faoswsTrade

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Abstract

The trade module is divided in two submodules: `complete_tf_cpc` and `total_trade_CPC`. Each module is year specific. This means that, at the time being, the trade module runs indipendently for each year. In order to run the `total_trade_CPC`, the output of `complete_tf_cpc` is needed. All tables and graphs present in this documentation are just examples. More details on the data are given in the code.

1 Complete tf cpc

1.1 Data

Raw data are provided by the SWS Team (subunit of Team F) for both UNSD Tariffline and Eurostat Data. The data is prefiltered as shown below. In all cases, the module downloads only records of commodities of interest. The HS chapters are the following:

```
01, 02, 03, 04, 05, 06, 07, 08, 09, 10, 11, 12, 13, 14, 15, 16, 17, 18,
19, 20, 21, 22, 23, 24, 33, 35, 38, 40, 41, 42, 43, 50, 51, 52, 53.
```

In the future, if other commodities become of interest for the division, it is important to include additional chapters in the first step of the downloading.

```
##   reporter partner       hs flow year     value weight qty qunit    hs6
## 1       90     458     3303    1 2009  54.75252     NA  NA     1   3303
## 2      184      36 07121000    1 2009 634.93650     NA  NA     1 071210
## 3      184      36 09011200    1 2009 470.57794     NA  NA     1 090112
## 4      184     554 12100000    1 2009 544.94550     NA  NA     1 121000
## 5      184     504 21050020    1 2009 379.96200     NA  NA     1 210500
## 6       90      36     5203    1 2009  36.37752     NA  NA     1   5203
```

1.1.1 Eurostat

- only numeric codes of reporters and partners are kept (letters are not allowed).
- only numeric CN8 codes (`hs`) are kept (letters are not allowed).
- only `stat_regime` equal to 4 is kept.

  > In this system ["Statistical regime 4" or "Total trade"], the recorded aggregates include all goods entering or leaving the economic territory of a country with the exception of simple transit trade. In particular, all goods received into customs warehouses are recorded as imports, regardless of whether they subsequently go into free circulation in the Member State of receipt. Similarly, outgoing goods from customs warehouses are included in the general trade aggregates, at the time they leave the Member State.

  See pag. 9 in *DG Trade Statistical Guide*, June 2016, http://trade.ec.europa.eu/doclib/docs/2013/may/tradoc_151348.pdf

1.1.2 UNSD

- only numeric HS (`hs`) codes are kept (letters are not allowed).

1.2 Process

1.2.1 Aggregate UNSD Tariffline individual Shipments

The tariffline data from UNSD contains multiple rows with identical combination of reporter / partner / commodity / flow / year / qunit. Those are separate registered transactions and the rows containinig non-missing values and quantities are summed. Missing variables of the same type are also summed, as they will produce a missing aggregated value for missing disaggregated values while correctly summing the remaining variables.

1.2.2 Mapping UNSD Tariffline and Eurostat data

At this stage a standardization/mapping step is performed. The details are divided between UNSD Tariffline and Eurostat due to the nature of the differences among the two datasets.

1.2.2.1 UNSD Tariffline

1. UNSD Tariffline data reports area code with Tariffline M49 standard (which are different for official M49). The area code is converted in FAO country code using a specific convertion table provided by Team ENV.

2. European countries are removed.

3.
   ```
   Area codes not mapping to any FAO country code or mapping to
   code 252 (which correponds to undefined areas) are separately
   saved and removed from further analyses.
   ```

   ```
   ##     m49 fao
   ## 164 270  75
   ## 26  280  79
   ## 294 716 181
   ## 241 634 179
   ## 38  471 252
   ## 106  51   1
   ```

4. The flow codes of re-Import (code 4) are recoded into Import (code 1) and codes of re-Export (code 3) to Export (code 2). This procedure is applied following UNSD standards:

   > Exports of a country can be distinguished as exports of domestic goods and exports of foreign goods. The second class is generally referred to as re-exports. The exports shown in our database contain both the exports of domestic and foreign goods. Re-exports are exports of foreign goods in the same state as previously imported; they are to be included in the country exports. It is recommended that they be recorded separately for analytical purposes. This may require the use of supplementary sources of information in order to determine the origin of re-exports, i.e., to determine that the goods in question are indeed re-exports rather than the export of goods that have acquired domestic origin through processing. Re-imports are goods imported in the same state as previously exported. They are included in the country imports. It is recommended that they be recorded separately for analytical purposes. This may require the use of supplementary sources of information in order to determine the origin of re-imports, i.e., to determine that the goods in question are indeed re-imports rather than

> the import of goods that have acquired foreign origin through processing. There are several reasons why an exported good might return to the country of origin. The exported good might be defective, the importer might have defaulted on payments or cancelled the order, the authorities might have imposed an import barrier, or demand or prices in the country of origin might have made it worthwhile to bring the good back.

