perhaps the

[46] This is according to the ILO's International Classification of Status in Employment, ICSE-93, with data from 1991 to present.

[47] For country-years missing these concepts s_i and γ_i in raw ILOSTAT (2021) data—particularly for the era prior to 1991—we impute observations using the same procedure as above.

[48] Note, however, that we are using the IMF Historical Government Finance Statistics for the period 1972-89, not the version that is readily available online for the period since then. The historical dataset is available as a CD-ROM with dedicated software.

most significant because it fills data gaps from these other three with extensive archival work to stitch together harmonized long-run series for the more than 150 countries.

Our archival work started in the Government Documents section of the Lamont Library archive at Harvard University. For each country in our data-set, we scanned, tabulated, processed, and unified official data from the public budget and national statistical yearbooks, to retrieve the official statistics on revenue collection even in remote historical eras. To complement hard-copy archival data, we also retrieved individual countries' online datasets, usually published by a national statistical office or ministry of finance, or sometimes cross-country datasets from international organizations and scholarly efforts (e.g., CIAT and IDB, 2019; Fisunoglu et al., 2011; Lotz and Morss, 1970). Lastly, we would fill remaining gaps by scouring scholarly sources for individual studies detailing the aggregate and disaggregated levels of (central and decentralized levels of government) tax revenue collection. To corroborate levels and trends of tax revenue across sources, in this way, also helped in our triangulation and harmonization effort discussed below. These sources—and their harmonization (see also 'stitching' section below)—are detailed country-by-country in a forthcoming compendium of country case studies.

Revenue Concepts We classify each type of tax revenue following the OECD Government Revenue Statistics (OECD, 2020). We consider the following simplified classification (see also Table A1).

- The '1000' series of taxes, covers taxes on income and profits:

  > This heading covers taxes levied on the net income or profits (i.e. gross income minus allowable tax reliefs) of individuals and enterprises. Also covered are taxes levied on the capital gains of individuals and enterprises." (OECD, 2020).

  We always further separate the 100 series between personal income taxes (PIT, 1100) and corporate income taxes (CIT, 1200)

  - An important parameter is the share of PIT assigned to capital. As discussed in Section 3.1.2, in non-OECD countries we do not usually directly observe the level

of PIT revenue that derives from capital income and gains, as opposed to labor. To obtain a capital share of PIT we apply the following method (also discussed in Section 3.1.2): first, we estimate a PIT exemption threshold from Jensen (2021), where countries with a higher PIT exemption threshold are assumed to have a higher level of capital income within PIT than countries with a lower PIT exemption threshold; second, we note countries where a dual-taxation PIT system has set the taxation of capital income within PIT to a measurably lower rate than the taxation of labor income within PIT.

- The '2000' and '3000' series of tax revenues, include respectively social security contributions and taxes on payroll and workforce:

  > Classified here are all compulsory payments to general government that confer an entitlement to receive a (contingent) future social benefit. ... Contributions for the following types of social security benefits would, *inter alia*, be included: unemployment insurance benefits and supplements, accident, injury and sickness benefits, old-age, disability and survivors' pensions, family allowances, reimbursements for medical and hospital expenses or provision of hospital or medical services. Contributions may be levied on both employees and employers. ... Contributions to social insurance schemes which are not institutions of general government... are not considered as social security contributions. (OECD, 2020)

  We also include here all payroll taxes, i.e., 'taxes payable by enterprises assessed either as a proportion of the wages or salaries paid or as a fixed amount per person employed.' We consider all such social contributions and payroll taxes attributable as taxes on labor income, as shown in Table A1.

- The '4000' series comprises property and wealth taxes:

  > This heading covers recurrent and non-recurrent taxes on the use, ownership or transfer of property. These include taxes on immovable property or net

wealth, taxes on the change of ownership of property through inheritance or gift and taxes on financial and capital transactions. (OECD, 2020)

We attribute these revenues as taxes on capital income.

- The '5000' series, are indirect taxes on goods and services, including tariffs and trade taxes, value-added taxes, sales taxes, excises, and other forms of consumption taxes and taxes on production. Importantly, we consider these taxes both prior and proportional to factor income returns, such that the attribution of indirect taxes to factor incomes can be considered precisely proportional to factor incomes in the total economy.[49] If we were to include these taxes in our estimates of effective tax rates (see Section 3.1.2), we would only increase the levels of effective tax rates, but we would not change their trends relative to one another.

Finally, note that we exclude other non-tax revenues and tax expenditures from consideration. Once we classified each type of tax according to the simplified OECD (2020) framework, we proceeded to stitch together long-run tax revenue series for all countries.

Appending and Stitching Data Sources In brief, our comprehensive tax revenue data collection and harmonization process observed a simple set of rules. When more than one source existed to document levels of tax revenue in a given country-year (with tax revenues disaggregated as in the classification above), we compare statistics in the years of overlap and prioritize sources as follows:

1. OECD revenue statistics take precedence.

2. If OECD data is unavailable, then we use HA (historical archive, government documents from Harvard University Library archives and elsewhere [see above]).

3. If remaining country-years are missing, we use complementary sources, including: ICTD/UNU-WIDER (2020) data that begins in 1980; IMF GFS (2005) that covers the period from 1972-1989; or, additional sources as described above. For social

[49] In this sense, we also measure *factor-price* domestic product, i.e., net of indirect taxes.

contributions in particular, two complementary sources provded helpful: the 'D61' statistic on social contributions in the household sector in UN SNA (1968) and UN SNA (2008) are accurate (to the best of our knowledge) and extensive in its coverage; and, the data from Fisunoglu et al. (2011) provide additional coverage based on manually digitized versions of offline IMF archival documents.

