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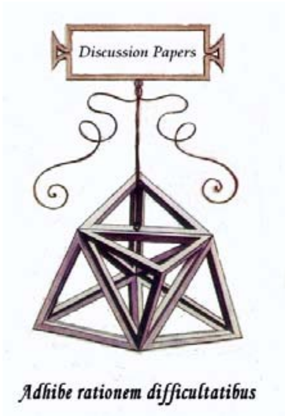

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EVALUATING TAX REFORMS WITHOUT UTILITY MEASURES: THE PERFORMANCE OF REVENUE POTENTIALITIES

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n. 7

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EVALUATING TAX REFORMS WITHOUT UTILITY MEASURES: THE PERFORMANCE OF REVENUE POTENTIALITIES

Abstract

EVALUATING TAX REFORMS WITHOUT UTILITY MEASURES: THE PERFORMANCE OF REVENUE POTENTIALITIES

The desirability of revenue-neutral commodity tax reforms is traditionally evaluated by comparing the marginal cost of public funds (MCF) raised through different taxes. In simple theoretical models, however, it is possible to rely on more simple indicators, which do not imply a measure of consumer utility (Hatta (1986), Slemrod and Yitzhaki (1996), Bulckaen and Stampini (2001)). Unfortunately, the extension of such appealing policy rules to more complex economic frameworks is not straightforward and has not been assessed so far. We attempt to fill this gap and analyze the reliability of decisions based on revenue potentialities – defined as ratio between marginal revenue and tax base – through simulations within a numerical model of the Italian economy. Six hundred commodity tax reforms are simulated, with very encouraging results: forecasts based on the comparison of revenue potentialities are correct in 83 percent of cases simulated. Furthermore, forecast precision increases to 100 percent when revenue potentialities are sufficiently differentiated. Overall, the paper shows that revenue potentialities are reliable indicators for policy making.

Classificazione JEL: H2, D58

Keywords: commodity tax reforms, revenue potentiality, marginal cost of public funds (MCF).

Summary

1. INTRODUCTION

The desirability of commodity tax reforms is traditionally evaluated by comparing the marginal cost of public funds (MCF) raised through different taxes – i.e. by comparing the welfare loss associated to raising one additional unit of revenue through such taxes. Simple theoretical models, however, show that indicators which do not rely on measures of utility could be used instead (Hatta (1986), Slemrod and Yitzhaki (1996), Bulckaen and Stampini (2001)). Nonetheless, no empirical evaluation of this possibility has been performed so far. Applied works have generally ignored it, and have focused on the utilitarian concept of MCF. In the present paper, we attempt to fill this gap by analyzing the possibility to forecast the welfare effects of revenue-neutral commodity tax reforms through the comparison of revenue potentialities – defined as the ratio between marginal revenue and tax base – hence without relying on measures of utility.

We focus here on efficiency only. In the framework of a traditional single consumer model, welfare is increased by raising the rate of taxes with higher revenue potentiality and decreasing the rate of taxes with lower revenue potentiality. The intuition behind this conclusion is that some taxes are able to raise revenue "more easily" than others, and reforms are desirable if the tax burden is redistributed in the direction of the former[1]. Therefore, the desirability of tax reforms depends on two sets of parameters only: marginal revenues and tax bases. The estimation of revenue potentialities requires some knowledge on uncompensated demand elasticities or could be obtained econometrically, by analyzing the relation between revenue and tax rates throughout time. This result has potential high empirical relevance, as it makes no reference to utility measures.

The appealing policy rule based on the comparison of revenue potentialities, however, holds perfectly only in the simple theoretical model. Its value in more complex applications has never been inquired. The present paper aims exactly at evaluating the reliability of predictions based on revenue potentialities in complicated economies, characterized, for example, by intermediate goods, trade with the rest of the world, interaction among different

[1] A related conclusion is reached by Smart (2002) in terms of compensated revenue, given a predetermined level of welfare.

forms of commodity and income taxation. One way to proceed would be to work out a formal theoretical model including the mentioned characteristics. However, the algebra would soon become untreatable and strong simplifying assumptions would be necessary in order to find an intuition behind mathematical results. We choose an alternative approach and proceed with the help of a computable general equilibrium (CGE) model. Two reasons support the choice of a CGE model as an appropriate evaluation tool. First, the model allows both to compute tax revenue potentialities (the new approach) and to simulate the effects of tax reforms on welfare (the traditional way, equivalent to comparing MCFs), all consistently and within the same analytical framework. Second, a CGE model allows introducing remarkable features, moving towards the degree of complexity of real economic systems, though retaining the same underpinnings of the simpler theoretical model.

While evaluating the reliability of forecasts based on revenue potentialities, we also analyze the performance of a rule proposed by Hatta (1986), based on the comparison of tax rates only. In a standard model, Hatta shows that, if some conditions regarding commodity substitutability hold, revenue-neutral tax reforms in the direction of a uniform tax rate increase welfare. The process starts with the reduction of the highest tax rate, compensated by an increase in the lowest. Welfare gains are obtained up to a certain degree of proximity to a uniform tax rate structure. Two opposite forces are at work. The effects of the reform depend both on the degree of substitutability among commodities and on substitutability between commodities and leisure (Bulckaen (1992), Hatta (2004)). Welfare increases if benefits from the reduction of distortions related with commodity substitution are higher than the loss due to the substitution of commodities for leisure, which determines a decrease in labor supply. However, Hatta concludes that the second best structure of commodity tax rates is likely to be very close to uniform.