See: http://unstats.un.org/unsd/tradekb/Knowledgebase/Reexports-and-Reimports

5. Set all HS codes to the maximum length (by reporter / flow).

6. Commodity codes are reported in HS codes (*Harmonized Commodity Description and Coding System*). The codes are converted in FCL (*FAO Commodity List*) codes. This step is performed using a table incorporated in the SWS. In this step, all the mapping between HS and FCL code is stored. If a country is not included in the package of the mapping for that specific year, all the records for the reporting country are removed. All records without an FCL mapping are filtered out and saved in specific variables.

```
##    validyear area flow   fromcode     tocode  fcl
## 1         NA   81    2 0407001900 0407001900 1062
## 2         NA  154    2 2009291100 2009291100  510
## 3       2009  157    1 0714200090 0714200090  122
## 4         NA  211    1   20059910   20059910  472
## 5         NA   84    2   02073685   02073685 1075
## 6         NA  101    2  230610000  230619999  332
## 7         NA   13    2   19052000   19052999   22
## 8         NA  236    2 0204210000 0204210000  977
## 9         NA  134    1   04069019   04069019  904
## 10        NA    9    1   09012100   09012199  657
```

7. Information of the FCL units is added.

```
##   fcl fclunit
## 1  15      mt
## 2  16      mt
## 3  17      mt
## 4  18      mt
## 5  19      mt
## 6  20      mt
```

8. Data convertion of units of measurements are applied to meet FAO standards, where all weights are reported in metric tonnes, animals in heads or 1000 heads and for some commodity just the value is provided.

9. Commodity specific conversions are added.

1.2.2.2 Eurostat

1. Eurostat classifies areas in their geonomenclature. These codes are converted in FAO country codes using a specific convertion table, stored in the SWS, provided by Team B/C. Area codes not mapping to any FAO country code or mapping to code 252 (which correpond undefined areas) is reported and the records for these area codes are removed.

```
##   ComM49 FAO        Name
## 1      1  68 France
## 2      2  15 Belg.-Luxbg
## 3      3 150 Netherlands
## 4      4  79 Fr Germany
## 5      5 106 Italy
## 6      6 229 Utd. Kingdom
```

2. Commodity codes are reported in CN8 codes (*Combined Nomenclature 8 digits*). The codes are converted in FCL (*FAO Commodity List*) codes. This step is performed using the same package (`hsfclmap`) as for UNSD Tariffline. If a specific record has a CN8 code not mapping to any specific FCL code, then the record is reported and removed. If a country is not included in the package of the mapping for that specific year, all the records for the reporting country are removed.

3. Information of the FCL units is added. This step is straighforward since for Eurostat the units are for the vast majority correct.

4. Some commodity specific conversions are needed as Eurostat reports the figures in a different unit with respect to FAO.

5. Values are converted from EUR to USD using the table, stored in the SWS, with avarage EUR/USD exchange rate for each year provided by Team B/C.

```
##   Year ExchangeRate
## 1 2000     0.924020
## 2 2001     0.892860
## 3 2002     0.946000
## 4 2003     1.131200
## 5 2004     1.243304
## 6 2005     1.245755
```

1.2.3 Unified Official Trade Flows Dataset

UNSD Tariffline and Eurostat datasets are ready to be merged togheter. The final tables has all the countries worldwide.

1.2.4 Standardization, editing and outlier detection

1.2.4.1 Application of Notes

Perennial and yearly specific notes are mdb files provided by the Team B/C already saved in a R friendly dataset. The notes might be of different nature. They might be a multiplicative factor, or forcing a value. More information about the notes can be provided by team B/C. The notes might be year specific or for all years (in this case reported as NA) and might refer to HS or/and FCL codes. This notes (or adjustments) were developed during the years and they are available from 1997 to 2013.

Remark: There is currently a revision of the adjustments table. This revision is needed as notes were developed when trade data was obtained from countries and was not standardised. Now given that trade data comes from international organisations (Eurostat and UNSD) the standardisation *should* be almost complete but sometimes it seems that the procedure was not applied (and in this case the application of a note is required).

