Techniques for modelling structural change
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CGE modelling in transition economies: an Appraisal

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1. **Introduction**

Why do we want to construct economic models? We believe that there are at least three reasons: (a) to improve our understanding of economic processes; (b) to make predictions; and (c) to analyse the likely effects of economic policy and changes in such policy. For problems of types (a) and (b) many types of modelling approach can and have been devised, and are more or less effective under different conditions. For problems of type (c), the choices are more limited and the decision in any given case depends on the type of policy being investigated, the number of sectors affected, the relevant time period, and a few other factors.

In simple cases, such policy analysis can employ partial equilibrium type models of a single market or a small group of interacting markets. However, where the policy of interest affects many sectors, and probably in different ways, and where it might also affect population groups in diverse ways, there is a need for something more. The only families of multi-sectoral models that go some way towards meeting these desiderata are input-output models and CGE models. In this paper we focus on the latter.

2. **Modelling transition using CGE models**

CGE models define a set of agents (households; firms or sectors; the government; and the rest of the world - RoW) and a set of markets, and then construct supply and demand relationships for each market, ensuring that these respect the standard accounting identities. Formally, an equilibrium price vector, $p^* \geq 0$, has the property that the excess demands $z(p^*) \leq 0$, and in analysing the effects of policy changes we are essentially exploring a set of equations of the form:

$$z(p^*(\alpha), \alpha) = 0 \qquad (1)$$

where α is a vector of relevant policy variables.

In a one-period model, the relevant set of markets is usually the list of sectors identified on the production side, plus markets for labour and possibly capital. In an open economy the treatment of imports and exports is important: e.g. imports of given sector's output may be treated as imperfectly substitutable with the corresponding domestic good, without the model having to consider supply and demand for the imported good in the whole world economy. This remark simply indicates that any given model has to have a boundary, since we can never hope to model everything. However, the implications of this remark give rise to some of the difficulties identified in the next section.

In a multi-period model we also have to specify how investment in one period gives rise to new capacity in subsequent periods, and the formulation of savings behaviour can become more difficult. Assumptions about the functioning of capital markets are also relevant here.

Policy variables in these models can take a number of forms: tax rates, subsidies of all kinds, shifts in supply and demand functions, pricing rules, distribution parameters, components of autonomous government spending, etc. Although simple to state, incorporating these policies in formal models is not always straightforward, to put it mildly.

The models typically work best in an environment where some structural change is going on, but where its pace is fairly moderate or even slow, and its extent is also not large. Under these conditions the typical equilibrium assumption of CGE models does not strain credulity to an unreasonable extent. In any case, the standard equilibrium assumptions can be relaxed a little by allowing non-neoclassical closures in certain key markets, such as the labour market. In this way, important phenomena such as unemployment can be incorporated in the models.

However, the crucial point about transition economies is precisely that large structural changes are taking place, and they are taking place at great speed. What does this imply about the usefulness of CGE models? To answer this, we review some of the more awkward problems in the next section.

3. **Drawbacks of CGE models**

It is easy to list objections to the CGE modelling approach, starting with the fundamentally static character of the analysis. One can of course circumvent this shortcoming by allowing economic agents to pursue intertemporal optimisation. However, whilst this leads to many additional problems, for example regarding appropriate techniques of modelling expectations formation, the increased complexity which an intertemporal framework entails often means that modellers face a trade-off between the attention to behavioural detail and the degree of disaggregation which can be introduced, and thus may detract from one of the main benefits of CGE modelling in terms of multisectoral analysis. Whilst this does not necessarily preclude intertemporal analysis of household behaviour, where there are a small number of households, we propose following a more traditional path for investment dynamics in the productive sectors by following a ‘sequencing’ method, whereby a series of single period solutions are linked with investment which augments the capital stock, given a suitably chosen closure rule to relate savings and investment. Additionally we assume that capital is imperfectly mobile between sectors, and as such an further rule is introduced to allocate the available savings between productive sectors.