Hatta's rule is indeed the simplest possible (a golden one) that a policy maker can use when deciding about restructuring commodity taxes. Revenue-neutral reforms that reduce the distance between sufficiently different tax rates, by reducing the highest and increasing the lowest, will increase efficiency and welfare. However, defining commodity tax rates in economies where consumption taxes, production taxes of various kinds and tariffs coexist may not be trivial. Aggregate average commodity tax rates may not properly account for the interaction among distortions and related behavioral responses. Also the relevance of Hatta's rule in a complex economy needs being evaluated.

The paper is organized as follows. Section 2 presents the theoretical model for tax reform evaluation, within which the decision rule based on revenue potentialities is derived. Section 3 describes the computable general equilibrium model used for the simulations, points out the differences with respect to the theoretical model and briefly describes data used for calibration. Section 4 provides a more formal description of the methodological approach, presents the main findings on the performance of the revenue potentiality rule and of Hatta's rule and describes the policy implications of the analysis. Conclusions are provided in Section 5.

2. THEORETICAL MODEL

For the theoretical analysis, we use a standard model of commodity tax reforms. The economy is composed by a single consumer, who derives utility from leisure (x^0), from n commodities (x^i, $i=1,...n$) and from a public good provided by the State (r). As usual in the literature, we assume that r is weakly separable from commodities and leisure in the utility function, hence demands for commodities and leisure do not depend on it. The uncompensated demand functions are represented by the vector $\boldsymbol{x}$ (with dimension n+1), which depends on the vector of consumption prices $\boldsymbol{q}$ and on the exogenous income y [2]:

$$\mathbf{x} = \mathbf{x}(\mathbf{q}, y) \qquad (2.1)$$

Exogenous income is assumed to be equal to zero. Net demand for leisure is negative ($x^0<0$), so that labor supply is positive. The individual budget constraint is given by:

$$\boldsymbol{q}' \boldsymbol{x} = 0 \qquad (2.2)$$

Production is described by a linear technology, with labor as the only factor of production:

[2] In what follows, the apex refers to the good (x^i, i=0, 1, …n), boldface type indicates a vector ($\boldsymbol{x}$), prime indicates vector transpose (′) and the subscript indicates the derivative, the gradient or the Jacobian matrix of the element ($\boldsymbol{x}_i$).

$$\boldsymbol{p}'\boldsymbol{x} + r = 0 \tag{2.3}$$

in which $\boldsymbol{p}$ is a vector of positive constants proportional to production prices.

We exclude the presence of lump sum taxes; hence, the public sector draws tax revenue through proportional taxes only.

Because of our assumption of constant returns to scale, we can normalize production and consumption prices assuming leisure as the untaxed good[3]. Furthermore, in order to simplify the analysis, we define the units of measure in order to obtain all constants of the production function and all production prices equal to one ($\boldsymbol{p}=\boldsymbol{\iota}$, vector of elements equal to 1). Hence, consumption prices are given by the following expression:

$$q^i = (1 + t^i), \quad i = 0,...n \tag{2.4}$$

where t^i is the i-th element of $\boldsymbol{t}$, vector of tax rates, and $t^0=0$.

Total tax revenue is used to purchase r. In order to analyze the welfare effect of a reform which increases the tax rate on good 1 and recycles the additional revenue by reducing the rate on the arbitrary good n, we differentiate the utility function of the representative consumer:

$$U = V(\boldsymbol{q}(\boldsymbol{t}), y, r) \tag{2.5}$$

where V is the indirect utility function and, using Roy's identity, we obtain:

$$\frac{dU}{\lambda} = -\left(x^1 \cdot dt^1 + x^n \cdot dt^n\right) \tag{2.6}$$

where $\lambda = \dfrac{\partial V}{\partial y}$ is the marginal utility of exogenous income.

By differentiating the government budget constraint, we obtain the relation between tax rate variations implied by the condition of revenue-neutrality. We obtain:

[3] A labor tax which reduces wage proportionally is equivalent to a flat commodity tax on all commodities. Bulckaen and Stampini (2002) show in detail that a tax on labor amplifies commodity tax rate differentials.

$$dt^1 = -\frac{-\iota' x_n}{-\iota' x_1} \cdot dt^n \tag{2.7}$$

Subscripts indicate the price with respect to which every element of the vector is differentiated. The term $\frac{-\iota' x_n}{-\iota' x_1}$ is the ratio between the marginal revenue of the two taxes affected by the reform[4]. We assume that both taxes are revenue increasing, so that $\frac{-\iota' \mathbf{x}_n}{-\iota' \mathbf{x}_1} > 0,\ \mathbf{dt^1} > 0,\ \mathbf{dt^n} < 0$.

