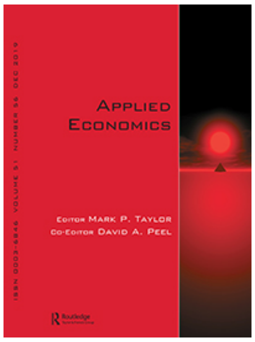

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Building a computable general equilibrium tax model for Italy

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ABSTRACT

In this paper, we develop a multi-sectoral computable general equilibrium tax model for Italy allowing for a number of fiscal tools. We illustrate the methodology for modelling and accommodating the full range of direct and indirect taxes into the national general equilibrium model. In particular, we build a commodity tax matrix by commodity, source, user and tax type; and a production tax matrix by industry and tax type. We also put a special emphasis on the institutional sector accounts, incorporating a detailed system of equations. Our model provides a powerful tool for acquiring new insights in fiscal policy analysis, through the assessment of tailored tax reforms, which can consist of either changes in tax rates and tax bases for indirect and direct taxes. Finally, to validate the model we perform an equalizing Value-Added-Tax rates reform. We find that a budget-neutral uniform tax rate reform would be GDP and welfare improving. However, results across agents and sectors vary.

KEYWORDS

Computable general equilibrium (CGE) tax model; direct and indirect taxation; Value-Added-Tax reform; Italy

JEL CLASSIFICATION

C68; H20; H30

I. Introduction

This paper describes the main features of the multi-sectoral computable general equilibrium (CGE) tax model for the Italian economy, ORANI-IT. The model, designed for the Department of Treasury of the Italian Ministry of the Economy and Finance in collaboration with the Centre of Policy Studies (CoPS), is intended for policy analysis. Within the general equilibrium framework, we reproduce the full range of direct and indirect taxes making the model a suitable tool for fiscal policy analysis. In particular, we accommodate an extremely detailed indirect commodity taxes matrix by commodity, user, source and tax type; and production taxes matrix by industry and tax type. In doing so we provide a roadmap into the complex data-job required to add new features into a CGE model, as it can result challenging by limited data availability and by the model dimension. We finally use the model to assess the impact of a revenue-neutral Value-Added-Tax (VAT) reform.

In the general equilibrium tax literature, the path-breaking Harberger's model (1962) for tax policy analysis, investigating the incidence and efficiency effects of taxes, has been a major stimulus to subsequent works. Harberger (1964) develops a procedure for estimating the welfare cost of a distortionary factor tax, presenting the generalized triangle formula. Shoven and Whalley (1973) incorporate taxes into a multi-sectoral general equilibrium framework to analyse the impact of government tax policy. With the aim of assessing alternative fiscal designs, Ballard, Scholz, and Shoven (1987) extend the general equilibrium framework for tax policy evaluation previously developed by Ballard et al. (1985), via the inclusion of a VAT framework. CGE modelling represents a suitable tool for assessing the efficiency effects of tax policies (See Fullerton, Henderson, and Shoven (1984), McLure (1990, 38), and Fehr, Rosenberg, and Wiegard (1995, 39–40)), thanks to its capability to accommodate large amounts of economic details.

This paper contributes to the general equilibrium tax literature and in particular to filling the existing gap in the Italian CGE literature, as there has been little research on the topic. Ciaschini et al. (2012) build a bi-regional CGE model based on a bi-regional Social Accounting Matrix for Italy for 2003, aimed at verifying the impact of an environmental fiscal reform. The model refers to previous studies by Ciaschini and Socci (2007), and by Fiorillo and Socci (2002).

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Standardi, Bosello, and Eboli (2014) present a sub-national version of the GTAP model for Italy, with the aim of assessing climate change impacts. Our work is from a different prospective, as it is intended as a tool for fiscal policy analysis.

This paper is organized as follows. Section 2 provides an overview of the model structure. Section 3 is devoted to the modelling of the commodity and production tax matrices. Section 4 reproduces the institutional sectors accounts. Section 5 analyses a budget-neutral uniform VAT rate reform. Section 6 concludes.

II. Model overview

The theoretical structure and computer code of the Italian model closely follow those of ORANI, model developed at CoPS, fully documented in Dixon et al. (1982) and Horridge (2003). ORANI and many CGE models based on its theoretical structure have been widely used as tools for practical policy analysis. Although ORANI represents the skeleton of our model, we adapt and extend its theory to better meet the features of the Italian economy and the requirements of fiscal policy analysis.

Within a neoclassical setting, ORANI-IT models the behaviour of several agents in the economy, namely: domestic producers divided into 63 industries; investors divided into 63 industries; a single representative household; a foreign sector; and the central government. The production structure features a multi-input, multi-output specification that is kept manageable by a series of separability assumptions and relies on a nested structure. Each industry produces several commodities combining intermediate inputs – domestic and imported – and factors of production, according to the available Leontief production technology. Domestic and imported commodities are imperfect substitutes (Armington specification). The factors of production labour – divided into gender, age, sector and professional position[1]– land and capital are combined through a Constant- Elasticity-of-Substitution (CES) function.

