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Tax Reforms and Fiscal Shock Smoothing

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Abstract

This paper examines the role of tax policy reforms in enhancing fiscal shock smoothing in a panel of 13 OECD economies during the period 1980-2017. The results suggest that tax reforms, in particular those that broaden the tax base, significantly enhance the ability of fiscal policy to mitigate the impact of growth shocks on disposable income. We find that the magnitude of shock smoothing increases from an average of 2 percent to 3-3½ percent following the reform. The effects are considerably higher for tax base than tax rate changes, and also higher for indirect tax than direct tax changes. The effects are symmetric—that is, the increase in shock smoothing following a reform expanding the tax base (rate) is similar to the decline in shock smoothing after a reform narrowing the tax base (rate). Tax elasticity, collection efficiency, and the progressivity of the tax system are important channels through which tax reforms affect fiscal stabilization.

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I. INTRODUCTION

Fiscal policy has an important role in fostering macroeconomic stabilization and, through this channel, supporting medium-term growth. Fiscal policy can help reduce fluctuations in output and employment. Fiscal policy can also reduce macroeconomic uncertainty, thereby fostering a favorable environment for the accumulation of physical and human capital (Aghion and others 2010).

How do tax reforms affect the ability of fiscal policy to smooth shocks to growth? First, these reforms could make taxes more or less responsive to economic fluctuations, affecting the so-called *fiscal automatic stabilizers*. For instance, tax revenues usually vary more—while disposable income and consumptions change less—with respect to output in countries with a broader tax base or higher tax rates. Therefore, reforms broadening the tax base and/or increasing tax rates would increase shock smoothing through the tax policy channel. Second, by making the personal income tax more or less progressive, tax policy reforms could also influence how disposable income (or consumption) react to tax changes.

While theory predicts that tax reforms can affect shock smoothing, there is little empirical evidence on the magnitude of these effects. Indeed, studies on the drivers of fiscal stabilization have mostly focused on structural determinants—such as openness, financial development—or spending-side reforms. [2] Some authors have focused on the level of direct and indirect taxation and its impact on budget outcomes, discretionary fiscal policy, or automatics stabilizers (Arreaza and others 1999; Afonso and Furceri 2008; Taylor 2009; Follette and Lutz 2010; Dolls and others 2012; Fatas and Mihov 2012; Vegh and Vuletin 2014). But only a few individual-country studies have focused on the role of tax policy changes in enhancing shock smoothing (Auerbach and Feenberg 2010; Devereux and Fuest 2009). This paper tries to fill this gap and studies this issue across a set of advanced economies.

To do so, we focus on two main research questions. First, to what extent and which tax policy reforms affect the response of disposable income (consumption) to GDP shocks (the so-called *fiscal shock smoothing*)? Second, through which channels do tax reforms affect fiscal shock smoothing? In theory, two channels could be identified: (i) *fiscal automatic stabilizers* and (ii) the impact of taxes on disposable income and consumption. To study these channels, we consider the effect of tax reforms on variables that are a combination of these two effects: the elasticity of taxes with respect to output, the efficiency of revenue collection, and the progressivity of the tax system.

To provide an answer to these questions, we rely on major tax reform episodes identified in the IMF Tax Policy Reform Database (TPRD) and Dabla-Norris and Lima (2018).[3] The TPRD provides comprehensive and detailed information regarding announcement and implementation dates of

[2] For instance, IMF (2015) and Furceri and Tovar Jalles (2018) focus at the counter-cyclicality of the fiscal policy studying one spending-side of fiscal stabilization.

[3] Data are available at https://www.imf.org/en/Publications/WP/Issues/2018/05/11/Tax-Policy-Measures-in-Advanced-and-Emerging-Economies-A-Novel-Database-45870.

changes in various tax rates and bases for 23 OECD countries throughout 1970-2016. Dabla-Norris and Lima complement this information including the magnitude and motivation behind each policy action for 13 OECD countries.[4] As both fiscal shock smoothing and tax policy changes could be affected by business cycle fluctuations, we focus only on policy changes that were not implemented for the purposes of stabilizing output and, therefore, can be considered as *exogenous* in the context of our work.[5] As these *exogenous* reforms are identified using the Dabla-Norris and Lima database, our sample consists of a panel of 13 OECD countries during the period 1980-2016.

Our main findings can be summarized as follows:

- Reforms to broaden the tax base have economically and statistically significant effects on the ability of fiscal policy to smooth shocks. After major reforms to broaden the base of direct (indirect) taxes, fiscal shock smoothing increases on average from 2 percent to 3 percent (from 1½ percent to about 3½ percent).

- The impact of reforms to increase the tax rate is smaller and less precisely estimated. Reforms that increase indirect tax rates improve fiscal stabilization, but the magnitude of the impact is lower than in the case of reforms that broaden the tax base. The effect of direct tax rate reforms on fiscal stabilization is not statistically significant, on average.

- The effects of the tax rate and base reforms are symmetric. The effects of reforms increasing and decreasing tax rates or bases are not statistically different from each other in terms of magnitude. In other words, the increase in shock smoothing following a reform expanding the tax base (raising the rate) is similar to the decline in shock smoothing after a reform narrowing the tax base (lowering the rate).

- Tax elasticity, tax progressivity, and tax collection efficiency are key channels through which tax reforms affect fiscal shock smoothing. Major reforms to broaden the tax base have economically large and significant effects on all these channels. The impact of tax rate increases on these channels is either not statistically significant (tax elasticity) or significantly smaller than that of tax base reforms (tax progressivity and collection efficiency).

The rest of the paper is organized as follows. Section II discusses the empirical methodology and the tax reform episodes considered in the analysis. Section III presents the results and a battery of robustness checks. Section IV concludes by summarizing the main findings and providing policy implications.

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[4] We use a working paper version of their data from September 2018 that were matched with the TPRD database. Austria, Australia, Canada, Denmark, France, Germany, Italy, Ireland, Japan, Portugal, Spain, the United Kingdom, the United States.

[5] Other tax policy changes can affect the structure of the tax system and fiscal shock smoothing. To test the robustness of our results, we include all tax reforms identified in the TPRD or, alternatively, instrument a change in the tax-to-GDP ratio by 'our' exogenous tax policy reforms (Section III C).

II. Data and Empirical Methodology

A. Data

Tax Reforms

Many advanced and emerging market countries have implemented quite substantial tax policy over the last few decades. Using the Tax Policy Reform Database, Amaglobeli and others (2018) show that OECD countries have implemented about 575 major tax bases and 520 tax rate changes since the mid-1970s (Table A1 in Appendix). Changes of PIT and CIT bases have been more frequent than those of direct taxation rates. Conversely, changes to direct taxation rates have been more numerous than those of their base. In all, CIT and PIT rates decreased significantly until 2007 while VAT rates increased slightly while the average tax-to-GDP ratio remained relatedly unchanged (Figure A1 and A2 in Appendix). The latter might suggest that the effects of the tax cuts and tax base expansions have somewhat offset each other.

To analyze the impact of tax reform on fiscal shock smoothing, we focus on tax policy reforms that have been implemented for reasons other than for stabilization purposes. These reforms could be considered as *exogenous* in the context of our work, therefore, attenuating the concerns that both fiscal shock smoothing and tax reforms could be affected by economic fluctuations.[6] To this purpose, we use the information identified in the TPRD and developed by Dabla-Norris and Lima (2018). Both datasets are built using narrative approaches. They provide granular information on tax policy changes (e.g., reforms affecting the tax base), the direction of these changes (decrease and increase), and the dates (announcement and implementation). The estimates of the expected revenue yields and motivation (output stabilization, consolidation, long-term growth, or political considerations) behind each policy change come from Dabla-Norris and Lima (2018). The sample consists of a balanced panel of 13 OECD countries over the period 1980 to 2017, and it is determined by the availability of *exogenous* direct and indirect tax reform episodes. We use the fiscal consolidation database by Alesina and others (2015) as a robustness check.

Identification of Reform Episodes

We analyze the impact on shock smoothing of reforms to direct taxes—personal income tax (PIT) and corporate income tax (CIT)—and indirect taxes—value-added tax (VAT). Reforms are categorized by type (base and rate changes), and the direction of the change (increase or decrease). First, we consider the overall direct and indirect tax reforms. Then, we distinguish between PIT and CIT reforms, their different types (base and rate changes) the directions. We use the same strategy to identify all reform episodes. In particular, the year in which reform is identified corresponds to its announcement date to minimize the problem of "fiscal foresight."[7]

[6] We include other tax policy reform dummies and, alternatively, instrument a change in tax to GDP ratio using the exogenous tax reforms (Mertens and Ravn, 2012; Dabla-Norris and Lima 2018) to control for all changes in the taxation structure that could affect fiscal shock smoothing (Section III C).

[7] Agents receiving news about tax policy changes in advance may alter their behavior well before the changes occur. An econometrician who uses the year of implementation of tax policy would rely on a different information

In the baseline analysis, we focus on major tax reforms—defined as those with expected revenue yield (loss) above ½ percent of GDP to mitigate measurement errors. [8] In the robustness checks, we relax this assumption and show that the results are robust to alternative thresholds.

After having identified major reform episodes, we construct an indicator variable (*R*) that counts, cumulatively, the number of major reforms announced in a country from the beginning of the sample period. It increases (decreases) by 1 (-1) in the year of the major reform. Table 1 illustrates the construction of the indicator for direct tax rate reforms. The advantage of using the cumulative tax reform indicators compared to a more standard '0-1' approach is that it captures more precisely the past regulatory changes (or their reversals) and allows for more precise estimates of the reform impact (see Section III B). [9] We latter check how our results compared with the '0-1' approach and if the results are robust to alternative thresholds for the revenue yield (loss).

Overall, we identify 77 major tax reform episodes, which correspond to almost six major tax reforms by country over the sample period (Table A2 in Appendix). About 70 percent of these reforms are related to direct tax policy changes. Within the group of direct tax reforms, base and rate changes are nearly equally distributed (23 and 26 episodes of base and rate reforms, respectively). In contrast, for the group of VAT reforms, most of the large changes have occurred for the tax rates (8 and 20 episodes of base and rate reforms, respectively).