More details on how to read the notes can be given by team B/C.

```
##   year flow      hs  fcl partner weight  qty value special reporter
## 1 2012    1      NA   17      NA     10 <NA>  <NA>    <NA>        8
## 2 2005    2      NA 1168      NA    100 <NA>  <NA>    <NA>       11
## 3   NA   NA      NA  836      NA    0.6 <NA>  <NA>    <NA>       52
## 4 2013    4      NA  702     194    0.1 <NA>  <NA>    <NA>       13
## 5 2011    1      NA 1061      NA    0.1 <NA>  <NA>    <NA>       37
## 6 2013    2 9030000  671     231     10 <NA>  <NA>    <NA>       33
```

1.2.4.2 Unit Values computation

For each record having both quantity and value (thus excluding all commodity reported just as value), the unit of value (u_v) is computed as following:

```
$$u_v = \frac{qty}{value}$$
```

1.2.4.3 Outlier Detection and Imputation

Based on the units of measurement we might have cases of anomalous observations (outliers). The target variables are traded quantities so the outlier test on the unit values is a tool to correct quantity data. Outliers are calculated based on the distribution of the logarithm of the unit of value for the same country, year and flow at the HS level (tariffline level). The reason to identify the outlier at the HS level is due to the fact that, under the same FCL code, different commodity might fall in it (i.e. maize seed and seed).

Outliers are detected using Tukey's procedure:

$$\text{x is outlier if} \begin{cases} x < Q1 - k * IQR, & \text{lower outlier,} \\ x > Q3 + k * IQR, & \text{upper outlier.} \end{cases}$$

where $Q1$ and $Q3$ are the first and third quartile, respectively, IQR is the interquartile range ($IQR = Q3 - Q1$), and k is a coefficient for the outlier detection (set to 1.5 as suggested by Tukey). See: Tukey, John W., (1977), Exploratory Data Analysis, Addison-Wesley.

Traded quantities that are identified as outliers are then corrected by dividing the corresponding value (which remain fixed) by an appropriate median unit value, which is calculated in a specific-to-generic fashion (in all cases, the unit values are calculated separately for imports and exports). A first attempt is done by calculating unit values at the most specific HS level (i.e., the one at which the quantity is expressed). If the number of partners for which this unit value can be calculated is greater than a certain threshold (currently 10) the median unit value across partner is calculated and used for imputation. If the first attempt fails (i.e., it is not possible to calculate a unit value at the most specific HS level), then the same approach is used by taking into account more generic HS levels, in particular at eight and six digits, and the most specific level for which a sufficient number of partners is available is used for calculating the median unit value. Usually a suitable median can be calculated at the 8-digit level or, at least, at the 6-digit level. However, if the previous strategies fail, which implies that there is not a sufficient number of partners in order to calculate the median, two attempts at calculating a non reporter specific median unit values (i.e., median unit values valid for all reporters) are sequentially undertaken: by HS and by FCL. In the most difficult cases it should be possible to calculate the median unit value by HS, thus that at the FCL level is used as the strategy of last resort. Actually, for completeness sake, the very last fallback is the median unit value by flow. This is the most generic unit value that can be used for imputation and is calculated just for precaution as it is very unlikely that an appropriate more specific median unit value can not be calculated.

In short, the first one of the following median unit values that can be calculated is used for imputation (import and export unit values are always calculated separately):

1. most specific HS code, across partners;
2. 8-digit HS level, across partners;
3. 6-digit HS level, across partners;
4. most specific HS code, across reporters;
5. FCL code of the most specific HS code, across reporters;
6. by flow (whithout taking into account any commodity code).

Remark: in the module, one of the input parameter for the user is the outlier coefficient. By default this is set up to 1.5. More info regaring the outlier coefficient is given in the Future Work section.

1.2.4.4 Missing Quantities Detection and Imputation

For records in which the commodity has to be reported in quantity and the quantity is missing and the value is present, the corresponding quantity is imputed dividing the corresponding value by the median of the units of value obtained as explained above.

1.2.5 Mirroring and Balancing

The module produce the list of non-reporting countries: these are the countries present as partners but absent as reporters. For these countries the mirroring routine is applied: the corresponding trade of the non-reporting countries are extracted from the partners inverting the flows. The quantities are the same while the values are corrected by a factor of 12% due to the CIF/FOB conversion. This need more work, details in the Future Work section.