It is useful to write equation 2.7 as:

$$dt^1 = -\alpha \cdot \frac{x^n}{x^1} \cdot dt^n \tag{2.8}$$

where $\alpha = \frac{\frac{-\iota' x_n}{x^n}}{\frac{-\iota' x_1}{x^1}}$ is the ratio between the revenue potentialities (*RRP*) of the two taxes; each revenue potentiality is defined as the ratio between marginal revenue and initial tax base:

$$RRP^i = \frac{\partial r / \partial t^i}{x^i} = \frac{-\iota' x_i}{x^i} \tag{2.9}$$

Equation 2.6 can now be written as:

$$\frac{dU^{(1,n)}}{\lambda} = -(1-\alpha) \cdot x^n \cdot dt^n \tag{2.10}$$

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[4] The budget constraint of the public sector is given by:

$r = \mathbf{t}'\mathbf{x}(\mathbf{q}(\mathbf{t}), y)$

Hence: $\frac{\partial r}{\partial t^i} = x^i + \mathbf{t}'\mathbf{x}_i$.

By differentiating the budget constraint of the individual consumer $\boldsymbol{q}'\boldsymbol{x} = 0$ we obtain:

$x^i + \boldsymbol{q}'\boldsymbol{x}_i = 0$.

It follows that:

$\frac{\partial r}{\partial t^i} = x^i + \mathbf{t}'\mathbf{x}_i - x^i - \mathbf{q}'\mathbf{x}_i = -\iota'\mathbf{x}_i$

is the marginal revenue of tax *i*.

Tax reforms increase welfare when the tax burden is transferred from taxes with low revenue potentiality to taxes with higher revenue potentiality, i.e. when $\alpha<1$. The intuition behind this result is that taxes which can produce revenue "more easily" generate less distortions.

According to equation 2.10, the welfare effect of any possible tax reform can be evaluated without measuring utility, simply by estimating and comparing the revenue potentialities of two taxes.

3. APPLIED MODEL FOR SIMULATIONS

To evaluate the performance of revenue potentialities in more complex frameworks (as opposed to the simple theoretical model discussed above) we have simulated fiscal reforms within a computable general equilibrium model of the Italian economy with which the authors had worked in recent years. Details can be found in Accardo et al. (2002). The model is a standard, static and perfectly competitive model which had been calibrated on the basis of a social accounting matrix (SAM) for 1993 derived from the Input-Output table for year 1990. As our aim is not identifying potentially positive tax reforms for the Italian economy, but rather verifying the forecasting power of revenue potentialities, the year to which the SAM is referred is not of fundamental importance.

The model encompasses 30 production sectors, each producing a single output using intermediate inputs of all other goods, primary factors and imported goods, which are considered different from domestic goods consistently with the Armington assumption.

The 30th sector aggregates the final branches of the Input-Output table and represents the supply of public services. There is also an additional sector corresponding to investements and variation of inventories of the Input-Output table which produces the so called "investment good" using inputs of all other goods, in fixed proportions, but no primary factors: its output is demanded by consumers as savings, by production sectors in order to model depreciation and is also employed to model trade and public deficits (or surpluses).

There are three primary factors: capital whose supply is fixed and two types of labour with variable supply; self employed workers are distinct from employees though the variable supply is modeled for a labour aggregate in order to reproduce an uncompensated wage elasticity equal to 0.2.

The model encompasses three consumers: a private household, whose utility depends on leisure and consumption of commodities; a "public household" demanding the output of the 30th sector, collecting total tax revenue and making transfers to consumers; a third, fictitious, consumer models the transactions with the rest of the world: it demands total exports and supplies each imported good according to fixed price elasticity functions.

Both on the production and on the consumption side constant elasticity of substitution functions are employed. Each production sector is modeled as a three stage nested structure: at the bottom stage there are two nests, one producing value added through the use of primary factors, according to a Cobb-Douglas function, while the other aggregates intermediate inputs and the investment good in fixed proportions (zero elasticity of substitution). This aggregate enters a higher stage where it combines with imported good of the same type as that produced by the sector, according to an elasticity of substitution equal to 0.1. Finally, at the top stage, value added and the aggregate of domestic intermediate and imported goods are combined, with a zero elasticity of substitution, to give the sectoral output.

The utility function of the aggregate private consumer has a three stage structure. At the bottom, the thirty commodities are aggregated into a single consumption good according to an elasticity of substitution equal to 0.5; this aggregate enters a higher stage, where it is combined with leisure in order to obtain what we call present consumption: the derived aggregate labor supply is then divided into the two types of labor in fixed proportions; at the top stage, present consumption is combined with the investment good according to a Cobb-Douglas function.

The aggregate consumer has a disposable income made of capital income from the public household (interests on public debt) and production sectors, labor income (of both types), and transfers from the public household (pensions and other subsidies).

The modelization of the tax system is quite complex and complete. On the production side bear net indirect taxes, tariffs, part of the value added tax (VAT), energy specific taxes, social security contributions on wages and income from self-employment, local taxes on capital income (ILOR[5]). On the consumption side bear

[5] This tax no longer exists (but existed in 1993).

personal income taxes (IRPEF), corporate income taxes (IRPEG), taxes on real estate capital gains (INVIM), deduction on interests, car property fees and, most important, VAT on final consumption.

