Micro-Macro Simulation of Corporate Tax Reforms

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Abstract Firm models are relatively rare in spite of the large number of models for households presented in the literature. The aim of this chapter is twofold. First, we illustrate the new microeconometric model on corporations currently used by Istat for revenue forecasting and policy analysis. Second, we discuss the advantages of combining microsimulation and computable general equilibrium models in simulating of corporate tax reforms.

Keywords Microsimulation · Taxation · General equilibrium · Ex-ante policy analysis

1 Introduction

The purpose of this chapter is to discuss how microsimulation and computable general equilibrium model (CGE) models can be effectively integrated in evaluating the impact of fundamental corporate tax reform proposals. While the use of microsimulation models is essential in modelling the distributive effects of corporate taxation and revenue forecast, it is limited, in the case of reforms involving changes in prices, wages and macro variables, by the inability of this kind of tools to model adjustments in several markets. Governments influence market outcomes by altering prices by means of taxes and subsidies and might exert significant impact on investment and the economic growth rate of various sectors of the economy. By contrast, CGE models—through their theoretical foundation in microeconomics—are powerful tools in the assessment of the impact of exogenous variables and policy measures (i.e., tax rates) on economic equilibria (i.e., prices and quantities) by the interaction of the demand and supply in goods and factor markets. However, since CGE models are based only on a few types of firms, they are unable to capture the full range of heterogeneity across firms. Henceforth, CGE models may fail to account for large part

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of both the distributional effects and the revenue impact associated to the economic adjustments.

In spite of the fact that firms are central units in economic decision-making, and information on the distributional and economic impact of business taxation is highly relevant for economic policy, to the best of my knowledge, no attempt has been made to combine microsimulation with CGE and macro modelling for the analysis of fundamental corporate tax reforms. For instance, the adoption of corporate tax reforms proposed in the literature to address the corporate debt bias was studied using several applied general equilibrium models (Keuschnigg and Diez 2007; Radulescu and Stimmerlmayr 2007; de Mooij and Devereux 2011) as well as in microsimulation analysis (see Finke et al. 2014; Caiumi and Di Biagio 2015), but the two methodologies were never combined.

Analogously, the proposal to adopt a single set of rules for companies operating within the EU was separately assessed through general equilibrium models (Betterndorf et al. 2009) and microsimulation studies (Fuest et al. 2007; Devereux and Loretz 2008). More recently, the re-launch of the Common Consolidated Corporate Tax Base (CCCTB) reform proposal was examined in the impact assessment using CORTAX, a CGE model describing 28 countries of the European Union, other relevant economies in the world, such as the US and Japan, and a tax haven. Macroeconomic results show that a fairer and more efficient corporate tax system will positively affect investment, employment, GDP and welfare in Europe. However, results vary across countries and the CORTAX model fail to provide forecast value for the tax revenue impact of the CCCTB for each Member State. For this purpose, the simulation exercise based on CORTAX should be complemented with a microsimulation approach. Alternative modelling approaches easier to implement, such as drawing a whole distribution of 'effective tax rates' based on the approach proposed by Eeger et al. (2009) and building models for 'average firms' in the sub-groups of the whole population,[1] are not adequate to account for relevant impact of policy measures for heterogeneous populations.

More recently, Bhatterai et al. (2017) simulated the effects of corporate tax reform proposals in the United States, using a two-tier modelling design, with a large dynamic computable general equilibrium model to address the macroeconomic magnitudes. The dynamic CGE was also linked to a micro-simulation tax calculator model to measure the distributional effects on household income, while disregarding the impact on corporations.

Given this evolving background of converging macro and micro approaches, this chapter analyzes the advantages of combining microsimulation and computable general equilibrium models in simulating corporate tax reforms. To this aim, it also illustrates the analytical potential of the new micro-econometric model on corporations currently used by Istat for revenue forecasting and policy analysis. The chapter is organized as follows. Section 2 is devoted to the main tenets of microsimulation analysis of corporate tax reforms. Section 3 presents ISTAT-MATIS a new microsimulation model on corporations developed by the Italian National Institute of Statistics

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[1] See for an example, Roggeman et al. (2014) based on the 'European Tax Analyzer' (Spengel 1995).

