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## **The Dynamics of Tax Compliance**

**Francesco Pappadà**

**JEL Codes: E26, E62, H26.**

**Keywords: Tax compliance, Volatility, Fiscal policy.**



# The Dynamics of Tax Compliance

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## Abstract

The literature on tax compliance has focused on its *level* but little is known about its *dynamics*. This paper shows that fluctuations in tax compliance are driven by changes in the state of the economy and the response of tax compliance to them. Tax compliance is markedly volatile and there are large differences in such volatility across countries. A large fraction of these differences (about 70%) is explained by different responses of tax compliance to tax changes and output fluctuations.

JEL: E26, E62, H26.

Keywords: tax compliance, volatility, fiscal policy.

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## 1 Introduction

The literature on tax evasion has clearly established the determinants of tax compliance. In a recent literature review, [Slemrod \(2019\)](#) summarizes three main factors: i) the level of tax base and rates, ii) the remittance rules, namely the entity which reports tax liability, and iii) the enforcement rules. These factors determine the degree of tax evasion, which is quite heterogeneous across countries.<sup>1</sup> While the *level* of tax compliance has received much attention, far less attention has been paid to its *dynamics*. However, the dynamics of tax compliance should be relevant for policymakers. Fluctuations in tax compliance may indeed translate in volatile tax revenues, affecting the ability of governments to finance public expenditures, and constraining the conduct of fiscal policy.

This paper provides novel empirical evidence on the volatility of tax compliance and its determinants. The main results are twofold. First, I show that tax compliance is very volatile, and there is large cross-country heterogeneity in such volatility. Some countries experience large fluctuations in tax compliance, whereas other have a much more stable tax compliance. Interestingly, the countries where the tax compliance is more (resp. less) volatile are not necessarily the ones where the informal sector is large (resp. small).

Second, I study the determinants behind the cross-country differences in the volatility of tax compliance. There are two potential forces behind the fluctuations in tax compliance: i) changes in the state of the economy (e.g. tax reforms or output fluctuations) and ii) the elasticity of tax compliance to these changes in the state of the economy. I decompose the contribution of these two factors to the volatility of tax compliance and show that the second factor is predominant. Tax compliance tends to be more volatile in countries where it is more sensitive to the state of the economy. More precisely, the country-specific elasticities of tax compliance to tax policy and output fluctuations explain about 70% of the overall cross-country differences in the volatility of tax compliance, whereas tax policy and output fluctuations explain about 20% of it.

## 2 The dynamics of tax compliance

### A measure of tax compliance

I construct a measure of tax compliance for 35 countries by comparing (i) actual Value-Added Taxes (VAT) revenues, as reported by government sources, and (ii)

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<sup>1</sup>See [Schneider and Enste \(2013\)](#) for cross-country estimates of the informal sector.

consumption across good categories subject to different VAT rates, as reported in household consumption surveys. I rely on VAT compliance as measure of tax compliance for two reasons. First, it allows the construction of a credible measure of tax compliance across countries and over time. Second, VAT is more frequently adjusted than other tax instruments.<sup>2</sup>

My measure of tax compliance compares tax receipts to expected receipts as predicted by tax rates and actual expenditures. Letting  $tr_{itc}$ ,  $\tau_{itc}$  and  $c_{itc}$  denote VAT revenues, VAT rate and consumption of good  $i$  in year  $t$  and country  $c$ , the measure of VAT compliance is defined as:

$$\gamma_{tc} = \frac{\sum_i tr_{itc}}{\sum_i (\tau_{itc} c_{itc})}.$$

The gap between tax revenues and expected tax revenues, as captured by the distance between  $\gamma_{tc}$  and 1, reflects imperfect tax enforcement from tax authorities. Such measure cannot however shed light on the nature of tax leakages, whether they come from informal exemptions, corruption of tax authorities or non-cooperative tax evasion from agents. The measure accounts for possible changes in consumption patterns  $c_{itc}$  as a response to differential tax rates across goods. Fluctuations in tax compliance can only arise from changes in tax compliance *within* good categories.

I use distinct data sources for total tax revenues, and for reported consumption of 48 disaggregated good categories between 1995 and 2013 in 35 countries.<sup>3</sup> I observe total VAT receipts,  $tr_{tc} = \sum_i tr_{itc}$ , in national accounts. I use annual household expenditure surveys to create actual consumption,  $c_{itc}$ , in each sub-category of good.<sup>4</sup> The information in household surveys comes from the purchaser side thereby alleviating under-reporting of undeclared transactions. I also extract from the European Commission documentation and national sources the different tax rates and I reference good categories that are subject to these rates for each country/year. This allows to account for adjustments in the composition of exempted categories.<sup>5</sup>

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<sup>2</sup>The corporate tax rate and the income tax rate are typically adjusted once every 8-12 years; adjustments are then non-negligible. By contrast, the effective VAT rate is more often modified, reflecting frequent changes in the classification of goods across the different brackets. Furthermore, the systematic analysis of fiscal consolidations classified by [Alesina et al. \(2016\)](#) shows that almost half of the tax surplus is generated through reforms of indirect taxation.

