Giulia Aliprandi
Banque de France and Paris School of Economics
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Discretionary tax changes and the underground economy: new narrative evidence for Italy

Abstract

This paper estimates the dynamic effects of discretionary tax changes when tax evasion is present, focusing on the case of Italy. Using a new quarterly database that separate underground and observed output, I am able to document a robust positive response of tax evasion and strong negative effects on observed output following a change in the tax rate. These dynamics are estimated with a VAR model where the fiscal shock is identified using a newly constructed narrative measure.

Keywords Informal/underground GDP - Narrative approach -Tax multipliers- Fiscal policy

JEL Codes E23, E32, E62, H20, H30, E26

1 Introduction

Following the recent debt crisis, countries conducted major fiscal changes in order to consolidate their deficits. As a consequence, the impact of tax reforms on economic activities has been widely explored in the literature, and the debate on the size of the tax multipliers[1] has flourished over the past years touching different aspects: from the effect of different types of instruments, to cross country differences and state dependence. However, a major element has been overlooked: tax evasion[2].

This is questionable, since official GDP estimates of most countries are adjusted to include the underground sector[3]. As stressed by Pappa et al. (2015), tax measures have an impact on the size of unreported output by affecting the incentives to tax evade. This has important secondary effects whenever it triggers a reallocation of resources between the formal and informal sectors[4]. It follows that an evaluation of tax policies effects on GDP, that ignores the dynamics of tax evasion, could lead to unreliable results and recommendations. This is particularly relevant for countries characterized by a large underground sector, as the majority of Mediterranean and Eastern European countries.

This paper shows that these dynamics are consistent and should not be neglected. When using a measure that, like GDP, aggregates the non observed and observed part of the economy, the different movements of the two components cannot be identified. Analysing the case of Italy, the estimation of a tax increase of 1% of GDP yields negligible and non-statistically significant results when performed on total GDP. In contrast, when separating the two components it emerges that, after one year, the underground economy grows of about 15% year and the observed economy decreases of 3.4%. The observed economy is more affected than we would expect by only looking at official GDP measures.

Empirical evidence on this topic is scarce, since data are not available on international basis and are difficult to collect even for OECD countries. Measuring the Non Observed Economy[5] (NOE henceforth) is inherently difficult for both the unobserved nature of the activities and the difficulty in precising the boundaries of the sector. Despite this, most countries make adjustments for NOE in order to arrive at exhaustive estimates of GDP and national accounts. As reported in figure 1, the size of the adjustment operated by countries can be quite large. The information collected in a survey of the OECD in 2012 shows that Northen European and Anglo Saxon economies have a relative low levels of adjustment (1% to 5% of GDP) while other European economies have mid-range values (5% to 8% of GDP). In contrast, Italy, Mexico and Eastern European countries have consistently high NOE (9% to 17% of GDP). Many other countries that participated to the survey (like Portugal and Spain) confirmed that they adjust GDP estimates but preferred to keep the information on the size of the adjustment confidential. Statistical offices do not extensively publish NOE results, making it extremely hard to disentangle

[1] Among others: Alesina and Ardagna (2009), Romer and Romer (2010), Favero et al.(2011), Auerbach and Gorodnichenko (2012), Alesina et al.(2015).

[2] With the exception of: Pappa et al.(2015), Pappadà and Zylberberg(2016), Busato et al.(2016)

[3] Underground activities are productive and legal but are deliberately concealed from public authorities to avoid payment of taxes or compliance with regulations. it excludes all illegal activities

[4] Pappa et al(2015) use a DSGE model to assess the consolidation effects when a large informal sector is present showing that tax hikes have an amplified effect in Greece, Italy, Portugal and Spain.

[5] NOE covers different types activities, an extensive explanation can be found in Appendix A.

the observed and the non observed economy in the official GDP measures.

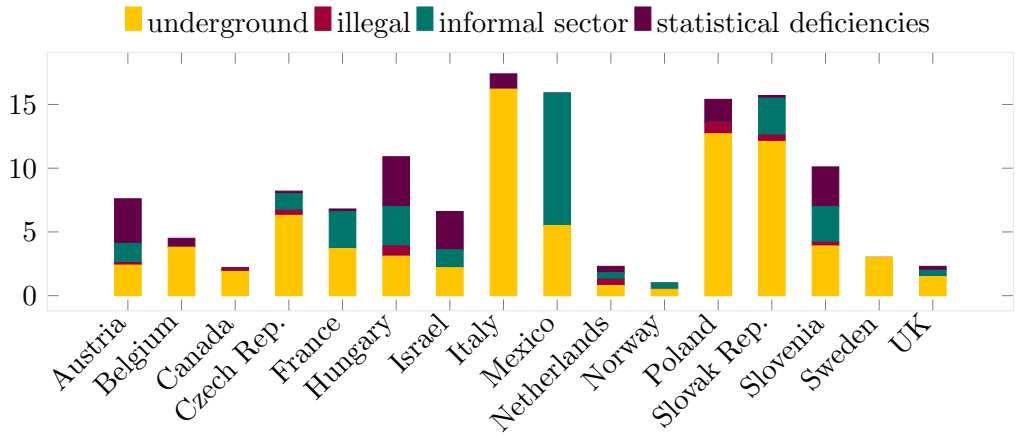

Figure 1: Non Observed Economy (and its components) adjustments as a percentage of GDP *Data source: OECD Survey 2012*

Data availability is one of the main challenges when analysing the effect of tax changes on observed and underground economy, together with the correct identification of tax shocks as in any empirical study trying to estimate fiscal policy effects. Italy is one of the few countries for which data on the underground sector is available. I exploit the databases provided by the Italian National Revenue Agency and Basile et al. (2016) to recover the dynamics of the observed and underground economy.

