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Working Paper · February 2016

DOI: 10.13140/RG.2.1.3671.2729

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February 2016

**THE GROWTH AND VARIABILITY OF LOCAL TAXES:
AN APPLICATION TO THE ITALIAN REGIONS**

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THE GROWTH AND VARIABILITY OF LOCAL TAXES: AN APPLICATION TO THE ITALIAN REGIONS

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This version: 03rd February 2016

Abstract

This paper investigates the short- and long-run responses of tax bases used by sub-central governments with regard to regional GDP. The methodology is applied to the two main taxes levied by the Italian regions over the period 2001-2012, the surtax on the personal income tax (RPIT) and the regional tax on productive activities (RTPA). Our results suggest that both tax bases do not exhibit long-run potential growth and that they are pro-cyclical. Furthermore, this pro-cyclicity is higher in the case of RTPA and during recession periods in all regions. The results cast some doubts on the adequacy of these two bases to provide an adequate financing source to provide health and other regional public services, normally highly demanded during business cycle contractions.

Keywords: Income elasticity, Regional tax bases, Error correction model, Italy

JEL Classification: H240, H250, H770, R500

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1. Introduction

In a unitary, and mostly centralized country, the central government assumes almost exclusive responsibility for fiscal policy, while in a federal or decentralised country tax and spending decisions largely become a responsibility shared by all levels of government ([Shah 2006](#)). The allocation of tax/spending responsibilities under a federal system entails that attention should be paid to the consequences for stabilization policies¹ and this is often done by assigning stable and cyclically less sensitive tax revenue sources and expenditure responsibilities to sub-national governments. Higher tax decentralization – also in unitary countries – may indeed give rise to new problems in terms of financial stability and of both automatic and discretionary stabilization policies. More generally, decentralisation may jeopardize national fiscal policies, thus endangering the country's macroeconomic stability ([Ter-Minassian 1997](#)), because of possibly uncoordinated and pro-cyclical local (and state) tax and spending policies ([Fedelino and Ter-Minassian 2009](#); [Rodden and Wibbels 2010](#); [Hines et al. 2010](#)).

These aspects go beyond the well-known equity and efficiency considerations about fiscal decentralization and imply a closer look into local tax systems and their potential long-term growth combined with short-term cyclical stability. According to the existing literature mainly referred to the American case ([Sobel and Holcombe 1996, 1997](#); [Sobel and Wagner 2003](#); [Felix 2008](#); [Fricke and Süßmuth 2014](#)), these two elements are crucial for each kind of sub-national taxes in a decentralized system wherein an expansion of spending programs as well as an extension of resources needed to finance them would be ensured.

A certain degree of correspondence between tax and expenditure domains at the local level is more relevant² especially when local spending is aimed at social and

¹ As argued by Musgrave (1969) in his seminal contribution, governments should focus on three main goals: macroeconomic stabilization, efficiency in resource allocation, and income distribution.

² More generally, according to the Second Generation Theory (SGT hereafter) of fiscal decentralization, expenditure decentralization decisions should be matched by an increase in taxing power of local governments. By this way, decentralization process based on local governments relying on their own resources would be more efficient than one based on intergovernmental transfers.

welfare purposes meeting different individuals' needs (e.g., health, education, a safe environment), a case in which the demand function has usually a strong countercyclical component. As a matter of fact, Sacchi and Salotti (2014) provide empirical support to this statement, finding that tax decentralization is positively correlated with, among others, healthcare and education local spending. This suggests that at the local level, the link between those who benefit from the programmes and those who finance them (for instance, through charges and user fees) is likely to be strengthened.

It is worth noting that part of the literature considers the properties of growth and stability of taxes as inversely related ([Groves and Kahn 1952](#); [White 1983](#); Ladd and Weist 1991; [Dye 2004](#)). However, in some cases, it has been demonstrated (e.g., [Dye and McGuire 1991](#); [Bruce et al. 2006](#)) that their correlation could basically depend on different institutional settings (e.g., more or less decentralization). Thus, the investigation on how this relationship may evolve across and within countries becomes important especially when the underlying conditions of decentralization change over time.

Indeed, although decentralization reforms have recently spread in several countries, testing the growth and variability of local taxes is a difficult empirical task, because international comparisons are quite problematic due to different contexts and institutional settings as well as to the lack of homogenous data. In addition, as noted by [Rodden and Wibbels \(2010\)](#), existing comparative studies emphasize the role of national tax-transfer systems as a whole in cushioning asymmetric regional shocks, but less is known about the cyclicity of sub-national tax policies. The recent sovereign debt crisis combined with the downturn in economic activity in many developed countries has contributed to increase the interest in investigating the role of local governments with respect to the business cycle in a framework characterized by many fiscal intergovernmental relationships.

As for the potential long-term growth of tax bases and tax revenues, comparing the elasticity of local taxes allows a determination of which tax performs better in areas characterized by different levels of per capita income, different income growth rates

and composition of the tax burden (i.e. direct *versus* indirect taxes).³ When changing taxes to generate additional tax revenues, government officials and public policymakers should consider the implications of such revisions on the long-run expected growth and volatility of tax revenues (Sobel and Wagner 2003).

For what concerns the stability issue, instead, it would be useful to evaluate the short-run deviations with respect to the estimated trend of the economic growth, in order to provide an efficient ranking of alternative forms of taxation. Such information is necessary to guarantee the stability of a decentralized system and to decide whether the structure of local taxation should be highly concentrated on a few large tax bases or spread over many taxes, as well as to choose among different degrees of progressivity. Moreover, as the possibility of decentralized governments to use rainy day funds under adverse economic conditions will tend to decrease gradually, the question whether to use less cyclical and more stable taxes deserves a lot of attention, especially when important spending programs have to be financed.

To the purpose of integrating and expanding the previous studies on the topic, this paper estimates the short- and long-run income elasticity of Italian regional taxes – the surtax on the personal income tax (RPIT) and the regional tax on productive activities (RTPA) – over the period 2001-2012 through an error correction model (ECM), taking into account also geographical and socio-economic differences. This method allows us to draw useful policy implications for a sustainable sub-central tax structure and for a suitable spending assignment across lower tiers of government. The focus on regions is justified by the fact that, even though certain degree of taxing power have been recently left to Provinces and Municipalities, the major relevant changes have been referred to regions (e.g., the Legislative Decree 56/2000; the Constitutional Law 3/2001; the Law 42/2009; the Legislative Decree 68/2011). Our results show that the two main taxes may have undesirable characteristics for both long-run growth and for cyclical reactions, casting some doubts on their adequacy to provide stable tax flows to finance local public services. Moreover, it is also shown that recession times may have even higher undesirable impacts in all regions, especially in the case of RTPA.

³ Usually, corporate income taxes experience the greatest short-run variability, followed by personal income taxes, sales taxes, and excise taxes (see Sobel and Holcombe 1996, 1997; Garrett 2009).

