Further developments in the decomposition of the Eurostat net tax matrices and their transformation to GTAP format

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Abstract

To supplement the GTAP9 data with detailed information on the taxes and subsidies on products the European Commission's Joint Research Centre (JRC) provided the most recent set of the Eurostat 'Taxes Less Subsidies on Products' (TLS) matrices compiled for 2010. The coverage was 27 EU Member States. For some countries some *components* (or 'layers') of the TLS matrix (concretely the VAT and Subsidy matrices) were also available, therefore in the decomposition process these also were taken into account. The country-specific TLS matrices (originally available in product by industry break-down) were decomposed to their VAT, excise tax, custom duty, 'other taxes on products' and subsidy components. This decomposition into multiple components goes beyond what is usually required for a GTAP data update. Nevertheless as taxation and pricing is one of the most important policy instruments, a higher degree of detail may make the EU data not only more suitable for tax policy analysis with multi-sectoral models, but also for energy, climate, agriculture and many other policy areas.

For Spain (ES), where the TLS matrix allegedly exists but is classified as *confidential*, the INSD bi-proportional matrix adjustment method was applied to estimate the TLS matrix itself by using the 2010 "Use matrix" as the reference matrix. This was rendered possible by the fact that the JRC also provided the "Use tables" for 27 EU-countries (missing only for BG). The JRC provided data also included the corresponding Input-Output tables (IOTs) themselves for all the 28 EU-countries and the 'Use Tables at basic prices' (Usebp tables) for 26 countries. These were needed to compute the implicit effective tax rates.

For the decomposition many '*auxiliary' data* were acquired and processed. These data partly were downloadable from the Eurostat public database while others had to be obtained from the national statistical offices or other national statistics. The most important such databases were the 'Excise Revenue Tables' and 'National Tax List' data (NTL) of DG TAXUD, the Eurostat's national accounts database and various publications of the national statistical offices, in particular their sometimes more detailed Supply and Use tables and occasionally available tax/subsidy matrices.

The TLS tables had to be transformed so as to match the *GTAP submission requirements*. These require the submission of the domestic and import products related TLS tables in GTAP-sector break-down only but not the TLS layers. However, to be able to estimate the TLS tables in GTAP-sector break-down reliably we had to transform its components (layers) *separately*.

The overview of the general decomposition and transformation method was presented in 2016 at the 19th Annual GTAP-conference (‘*Decomposition of the ESA2010 Eurostat net tax matrices and the transformation to GTAP format*’). This paper presents the *further development* of the *method* and the estimation *results*.

The paper is structured as follows:

Section 1 presents the *data sources* and the main types of *data problems* like inconsistencies within and between the various datasets, heterogeneity of the country-specific datasets both in format and accounting methods, inconvenient data (e.g. negative values where nonnegative values are expected).

In *Section 2* the new *methodological considerations* and the new features of the *decomposition* and *transformation process* are discussed. The new methodological considerations include the way how the Market Access Map (MacMap) custom duty data were used, how the sparse nature of certain TLS-layers (e.g. that of the custom duty-, VAT- and Subsidy matrix) could be exploited, how to deal with the apparent inconsistencies of the TLS matrix and the TLS row of the IOTs, how the original TLS tables (available in product by industry break-down) can be transformed to product by product break-down, how the GTAP profile cleaning of the TLS layers (which practically means the reallocation of certain subsectors to others) should be done, how the transformation of the IOTs at basic prices (UF tables) should be done integrated with the TLS tables (lest many weird implicit taxes rates show up as the consequence of that the split of the UF table of the C10-12 sector is done before considering the corresponding TLS figures), how to estimate the country-, use(r)- and TLS-layer-specific *transformation coefficient/share matrices*, how to identify a proper tax base for the rather heterogenous and mysterious ‘other taxes on products’, how to set reasonable lower and upper bounds (caps) for the implicit tax rates.

Section 3 is devoted to the description of the elaborated *TLS-layers reconciliation model*, which separately for each country reconciles the (individually) transformed TLS layers with the aggregate TLS matrix (achieves the add-up consistency) and other external indirect tax data and which imposes all *balance requirements* and *other constraints* (implicit tax rates, proportions, block-totals, etc.) on the model estimates of the TLS layers in GTAP-sector break-down (in particular the estimated elements of the VAT- and Subsidy-matrices and the exports- and stock accumulations related taxes and subsidies). The model finds – separately for each country - such TLS-layers which are 'closest' to their priors, more precisely in which the *sum of the squared relative differences* between the model estimated and prior cell values is *minimal*. In this section it is also presented how the resulting TLS layers are *split to imported and domestic* commodities related parts.

The *numerical results* of the model estimates are presented and discussed in detail in *Section 4*. The paper concludes that despite the various data problems and methodological challenges, the model seems to have produced *reasonable results* (even for the subsidy matrix) for each EU countries. Investigation of this revealed that this is due to large extent to the fact that in most cells (one cell representing the use of a given product by a given user) the available 'net tax' figure contains only one or two types of taxes (the other TLS layers are zero), therefore the minimization of the relative distance (objective) function ‘pulls’ the distributable tax/subsidy amounts to the right cells (position) of the relevant TLS layer matrices, even without being informed about the precise tax mechanisms. The remaining problems are so few (about 1 % of the positive implicit tax rates of the estimated TLS-layers proved to be unrealistic) that one could compile easily a full list of them and carry through a one-by-one examination. This section also presents the preliminary results of a similar exercise done with the recently published *2015 Eurostat TLS-matrices*.

In summary, the results can be regarded to be quite novel and hopefully encouraging for other researchers (e.g. outside the EU) to apply this or similar method to estimate TLS-layers. A more direct benefit of the exercise was that during the process extensive and in-depth knowledge was accumulated of the country-specific *tax mechanisms and accounting practices,* which may be extremely useful in the *future revision/extension* of the TLS estimates. Also in the process a *transparent, reproducible* method (well-commented and maximally generalised GAMS-codes) as automated as possible (mainly using the GAMS GDXXRW facility and GAMS-Excel interface to read in the data and report the results) was developed.

Elaborating the transformation matrices from the IOT sectors to the GTAP-sectors helped to clarify the NACE Rev.2–GTAP sectors *correspondence,* which the GTAP-experts also welcomed as a good basis for the needed revision of the GTAP sector definitions so that they be compatible with the new NACE Rev.2/ISIC Rev.4 classifications.