In this context, identification is achieved using the narrative approach pioneered by Romer and Romer (2010) adapted to the case of Italy. This methodology requires the use of historical evidence to construct a fiscal shock that is uncorrelated with other economic fluctuations. Using several government documents like laws, reports and speeches, I construct from scratch a new quarterly time series of tax changes that took place in Italy from the 1980 to 2011. I then follow Romer and Romer (2010) and use the justification given in the narrative record to isolate those policy changes that were not responding to or influenced by other macroeconomic fluctuations. In this way, I obtain an "exogenous" tax shock that will be used in the estimation. Furthermore, I extend the classification to identify and exclude tax changes that were taken to fight tax evasion. This step will be necessary to avoid endogeneity issues in the empirical analysis of the underground sector. The exogeneity assumption is further tested using a granger causality test. The narrative shock is then included in a standard fiscal VAR as an exogenous variable and used to estimate the macroeconomic effect of tax changes in Italy with two models: one where the observed and the underground production are separated and another where they are aggregated, as in the official national accounts. The estimates of the two different models reveal that using only the aggregate measure of GDP gives an incomplete picture of the consequences of tax increases: it completely overlooks the reallocation from the observed to the underground production sector. When looking at the observed part of GDP tax increases are found to be contractionary and unreported production rises significantly.

These conclusions are particularly relevant in the current situations where countries

with a large informal sector have consolidated their budgets through revenues increasing measures . These countries might be harmed both from the hampered growth and the regular-irregular dynamics of the GDP.

This paper is structured as follows. Section 2 compares two main references in the empirical literature of fiscal multipliers and describes the identification strategy used in this paper. In section 3 the procedure to construct the narrative shock is detailed, the obtained variable is then described in section 4. The following section 5 proceeds to the description and estimation of the models and presents the main results of the paper. In section 6 I explain how I checked the robustness of the main results. Finally, section 7 concludes.

2 Framework and methodology

This paper is related to the empirical literature of fiscal multipliers, which is mostly based on VAR approaches. Shocks to fiscal and macro variables are often contemporaneously correlated. This explains why estimating the causal effect of fiscal policy on economic activities represents a challenge.

Tax changes might be caused by different factors which are hard to disentangle: they might be legislated for political reasons or in response to economic conditions or they might occur automatically because of income, inflation or other changes in the economy. There is a problem of endogeneity: it is complex to isolate a change in government revenues from other factors affecting the economy. As a result, some additional identifying assumptions are needed in order to isolate truly exogenous fiscal shocks.

The recent empirical literature has delivered two main approaches to estimating tax multipliers. The first one pioneered by Blanchard and Perotti (2002) is based on structural vector auto regression (SVAR) analysis. The shocks are identified by adding some timing restriction and calibrating the output elasticity of revenues. The second strand of the empirical literature, initiated by Romer and Romer (2010), relies on the narrative approach. In this case, the tax shock is constructed on the basis of historical evidence and used in a regression with a measure of aggregate activity. In this paper the analysis will be conducted using the second method since the focus is on discretionary tax measures. Moreover, concerning the particular case of Italy, a source of mismeasurement could come from the several fiscal amnesties[6] that were granted over the last 30 years, in this case an increase in revenues could be mistaken for a change in taxation.

Thus, in order to consistently estimate tax effects on the economy I use the identification approach pioneered by Romer and Romer for monetary policy and later on for fiscal policy. The idea developed in Romer and Romer (2010) is to directly construct the "exogenous" policy shock from historical evidence, rather than recovering it by applying a priori assumptions to the model. Their narrative measure of tax changes is based on discretionary changes to taxation which are meant to capture the intentional action on policy-makers, as opposed to the automatic effect of business cycle on revenues. In a minimal framework describing how tax changes ΔT_t affect output growth ΔY_t is illustrated below,

$$\Delta Y_t = \alpha + \beta \Delta T_t + \epsilon_t. \tag{1}$$

[6] Amnesties were granted in 1982, 1991, 1994, 2002.

We can think that tax changes ΔT_t react to both ϵ_t, which could for example represent changes in government spending, monetary policy shocks, natural disasters and to some additional influences which are not related to developments likely to affect output in the near term (the ω_t in the equation below):

$$\Delta T_t = \sum_{i=1}^{K} b_t^i \epsilon_t^i + \sum_{j=1}^{L} \omega_t^j. \tag{2}$$

Substituting equation (2) in (1) clearly shows why estimating tax changes effects can deliver biased results: many of these changes are directly correlated with the error term ϵ_t.

$$\Delta Y_t = \alpha + \beta \Big[\sum_{i=1}^{K} b_t^i \epsilon_t^i + \sum_{j=1}^{L} \omega_t^j \Big] + \epsilon_t \tag{3}$$

Thus, to correctly estimate the effects of tax changes on output it would be ideal to recover the ω_t shock which is not correlated with other factors affecting output. To do so, they directly construct the shock by using several government documents they record the timing, size and motivation of every legislated tax change and retain those uncorrelated with the economic situation. As explained in greater detail in the following sections, I will use this methodology to identify discretionary tax shocks and adapt it to the case of Italy and the analysis of the underground GDP dynamics.

The study of Romer and Romer (2010) reveals that GDP is more responsive to discretionary changes in taxes than in the Blanchard and Perotti study. Blanchard and Perotti find small effects while Romer and Romer find fall in output of 3.08 percent after 10 quarters (in response to 1 percent of GDP tax increase). According to Mertens and Ravn (2014) the difference in the results could be due to an imprecise measure of the output elasticity of tax revenues used in BP to complete the identification of structural shocks.

3 Construction of the shock for Italy

To obtain the exogenous shock having the characteristics outlined in the previous section, the first step will be to identify all the legislated tax changes that took place over the sample. For each change it is necessary to determine the timing, size and most importantly the motivation. In this section I will explain how tax changes are collected and classified to obtain the measure we are looking for.