Figure 1 and 2 show the average evolution of the reform indicator for direct and indirect tax base and rate reforms with quite heterogenous variations across countries (as shown the 90-10th percentile range). For direct taxes, the indicator shows a higher number of major reforms to expand the base than to increase the rate, although with variation across countries. In contrast, for indirect taxes, the indicator shows a higher number of major reforms to increase the rate than to expand the base."

Channels

Following the approach of Arnold (2008), we compute the following tax progressivity indicator: 1- (100-marginal tax rate)/(100-average tax rate). To proxy tax collection efficiency, we use VAT collection-efficiency (hereafter 'C-efficiency'), which is computed as the ratio of the actual VAT revenue to the theoretical revenue derived from the product of final aggregate consumption and the VAT standard rate, under conditions that taxes are perfectly enforced (Ueda, 2017). Using VAT C-efficieny indicator allows us to capture a double effect of improving collection efficiency and/or removing policy gaps.

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set than that used by economic agents, and this may lead to biased estimates. See, for instance, Forni and Gambetti (2010).

[8] A threshold of ¼ percent of GDP is applied for CIT and PIT reforms.

[9] In a '0-1' approach, the reform indicator takes values of 1 in a year of the reform, independently of the number of reform episodes, and zero otherwise. To control for the initial differences in the taxation system (e.g., tax-to-GDP ratio, measures of progressivity and of tax collection efficiency) we include country-fixed effects (Section III C).

Macroeconomic Data

Data on national accounts are taken in real and local currency terms from OECD national account statistics. Data for control structural policy changes come from Duval and others (2018) and macroeconomic variables from the IMF World Economic Outlook, Fiscal Monitor, and International Financial Statistics. Data on financial crisis episodes are taken from Laeven and Valencia (2018). Data on spending shocks come from Furceri and Zdzienicka (2018).

B. Empirical Framework

We estimate the impact of tax reforms on fiscal shock smoothing by extending the seminal approach proposed by Asdrubali and others (1996). Their method consists of decomposing Gross Domestic Product (GDP) into national aggregates: Gross National Product (GNP), Net National Income (NI), Disposable National Income (DNI), and total consumption (the sum of Government Consumption and Private Consumption (G+C)).

$$GDP_i = \frac{GDP_i}{GNP_i}\frac{GNP_i}{NI_i}\frac{NI_i}{DNI_i}\frac{DNI_i}{(DNI+G)_i}\frac{(DNI+G)_i}{(C+G)_i}(C+G)_i \quad (1)$$

Asdrubali and others (1996) show that taking the log change of both sides of equation (1), multiplying each term by the log change in GDP, and taking expected value allows obtaining the decomposition of cross-sectional variance in GDP:

$$var\{\Delta\, log\ GDP_i\} = cov\{\Delta \log GDP_i, \Delta \log GDP_i - \Delta \log GNP_i\} + cov\{\Delta \log GDP_i, \Delta \log GNP_i - \Delta \log NI_i\} + cov\{\Delta \log GDP_i, \Delta \log NI_i - \Delta \log DNI_i\} + cov\{\Delta \log GDP_i, \Delta \log DNI_i - \Delta \log(C+G)_i\} + cov\{\Delta \log GDP_i, \Delta \log (C+G)_i\} \quad (2)$$

Dividing each side of equation (2) by the variance of $\Delta\, log\ GDP_i$ allows to obtain the following:

$$1 = \beta^m + \beta^d + \beta^g + \beta^s + \beta^u \quad (3)$$

where the β coefficients is the ordinary least squares (OLS) estimates of the slope of the regressions. In practical terms, this method consists of estimating the set of panel equations (4)-(8) with where the β coefficients capturing the percent amount of smoothing achieved at each level.

$$\Delta\, log\ GDP_{i,t} - \Delta\, log\ GNP_{i,t} = \alpha_t^m + \beta^m \Delta log GDP_{i,t} + \varepsilon_{i,t}^m \quad (4)$$

$$\Delta \log GNP_{i,t} - \Delta \log NI_{i,t} = \alpha_t^d + \beta^d \Delta log GDP_{i,t} + \varepsilon_{i,t}^d \quad (5)$$

$$\Delta \log NI_{i,t} - \Delta \log DNI_{i,t} = \alpha_t^g + \beta^g \Delta log GDP_{i,t} + \varepsilon_{i,t}^g \quad (6)$$

$$\Delta \log(DNI)_{i,t} - \Delta \log(C+G)_{i,t} = \alpha_t^s + \beta^s \Delta log GDP_{i,t} + \varepsilon_{i,t}^s \quad (7)$$

$$\Delta \log(C+G)_{i,t} = \alpha_t^u + \beta^u \Delta log GDP_{i,t} + \varepsilon_{i,t}^u \quad (8)$$

In particular, the coefficient β^m indicates the percentage of shock smoothed by international factors flows, β^d represents smoothing provided by capital depreciation, β^g indicates smoothing from net transfers (transfers minus taxes), and β^s the percentages of shock smoothened by private and public saving. By construction, $\sum \beta s = 1$. Full stabilization is achieved in an economy if β^u is equal to 0. There are no constraints imposed on each beta coefficient, which implies that some channels can either smooth more than 100 percent of the shock (β >1) or contribute to dis-smoothing (β<0).

To assess the impact of tax policy reforms on macroeconomic stabilization through budget outcomes, we extend equation (6) as follows:

$$\Delta\, log\, NI_{i,t} - \Delta\, log(DNI)_{i,t} = \alpha_i + \tau_t + \beta_1 \Delta logGDP_{i,t} + \beta_2 \Delta logGDP_{i,t}\ R_{i,t} + \ \gamma R_{i,t} + \ \theta X_{i,t-1} + \varepsilon_{i,t} \quad (9)$$

where the coefficient β_1 captures the average amount of shock smoothing through fiscal policy, and the coefficient β_2 is the incremental amount of shock smoothing through fiscal policy in the years following tax reforms. *R* denotes tax reforms for country *i* at time *t*. *X* is a set of control variables that could affect tax reform implementation, taxation system, and shock smoothing (such as financial crises, economic activity, other tax and structural reforms—see Section III B for more details). Country- and time-fixed effects (α_i and τ_t, respectively) are included to control for unobserved country-specific and time-varying global factors, respectively. As focusing on the tax reforms may ignore a large part of shock smoothing occurring through spending side measures, we systematically control for spending shocks and reforms.

III. Empirical Results

This section presents the baseline results, the channels through which tax reforms affect fiscal stabilization, and provides a battery of robustness checks.

A. Baseline

Tax Reforms and Fiscal Stabilization

The results based on equation (9) suggest that tax reforms have a significant impact on fiscal shock smoothing (see also Table 2). Figure 3 shows that major direct tax base reforms have increased the amount of shock smoothing through net transfers from 2 percent to about 3 percent.[10] In contrast, the effects of direct tax rate reforms are not statistically significant, on average. Looking at the effects of PIT and CIT reforms separately gives similar results (Figure 4 and 5, respectively).

Figure 6 indicates that the results for indirect tax reforms are quantitively similar to direct tax reforms. Both indirect tax rate and tax base reforms have a statically significantly impact on fiscal

[10] This average amount of shock smoothing achieved through net transfers corresponds broadly to what has been found in the literature for advanced economies (Furceri and Zdzienicka, 2015).

shock smoothing.[11] In particular, VAT base reforms have increased shock smoothing by about 2 percentage point to about 3.5 percent. This effect is significantly larger than that of VAT rate reforms, which increase shock smoothing by 0.4 percentage point (from 1.7 to 2.1 percent).

These findings also have significant implications for the design of fiscal policy measures. Reforms that broaden the tax base, whether for direct or indirect taxes, not only generate substantial tax revenue and are less detrimental for growth in the short-run (Dabla-Norris and Lima 2018), but they are also more effective in fostering macroeconomic stabilization.

Symmetric Impact of Tax Reform

We find that the effects on shock smoothing are symmetric—the coefficients are similar regardless of whether the reform (base or rate) is expected to enhance or worsen revenues (the coefficients are not statistically different from each other). Direct tax base reforms that raise revenue tend to increase fiscal shock smoothing from about 1.9 to 2.9 percent, while tax base reform that reduce revenue decrease fiscal stabilization by a similar magnitude to 0.9 percent (Figure 7). Similar results are obtained for VAT rate reforms (Figure 8). Our sample does not contain *exogenous* episodes of VAT base reforms that reduced revenue, so it is not possible to test whether the effect of tax base reforms is symmetric.

As implemented tax policy changes varied quite substantially across countries and over time in terms of their magnitude and, more importantly, their direction (Section II B), the symmetric effect of reforms on shock smoothing help explain to a large extent why fiscal policy stabilization has changed little over time (Furceri and Zdzienicka 2015).

Channels

Two channels can explain the impact of tax reforms on fiscal shock smoothing: (i) the response of taxes to economic fluctuations and (ii) the impact of taxes on disposable income or consumption. We study these channels by analyzing, successively, the effects of tax reforms on tax elasticity (with respect to output), tax collection efficiency, and tax progressivity.

To assess the impact of tax reforms on the responsiveness of tax revenue to changes in GDP, we use the following equation (similar to equation 9):

$$\Delta Y_{i,t} = \alpha_i + \tau_t + \beta_1 \Delta GDP_{i,t} + \beta_2 \Delta GDP_{i,t}\ R_{i,t} + \gamma R_{i,t} + \theta X_{i,t-1} + \varepsilon_{i,t} \quad (10)$$

where $\Delta Y_{i,t}$ captures the change in nominal tax revenue, $\Delta GDP_{i,t}$ stands for the change in nominal GDP. Other variables are similar to those used in equation (9), and the set of control variables X is expanded to include changes in domestic prices.

To determine the impact of tax reforms on tax progressivity and collection efficiency:

[11] We focus on the impact of VAT reform on fiscal shock smoothing, i.e., shock smoothing through net transfers. The impact of this consumption tax could also affect shock smoothing through other channels.

$$\Delta Y_{i,t} = \alpha_i + \tau_t + \beta R_{i,t-1} + \gamma X_{i,t-1} + \varepsilon_{i,t} \quad (11)$$

where $Y_{i,t}$ is tax progressivity (collection efficiency).

In both cases, we control for lagged values of the dependent variables and, thus, use the GMM estimator to minimize endogeneity bias.

The results confirm that these three channels can help explain the impact of tax reforms on fiscal shock smoothing.