<sup>3</sup>I rely on OECD and Eurostat and their harmonized 48 COICOP (Classification of Individual Consumption by Purpose) sub-categories of goods.

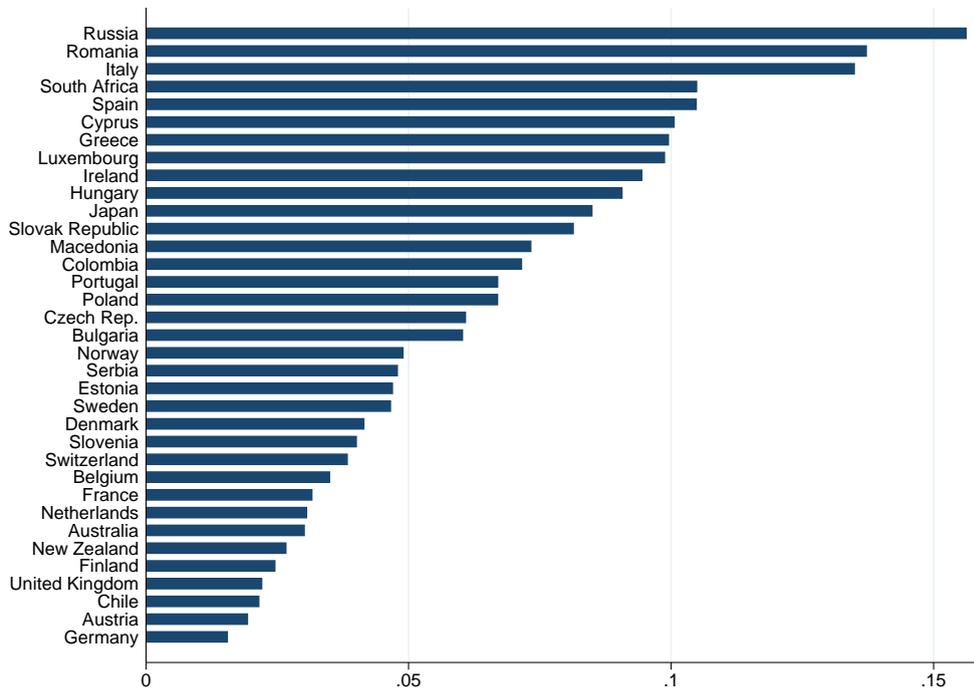
<sup>4</sup>These household surveys are standardized across countries, and they follow similar methodology (i.e., sampling and questionnaire). The aggregate consumption constructed from these surveys strongly correlates with total output, but there exists (standard) measurement error (see [Aguilar and Bils, 2015](#); [Kolsrud et al., 2019](#), for a correction method and a comparison with registry data). This error will translate into a measurement error in the denominator of the expression for  $\gamma_{tc}$ .

<sup>5</sup>See [Pappadà and Zylberberg \(2017\)](#) for additional details about the measure of VAT compli-

## The volatility of tax compliance

This section provides descriptive statistics on the dynamics of tax compliance. Figure 1 plots the within-country standard deviation of tax compliance between 1995 and 2013 in my sample of 35 high- and middle-income countries.<sup>6</sup> This Figure shows that there is a large heterogeneity in the volatility of tax compliance across countries.

Figure 1. Volatility of tax compliance.