The rest of the paper is organized as follows. After a brief review of the related empirical literature in Section 2, a description of the main characteristics of the tax structure in Italian regions is provided in Section 3. Section 4 explains the empirical strategy, data and variables, while Section 5 discusses the results. Finally, Section 6 concludes and provides some policy implications.

2. The review of empirical studies

The elasticity of tax revenues plays a crucial role in monitoring and forecasting public finances.⁴ This is obviously important at a central level, but even more important at a sub-central level, where tax sources are usually limited and applied only to specific tax bases. Despite its importance, the empirical evidence on the estimation of tax revenue elasticities is relatively sparse and the issue not widely analysed.⁵

In general terms, it is possible to identify three different concepts of tax elasticities (Koester and Priesmeier 2012). The first is the *tax base elasticity (TBE)*, by which the dynamic of tax revenues is investigated on the basis of the changes between the corresponding tax bases and some macroeconomic variables, such as the GDP (Bruce et al. 2006). The second concept is the *tax revenue elasticity (TRE)* with respect to macroeconomic variables, which explains the dynamic of revenues directly on the basis of the relationship between tax revenues and a measure of aggregate income (Acquaah and Gelardi 2008). The third, is a different concept of *tax revenue elasticity* measured against the dynamic of the corresponding tax bases (Bouthevillain et al. 2001).

In order to analyse the variability of state and local taxes, different approaches can be followed. A traditional way is to adopt the portfolio theory (Markowitz, 1952; Felix,

⁴ As an example, the methodology by OECD (see Girouard and André 2005) to calculate countries' cyclically-adjusted budget balances is based on the estimations of tax revenues elasticities. It also takes into account new tax reforms which have modified the sensitivity of tax receipts with respect to the tax base as well as methodological innovations to ensure greater cross-country consistency in the estimates of tax base elasticities.

⁵ In the same vein, both the OECD National Accounts and the IMF Government Finance Statistics provide cyclically-adjusted balances (CAB) for general government only, whereas CABs are not available for separate government levels.

2008) whose general idea is that states choose from a variety of tax instruments (e.g., general sales taxes versus excise taxes, personal versus corporate income taxes, property taxes, etc.), differently responding to upturns and downturns in the economy. According to this approach, analogously to financial portfolios, the growth and volatility of state tax revenues would depend on the composition of each state's tax portfolio. More recently, this approach has been followed by [Garrett \(2009\)](#), who evaluates how closely a state's revenue portfolio is built to minimize the overall variability in total state tax revenue in the United States. In the same vein, Cornia and Nelson (2010) argue that local policy-makers should carefully anticipate the possible impacts of tax changes on the long-term growth and volatility of their tax portfolios, as their choice of some tax parameters (e.g., tax bases and tax rates) may alter the tax revenue growth and volatility. To this purpose, they also suggest that local governments should change the composition of their tax portfolios to minimize the impact of the business cycle especially in the short-run. As a consequence, local governments need to consider the natural tendencies of their economies when formulating tax policy. On the other hand, local governments are often severely constrained in their choice of tax instruments, which reduces the relevance of the portfolio theory for local tax financing.

With such constraints, the relevant question becomes that of investigating the tax revenue variability with respect to the taxes that local governments can actually apply. Put differently, the analysis moves from the *optimal* set of taxes that should be chosen by local governments (as implicit in the portfolio theory) to the consequences that the business cycle may have on the taxes that local governments are allowed to apply. To this last purpose, it is a more common approach to investigate the tax revenue variability on the basis of regression analyses, where either tax base or tax revenue elasticities are calculated ([Williams et al. 1973](#); [Sobel and Holcombe, 1996 and 1997](#)). In this field, [Dye and McGuire \(1991\)](#) examined the elasticity and stability of both the personal income taxes and sales taxes, concluding that both tax structures vary significantly, and that both flat and progressive income taxes are likely to grow faster than either a broader or a narrower-based sales tax. However, [Dye \(2004\)](#), for the US, highlighted that the excessive cross-state variation in cycles and tax structures does not allow to draw any stable conclusion in terms of short-run elasticity.

Other studies have analysed the relationship between tax elasticities and variables other than the business cycle. [Craig and Heins \(1980\)](#), for example, introduced the idea that the tax elasticity may drive public spending, and verified that the level of public spending by state governments in 1970 and 1975 were positively related to the level of tax elasticities in most US states. In [Wolswijk \(2009\)](#), instead, the short and long-run behaviours of tax receipts in the Netherlands in 1971-2005 are examined with respect to their corresponding tax bases. It emerges that short-term elasticities may deviate from long-term ones (with differences being large especially in “bad times”) and that significant differences in the elasticities of the Value Added Tax and of the corporate income tax may occur. In the same vein, [Tosun and Abizadeh \(2005\)](#) – even though focusing on the national level – provide evidence that different taxes respond differently to the growth of per capita GDP in some OECD countries over the period 1980-1999. While the shares of personal and property taxes seem to positively react to economic growth, the shares of the payroll and goods and services taxes show a relative decline, which implies that economic growth may have a significant impact on the tax mix in advanced economies. Following the same reasoning, [Hou and Seligman \(2010\)](#) employ a panel dataset of the counties in Georgia to investigate the effects of consumption taxes on the long- and short-run volatility of local tax revenues. The main result is that a permanent substitution of property taxes with consumption taxes amplifies the variability of own-source revenues.

The recent global financial and economic crisis has encouraged the analysis of the volatility of tax revenue in downturn and of how this impact may spread across government levels. [Hines et al. \(2010\)](#), for example, study the effects of state, local and federal taxes in the US during the period 1947-2010. His findings suggest that per capita federal tax collections tend to decline in years in which the economy performs poorly, whereas state and local tax collections are much more stable. More recently [Fricke and Sussmuth \(2014\)](#) analyse the trade-off between growth and volatility of tax revenues in Latin America during the period 1990-2010. Their findings suggest that tax revenues above (below) the long-run equilibrium may react stronger (weaker) to business cycle dynamics. [Liu and Poplawski-Ribeiro \(2015\)](#) also estimates short-and long-run fiscal elasticities with respect to various cyclical factors for more than 90 countries. They find that revenue elasticities with respect to real GDP on average are

greater than one in the short-run, and greater in developing countries than in advanced economies both in the short- and long-run.

To the best of our knowledge, instead, there are no studies that have analysed the impact of the economic cycle on the variability and stability of local taxes in Italy. In our view, there are at least three good reasons to perform this analysis. First, Italy has a dual economy with very different growth path across Northern and Southern regions, which means that the same cycle may cause asymmetric impacts in different areas. Second, Italy is a country that has significantly suffered the recent economic crisis, which provides a good laboratory to test the performance of the main regional taxes. Third, Italian regions have a constrained set of tax instruments – whose parameters are mostly determined at the central level – that might turn to be suboptimal for the purpose of reducing variability in the short run and insuring stability in the long run.

