

Decomposing price and other effects in the CAPRI market model for result analysis

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Why result decomposition?

Results of the global market model in CAPRI are driven as in all price endogenous models by the simultaneous interactions between price induced quantity changes and quantity induced price changes. In most cases, quantities are defined by behavioral equations which depend on prices. The model solution is obtained by letting a numerical solver searching systematically for a vector of prices which closes simultaneously all market balances – similar of finding the intersection of the supply and demand curve in the one product case. In the latter case, we graphically see how far we had to move on the supply and demand curve after a shock to find the new market equilibrium. Once we add more products, updating the cross prices will shift supply and demand curves and the analysis becomes far more demanding. Further on, in more complex models, different prices (market, producer, consumer) drive specific quantities and demand is broken down into different components.

The result set of a model run reports only the final combined effect of these often complex interactions between price and quantity changes. Even experienced users of quantitative tools are often left guessing how these final results came about. The exploitation tools report price changes and those in quantities for production, feed use, human consumption etc., but how relate the two to each other?

Users have in the past sometimes employed point elasticities reported as results from the parameter calibration of the behavioral functions in the market model to analyze model outcomes. Doing so is cumbersome and error prone as elasticities and price changes must be loaded from disk and copied e.g. into EXCEL where then the appropriate formula need to edited. It is clearly not a proceeding which can be used for all markets and market balance positions in any scenario analysis. These exercises had therefore mostly been triggered by quite case specific questionable results. Additionally, as the functional forms in CAPRI are not iso-elastic, using point elasticities from the calibration point gives only approximate results.

The now integrated result decomposition allows analyzing for all markets and quantity position of the market balance in the market model what own and cross price effects and some other factors contribute to final quantity changes simulated by the market model. It thus relates mostly to the price induced changes in quantities. It aggregates these changes to block of regions and block of

products, so that, as usual, a drill down approach from changes at aggregate level to more specific ones can be performed.

Methodological approach

The basic idea consists in re-calculating the behavioral equations driving the quantities in the market model by fixing some prices to the calibration point while updating others to the final results.

Take e.g. the human consumption demand for beef in a Member State. In order to determine the own price effect, the consumer price for beef is set to the one simulated during the model run and all other consumer prices are set to the prices of the base line. Afterwards, the demand function for beef is calculated and the resulting beef demand quantity is stored in a reporting array. Next, the beef price is set back to the base line level, and all other prices to the simulation result. The beef demand is then recalculated again to determine the effect of cross price changes only. And then, only the prices for certain groups of products such as meat (excluding the own price) are set to the simulation results, keeping all other prices at baseline levels.

By doing so, we generate one array for each country and position of the market balance which shows in the rows the single products and in the columns which prices had been updated from the baseline to the simulation results whereas the cells of the array comprise the calculated quantities. The resulting overall matrix is quite large, if any country or country block would show a non-zero entry for each market balance position and product, we would generate a matrix with 60 regions x 5 market balance positions x 47 products x 11 price changes (plus specific effects depending on the position) ~ 150.00 entries, even without aggregating the results to product groups and group of regions. As explained below, the resulting informational overload is avoided by converting everything to percentage changes against the baseline and only storing changes above a certain threshold.

Summarizing, the reported quantity changes inform hence the user about the effect of certain price changes under the condition that anything else is kept unchanged at the calibration point. One could naturally alternatively use the final results as the comparison point. However, by doing so, comparing different scenario would be more difficult as each time a new comparison point would be chosen.

Depending on the functional forms and the terms entering the equation, summing up these changes might only yield approximate results for the true results in a simulation. Nevertheless, such decomposition might help in understanding the outcome of a simulation as well as hint at eventually implausible choice of parameters.

Technical implementation

The technical implementation consists in a relatively compact GAMS program ("reports\bev_func_decomp.gms") which calculates for all positions of the market model product balance (production "PROD", feed use "FEED", human consumption "HCON", processing "PROC" and biofuel feedstock demand "BIOF") the effect of own price and cross price changes. For the demand positions, the effect of the Armington utility aggregator is reported as well. For feed, the impact of the changed sectoral energy demand as integrated in the behavioral equation for feed demand is calculated additionally. In case of the dairy output equations, changes in milk fat and protein are added. Cross price effect are broken down to the reporting groups generally used such as cereals ("CERE") or oilseed ("OILS").