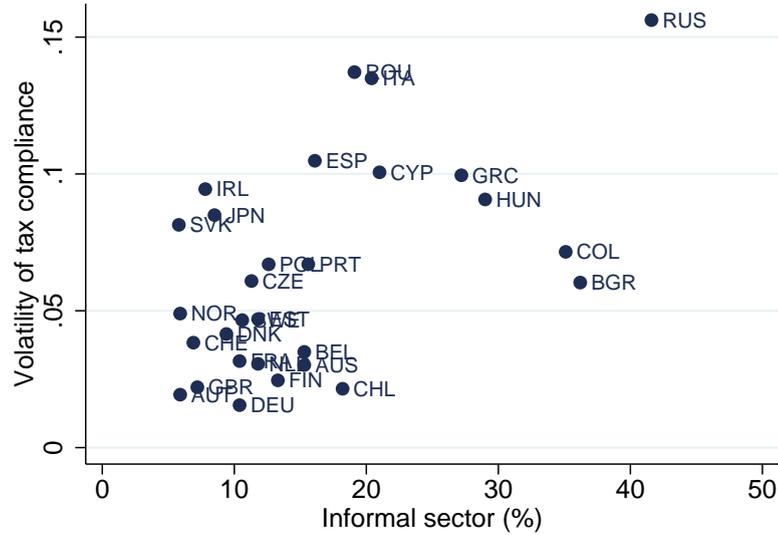
Interestingly, economies that are close in terms of economic development and tax enforcement display stark differences in terms of volatility of tax compliance (see for instance Ireland vs. United Kingdom, or Colombia vs. Chile). Moreover, these differences do not reflect differences in the size of the informal sector. In Figure 2, I compare the volatility of tax compliance to a more standard measure of imperfect tax enforcement, i.e., the size of the informal sector as computed in [Schneider and Enste \(2013\)](#). While there is a positive correlation between the two measures, countries with similar incidence of the informal sector markedly differ along fluctuations in tax compliance. What could explain these differences?

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ance and the corrections to clean for i) within-year VAT reforms, ii) VAT reforms for sub-categories of goods within a 2-digit classification, and iii) reforms that modify the tax environment without modifying tax rates.

<sup>6</sup>In the sample, tax compliance is 0.86 on average, which is arguably quite high—maybe due to the over-representation of rich economies or the built-in incentives to report VAT compared to other taxes.

**Figure 2.** Volatility of tax compliance and the size of the informal sector.



Notes: This Figure displays the within-country standard deviation of VAT compliance along the y-axis (1995–2013), and the size of the informal sector as computed in [Schneider and Enste \(2013\)](#) along the x-axis.

### Explaining the cross-country differences in the volatility of tax compliance

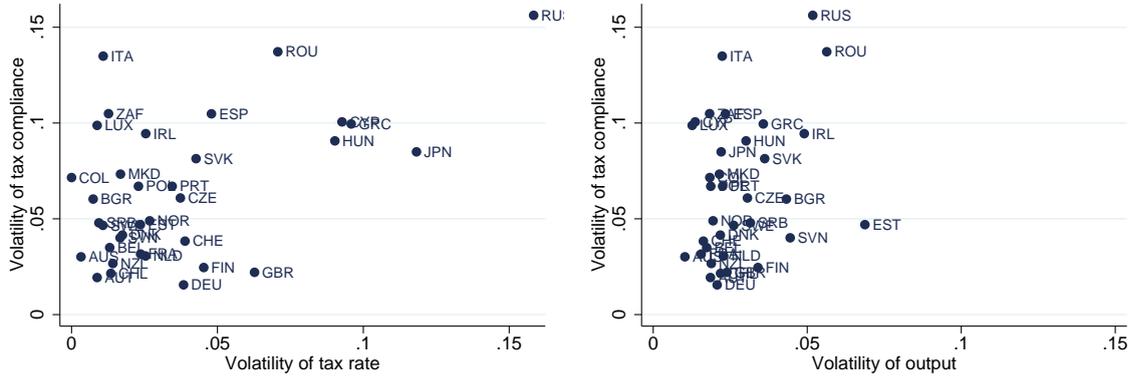
There are two potential determinants of the fluctuations in tax compliance: the changes in the state of the economy  $Z_c$  – for instance tax rates and output – and the elasticity of tax compliance to such changes  $\varepsilon_{Z_c}$ . This implies that the volatility of tax compliance in country  $c$  may be written as  $\text{var}(\gamma_c) = \varepsilon_{Z_c} \cdot \text{var}(Z_c)$ .

In this section, I decompose the contribution of these two factors to the volatility of tax compliance and then analyze to what extent they explain the differences across countries. I first explore the role of the volatility of tax rates and output. Panel (a) and (b) of [Figure 3](#) show that countries with larger tax changes and output fluctuations tend to display a larger volatility of tax compliance. However, there are substantial differences in the volatility of tax compliance for given fluctuations in output and tax rates. I then quantify the elasticity of tax compliance to tax rates by estimating the following baseline specification in difference:

$$\Delta \ln \gamma_{tc} = \varepsilon_\tau \Delta \ln \tau_{tc} + \varepsilon_y \Delta \ln y_{tc} + \beta \mathbf{X}_{tc} + \delta_t + \mu_c + e_{tc}, \quad (1)$$

where I consider a country  $c$  in year  $t$  and denote  $\Delta \ln \gamma_{tc}$  as the annual percentage change in VAT compliance;  $\Delta \ln \tau_{tc}$  is the main measure of fiscal policy, i.e., the annual percentage change in the standard VAT rate; and  $\Delta \ln y_{tc}$  is the annual percentage change in output. The vector  $\mathbf{X}$  includes the following set of time-

