EXPAMOD – connecting the farm and market levels

I. Pérez Dominguez, I. Bezlepkina, A. Kanellopoulos, T. Heckelei,
A. Oude Lansink, E. Romstad
Joint Research Center of the EC,
Institute for Prospective Technological Studies, Sevilla, Spain
Contact: Ignacio.perez-dominguez@ec.europa.eu

Introduction

Farm management models help quantifying changes in land use patterns and agronomic practices for a given set of prices and policies. These changes impact indicators of multi-functionality like the visual character of agricultural landscapes, biological diversity, and pollution levels. However, prices are unlikely to remain constant as policies change. Therefore, farm level optimization results based on exogenous prices may no longer be valid. Market level models, on the contrary, are able to capture the supply and price impacts derived by policy shocks at the farm and regional level, but are generally not sufficiently detailed for the calculation of environmental impacts, since they lack differentiated agronomic practices.

By linking farm level and market level models through a newly developed econometric model, EXPAMOD, we seek to mitigate this weakness and endogenize the price-quantity response in farm management models. This paper explains how EXPAMOD works, and applies it to a number of policy scenarios as used in SEAMLESS (Van Ittersum *et al.*, 2008).

The main modelling benefit of our approach is that it enables combining the strong points of farm management (the detailed linkages to agronomic and natural science models), and market level models (endogenous prices and closure of the economy). From a policy analysis perspective the resulting farm type and acreage responses provide a much improved base for various environmental and landscape modelling exercises.

Methods

Our modelling chain consists of three models. First, FSSIM, a normative mathematical programming model that is specifically fitted for model farm types and regions across Europe. Second, CAPRI, a comparative static partial equilibrium model of the European agricultural sector. Third, EXPAMOD, an econometric model that estimates changes in supply responses, and statistically propagates these responses to out of sample farm-region combinations.

The first step in our model chain is a collection of farm models, FSSIM, for several representative farm types with different exogenous price sets for a baseline and a policy scenario. Next, the econometric model, EXPAMOD, is used to estimate changes in supply responses for the exogenous price sets. Changes in relative farm level profits are then used to assign new weights to the farm types covered by the analysis. The supply changes at the micro level and the revised weights for the farm types are then used to adjust supply in the market model CAPRI, so that revised prices are obtained. Finally, these prices are fed back to FSSIM.

A major challenge for connecting the farm and market level is that the number of model runs at the farm level is limited due to the input data requirements of farm level model, FSSIM. Therefore, FSSIM is run for a stratified sample of model farms and regions to cover the main variation in the EU-27 of farm types and agro-climatic zones. Following Andersen *et al.* (2007), the selection of sample regions was made at the NUTS2 level, as this is the minimum disaggregation level for the market models in SEAMLESS. Nevertheless, the major source of farm type data is only available for FADN regions, i.e. regional classification used by Farm Accountancy Data Network, so that a mapping between both classifications is necessary (Janssen *et al.*, 2008). Due to laborious requirements on the data collection, 16 sample regions were targeted as this was judged to be feasible for data collection and modelling purposes.

In FSSIM regional supply at NUTS2 is recovered by aggregating farm type supply using farm weights from the FADN (see, Wieck & Heckelei (2007) for further details). How well the farm types selected represent the farm composition within a NUT2 region is an important issue for EXPAMOD. The weights derived from the observed data are only suitable for the calibration of the model in the base year, since they refer to FSSIM results. Since SEAMLESS targets the *ex-ante* impact assessment of agricultural policies, the projection of agricultural markets to a baseline period in the future, requires additional assumptions on technological development, changes in consumer demand, inflation, GDP growth, etc. These effects are explicitly handled by the CAPRI model and fed back into FSSIM.

The price impacts from supply changes in the farm optimization models generate information interpreted as 'pseudo-observations' for the econometric estimation of EXPAMOD. The current simulation design implements varying 'one-price-at-a-time'. The price vector, for each scenario, is kept at the 100% level of the initial price vector obtained from CAPRI and additional price-quantity vectors for four different price shocks in FSSIM are considered (–40%, –20%, +20%, and +40% from the initial price). These scenarios generate information on own and cross price-quantity effects that are reintroduced in the extrapolation routine of EXPAMOD. In most cases, price changes are likely to be far smaller. However, sufficient variation of prices is needed to stabilize the estimates of the price-related coefficients.

Results and discussion

The tests, performed with a flexible functional form, show plausible results and a high statistical explanatory power. Nevertheless, some poor predictions have been observed for estimations with a low number of observations and high number of parameters. This should be easily solved by generating a higher number of pseudo-observations. Additionally, a higher variance has been observed compared to the data (especially for products under a quota regime, such as sugar beet) and a closer link of results to the biophysical and farm management variables would be desirable. Out of sample tests are envisaged to provide relevant validation of strengths and weaknesses of the statistical extrapolation.

Our approach may also be applicable to scale up non-economic results, such as environmental impacts. However, further research is needed to refine the method employed for up-scaling such impacts, in particular where the spatial distribution of impacts matter.

References

Andersen, E., *et al.*, 2007. The environmental component, the farming systems component and the socio-economic component of the SEAMLESS database for the Prototype 2, D4.3.5-D4.4-D4.5.4. SEAMLESS integrated project, 195 pp.

Janssen, S., *et al.*, 2008. A European database for policy evaluation and assessment of agricultural systems. Environmental Science & Policy. (forthcoming)

Van Ittersum, M.K., *et al.*, 2008. Agricultural Systems 96: 150-165.

Wieck, C. & T. Heckelei, 2007. Agricultural Economics 36: 203-220.