1.3 Flags

Both records with imputation with outlier or mirroring imputation have a special flag:

- flagObservationStatus: this flag is **I**, which means imputed
- flagMethod: this flag is **e**, which means estimated with a statistical algorithm.

For all the other records empty string flags are saved.

More information on the Flag is given in the *Future Work section.*

1.4 Convertion to FAO SWS standards

At this point the table is almost ready to be save in the SWS. Additional mapping and aggregation are necessary in order to respect the SWS standards:

- Conversion of FCL into CPC codes. This conversion is based on the table of conversion 2.1 expanded. If some FCL codes are not mapped into CPC ones, the corresponding records are filtered out. Since the mapping between FCL and CPC is one-to-one there is no aggregation at this point. The routine just add the corresponding CPC code.
- Conversion from FAO country code to M49.
- Each row of the final output must be or quantity or value specific, while so far the module keeps this information in one row. We therefore split this information in two separated rows.

The first submodule saves the final output in the `completed_tf_cpc_m49` dataset, within the trade domain.

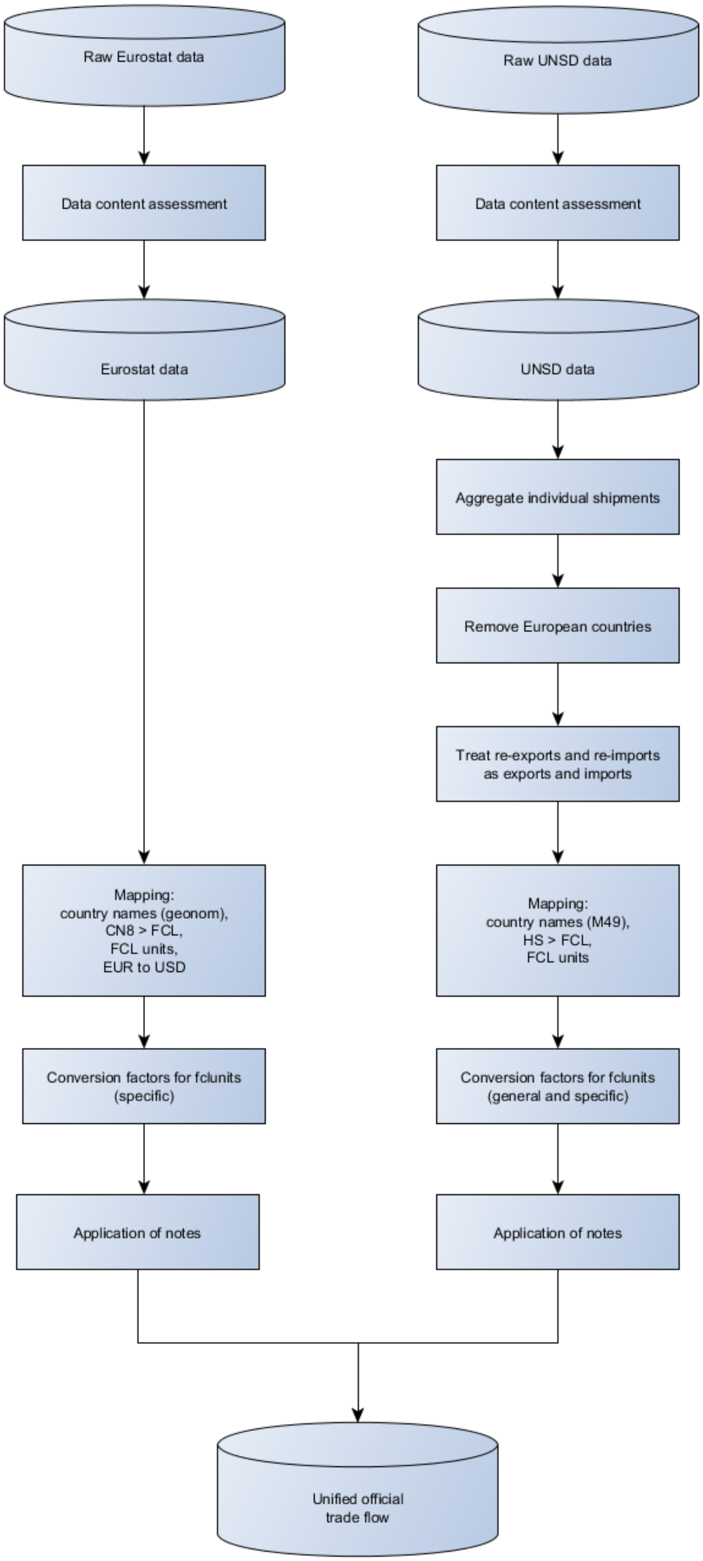
2 Total trade CPC

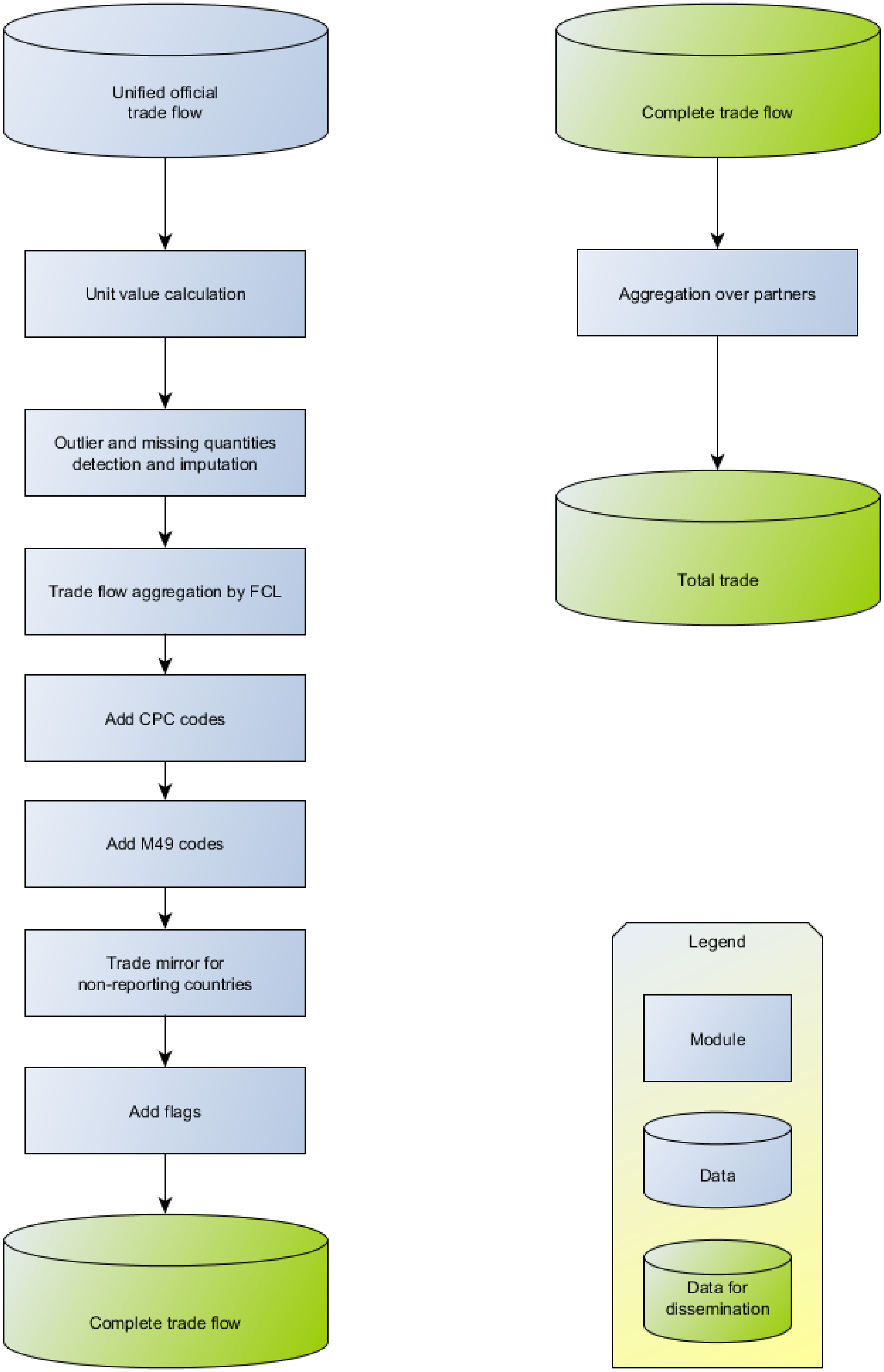
This second submodule uses as input the output of the previous submodule. These two modules are separated because the two outputs are needed for different purposes, not only, the resulting matrices have different dimensions.

This module aggregates total trade flow by reporting country for partners countries to a single total trade for each unique CPC commodity code.

The module save the ouput into the dataset `total_trade_cpc_m49`, within the trade domain.