(ISTAT). Section 4 illustrates the ex-ante full distributional impact of the adoption of an allowance for corporate equity regime in Italy using MATIS. Section 5 concludes.

2 Microsimulation Modelling for Policy Analysis at the Firm Level

Corporate tax microsimulation models compute the net tax liabilities for individual firms and are used to forecast the revenue impact as well as the distributional consequences of tax reforms. These models are ultimately used to assess ex-ante whether policy initiatives had the intended or unintended effects on relevant targeted groups of the firm's population.

Compared to the expanding literature on households, microsimulation models for firms are relatively rare (for a survey see Ahmed 2006; Buslei et al. 2014). Firm models are more complex than household models both because firm behaviour involves inter-temporal aspects and tax rules are usually also more complex. In addition, access to firm data, especially tax, is more restricted compared to household data.

The starting point for tax microsimulation models is a (large) microdata set which provides comprehensive information on the determinants of individual tax liabilities. In principle, corporate tax models require the use of two complementary company level data sources—confidential corporate tax return data and accounting data—because usually corporate taxable income differs from economic income. Corporate tax returns allow researchers to precisely determine the tax position of corporations in each fiscal year as well as to recover information on the use of non-debt tax shields, like capital allowances, losses carry forwards and preferential tax treatments. Knowledge of loss offsetting and firms' ability to shift taxable profits over time are especially important for revenue forecasting. However, to completely identify heterogeneity in business activities other information are required. In particular, company accounts provide information of interest on the economic determinants of corporate profits.

Information from financial statements integrated with other sources of economic content at the corporate level is also valuable when the scope of the analysis requires to go beyond 'the dry run' (also called first-round effects) and estimates of empirical behavioural models may be welcome. Corporate tax reforms are sometimes targeted at affecting firm behaviour, such as investment, employment and financing decisions, as well as profit-shifting incentives. It follows that a key shortcoming of static modelling is neglect of behavioural responses to policy changes.

One viable solution to overcome such limitation is enriching a static microsimulation model with elements of behavioural responses as proposed by Chetty (2009), thus avoiding the need to develop a fully specified structural behavioural model. This has been done in a study of the impact of German 2008 corporate tax reform by Finke et al. (2013) by complementing non-behavioural computation with elasticities

for several firm choice variables. Of course, there is a price to pay when the empirical measures of elasticities are taken from the related economic literature.

Another common shortcoming of firm's models is that they are usually static models—by definition—do not account for time, that is to say for the gradual entry into force of corporate tax reform. A notable exception is the ISTAT-MATIS microsimulation model which is based on a multi-period framework.

3   The ISTAT-MATIS Corporate Tax Model

ISTAT-MATIS is a corporate microsimulation model for Italy (for more details see Caiumi and Di Biagio 2015). MATIS simulates corporate tax liabilities according to fiscal rules and it is used on a regular basis by the Italian Central Institute of Statistics for revenue forecasting and policy analysis. It has two distinguishing features. First, it relies on the use of the largest complementary database in existence. To improve accuracy in revenue forecasting, the model relies on confidential corporate tax returns for all Italian corporations. Further, to assess ex-ante the full distributional impact of tax changes, the tax database is integrated with supplementary data.[2] The richness of the database allows to identify a broad range of category of firms in accordance with technological intensity, financing structure, profitability, size, age, location, export orientation, and ownership structure. Secondly, the model reproduces all the complexities of the corporate tax base through a multi-period framework.[3] This requires observations at the firm level for consecutive time periods (panel data). Currently, the integrated database covers the years 2005–2015.

Being based on the entire population of corporations, our results allows for conclusions on the distribution of the tax burden among taxpayers as well as on the revenue impact of tax changes. The model reproduces in detail the key features of the corporate tax in Italy, in particular the treatment of corporate losses, the consolidated taxation mechanism, the interest deductibility regulation, the local business tax and the allowance for corporate equity. At the current stage, the model does not account for behavioural responses by taxpayers to tax changes. Therefore, its analytical capacity is limited to first round effects.