We always referred to a variety of scholarly sources for every country, to corroborate against each other and against these sources for the 'stitch' years across overlapping eras with data from multiple sources.

To check the robustness of long-run tax revenue series, country-by-country, and to minimally interpolate where necessary (rarely),[50] we applied the following rules:

1. We do not include a country in our sample if there are fewer than 10 years of observed tax revenue data.

2. We never interpolate more than four years without data during a time series.

3. Only in rare cases do we use more than two data sources per country.

4. If any discrepancies existed during 'stitch' years across data sources, we study the nature of the discrepancy in a review of scholarly sources—to then retrieve statistics on the revenues that are missing from the less-accurate source; and to 'backcast' using year-on-year growth rates of the less-accurate source, if necessary (see UNSD, 2018).

5. To check that we were not missing significant sources of decentralized tax revenues, we use the recent OECD-UCLG (2019) study to find the countries with significant state and local public finance revenue collection, and collected more data for any countries where necessary.

6. We make explicit any assumptions about PIT vs. CIT split during historical eras where the government documents do not clarify the nature and relative weights of individual vs. corporate collection of income tax revenue. In these cases, we rely on local scholarly sources that discuss the legislation.

[50] We interpolated some tax revenue data in only 5% of nearly 7000 observations.

7. Similarly, in any (rare) cases where the OECD data did not measure the PIT vs. CIT split (and only ascribed certain revenues to a generic total income tax), we often find that actually the split can be made after studying the details of countries' tax legislation. This only occurs rarely in practice.

8. We check for significant regime change, political conflict, inflation episodes or other macro-economic crises that cast significant doubt on the credibility of estimates and the continuity of tax revenue time series. We do not interpolate between years characterized by such events.

9. We exclude all tax revenue observations for territories prior to independence as well as all countries during the Communist era.

Starting from this set of rules, we implement several checks on the quality of our factor income and tax revenue datasets. They are outlined on a country-by-country basis in the online appendix. As an illustration, below we reproduce the checks that were implemented for the tax revenue series in China.

B.3 Case study: China's establishment of a modern tax system in 1994

Based on the rules we established, we only include ex-command economies into our data starting in 1994. Given China's importance for the global economy, we discuss here the reason for this choice.

The tax revenue data for China covers most of our sample period, although it improves a in quality in the 1980s.[51] Prior to the 1980s, China had a command economy's model of 'profit delivery,' in which the state spent directly the revenues of profitable SOEs and subsidized unprofitable ones, an example of soft budget constraints (Kornai, Maskin, and Roland, 2003). As part of the decade of economic reforms beginning in 1978, a corporate income tax appears in China around 1983-84 (Wong and Bird, 2008). A decree from the State Council in 1983 put a new 55% tax on the profits of enterprises, which were still almost entirely state-owned. Starting in 1985, we observe CIT revenue in the data, although

[51] Official public finance statistics are available online at https://data.stats.gov.cn/english/index.htm.

it appears implausibly high (as a percentage of NDP, or of capital income). In addition, not long after, the tax system was further reformed into a 'fiscal contracting' system whereby firms negotiated a fixed tax revenue level (regardless of economic outcomes) to local governments, who in turn delivered a share to the central government. This system resembles a firm "poll" tax, and subsumed all types of tax revenues, including CIT, VAT and payroll, making it impossible to assign taxes to capital or labor. For these reasons, we exclude this sort of 'pseudo'-CIT revenues dating from 1985 through 1993.

China's modern tax system arguably begins in 1994. A valuable resource to study the introduction of a modern tax system is the World Bank (2008)'s book "Public Finance in China". The book, argues that prompted by low central government revenues, China established in 1994 a central tax administration; reformed the broken 'fiscal contracting' system; unified the PIT; created a VAT; and reduced 'extra budgetary' (non-tax) revenues.[52] Thus from 1994 onward we can categorize tax revenue by sources, assign them to capital or labor, and thus construct ETRs. It should be noted, however, that to the extent that they were measurable, tax revenue appeared higher in the 1980s than in the 1990s in China.

[52]The state-run media summarizes these policy reforms succinctly (China Daily, 2018), and agrees with scholarly work (e.g., World Bank (2008) see esp. pp.13-22; or Wong and Bird (2008) pp.430-440)

Table B1: Main Data Sources

	country-year obs.	%
Panel A: Factor Share Data		
SNA2008	2403	34.8%
SNA1968	1484	21.5%
composite/imputed	3016	43.7%
N	*6903*	*100%*
Panel B: Tax Revenue Data		
OECD	2881	41.7%
Harvard/archives	2092	40.2%
ICTD	1276	18.5%
N	*6903*	*100%*

Notes: For the *N*=6903 country-year observations in which we estimate effective tax rates on capital and labor income (over 156 countries since 1965), Panel A presents the sources of our factor share data (on national income components), while Panel B presents the sources our tax revenue data (on total revenues disaggregated by type of tax). In the former, we use online data from UN SNA (2008) and archival data from UN SNA (1968). In the latter, we draw tax revenue data from sources including OECD (2020), ICTD/UNU-WIDER (2020), and IMF GFS (2005), as well as extensive archival research in the Harvard University Library, online sources, and IMF historical data. (See Appendix B.)

Appendix C Event studies

C.1 Description of trade events

Our selection of trade events is determined by three criteria: (i) the event can unambiguously be related to measurable policy reforms; (ii) the policy reforms induced large changes in trade barriers; and (iii) the event has been studied in peer-reviewed academic publications. The first criterion improves the transparency of the event-study design, which rely on changes in outcomes around an explicitly defined policy event. The second criterion increases the likelihood that we are able to observe sharp breaks in trend in our macroeconomic outcomes which coincide with the timing of the policy event. The third criterion allows for our results to be compared to previous work, and for anyone to study the narrative surrounding these reforms. These prior papers have already established positive effects of the reforms on cross-border trade (and other economic outcomes).