- After major reforms that broaden the direct (indirect) tax base, tax elasticity with respect to GDP increases, on average, from 1.1 (0.5) percent to 1.3 (1) percent (Figure 9 and 10). In contrast, the impact of major direct and indirect tax rate reforms is not statistically significant, on average.

- Figure 11 indicates that major reforms that broaden the PIT base increase tax progressivity by 6 percentage points (60 percent of the standard deviation of the indicator). The impact of PIT rate reforms is lower—2.5 percentage points—and less precisely estimated.[12]

- Finally, major changes in both VAT base and rate increase the VAT collection efficiency by 1.5 and 1.2 percentage points, respectively (Figure 12).

B. Robustness Checks

Additional Controls

A possible concern with the identification strategy is that, while the tax reform episodes are *exogenous* to macroeconomic fluctuations, they might be endogenous to other developments and other reforms that could also influence fiscal shock smoothing. To minimize omitted variable bias and endogeneity concerns, we check the robustness of our results adding lagged GDP, the public debt level, financial crises, other structural reforms (e.g., labor and product market), EU adhesion dummy, or time trends. The results obtained using this extensive set of controls are similar and not statically different from the baseline.[13]

Another possible concern is related to the fact that our analysis 'ignores' the effects of spending policy reforms (IMF 2013, 2015). To minimize this possible bias, we systematically control for spending shocks and reforms.

Our reform indicators based on the reform yields capture the impact of relatively large tax policy reforms and, thus, ignores all other—e.g., minor—tax reforms that could affect the structure of

[12] Under the progressive tax system, tax liabilities increase by more than one when taxable income increases. The results show that reforms that broaden PIT bases have, on average, contributed to an increase in taxes paid by high-income households and/or to a decrease in taxes paid by low-income ones.

[13] We report illustrative results controlling for initial debt level in Figure 13. Additional results are available upon request.

the tax system. In other words, our identification strategy could introduce an 'attenuation' bias (Duval and others 2017) and underestimate the impact of tax reforms on fiscal shock smoothing. To address this issue, we run two types of robustness checks. First, we control for other contemporaneous and lagged tax reform indicators included in the TPRD database. The results—available upon request—are broadly in line with the baseline. Second, to ensure that we control for all tax policy changes, we instrument a change in tax-to-GDP ratio using 'our' *exogenous* tax reforms as an instrument. The advantage of this approach is that the change in tax-to-GDP ratio instrumented by the tax reform indicator captures not only the information in the narrative tax reform but also is correlated with observed tax changes (Mertens and Ravn 2012, Dabla-Norris and Lima 2018). Another advantage of using an Instrumental Variable (IV) estimator is to account for potential measurement errors resulting from the fact that announced size of tax policy reforms could be over- or underestimated (Dabla-Norris and other 2019). Figure 14 indicates that the results are broadly in line with our baseline, which suggests that these potential biases are not a concern.

Alternative Estimators

While the coefficient β^g is, by construction, an OLS estimator of the fiscal shock smoothing (Section B), current net transfers could be affected by the economic outcomes in previous years. We include lagged GDP and net transfers as regressors and estimated equation (9) using a GMM estimator. Figure 15 shows that the results are similar and not statically different from the baseline. Following Asdrubali and others (1996), to address possible heteroscedasticity issues, we also estimate equation (9) using the GLS estimator. Also, in this case, the results—available upon request—are similar to those obtained in the baseline.

Alternative Identification of Reforms Episodes

We use alternative thresholds to identify major reform episodes. In particular, we increase the threshold from ½ percent of GDP to 1 percent of GDP. Figure 16 shows that the results are in line with the baseline. As expected, however, the impact tends to be larger the larger is the revenue yield (loss) of the reforms.

We also apply an alternative '0-1' approach to quantifying tax reforms. The reforms indicator takes the value of 1 in a year after a tax reform yielding at least 0.5 percent of GDP is announced, and zero otherwise. The results (Figure 17) are broadly in line with the baseline, but less precisely estimated. This is because our 'cumulative' baseline indicator allows for a more precise estimate accounting not only for the number of previous and contemporaneous reforms but also for the level impact of each reform, as well as for potential reform reversals.[14]

Finally, we test tax reforms identified by Alesina and others (2015). Using our identification strategy, we identify a similar number of major direct and indirect reforms for the same country

[14] Besides, to address cross-country difference at the beginning of the estimation period (i.e., 1980), we control for other characteristics of the tax system (e.g., tax progressivity, collection efficiency, tax-to-GDP ratio) and include country-fixed effects.

sample as that used in our paper. Figure 18 indicates that the results are broadly in line with the baseline.

IV. Conclusions and Policy Implications

Our analysis shows that tax policy reforms aiming at enhancing revenue have a significant impact on fiscal stabilization. The magnitude of shock smoothing through fiscal policy channel increases from about 2 percent to 3-3½ percent, on average. The effect is larger and more precisely estimated for reforms that broaden the tax base than for those that increase the tax rate. The effects are considerably higher for indirect tax than for direct tax changes.

We also test for possible channels through which tax reforms increase fiscal stabilization and find that reforms that increases fiscal shock smoothing are also those that improve tax elasticity, tax progressivity, and the tax collection efficiency. In other words, tax reforms affect fiscal shock smoothing by increasing both fiscal automatic stabilizers and how outcomes (disposable income, consumption) react to tax policy changes. Finally, our results show that the effects are symmetric, i.e., tax reforms increasing and decreasing tax rates or bases are not statistically different from each other in terms of magnitude. This last finding explains why the average shock smoothing through fiscal policy has changed little over time. In fact, despite some common trends, tax policy changes varied quite substantially with many countries (Amaglobeli and others 2018) with the tax rate and base reforms having offsetting effects on fiscal stabilization.

Our findings also have significant implications for the design of fiscal policy measures. Reforms that broaden the tax base, whether for direct or indirect taxes, not only generate substantial tax revenue and are less detrimental for growth in the short-run (Dabla-Norris and Lima 2018), but also foster macroeconomic stabilization and higher growth over the medium term.

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Table 1. Example: Identification of Reform Episodes

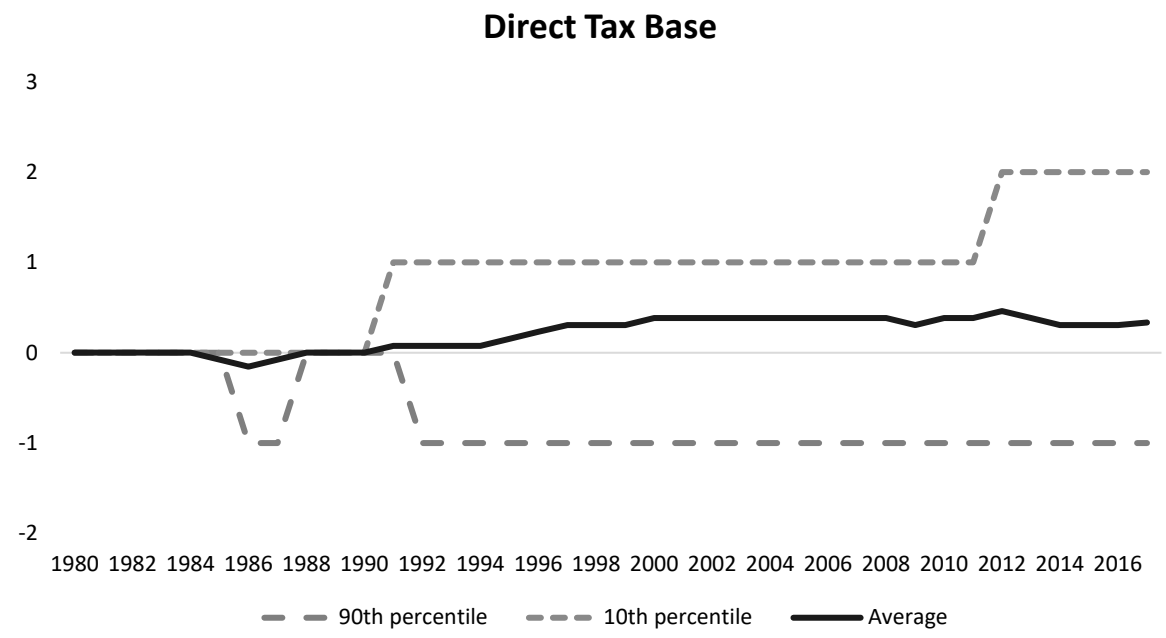
year	Expected Revenue of Direct Tax Rate reform (% of GDP)	Direct Tax Rate Reform Indicator (*R*)
1999	0.00	0
2000	**-0.87**	**-1**
2001	0.00	-1
2002	0.00	-1
2003	0.00	-1
2004	0.00	-1
2005	**2.12**	**0**
2006	0.00	0
2007	0.00	0
2008	0.00	0
2009	0.00	0
2010	**3.96**	**1**
2011	0.23	1
2012	**0.84**	**2**
2013	0.00	2
2014	0.00	2
2015	0.00	2
2016	0.00	2
2017	0.00	2

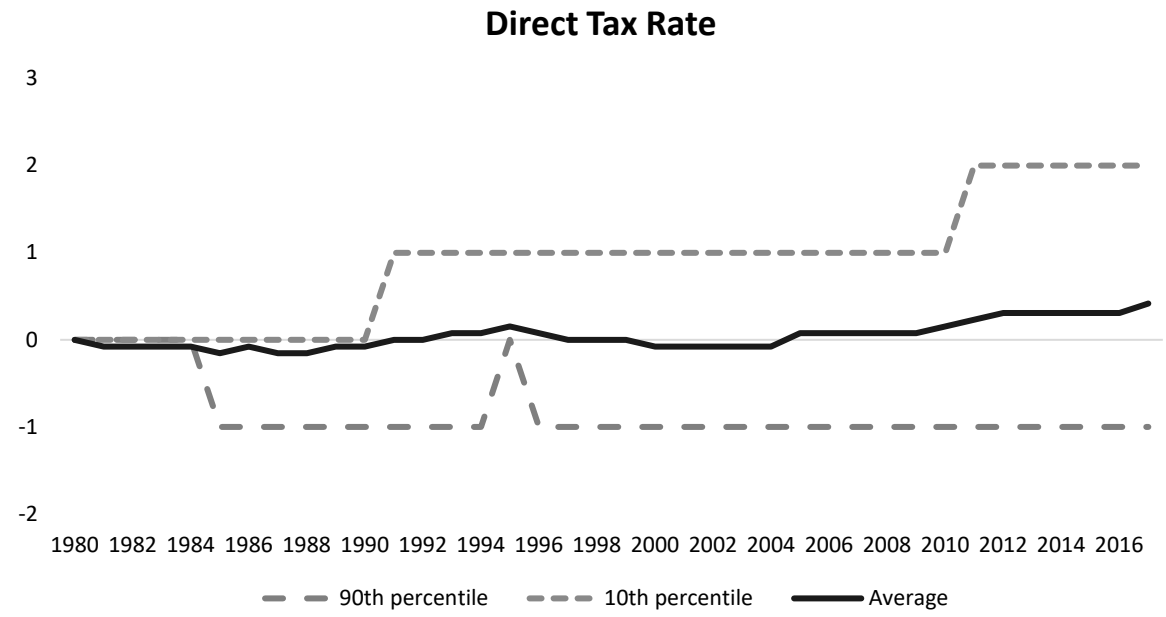
Note: Reform indicator is a discrete variable that counts, cumulatively, the number of major reforms announced in a country from the beginning of the sample period. It increases (decreases) by 1 (-1) in the year of the reform, when the expected reform revenue yield (loss) exceeded ½ percent of GDP.
Source: TBRD (2018) and authors' estimates.