At each nest, firms choose the optimal composite of inputs, subject to the production technology available in the economy. To generalize, each firm j demand input i (z_{ij}) according to a minimization costs problem:

$$min_z \sum_i w_i z_{ij} \tag{1}$$

Subject to $f(z_{ij}) \geq q_j$

where w_i is the market price of input i (with i = 63 for the nest of intermediate inputs; or i = local or imported for the nest of source type; or i = labour, capital or land for the nest of primary factors; or finally i = male, female; i = age range; i = employees, self-employers; i = 63 sectors for the nests of labour), and qj represents industry'j's activity level. The optimal demand for inputs is found by mean of first-order conditions. Combining the optimization problems with market clearing conditions, we compute the competitive equilibrium price and output. From the homogeneity of degree zero of the demand for inputs in the price vector, it follows that only relative prices are determined in equilibrium; and demand for each input depends on the overall factor demand and on the relative price. This implies that changes in relative prices will induce substitution in favour of relatively cheapening inputs. From the system of first-order differential equations it follows that demand for each input i by firm j, z_{ij}, is expressed in terms of percentage changes:

$$z_{ij} - a_{ij} = z_j - \sigma_{ij}\left(w_i + a_{ij} - \sum_i S_{ij} w_i\right) \tag{2}$$

where σ_{ij} indicates the elasticity of substitution between inputs, S_{ij} is the share of good i in the total input composite, w_i is the market price of input i and a_{ij} indicates technical change. The same form holds for commodities supply, with a positive sign for the elasticity of transformation. At any activity level, industry j chooses a commodity output combination which maxi-

[1]We collect micro-data on labour income from the IT-SILC database – provided by the Ministry of Economy and Finance – featuring a disaggregation by gender, age, sectors, and professional position. The purpose is to enable a more informative assessment of the impact of shocks on the demand of labour, as well as of market-labour related policies, such as reforms of taxes on labour. Demand for labour in each industry is determined from an optimization problem, which minimizes the total cost of labour. As substitution possibilities are governed by choice of functional forms, we adopt a CES functional form to model the demand of labour for each of the characteristics. In practice, starting from the demand of labour by industry, we introduce additional nests, each of which describing the cost minimization problem faced by firms. Starting with the bottom nest, we first model the demand by gender, followed by the demand by age, classified in 13 classes of age, and then the demand by professional position, classified as employees versus self-employers, to conclude at the top nest with the existing demand by industry.

mizes its revenues.

Aggregate investment follows from a minimizing costs problem. Investment across industries is driven by the expected return on capital.[2]

A representative household face a maximization problem structured in two nests: first, she chooses how much of each good to consume; and then, the proportion of imported and domestic through a CES function. The utility (U) is shaped by a Klein–Rubin function, which is non-homothetic, allowing budget shares to vary in response to changes in relative prices and income. Total household demand (xs) adds up the subsistence (xsub) and luxury (vlux) components. The subsistence consumption depends on the population Q and preferences (xsub and slux). Luxury demand is modelled through a Cobb–Douglas demand function, with luxury spending as a fixed portion of supernumerary income.

$$U = \prod_c \{xs(c) - xsub(c)\}^{slux(c)} \tag{3}$$

$$xs(c) = xsub(c) + slux * vlux(c)/ps(c) \tag{4}$$

$$vlux = vtot - \sum_c (xsub(c) * ps(c)) \tag{5}$$

where ps are prices and vtot total expenditure.

Government is assumed to move in line with real household consumption.

All markets clear. For each commodity, the quantity produced by firms equals the sum of the intermediate and final demands. The value of output by each industry equals the total of production costs, reflecting the model's zero pure profit assumption.

The model is calibrated on the Supply and Use Tables (SUT) of the Italian economy for the year 2008 released by ISTAT.[3] Generally, the initial solution is based on the most recently historical data available. However, this is not the case for this model, which despite the availability of the SUT for 2014, relies on 2008 data. Considering that the year 2008 it is a quite immune scenario from the harsh economic crisis, it is preferred to build a more representative baseline scenario.

Flows between economic agents are illustrated in Figure 1. The column headings in the matrix identify the demanders: domestic producers divided into I industries; investors divided into I industries; a single representative household; an aggregate foreign purchaser of exports; government demands; and changes in inventories. The first row shows flows in year t of commodities to each user, valued at basic price. Each of these matrices has CxS rows, one for each of the 63 C commodities from S sources (domestic and imported). The second row shows the values of margin services M used to facilitate the flows of commodities C from S sources. The commodities used as margins are domestically produced trade, road transport, rail transport, water transport and air transport services. The third row shows sales taxes on flows to different users. The tax rates can differ between users, sources and, as we will see in detail in the next section across tax types. Accommodating the tax type dimension is in fact one of the main contributions of this paper. In particular, we further specify the commodity matrices V1TAX to V5TAX and the production tax matrix V1PTAX into specific tax-types. Current production also requires three types of primary factor: labour, fixed capital, and agricultural land. Industries also pay production taxes and other costs, which cover various miscellaneous costs for firms.

The full system of equations can be found at Felici and Gesualdo (2014). In the next section, we include an extensive tax module. The output is a powerful tool for fiscal policy analysis.