Selection of events These criteria lead us to focus on the six trade liberalization events referenced in review articles by Goldberg and Pavcnik (2007) and Goldberg and Pavcnik (2016), GP henceforth, to which we add China's WTO accession event (studied in Brandt et al., 2017). These liberalization events all feature reductions in tariff barriers, the most commonly studied component of globalization, in part because it is easier to measure on a consistent basis across space and time, as compared to non-tariff trade barriers and other forms of globalization. These events also features reductions in non-tariff barriers which are harder to measure; for example the number of products subject to import licences and quotas fell. Fortunately, tariff and non-tariff barrier reductions seem highly correlated (Goldberg and Pavcnik, 2007).

All selected events feature large reductions in tariff rates. Most of the selected countries did not participate in the early GATT/WTO negotiation rounds; consequently, tariffs remained high in these countries prior to the events, such that reductions in tariff rates remained an available policy lever.[53] These trade liberalization events were drastic: Brazil

[53]Some countries were not GATT members by the time of the event, such as Mexico; others (Brazil, Colombia, India) were nominal GATT members, but were not forced to reciprocate tariff concessions negotiated with GATT until the Uruguay Round (Goldberg and Pavcnik, 2016).

cut tariff rates from 58.8 percent to 15.4 percent; India reduced rates from 80 percent to 39 percent; China reduced tariffs from 48% on average to 20%; Mexico reduced tariff rates from 23.5% to 11.8%, while import licence requirements went from covering 92.5% of national production to 25.4%; Colombia's tariffs were reduced from 27% to 10% and import requirements dropped from 72% of national production coverage to 1.1%. In the selected countries, "tariff reductions constitute a 'big part' of the globalization process" (Goldberg and Pavcnik, 2016). The timing of these events and references to additional papers which study the events in detail are provided in Table C1.

Timing of events Most studies provide detailed discussions of the context surrounding the events. We repeat the rationale cited for the liberalization events and discuss why these events are plausibly exogenous to the country's economic circumstances at the time.

- **Brazil** The liberalization event of 1988 is detailed in Dix-Carneiro and Kovak (2017). The authors note that the high pre-reform average level of tariffs was driven by large cross-industry variation in protectionism and that the reform was unexpected:

  > "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 licences and removed nearly all of the remaining special customs regimes." (Dix-Carneiro and Kovak, 2017)

- **Columbia** Similarly to Brazil, tariff reductions in Colombia in 1985 were driven by the country's commitment to impose uniform rates across products and industries under the negotiation commitments to the WTO. In Colombia's case, Goldberg and Pavcnik (2007) note that the reform objective was to reduce cross-industry dispersion under WTO negotiations, thereby making "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 event in 2001, but that the

tariff reductions implemented in the immediate post-accession period were large, "less voluntary" and largely complied with the fixed WTO accession agreements. Importantly, the potential accession to WTO contributed to timing of the privatization initiatives in the pre-WTO years, in which the Chinese government restructured and reduced its ownership in state-owned enterprises. While the privatization efforts began in 1995 and were also gradual (Jefferson, 2016), given their importance in the national economy, it is possible that additional sell-offs in the immediate post-WTO years contribute to the observed break in 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, the 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) provide an extensive discussion of the Indian reform, arguing that it "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 India's balance of payment crisis, which was triggered by"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" (Topalova and Khandelwal, 2011).

- **Vietnam** The 2001 reform in Vietnam was implemented as a broad trade agreement that did not involve negotiations over specific tariffs (McCaig and Pavcnik, 2018). The reform was driven by the American government's decision to reclassify Vietnam from 'Column 2' of the US tariff schedule to the 'Normal Trade Relations' schedule. 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. McCaig and Pavcnik (2018) show that there are no differential trends between Vietnamese exports to the US relative to exports to other high-income countries. Vietnam's case is compelling since the liberalization even was triggered by a foreign party, rather than by its own government.

These descriptions of reform context do not argue that liberalization events were triggered by trends in taxation needs. Thus, this narrative analysis complements the absence of a pre-trends result (Figure 7), to help alleviate endogeity concerns in the timing of the events.

Post-event reforms Yet, even if the reform timing is uncorrelated with confounding trends, the interpretation of the event studies depends on whether other reforms and macroeconomic shocks occurred in the immediate post-reform years. The detailed review provided in (Goldberg and Pavcnik, 2007) is very helpful, as it notes all major further events which followed the initial liberalization events. Argentina's event in 1989 is followed by accession to Mercosur in 1991; Brazil's event in 1988 is followed by accession to Mercosur in 1991 and the currency crisis in 1998; India's event in 1991 is 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 and accession to NAFTA in 1994.

Their discussion suggests that other reforms did occur, often a few years after the trade liberalization event; and, these reforms served to reduce other non-tariff barriers to cross-border flows. As such, while the immediate post-event impacts may more likely be attributed to trade liberalization, the medium-run impacts might be better interpreted as the reduced-form effects of globalization more generally, which includes an increase in the flow of goods, services, and capital, as well as further policy responses.

C.2 Event study methodology

Sample Construction Our sample is constructed by applying a synthetic matching procedure to every treated country, for each outcome of interest. The donor pool (the set of all control countries from which to chose the synthetic control group) has to be fully balanced in all pre-event periods. Thus, we discard all countries with data gaps before 1976. This gives us a sample of 103 countries for each outcome.[54] We have ten 'pre' event

[54]The exception to this rule is the trade variable, where we have more data gaps and consequently must drop more countries from the donor pool. Here, the donor pool consists of 90 countries.

years for every country, except for Mexico and Colombia, where we have nine pre-period years.[55] We then pool together all seven treated countries and their synthetic control units.