The value added tax on final consumption deserves a more detailed explanation as this is the subject of our simulations. In the social accounting matrix, value added taxes bear on all sectors but "Letting of dwellings, imputed rents" (Sector 28) and "Public administration" (Sector 30), which are exempt. However, "Construction and public works" (Sector 18), "Trade"(Sector 20) and "Mining of metal ores" (Sector 3) have a very low level of final consumption: the first sells a big part of its production to the Public Administration, the others do not sell directly to final consumers. Hence, VAT bearing on these sectors is modeled as indirect tax on total production rather than VAT. Overall, possible reforms can then affect 25 value added tax rates.

The main source of data is the input-output table of the Italian economy in 1990 released by the National Institute of Statistics (ISTAT), projected to 1993 and reaggregated in thirty sectors/commodities. As far as concerns taxation and social security contributions, information was provided by ISTAT (1997) and Ministry of Budget and Economic Planning (Ministero del Bilancio e della Programmazione Economica, 1993, 1994).

With respect to the theoretical model described in Section 2, the applied model is characterized by a high degree of complexity. Several differences are noteworthy. In particular:

- intermediate goods exist, so that only part of total production affects consumer welfare directly;
- consumption taxes interact with many other types of taxes on income, production and imports;
- labor is not the only production factor;
- the economy is open to trade with the rest of world.

Within this framework, which attempts to reproduce the complexity of real world economies, we aim to assess if revenue potentialities can be used for the evaluation of welfare effects of commodity tax reforms.

4. METHODOLOGY AND RESULTS

For the reasons explained in Section 3, value added taxes bear on 25 commodities. For each one, we simulate 24 reforms. Overall, we therefore simulate 600 revenue-neutral tax reforms[6].

4.1. METHODOLOGICAL APPROACH

The marginal revenue and hence the revenue potentiality of each commodity tax (RRP^i ; i=1, … 25) is computed within the CGE model, by simulating a marginal increase in the tax rate.

We then formulate forecasts on the desirability of each tax reform. We do it both with respect to the rule in equation 2.10 – based on revenue potentialities - and to Hatta's rule - based on tax rates only. According to the former, we expect that a revenue neutral tax reform which increases the rate on commodity i and reduces the rate on commodity j will increase (decrease) welfare if RRP^i is greater (smaller) than RRP^j (i.e. if α in equation 2.10 is less than 1). Following the latter, welfare is expected to increase (decrease) if t^i is lower (higher) than t^j. In both cases, the expectation on the welfare change for the reform (i,j) is inverse in sign to the one for the reform (j,i). If we predict that reform (i,j) increases (reduces) welfare, then we also predict that reform (j,i) reduces (increases) it.

The following task is to simulate tax reforms and to compute the welfare change for the representative consumer in terms of equivalent variation ($dU^{i,j}$). The first finding is that the sign of the welfare change produced by reform (i,j) is inverse to the one produced by reform (j,i). If reform (i,j) increases (reduces) welfare, then reform (j,i) reduces (increases) it.

By comparing expected (ex ante) and resulting (ex post) sign of the welfare change of each reform, we can build a matrix of successes and errors in forecasting. The matrix is square, with dimension 25*25; the main diagonal is empty, representing trivial reforms that increase and reduce the same tax rate, at once. Each cell of the matrix corresponds to one reform.

Both matrices of forecasts are symmetric. If our forecast of the welfare change sign produced by reform (i,j) is correct (mistaken), then the same is true for reform (j,i). In the following section, we

[6] Simulations are performed with MPSGE, a software specifically prepared for computable general equilibrium models; for details see Rutherford (1994).

analyze the quality of predictions (the share of successful forecasts) based on both rules.

4.2. MAIN FINDINGS

Following the procedure of assessment outlined in Section 4.1, we find that the comparison between tax revenue potentialities correctly forecasts the sign of welfare effects of revenue-neutral commodity tax reforms in 83 percent of cases.

Following Hatta's rule, i.e. by comparing total commodity tax rates (made of consumption taxes, net production taxes, energy specific taxes, tariffs on imports[7]), the percentage of successful predictions amounts to 64 percent. Therefore, at a first look, Hatta's rule proves to be less effective in forecasting welfare effects of tax reforms.

We are now interested in understanding the causes of forecasting errors. We aim at identifying the cases in which the comparison of revenue potentialities must be used more carefully and the cases in which, instead, the criteria can be used safely for policy decisions. We carry out two kinds of analysis. First, we analyze sectors in order to identify characteristics associated with high numbers of forecasting errors. Second, we focus on reforms, considering the characteristics of both sectors involved.

4.2.1. SECTOR CHARACTERISTICS AND FORECASTING RELIABILITY

In this section we make reference to the revenue potentiality rule only. Table 1 reports sector characteristics and the number of forecasting errors[8].