III. Modelling the tax dimension

The tax model data structure

In this section, we present the tax extension to the core CGE model that mostly consisted in adding a tax dimension to the commodity and production matrices illustrated in Figure 1 (V#TAX and V1PTX). Commodity taxes are represented by a matrix (matrices V1TAX to V5TAX in Figure 1) of net total taxes by commodity, user, source and tax type. The disaggregated structure allows to

[2]Investments by commodity so constructed are generally then broken-down across industries in proportion to their capital stock, with the underlined assumptions that all industries have the same commodity composition of investment expenditures and the same rate of return to capital. However, we depart from this approach by using actual data on investment by 37 industries released by ISTAT. The data manipulation procedure requires an initial investment pattern that we borrow from the Monash model (see Dixon and Rimmer 2002)..

[3]http://www.istat.it/it/archivio/60913..

		Economic Agents					
		Producers	Investors	Household	Export	Government	Change in Inventories
	Size	I	I	1	1	1	1
Basic Flows	C×S	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS
Margins	C×S×M	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	n/a
Taxes	C×S×CT	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	n/a
Labour	G×A×I×O	V1LAB					
Capital	1	V1CAP					
Land	1	V1LND					
Production Tax	PT	V1PTX					
Other Costs	1	V1OCT					

C = Number of Commodities
I = Number of Industries
S = Domestic, Imported
M = Number of Commodities used as Margins
CT = Number of Commodity Tax types
PT = Number of Production Tax types
A = Number of Age
G = Female, Male
O = Number of Occupation Types

Figure 1. The ORANI-IT-F flows database.
Source: Horridge (2003) with authors' adaptations

simulating the effects of commodity-and-user-specific tax changes across tax types. In such a way, tax rates on a commodity used as an intermediate input to producers can divert from that on household consumption of the same commodity. Production taxes are represented by a vector of net production taxes by industry and tax type (matrix V1PTAX in Figure 1).

Concerning data requirement, we use information from the SUT, as well as additional tax revenues data for detailed commodity and production taxes and subsidies from government statistics.[4] We then explicitly model each tax, by identifying the relevant tax base in the model and by coding statutory tax rates.[5] For each tax type, an initial estimate of the expected tax revenues is then computed by applying the legislated tax rate to the relevant tax base. The estimated revenues are likely to differ from the actual tax revenues as reported in government finance statistics for several reasons, such as: various tax reduction and exemptions, that may not have been captured in the calculation; less than full compliance tax rate; and possible shortcomings in the input-output representation of the size of the tax base. Hence, the initial tax matrix by tax type is scaled down in order to meet the target, as reported in the official statistics.

The commodity taxes matrix

In computing a commodity tax matrix by commodity, source, user and tax type we face data constraint. The SUT provide data on net taxes on products by commodity only, no information on the user is provided. Therefore, to pin down the user dimension, we compute the commodity tax matrix in conjunction with the matrix for margins (V1MAR to V5MAR Figure 1); and exploit the information provided by the difference

[4]Tavola 15 and Tavola 19. http://www.istat.it/it/archivio/63156..
[5]The allocation of each tax type to the relative commodity was based on a guideline provided by ISTAT: Ripartizione delle imposte indirette per rami e classi di attività economica. Anni 1951–1965, Supplemento straordinario al bollettino mensile di statistica n.11- novembre 1996..

between the USE table at purchasers price and the USE table at basic prices – difference that is composed by net taxes plus margins. The procedure relies on the assumptions that all intermediate and final usages of a commodity are taxed at the same rate, and that no taxes are levied on stocks.[6]

For each commodity tax, the tax burden is allocated to the relevant flow of goods and services by estimating the theoretical tax revenues, based on the values of the tax base and the tax rate. The resulting estimate is then proportionately scaled to the actual total revenues collected, as reported in the government statistics.[7] Specifically, we use the following formula for calculating the tax revenues from flows of good c from source s to user u, $CTAX^{ct}_{(c,s,u)}$:

$$CTAX^{ct}_{c,s,u} = \frac{REV^{ct} * TBASE^{ct}_{c,s,u} * LR^{ct}_{c,s,u}}{\sum_{c \in COM} \sum_{s \in SRC} \sum_{u \in USER} TBASE^{ct}_{c,s,u} * LRc^{t}_{c,s,u}} \tag{6}$$

With $REV^{c}t$ is the total revenue of tax ct reported in government statistics[8]; $TBASE^{c}_{(c,s,u)}t$ is the relevant tax base for tax ct; and $LR^{c}_{(c,s,u)}t$ is the legal tax rates for ct on flow (c,s,u).

For those taxes that do not have clear cut legal rate, we assume that the tax rate is the same for all commodity, sources and users; and hence the total tax revenues are allocated to (c,s,u) in proportion to the values of these flows in total tax base for the relevant tax type. These tax bases and rates rely on our current understanding of Italian tax legislations and on the tax values given in the SUT.

The resulting four-dimensional net commodity taxes matrix must satisfy the following conditions: total net tax revenue for each commodity, summed over sources, users and tax types, must equal the value of the column 'Net taxes less subsidies on products' in the Supply table; total net tax revenue for each user, summed over commodity, sources and tax types, must equal the difference between total commodity consumption by user in the Use table purchasers' prices and those in the Use table at basic prices; the total value of each tax type or subsidy, summed over commodity, sources and users, must equal government statistics for the tax type or subsidy. We combine the outcome with the subsidy matrix, described in the next section, to finally building the commodity tax matrix.