The adopted model framework is particularly advantageous in the evaluation of tax reforms that are gradually introduced into force. Tax changes often provides advantages partially offset by restriction in other provisions and the sign of the net effect on tax liabilities may vary over time. More precisely, the model is aimed at monitoring the dynamic effects of an ACE-type regime that was integrated in the

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[2]The sources involved in the integration process are the company accounts database, the ISTAT archive on national business groups, the statistical register of Italian active enterprises (acronym ASIA), information on spin-offs and mergers, and business structural surveys, in particular the survey on foreign trade (COE), the survey on Italian enterprises controlled by foreign firms (Fatsinward) and the survey on resident firms with foreign subsidiaries (Fats-outward).

[3]For example, interest deduction add-backs (carry forwards), losses carry forwards and tax allowances carry forwards.

Italian tax law ('Aiuto alla Crescita Economica') in 2011 with the aim to remove the favourable tax treatment of debt and stimulate companies' own capitalizations.[4] In the next section, we show the potential of MATIS in highlighting the effects of the Italian ACE regime on the corporate tax burden.[5]

4 The Distributional Effects of Introducing an ACE-Type Regime

Under the new ACE regime, a notional return on equity is deductible against corporate profits. The Italian ACE is applied on an incremental basis in order to minimize revenue losses. Starting from tax period 2011, taxable income is split into two components, ordinary and above-normal return. Ordinary income is exempt under ACE. The ordinary return is computed by applying a notional interest rate to new equity generated after 2010. Therefore, the increments of equity capital cut down the average tax rate of benefiting firms gradually over time. In practice, an incremental ACE-type reform induces a selective abatement of the average tax rate depending on the financial policy of firms with increasing effects in the long run.

In Caiumi and Di Biagio (2014) the model was used to analyze the revenue impact and the distributional effects of the newly introduced ACE regime both in the short and in the long run. One crucial aspects of an incremental ACE is that benefits are granted on the net increments of equity accumulated from a certain point in time. In the long run, however, new equity would have replaced old equity then the tax benefit will be granted to the entire capital stock.

Figure 1 shows how the implementation of the ACE affects the distribution of average effective tax rates (ETR) computed as the ratio of the company's tax-debt over before tax-profits for the whole population of Italian corporations. After only four years from its introduction, in 2014, the new ACE has provided significant advantages to beneficiary firms. After computing the ACE deduction, the ETRs for this type of firms drop below or at same level of the ETRs estimated for non-beneficiary firms (26.2% points at the median value) that likely adopt different tax shields, such as debt. The estimated cut in the average effective tax rates equals 2.3% points at the median value.

Focusing on companies benefiting from the reform, the full implementation of the ACE regime is simulated by considering companies' total equity as the ACE base.

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[4]The ACE regime is a potential reform option that was originally proposed for the U.K by the Institute of Fiscal Studies (IFS 1991).