The quality of forecasts is not uniform; the number of errors varies notably by sector, from a minimum of zero for "Energy products", "Agricultural and industrial machinery", "Miscellaneous manufacturing" and "Other services" (the effect of all 24 possible

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[7] The performance of the rule based on the comparison of consumption taxes only is worse than the one based on total commodity taxes.

[8] As the matrix of forecasts is symmetric, "sector" can be intended indifferently either as the activity in which the commodity tax rate increases (with revenue-neutrality guaranteed by a rebate in the other 24 tax rates, in 24 different reforms) or as the one in which the commodity tax rate decreases (with revenue-neutrality guaranteed by increases in other commodity tax rates).

tax reforms is forecasted correctly) to a maximum of eight for "Business services".

Table 1 reports information on the destination of total production, i.e. on the share used as intermediate input, consumed by households, purchased for investment purposes, demanded by the State (public expenditure) or by the rest of the world (exports). Remarkable differences can be noticed. For example, on average 39 percent of production is consumed by households; however, this share varies from a minimum of 1 percent, for "Agricultural and industrial machinery", to a maximum of 88 percent, for "Hotels and restaurants". Similar variability can be observed in the share used as input by other sectors. It is interesting to notice that on average 12 percent of total production is exported, with peaks of 37 percent for "Agricultural and industrial machinery" and 68 percent for "Water and air transport".

By analyzing the characteristics of the sectors, we can get a first idea on which deviations from the theoretical model determine a higher number of forecasting errors. The "Energy products" sector, for which we are able to predict the result of all reforms correctly, seems to have average characteristics, apart from the highest (non-consumption) commodity tax rate and the lowest revenue potentiality. In the "Agricultural and industrial machinery" sector, a very small share of production is allocated to final consumption, while exports are very important (remarkable differences with respect to the simple theoretical model), but forecasting is still perfect, probably because of the outstandingly high level of the revenue potentiality. "Miscellaneous manufacturing" and "Other services", the other sectors for which all predictions are correct, are characterized by average tax rates and revenue potentiality, but have a very high share of production allocated to final consumption. The sector which supplies "Business services", for which the share of wrong forecasts is highest, has a very high share of production used by other sectors as input in production and a very low share allocated to final consumption. It is interesting to look at the index of correlation between the number of errors in forecasts and other sector characteristics (Table 2). In general, it can be noticed that a higher share of final consumption is associated with better forecasting power. This is consistent with our expectation, as in the theoretical model all production is consumed by households. Other destinations of production are associated, to some extent, with increasing numbers of errors.

4.2.2. REFORM CHARACTERISTICS AND FORECAST RELIABILITY

Tax reform effects, so as the success of our forecasts, depend crucially on the characteristics of both sectors involved. Consistently with equation 2.10, we first analyze if success in prediction increases with the difference between revenue potentialities.

As the matrix of success in predictions is symmetric, only half cases need being considered. We restrict the analysis to the ones in which the revenue potentiality of the increasing tax is higher than the revenue potentiality of the decreasing one, so that $\alpha<1$. In these cases, a welfare increase is expected.

In Table 3, values of α – all below 1 – are divided in five quintiles (each one referring to sixty reforms). The lower the value of α – i.e. the bigger the difference between the two revenue potentialities – the higher the probability of success of the predictions based on Equation 2.10. The percentage of successful forecasts is equal to 60 percent when α lies between 0.98 and 1 (fifth quintile), amounts to 75 percent when α is between 0.955 and 0.98 (fourth quintile) and grows to more than 90 percent when α is lower than 0.919. The share of correct forecasts increases monotonically when α decreases, up to a maximum of 98 percent for the first quintile (α below 0.876). All forecasts are correct when α is lower than 0.85 (the revenue potentiality of the increasing tax is 17 percent higher than the one of the decreasing one – not shown in the Table). This suggests that the policy maker should start reforming the tax system by increasing the rate of the tax with highest revenue potentiality and decreasing the one with lowest revenue potentiality[9]. These are not only the cases in which forecasts are most reliable, but also the reforms that guarantee a higher increase in welfare. In fact, Table 3 shows also that the welfare change is inversely and monotonically related with the value of α.

The quality of the performance of Hatta's rule, based on the difference between total commodity tax rates, is analyzed in Table 4. Again, being the matrix of success in predictions symmetric, for every couple of commodities we consider the reform which

[9] It can be noted the analogy with Hatta's suggestion to start reforming by increasing the lowest tax rate and decreasing the highest.

increases the lower tax rate and decreases the higher. These are the reforms for which an increase in welfare is expected. In Table 4, tax rate differentials are divided in five quintiles. Not only the overall share of correct forecasts is lower than for the revenue potentiality rule, amounting to 64 percent, but precision does not increase monotonically with tax rate differentials. The third quintile, regarding the cases in which the decreasing tax rate is 3.8 to 7 percent higher than the increasing, is the one with the lowest percentage of correct forecasts (45 percent). Furthermore, the tax rate differential does not appear to be a good indicator of the change in welfare. For all cases considered in Table 4, a welfare increase is expected. Nevertheless, the average welfare effect of the reforms of the three median quintiles is negative. The performance of Hatta's rule in a more complex economy is therefore not satisfactory. The simple comparison of commodity tax rates does not account properly for the interaction among different kinds of taxation and for the behavioral responses of consumer and producers in a non-basic model.