Empirical Strategy Using this panel, we estimate the following event study regression:

$$Y_{it} = \sum_{j=-10, j\neq -1}^{10} \beta_j * \mathbb{1}(j = t)_t * D_i + \theta_t + \kappa_i + \pi_{Year(it)} + \epsilon_{it}$$

where θ_t and κ_i represent, respectively, time relative to/from the event and country fixed effects, and where $\pi_{Year(it)}$ is a set of fixed effects for calendar years. D_i is a dummy equal to one if observation i is a treated country. Hence, β_j capture the difference between the treated countries and the group of synthetic controls across event time, with year t-1 as the reference period.

In addition to the event study regressions, we also use this setting to estimate a simple difference-in-difference coefficient:

$$Y_{it} = \beta^{DiD} * \mathbb{1}(j \geq 0)_t * D_i + \theta_t + \kappa_i + \pi_{Year(it)} + \epsilon_{it}$$

Here, μ^{DiD} can be interpreted as an average treatment effect over the first 10 years post treatment. We run both regressions—the event study and the difference-in-difference regression—on a set of nine outcomes, and cluster standard errors at the country level. We note that statistical inference based a small sample size should be approached with caution (Abadie, Diamond, and Hainmueller, 2010). We therefore also report standard errors based on the wild bootstrap method (Cameron, Gelbach, and Miller, 2008) for β^{DiD}, in Table A2.

Moreover, we use the imputation method developed by Borusyak, Jaravel, and Spiess (2021) to report average treatment effects comparable to β^{DiD} with a technique that deals with issues with two-way fixed effects and heterogeneous timing of events (such as our setting). The approach provides a transparent alternative method to the difference-in-difference equation specified above. The average treatment effect τ is calculated in three steps, detailed below.

[55] Moreover, China and Vietnam only have tax revenue data from 1994 onward, but its event happens in 2001. We therefore only match on seven pre-period years.

1. We use untreated countries as well as treated countries in the years before treatment, to estimate unit and (relative) year fixed effects:

$$Y_{it} = \theta_t + \kappa_i + \pi_{Year(it)} + \epsilon_{it}$$

if $t < 0$ or $D_i = 0$. We note that to bring the approach developed by Borusyak, Jaravel, and Spiess (2021) closer to our estimation strategy, we include fixed effects for the years in relative time.

2. Equipped with the fitted values $\hat{\theta}_t$ and $\hat{\kappa}_i$, we can now impute the unit specific treatment effect as:

$$\hat{\tau}_{it} = Y_{it} - \hat{\theta}_t - \hat{\kappa}_i - \hat{\pi}_{Year(it)}$$

3. The final step is to average over those coefficients to produce a treatment effect. We report unweighted averages, but heterogeneity in treatment effects could be accounted for by specifying weights.

Simultaneously Matching on Main Outcomes As we perform the synthetic matching procedure for each event and outcome based on the outcome, we have a different 'synthetic' control for each country in every outcome. This means that while we use the same group of treated countries in every regression, the set of control countries that feeds into the synthetic control group varies across outcomes. We want to test that our results hold up in a more rigid setting.

To ensure robustness to a more restrictive synthetic control, we repeat all of the above analysis, using a slightly different approach of constructing the synthetic control countries. Specifically, we use our four main outcomes—trade (as a percentage of domestic product); capital share of domestic product; and effective tax rate on labor and capital—to predict one synthetic control group per treated country. The resulting weights for the three most prominent countries in each control group are reported in Table **??**. This exercise allows us

to still run separate regressions for each outcome, but with the exact same composition of the control group in each regression.

Level and event study graphs for each outcome are reported in Figure A8. While it is obvious that for some outcomes, the levels do not line up exactly in the 'pre' periods, the graphs confirm the conclusions from Figure 7. In Table **??**, we also report all estimated coefficients (including the simple difference-in-difference estimate) of this alternative approach. While we prefer the approach presented in the main body of this paper in Section 6.1, this robustness exercise does demonstrate that the results there do not hinge on the flexible nature of our synthetic control design.

C.3 Capital liberalization: Events and results

In this subsection, we provide details on the event-study analysis of capital liberalization in Section 8. We use the 25 liberalization events in developing countries measured by Chari, Henry, and Sasson (2012). The authors identify liberalization dates using the point in time when countries first permitted foreigners to purchase shares of companies listed on the domestic stock market. At first glance, this event may appear to be a narrow way to define capital liberalization, but the authors provide several arguments that the dates in fact serve as indicators for larger move towards open capital markets.

First, net equity inflows soared in the periods where developing countries liberalized their stock markets. While such flows were practically non-existent in the 1970s and early 1980s, they accelerated sharply around the end of the 1980s when most countries implemented their liberalization reforms. It is important to note that stock market liberalizations account for a significant fraction of foreign direct investment (FDI). Indeed, for purposes of official statistics, FDI includes any stock transaction (that is, a cross-border merger or acquisition) that results in the purchaser owning 10 percent or more of the voting shares. Chari, Henry, and Sasson (2012) quote data from Latin American and East Asia which show that cross-border mergers and acquisitions account for 40% to 60% of FDI. Second, by facilitating cross-border financial flows and ownership, stock market liberalization induces large inflows of capital goods. The authors quote other studies

which show that, following capital liberalization, the share of capital goods in total imports rises by 9%. Through this channel, the liberalization events contribute to raising aggregate investment. Third, policymakers often worry that increased net equity inflow can easily convert into net outflow at the early signs of macro-economic instability. In turn, the increased outflow can compound the instability and introduce volatility. But the authors note that the liberalization events considered here were not marked by any reversal of the liberalization policies or the equity inflows in the post-reform years. This allows us to study the effects of liberalization reforms more cleanly and over longer time-horizons. Fourth, there are difficulties in determining precise liberalization dates and the literature has mainly chosen to ignore this measurement problem (Eichengreen, 2001). By focusing on the initial date where stock markets were first opened to foreign capital, the events are more cleanly measured than other candidate de-jure policy changes which may be harder to pinpoint. For further details about the complexities of determining liberalization dates, see Henry (2007).