3.1 Narrative sources

A first step in the narrative approach is to identify and collect revenue effects for all the discretionary policy changes. Taxation changes can be enacted either with the annual budget (legge finanziaria) or with single laws throughout the year. These laws are accompanied by some technical reports that contain the expected revenue changes. To keep track of all the laws enacted during the year I use several documents elaborated by the Italian government. The budget and law changes are explained in the Relazione

Previsionale e Programmatica (RPP) which was published every year in september until 2005. This document was then updated in February with the Aggiornamento della Relazione Previsionale e Programmatica (AGGRPP). These two documents allow me to keep track of all the changes that took place over the years. I further complete the information collected in the RPP and AGGRPP with those of the Relazione Generale sulla Situazione Economica del paese (RGE) which is published in march and reviews all policy changes that took place the preceding year. All these different documents contain precise information about the date and size of each measure, allowing me to verify and complete revenue estimates coming from different documents. I often compare these information with those published in the bulletins of the Bank of Italy. Using all these sources, I manage to identify nearly 800 tax changes that took place between 1980 and 2011.

Implementation and announcement dates are found in the bills of every tax measure. In the vast majority of cases laws are first passed as a "decreto legge" (Decree law) and are then approved by the parliament. A "decreto-legge" is a provisional measure enacted by the government in case of urgency, which is invalidated if not approved by the parliament within 60 days. When dating the measures, it is crucial to verify whether the scheduled implementation differs from the law approval: changes in the tax code could be legislated well in advance of scheduled implementation. In Italy, laws are rarely implemented with a large delay and in the majority of cases they are preceded by a decreto legge which is immediately enforced. In order to control for expectations, I will use the date of the "decreto legge" when recording the legislated measures.

3.2 Motivation classification

Having collected the date and size of all tax changes in the sample the following step, in order to define the exogenous shock, consists in splitting the series by motivation. Each bill is accompanied by a speech which justifies and motivates the effects of the law[7]. This information allows to distinguish between "endogenous" and "exogenous" measures and obtain the tax shock.

Following RR, a policy decision is defined "exogenous" if it is not designed to offset other macroeconomic shocks and "endogenous" if it is supposed to offset macroeconomic fluctuations. The careful analysis of the documents described in the preceding section, allows to assign a clear purpose to every tax change.

Endogenous changes are classified in four main categories: countercyclical, deficit reduction, spending driven and tax evasion. Countercyclical measures are those taken in response to current or future economic conditions. The objective is usually to stimulate demand or supply. Demand management changes aim at adjusting aggregate demand in response to macroeconomic fluctuations, usually negative output shocks. What is important is that the tax change is used to regulate demand in order to offset another shock. Following the same logic supply-side reforms are classified as endogenous if they offset a shock. An example are the measures introduced in 2009 to support the production sector through the crisis. Spending-driven tax changes are those that

[7]This information is complemented with technical notes and other documents that state the general aim of the government policy. Stated justifications for actions are taken at face value as in RR and Cloyne.

explicitly finance a spending action. An example of this type of measure is the tax increase implemented in the 1981 to fund transfers to cities and provinces. The following endogenous category consist of tax increases that aimed at reducing an increase in current deficit triggered by another shock. The tax increases enacted in the recent debt crisis are a clear example of this type of measure. The last endogenous category consists of measures taken to contrast tax evasion. Many tax measures were taken to contrast tax evasion and reduce the size of the underground sector. In RR and Cloyne these measures are included in the "ideological changes" category and classified as exogenous.In our case it is key to affect these changes to the endogenous category in order to properly assess the effect of taxes on the underground sector.

Turning to exogenous actions, there will be four categories: ideological, long-run, external institution and deficit consolidation. Ideological changes are usually taken for political or philosophical reasons with no explicit aim at influencing economic performance. Examples of these actions are tax cuts which target low pension or people with low income. Long-run measures are part of the government long term strategy to improve long run productivity, efficiency and competitiveness but not to offset a shock. The category "external bodies" includes those measures that are imposed to policy-makers by external institutions. An example is the enforcement of European directives aimed at harmonising VAT rates or fuel taxes among European countries. Tax changes driven by deficit consolidation motivation are particularly delicate to classify since they might be confused with endogenous deficit reductions. From what emerges from the narrative record, deficit was lowered either for consolidation motives (debt restructuring, structural deficit reduction) or for more immediate needs related to the contemporaneous economic context (as in the recent crisis). In the first case the tax change is usually not correlated with other shocks hitting the economy while in the other case it is. It is important to be very careful when classifying these two different types of measures. In the case of deficit reductions the decision is taken as a consequence of contemporaneous events and the causes are often clearly stated, which make it easier to classify them. A deficit-consolidation tax change is taken in spite of or regardless of its effects on output in the short run.

To sum up, we have the following endogenous categories:

- Demand management: aimed at boosting consumption, growth or to curb inflation
- Stimulate production: help for businesses during a downturn, support for specific sectors
- Fund spending decisions: balance a specific spending decision
- Offset debt crisis/deficit reduction: deal with a budget or external deficit contemporaneously caused.
- Tax evasion: reduce the size of the underground sector, reduce tax evasion.

The policy changes classified as "exogenous" are those not designed to offset a macroeconomic shock, unrelated to events likely to affect output in the near term. taken for the following reasons:

- Ideological: social or political clauses, not to offset a current shock
- External institution: enforcement of directives coming from external bodies or court rulings
- Long run performance: measures taken to improve long run productivity , efficiency and competitiveness but not to offset a shock, simplification measures
- Deficit consolidation: lower inherited deficit, does not include decision motivated by current economic conditions.

3.3 From narrative measures to quarterly shock

Having assigned a motivation to each revenue change, applying the methodology described in the previous section, I proceed to the following step and aggregate the tax series based on motivation and implementation date. The objective is to construct a quarterly time series of the change in the average tax rate.

When assigning the measures calendar dates to quarters, I follow RR. They assume that changes that were implemented in the second half of the quarter have their economic effects in the following quarter. This means that a tax passed in the second part of the quarter will be dated with the following one.

