An optimisation approach for updating product data in supply and use tables

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Author: Jeroen Kole

Statistics New Zealand has successfully applied a linear optimisation model to support the implementation of updated input and output product breakdowns in the supply and use framework.

Statistics New Zealand applies a supply and use framework to balance the annual current price production and expenditure estimates of gross domestic product (GDP). The balancing process requires up-to-date detailed product data by industry. The most recent product data was collected via a new range of specific commodity collections in the period 2003-2008. An optimisation model was developed to support the comprehensive implementation of the new product data in the balanced annual accounts for the years ending March 2006 and 2007.

The paper will describe the data collection strategy and supply and use framework, introduce the optimisation model and discuss how this was integrated in the supply and use balancing process.

The three standard phases in the supply and use balancing process are analysis of industry and final expenditure accounts, manual commodity balancing and an automatic iterative procedure (RAS) to complete balancing. The optimisation model has been applied in an additional phase prior to manual commodity balancing. At the start of manual commodity balancing, industry specific input and output commodity proportions from the latest balanced year are applied to the current industry accounts. The idea behind the optimisation model is to start the manual commodity balancing with an improved set of balanced proportions based on the most up-to-date product data. This is important, because a large set of new and initially inconsistent data had to be implemented in a short period of time.

The model is a linear program, in which a "distance" to values reflecting new commodity proportions is minimised. Decision variables represent income (supply) and expenditure (use) values by industry and product, bounded by values reflecting old and new proportions. The linear constraints in the model reflect fixed industry income and expenditure totals and supply-use balance for all goods and services. The model uses the latest balanced year's data, so it has always a feasible and optimal solution. The linear program effectively re-allocates the commodity proportions for this balanced year, such that the optimal solution is closer to the new proportions. These optimised proportions are used to create an improved starting point for manual commodity balancing of next year's accounts to be balanced.

An important part of the additional phase was a review of the new product data from an industry and product perspective. The industry review checked that the product data for each industry was representative for the years ending March 2006 and 2007. Aim of the product review was to resolve obvious consistency and plausibility issues around use and supply of goods and services. The optimisation model was used in an iterative process. Optimised proportions were applied to the years to be balanced. Review of the resulting accounts and imbalances lead to further improvements to the product data. This was repeated until no further significant reduction of imbalances could be achieved. The remaining data inconsistencies in the supply and use system have been resolved with manual balancing and RAS.

Statistics New Zealand has published annual balanced accounts up to the year ending March 2007 in November 2009. The intention is to compile and release supply and use and input-output tables in basic prices containing the updated product data.

The combination of manual and automatic balancing techniques to introduce a large amount of new data in the supply and use framework has been challenging but very successful. The model could be extended with variable industry totals and final expenditure data, and weights reflecting reliability of data sources. Intention is to continue and further develop this optimisation approach.