3 Flow Chart Process


Raw Eurostat data
Raw UNSD data
Data content assessment
Data content assessment
Eurostat data
UNSD data
Aggregate individual shipments
Remove European countries
Treat re-exports and re-imports as exports and imports
Mapping: country names (geonom), CN8 > FCL, FCL units, EUR to USD
Mapping: country names (M49), HS > FCL, FCL units
Conversion factors for fclunits (specific)
Conversion factors for fclunits (general and specific)
Application of notes
Application of notes
Unified official trade flow


Unified official trade flow
Unit value calculation
Outlier and missing quantities detection and imputation
Trade flow aggregation by FCL
Add CPC codes
Add M49 codes
Trade mirror for non-reporting countries
Add flags
Complete trade flow
Complete trade flow
Aggregation over partners
Total trade
Legend
Module
Data
Data for dissemination

4 Future work

4.1 Validation Steps

This section represents the most high priority task for the trade module.

4.1.1 Raw Data - Data content assessment

- In the vignettes folder, a sample of pre-analysis is given, but not integrated in the main module (file name: preanalysis_2009.Rmd). The pre-analysis script calculate the total number of records for both Eurostat and UNSD Tariffline datasets and the distribution of length of the commodty HS codes (for UNSD Tariffline and CN8 for Eurostat) is performed. For each country we report if data includes imports, exports, re-exports and re-imports at all possible length. All records with hs-length (for UNSD Tariffline) or CN8-length (for Eurostat) less than 6 are removed. The pre-analysis script produces a html file.
- The pre-analyses of the assessment of the data has to be integrated in the module. The script is just a guide but improvements are needed (i.e. tables).

4.1.2 Report and check of discarded elements after mapping

- At the moment the module is saving the unsolved mapping records in a separated variable, but not reported anywhere.
- Each mapping routine might produce some unsolved mapping. All unsolved mapping should be reported and possibly solved in the future.

4.1.3 Destination Table

- The `complete_tf_cpc` module produces output for all the records passing all the routines and not filtered out. The module does not check if any commodity is missing. A possible solution would be to have a destination table with all the commodities of interest and the module should fill the destination table. In this way the output validation step should be achieved.

4.2 Time Series Analysis

- Upon availability of time-series data, a check of the CPC-based unit values across the time series should be performed. Differentiation between errors in the order of magnitude on quantities and values (time series) and outliers (cross section). An additional submodule of imputation of missing data using time series analysis would be a solution.

4.3 CIF/FOB

- The CIF/FOB correction for mirroring is, at the time being, set up to 12%. This has been suggested by team B/C.
- Additional work might be done in order to assess if the estimate is appropriate. There might be different range of percentages for different type of countries and by distance between reporters and partners. A study can be conducted on available records on both side: this means records for which the commodity is reported by the reporter and by the partner.