3. Regional taxes in Italy: normative features and trends

The main taxes applied by the Italian regions are the regional tax on productive activities (RTPA) and the regional personal income tax (RPIT).⁶ RTPA is applied to all taxpayers engaging in a productive or professional activities.⁷ Its tax base is determined by the net value of local production, where the deduction of both financial costs (interest payments) and labour costs (wages, salaries, social security contributions) is not allowed, even though capital and labour are used as inputs in the production process. To this respect, RTPA differs from the corporate income tax (also applied in Italy at the central level), as the former is based on the definition of the value added (net of depreciation), while the latter falls only on profits (which is only part of the value added calculated for RTPA purposes).

RPIT, instead, is a surtax on personal incomes levied at the regional level and applied to all taxpayers who pay the central personal income tax. Both taxes have been introduced in January 1998 (Legislative Decree n. 446/1997), with some degree of autonomy left to regions to set tax rates and, to a less extent, tax bases.

⁶ *Irap* and *Addizionale Regionale IRPEF* in Italian.

⁷ This tax is also applied to all public entities (State, Regions, Provinces and Municipalities).

In 2009 (according to the latest data available from the *Institute for the Study of Regionalism, Federalism and Self-Government*, ISSiRFA from now), Ordinary Statutory Regions (OSR)⁸ had own taxes generating more than 46 billions of euro and representing 42 per cent of the current total tax revenues at the regional level. Among them, RTPA for both the public and the private sectors is the most important tax source, as it provides more than 32 billions of euro, which means about 70 per cent of the total regional taxation.⁹ RPIT, instead, provides 6.8 billions of euro, representing 15 per cent of the total. Other minor taxes (the vehicle tax, the additional tax on consumption of natural gas, the regional tax on tertiary education, etc.) complete the framework. From this preliminary picture, it emerges a fairly rigid tax structure at the regional level, that concentrates about 85 per cent of the total regional taxes in two items, RTPA and RPIT.

As for the current handling of such taxes, it is worth recalling that regional governments have limited fiscal autonomy, as they can vary only the tax rate of RTPA and RPIT within narrower bounds and without any power to determine their tax bases.¹⁰ In the period covered by our analysis, regions must apply the taxes (i.e. they cannot choose to not apply them) and can choose to vary the base rate of one percentage point in both directions in the case of RTPA (giving a minimum tax rate of 2.98 per cent and a maximum tax rate of 4.82 per cent)¹¹ and of 0.5 percentage points upwards for RPIT.¹² On the other hand, for the private component of RTPA, regions have the possibility to vary the tax rate for specific categories of taxpayers (e.g., tax

⁸ We mainly focus on the OSR as the Special Statutory Regions (SSR) are characterized by different financing mechanisms mostly based on the devolution to these regions of all taxes collected in their territories. However, we include the SSR into the empirical analysis also for robustness purposes.

⁹ On average, the public RTPA provides 25 per cent of total revenue, with a peak of 32 per cent in Lazio, where the bulk of the public administration is located. It is applied with a fixed rate of 8.5 per cent, in this way differing from the standard rule for RTPA on private activities.

¹⁰ In addition, even without direct target constraints on the revenues from such taxes, their amounts are basically addressed to finance regional health needs, so representing a compulsory component of citizens' tax burden.

¹¹ Percentages slightly different from both the ordinary minimum and maximum values (2.9% and 4.9%, respectively) are due to the conversion procedure occurred between 2008 and 2009, when the base tax rate decreased from 4.25% to 3.90%. Thus, the reduction in the range of variation - calculated according to the ratio between 3.90% and 4.25% - would go from 1 to 0.92 percentage points.

¹² Actually, the opportunity to change the tax rate has been seldom used until 2004, as regions have been prevented by the Financial Law (L. 289/2002, L. 350/2003 and L. 311/2004) to increase both RTPA and RPIT, a limit that has been removed from 2004.

relief for non-profit organizations, new and young firms, social cooperatives, agricultural firms, banking and financial sectors) and to make decisions on other aspects of the tax administration.

However, even though a certain degree of autonomy has been recognised to regions by a number of federalist reforms, the effective power and control that regional governments may exercise over their tax revenues is severely limited, also according to international standards (for further details see Blöchliger and Nettley 2015). As highlighted by OECD (1999), tax autonomy is the greatest if sub-central governments are free to determine both the taxable base and the rates of a tax, without any aggregate limits on revenues, base or rate enforced by the central government. It is clear that neither RTPA nor RPIT fulfil these conditions. This characteristic can have negative implications for the tax burden at the regional level. In particular, it may generate the undesirable outcome that changes of the regional tax burden may not be wholly due to discretionary tax policies by sub-central governments, but to automatic increases of tax rates of RTPA and RPIT imposed by the central government to cover central needs. As a matter of fact, both taxes are strictly linked to the financing of the National Health Service (NHS), which means that the central government can impose the automatic application of the maximum tax rate of both taxes in any Region in the case of health deficits (some notable examples are Lazio, Liguria, Campania, Abruzzi and Molise in 2007). As a suboptimal consequence, the share of tax revenue in many regions is not determined by autonomous policy choices, but mostly owed to the central government's fiscal needs.

If one adds that the duality of the Italian economy determines a rather unequal distribution of tax yields across regions, it becomes clear that the rigidity of the structure of local taxes introduces some significant asymmetries in the ability of different regions to provide an adequate level of services. For example, RTPA is unequally distributed among regions reflecting the high concentration of industries and productive activities in the Northern part of the country, as well as a high degree of tax evasion. In terms of per capita tax revenues, the richest region collects about four times as much resources than the poorest one (Braiotta *et al.* 2012). A similar trend – even though at a reduced scale – emerges also for RPI, which only partly depends on the different tax effort provided by regions.

4. The empirical analysis

4.1. *The model specification*

The empirical analysis employs a balanced panel of 20 Italian regions for the period 2001-2012. To estimate both short- and long-run responses of the tax bases of RTPA and RPIT to regional GDP, an error correction model (ECM) is used that has been widely applied in the literature to calculate the income elasticity of tax revenue (e.g., Wolswijk 2009). The model considers both levels and changes of the relevant variables in order to identify both the long-run growth potential and the short-run cyclical variability of a tax base through a single equation (for similar application of the ECM on Italian regional data and small time span see recently Grisorio and Prota 2013, 2015). Indeed, if income and tax bases are non-stationary in their levels – as it usually happens – the estimated coefficients of variables in levels would provide only the long-run relationship between income and tax base (see Sobel and Holcombe 1996). Thus, a second regression based on stationary versions of the same variables should be implemented to obtain the short-run relationship.