For these reasons, the authors consider the stock market liberalization events to be meaningful indicators of countries' progression towards freer capital inflows. The authors select 25 liberalization events which: are recorded in official sources (Standard and Poor's Emerging Markets Database); are verified from primary sources; and, have been used elsewhere in the literature. Table C2 lists the 25 countries with their liberalization dates.

Our sample is constructed by applying a synthetic matching procedure to every treated country for each outcome of interest. We follow the methodology and estimation techniques described in detail in Appendix Section C2. Table C2 provides details on the main countries that form the synthetic control group for each treated country and each outcome. Our main measure of capital openness is the sum of foreign assets and liabilities. This stock is expressed as a percent of GDP; given the strong right-skew, we use the log of this ratio in the analysis. We find similar results when using alternative measures of capital openness, including portfolio equity assets and liabilities (% of GDP) and the KOF financial globalization index (Gygli et al., 2019). Moreover, we also find that the liberalization events led to positive changes in the de jure index of capital openness produced by Chinn and

Ito (2006). These results are available upon request. Finally, we note that due to limited data availability, we were not able to study the impact on foreign direct investment.

The level and event-study graphs for each outcome (capital openness; capital share of national income; capital share of corporate income; ETR_K; ETR_L) are reported in Figure 8. The statistic in the top-left corner reports the F-statistic and p-value for the joint significance of all post-liberalization dummies. It is important to note that, when jointly considered, the post-liberalization coefficients for ETR_K are not statistically significant. The panels make clear this is because the statistically significant effect on capital taxation materializes with a few years' lag to the liberalization event. Appendix Figure A12 shows that the results are robust to creating synthetic controls for each event-country based on matching the four outcomes simultaneously (capital openness; capital share; ETR_K; ETR_L). In particular, the events continue to be associated with a large increase in capital openness, a positive impact on capital taxation and a muted (null) impact on labor taxation.

Table C1: Weights in Synthetic Control for Trade Liberalization Events

Country	Event Year	Capital share (NDP)	Weight	ETR on capital	Weight	ETR on labor	Weight	Trade Openness	Weight	Reference
Argentina	1989	Uruguay	28.7 %	Bangladesh	41.6 %	Chile	35.9 %	Bangladesh	97.3 %	Goldberg and Pavcnik (2006)
		Oman	18.6 %	Haiti	14.1 %	Togo	31.6 %	United States	2.7 %	
		Bolivia	16.2%	Bolivia	13.4 %	Jordan	16.8 %	.	.	
		...	...	...	...	...	...	.	.	
Brazil	1988	Bolivia	9.1 %	Jordan	35.7 %	Panama	25.7 %	Bangladesh	59.8 %	Goldberg and Pavcnik (2006), Dix-Carneiro and Kovak (2017)
		Eswatini	7.6 %	Sudan	21.2 %	Guyana	21.7 %	United States	32.2 %	
		Mauritius	7.0 %	Zimbabwe	12.7 %	Chile	14.5 %	Japan	6.1 %	
		...	...	...	...	...	...	...	...	
China	2001	Sweden	37.0 %	Congo	41.8 %	Kuwait	31.1 %	United States	36.2 %	Brandt et al. (2006)
		Switzerland	24.3 %	Nicaragua	26.3 %	Pakistan	22.9 %	Bangladesh	36.0 %	
		Sierra Leone	21.1 %	Gabon	14.2 %	Uganda	20.2 %	Dominican Rep.	12.2 %	
		...	...	...	...	...	...	...	...	
Colombia	1985	Lesotho	17.0 %	Kuwait	67.9 %	Paraguay	45.5 %	Bangladesh	50.7 %	Goldberg and Pavcnik (2006; 2016)
		Nicaragua	9.5 %	Gabon	14.6 %	Sudan	15.0 %	Iran	22.6 %	
		Bahrain	8.1 %	Sierra Leone	12.6 %	Cameroon	11.5 %	Guatemala	12.5 %	
		...	...	...	...	...	...	...	...	
India	1991	Nepal	8.0 %	Uganda	41.4 %	Lebanon	37.9 %	United States	76.4 %	Goldberg and Pavcnik (2006, 2016); Topalova et al. (2009)
		Nicaragua	6.9 %	Bolivia	14.0 %	Oman	17.6 %	Bangladesh	23.6 %	
		Iceland	5.8 %	Haiti	4.6 %	Jordan	16.2 %	.	.	
		...	...	...	...	...	...	.	.	
Mexico	1985	Paraguay	36.3 %	Sierra Leone	33.2 %	Tunisia	31.1	Bangladesh	72.0 %	Feenstra and Hanson (1997); Goldberg and Pavcnik (2006, 2016)
		Botswana	18.7 %	Bahrain	23.6 %	Zimbabwe	25.8 %	Uruguay	9.6 %	
		Philippines	14.3 %	Bolivia	14.7 %	Uruguay	15.9 %	Spain	8.0 %	
		...	...	...	...	...	...	...	...	
Vietnam	2001	Nepal	27.5 %	Korea	45.8 %	Bangladesh	72.8 %	Thailand	42.4 %	Goldberg and Pavcnik (2016), McCaig and Pavcnik (2018)
		United States	10.1 %	Luxembourg	19.2 %	Myanmar	22.6 %	Ghana	22.6 %	
		Switzerland	4.7 %	Trinidad & Tob.	17.3 %	Haiti	4.6 %	Venezuela	21.7 %	
		...	...	...	...	.	.	...	...	

