

CONCLUSION

In this thesis we analyse and investigate the method of linking Computable General Equilibrium (CGE) models to Microsimulation (MS) models which has recently developed in the literature that studies developing countries.

CGE models are useful instruments for the study of a reform or a shock that has economy-wide effects, and in particular of those reforms/shocks that can produce structural and sectoral changes on the whole economy. Anyway, one of the limits of CGE models is that, as they generally follow the representative household approach, they are often unable to capture within-group distribution and some specific individual agents' behaviour. This is however of particular importance when we want to carry out income inequality and poverty analysis.

On the other hand, microsimulation (MS) models are accurate instruments in the representation of the tax-benefit system, and in the analysis of individual behaviour (such as labour supply or consumption) in response to a change of the tax-benefit system. In this respect, microsimulation models are very helpful and precise in the study of income distribution and poverty issues, as they work at a very detailed level, that is at the level of the individual or of the single household. The main drawback of these models is that they carry out only partial equilibrium analyses, thus not being able to capture the general equilibrium impact of a reform of the tax-benefit system. Moreover, if we want to analyse the distributional and poverty effects of a reform which takes place at the macroeconomic level (as it could be for instance a reform of the trading system), this is simply not doable with a microsimulation model. However, this kind of studies can be very important for poverty and inequality issues, especially in the case of developing countries where structural shocks and macroeconomic reforms are more likely to take place.

Linking CGE and MS models allows to overcome simultaneously the limits of both models and to obtain a more comprehensive instrument for the analysis of the effects of policy reforms and structural shocks on poverty and inequality. The modelling tool resulting from the link of the two models is indeed able to account for full agents' heterogeneity and microeconomic behaviour at the individual or household level,

structural changes of the economy and general equilibrium effects of economic policies at the same time.