Table 2: Effect of Tax Reforms on Fiscal Shock Smoothing (Percent)						
	Direct tax	Direct tax base	Direct tax rate	Indirect tax	Indirect tax base	Indirect tax rate
Net tax and transfers (β_1)	1.560 *	1.898 *	1.877 *	1.634 **	1.328 *	1.681 **
	(1.75)	(1.78)	(1.76)	(2.45)	(1.85)	(2.11)
Net tax and transfers after tax reform (β_2)	0.953 *	0.994 ***	0.749	0.632 **	2.115 *	0.443 *
	(1.84)	(3.14)	(0.74)	(2.80)	(2.02)	(1.85)
Tax reform (γ)	-0.049 *	-0.018	-0.040	-0.041 *	0.017	-0.054 **
	(-1.89)	(-0.66)	(-1.52)	(-1.92)	(0.48)	(-2.86)
N	322	322	322	375	375	375
R2	0.22	0.22	0.22	0.24	0.24	0.23
Joint significance test	**	**	*	**	**	**

Note: Based on equation (9). Country- and year-fixed effects, and other tax reforms are included but not reported. T-statistics based on robust clustered standard errors in parentheses. ***,*, * denote significance at 1 and 5 percent, respectively.

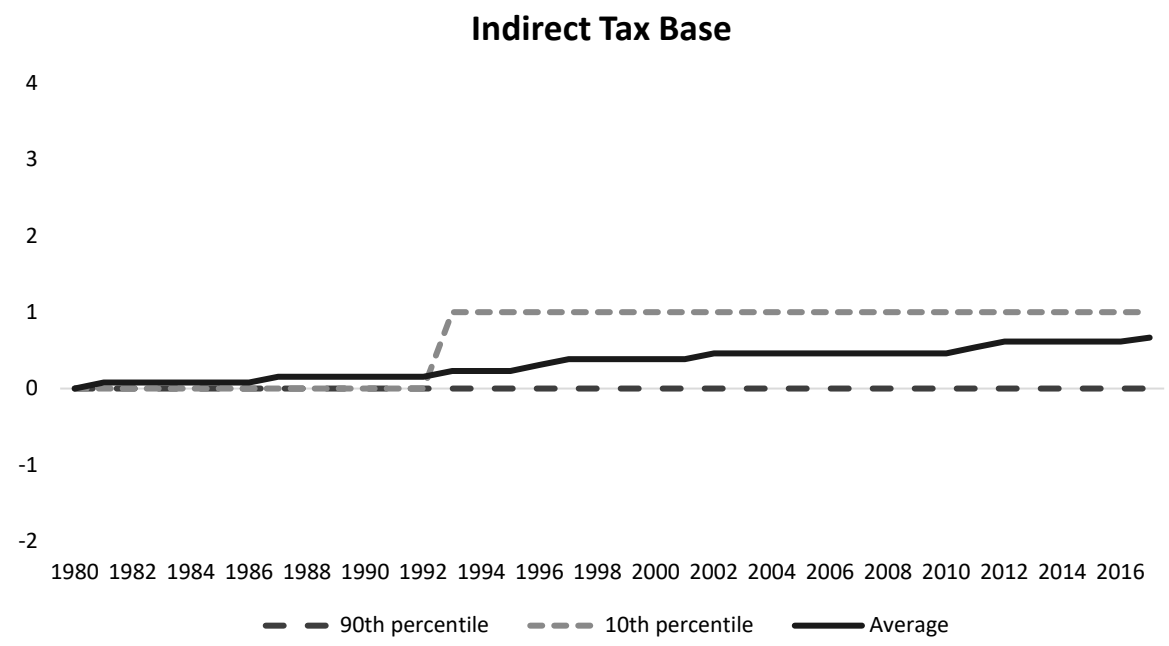
Figure 1. Direct Tax Reform Indicators Over Time

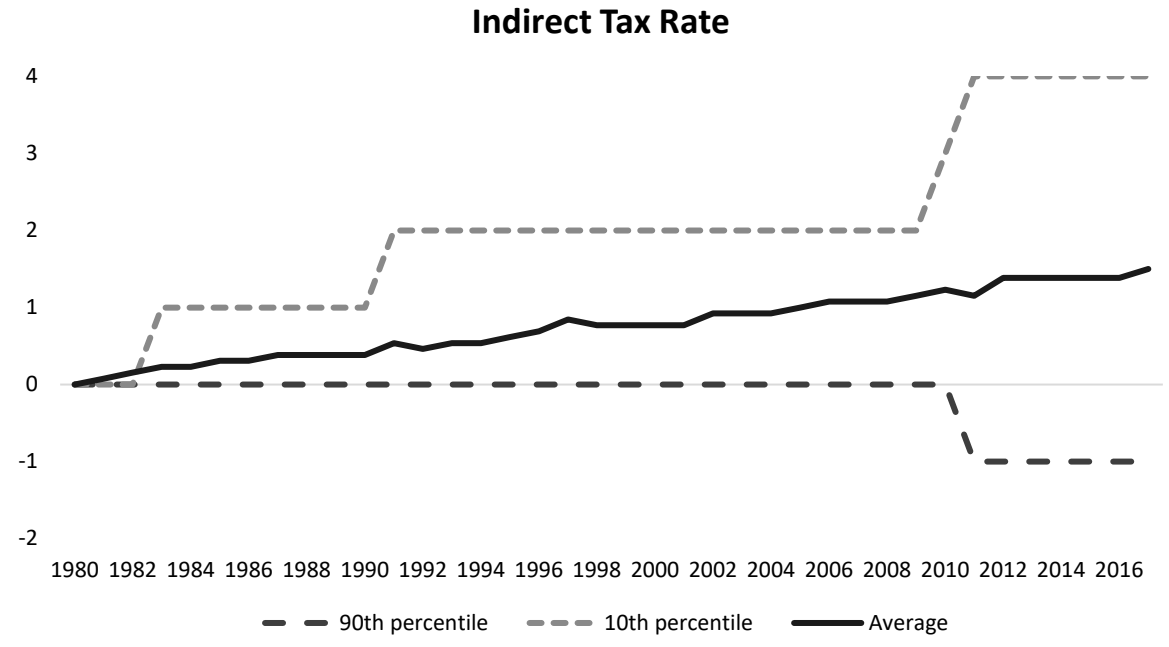




Note: The reform indicator (R) is a discrete variable that counts, cumulatively, the number of major reforms announced in a country from the beginning of the sample period. It increases (decreases) by 1 (-1) in the year of the reform, when the expected reform revenue yield (loss) exceeded ½ percent of GDP for indirect and total direct reforms (and ¼ percent of GDP for CIT and PIT reforms). The continous line indicates the average value of reform indicator per year accros countries. The upper (lower) dashed grey line indicates the 10^{th} (90^{th}) percentile value of reform indicator per year accros coutnries. Source: TPRD; Dabla-Norris and Lima (2018); Authors' estimates.

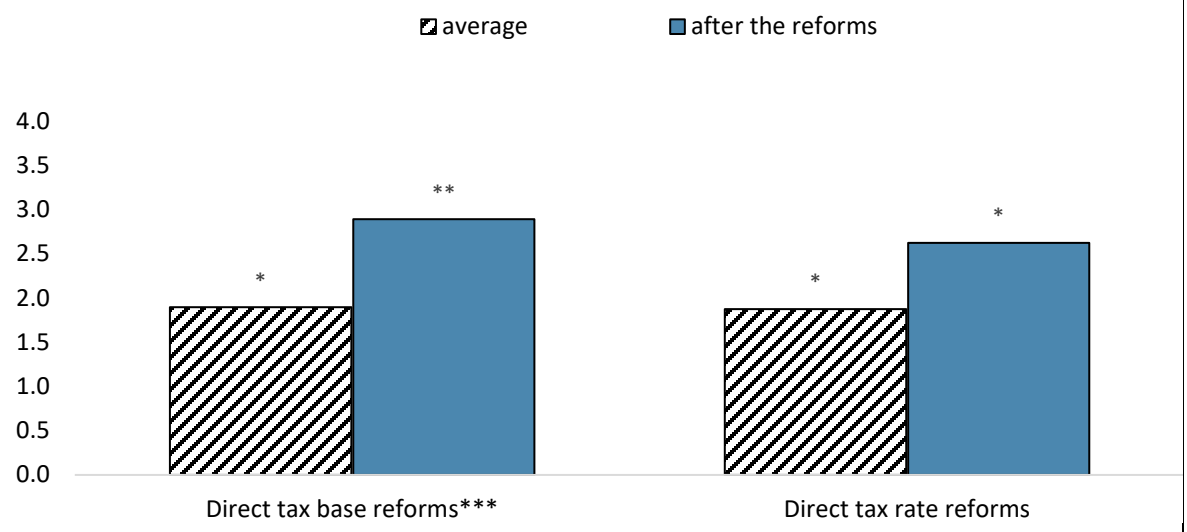
Figure 2. Indirect Tax Reform Indicators Over Time





