**CHAPTER 1**

**Introduction: What are Microsimulation Models?**

Microsimulation models are tools that allow for the simulation of policy effects on a sample of agents (individuals, households, firms etc) at a micro level. Microsimulation models for tax policy are primarily used for three purposes-

1. Revenue Forecasts
2. Distributional estimates of policies on taxes and taxpayers
3. Macroeconomic analysis of how tax policy affects key macroeconomic variables
4. Tax gap analysis

A microsimulation model differs from standard economic models because it usually takes into account heterogeneity among *each* agent in the sample. Using powerful computing techniques and large micro-level data sets which are primarily based on administrative data (such as tax returns), the impact of policy changes is studied at the level of each individual agent. These impacts can then be aggregated to the level of sectors, sub-sectors, commodities, population deciles and so on, thus providing a rich set of scenarios for the policy-maker.

The advantage of microsimulation models over standard economics models is two-fold. First, as noted above, microsimulation models fully take the individual level heterogeneity into account as they are observed in micro data sets. Standard economics models on the other hand, usually employ a ‘representative agent’ framework where a representative individual or firm is said to embody all the features and characteristics of the average agent. Such an assumption prevents any detailed analysis at the level of individual agents and can also hide certain individual level behaviour which may be important for the policy under consideration. Secondly, microsimulation models allow an estimation of the cost/benefit of a reform down to the individual level which cannot usually be done by standard economics models. The cost/benefit as well as winners/losers of a reform can be calculated at any level of aggregation required by the policy-maker and this allows for a rich perspective and informed decision making.

A microsimulation model usually comprises of three elements-

1. A micro data set, containing economic and/or socio-demographic characteristics of a sample or universe of agents.
2. The rules of the policies to be simulated. For example, in the case of a simple Personal Income Tax model, the rules would comprise of the tax logic incorporated in the Income Tax Returns.
3. A theoretical model of the behavioural response of agents. This aspect is missing in the simpler microsimulation models but can be added when more precise and sophisticated analysis becomes essential for policy-makers. Modelling the impact of tax policy on the labour-supply decision of an individual is an example of such a theoretical model. The choice of model to be incorporated depends on the questions which are required to be answered by the microsimulation model.

Microsimulation models can be categorised into two types- *Arithmetical Models* and *Behavioural Models*. Arithmetical Models are those in which behavioural aspects of agents are ignored. In arithmetical models, the impact of policy changes is studied ‘*ceteris paribus*’ i.e by keeping all other factors constant. This typically involves changing the policy parameters to calculate resulting impact on incomes or tax payments of individual agents. The same rules as the existing policy are used in calculating impacts. While behavioural features such as change in compliance or demographic characteristics are typically ignored, arithmetical models are useful because of two reasons- i) The ability to handle large volumes of data and calculate impacts instantly and ii) Calculating the impact of a policy ‘package’ or several reforms taking place simultaneously. Implementing arithmetical models alone can involve writing several hundreds of lines of code.

Behavioural models include a detailed representation of the behavioural response of agents. The type of behaviour taken into account differs across models, even though consumption and labour supply are the most frequent focus of interest. For instance, given the pre-tax prices and wage rates and given the form of the budget constraint, behavioural microsimulation models usually compute the optimal consumption demand and labour supply of each agent. Using such a framework would then allow us to accurately study how changes in tax rates affect for instance the consumption decision of each individual or investment decisions of each firm. These factors may prove to be crucial when simulating the impact of policy changes in the GST or the corporate income tax. While they allow for greater richness, behavioural models are significantly more complex than arithmetical models.

Some of the major microsimulation models being used in advanced countries are:

1. EUROMOD- It is a tax-benefit microsimulation model for EU countries. It is used to calculate the effects of taxes and benefits on household incomes and work incentives for the population of each country and for EU as a whole. It is also used to evaluate the effects of tax-benefit policy reforms and other changes on poverty, inequality, incentives and government budgets.
2. SOUTHMOD- It is also a tax-benefit microsimulation model built on the EUROMOD platform by the United Nations University (UNU-WIDER) and the University of Essex for developing countries. The model has been built for African countries such as Ghana, Zambia, Mozambique and South Africa among others.
3. OTA Microsimulation Models- It comprises of 4 models used by the Office of Tax Analysis, Department of Treasury, USA- i) Individual Income Tax Model; ii) Individual Income Tax Receipts Model; iii) Tax Distributional Model; iv) Corporate Income Tax Model.
4. Tax Calculator Model used by Congressional Budget Office, USA comprising mainly of an income and payroll tax calculator to simulate the impact of past and future laws.

As noted previously, microsimulation models rely on micro-level data to simulate policy impacts. Consequently, such models are data intensive and require unit-level data as a key input. Data sources include administrative data such as tax returns (Income Tax Returns, GST Returns etc) as well as consumption, income and other surveys (such as NSSO consumption surveys, Annual Survey of Industries etc). Since the information captured in surveys and administrative data is different for each country, microsimulation models are highly customised for a country based on the data sets available. The simulations which are run are ultimately limited by the extent to which the data is representative of the whole population.

**References**

1. F.Bourguignon and A.Spadaro, “Microsimulation as a Tool for Evaluating Redistribution Policies”, Journal of Economic Inequality. Apr 2006, Vol. 4, Issue 1, pp. 77-106.