**Figure 3.** Volatility of tax compliance, tax rate and output.



Notes: Panel (a) (resp. panel (b)) displays the within-country standard deviation of VAT compliance along the y-axis (1995–2013), and the within-country standard deviation of VAT (resp. the within-country standard deviation of GDP) along the x-axis.

varying controls: annual changes in the sectoral decomposition of economic activity across 1-digit sectors and in trade (the ratio of exports and imports over GDP). These controls partly clean for confounding factors co-moving with tax compliance and fiscal policy. Finally, the inclusion of country fixed effects,  $\mu_c$ , conditions the analysis on country-specific trends and  $\delta_t$  are year fixed effects capturing aggregate dynamics in tax compliance.

**Table 1.** Elasticity of tax compliance.

Tax compliance	(1)	(2)	(3)
Tax rate	-.357 (.066)	-.361 (.066)	-.358 (.067)
GDP growth	.201 (.135)	.205 (.139)	.213 (.139)
Controlling for sectoral composition	No	Yes	Yes
Controlling for trade	No	No	Yes
Observations	527	527	527

Notes: Robust standard errors are reported between parentheses. The unit of observation is a country in a given year. All specifications include year- and country-fixed effects; we sequentially add the following controls: annual changes in the sectoral decomposition of economic activity across 1-digit sectors in columns 2-3; and annual changes in trade (the ratio of exports and imports over GDP) in column 3. The dependent variable is the annual percentage change in VAT compliance. *Tax rate* is the annual percentage change in the standard VAT rate; *GDP growth* is the annual percentage change in output (see specification 1).

Table 1 uncovers an important, yet overlooked, characteristic of tax compliance: it fluctuates markedly with fiscal policy and with the business cycle. I find that the average elasticity of tax compliance to the tax rate is about  $-0.36$ , and, as shown

in columns 2 and 3, the correlation is robust to the addition of controls (sectoral composition in column 2 and trade in column 3). In parallel, an increase of one percent in output is associated with an increase of 20 percent in tax compliance.

The heterogeneous dynamics of tax compliance across countries may be explained by different fluctuations in the state of the economy and different responses of tax compliance to them. What is the contribution of each factor? In order to answer this question, I introduce the following decomposition:

$$\text{var}(\tilde{\gamma}_c) = \text{var}(\varepsilon_{\tau c} \cdot \bar{\tau}) + \text{var}(\varepsilon_{yc} \cdot \bar{y}) + \text{var}(\varepsilon_{\tau} \cdot \tilde{\tau}_c) + \text{var}(\varepsilon_y \cdot \tilde{y}_c) + u, \quad (2)$$

where I define  $\tilde{x}_c = \text{var}(\Delta \ln x_{tc})$  and  $\bar{x} = \text{avg}(\tilde{x}_c)$  for each variable  $x_{tc}$ ;  $\varepsilon_{\tau c}$  (resp.  $\varepsilon_{yc}$ ) is the country-specific elasticity of tax compliance to changes in tax rates (resp. output fluctuations) and  $u$  is the residual. As reported in Table 2, the country-specific responses of tax compliance to tax policy and output fluctuations account for the largest fraction (around 70%) of the differences in the volatility of tax compliance across countries, whereas the differences in output fluctuations and tax policy account for a smaller fraction (around 20%).

**Table 2.** Decomposition of cross-country differences in the volatility of tax compliance.

Response to tax policy	$\text{var}(\varepsilon_{\tau c} \cdot \bar{\tau})$	.34
Response to output	$\text{var}(\varepsilon_{yc} \cdot \bar{y})$	.39
Fluctuations in tax policy	$\text{var}(\varepsilon_{\tau} \cdot \tilde{\tau}_c)$	.17
Fluctuations in output	$\text{var}(\varepsilon_y \cdot \tilde{y}_c)$	.04
Residual	$u$	.06

Notes: The table reports the share of each component of the cross-country differences in the volatility of tax compliance.

### 3 Final remarks

This paper shows that the response of tax compliance to the state of the economy explains a large fraction (around 70%) of the differences in the volatility of tax compliance across countries. The determinants of the elasticity of tax compliance to the state of the economy remain unclear, and further research should investigate them. Among the possible explanations, there could be the sectoral composition of tax reforms or the implementation of these reforms over the business cycle.