The subsidies matrix

Taxes in the SUT are net of subsidies. We collect data on revenues for total subsidies by 39 aggregate sectors in the economy[9]; and sub-totals of subsidies on commodity and on production. These data come to represent our targets.

Creating the subsidy matrix on products and subsidy matrix on production involves two tasks: splitting total subsidies by 39 sectors into subsidies on 39 commodity and subsidies on 39 production industries; and then allocating the resulting subsidies to 63 commodities and 63 industries following ORANI-IT's production structure. More in detail, we first create initial matrices for subsidies on products and on production for 39 sectors, by using the reported subsidy data and some assumed shares[10] of subsidies by subsidy-type in each sector. We then use a RAS procedure to adjust the initial matrices, so as to ensure they meet the targets described above. Finally, we allocate subsidies by 39 industries to 63 commodities and 63 industries, by multiplying the subsidies for 39 sectors by the shares of 63 commodities and 63 industries in the corresponding 39 sectors.

The production taxes matrix

Production taxes are allocated to different industries based on the tax legislation. First, initial estimates for production tax revenues

[6]Italian data on tax revenues by user (as deducted by computing the difference by users between USE at basic prices and USE at purchasers' prices) show positive values on stocks. Therefore, in order to reflect the theory and at the same time to meet the total tax revenues as indicated in the SUT, we reallocate tax revenues on stocks to other users, in proportion to their shares on total tax revenues..

[7]*Source: Tavola 15-* Conti ed aggregati economici delle Amministrazioni pubbliche, ISTAT http://www.istat.it/it/archivio/63156..

[8]*Source: Tavola 15-* Conti ed aggregati economici delle Amministrazioni pubbliche, ISTAT http://www.istat.it/it/archivio/63156.

[9]Tavola 19 – Contributi alla produzione erogati dalle amministrazioni pubbliche e dall'Unione Europea per branca di attività economica. http://www.istat.it/it/archivio/63156.

[10]We base an initial disaggregation of the total value of each of the 39 subsidies by subsidy-type on initial guesses, made up on the basis of gathered information on the categories of subsidies granted in Italy, as well as on ISTAT data on subsidies by nine aggregated industries for 2000, found at: Metodologia di stima degli aggregati dei conti nazionali a prezzi correnti. Anno base 2000", Prospetto 3.25 and 3.25 bis, ISTAT. http://www3.istat.it/dati/catalogo/20120207_00. (Source: ISTAT, Conti ed aggregati economici delle Amministrazioni pubbliche: Tavola 19 – Contributi alla produzione erogati dalle amministrazioni pubbliche e dall'Unione Europea per branca di attività economica, anno 2008, http://www.istat.it/it/archivio/63156).

are computed for industry-specific production taxes by multiplying the tax rates with the tax base, which in most cases, is industry value added. The revenue from production tax type levied on industry i, $PTAX_i^{pt}$, is calculated as:

$$PTAX_i^{pt} = \frac{REV^{pt} * TBASE_i^{pt} * LR_i^{pt}}{\sum_{i \in IND} TBASE_i^{pt} * LR_i^{pt}} \qquad (7)$$

With REV^{pt} is total revenue from production tax type as reported in government statistics[11]; $TBASE_i^{pt}$ is the tax base on which the tax pt is levied; and LR_i^{pt} is the legal rate of the tax pt on industry i.

For many taxes, the rate is assumed to be uniform across industries. After allocating production taxes across industries as described above, we then use the RAS procedure to ensure the final net production tax matrix meets the following constraints: the gross value of production taxes by industry must equal the 'Other taxes on production' vector in the Use table summed with subsidies on production, as calculated in the previous section; and the revenue of each tax, summed over industries, must equal government statistics. The resulting matrix is then combined with subsidies to obtain the V1PTAX matrix by industry and tax type.

IV. Modelling sector accounts of national income

In this section, we model the national income accounts for the institutional agents based on the economic sector accounts.[12] The model accommodates income accounts for domestic economic agents, government and households, and transactions with the rest of the world. The households account is inclusive of flows for households, NPHIS, financial and non-financial institutions, and is netted out to account for the internal flows between households and industries. Transactions between domestic economic agents and economic players resident abroad are recorded in the 'rest of the world' account, which is viewed from the perspective of the residents in terms of net payments (This convention is motivated by the presence into the model of net foreign liabilities).

Government outlays have an impact on GDP, as they affect the demand directly through the purchase of intermediate consumption goods, or indirectly via transfers and subsidies. Government incomes encompass final revenues and financial transactions. Final revenues include capital incomes, interests income, indirect taxes, direct taxes and social contributions, international aids, current transfers, tax on capital, investment grants and other capital transfers from household. Financial transactions capture changes in the governments' net liabilities and represent the difference between government revenue and expenditure. Turning to households, disposable income represents the key indicator, which consists of primary factors income, social benefit incomes, social security payments, direct taxes and other incomes. Household financial assets consist of saving (net of investment) augmented with capital transfers.