In order to better understand the performance of predictions based on revenue potentialities, we analyze the effect of two major differences between the theoretical model and real economies, as mirrored by the applied CGE model. We focus on the share of total production allocated to final consumption and on the level of other commodity taxes (net production taxes, energy specific taxes, tariffs on imports). In the theoretical model, in fact, all production is consumed and taxes on final consumption are the only form of taxation.

Table 5 shows how forecast reliability, given the value of α, is affected by the level of production allocated to household consumption. Three cases are considered: the share of consumption is in both sectors below the median, the share is below the median in one sector and above in the other, the share is above the median in both sectors. The last case is the closest to the assumption of the theoretical model. With the exception of the category in which the difference between revenue potentialities is smallest (fifth quintile), the share of production allocated to consumption does play a role. Predictions are systematically more reliable when the share of consumption is high in both sectors affected by the reform. In this case, all predictions are correct if α is smaller than 0.955. In the fourth quintile, for values of α between 0.955 and 0.98, 94 percent of predictions are correct.

Table 6 shows how forecast reliability, given the value of α, is affected by the level of other commodity taxes. This characteristic of the sectors involved in the reform does not seem to play a significant role, suggesting that revenue potentialities effectively pick up the effect of the interaction among different taxes. The reliability of predictions is not systematically higher when other commodity taxes are low (below the median in both sectors), as we would expect.

Overall, the comparison between tax revenue potentialities seems to be a reliable tool for policy decisions regarding commodity tax reforms. Reliability increases with the difference between tax revenue potentialities, especially when the reform regards sectors with high shares of production consumed by households.

4.2.3. POLICY IMPLICATIONS

A list of reforms characterized by high difference between revenue potentialities and by high shares of final consumption in both sectors – the set for which our predictions are most reliable – is provided in Table 7.

Though the effects of all reforms involving the energy sector are predicted correctly, suggesting a decrease in energy taxes, we do not include such reforms in Table 7. In fact, energy consumption is responsible for the production of major negative environmental externalities. It is possible that the high level of taxation on this category of commodities is due to the will to correct such distortions and set the right incentives for private choices. Our model could accommodate externalities and be used to derive a decision rule for cases in which consumption distortions and other distortions change in opposite directions, creating a trade-off, but this goes beyond the scope of the present paper.

Simulations suggest that an increase in efficiency could be obtained by increasing the taxation on consumption of services (in particular in the sectors “Hotel and restaurants” and “Communications”) and agricultural goods and by reducing the taxation on commodities produced by the manufacturing industries (in particular in the sectors “Textiles, made-up textiles articles” and “Leather, footwear”). The policy maker could either concentrate on specific sectors, using the indications of Table 7, or take a more comprehensive stand and operate on groups of sectors (i.e.

agricultural sector, manufacturing industry, services) studying the right combination of tax rates changes.

A caveat to the above policy recommendations is related to the year of the Social Accounting Matrix on which the model is calibrated. The release of a new input-output table by the National Institute of Statistics would help providing more relevant recommendations for the current policy debate. However, our simulations use data among the most recent officially available and a certain lag is normal in the applied literature on tax reforms. A second caveat is related to the transaction costs of changing and differentiating the tax rate structure, including political and social bargaining (the need to reach an agreement between government and opposition parties, and with the worker unions) and the administrative costs of the change. Nonetheless, simulations identifying profitable direction of tax reforms are still valuable tools to lead the first steps of the process ending in concrete political decisions. Eventually, our simulations involved the value added tax, on which discretionary change by a single member of the European Union are not viable. However, it should be reminded that nominal and effective tax rates differ broadly and that the government could still affect the latter by operating on tax deductions and by fighting tax evasion.

The above caveats do not diminish the relevance of our work, mainly because our fundamental goal was not (only) identifying welfare improving commodity tax reforms, but rather evaluating the performance of the revenue potentiality rule.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

A simple theoretical model shows that the desirability of revenue-neutral commodity tax reforms can be assessed without utility measures, through the comparison of the ratio between marginal revenues and tax bases, i.e. through the comparison of revenue potentialities. Nevertheless, empirical works have so far failed to exploit this result and have extensively relied on MCFs and measures of utility. The performance of rules which do not require utility measures has never been evaluated. Our paper had two goals. The main one was to provide a first attempt to evaluate the reliability of the policy rule based on revenue potentialities, when applied to the more complex setting of a real economy, as mirrored by a CGE model.

Six hundred possible consumption tax reforms were simulated, with very encouraging results. Overall, forecasts based on the revenue potentiality rule were correct in 83 percent of cases. By increasing the rate of a tax with higher revenue potentiality and decreasing the rate of a tax with lower potentiality, an increase in welfare was obtained in 83 percent of cases.