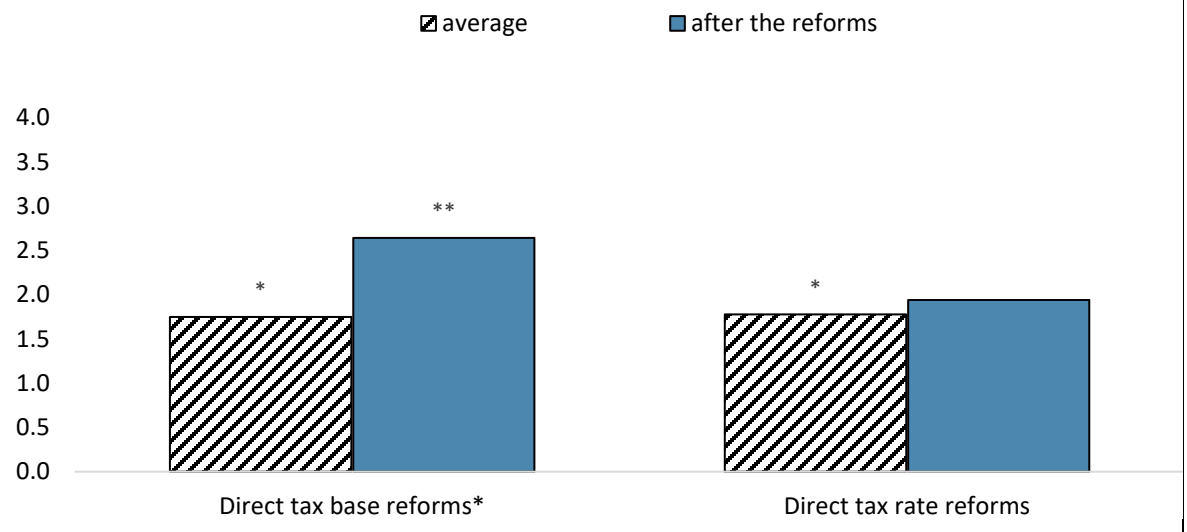
Note: The reform indicator ® is a discrete variable that counts, cumulatively, the number of major reforms announced in a country from the beginning of the sample period. It increases (decreases) by 1 (-1) in the year of the reform, when the expected reform revenue yield (loss) exceeded ½ percent of GDP for indirect and total direct reforms (and ¼ percent of GDP for CIT and PIT reforms). The continous line indicates the average value of reform indicator per year accros countries. The upper (lower) dashed grey line indicates the 10^{th} (90^{th}) percentile value of reform indicator per year accros coutnries. Source: TPRD; Dabla-Norris and Lima (2018); Authors' estimates.

Figure 3. Effect of Direct Tax Reforms on Fiscal Shock Smoothing (Percent)



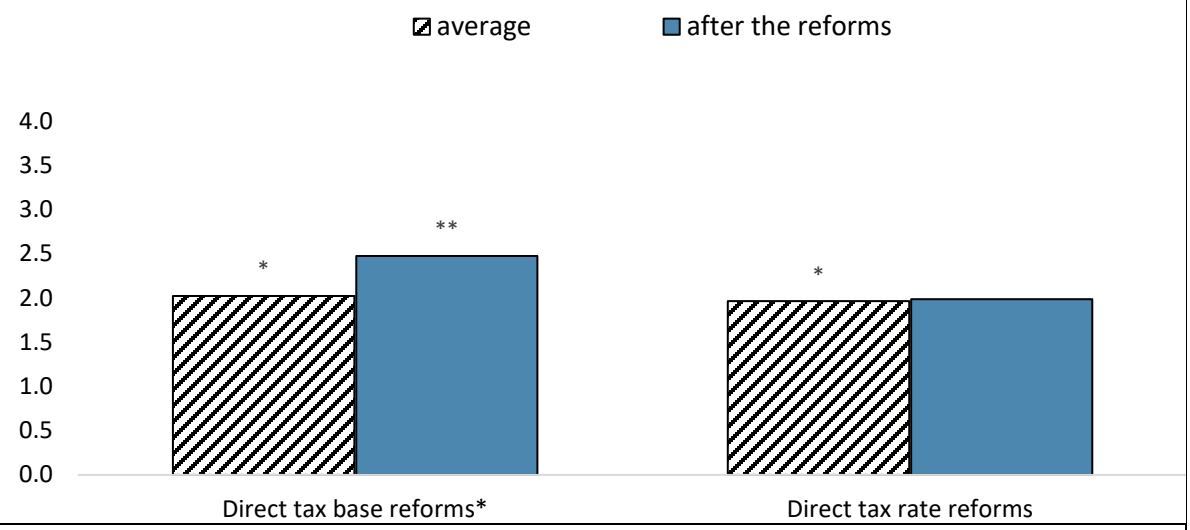
Note: Blue bars denote the fiscal shock smoothing in the years of reform ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average fiscal shock smoothing (β_1) with signficance level. Estimates based on equation (9). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Figure 4. Effect of PIT Reforms on Fiscal Shock Smoothing (Percent)



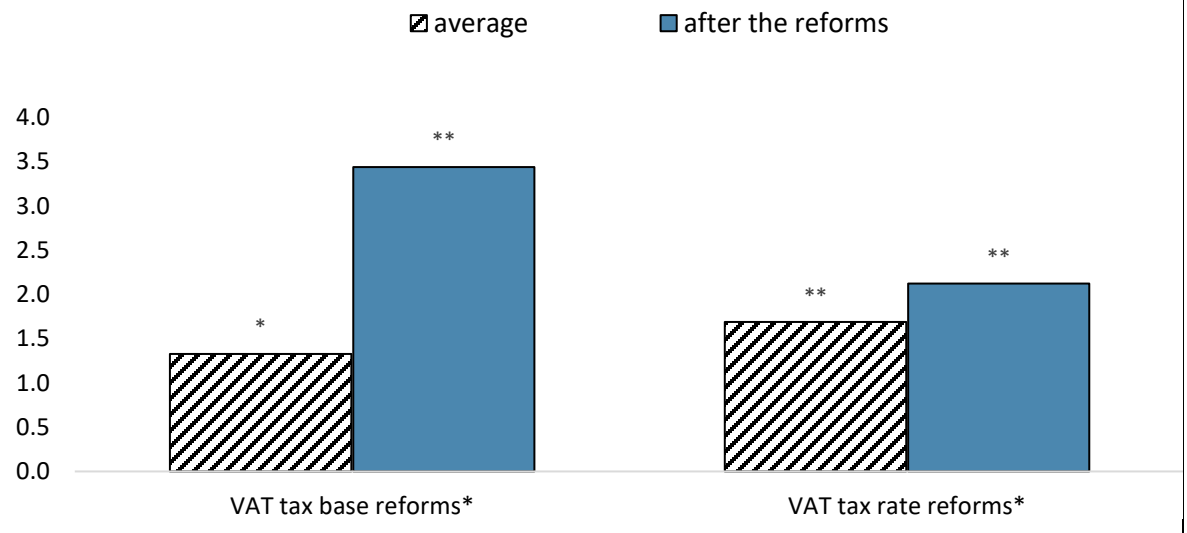
Note: Blue bars denote the fiscal shock smoothing in the years of reform ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average fiscal shock smoothing (β_1) with signficance level. Estimates based on equation (9). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Figure 5. Effect of CIT Reforms on Fiscal Shock Smoothing (Percent)



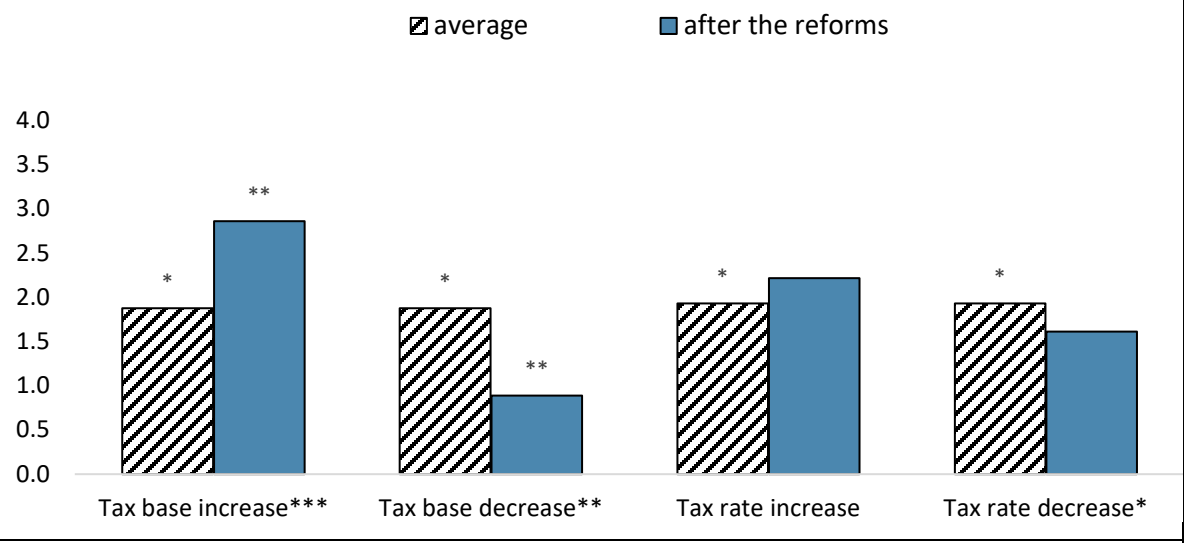
Note: Blue bars denote the fiscal shock smoothing in the years of reform ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average fiscal shock smoothing (β_1) with signficance level. Estimates based on equation (9). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Figure 6. Effect of Indirect Tax Reforms on Fiscal Shock Smoothing (Percent)