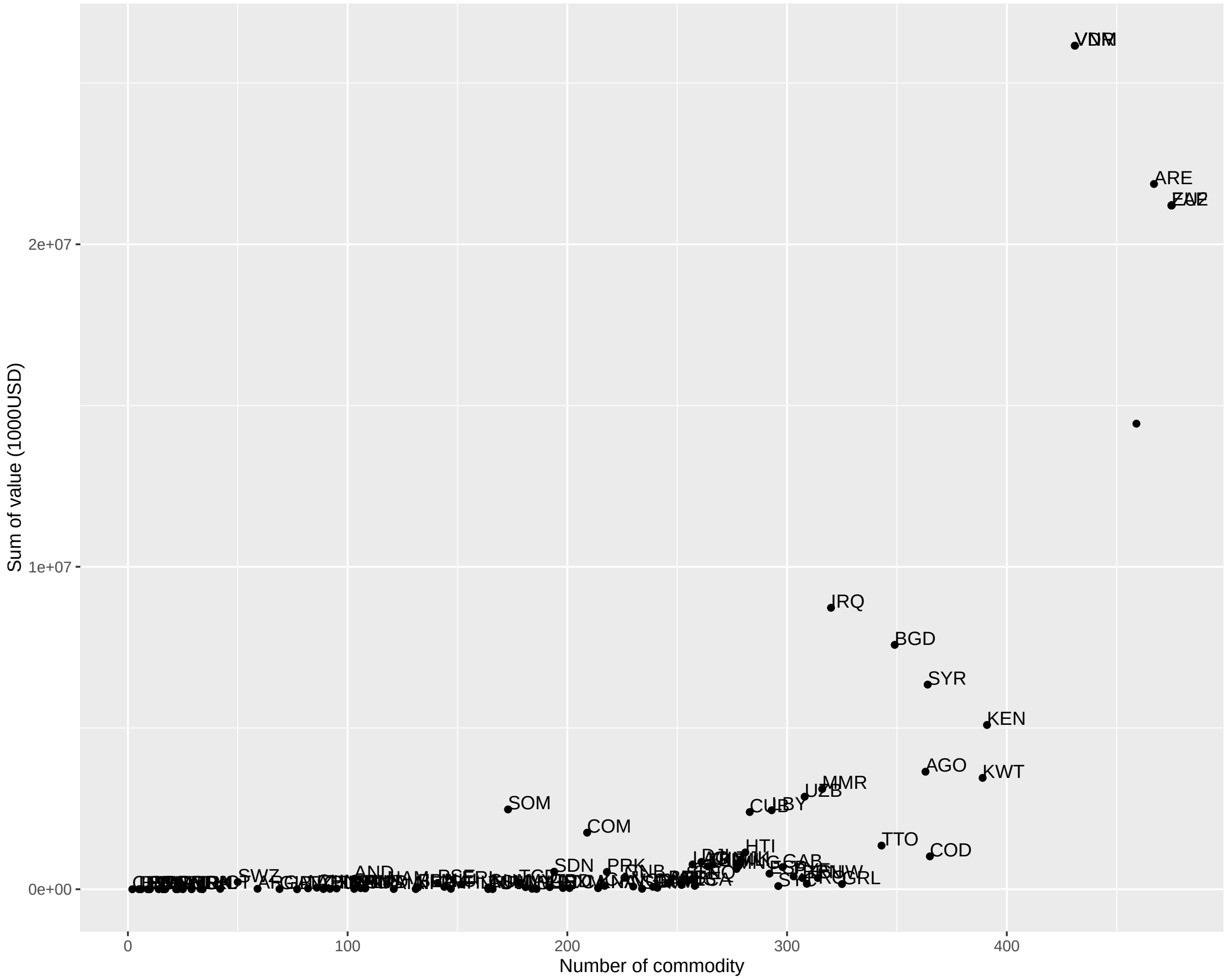


Figure 1: Sum of all self trade records by country.

4.4 Re-import and Re-export

- All re-imports and re-exports are considered as, respectively, imports and exports.
- More study might be conducted in order to identify countries more prone to report re-import and re-export.

4.5 Self Trade Analysis

- A script within the vignette folder, named selftrade.R, has been used to perform some simple analyses on the self trade. The script filter all records for which the reporter and the partner are the same. The script compute the sum of all value across all commodities per country (Figure 1), or the sum of all the value for each commodity across all countries (Figure 2). In this way we can spot out the countries reporting massive self trade as well as which are the main commodities reported in self trade.

  This is an example of the graphical output (still part of the script).
- This might be incorporated in the module and might produce suitable output within the SWS. More documentation is needed.