It is important to highlight that in short-run estimations, elasticities can be biased by the presence of an error correction ([Engle and Granger 1987](#)), due to the fact that two non-stationary variables, having a long-run relationship, will tend to move back together whenever they get too far apart.¹³ To overcome this issue we assumed one lag as the appropriate timing of adjustment, and a disequilibrium relationship involving first-order lags of both endogenous and exogenous variables in order to give the following ECM model for a cross-section ($i = 1-20$) time-series ($t = 2001-2012$) analysis:¹⁴

¹³ In other words, one variable can move up in the same period during which another is moving down simply because the variables deviated from the levels implied by their long-run relationship.

¹⁴ Equation (1) is obtained by adding the error-correction term derived from a long-term equation – where variables are considered in levels – to a short-term equation – where variables are considered in differences – suggesting that deviations from the long-run tax base path may have an impact on short-term tax base.

$$(1) \quad \Delta \ln(TB_{it}) = \delta_1 \Delta \ln(Y_{it}) + \delta_2 [\Delta \ln(Y_{it})]^2 + \lambda_1 \ln(Y_{it-1}) + \lambda_2 [\ln(Y_{it-1})]^2 + \theta \ln(TB_{it-1}) + \sum_{j=1}^s (\gamma_j \Delta Z_{jit}) + \sum_{j=1}^s (\omega_j Z_{jit-1}) + \alpha_i + \tau_t + \varepsilon_{it}$$

Where TB_{it} is the regional per capita tax base in logarithmic form; Y_{it} is the per capita regional GDP in level and its square to deal with possible nonlinearity between tax bases and regional GDP, both in log-form; Z_{it} includes a set of control variables (described in paragraph 4.2); α_i and τ_t capture, respectively, region and time fixed-effects; ε_{it} is the error term.

As suggested by Wickens and Breusch (1988) for small samples, and by [Banerjee et al. \(1986\)](#) for multivariate models, the $\hat{\delta}$'s estimated coefficients directly provide the short-run responses. Thus, the short-run income elasticity of a tax base in each region i can be obtained as follows:

$$(2) \quad \eta_i = \hat{\delta}_1 + 2\hat{\delta}_2 \Delta \ln(\bar{Y}_i)$$

where $\hat{\delta}_{1,2}$ come from the estimation of equation (1) and $\Delta \ln(\bar{Y}_i)$ is the difference of average GDP per capita (in log) in region i over the period 2001-2012. Equation (2) directly derives from the inclusion of the squared term in equation (1) and allows measuring different elasticities across regions, which measure the cyclical component of the tax base variability. A η_i greater than one indicates that the tax base fluctuates more than regional income over the business cycle, indicating a potential greater sensitivity of the corresponding tax revenues. The opposite holds true when η_i is lower than one.

The estimation of the long-run income elasticity, for each Region, can be recovered by the following expression:

$$(3) \quad \phi_i = - \left[\frac{\hat{\lambda}_1 + 2\hat{\lambda}_2 \ln(\bar{Y}_i)}{\hat{\theta}} \right]$$

where $\hat{\lambda}_{1,2}$ is obtained from equation (1), $\ln(\bar{Y}_i)$ is the average per capita GDP (in log) in region i , and $\hat{\theta}$, the estimated coefficient of the lagged dependent variable in equation (1), represents the speed of adjustment towards the long-run equilibrium. When ϕ_i is greater than one, it means that the tax base grows faster than the regional income, suggesting a more rapid convergence towards the long-run equilibrium.

It is worth recalling that the use of the ECM is allowed when the degree of integration of the variables are different from $I(0)$. If all series were stationary, the distinction between long- and short-term relationships would be superfluous and meaningless. Thus, the estimation of equation (1) requires the relevant series to be non-stationary in levels and stationary at some difference.

Some preliminary panel unit roots tests should be performed such as those developed by Harris and Tzavalis (1999) for balanced panel and by Im *et al.* (2003) for unbalanced panel. These tests are particularly useful when the number of time periods (T) is fixed and small (less than 10 or 15 as in our case), as they allow small-sample adjustment to T (see Hlouskova and Wagner, 2006 for an overview of the types of panel unit root tests). However, both previous tests assume that the individual time series in the panel were cross-sectionally independently distributed. To some extent, this is a restrictive assumption, particularly in the context of regional (and cross-country) regressions (see [Pesaran, 2007](#)). To partly remedy this shortcoming, the series have been cross-sectionally de-measured before performing the unit root test.

4.2. Data and variables

As for the dependent variable (TB_{it}), we consider both the actual tax base of the private component of *RTPA* and the actual tax base of *RPIT*. In both cases, the dependent variables are expressed in per capita terms and logarithmic form. The choice to calculate the tax base elasticity is supported by a general agreement emerged on using the tax bases as dependent variables to deal with the growth and variability of sub-central tax instruments (e.g., [Groves and Kahn 1952](#); [Wilford, 1965](#); [Mikesell 1977](#); [Sobel and Holcombe 1996](#); [Bruce et al. 2006](#)), especially for the non-negligible advantage to eliminate distortions linked to the measurement of effective tax rates and

their changes.¹⁵ Our data on tax bases come from the *Italian Revenue Agency* (they are available until 2011 for *RTPA*; until 2012 for *RPIT*), while data on regional population used for the per capita normalisation come from the *Italian National Institute of Statistics*.

It is worth noting that since the cyclical movements of output can systematically affect regional tax bases, cyclically-adjusted tax bases are used with the aim of factoring out the cyclical effects from conventional measures.¹⁶ To this purpose, our tax bases have been decomposed into ‘trend’ and ‘cycle’ by using the Hodrick and Prescott (1997) filter to remove seasonal components. Once the tax bases have been decomposed into trend and cycle, co-movements between the cyclical components of the tax base and the cyclical component of output can be obtained and used to correct tax bases.

Among the right-hand side variables, we include the log of per capita regional GDP (Y_{it}) in level, while its square is introduced to capture the potential nonlinear relationship between tax base and income. Unlike some previous studies (mainly on the US), sub-central income is included rather than national income, with the aim of capturing potential deviations of regional business cycles from the national one. Data on regional GDP come from the *Italian National Institute of Statistics*.

Finally, a set of control variables (Z_{it}) takes into account for the external factors potentially influencing the *RTPA* and *RPIT* tax bases. To deal with this issue, we control for different characteristics. First, particularly important for the dynamic of *RPIT* that mainly falls on labour incomes, the *working age population* at the regional level is introduced (measured by the share of population between 15 and 65 years old over total population). As a by-product, this measure also controls for the characteristics of the socio-economic context. Second, for the specification considering *RTPA*, the share of *self-employees* over total population is considered. The reason is that *RTPA* is directly paid by self-employed and entrepreneurial incomes and not by

¹⁵ Others consider, instead, tax revenue as dependent variable in order to investigate the short- and long-run behaviours of tax receipts with regard to their tax bases ([Fox and Campbell 1984](#); [Dye and McGuire 1991](#); [Felix 2008](#); [Cornia et al. 2010](#)).