In order to impute the resulting economic flows from domestic production across domestic agents, we assume shares of government ownership in each of the industry. Receipts and expenses relating to various forms of property income are carefully modelled. In particular, interest payments and dividends are reconciled with net foreign liabilities and domestic debt.

The national income account provides data on investments income, which is comprehensive of interest payments, dividends and reinvested earnings, for each institutional agent, but no information is given regarding the flows between the agents. For modelling purpose, these flows are reconstructed, relying on data on the stock of debt and the net investment foreign position, and on plausible assumptions. We gather data on total government and private net debt and on total and government net international investment position from the Bank of Italy's database (BIP on-line: financial account by institution and international investment position for 2008). We then compute the private net investment position and the domestic debt as residuals.

We model investment income as the product of the relevant stock and interest rate. Specifically, government pays interest on its foreign debts and domestic debt; households pays investment

[11]Source: Tavola 15- Conti ed aggregati economici delle Amministrazioni pubbliche, ISTAT.
[12]http://www.istat.it/it/archivio/58448..

income (which include both interest and dividends) on its net foreign liabilities, and receive interests on its loan to government; RoW receives investment income from both government and households on Italy's net foreign liabilities.

Next, using data on tax revenues released by ISTAT[13] we model direct taxes. Households pay the main income tax IRPEF and withholding income taxes ISOS. Industries pay IRPEF or IRES, depending on their legal structure. In particular, the proportion of households in the total IRPEF payment was deducted by recalling data on IRPEF fiscal declaration, released by the Ministry of Finance.[14] IRES is allocated between households and government by using government capital shares.

Enriching the model with new details requires the modification of the model structure, in order to accommodate new variables. All equations describing institutional agents' accounts are linearized and added into the model. Including national accounts enables many interesting simulations whereby government and household expenditures can be linked to their revenues or disposable income, which are affected by changes in policies relating to taxes, transfers, and changes to interest rates. Equations for revenue-neutral simulations are incorporated into the model to allow simulations where the fiscal burden is switched from one tax to another, with no effect on the government budget. Additional shifters with tax dimension are then incorporated in the equations describing the power of tax for commodity taxes, to allow for tax-specific shocks. Exercises aimed at redesigning the fiscal system can be assessed. Overall, the model is a powerful tool for tax policy analysis. This concludes our discussions on the construction of the CGE tax model for Italy.

V. A budget-neutral uniform VAT rate reform

Italy has settled for a VAT system with a dual reduced rates structure and a standard rate. In times of fiscal consolidation, the tendency has been that of gradually increasing the standard rate. However, the VAT could still play an important role in collecting revenues, but in ways less distortional and fairer than further raising the standard rate. Examples are reforms aimed at broadening the tax base by limiting the use of reduced rates and exemptions.

In this paper, we assess the economic impact of moving the system to a uniform rate on all economic transactions. A legislative attempt to redesign the Italian tax system was done with delega fiscale.[15] IMF (2012) identifies in the narrow tax base one of the most concerning issue in Italy, particularly due to reduced rates and imperfections of compliance. MEF (2011) in a report aimed at identifying and costing 720 tax expenditures evaluates at 2.5% of GDP the tax expenditure in the form of reduced VAT rates. Along with this, OECD (2012) finds a C-efficiency[16] for VAT at 41% in 2008 in Italy, proving the erosion of the tax base resulting from poor implementation and/or poor policy design. de Mooij and Keen (2012) decompose the policy gap of around 44%[17] into two factors, which account for the departure of the system from a uniform tax rate and for the impact of exemptions. Using data from Ministero dell'Economia e delle Finanze (2011), the authors compute a rate dispersion of 0.25% and an exemption gap of 0.26%. In per cent of GDP, this means lost revenues for 2.9% due to lower rates. Using the same estimates, IMF (2014) evaluates the potential of design and compliance improvements. Results show that having the policy gap would bring a collection of resources accounting for about 2.7% of GDP. These findings open room for the redesign of the rate structure in terms of uniformity and coverage of the VAT.

Copenhagen Economics (2007) finds a strong support for having uniform VAT rates in the European Union. Despite some exception for

[13] http://www.istat.it/it/archivio/63156.
[14] http://www.finanze.gov.it\/stat_dbNew\/index.php..
[15] Schema di disegno di legge Delega al governo recante disposizioni per un sistema fiscale più equo, trasparente e orientato alla crescita, 18/06/2013, Articolo 4, commi 4 e 5 (Razionalizzazione della imposta sul valore aggiunto e di altre imposte indirette)..
[16] The C-efficiency is a measure of the broadness of the tax base developed by the IMF, computed as the ratio of VAT revenues to the product of the standard VAT rate and consumption. OECD builds on this concept developing the VAT Revenue Ratio (VRR). The measure is at 1 when the system is close to the pure VAT regime, imposed on all final consumption at a single rate, and where all the tax is collected by the tax administration. A ratio lower than 1 indicates an erosion of the tax base at the standard rate. A VRR at 0.41 suggests that more than an half of the potential revenues are not collected because of the deviation from the pure VAT system, as higher rates and differences between rates may encourage tax avoidance and evasion.
[17] This value indicates that revenues were around 44% of what it would have been if the standard rate would have been applied to the actual consumption.