Once aggregated and properly dated, the revenue changes need to be put on a consistent basis. The revenues forecasts are in nominal terms and recorded as the "full year" change so I express them as a percent of annualized level of nominal GDP in the year the change occurred. The aim is to summarize the tax code changes by a single number, the implied average tax rate. This means that I do not discriminate between changes in marginal and average tax rates, labor and capital taxation, direct or indirect taxes. Also I cannot include revenue neutral changes since the impact of two opposite measures would be equal to zero when aggregating. Investigating the impact of such a disaggregated measure would be of great interest but this entails a large loss of degrees of freedom, making the estimation extremely challenging in a small sample as the one available for Italy. This paper focuses on the impact of tax changes as summarized by their total impact on tax liabilities.

4 The new measure of fiscal shock

Using the narrative sources and aggregating the different measures it is possible to obtain the measure of fiscal shocks that appears relatively exogenous to output. These changes should be valid for investigating macroeconomic effects of tax changes. In the following section, I describe the main properties of the obtained measure and test its exogeneity more formally.

4.1 Properties of the new tax dataset

Figure 2 illustrates exogenous series obtained following the procedure described in the above sections. It can be noticed that many observations are zero since this series

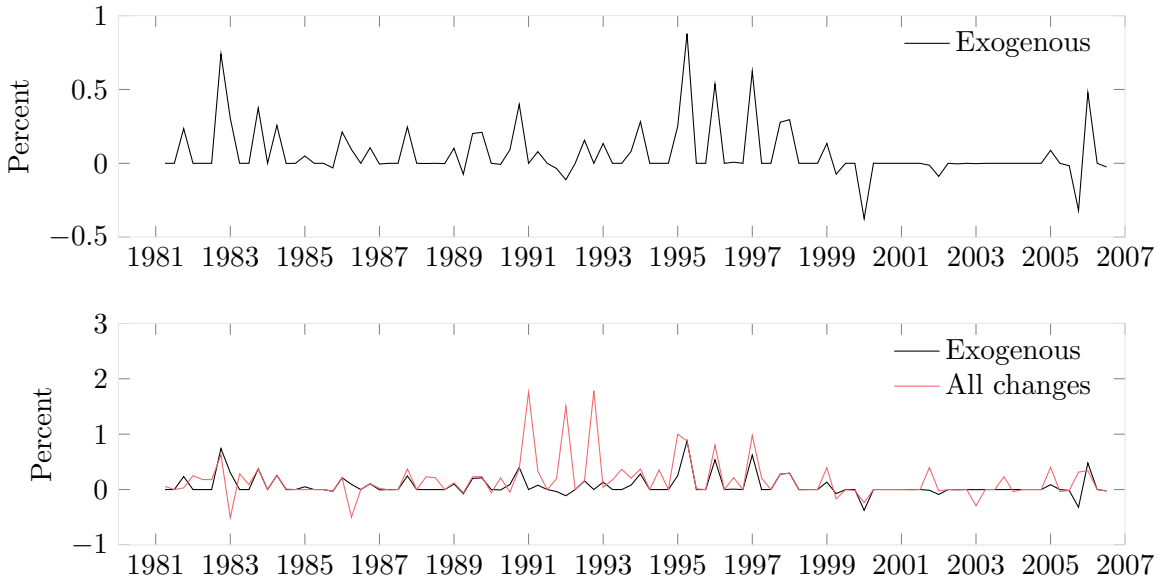

Figure 2: Exogenous policy changes and all policy changes

includes only legislated tax changes that occur at discrete times. Also, the majority of tax changes are tax increases both in the exogenous and endogenous case.

The series has a mean of 0.06 percent of GDP. There is a fair amount of variation and the standard deviation is 0.18. These values are close to those of the measures constructed for the US and the UK. The full discretionary series which includes both exogenous and endogenous changes has a higher mean, 0.16, and is more volatile, with a standard deviation being 0.37, reflecting the presence of countercyclical actions and some important deficit reduction measures.

Concerning different subcomponents of the exogenous category, deficit consolidation measures are the largest group.

4.2 Exogeneity test

To verify the exogeneity of the constructed series it is possible to test whether it can be predicted on the basis of past information. To this end, I perform a VAR granger causality test to check the predictability of the fiscal shock.

Table 1 contains the p-value of the F-tests of the hypothesis that four lags of X_t have no predictive power on the tax changes on the basis of linear regressions. The vector X_t includes output (total, regular and underground), investment, consumption, government, spending, inflation and the short-term interest rate.

The results show that the selected tax changes are unpredictable on the basis of past information, the p-value being 0.718 (it was not possible to reject the hypothesis that all the coefficients in the tax equations are zero). For comparison, I also run the test on the endogenous series and it can be seen that it is indeed predictable. The p-value of 0.006 allows the rejection of the null hypothesis. In this section the series in X_t

are seasonally adjusted. I obtain similar results if I use growth rates or detrended series. In addition, I test the components of the exogenous series by motivation, always confirming that the exogenous series are unpredictable.

Variable	Test Statistic	p-value
Exogenous series	15.97	0.718
Endogenous series	39.37	0.006

Table 1: Granger causality test

5 The effects of tax changes on output and the underground sector

The following step is to use the newly constructed fiscal shock measure to examine the relationship between tax changes and economic activity. To disentangle the effects of tax changes on the regular and unreported GDP and verify whether their dynamics compromise the evaluation of the effects of tax increases on the whole economy, I will estimate two different models. In the first one, as usual in the literature, I estimate the effects of tax changes on GDP. In this case the regular and underground components are not discernible. In the second model the GDP measure is disaggregated, allowing to disentangle the different dynamics of the underground and regular components.

5.1 Data

It is useful to clarify some terminology and describe the dataset that will be used in the estimation. I will distinguish between total GDP (Y), observed or regular GDP (Y^R) and unreported or underground GDP (Y^U), with $Y = Y^R + Y^U$. Unreported GDP includes legal activities and transaction that are not reported to tax authorities [8].