The assessment was further refined with a more detailed analysis of forecasting errors. We showed that the quality of forecasts increased to 100 percent when revenue potentialities were sufficiently differentiated. This suggests that the policy maker should start reforming the tax system by increasing the rate of the tax with the highest revenue potentiality (and decreasing the rate of the tax with the lowest). Furthermore, the ratio between revenue potentialities performed well as indicator of the size of the change in welfare. The reliability of forecasts improved further when a high share of the production of the two sectors was allocated to final consumption.

Also the performance of Hatta's rule – the simplest possible – based on the comparison of commodity tax rates, was evaluated. Results were less encouraging. Forecasts were correct in 64 percent of cases and their reliability did not increase when tax rates were more differentiated. In addition, the difference between tax rates did not provide good indications on the magnitude of the change in welfare.

Overall, revenue potentialities proved to be reliable indicators. They seem to provide the policy maker interested in reforming the commodity tax system with sufficient information to obtain an increase in efficiency and welfare. However, we are aware of the fact that our result may vary within alternative models, with different frameworks and characteristics. Therefore, our second goal was to point out the general need for evaluation, show a possible way of performing it and invite other scholars to verify the generality of our results.

Eventually, an interesting extension of the present work will be to apply the revenue potentiality concept to other kinds of taxes, mainly on labor and capital income. In fact, the reliability of revenue potentialities as indicators of the welfare change produced by tax reforms holds theoretically for every tax which may be of interest for the policy maker.

TABLES

Table 1 – Sector characteristics and forecasting errors (average values of production shares and tax rates are weighted by production size).

	Sector	*Production*	*Intermediate Input*	*C*	*G*	*I*	*Export*	*Import*	*CT*	*VAT*	*RRP (*1000)*	*N. forecasting errors (rrp rule)*
		bln. €	% of production						%	%		n.
1	Agriculture, cattle, forestry, fishing	57	0.45	0.50	0.01	0.00	0.05	0.13	-0.24	0.01	9.237	5
2	Energy products	62	0.52	0.39	0.04	0.01	0.04	0.22	0.33	0.09	7.192	0
4	Other mining and quarrying	28	0.72	0.05	0.01	0.06	0.16	0.08	0.01	0.04	9.879	6
5	Chemicals and pharmaceuticals	57	0.43	0.38	0.04	0.01	0.14	0.25	0.02	0.05	8.299	4
6	Metal products	40	0.57	0.07	0.01	0.21	0.14	0.05	0.01	0.10	9.146	5
7	Agricultural and industrial machinery	50	0.14	0.01	0.02	0.47	0.37	0.17	0.01	0.04	10.714	0
8	Office machinery, precision, optical inst.	16	0.09	0.20	0.04	0.41	0.25	0.34	0.03	0.07	9.409	4
9	Electrical equipment	43	0.26	0.23	0.02	0.29	0.21	0.25	0.03	0.08	9.215	4
10	Transport equipment	52	0.09	0.35	0.04	0.29	0.22	0.26	0.02	0.12	8.421	6
11	Food products, tobacco, alcoholic bev.	88	0.22	0.72	0.02	0.00	0.05	0.10	0.03	0.04	8.387	6
12	Textiles, made-up textile articles	54	0.05	0.69	0.00	0.01	0.24	0.10	0.01	0.04	8.244	4
13	Leather, footwear	19	0.05	0.61	0.01	0.00	0.33	0.09	0.01	0.06	8.258	5
14	Wood, wood furniture	22	0.21	0.51	0.01	0.12	0.15	0.09	0.01	0.06	8.331	7
15	Paper, printing, publishing	26	0.48	0.34	0.09	0.01	0.08	0.12	0.00	0.05	8.117	6
16	Plastic and rubber	22	0.64	0.17	0.02	0.01	0.16	0.10	0.01	0.05	8.562	2
17	Miscellaneous manufacturing	16	0.05	0.72	0.01	0.02	0.20	0.08	0.01	0.07	8.109	0
19	Recycling, repair	25	0.54	0.42	0.03	0.01	0.00	0.04	0.01	0.09	8.327	6
21	Hotels and restaurants	46	0.11	0.88	0.01	0.00	0.00	0.00	0.00	0.05	8.785	3
22	Land transport, transport via pipelines	34	0.81	0.16	0.01	0.00	0.01	0.00	-0.26	0.16	8.648	3
23	Water and air transport	11	0.20	0.10	0.02	0.00	0.68	0.10	0.00	0.05	8.984	6
24	Supporting and auxiliary transport act.	13	0.83	0.14	0.01	0.00	0.02	0.13	0.00	0.03	8.809	6
25	Communications	13	0.52	0.35	0.09	0.00	0.03	0.02	-0.08	0.05	8.472	2
26	Financial intermediation, insurance	49	0.89	0.05	0.02	0.00	0.04	0.06	0.07	0.05	9.202	6
27	Business services	57	0.75	0.05	0.10	0.04	0.06	0.08	0.02	0.15	8.464	8
29	Other service activities	53	0.17	0.79	0.03	0.00	0.01	0.02	0.02	0.03	8.454	0
	MIN	11	0.05	0.01	0.00	0.00	0.00	0.00	-0.26	0.01	7.192	0
	MAX	88	0.89	0.88	0.10	0.47	0.68	0.34	0.33	0.16	10.714	8
	AVERAGE	38	0.38	0.39	0.03	0.08	0.12	0.12	0.01	0.07		

Table 2 – Correlation between forecasting errors and sector characteristics.