¹⁶ Indeed, if a regional tax base is larger simply because the economy is going through an expansionary phase of the business cycle, and tax revenue is consequently higher, tax base figures should somehow be adjusted to allow for the effects of the business cycle on them. More generally, disregarding the simultaneity between fiscal policy and the business cycle can result in larger elasticities of revenues and expenditures as well (Boije 2004).

dependent workers. Since the distribution of self-employed people and productive activities is rather unequal across regions, this variable indirectly controls for the influence of the composition of the working population. Third – and again because of the characteristics of *RTPA* – the regression also controls for the regional density of firms (the *number of firms per squared kilometre*). The very unequal distribution of productive activities between the North and the South may in principle affect the estimated elasticities. Finally, a dummy to include the *central government's discretionary interventions* in the case of *RTPA* and of *RPIT* is also introduced to isolate the factors that are not under direct controls of regional governments. It is worth recalling that both *RTPA* and *RPIT* are set by the central government and that a limited autonomy is left to regional governments.¹⁷

All these variables are expressed in logarithmic form and come from the *Italian National Institute of Statistics*. In addition, region-specific time-invariant effects (λ_i) are also included to catch unobservable regional specific patterns and mostly to control for time-fixed determinants of such tax bases (e.g., institutional factors). More specifically, time-fixed effects (τ_t) are used to control for national shocks that may affect more than one Region at the same time. Finally, as the error term (ε_{it}) is likely to be serially correlated as well as cross-sectionally correlated, we use a fixed-effect estimator which is robust to heteroskedasticity, cross-sectional dependence and autocorrelation up to some lags (see Section 5.4 for details). Table 1 contains descriptive statistics of the variables.

Insert Table 1 about here

5. Results and discussion

The empirical assessment of short- and long-run responses of *RTPA* and *RPIT* to regional GDP consists of four steps. In the first step, the focus is on testing the presence of cross-sectional dependence in our data. In the second step, we control for stationarity using the unit roots Pesaran test ([Pesaran, 2007](#)). The third step requires to

¹⁷ Some examples refer to the correction of health deficits in southern and central regions (see Section 3 for details).

investigate the cointegration between regional GDP and the two tax bases using the Westerlund test ([Westerlund, 2007](#)), which is recommended especially in the case of cross-sectional correlations (if any). Finally, the fourth step will show and discuss the ECM results.

5.1. *Cross-Sectional Dependence Test*

As a first step of the empirical analysis, it is important to check the presence of cross-sectional dependence. This test is fundamental to control for unobserved common factors that heterogeneously affect each cross-section unit and that, when correlated with the regressors, lead to inconsistent estimations of the regression coefficient. This issue is here investigated by implementing the most commonly used test for cross-sectional dependency ([Pesaran, 2004](#)). Table 2 reports the results of the CD-test, which allows for the computation of the test statistics both when variables are individually considered and when multiple variable series are tested at the same time. Our findings suggest that the null hypothesis of cross-sectional independence is rejected for all variables under investigation.¹⁸ This outcome requires to proceed by testing for unit root and for the presence of cointegration, and finally estimating cointegrating relationships with cross-sectional dependence.

Insert Table 2 about here

5.2. *Unit Root test*

In order to correctly apply the ECM, a test of stationarity is required. To this purpose, we use the “second generation” of unit root tests that take into account the presence of cross-sectional dependence.¹⁹ More specifically, we use the Pesaran (2007) unit root test

¹⁸ Similar results are obtained when multiple variable series are tested at the same time and the same CD-test is applied to the group of variables included in the specifications under investigation. These results are not reported in the paper but they are available upon request.

¹⁹ Indeed, there are also the panel unit roots test proposed by Im *et al.* (2003), the IPS test, and by Breitung (2000), but those do not account for cross-sectional dependence in the data. Hence, they cannot be employed in our case.

(the CADF test) on levels and first differences (with intercept only and trend).²⁰ As in this case the size of T is fixed (and is not large enough to rely on asymptotic properties), the test is applied to the deviations of the variable from the initial cross-sectional mean, by this way assuring that the CADF statistics do not depend on the nuisance parameters. Overall, Monte Carlo simulations have shown that the cross-sectionally augmented unit root test proposed by Pesaran (2007) performs well in small samples (Grisorio and Prota, 2015). Results reported in Table 3 show that the share of working population, the share of self-employees, the number of firms per square kilometre, and the per capita regional GDP are non-stationary in levels and stationary in first differences. Likewise, $RPIT$ and $RTPA$ are stationary in first differences.

Insert Table 3 about here

5.3. Westerlund cointegration test

The third step is to test for cointegration. In particular, it is required to test whether the two tax bases and the per capita regional GDP are cointegrated using the test developed by Westerlund (2007) that controls for cross-sectional dependence. Monte Carlo simulations suggest that the tests have good small-sample properties with small size distortions and high power relative to other popular residual-based panel cointegration tests. The null hypothesis of the Westerlund is the lack of cointegration; the alternative hypothesis depends on the specific test: the group mean test (Gt and Ga) and the panel test (Pt and Pa).²¹ We test two models: on the left side, we report the cointegration test between $RTPA$ and the per capita regional GDP; on the right side, we report the same tests for $RPIT$ and per capita regional GDP. In addition, we bootstrapped robust critical values for the test statistics related to the Westerlund ECM panel cointegration tests. Given that the Akaike optimal lag and lead search is time consuming when combined with bootstrapping, we kept the short-term dynamics fixed. Results are shown in Table 4. When we take into account cross-sectional dependencies, the tests, regardless of the specific statistic used, still reject the null

²⁰ We used the Akaike information criterion (AIC) to determine the optimal lag length.

²¹ For more technical details see also Persyn and Westerlund (2008).

hypothesis of no cointegration at the conventional significance level, which means that the model of equation (1) can be estimated with both alternative dependent variables.

Insert Table 4 about here

5.4. *The results of the Error Correction Model*

This section reports the estimations of the long- and short-run income elasticity of both tax bases (*RPIT* and *RTPA*) over the period 2001-2012 for each region after estimating equation (1) and taking into account the outcome of the previous tests. As the Pesaran (2004) CD test indicates that residuals are cross-sectionally correlated, we estimate the ECM using the fixed-effect estimator with the Driscoll and Kraay (DK) corrected standard errors, which is robust to heteroskedasticity, cross-sectional dependence and autocorrelation (Driscoll and Kraay, 1998). After observing the residual correlation over time, we use a two-lag correction for auto-correlated errors.²²

Table 5 shows the ECM estimations for *RPIT* and *RTPA*. Model 1 and Model 2 have *RPIT* as dependent variable, with the difference that Model 2 includes control variables that are instead excluded in Model 1. Analogously, Model 3 and Model 4 refers to *RTPA*, excluding and including control variables. Some things are worth noting.