The official release of Italian GDP recorded in National Accounts includes unreported production and thus corresponds to Y, total GDP. This measure obviously does not allow the analysis of the two different components. To overcome this issue and disentangle the dynamics of regular and unreported GDP I employ the new database constructed by Basile et al (2016). They exploit the new time series estimate of the unreported Value Added Tax (VAT) base provided by the Italian Revenue Agency of the Ministry of Economy and Finance and estimate a quarterly time series of unreported production. This time series is calculated as the comparison of actual values, mainly derived from VAT returns and theoretical ones derived from National Accounts and macroeconomic data[9]. Evading VAT means under-reporting production, labour activities and revenues so this series is relevant to both unreported production and tax

[8] This measure does not include black market illegal activities such as drugs sales, prostitution and criminal transaction. The focus is on legal transactions that are not reported.

[9] For further details on the construction of the series see Marigliani and Pisani (2007).

evasion. For this reason when proceeding to the estimation it will be used as used as a proxy for "unreported production".

As the authors, I underline that this is only part of the tax evasion phenomenon: it accounts for uncollected VAT revenues. However, as outlined above, VAT evasion is a"prerequisite" and contains other forms of non-compliance. Therefore according to the Revenue Agency the dynamic of uncollected VAT revenues could well approximate the whole evaded tax revenues.

This data is available from 1980:I to 2006:IV. The variables used in the estimation are in log real per capita terms and include total GDP, underground GDP, regular GDP and government expenditures[10].

5.2 Specification

I follow Cloyne (2013) and Mertens and Raven(2013) and estimate the effects of the narrative shock on the endogenous variables in the following VARX:

$$X_t = A_0 + A_t t + B(L)X_{t-1} + C(L)d_t + e_t. \tag{4}$$

Following the discussion in the previous sections the narrative shock d_t is included as an exogenous variable in the VAR framework. The vector X_t contains the endogenous variables. To compare the effects of tax increases on total GDP (Y) and regular (Y^R) and unreported GDP (Y^U) I will specify two different models: in the first X_t will contain total GDP and government consumption while in the second total GDP will be disaggregated in regular (Y^R) and unreported GDP (Y^U).

In the above equation B(L) and C(L) are lag polynomials with lags P and Q respectively. Since the estimation is performed on a small sample there is a trade-off between long lag structure and and protecting degrees of freedom, in this case P=4 and Q=12. These values are common in the literature, I follow Cloyne (2013) and Romer and Romer (2010). Also, I perform some robustness checks to test the sensitivity to these values.

The figures below report the baseline results together with 68 and 95 percent non parametric, non-centred bootstrapped confidence intervals using 10000 replications.

5.3 Response of total output

Figure 3 reports the results concerning the effects of tax increases on GDP (Y), it illustrates the impulse response function to a 1 percentage point increase in taxes as a percentage of GDP. The GDP response to this shock is slightly positive but non-statistically significant, error bands are quite large and do not allow for a precise estimate of the GDP trajectory. The results are similar to those of Giordano et al. (2007) that estimate fiscal multipliers for Italy in a VAR framework. They find that revenues shocks have a negligible effect on output. In contrast, in the case of the UK and the USA the peak effects is at the 12th quarter where GDP rises of about 2.5 percent.

When drawing a comparison with these studies it is important to keep in mind that the fiscal shock constructed for Italy mainly includes discretionary tax increases while

[10]More precise data definitions are given in the appendix.

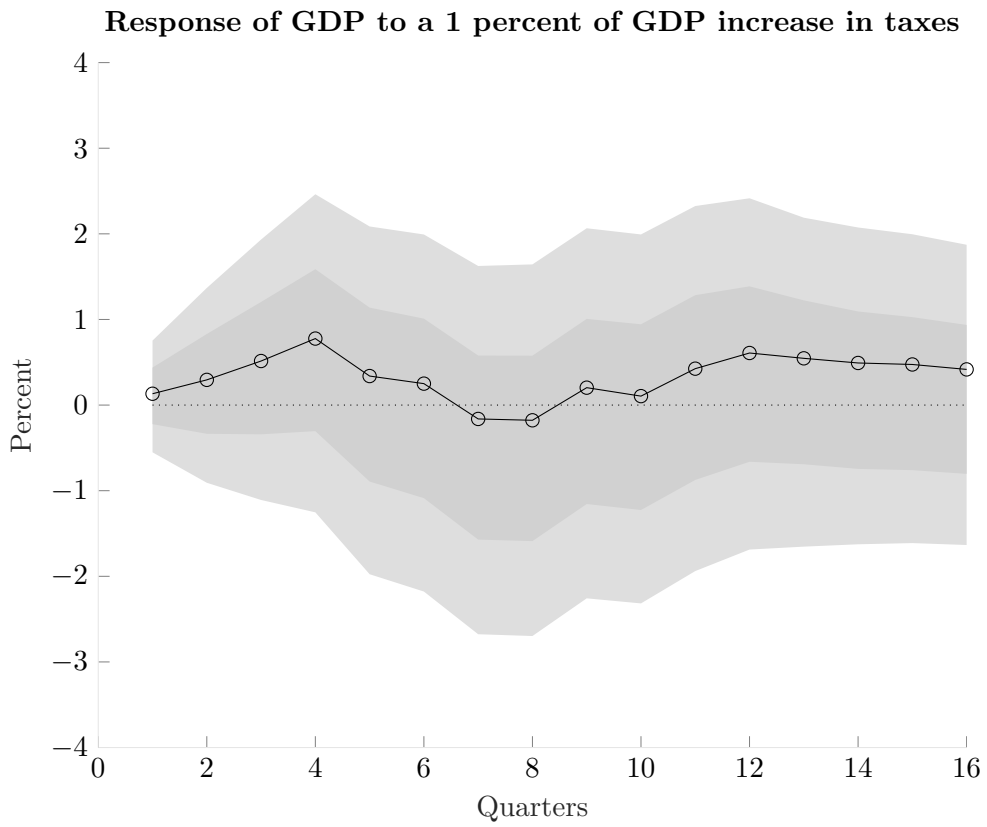

Figure 3: The effects of a tax increase on total GDP

Cloyne and RR have a more balanced shock consisting of both positive and negative measures[11]. Using this shock in their specification it is implicitly assumed that tax cuts and tax increases have symmetric effects. Hussain and Malik (2016) test this hypothesis and re-estimate the models separating the exogenous measures in tax increases and decreases. They find that a tax increases have negative but insignificant effects in the USA and strong negative effects in the case of the UK (-5% after ten quarters).