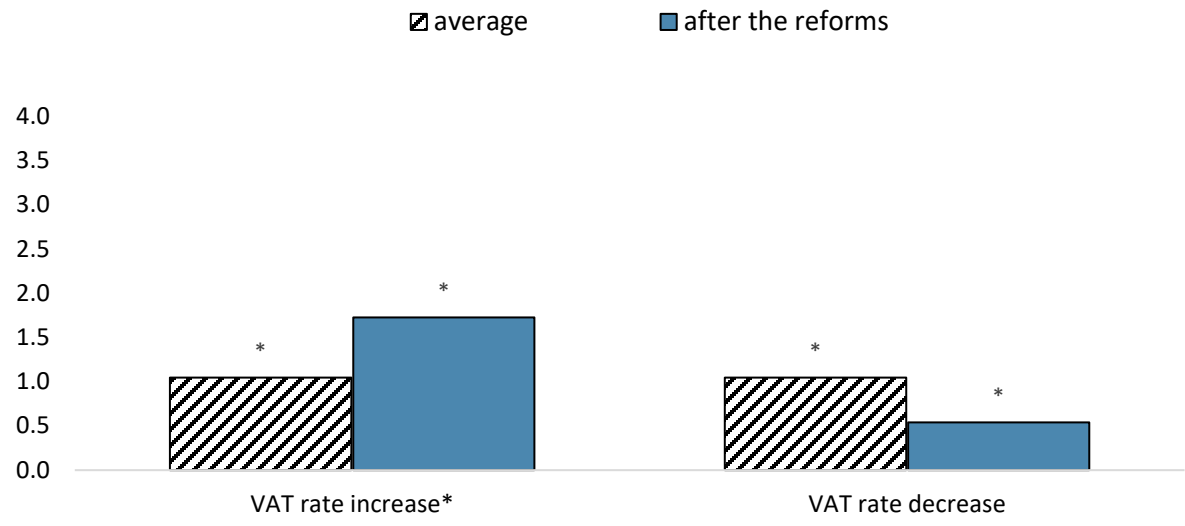
Note: Blue bars denote the fiscal shock smoothing in the years of reform ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average fiscal shock smoothing (β_1) with signficance level. Estimates based on equation (9). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported the the x-axis.

Figure 7. Effect of Direct Tax Reforms on Fiscal Shock Smoothing Depending on the Direction of the Reform (Percent)



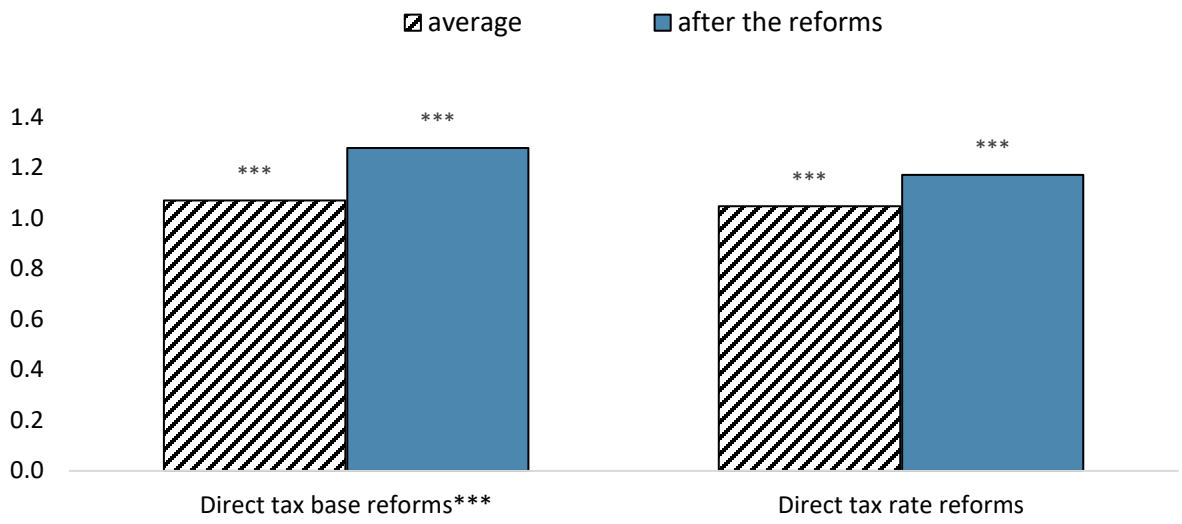
Note: Blue bars denote the fiscal shock smoothing in the years of reform ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average fiscal shock smoothing (β_1) with signficance level. Estimates based on equation (9). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Figure 8. Effect of Indirect Tax Rate Reforms on Fiscal Shock Smoothing Depending on the Direction of the Reform (Percent)



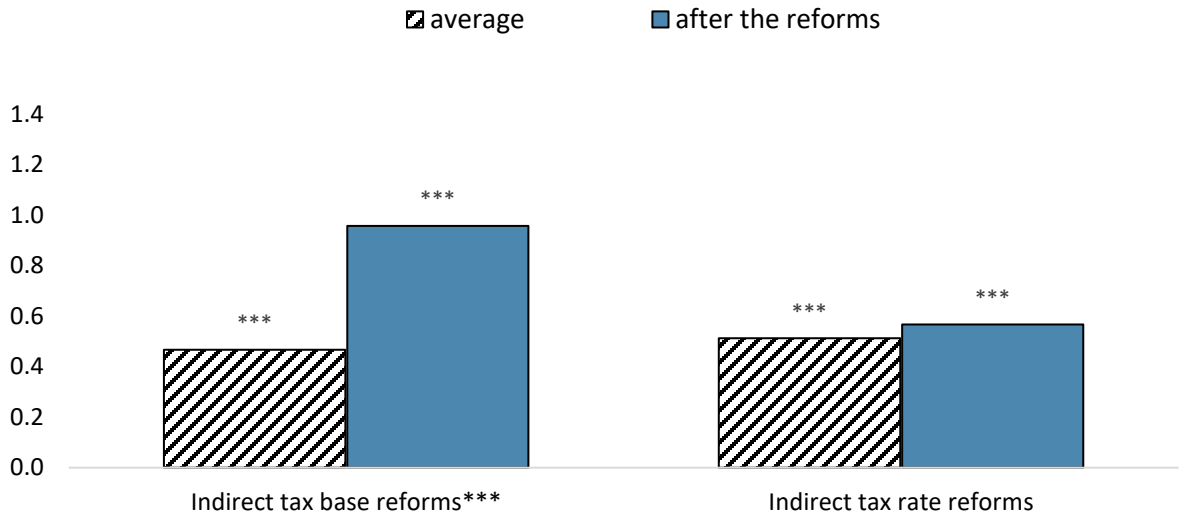
Note: Blue bars denote the fiscal shock smoothing in the years of reform ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average fiscal shock smoothing (β_1) with signficance level. Estimates based on equation (9). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Figure 9. Effect of Direct Tax Reforms on Tax Elasticity with Respect to Output (Percent)



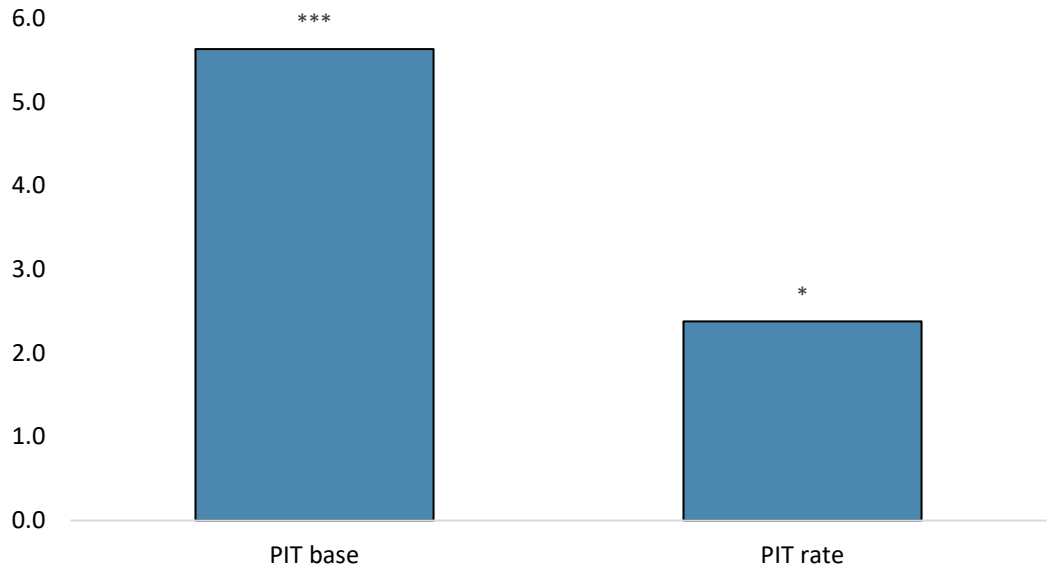
Note: Blue bars denote the tax elasticity with respect to GDP years of reforms ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average tax elasticity with respect to GDP (β_1) with its signficance level. Estimates based on equation (10). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Figure 10. Effect of Indirect Tax Reforms on Tax Elasticity with Respect to Output (Percent)



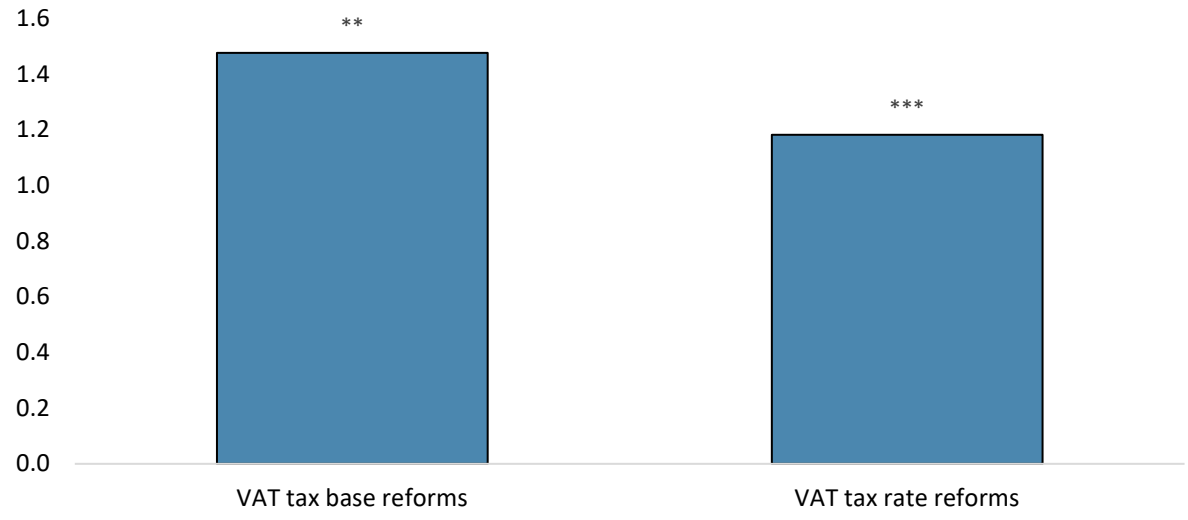
Note: Blue bars denote the tax elasticity with respect to GDP years of reforms ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average tax elasticity with respect to GDP (β_1) with its signficance level. Estimates based on equation (10). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Figure 11. Effect of PIT Reforms on Tax Progressivity (Percentage Points)