Insert Table 5 about here

First, according to equation (3), a necessary condition for the long-run elasticity is the significance of the coefficients of the per capita regional GDP. The relevant coefficients are not statistically significant (with the exception of a weak significance in Model 1). This implies the rather negative outcome that there is no region where either tax base has a long-run growth potential. In other terms, from a policy perspective, neither *RPIT* nor *RTPA* are expected to provide growing flows of tax revenues in the Italian regions, and this occurs without differences between the more and less developed parts of the country. Even though one justification of this negative outcome may be that of considering a relatively short period of time (12 years), the results can

²² Results are also robust to increasing the lag-structure up to three (not reported in the paper).

nevertheless provide a useful basis for central and regional policy decisions. In particular, the strict link between these two taxes and the provision of the National Health Service suggests that over time additional funding would be required, given the likely increasing needs of the health sector led by an increasing older population. In more general terms, the absence of a long-run growth potential might compromise local public spending, if one takes into account the limited borrowing capacity of local governments and unless alternative financing sources, like central transfers, will become available.

Second, short-run elasticities, that are instead driven by the coefficients of changes of per capita regional GDP and its square, have statistical significance in all cases (with the exception of the squared term in Model 4). In particular, the significance of the squared term allows to calculate regionally differentiated average short-run elasticities, that are reported in Table 6. The first two columns show these elasticities for *RPIT* and *RTPA* over the whole period. All estimated elasticities are positive, which means that both tax bases are pro-cyclical in all regions. At the same time, since all short-run elasticities are below one, tax bases fluctuate proportionally less than regional incomes.

Of some interest for the Italian regional tax policy is the evidence that the cyclical response of *RTPA* is on average more than twice as much that of *RPIT*, with almost the same pattern in many regions. This outcome may to some extent suggest that *RTPA* is a less adequate financing source for local governments, especially if one takes into account the lower ability of local governments to smooth temporary deficits with borrowing instruments.

Third, the estimated average pro-cyclicality over the whole period may conceal different behaviours in expansionary and recession times. The economic situation of Italy in the period of analysis, with a deep recession started in 2008 and covering all the subsequent four years of the sample, provides a useful laboratory to investigate this issue. The four columns on the right hand side of table 6 indeed show the estimated short-run elasticities by two sub-periods (2001-2007 and 2008-2012) for *RPIT* and *RTPA*. As can be easily seen, pro-cyclicality is higher in recession times in all regions, which means that tax bases decrease proportionally more in recessions than what they increase in expansionary periods. To some extent, this asymmetry may exacerbate the insufficiency of these two tax bases to provide adequate financing sources for regional governments. Even in the case of *RPIT*, which is on average less reactive to the cycle,

the short-run elasticity in recession is twice as much the corresponding elasticity in the first sub-period, with bigger increases in the Southern regions.

This last observation paves the way to a fourth interesting outcome. Looking at table 6, one could conclude that differences among regions are not striking, and that the unequal distribution of tax bases across regions mainly affects the level of tax resources, rather than their behaviour with respect to the economic cycle.

Insert Table 6 about here

However, as one can observe from Figure 1 and 2, it is clear that the comparison of the short-run elasticities before and during the crisis has a territorial dimension. In particular, it emerges that before the crisis (i.e. in “normal” times), elasticities are greater in the Northern regions (the richest regions) both for *RTPA* and *RPIT*. At the contrary, when the sub-period of crisis is isolated, elasticities are greater in the Southern regions again for both taxes. This means that in normal times both tax bases grow faster in the North than in the South, while in bad times the tax bases fall faster in the South than in the North. This implies that neither tax contribute to stabilise the gap among Northern and Southern regions; rather, they contribute to widen it, implicitly burdening the central government of possible redistributive territorial policies.

Insert Figures 1 about here

Insert Figure 2 about here

6. Concluding remarks

This paper has shown that the two main taxes used by Italian regional governments, *RPIT* and *RTPA*, have not fully desirable characteristics in terms of long-run potential growth and reactions to the economic cycle.

Our analysis, based on a ECM, reveals first the absence of a long-run potential growth, casting some doubts on the ability of these two tax bases to provide stable tax flows over time. Second, both taxes exhibit pro-cyclicality, which is larger in the case of

RTPA and during recession periods in all regions, with the Southern regions potentially paying the highest price in bad times.

This accentuated pro-cyclicality and the absence of a clear evidence of a long-run potential growth are two critical issues of the system of regional financing, if one takes into account that both taxes are linked to the financing of the National Health Service in Italy. More generally, regional governments are responsible for public health and related functions which are more heavily demanded, normally, during business cycle contractions and adverse economic conditions.

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Tables

Table 1 – *Descriptive statistics*

Variable	Definition	Mean	Std. Dev.	Min	Max	Observations
<i>RTPA</i>	Regional Tax base on Productive Activities per capita (euro)	10582	3897	4423	20781	220
<i>RPIT</i>	Regional Personal Income Tax base per capita (euro)	10824	2839	5642	15502	240
<i>Regional GDP</i>	Regional GDP per capita (euro)	24005	5966	13742	35464	240
<i>Working population</i>	Share of population between 15 and 65 years old over total population in each region (%)	67.00	1.55	62.72	71.14	240
<i>Self-employees</i>	Share of self-employees over total population in each region (%)	10.64	2.10	6.32	15.16	240
<i>N firms</i>	Number of firms per squared kilometer in each region	18.05	10.45	4.00	41.00	240
<i>Discretionary CG on RTAP</i>	Dummy equal to 1 for central government's intervention on RTAP	0.25	0.43	0.00	1.00	240
<i>Discretionary CG on RPIT</i>	Dummy equal to 1 for central government's intervention on RPIT	0.17	0.37	0.00	1.00	240

Source: Authors' calculations

Table 2 – Cross-dependence tests

Variable	CD-test	p-value
<i>RTPA</i>	35.69	0.000
<i>RPIT</i>	43.97	0.000
<i>Regional GDP</i>	43.98	0.000
<i>Working population</i>	11.57	0.000
<i>Self-employees</i>	14.55	0.000
<i>N firms</i>	19.79	0.000

Note: CD-test presents the Pesaran (2004) cross-section dependence statistic which has a standard normal distribution and tests the null hypothesis of cross-section independence.