This makes the evidence concerning Italy even more at odds with the multipliers estimated for these two countries. Being increased tax rates one of the main determinants of tax evasion, and hence of the underground sector size, we could think that the underground sector could play an important role if its tax-elasticity is high enough. The second version of the model will test this hypothesis.

5.4 Response of regular and unreported output

Having estimated the response of total output to tax changes, I compare it to the reaction of its two components: regular and unreported GDP. In this case the vector of endogenous variables X_t in equation 4 now contains Y^R and Y^U plus government consumption as in the preceding case. The results reported in this section are broadly in line with those of Basile et al.(2016) which study the effects of both spending and

[11]In the case of Cloyne there are 72 tax cuts and 41 tax increases while in RR tax cuts are 23 and tax increases are 22.

taxation in a different empirical framework.

In figure 4 I plot the IRFs to one 1 percentage point increase in taxes as a percentage of GDP of regular and unreported output. As expected, a larger tax rate triggers an increase in unreported output: after the shock, unreported production rises to reach its peak after one year, where the increase is of 15% statistically different from zero. As it can be observed on the plotted IRF the confidence interval is not tight around this value reflecting the fact that the proxy for the underground economy is not perfect. However, the results point to positive and sizeable change in response to a tax increase. The regular component of output follows an opposite path: it decreases following the shock to reach its lowest level (-3.4%) after 5 quarters. This estimate is very close to the results obtained for the UK and the USA.

High tax burdens are usually considered one of the main causes of tax evasion, since it induces taxpayers to expose smaller amounts of their revenues. The evidence presented in figure 4 supports this hypothesis. These results suggest that the tax increase induces a reallocation among the regular and the unreported sector, causing its enlargement and, as a consequence, an increase in tax evasion. The mechanisms that might come into play are different. In the case of corporate taxation the resource reallocation might be cause by the higher net expected returns from the underground production. When considering taxes on personal income the effect might operate through a labour-supply channel: the tax increase makes the the net-wage gap differential larger pushing household to relocate their labour services to the underground market. Also, this analysis supports the idea that changes in taxation involve both components of GDP: omitting the underground economy does not allow to correctly evaluate the effects fiscal shocks. To verify the coherence of the obtained results, I compare the IRF estimated in the first model with those of the second one. I compute the weighted average of the IRFs of the underground and observed economy and sum them to compare the resulting function with the one estimated on total output. As can be observed in figure 5 in the appendix the weighted average IRF corresponds to the one of total GDP. Finally, in keeping with the existing literature my results should be interpreted as the average effects of exogenous tax changes. Of course different taxes may have different effects.

6 Robustness checks

In this section I check whether the findings of the previous sections regarding the response of regular and unreported GDP are sensitive to some key aspects of the analysis.

I consider whether the results are affected by the lack of control for other structural shocks. To this end, I augment the VAR framework used above to control for monetary policy. The results are not affected by the inclusion of these controls and are very similar to the benchmark estimates. In addition, the dynamics of the underground sector are reported to be affected by the fraction of unemployed people in the population. For this reason I add unemployment as an endogenous variable to the model and proceed to the estimation. Once again, the estimates are robust to the change in specification.