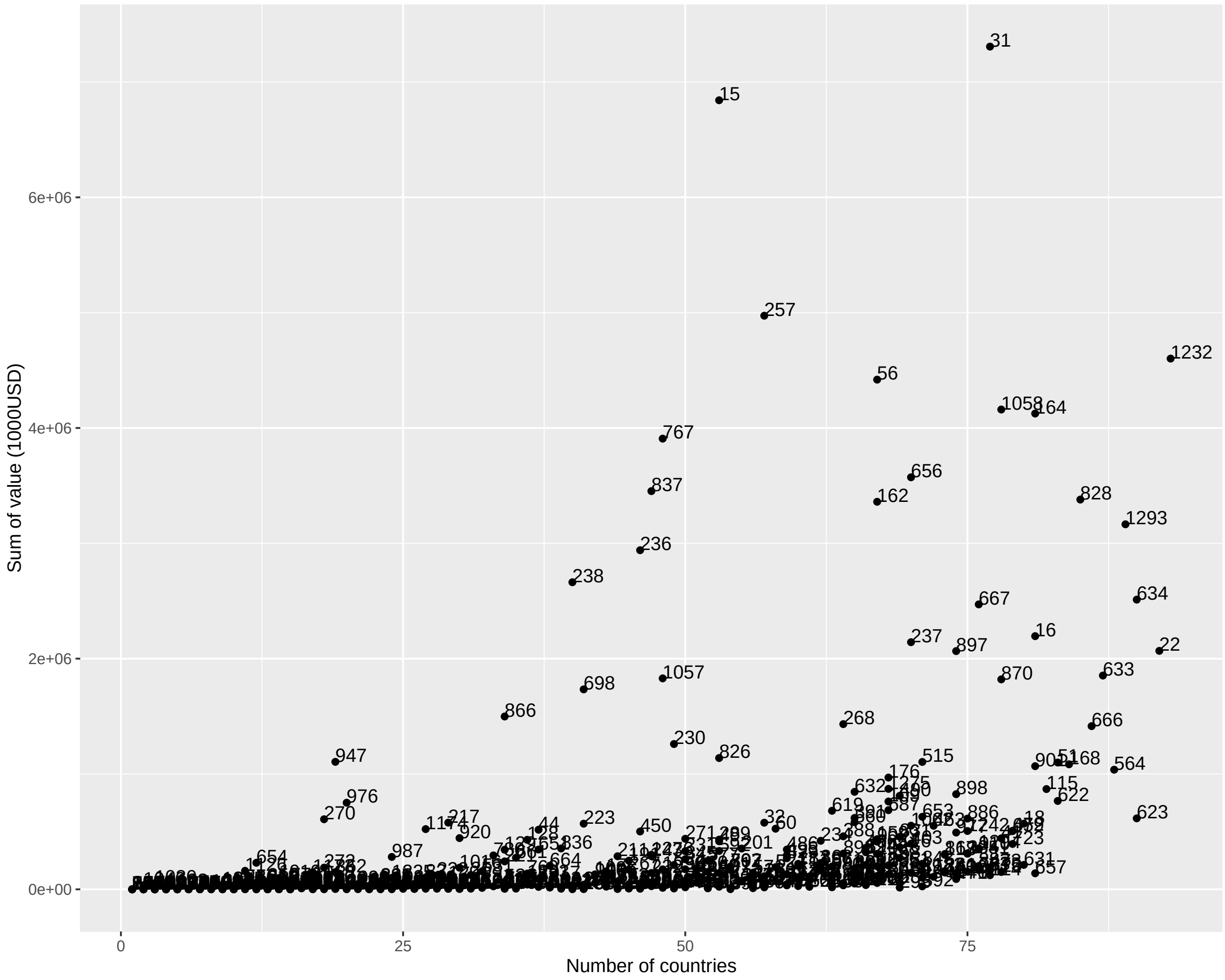


Figure 2: Sum of all self trade records by commodity. Codes in FCL.

4.6 Pseudo-automatic mapping of commodities

- An additional method has to be added in the future: the algorithm should try to trim the code not mapped and try to map them with shorter HS codes. If any of shorter codes (from right to left) are then not mapped, we can definitely discard the record. If a specific record has a HS code not mapping to any specific FCL code, then the record is reported and removed.

4.7 Mapping from HS to FCL/CPC

- In the module for commodities we have 2 different mappings. From HS to FCL, using mapping produced by team B/C and then from FCL to CPC 2.1. In the future direct mapping from HS to CPC has been asked from management. A possible solution, where adding the column with the one-to-one CPC codes has been sent to Carola (09.06.2016), but anyway this needs revision (link)

4.8 Mapping from Comtrade M49 and Geonomenclature directly to M49

- The country codes, as the commodity ones, have two steps of mapping. This results in higher risk of data loss due to unsolved mapping.
- A direct map from Comtrade M49 (Tariffline UNSD) to M49 and from Geonomenclature (Eurostat) to M49 would be ideal.

4.9 Flag management

- This activity has high priority and is currently in progress.

4.10 Outlier identification

- Outliers are identified by using the median unit value by the most specific HS code. There is a problem in this procedure as sometimes the number of reporters for the specific HS code can be low. This is what led to the reimplementation of the imputation procedure that now uses a specific-to-generic median unit value calculation. Thus, a similar procedure should be implemented for *detecting* outliers.

4.11 Outlier coefficient

- The outlier coefficient is set up to 1.5. The outlier coefficient is a input parameter of the `complete_tf_cpc` submodule.
- After discussion with team B/C (23.06.2016) a specific analysis has to be perfomed to understand what is the best coefficient to be used in order to reflect old results. After this analysis, the outlier coefficient should be hard-coded within the code of the module without letting the user to modify it anymore.

4.12 Food-aid

- This has to be incorporated also to understand the trend in a time series analysis. This needs special study to understand if we can get the data just from the exports not reported as imports in the partner.

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