[5]A first scenario is obtained reproducing the legislation implemented in 2011 onwards over some consecutive periods (first year of simulation 2008). An alternative scenario ('Long-run ACE') is based on the assumption that ever since 2011 the ACE allowance were applied to the entire stock of equity. This simulation exercise (counterfactual scenario) allows investigating the impact of the *incremental* ACE in the long run, when companies would have accomplished a process of capitalization such that they will be granted a deduction against the taxable base for the entire stock of equity.
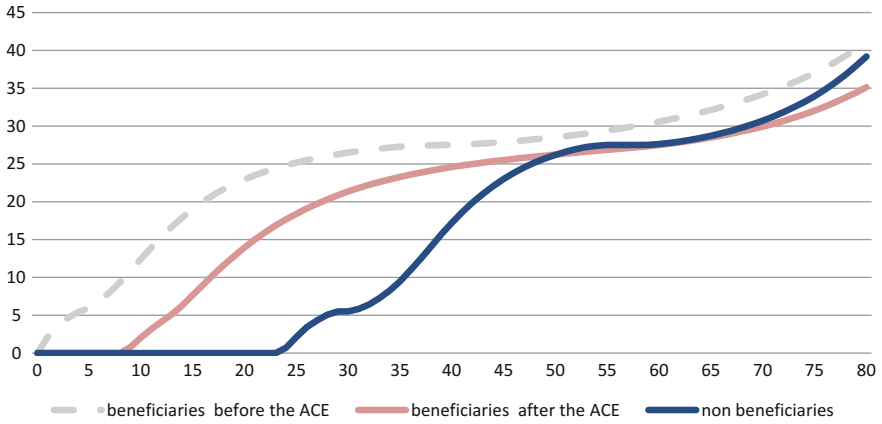
Fig. 1 The incremental ACE after 4 years from its implementation. Effective tax rates for ACE beneficiaries and non beneficiaries
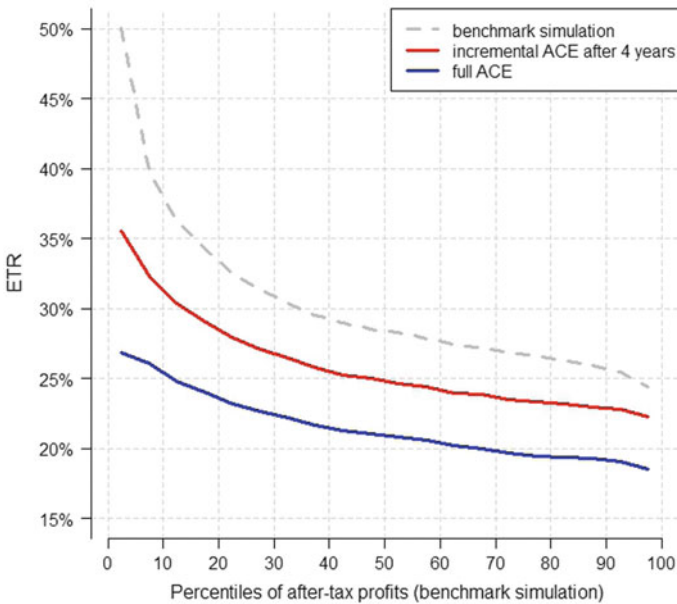
Fig. 2 The incremental ACE at work: short run and long run effects for beneficiary firms. Effective tax rates

Although ETRs are significantly further reduced for all companies, firms in the lower percentiles of the distribution of after-tax profits mostly benefit by the progressive convergence towards the full ACE regime (Fig. 2).

In Table 1 (ISTAT Annual Report (2014), Chap. 5) tax savings for beneficiary firms are measured in terms of the reduction of the statutory tax rate (27.5%), the average

tax rate (ATR) being computed as the ratio of the tax debt over the taxable base before the ACE deduction. In 2012, around 20% of the industrial and commercial companies benefited of the allowance mechanism with an average tax saving lower than 1% point (0.8%). After five years (in 2015) the share of beneficiaries will raise to 31.4% and the tax cut will increase to 2.9% points. In the long-run the entire stock of equity will be qualifying for ACE and almost half of the taxpayers will be granted a tax cut equal to 8.5% points of the statutory tax rate.[6]

Looking inside the distribution of the ACE benefits, we see that the ACE mechanism is more frequently used by manufacturing firms, especially those characterized by high and medium-high technological intensity. The share of beneficiaries also increases with firm size. However, the intensity of the tax benefits decreases with firm size, as the abatement of the statutory tax rate granted by the incremental ACE is higher for small firms in comparison to larger ones. This holds true both in the second year of implementation (real data) and after five years (simulation results). Indeed, the distributional effects increases over time, likely because the cumulative framework of the allowance mechanism. In 2012 the tax bonus ranges from 1.7% points for smaller firms (turnover less than 500,000 euro) to 0.6% points for larger ones (with turnover higher than 50 million of euro). After five years, in 2015, the tax discount ranges from almost 6% points for firms in the first turnover class to less than 2% points for larger firms. In the long run the latter effect vanishes, all firms are granted a *full* ACE deduction and the tax cut turns out to be less affected by firm size.