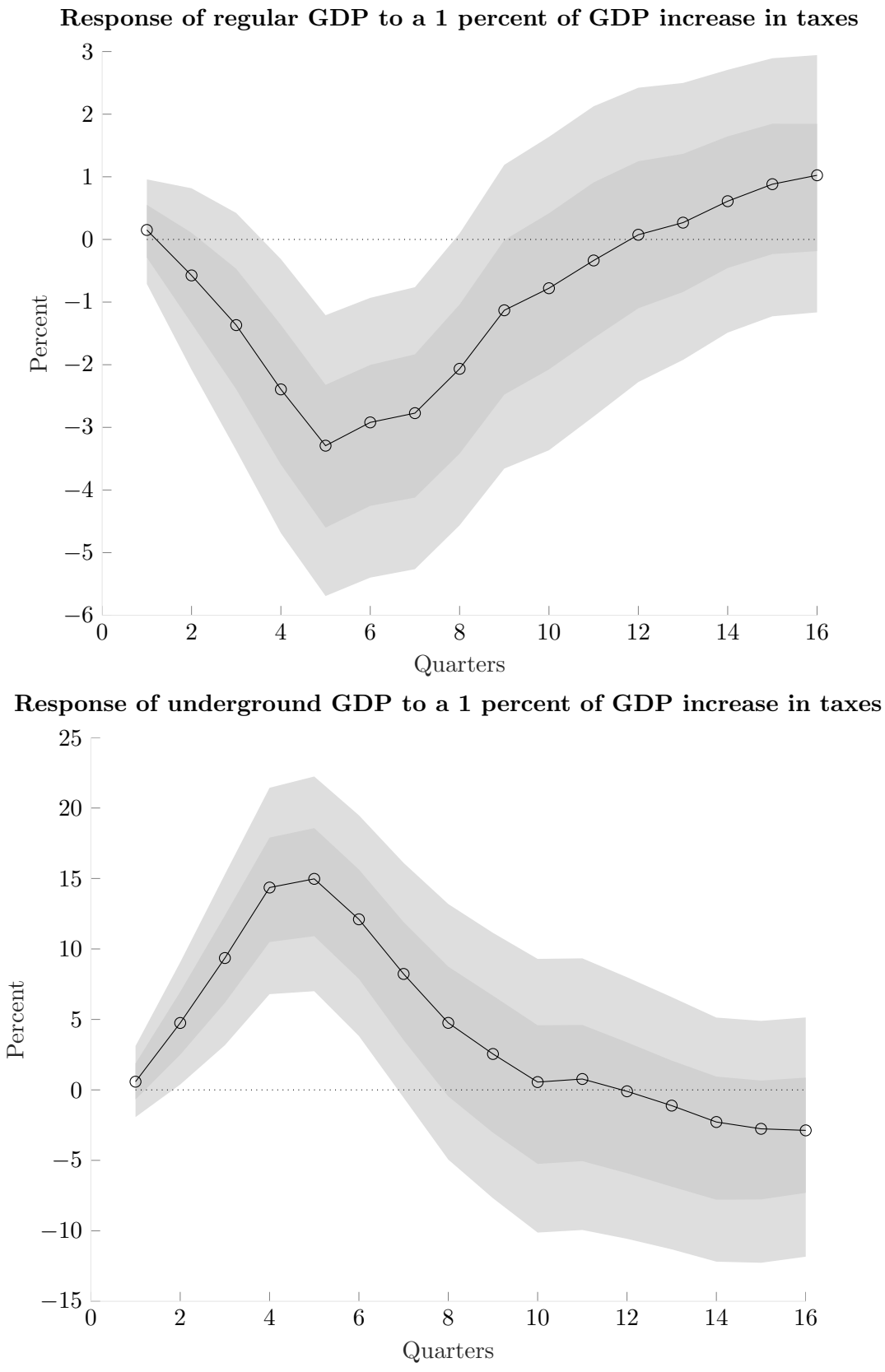

Figure 4: The effects of a tax increase on regular and unreported GDP

Another concern might relate to the size of the fiscal shocks recorded in the narrative data. The results may derive from particular tax changes rather than being robust across measure. High sensitivity to particular measures would reveal the results cannot be considered as general but are induced by some features specific to a single tax act. To examine this issue, I proceed by estimating the model eliminating from the sample those tax measures that entailed large changes in tax liabilities. The results for observed and unreported output are reported in figure 6 together with the benchmark estimates and their confidence interval. It shows that the main results are robust to eliminating large measures.

Finally, I check the sensitivity of the estimates to different values of P and Q and conclude that these different specifications do not affect the main estimation outcomes.

7 Conclusion

In the present time, many countries are facing very difficult situations: rising public debts that call for further deficit reductions. Many European countries had to consolidate their budgets relying heavily on the use of tax measures. The consequences of fiscal consolidations, especially if carried out through tax increases, need to be deeply understood.

This paper contributes to this to this issue by revisiting the effects of tax increases explicitly taking into account the dynamics of tax evasion. To this end I construct from scratch a new narrative dataset of legislated tax changes in Italy and carefully classify each measure to construct an exogenous tax shock. I then estimate the effect of tax changes on GDP and its two components (observed GDP and underground GDP) using two separate models. My findings are in line with the existing literature, pointing to a negative effect of tax increases on GDP and positive effect on underground production. Tax increases trigger a reallocation of output from the observed to the underground sector.

This aspect should not be overlooked because a larger size of the underground sector has several implications for welfare: it undermines the efficiency of the tax system and the achievement of social equity. Moreover, a growing irregular sector deteriorates production and competitiveness, bearing long terms consequences for growth.

Appendix A: NOE definitions

Starting from the 1990s, the national statistical institute of the OECD countries adopted some international definitions established through the SNA93 and SEC95 accounting systems, which provides a yardstick for national accounting estimates and guarantees homogeneity in the statistical evaluation of GDP. To provide a definition that makes the concept of underground economy comparable and fairly uniform across European community members Eurostat has provided details on how to account for the non observed economy (NOE). Its different components are the following:

- underground economy: regard legal production which is unofficial and unrecorded in order to avoid compliance with taxation, social security, labour and administrative legislation.
- informal economy: includes all legal activities carried out by individuals, small or home enterprises (part-time secondary work, babysitting and so on) and goods and services produced and consumed within the household.
- illegal economy: includes all criminal economic activities such as trade of illegal drugs, prostitution, etc.

In this paper the focus is on the underground economy as defined above, and does not include informal or criminal activities.

Appendix B: Data definition and sources

Specific definitions of the other macroeconomic data used in the main paper can be found in table (2). Per capita variables are the real chained volume measures, seasonally adjusted, divided by population. Log variables are multiplied by 100 so that the log change in a variable is a growth rate expressed in per cent (the tax variable is a percentage).

ISTAT released in 2011 a series covering the perios 1980-2011. No updated series going further than 2011 is currently available. The series of Basile et al(2016), which reconstruct the values for the underground economy are available from 1980 Q1 to 2006 Q3. The estimates are performed on this last sample and robustness checks are carried out for the larger sample when possible.

Series	Source	Description
Output	ISTAT	GDP
Nominal Output	ISTAT	GDP in current prices
Underground output	Basile et al.(2016)	Estimates of underground production
Regular output	Basile et al.(2016)	Ttotal - underground output
Consumption	ISTAT	Household consumption expenditure
Investment	ISTAT	Gross fixed capital formation
Imports	ISTAT	Total imports
Exports	ISTAT	Total exports
Interest rate	FRED	3-Month or 90-day interbank rate
Population	OECD	Total population

