Assessing Long Run Structural Change
in Multi-Sector General Equilibrium Models

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# Abstract

CGE models are often used to assess policies and environmental impacts occurring at some distant future. Whereas these models are characterized by a detailed account of the economic structure, which is often essential when dealing with impacts affecting specific sectors, they are also calibrated on the basis of some past input-output or SAM tables, meaning that they mirror an economic structure quite different from the one we could possibly observe in the future.

To partially circumvent this problem, I have sometimes used a simple methodology, which I termed "pseudo-calibration" (e.g., in Bosello et al., 2006). With this method, I have exogenously varied endowments and/or productivities of primary resources (according to some given forecasts or scenarios) *before* running any counterfactual numerical simulation exercise.

A similar kind of solution can be found in dynamic general equilibrium models, for instance in the ENVISAGE integrated assessment model (Roson and van der Mensbrugghe, 2012), where endogenous dynamics of capital accumulation coexist with exogenously imposed changes in labor productivity, set at a level making the model path consistent with aggregate GDP growth rates, obtained econometrically.

More recently, Shared Socio-Economic Pathways (SSP) have been proposed as standardized reference scenarios in the field of climate change assessment (O'Neill et al., 2014). Quantitative information for these benchmark scenarios is, at present, quite limited: a data repository is maintained at IIASA, where economic modelers can found estimates of GDP and population levels. Again, to get a more meaningful and detailed description of the future economy, a CGE model can be "forced" to reproduce given GDP trajectories, by making some productivity parameters endogenous. For instance, in Roson and Damania (2016) we swapped the normally endogenous CGE variable "Real GDP" with the normally exogenous parameter "Productivity of the Value Added Aggregate", in order to obtain an enriched (and internally consistent) baseline framework, including production levels, trade flows and demand patterns.

The common denominator of the three cases above is a procedure imposing aggregate macroeconomic constraints onto a disaggregated general equilibrium structure. Although this can be a reasonable way to proceed in some circumstances, it is also clear that changes in the economic structure could be generated by more complex adjustment mechanisms. Like in Comin et al. (2015) we can identify two main drivers of structural change. First, industrial total productivity may change at various speeds, or factor productivity could do so, thereby making industrial productivity growth rates divergent, because of different factor compositions. Second, consumption patterns may change, because of diverse income elasticities, possibly associated with varying income distributions.

In a general equilibrium setting, there is a fundamental difference between supply and demand driven structural change. Indeed, supply variables like primary resource endowments and productivity are naturally exogenous, meaning that it may suffice to modify them in a non uniform way. On the other hand, consumption levels and patterns are naturally endogenous, so the question becomes evaluating whether the demand system in the model correctly captures the variations induced by shifts in relative prices and income.

Earlier CGE models typically used nested utility functions of the CES type, therefore imposing homotheticity and unitary income elasticities. However, even the standard GTAP model (Hertel and Tsigas, 1997) adopts non-homothetic, non-additive Constant Differences in Elasticity (CDE) utility/expenditure functions. Simpler ways to introduce non unitary income elasticities are based on Stone-Geary or Linear Expenditure Systems. Yu et al. (2004) make an empirical comparison between various demand systems, noting that "the most serious problem with the CDE stems from the observation that it precludes the possibility of goods switching from luxuries to necessities as income rises" and that "the LES performs more poorly than the CDE for most developing regions, due to its rapid convergence on the HCD [Homothetic Cobb-Douglas]. The CDE does not differentiate itself from the LES for developed regions where income growth is rather slow". The conclusion is that, even if the CDE performs better than simpler functions, it may not be sufficient to simulate complex, long run adjustments in demand patterns.

Matsuyama (2016) points out that, as a matter of fact, the evolution over time of industrial shares, in terms of employment, value added or expenditure, can well be non monotonic, and calls this phenomenon "Generalized Engel's Law". For instance, the share of manufacturing is typically hump shaped, increasing at earlier stages of economic development, then decreasing. To replicate this characteristic into a model, a sufficiently sophisticated demand system must therefore be adopted.

This paper is about the development of a a correct methodology to obtain long run estimates of structural change, considering both supply and demand drivers and delivering relevant results for applied economic models, not only CGEs. The different approaches found in the literature are critically evaluated first. Some preliminary results about structural change effects are subsequently presented and discussed.

## References


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