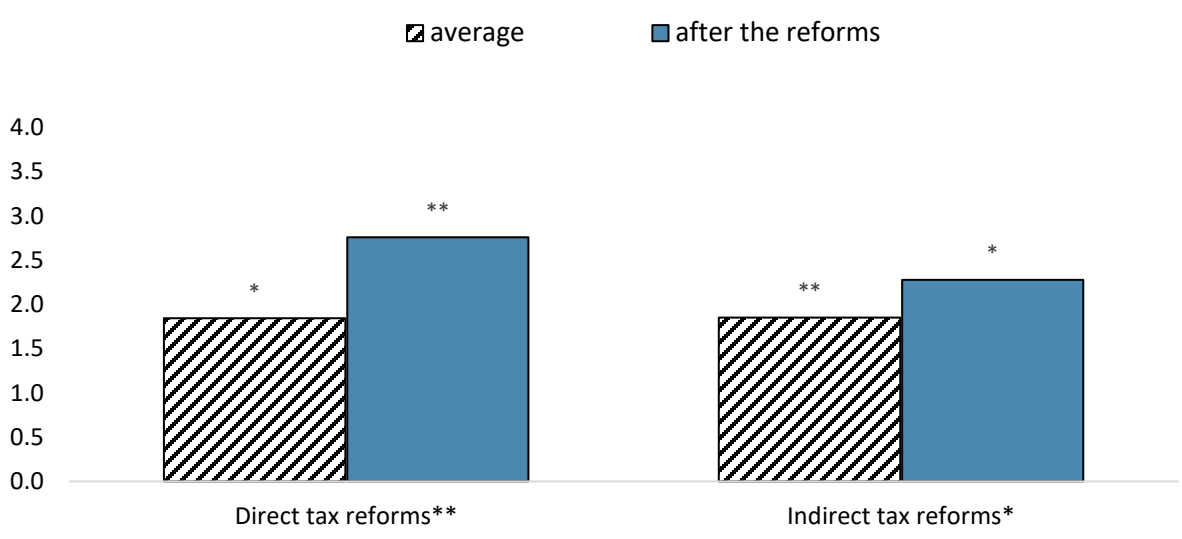
Note: Blue bars denote the impact of PIT reforms (β_1) on tax progressivity. Estimates based on equation (11). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.

Figure 12. Effect of VAT Reforms on C-Efficiency (Percentage Points)



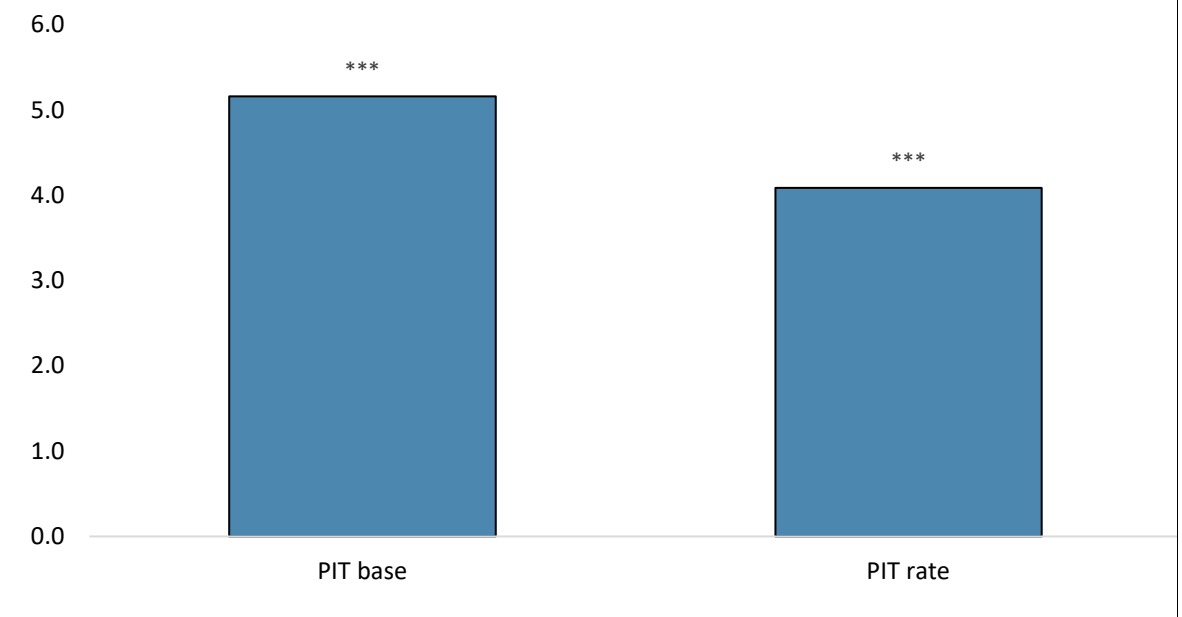
Note: the impact of VAT reform (β_1) on VAT C-Efficiency. Estimates based on equation (11). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.

Figure 13. Effect of Direct Tax Reforms on Fiscal Shock Smoothing Controlling for the Intial Level of Public Debt (Percent)



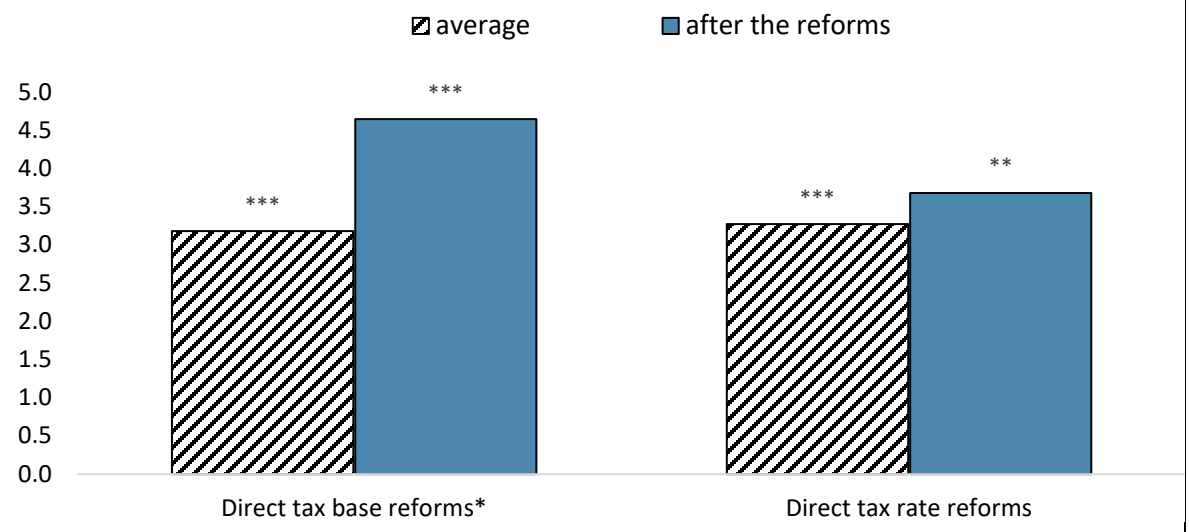
Note: Blue bars denote the fiscal shock smoothing in the years of reform ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average fiscal shock smoothing (β_1) with signficance level. Estimates based on equation (11). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Figure 14. IV Estimator: Effect of PIT Reforms on Tax Progressivity (Percentage Points)



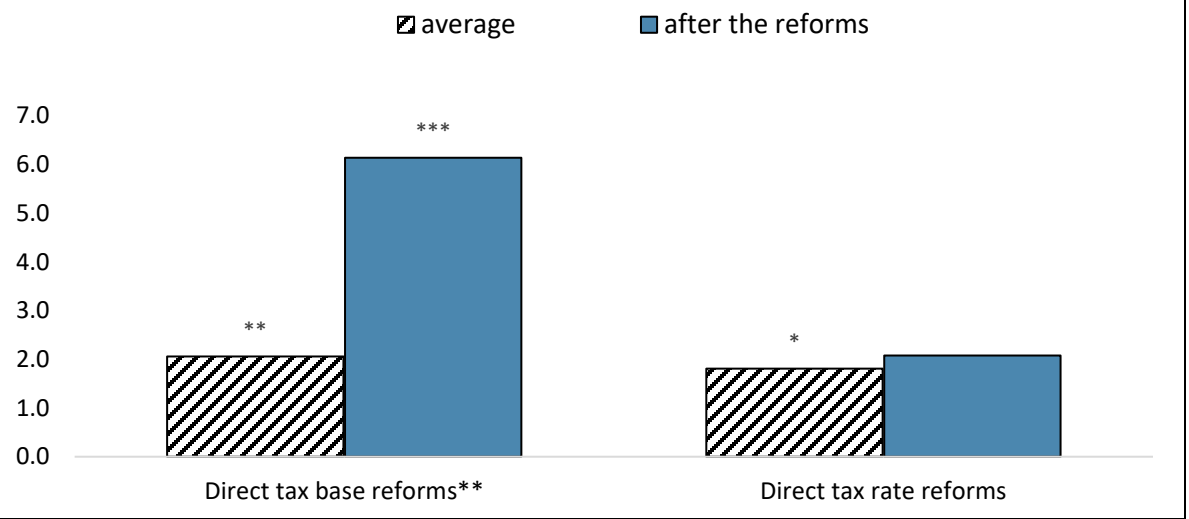
Note: Blue bars denote the impact of PIT reforms (β_1) on tax progressivity. Estimates based on equation (11). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.