Notes: This table shows the seven treated countries and the three countries with the largest weight in the synthetic control group for each outcome and each treated country. For each outcome, the pool of possible donor countries consists of 103 countries, with the exception of the trade variable, where we have only 90 countries with a balanced panel over the period considered. Note that the synthetic control method requires the panel of possible donor countries to be strictly balanced in all 'pre' periods that are used in the matching procedure. One additional restriction applies with respect to this sample. For the outcomes on trade and ETR_K, the extrapolation of Vietnam to the years 1991-93 lead to outlier values in those years, so we do not use these imputed values. This results in the panel for these outcomes to be slightly unbalanced in the years $t-10$ to $t-8$.

Table C2: Weights in Synthetic Control for Capital Liberalization Events

Country	Event Year	Capital share (NDP)	Weight	ETR on capital	Weight	ETR on labor	Weight	Capital Openness	Weight
Argentina	1989	Uruguay	19.7 %	Bangladesh	39.7 %	Chad	35.8 %	United States	42.3 %
		Qatar	16.0 %	Paraguay	29.8 %	Togo	35.8 %	Papua New Guinea	33.3 %
		Bolivia	11.8 %	Nepal	7.5 %	Uruguay	28.2 %	Tanzania	11.8 %
		...	...	...	...	...	...	...	...
Brazil	1988	Malawi	9.6 %	Sudan	34.0 %	Guyana	30.3 %	United States	54.1 %
		Swaziland	9.6 %	Mali	10.9 %	Congo	18.8 %	El Salvador	15.5 %
		Mauritius	7.8 %	Zambia	10.8 %	Togo	17.2 %	Iran	13.1 %
		...	...	...	...	...	...	...	...
Chile	1987	Zambia	46.0 %	Bolivia	45.8 %	Madagascar	49.9 %	Kuwait	35.8 %
		Botswana	15.8 %	Uganda	25.2 %	Uruguay	42.3 %	Lebanon	16.7 %
		Kuwait	13.0 %	Canada	19.0 %	Norway	7.6 %	Ireland	12.3 %
		...	...	...	...	...	...	...	...
Colombia	1991	Fiji	29.6 %	Bangladesh	59.2 %	Sudan	60.1 %	Kuwait	31.7 %
		Bolivia	17.1 %	Iceland	20.9 %	Trinidad and T.	24.5 %	Gabon	19.7 %
		Ireland	8.6 %	Papua New Guinea	11.2 %	Paraguay	14.9 %	Austria	13.0 %
		...	...	...	...	...	...	...	...
Egypt	1991	Qatar	33.1 %	Sierra Leone	43.3 %	Nicaragua	50.7 %	Bolivia	45.6 %
		Paraguay	18.2 %	Uruguay	24.3 %	Bahrain	23.1 %	United States	31.9 %
		Mauritius	10.9 %	Zambia	18.5 %	Luxembourg	13.0 %	Syria	18.0 %
		...	...	...	...	...	...	...	...
Spain	1993	Canada	22.6 %	Swaziland	22.1 %	Lesotho	30.3 %	Italy	44.6 %
		Swaziland	18.0 %	Jamaica	16.5 %	Norway	29.8 %	Singapore	30.5 %
		Albania	8.3 %	New Zealand	8.9 %	Italy	18.7 %	Sweden	12.9 %
		...	...	...	...	...	...	...	...
Greece	1994	Costa Rica	50.5 %	Myanmar	41.8 %	Panama	30.3 %	Botswana	13.5 %
		Mozambique	11.4 %	Bahamas	21.4 %	Austria	25.9 %	United States	9.4 %
		Albania	10.4 %	Malawi	19.2 %	Nicaragua	20.6 %	Saudi Arabia	8.6 %

		...	...	...	...	...	...	...	...
Indonesia	1989	Mozambique	20.4 %	Benin	17.1 %	Lebanon	36.0 %	Ireland	30.3 %
		Sweden	5.7 %	Uganda	16.3 %	Bahamas	19.5 %	Oman	21.1 %
		Gabon	4.8 %	Bangladesh	14.3 %	Myanmar	11.5 %	United States	19.3 %
		...	...	...	...	...	...	...	...
India	1986	Mauritius	7.4 %	Uganda	29.3 %	Lebanon	64.2 %	Peru	49.7 %
		Costa Rica	7.0 %	Bahrain	14.2 %	Chad	15.7 %	Denmark	19.9 %
		Finland	6.1 %	Peru	10.8 %	Peru	7.1 %	United States	14.6 %
		...	...	...	...	...	...	...	...
Israel	1989	Denmark	34.9 %	Sweden	39.1 %	Sweden	78.8 %	United States	20.9 %
		Algeria	27.5 %	Ecuador	17.8 %	Guyana	21.0 %	Mauritania	20.2 %
		Bahrain	17.5 %	Barbados	16.3 %	...	...	Saudi Arabia	19.4 %
		...	...	...	...	...	...	...	...
Jordan	1995	Haiti	23.8 %	Lebanon	29.4 %	Nepal	70.2 %	Gabon	21.9 %
		Afghanistan	19.7 %	Ghana	25.4 %	Ghana	16.4 %	Cameroon	19.7 %
		Saudi Arabia	19.2 %	Honduras	22.3 %	Honduras	13.4 %	Botswana	19.4 %
		...	...	...	...	...	...	...	...
Korea	1987	Lebanon	31.6 %	Uganda	38.2 %	Kuwait	14.3 %	United States	21.0 %
		Cote d'Ivoire	28.4 %	Iceland	17.1 %	Madagascar	11.6 %	Qatar	19.5 %
		Panama	11.9 %	Ethiopia	10.3 %	Bangladesh	10.0 %	Tanzania	15.2 %
		...	...	...	...	...	...	...	...
Mexico	1989	New Zealand	35.1 %	Niger	41.8 %	Chad	68.0 %	Saudi Arabia	43.5 %
		Oman	22.3 %	Sierra Leone	31.2 %	Uruguay	15.3 %	United States	20.7 %
		Panama	19.4 %	Central African Republic	10.4 %	Norway	8.9 %	Bolivia	20.2 %
		...	...	...	...	...	...	...	...
Malaysia	1987	Paraguay	14.8 %	Denmark	19.3 %	Sudan	25. %	Syria	31.4 %
		Kuwait	10.3 %	Ecuador	18.4 %	Mauritius	15.8 %	Guatemala	19.4 %
		Luxembourg	5.9 %	Switzerland	15.8 %	Togo	11.2 %	United States	18.0 %
		...	...	...	...	...	...	...	...
Nigeria	1995	Mozambique	40.0 %	Rwanda	60.3 %	Chad	26.4 %	Paraguay	36.1 %
		Zambia	20.1 %	Sweden	17.2 %	Myanmar	22.3 %	Denmark	27.0 %