Source: Authors' calculations

Table 3 - Pesaran CADF test

Variables	Levels				First differences			
	<i>Intercept only</i>		<i>Intercept and trend</i>		<i>Intercept only</i>		<i>Intercept and trend</i>	
	Z[t-bar]	P-value	Z[t-bar]	P-value	Z[t-bar]	P-value	Z[t-bar]	P-value
<i>RTPA</i>	0.359	0.64	-1.396	0.081	-5.68	0.000***	-5.318	0.000***
<i>RPIT</i>	4.461	1	5.871	1	-2.275	0.011**	-1.347	0.089*
<i>Regional GDP</i>	-2.355	0.009***	-2.141	0.016	-7.354	0.000***	-7.652	0.000***
<i>Working population</i>	0.393	0.653	-0.051	0.48	-6.311	0.000***	-4.78	0.000***
<i>Self-employees</i>	-1.748	0.04	1.983	0.976	-4.241	0.000***	-4.178	0.000***
<i>N firms</i>	-2.036	0.021*	0.438	0.669	-5.89	0.000***	-3.494	0.000***

Note: The test is based on the unit root null hypothesis. ***, **, *: statistically significant at 1%, 5%, 10%, respectively.

Source: Authors' calculations

Table 4 - Westerlund panel cointegration test

<i>RTPA and Regional GDP</i>				
Statistic	Value	Z-value	P-value	Robust P-value
<i>Gt</i>	-5.019	-10.825	0.000	0.000
<i>Ga</i>	-17.286	-2.573	0.005	0.011
<i>Pt</i>	-16.514	-10.871	0.000	0.000
<i>Pa</i>	-17.428	-4.595	0.000	0.090

<i>RPIT and Regional GDP</i>				
Statistic	Value	Z-value	P-value	Robust P-value
<i>Gt</i>	-5.071	-11.531	0.00	0.000
<i>Ga</i>	-11.095	0.467	0.68	0.002
<i>Pt</i>	-17.328	-11.446	0.00	0.000
<i>Pa</i>	-11.124	-1.238	0.11	0.014

Note: The test regression is fitted with one lag and lead and the Bartlett kernel window width set according to $4(T/100)^{2/9} \approx 3$. P-values are robust critical values obtained through bootstrapping with 800 replications.

Source: Authors' calculations

Table 5 - ECM estimations for RPIT and RTPA

<i>Dependent variable</i>	<i>RPIT</i>		<i>RTPA</i>	
	Model 1	Model 2	Model 3	Model 4
<i>RPIT</i> _{<i>t-1</i>}	-0.44*** (0.12)	-0.46*** (0.12)		
<i>RTPA</i> _{<i>t-1</i>}			-0.38*** (0.075)	-0.37*** (0.076)
Δ <i>Regional GDP</i> _{<i>t</i>}	0.23*** (0.057)	0.23*** (0.054)	0.53*** (0.15)	0.52*** (0.13)
<i>Regional GDP</i> _{<i>t-1</i>}	3.60* (2.08)	2.50 (2.40)	0.59 (1.17)	0.85 (1.21)
$(\Delta$ <i>Regional GDP</i> _{<i>t</i>}) ²	-2.14*** (0.41)	-1.74*** (0.48)	-4.19* (2.15)	-3.97 (2.86)
$($ <i>Regional GDP</i> _{<i>t-1</i>}) ²	-0.17 (0.11)	-0.11 (0.12)	-0.021 (0.061)	-0.038 (0.064)
Δ <i>Working population</i> _{<i>t</i>}		0.20 (0.17)		
<i>Working population</i> _{<i>t-1</i>}		0.25 (0.33)		
<i>Discretionary CG on RPIT</i> _{<i>t</i>}		0.0045 (0.0034)		
Δ <i>Self-employees</i> _{<i>t</i>}				-0.023 (0.029)
<i>Self-employees</i> _{<i>t-1</i>}				0.040 (0.042)
Δ <i>N firms</i> _{<i>t</i>}				0.00091 (0.0044)
<i>N firms</i> _{<i>t-1</i>}				0.070 (0.13)
<i>Discretionary CG on RTPA</i> _{<i>t</i>}				-0.0034 (0.0047)
<i>Regional fixed-effects</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
<i>Time fixed-effects</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>	<i>Yes</i>
Observations	220	220	200	200
Number of groups	20	20	20	20

Notes: a) The table reports the regression coefficients and (in brackets) the associated Driscoll and Kraay (1998) robust standard errors, assuming a 2-lag autocorrelation structure of the error term. b) *=significant at 10%; **=significant at 5%; ***=significant at 1%. c) The dependent variable is the first difference of the regional per capita tax base in logarithmic form of region *i* in year *t* ($\Delta \ln(TB_{it})$). The constant and a set of year and regional dummies are included but not reported in the table.