Figure 15. GMM Estimator: Effect of Direct Tax Reforms on Fiscal Shock Smoothing (Percent)



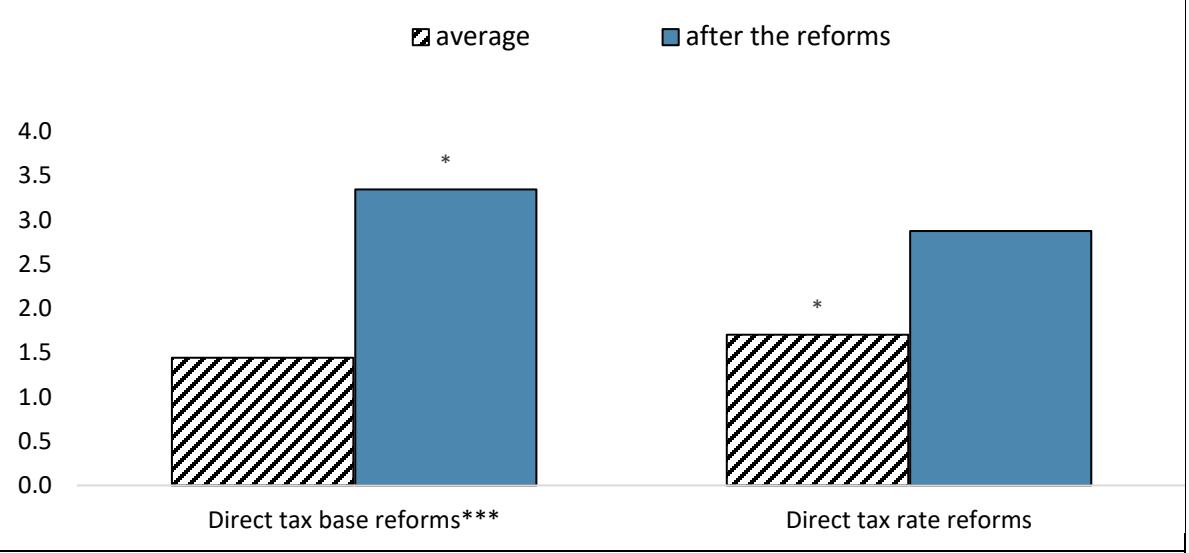
Note: Blue bars denote the fiscal shock smoothing in the years of reform ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average fiscal shock smoothing (β_1) with signficance level. Estimates based on equation (11). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Figure 16. Alternative Reform Threshold: Effect of Tax Reforms on Fiscal Shock Smoothing (Percent)



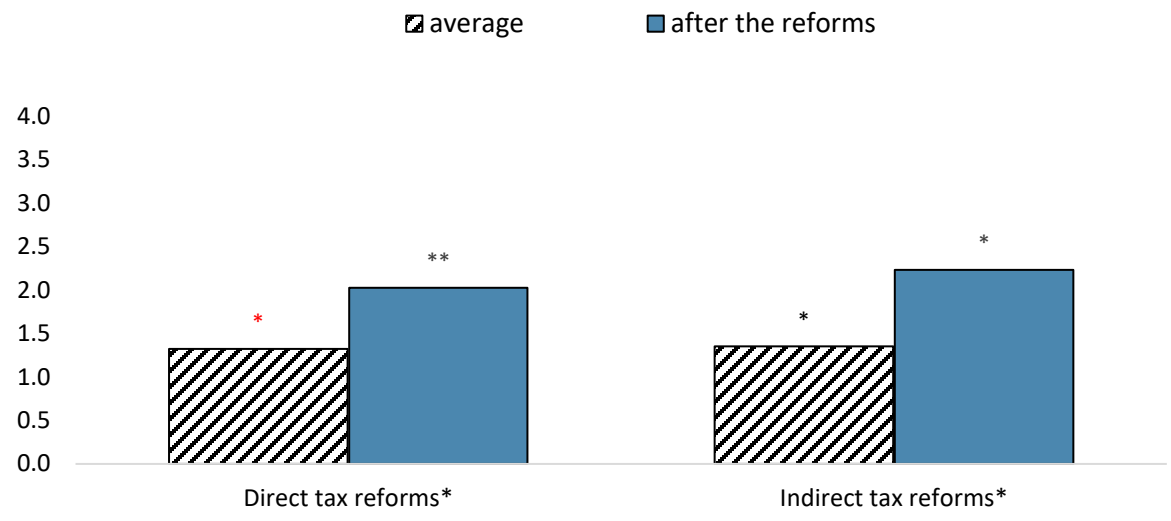
Note: Threshold for selecting the reform episodes is set at 1 percent of GDP. Blue bars denote the fiscal shock smoothing in the years of reform ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average fiscal shock smoothing (β_1) with signficance level. Estimates based on equation (11). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Figure 17. Alternative Reform Codification: Effect of Tax Reforms on Fiscal Shock Smoothing (Percent)



Note: Reform indicator takes value of 1 after a tax refrom yieling to at 0.5 percent of revenue gains is anoonced, and zero otherwise. Blue bars denote the fiscal shock smoothing in the years of reform ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average fiscal shock smoothing (β_1) with signficance level. Estimates based on equation (11). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Figure 18. Alternative Database: Effect of Tax Reforms on Fiscal Shock Smoothing (Percent)



Note: Tax reform episodes are selected based on the database of Alesina and others (2015). Blue bars denote the fiscal shock smoothing in the years of reform ($\beta_1 + \beta_2$) with a joint significance test; grey bars denote the average fiscal shock smoothing (β_1) with signficance level. Estimates based on equation (11). ***/**/* indicates significance at 1, 5, and 10 percent, respectively.The level of significance of β_2 is reported on the x-axis.

Appendix

Table A1. OECD: Distribution of Tax Policy Changes in the TPRD Database

	Base			Rate			All changes		
	Decrease	Increase	All changes	Decrease	Increase	All changes	country year	count of measures	average per country year
All sample	461	339	575	363	331	520	672	3285	4.9
Major	437	305	547	316	262	461	640	2692	4.2
Minor	110	75	161	101	132	192	271	593	2.2
Packages	332	242	408	255	214	358	458	2295	5.0
No Packages	231	143	320	167	183	304	477	990	2.1
Single year	439	325	553	319	308	480	646	2876	4.5
Multiyear	87	45	118	98	47	135	205	409	2.0

Source: Amaglobeli and others (2018)

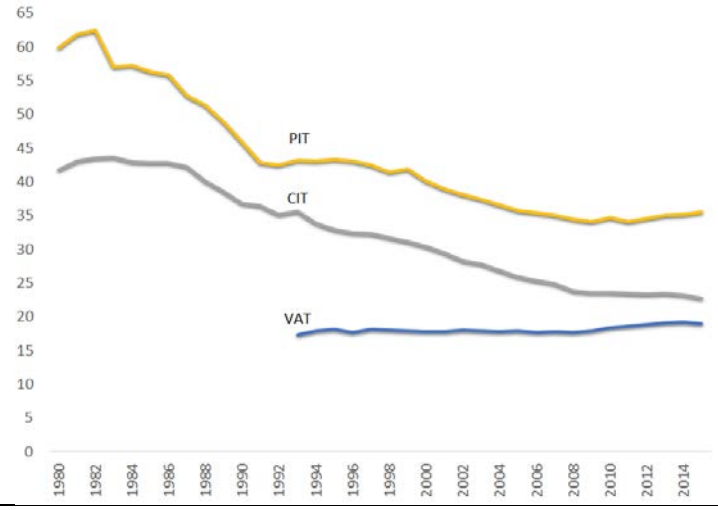
Table A2. 13 OECD Countries: Summary Statistics – *Exogenous* Database

	Number of Reform Episodes	Mean Expected Yields in Percent of GDP	Standard Deviation of Expected Yields in Percent of GDP
Direct tax base	23	0.2	1.8
Direct tax rate	26	-0.3	4.0
VAT Base	8	0.3	0.3
VAT Rate	20	1.2	1.7
Total reform	77		
Total observations	493		

	Mean of the Indicator	Standard Deviation of the Indicator
Tax Revenues (Annual Change, Nominal Value in Local Currency)	5.85	5.59
Tax Progressivity (Indicator)	24.57	9.57
VAT C Efficiency (Indicator Change, 3-year Average)	-0.31	1.77

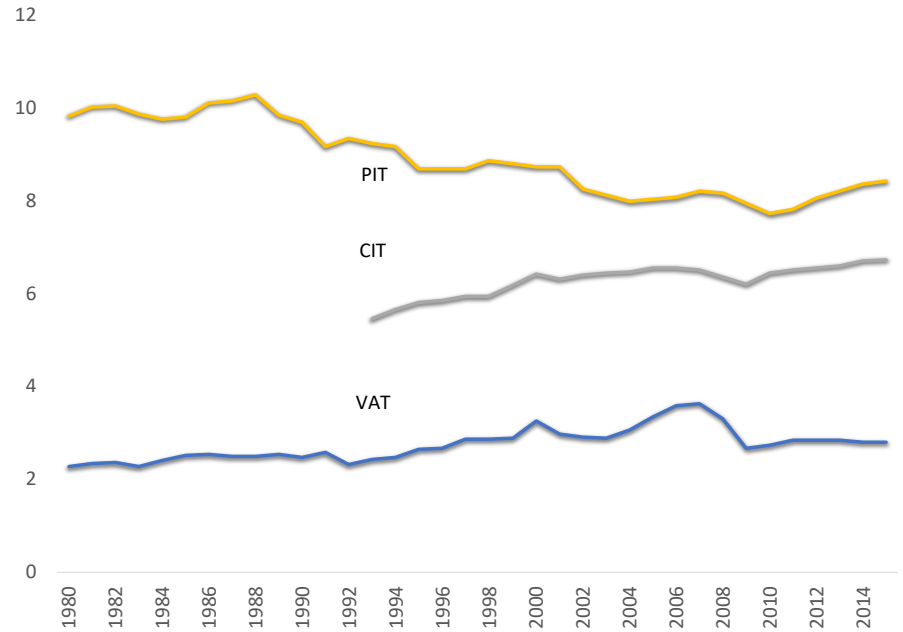
Source: Tax Policy Reform Database ; Dabla-Norris and Lima (2018) ; Authors' estimates.

Figure A1. OECD: Average Top Central Rates



Sources: OECD; and IMF staff calculations.

Figure A2. OECD: Average Tax Revenue (In Percent of GDP)



Sources: OECD; and IMF staff calculations.