labour-intensive services, the uniform rate appears to be a superior instrument to maintain a high degree of economic efficiency, to minimize a otherwise sizeable tax expenditure, and to smooth the functioning of the internal market. Their analysis is based on the CEVM model a global, multi-regional, multi-sector, general equilibrium model, specially designed to study the economic effects of VAT policies. CPB Netherlands Bureau for Economic Policy Analysis (2015) combines a static analysis of VAT with CGE WorldScan to estimate the potential effects of abolishing all zero and reduced VAT rates, and decrease the standard VAT rate for the reform to be revenue neutral. The study finds no effect on GDP on the EU-27 average. The effects on the other macroeconomic variables are also small; however, some employment and wage growth, benefitting low-skilled households relatively more than high-skilled households, is recorded. Boeters et al. (2010) simulate VAT reforms in Germany using a static CGE model. The consumption structure is designed to account for reduced rates, zero exemption and full taxation. Simulations compare a pure VAT reform, where the differentiated VAT is replaced with a uniform rate, and scenarios in which the additional revenues are compensated with alternative taxes. Bye, Strøm, and Åvitsland (2012) analyse the effects on economic efficiency of introducing a uniform VAT rate on all goods and services, including public goods and services. Using a CGE model results show welfare gains.

In our model, we account for differences in statutory VAT rates across commodities and users. We reproduce 130 users, comprised of 63 industries, 63 investors and four final users, namely: households, export, government and stocks. Therefore, we evaluate a 63 commodities x 130 users matrix, through careful inspection of information on Italian VAT legislation (Istituzione e disciplina dell'imposta sul valore aggiunto, DPR 633/72), which sets values for VAT rates at 0%, 4%, 10% and 20% in 2008, year of the model's calibration.

We move two reduced rates and the standard rate to a budget-neutral uniform rate, which we found is 13.51%, and investigate the impact of the policy in the short run, because of the urgent need for fiscal consolidation. In our model closure, the real wage is fixed and employment adjusts to clear the labour market. Industry capital stocks are fixed, and industry rates of return on capital stock adjust to clear the capital market. There are no changes in structural variables in the model, such as technologies and tastes. Households consumption moves with households disposable income (via an exogenous average propensity to consume), but real government expenditure is held exogenous. This means all changes in government revenues are reflected in the government budget balance.

In order to interpret simulation results correctly, it is important to understand how the changes in VAT rates affect different commodities and different users, namely: production; investment; household and government. Table 1 reports the initial legal rates for six aggregate commodities going to different users, and their variations to the uniform rate of 13.51%. Note that the average pre-simulation legal rate on intermediate inputs is higher than that for other users, because the shares of higher rated commodities, such as mining, manufactures and utilities, are higher for intermediate inputs than for other users. Therefore, the rate equalization reduces the legal tax rates on intermediate inputs to production but raises the tax rates on inputs to investment, household and government consumption. The tax burden on exports also decreases because of the fall of the rates on commodities which are typically consumed by tourists.

At the sectoral level, the rate equalization increases the average VAT legal rates on agriculture, construction, and services; and on the contrary, reduces the rates on mining, manufactures and utilities. However, different agents are affected differently, depending on their commodity consumption baskets. For example, the average rate on utilities declines for intermediate and investment users, but increases for household, government and exports. Results for key macroeconomic variables are reported in Table 2. Overall, the reform is beneficial for the economy. The tax reform shifts part of the tax burden away from production towards final usage, boosting real GDP and employment. The real producer wage decreases, encouraging firms to hire. We look into the change in the real cost of labour to producers via a back-of-the-envelope (BOTE) model as follows. The real producer cost of labour, which is the nominal wage rate (W)

Table 1. Legal rates, by six aggregate commodity groups and main users (%).

	Production	Investment	Households	Government	Export	Average
A. Pre-simulation legal rates						
1 Agriculture	10.06	10.45	10.45	10.00	4.76	9.72
2 Mining	19.97	20.00	20.00	20.00	0.17	19.53
3 Manufactures	15.20	17.11	15.19	10.00	4.64	12.52
4 Utilities	17.09	16.92	10.76	12.41	1.07	15.10
5 Construction	5.42	5.42	5.42	5.42	0.02	5.41
6 Services	15.33	15.51	11.74	7.52	4.85	12.38
Average	15.15	7.04	13.27	8.02	4.62	12.19
B. Post-simulation legal rates[1]						
1 Agriculture	13.51	13.51	13.51	13.51	6.26	12.91
2 Mining	13.51	13.51	13.51	13.51	0.11	13.20
3 Manufactures	13.51	13.51	13.51	13.51	3.62	10.87
4 Utilities	13.51	13.51	13.51	13.51	1.45	13.24
5 Construction	13.51	13.51	13.51	13.51	0.06	13.49
6 Services	13.51	13.51	13.51	13.51	4.96	13.20
Average	13.51	13.51	13.51	13.51	3.78	12.28
A. Change in legal rates						
1 Agriculture	3.44	3.06	3.05	3.51	1.50	3.18
2 Mining	−6.47	−6.49	−6.49	−6.49	−0.06	−6.32
3 Manufactures	−1.70	−3.60	−1.69	3.51	−1.02	−1.65
4 Utilities	−3.59	−3.41	2.74	1.10	0.38	−1.86
5 Construction	8.09	8.09	8.09	8.09	0.04	8.08
6 Services	−1.83	−2.00	1.77	5.99	0.11	0.82
Average	−1.64	6.46	0.24	5.49	−0.84	0.08

[1]Note that although we exclude the zero rate on exports to EU VAT registered businesses from this rate equalization experiment, the average legal (and effective) rate on exports still change, because of the taxed components of exports.