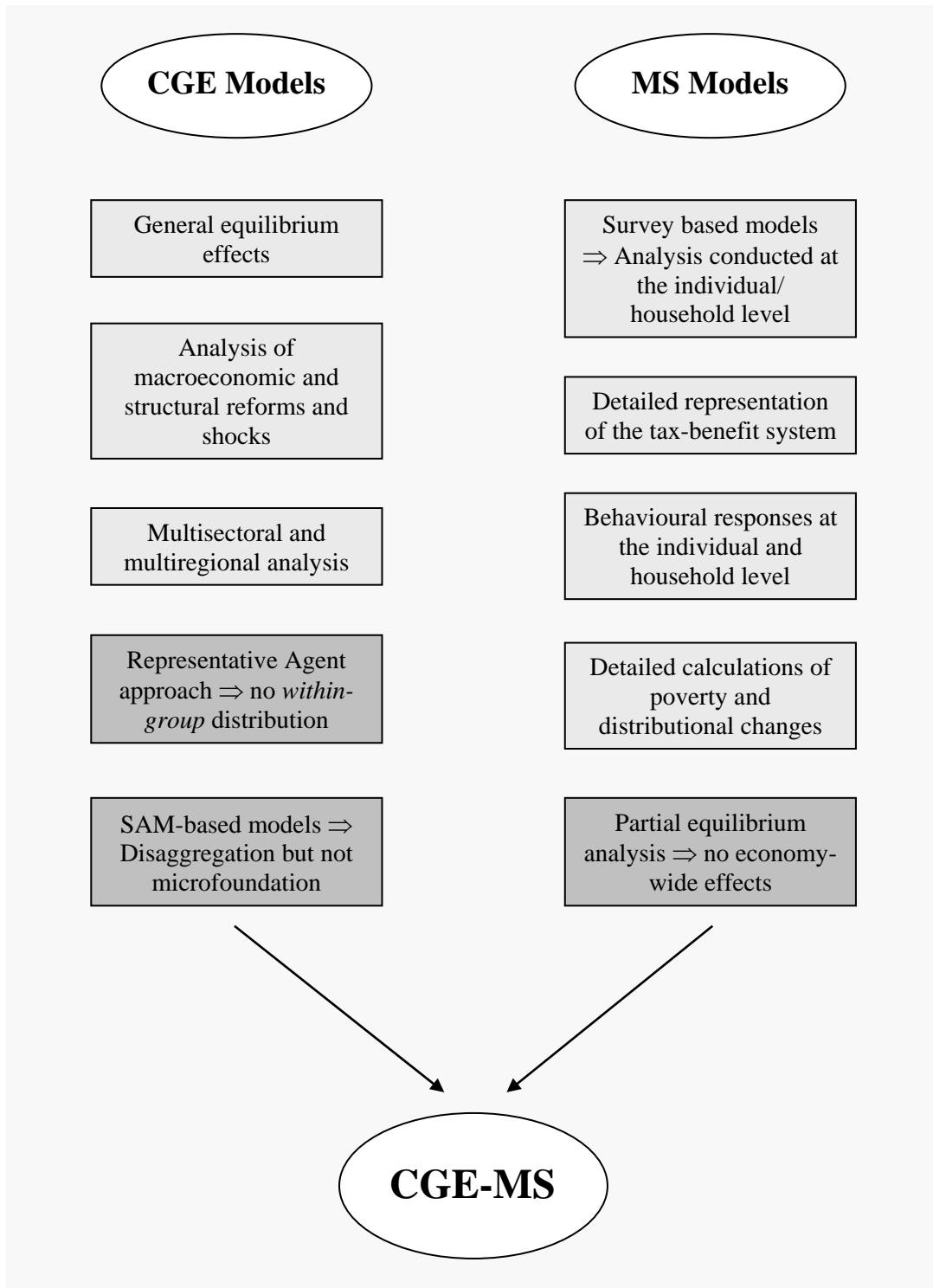


Figure 1 – CGE and Microsimulation Models

In the **first chapter** of the thesis we have tried to give an assessment of the recent developments observed in methods that link together CGE and microsimulation models, with a special concern for the different linking approaches existing in the literature for developing countries. There are three main approaches that are currently used in the literature: the integrated approach, which integrates the household survey into the CGE model, and the layered approach (Top-Down and TD/BU approaches), which instead develops the two models separately.

In the **second chapter** we have made a comparison of these three approaches. To do this we have built three models for the same economy and we investigate the different results coming out from the three different approaches. We have seen that most of the differences in the results coming out from the three main approaches arise when working with layered models (Top-Down and TD/BU approaches) rather than with integrated models.

We have observed that an integrated approach can be deficient on the aspect of the microeconomic specification and behavioural responses by individual agents. This is mainly due to the fact that the introduction of microeconomic behavioural equations into a CGE model looks of hard application and cumbersome for computational aspects. On the other side, a Top-Down approach completely disregards the possible feedback effects coming from the microeconomic side of the economy, which could in principle affect also the macroeconomic variables.

In our opinion the TD/BU modelling seems to be the most complete approach, as on one side it can include all the possible microeconomic estimates to account for behavioural responses by individual agents, and on the other side it also takes into account the feedback effects from the micro to the macro level of analysis. However, two main problems arise when using this approach. First of all, the way in which these feedback effects are reported into the CGE model can affect results in a fundamental way. In particular, the fact of using shares or parameters instead of absolute levels of endogenous variables, when possible, seems to lead to more consistent results. Secondly, eventual data inconsistencies between the micro and the macro datasets can also affect results seriously. This can be overcome only by adjusting either one or the other dataset, thus going back to the problem of data reconciliation encountered with the integrated model.

However, while with an integrated model we encounter this problem when building the model, when we run a TD/BU model without previously adjusting the data, we have the problem of data inconsistencies that enters the results and we are not able to distinguish which is the part of the change that is due to feedback effects and which is the part due to data inconsistencies.

Bourguignon *et al.* (2001) and Bourguignon *et al.* (2003b) also provide strong arguments for working with layered rather than integrated models. These arguments are most persuasive when, as in their work for Indonesia, it is regarded as very important to simulate realistically variation in labour supply and occupational choice responses to changing prices, wages and employment conditions.

A reasonable conclusion may be that integrated models are best for some purposes and layered models for others. The integrated models, indeed, appear cleaner and more transparent, and they show a better reliability under the point of view of the theoretical consistency between the two levels of analysis. They may have the drawback of not being able to fully capture even the direction and the relative magnitude of distributional and of other effects in terms of a full microeconomic analysis.

Layered models, in contrast, perhaps have an advantage when the concern is about short-term distributional impacts in a setting where realism is at a premium and theoretical niceties are not so important.

In general, however, when building such models one has also to take into account the practical advantages and drawbacks of the various approaches (see Figure 2): for instance, the layered approach requires time and effort in the building of the entire model, as one has to go through two different modelling techniques and two different databases. On the other side, one of the main advantages of the integrated approach is its simplicity and easiness of implementation. Its simplicity allows what is instead still missing in the framework of a layered approach: dynamics. Indeed, while with integrated models recursive dynamics is already introduced in a few examples, such as the model by Annabi *et al.* (2005) for Senegal, one of the main things still missing up to now in a layered framework is a dynamic featuring, which in the future will need further effort.