The dynamics of tax compliance have important implications on the conduct of fiscal policy. As shown in [Pappadà and Zylberberg \(2021\)](#), the fluctuations in tax compliance strongly distort the relationship between fiscal policy and default risk as credit markets internalize the cost of future distortions in tax compliance.

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## ONLINE APPENDIX

We provide here robustness and complements to the analysis presented in Section 2.

**The dynamics of tax compliance** In Table A1, we replicate the estimation of specification (1) and add—as further controls—the interactions between *Tax rate/GDP growth* and: a dummy for being classified as an industrial country in Vegh and Vuletin (2015) (column 1); a dummy for having above-median tax compliance (column 2); and a dummy for having an above-median informal sector (Schneider and Enste, 2013, see column 3). The rationale for doing so is that the heterogeneous response to fiscal policy and output may reflect various dimensions of heterogeneity across countries. I am generally quite agnostic as to why tax compliance is more or less responsive across countries of our sample. This exercise however shows that the volatility of tax compliance strongly predicts the size of the *tax compliance* response to fiscal policy, on top of other, important dimensions of heterogeneity, for instance, the level of development or the average size of the informal sector.

**Reverse causality** The estimate  $\varepsilon_\gamma$  may be contaminated by omitted variation and reverse causality. Fluctuations in a few sectors with higher tax evasion may induce the government to adjust the tax rate. A government observing a negative trend in tax compliance may decide to increase the tax rate to mitigate a revenue shortfall. In Table A2, we shed some light on the latter effect by regressing the change in the standard VAT rate on the lagged change in tax compliance. We find that the lagged tax compliance cannot predict future changes in fiscal policy.

**Table A1.** Robustness analysis—controlling for the heterogeneity in the level of development, the average tax compliance and the size of the informal sector.

Tax compliance	(1)	(2)	(3)
Tax rate	-.440 (.123)	-.387 (.107)	-.416 (.089)
GDP growth	-.284 (.171)	.144 (.239)	-.034 (.171)
Controlling for heterogeneity in	Development	Av. compliance	Av. informal
Extended controls	Yes	Yes	Yes
Observations	459	498	436

Notes: Robust standard errors are reported between parentheses. The unit of observation is a country in a given year. All specifications include year-, country-fixed effects and the following controls: annual changes in the sectoral decomposition of economic activity across 1-digit sectors and annual changes in trade (the ratio of exports and imports over GDP). The dependent variable is the annual percentage change in VAT compliance. *Tax rate* is the annual percentage change in the standard VAT rate; *GDP growth* is the annual percentage change in output (see specification 1). We augment the baseline specification (1) by adding interactions between *Tax rate/GDP growth* and a dummy for being a high-response country (see Section ?? for the definition of the *High-response* dummy). We add further interactions between *Tax rate/GDP growth* and: a dummy for being classified as an industrial country in [Vegh and Vuletin \(2015\)](#)† (column 1); a dummy for having above-median tax compliance (column 2); a dummy for having an above-median informal sector ([Schneider and Enste, 2013](#), see column 3). †: In [Vegh and Vuletin \(2015\)](#)'s classification, industrial countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom; non-industrial countries are Bulgaria, Chile, Colombia, Cyprus, Czech Republic, Estonia, Hungary, Korea, Malta, Poland, Romania, Russia, South Africa. Four countries of our sample are not classified by [Vegh and Vuletin \(2015\)](#) and six countries are not covered by [Schneider and Enste \(2013\)](#), hence the lower number of observations in columns 1 and 3 compared to our baseline.

**Table A2.** Tax compliance and VAT standard rates—reverse causality.

Tax rate	(1)	(2)	(3)
Tax compliance (lag)	-.021 (.035)	-.022 (.035)	-.027 (.035)
GDP growth (lag)	-.098 (.100)	-.104 (.101)	-.135 (.103)
Controlling for sectoral composition	No	Yes	Yes
Controlling for trade	No	No	Yes
Observations	463	463	463

Notes: Robust standard errors are reported between parentheses. The unit of observation is a country in a given year. All specifications include year- and country-fixed effects; we add the following controls: annual changes in the sectoral decomposition of economic activity across 1-digit sectors in column 2-3; and then annual changes in trade (the ratio of exports and imports over GDP) in column 3. The dependent variable is the annual percentage change in the standard VAT rate. *Tax compliance (lag)* is the annual percentage change in tax compliance in  $t - 1$ ; *GDP growth (lag)* is the annual percentage change in output in  $t - 1$ .