Table 2. Macroeconomic results.

	Variable	Simulation results		Variable	Simulation results
A	Real GDP and GNI		D	Disposable income	
	Real GDP (at market prices)	0.21		HH disposable income	0.52
	Real GNI	0.36		Government gross saving	1.76
B	GDP income components		E	Price indexes	
	Employment	0.38		Real wage	0.00
	Capital stock	0.00		Capital rental	0.62
	Real GDP (at factor cost)	0.18		Land rental	−0.90
	Total tax revenue	0.21		Price of primary factors	0.35
C	GDP expenditure components			GDP deflator	0.28
	Real private consumption	0.45		CPI	0.06
	Real investment	−0.09		Government price index	0.36
	Real public consumption	0.00		Investment price index	0.91
	Export volume	0.71		Export price index	−0.09
	Import volume	0.81		Terms of trade	−0.09

deflated by the producer price index (Pp), is linked to the real consumer wage rate, which is the nominal wage rate deflated by the consumer price index (Pc), via the following expression:

$$\frac{W}{Pp} = \frac{W}{Pc} * \frac{Pc}{Pp} \quad (8)$$

The consumer real wage $\frac{\mathrm{W}}{\mathrm{Pc}}$ is assumed to be fixed, hence changes in producer real wage follow changes in the ratio Pc to Pp:

$$\frac{\mathrm{W}}{\mathrm{Pp}} \sim \frac{\mathrm{Pc}}{\mathrm{Pp}} \quad (9)$$

Denoting the tax on production Tp, tax on consumption Tc, and market price of the product Pm, we can rewrite the price ratio in terms of these variables. In particular, Pc = Pm/(1+ Tc) and Pp = Pm/(1+ Tp), then:

$$\frac{\mathrm{W}}{\mathrm{Pp}} \sim \frac{(1 + \mathrm{T_p})}{(1 + \mathrm{T_c})} \quad (10)$$

Because of the VAT rates equalization, Tp reduces relative to Tc, causing the right-hand side of equation (10) to fall. As a consequence, the producer real wage reduces, producers hire more workers, and aggregate employment lifts. In turn, real GDP at factor costs rises.

With employment increased and capital stock fixed, the economy becomes less capital intensive, pushing the marginal product of capital and, with it, capital rental up. Household disposable income increases, despite a decline in land rental due to the decline in agricultural activities. Shifting the VAT burden away from production stimulates the overall production activity, generating additional primary factors income, which accrues to households. As in this simulation household expenditure moves with households disposable income, the private consumption increases.

Real investment declines because of the fall in the rate of return on capital stock, defined as the ratio of capital rental to investment price. Investment price index increases strongly mainly due to the increase in the VAT on construction, which is the main input to investment.

As household consumption and intermediate inputs contribute to over 80% of indirect tax revenues, the rise in household consumption and the expansion in the economic activity largely explain the increase in indirect tax revenues. It follows that real GDP at market prices increases slightly more than real GDP at factor costs.

Higher collection of tax revenues lifts government disposable income. With only a slight movement in government final consumption, due to the rise in government price index and an unchanged real public consumption, government budget balance (or gross saving) moves towards surplus.

Changes in real private consumption, real investment and real public consumption result into an increased real GNE, slightly higher than the increase in real GDP. The real balance of trade slightly improves. Export volume increases less than import volume, and the terms of trade worsen slightly.

Figure 2 shows a negative correlation between percentage changes in output and legal VAT rates for six aggregate sectors. Sectors that experience VAT rates cuts expand, and sectors VAT rates increases contract. However, the correlation is not perfect, because changes in VAT rates through prices, affect final demand and intermediate demand via input-output linkages.

Sectors that benefit from the tax reform include manufactures, utilities and services. Manufactures and services have VAT rates on their products reduced, and hence benefit directly from the rate cuts. They also gain from the expansion in demand, mainly from private consumption. Utilities do not gain from the VAT rate cut but gain from the expansion in demand by other industries and by private consumption. Mining enjoys a relatively large cut in VAT rates, but its expansion is limited by the fixity of subsoil assets. Sectors that are adversely affected by the tax reform are agriculture and construction, which have VAT rates increased on their outputs.