Source: Authors' calculations

Table 6 - Short-run elasticities by regions and sub-periods

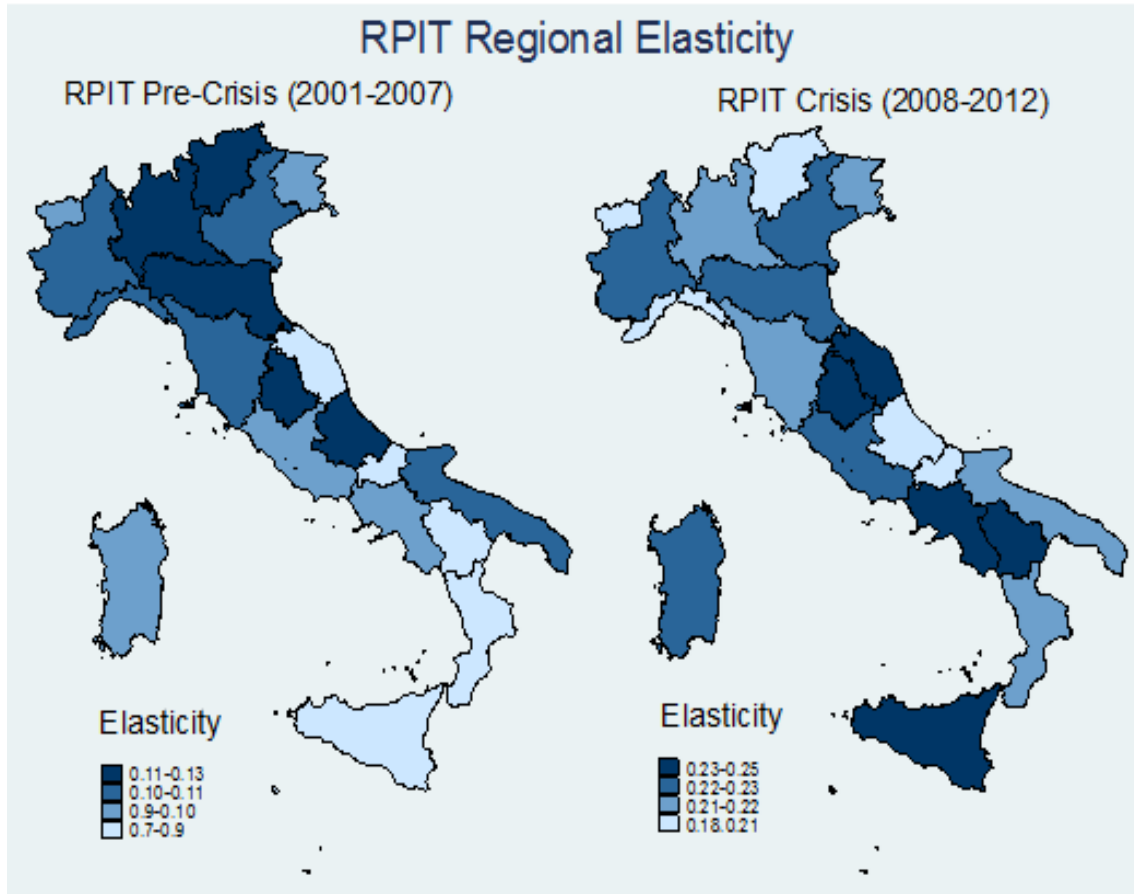
<i>Region</i>	<i>RPIT</i>			<i>RTPA</i>		
	2001-2012	2001-2007	2008-2012	2001-2012	2001-2007	2008-2012
Piedmont	0.166	0.113	0.230	0.405	0.300	0.530
Valle d'Aosta	0.147	0.105	0.198	0.368	0.285	0.467
Lombardy	0.167	0.123	0.219	0.406	0.321	0.509
Liguria	0.144	0.107	0.188	0.362	0.289	0.449
Trentino-Alto Adige	0.149	0.117	0.188	0.372	0.309	0.448
Veneto	0.170	0.115	0.236	0.413	0.305	0.542
Friuli	0.157	0.103	0.223	0.388	0.281	0.517
Emilia-Romagna	0.173	0.126	0.228	0.418	0.327	0.527
Tuscany	0.162	0.111	0.222	0.396	0.297	0.515
Umbria	0.183	0.128	0.249	0.438	0.331	0.567
Marche	0.165	0.097	0.246	0.403	0.270	0.561
Lazio	0.157	0.101	0.225	0.388	0.278	0.519
Abruzzi	0.155	0.133	0.181	0.383	0.340	0.435
Molise	0.136	0.075	0.208	0.345	0.226	0.488
Campania	0.166	0.099	0.246	0.405	0.274	0.562
Apulia	0.160	0.113	0.217	0.393	0.301	0.504
Basilicata	0.157	0.080	0.250	0.387	0.236	0.569
Calabria	0.147	0.083	0.224	0.368	0.243	0.519
Sicily	0.160	0.094	0.239	0.393	0.265	0.547
Sardinia	0.161	0.102	0.232	0.395	0.280	0.533
Mean	0.159	0.110	0.220	0.391	0.290	0.520

Note: The short-run elasticities are calculated as described by Equation (2). For *RPIT*, we use the estimated coefficients obtained from Model 1 in Table 5. For *RTPA*, we use the estimated coefficients obtained from Model 3 in Table 5. The first column of this table shows short-run elasticities by region over the whole period (2001-2012); the other two columns consider the pre-crisis period (i.e. 2001-2007) and the crisis period (i.e. 2008-2012), respectively.

Source: Authors' calculations

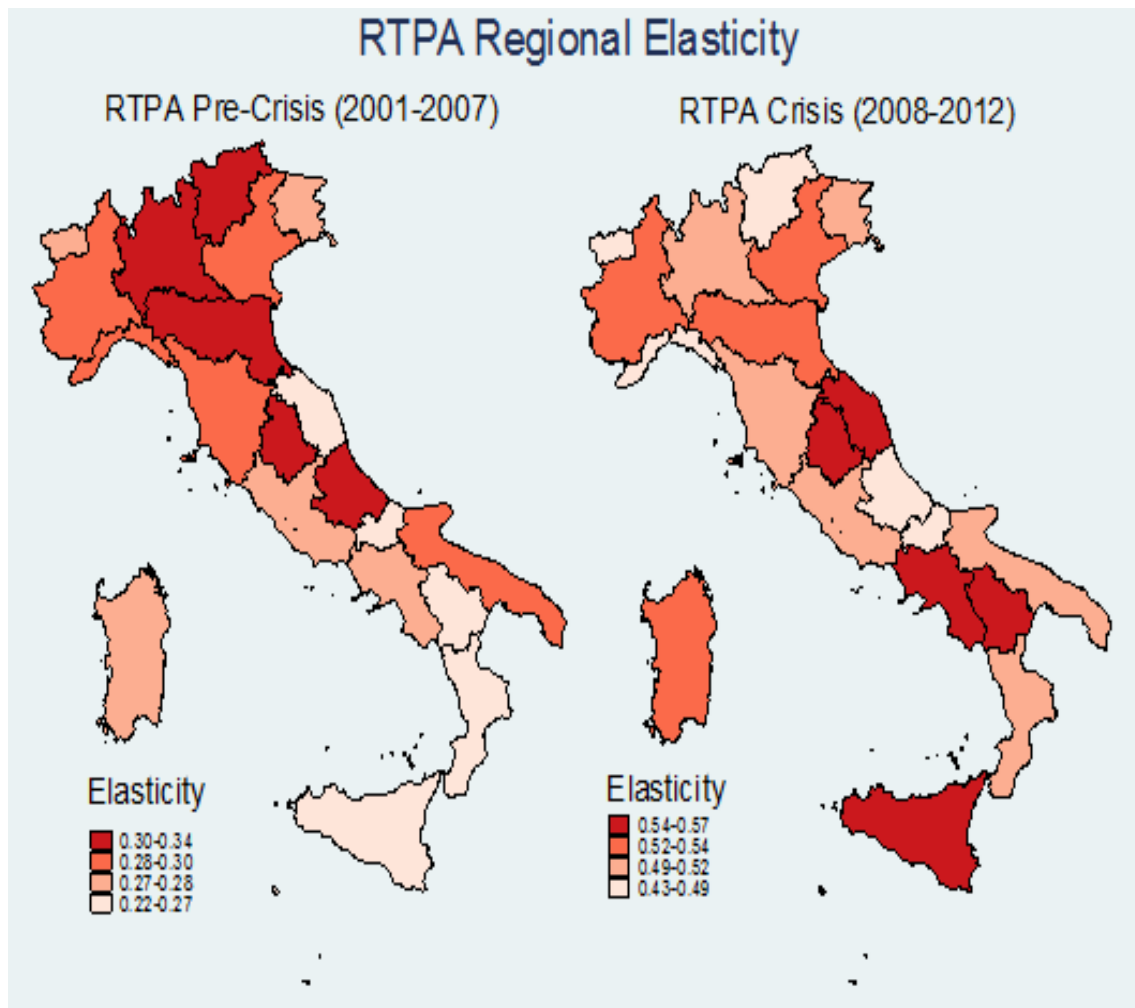
Figures

Figure 1 – RPIT regional elasticities, by levels



Source: Authors' calculations

Figure 2 – RTPA regional elasticities, by levels



Source: Authors' calculations