Correlation Index	N. forecasting errors
Intermediate input (%)	.27
Consumption (%)	- .29
G (%)	.08
Export (%)	.06

Table 3 – Relation between value of α and share of successful forecasting.

α range		Share of correct forecasts	Mean welfare change (mln. Euros)	Number of cases
0.671	0.876	0.98	8.032	60
0.878	0.919	0.93	4.838	60
0.919	0.955	0.87	3.174	60
0.955	0.980	0.75	1.961	60
0.980	1.000	0.60	0.807	60
Total		0.83		300

Table 4 – Relation between difference between total commodity tax rates and share of successful forecasting.

Tax rate differential range		Share of correct forecasts	Mean welfare change (mln. Euros)	Number of cases
0.000	0.016	0.63	0.678	60
0.016	0.038	0.70	-0.787	60
0.038	0.070	0.45	-2.586	60
0.070	0.161	0.60	-1.566	60
0.165	0.641	0.82	6.122	60
Total		0.64		300

Table 5 – Relation between value of α, share of consumption in the sectors involved in the reform and share of successful forecasting.

		Share of consumption in the two sectors			
α range		Both below median	One below, one above median	Both above median	Total
0.671	0.876	0.93	1.00	1.00	0.98
0.878	0.919	0.70	0.97	1.00	0.93
0.919	0.955	0.71	0.94	1.00	0.87
0.955	0.980	0.46	0.77	0.94	0.75
0.980	1.000	0.63	0.70	0.53	0.60
Total		0.70	0.90	0.80	0.83

Table 6 – Relation between value of α, other (than consumption) commodity tax rates in the sectors involved in the reform and share of successful forecasting.

		Rates of other commodity taxes			
α range		Both below median	One below, one above median	Both above median	Total
0.671	0.876	1.00	0.97	1.00	0.98
0.878	0.919	0.80	0.96	0.96	0.93
0.919	0.955	0.91	0.86	0.75	0.87
0.955	0.980	0.88	0.71	0.67	0.75
0.980	1.000	0.67	0.56	0.62	0.60
Total		0.85	0.81	0.85	0.83

Table 7 – List of reforms with sufficiently differentiated revenue potentialities and high share of final consumption in both sectors (group with no forecasting errors).

Sector whose tax is increased	Sector whose tax is decreased	alpha	Mean welfare change (mln. Euros)
Agriculture, cattle, forestry, fishing	Misc. Manufacturing	0.878	6.094
Agriculture, cattle, forestry, fishing	Textiles, made-up textiles art.	0.892	4.664
Agriculture, cattle, forestry, fishing	Leather, footwear	0.894	4.235
Agriculture, cattle, forestry, fishing	Chemicals and pharmaceuticals	0.898	3.522
Agriculture, cattle, forestry, fishing	Recycling, repair	0.901	4.276
Agriculture, cattle, forestry, fishing	Wood, wood furniture	0.902	4.715
Agriculture, cattle, forestry, fishing	Food products, tobacco, alch.	0.908	5.474
Agriculture, cattle, forestry, fishing	Transport equipment	0.912	4.813
Agriculture, cattle, forestry, fishing	Other service activities	0.915	2.185
Agriculture, cattle, forestry, fishing	Communications	0.917	1.482
Hotels and restaurants	Misc. Manufacturing	0.923	20.968
Hotels and restaurants	Textiles, made-up textiles art.	0.938	14.822
Hotels and restaurants	Leather, footwear	0.940	12.963
Hotels and restaurants	Chemicals and pharmaceuticals	0.945	9.916
Hotels and restaurants	Recycling, repair	0.948	13.118
Hotels and restaurants	Wood, wood furniture	0.948	15.029
Agriculture, cattle, forestry, fishing	Hotels and restaurants	0.951	1.239
Hotels and restaurants	Food products, tobacco, alch.	0.955	18.438
Communications	Misc. Manufacturing	0.957	2.371
Hotels and restaurants	Transport equipment	0.959	15.494
Other service activities	Misc. Manufacturing	0.959	9.503
Hotels and restaurants	Other service activities	0.962	4.075
Transport equipment	Misc. Manufacturing	0.963	9.864
Hotels and restaurants	Communications	0.964	0.914
Food products, tobacco, alch.	Misc. Manufacturing	0.967	3.718
Communications	Textiles, made-up textiles art.	0.973	1.637
Wood, wood furniture	Misc. Manufacturing	0.973	2.278
Recycling, repair	Misc. Manufacturing	0.974	3.548
Communications	Leather, footwear	0.975	1.415
Other service activities	Textiles, made-up textiles art.	0.975	6.043
Other service activities	Leather, footwear	0.977	4.989
Chemicals and pharmaceuticals	Misc. Manufacturing	0.977	8.676
Communications	Chemicals and pharmaceuticals	0.980	1.048

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