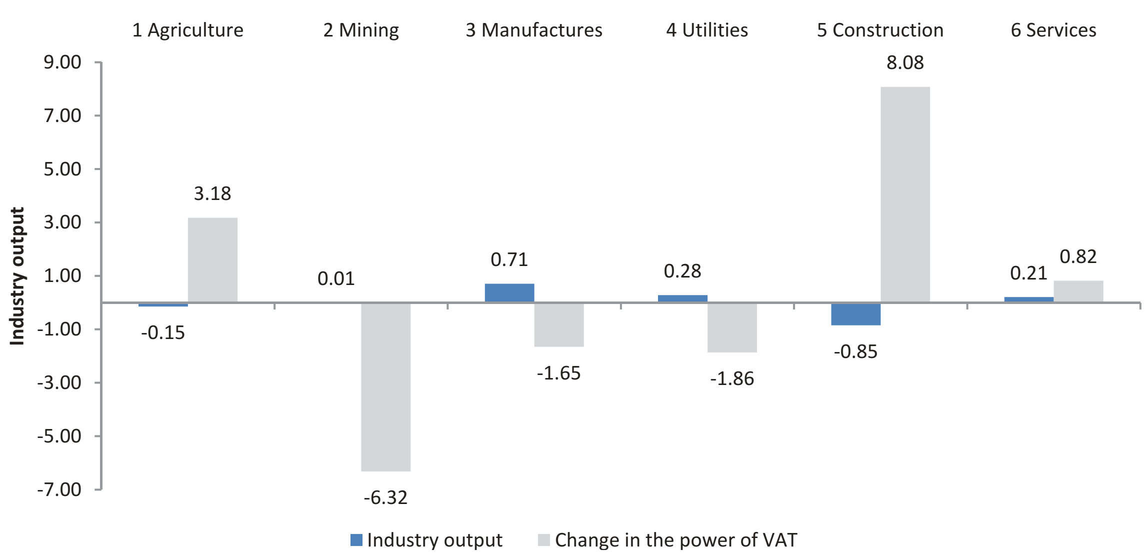

Figure 2. Sectoral outputs and changes in legal Vat rates on the outputs (%).

To sum up, winners benefit from the rise of demand, caused by the fall of the VAT rate on their goods and services; as well as, they benefit from a fall in the cost of production, caused by reduced rates on their inputs. All the biggest losers experience a rise in their VAT rate, followed by a rise in price. For example, construction that mainly sells to investment and self-production suffers from the fall in investment and the resulting further contraction due to internal demand. Some exceptions to the general negative relationship between changes in the VAT rates and in the sectoral outputs are waste treatment, some of the margins, printing; sectors that experience an increase in the total output, despite the increase in their VAT rates. We investigate the dynamic behind this result, by looking at the waste treatment sector. From the producer point of view, the supply curve shifts upwards because of the initial rise in the output price due to the higher VAT rate. On the demand side, the overall impact is positive, causing a shift of the demand curve downwards. With a quite high supply elasticity, the expansion in demand more than offsets the contraction in supply, with the result that the sector ends up in a new equilibrium, which features an higher level of output and a lower level of price, despite in the rise in the VAT rate.

To conclude, using a detailed CGE tax model of Italy, we have conducted a policy simulation whereby all VAT tax rates, except tax rates on zero-rated exports, are equalized to a budget-neutral uniform rate. Macro results show that moving to a simpler system of a uniform rate favourably affects the economy, through the fall in prices, due to the reduction of VAT rates levied on several goods and services. The reduction in the distortionary waste generated by the differential rates behaves like a rise in aggregate output. As the economy shifts to a broad-based tax, demand for several goods and services boosts, and with it, the economic activity. The shift is sufficient to preserve government VAT revenue but facilitates the collection of revenues from other taxes. Concerning the effectiveness of revenue-neutral tax shifts in addressing fiscal sustainability, this finding suggests that a base-broadening reform is likely to help collecting additional resources, with the collateral benefit of boosting the economic activity. Expanding on results at user level, government ends up paying more VAT. However, the increased VAT outlay is offset by the increase of tax revenues accruing to government from other taxes. Changes in the rates on intermediate inputs favourably affect household, through the channel of primary factors income. As industries experience output expansion their gross operating surplus increases along with the demand for labour, lifting household disposable income. Problematic is the taxation of investment. Investment in fact is harmed by the uniform rate reform, because of the rise of the VAT rate levied on its main input, construction. However, public borrowing requirement reduces thanks to the increased tax revenues.

VI. Conclusion

In this paper, we present the multi-sectoral computable general equilibrium tax model for Italy, ORANI-IT. The model accommodates a significant fiscal detail, modelling the full range of direct and indirect taxes. The result is an extremely detailed indirect tax matrix by commodity, user, source and tax type, providing a powerful tool for policy analysis. At the methodological level, the paper provides a framework for including a fiscal detail into a CGE model. We also accommodate a detailed modelling of sector accounts for national income, where major groups of revenue and expenditure items by government, household and net transactions with the rest of the world, are linked to relevant economic activities in the core model. As a result, the capacity of analysis of the national model is enriched, allowing for the analysis of a wide range of fiscal policies, tracing their impacts not only on the economy, but also on the government budget, household income and savings, and on the net lending/borrowing position of the nation. Finally, we use the model to assess the economic impact of implementing a VAT rate equalizing reform. Results suggest that a revenue-neutral base broadening reform would be GDP and welfare improving.

Disclosure statement

No potential conflict of interest was reported by the authors.

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