		Saudi Arabia	17.9 %	Papua New Guinea	13.8 %	Nepal	21.2 %	Oman	13.4 %
		...	...	...	...	...	...	...	...
Pakistan	1991	Nepal	7.5 %	Lebanon	39.3 %	Sierra Leone	40.9 %	Australia	18.2 %
		Mozambique	4.8 %	Bahamas	9.7 %	Bangladesh	14.8 %	Iran	14.2 %
		Tunisia	4.6 %	Malawi	8.3 %	Sri Lanka	14.0 %	Bolivia	8.7 %
		...	...	...	...	...	...	...	...
Philippines	1986	Congo	67.1 %	Mauritius	52.4 %	Peru	29.1 %	Cote d'Ivoire	21.7 %
		Iceland	15.5 %	Central African Republic	47.4 %	Chad	22.8 %	Kuwait	16.6 %
		Mozambique	11.1 %	...	...	Bahrain	21.6 %	Saudi Arabia	16.2 %
		...	...	...	...	...	...	...	...
Portugal	1993	France	94.3 %	Mozambique	40.0 %	Ecuador	32.6 %	Singapore	27.7 %
		Zambia	4.8 %	Guyana	26.8 %	Iceland	23.1 %	Iran	22.2 %
		Mozambique	0.8 %	Singapore	14.3 %	Finland	22.6 %	Canada	21.6 %
		...	...	...	...	...	...	...	...
Thailand	1987	Cote d'Ivoire	38.4 %	Bahamas	34.0 %	Lebanon	34.7 %	El Salvador	17.3 %
		Qatar	22.4 %	Gambia	20.2 %	Oman	24.3 %	Qatar	16.8 %
		Ireland	8.5 %	Haiti	11.8 %	Jamaica	9.7 %	Japan	12.7 %
		...	...	...	...	...	...	...	...
Turkey	1989	Oman	54.1 %	Honduras	65.4 %	Peru	65.6 %	Niger	23.9 %
		Sierra Leone	12.3 %	Benin	19.4 %	Norway	33.3 %	Germany	22.3 %
		United Kingdom	9.8 %	Canada	9.8 %	Iceland	0.9 %	France	15.8 %
		...	...	...	...	...	...	...	...
Taiwan	1986	Paraguay	24.6 %	New Zealand	26.8 %	Bangladesh	35.1 %	Saudi Arabia	52.4 %
		Congo	9.0 %	Bahrain	22.6 %	Haiti	23.6 %	Qatar	16.6 %
		Niger	7.1 %	Ethiopia	18.8 %	Central African Republic	11.2 %	Nicaragua	13.6 %
		...	...	...	...	...	...	...	...
Venezuela	1990	Sierra Leone	56.1 %	Gabon	48.6 %	Jamaica	51.2 %	Tanzania	31.4 %
		Kuwait	16.4 %	Oman	39.1 %	Lesotho	34.2 %	Panama	19.9 %
		Botswana	14.5 %	Mozambique	12.0 %	Barbados	14.5 %	United States	17.3 %

		...	...	...	...	...	...	...
South Africa	1995	Nepal	16.0 %	Sweden	57.3 %	Honduras	52.2 %	United States	24.0 %
		Honduras	15.1 %	Congo	16.5 %	Iceland	39.8 %	Panama	21.9 %
		Jamaica	14.5 %	Zambia	9.3 %	Barbados	5.4 %	Senegal	16.4 %
		...	...	...	...	...	...	...	...
Zimbabwe	1993	Belgium	35.6 %	Togo	52.9 %	Dominican Republic	42.3 %	Honduras	31.0 %
		Austria	31.9 %	Barbados	20.2 %	Iceland	35.6 %	Benin	30.5 %
		Mozambique	17.2 %	Trinidad and T.	12.3 %	Lesotho	13.4 %	Iran	10.5 %
		...	...	...	...	...	...	...	...

Appendix D Instrumental variables for trade

In this section, we outline the construction of the two instrumental variables. Both instruments are from Egger, Nigai, and Strecker (2019), which provide further details.