This is of course of difficult implementation, both on the side of modelling (both models should be dynamic) and on that of data requirements. In particular, either panel survey data or a good database to compute transition probabilities (see in more detail Chapter 1,

Section 2.2, page 39 on dynamic microsimulation techniques) are required for the building up of a dynamic microsimulation model. But this is not all. How the linking should be made is also an open question which until now did not receive a precise and detailed answer yet. A first attempt in this direction was made by Bibi and Chatti (2006) with their dynamic layered model for Tunisia.

In our applied analysis (**Chapter 3**), we develop a CGE-MS model for Nicaragua using a Top-Down approach. The model is used to simulate the effects of the Free Trade Agreement with the United States on income distribution and poverty in Nicaragua.

The main reason why we opted for a layered approach is that we wanted to estimate behavioural labour supply responses at the level of individuals. We did this through the estimation of a discrete choice labour supply model. This kind of switching regime equation is of cumbersome implementation into a CGE model, and in any case this would have implied the introduction of thousands of additional agents into the model, as in our survey there are 12645 individuals at working age.

The fact that we did not take into account the feedback effects from the micro into the macro level of analysis with a TD/BU approach is justified from the fact that the reform we simulate produces very small changes in the microeconomic structure of the country. We believe that these small changes are not sufficient to produce a significant adjustment in the macroeconomic structure of the economy.

Our analysis confirms the importance of using microsimulation techniques and survey data within the framework of a general equilibrium model. This way, indeed, it is possible to have a detailed insight into the distribution of incomes. In our applied study, for instance, we observe a small response of inequality at a national level, but if we disaggregate this result further, we can see that there is a systematic decrease of inequality in the urban areas, while in the rural areas inequality generally increases. The advantage of having such a model is that this process of disaggregation of the results has in principle no limits, until we reach the individual household level, so that we can study the effects of the reform on poverty and inequality in a very detailed way.

Integrated CGE-MS	Top-Down approach	TD/BU approach
Relatively simple to build (for a CGE modeller)	Full modelling flexibility (the two models are developed separately)	Full modelling flexibility (the two models are developed separately)
Full consistency between the two levels of analysis	Involuntary unemployment can be normally treated	Involuntary unemployment can be normally treated
Dynamic features can be rather easily introduced (recursive dynamics)	No data reconciliation is necessary	Feedback effects from micro to macro level are taken into account
Data reconciliation process required \Rightarrow either the macro or the micro data structure needs to be changed	Long modelling process (the knowledge of two modelling techniques is required)	Long modelling process (the knowledge of two modelling techniques is required)
It can easily become computationally cumbersome	No feedback effects (from the micro to macro level of analysis)	The use of different variables /parameters to communicate from the micro to the macro level can affect results
Rigidity in the choice of behavioural econometric equations (especially at the individual level)	Lack of consistency between the two levels of analysis	Data reconciliation is also necessary in order not to affect results
How to model unemployment at the household level?	No dynamics (until now) \Rightarrow only short-medium run analysis is possible	No dynamics (until now) \Rightarrow only short-medium run analysis is possible
		Convergence cannot be guaranteed

Figure 2 – Linking CGE and MS Models: Three Different Approaches

The main impact of the Treaty is to be found in the increase of exports, which, according to the supporters of the Agreement, are expected to be the leading engine of future development and economic growth in the country. Anyway, this increment in the amount of exported good is able to increase domestic production of only 1.5 percentage points in the best scenario. A small positive response of the economy to trade liberalization is also found in other studies, and especially in the work done by Sánchez and Vos (2006), who developed a dynamic CGE model for Nicaragua which also includes a positive shock on factor productivity that could be generated by the new investments in advanced technology coming from USA.

However, the results deriving from our analysis show that the introduction of the Free Trade Agreement with USA in Nicaragua cannot be seen as the unique solution to the high poverty rates and the unequal income distribution of the country. Indeed, even if we observe a systematic decrease of inequality in the urban regions, in the rural areas inequality generally increases.

Thus, the DR-CAFTA alone seems to be unable to bring about big changes in the structure of the economy, and especially for what concerns poverty and inequality reduction. It should at least be accompanied by other policies supporting lower incomes, especially in rural areas.