Figure 3 shows the differentials in the speed of convergence towards the *full* ACE. After five years the base qualifying for the ACE is approximately equal to 50% of the entire equity stock (*long-run* ACE base) for beneficiary firms with turnover lower than 500.000 euro, whereas it remains below 20% for corporations with turnover above 50 million euro. Therefore, smaller firms reach the tax exemption of the ordinary return of equity faster than larger companies. In contrast to the allegation that the ACE is mainly a tax relief for profitable and large firms, our microsimulation analysis shows that an ACE-type regime can be very beneficial for smaller companies and innovative firms that usually suffer from restrictions of their outside financing capacity. This is also confirmed by a recent econometric analysis on the effect to the Italian ACE on debt choices of companies (Branzoli and Caiumi 2017), showing that the reaction of SMEs to the changes in the tax incentives to equity financing has been even stronger than large companies.

Since firm size is usually identified at the core of different aspects explaining the poor performance of Italian firms, the ACE-type reform can proved to be a valuable policy option. To our knowledge this important result has not been highlighted in previous studies. In particular, this analysis can be compared in the literature with the study by Finke et al. (2014), which focus on the consequences of introducing an ACE regime in Germany using the behavioural microsimulation model ZEW

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[6]In this exercise, the ATR for year 2012 is computed directly from the tax returns data filed by corporations and fiscal groups ("UnicoSC" form and "CNM" form). The MATIS model was used to estimate the two alternative scenarios as described in footnote 4.

Table 1 The ACE at work: share of beneficiaries and average tax rate (2012 and 2015)

	Standalone companies and fiscal group	2012		2015		'Long-run ACE'	
		Beneficiaries (%)	Average tax rate (%)	Beneficiaries (%)	Average tax rate (%)	Beneficiaries (%)	Average tax rate (%)
Total	842,184	20.1	26.7	31.4	24.6	49.0	19.0
Economic sector							
Mining and manufacturing	128,411	26.0	26.7	36.4	24.8	54.6	19.6
Water, electricity, gas supply and sewerage	14,130	26.8	26.8	35.9	25.7	49.2	19.3
Construction	151,465	17.4	26.3	28.4	24.0	44.2	19.5
Trade	184,334	20.9	26.7	31.5	24.8	48.8	20.4
Other services	363,844	18.5	26.6	30.7	24.4	49.1	17.9
Technology and knowledge							
Manufacturing—technological intensity:							
High	3,881	30.0	26.9	39.2	25.7	57.7	20.7
Medium-high	23,338	32.0	26.8	42.6	25.3	61.5	19.8
Medium-low	50,304	26.3	26.6	37.2	23.9	55.6	18.2
Low	48,914	22.7	26.7	32.8	24.5	50.2	19.0
Services—knowledge intensity							
High	97,440	18.8	26.8	32.6	25.9	51.8	18.9
Low	450,738	19.4	26.5	30.6	23.4	48.4	18.4
Other	167,569	18.2	26.6	29.1	25.0	44.7	20.2

Table 1 (continued)