Table 2: Data sources and description

Appendix C: Weighted average

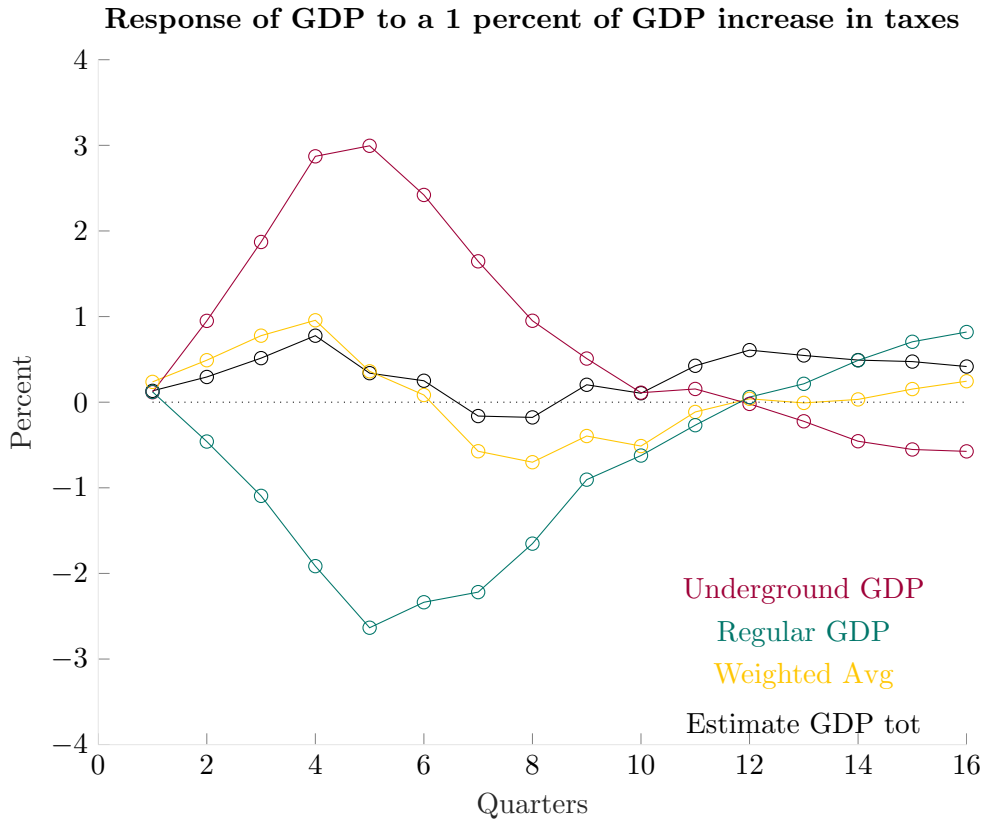

Figure 5: The effects of a tax increase on total GDP and the weighted average IRFs

Appendix D: Robustness checks

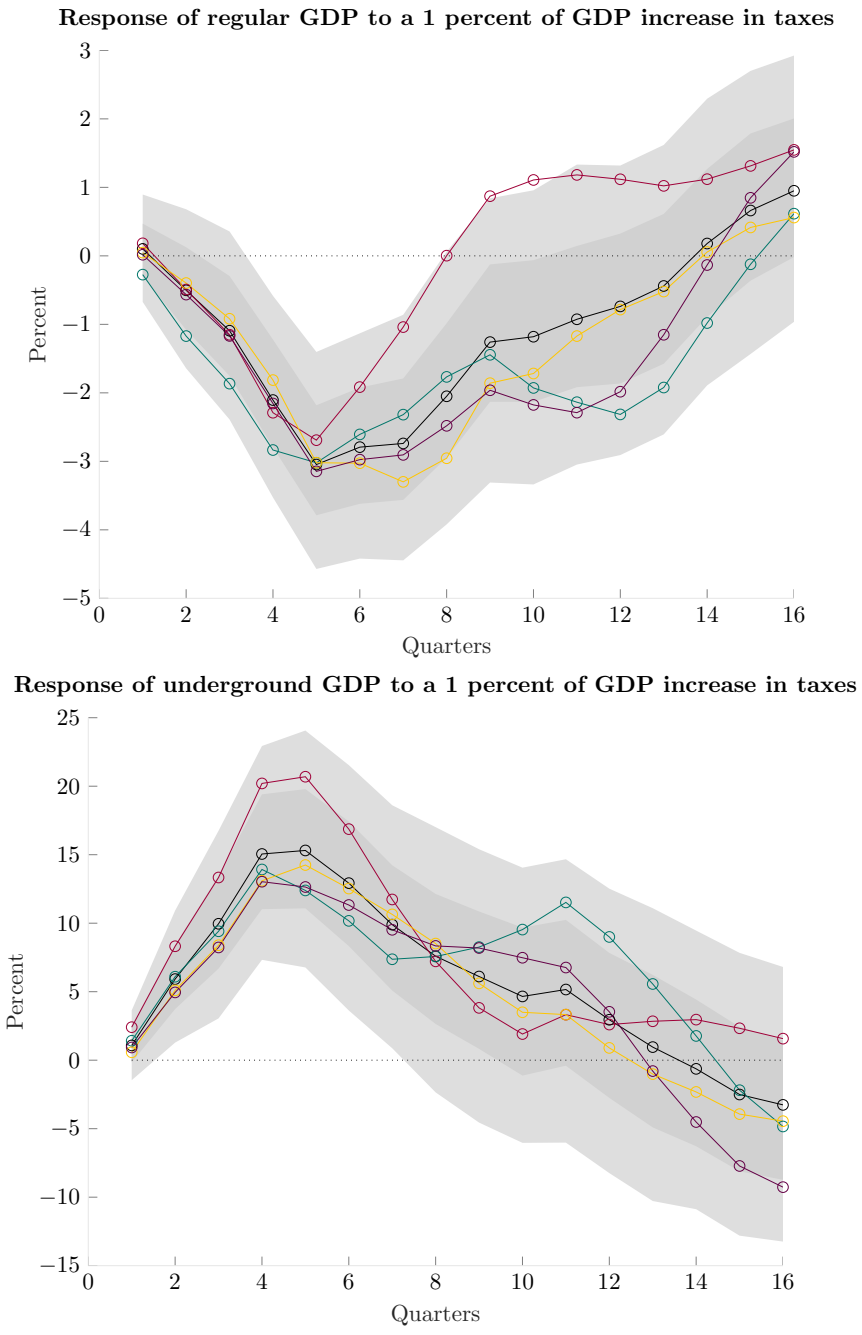

Figure 6: The effects of a tax increase on regular and unreported GDP

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