However, even once dynamics are introduced in this way, questions still remain as to the dynamic stability of key parameters, many of which will have been deterministically calibrated given the base period dataset of the CGE model. This treatment is clearly inappropriate when using CGE models to examine behaviour during periods of transition, as by its very nature, transition entails that there will be marked changes in such areas as technical progress in production, the evolution of demand preference structures, and the changing external environment with corresponding repercussions for external trade.

Thus we propose a purely deterministic approach to examining the dynamics of transition, based on a variety of expectations as to the possible evolution of the structure of the economy under study. Following this line of reasoning allows our approach to accommodate a 'man-machine' dialogue where a variety of scenarios can be generated reflecting alternative prevailing views on possible transition paths.

4. **Is there a feasible alternative?**

Our approach to modelling structural adjustment forms part of a collaborative research project '*Integrating Hungary and Romania into the European economy: policy analysis using input-output and general equilibrium models*' funded by the European Commission under its ACE programme. In order to facilitate our approach, we make use of an multisectoral partial equilibrium input-output framework, developed by Hughes and Hare (1994). Within this framework we introduce various assumptions concerning the development of the economy in terms of the growth of real GDP and the structure of its use, together with assumed structural changes in trade, consumption and production.

The expected changes in real GDP and its structure are derived from various sources, where each expectation gives rise to alternative development paths. Structural changes in trade are derived by assuming that the composition of exports and imports approach their respective terminal structures which reflect the country's long run comparative advantage, based on social profit indicators. Similarly the structure of consumption is assumed to approach a terminal composition based on regression equations which examine the relationship between consumption patterns and real income across a range of countries.

Technological change in production enters the framework by use of a capital vintage approach, whereby the initial capital stock embodies reference technological coefficients, which adjust over time according to the evolution of prices in the same manner as explained above, whilst subsequent capital investment (which is determined by an accelerator relation) is assumed to have technical coefficients which correspond to a reference economy. The rate of technical change thus stems from two sources: the changing coefficients on 'old' capital under the evolution of prices, and from the changing vintage composition of the capital stock of each sector, which in turn depends on the rate of depreciation and the demand for the particular sector's output, by way of the accelerator relation.

This model is the simulated for a horizon corresponding to the number of years which it is believed are required to complete the adjustment process. At this point, the results of the terminal period of the simulation in terms of the structure of export, imports, consumption, and productive technology are exported according to the same sectoral classification as that of the CGE model. These projections form the baseline development scenario for the general equilibrium analysis.

The dynamics of investment are now accounted for in the CGE model, by the use of a neo-classical closure, relating savings to investment. Given the assumption of sectorally immobile capital, available savings in any single period are allocated to the various productive sectors according to the required change in their capital stock between the initial and terminal periods, where the required terminal period capital stock is calculated by making use of the capital output ratio in the benchmark period, the expected rate of technical progress and the projected change in

demand for each sector's output. In addition, by a combination of introducing exogenous parameters to the CGE model and adjusting existing parameters, it is possible to introduce *ceteris paribus* changes in the sectoral composition of exports, imports, and household and government consumption which reflect the particular development scenario.

Simulating the CGE model now illustrates the results of the hypothesised scenario at the general equilibrium level. Furthermore, it is now possible to introduce a variety of market closures reflecting alternative behaviour (for example in the labour market as mentioned earlier) together with the possibility for opening and closing markets across time. By combining the input-output framework with the rigorous nature of general equilibrium, one can now examine the macro and microeconomic repercussions of a host a alternative hypothesised development paths.

5. **Conclusions**

Despite the drawbacks and problems of formulating CGE models to analyse structural change, as mentioned above, we believe that CGE models do have an extremely useful role to play in the analysis of transition and structural change, in that they provide a consistent and empirically rigorous framework for policy analysis and the repercussions of policy at the microeconomic level. This is particularly so if the traditional approach is extended in the admittedly, labour intensive form, outlined above.

We are extremely conscious of the stringent data requirements of CGE analysis, and this can be a potential source of difficulty, particularly if one is forced to adopt and attempt to reconcile data from a variety of sources. However, as structural change will frequently affect various sectors differently, we believe that CGE models provide a detailed and consistent mode of analysis where partial equilibrium tools are insufficiently comprehensive.

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