	Standalone companies and fiscal group	2012		2015		'Long-run ACE'	
		Beneficiaries (%)	Average tax rate (%)	Beneficiaries (%)	Average tax rate (%)	Beneficiaries (%)	Average tax rate (%)
Turnover							
<1	37,504	1.9	25.3	3.4	21.2	6.7	18.5
1–500.000	519,269	13.7	25.8	25.6	21.6	43.2	17.6
500.000–2 mln	178,061	28.2	26.4	41.4	23.3	61.6	19.5
2–10 mln	83,931	42.2	26.5	51.9	24.1	69.9	19.9
10–50 mln	19,204	51.1	26.7	56.7	24.5	73.4	19.4
>50 mln	4,215	54.2	26.9	56.4	25.6	73.7	18.7
Employees							
0	213,310	12.1	25.8	21.5	21.8	35.5	17.7
1–9	484,733	19.4	26.4	32.3	23.5	51.4	19.6
10–19	84,244	31.9	26.6	42.4	24.5	60.8	20.6
20–49	41,201	36.2	26.6	44.5	24.3	61.0	20.3
50–249	16,214	40.0	26.8	45.5	24.7	60.9	19.3
250–499	1,414	38.2	26.6	42.1	24.6	56.5	18.1
>=500	1,068	44.6	26.9	47.4	26.0	62.8	18.0
Location							
North West	243,762	25.1	26.8	38.0	24.8	56.0	19.2
North East	173,100	24.5	26.6	36.8	24.3	54.7	18.0
Centre	211,983	17.8	26.6	29.0	24.9	46.9	19.6
South	213,339	13.2	26.5	22.0	23.9	38.5	19.3
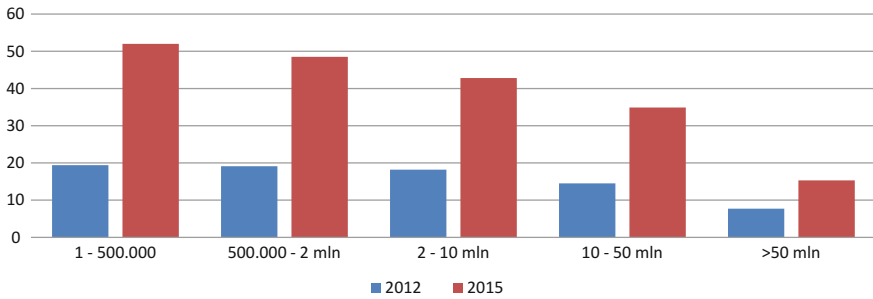
Fig. 3 Speed of convergence towards the *full* ACE by turnover class: ratio between net increments of equity over company's net worth (*percentage value*) *Source* ISTAT Annual Report, Chap. 5 (2014)

TaxCoMM. Their analysis relies however on clustering the sample of corporations in Germany based on structural parameters from the financial statements, instead of more direct firm characteristics, therefore restricting the possibility to precisely identify the reform "winners".

5   Concluding Remarks

The ISTAT-MATIS model provides many interesting insights on the dynamic role of an ACE-type regime on the tax burden distribution across the population of firms and over time. By relating the reform effects with the firm characteristics of policy interest, our analysis shows that the ACE relief is particularly favorable for smaller and innovative firms that are the backbone of our economy.

Nevertheless important developments of the toolbox remains to be accomplished in two key areas. The first relates to incorporating behavioural responses to tax reforms in our simulation framework. As the ACE, currently integrated into the Italian tax code in constancy of the statutory tax rate, entails a reduction of the incentive for indebtedness, not accounting for the debt/equity substitution effects implies that the revenue impact of the incentive mechanism is somewhat overestimated. Indeed, recent results (Branzoli and Caiumi 2017) suggests that the Italian ACE, although limited on capital increases, works effectively as a substitute for interest deductions in lowering the effective marginal tax rate for corporations. Of course, there are also other decision margins that may be affected by the reform. In principle, the ACE is designed not only to address the debt bias but also to promote investments. By decreasing the cost of capital, the allowance is expected to boost investment, leading to increased employment and growth all other things being equal. Location decisions and profit shifting, although relevant *per se*, are not of major concern in the current policy context in Italy, characterized by decreasing statutory tax rates. The second

area for improvement and for development is therefore to consider feedback effects between the micro and macro level.

A fully integrated micro-macro model is potentially a powerful tool to go beyond the partial equilibrium framework in which microsimulation models operate, if the objective is to disentangle the reform effects at the macro level and to explore the implications on welfare. The investment function estimated at the micro level can be aggregated and incorporated in the macro model which can be used to assess the overall impact of the reform—i.e. the introduction of the ACE (or its repeal if it is already implemented) for the context of interest here, on the economy as a whole and on tax collection, considering, in addition to corporate tax revenues, variation in personal income tax and consumption tax revenues triggered by the simulated policy changes.

It should be stressed that it would be relevant both for policy decision makers and the corporate community to have the opportunity to use the information stemming from the micro-macro simulation of tax reforms, incorporating institutional and economic changes in real time, through web accessible extension services targeted to all potential beneficiaries. The information is available, but its economic and social value has not been fully exploited yet.

This study may be interpreted as an initial endeavour towards a greater effort to routinely incorporate firms behaviour and their response to tax reforms in microsimulation models—not only at the national level but also at the EU level—and to consistently link them to macro analysis.

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