D.1 Instrument based on quantitative trade models

The first instrument leverages the general model structure of gravity models in general equilibrium. These models permit the calibration of country pair-year-specific trade costs from trade data. Models that use such models include Eaton and Kortum (2002); Anderson and Wincoop (2003); Arkolakis, Costinot, and Rodriguez-Clare (2012). These models rely on three specific assumptions. First, producers are either perfectly competitive and make zero profits or chrge a constant mark-up; prices are independent of the location of customers. Second, trade costs take the iceberg-form. Third, aggregate expenditure and its allocation across products can be separated through a two-stage budgeting decision. These three assumptions imply that bilateral consumption shares towards country j by consumers in country i in year t, denoted π_{ijt}, are multiplicative components that are exporter-year-specific (e_{jt}), importer-year-specific (ι_{it}) and pair-year specific (β_{ijt}) as follows

$$\pi_{ijt} = \quad e_{jt} \quad \times \quad \iota_{it} \quad \times \quad \beta_{ijt}$$

The component e_{jt} is proportional to country j's suply potential and broadly captures production costs and gross-of-tax factor income and is influenced possibly by both capital and labor taxation. The component ι_{it} is a function of the consumer price index, which varies across years and countries. The key intuition is that both e_{jt} and ι_{it} may capture country-year-specific factors, but the country pair-specific component β_{ijt} is free of any country-year specific factor. Instead, β_{ijt} captures trade frictions across country-pairs and time. Egger, Nigai, and Strecker (2019) exploit the multiplicative model structure about π_{ijt} to recover measures of β_{ijt}. The authors assume that transaction costs between domestic sellers and customers is constant, such that $\beta_{iit} = 1$. Both the importer-year component and exporter-year components can then be eliminated by normalizing import and export

trade shares by the importer and exporters' consumption from domestic sellers. In turn, the product of the normalized shares gives the bilateral fractions of importing-exporting country-pairs at a point in time:

$$\frac{\pi_{ijt}}{\pi_{iit}} \cdot \frac{\pi_{jit}}{\pi_{jjt}} = \beta_{ijt} \cdot \beta_{jit}$$

Finally, the sum of these costs $Z_{it}^{gravity} = \sum[\beta_{ijt} \cdot \beta_{jit}]$ measures total trade frictions for country i in year t and constitutes the instrument. Note that all exporter-year and importer-year factors are removed from the instrument. This instrument is valid if the *distribution* of trade costs among country-pairs (not its level) is not influenced by e.g. changes in factor income shares or domestic labor and capital tax revenues. To construct this instrument requires data on country-pair trade flows: we use the UN COMTRADE database to construct as large a sample as possible with non-missing values for bilateral consumption shares.

The first-stage regressions with $Z_{it}^{gravity}$ are reported in Appendix Table A7. The instrument is slightly stronger when using the log-level of trade or the share of goods-trade as the endogenous measure of openness.

D.2 Instrument based on global oil prices and transportation distances

Our second instrument exploits spatial heterogeneity across countries in a way that responds to oil price shocks. To build this instrument we require two parameters: global oil prices over time, and within-country transportation distances. For the former, we collect the long-run world price of oil from the well known 'OPEC Reference Basket' tracking crude oil prices (OPEC, 2021). For the latter, we measure transportation distances from the three largest three cities (from UN DESA, 2019) to their nearest ports,[56] using international shipping logistics calculators at SeaRates (2021). To calculate the distance of each city to each port, we look at the map of the city and its distance to port, through the lens of these

[56]One could measure the distance from city to the nearest *sea* port, or to the nearest container terminal of any kind. We made both measurements and ultimately make use of the latter. However, there is usually little difference when calculating the within-country variance of these measurements across cities, and this difference does not affect our results.

shipping logistics calculators. We manually enter and record the distances by road for each city to its nearest port. These distances vary within a country to the extent that a country is far from a port, and to the extent that cities (far from the port) are also far from one another.

We then take the variance of the oil price $p_t^{oil} \times$ distance d_i^k for each city k in country i and year t:

$$Z_{it}^{pricedist} = \frac{1}{2}\sum_{k=1}^{3}[(p_t d_i^k - p_t \overline{d_i})^2]$$

This variance is increasing in countries whose principal population centers are far from the nearest port *and*, more importantly, from each other, which implies a larger shock to transportation costs in spread-out (and far from the port) countries than in countries with concentrated populations (near to port).[57] It is this shock to trade that our instrument captures. Alternatively, we can measure the variance in distance and then multiply it by the global price. The distribution of the variance instrument $Z_{it}^{pricedist}$ across country-years would not change; the only impact would be a level-shift in factor p. While we consider the main approach to more closely capture the sensitivity of spatial concentration to shocks in transportation costs, results remain similar using this alternative measurement approach (results available upon request).

This second instrument is very different from the first instrument since it does not hinge on any theoretical assumptions and is valid under very different assumptions. Specifically, it relies on the assumption that the distribution of trade-costs induced by global oil price shocks across countries with different domestic trade networks is not correlated with contemporaneous changes in factor shares and tax revenues. Importantly, we verify that the main results are robust to allowing major oil producing countries to be on a separate, non-parametric time-path throughout the sample period.

[57] In this sense, our measure of the variance here does not here penalize a country for having its nearest port outside the national borders, or even thousands of kilometers away. The $Z_{it}^{pricedist}$ variance increases when distance-to-port varies within a country, not when the average distance-to-port increases. One could perhaps imagine an even stronger trade instrument that accounts for cross-country variance in the average distance-to-port with an additional parameter. However, in the first-stage results discussed here, we find sufficient evidence of a trade effect merely on the within-country variance of distance. An additional trade outcome not discussed here, of course, is on domestic trade between cities. We only measure an international trade effect, but one would similarly expect domestic trade to decrease as transportation costs increase.

Constructing the instrument $Z_{it}^{pricedist}$ as described above, the first stage results are presented in Appendix Table A7. The instrument is strongly associated with changes in trade within-country over time and is robust to using various measures of trade openness.