Forecast of international trade: Methodological note

September 2018

Table of Contents

Presentation

This document describes the econometric models developed by StudiaBo for the construction of the Forecast of annual foreign trade flows worldwide.
Specifically, StudiaBo has developed a **Demand Model** aimed to provide a forecasting scenario of imports by product and market, starting with the GDP forecasts of the different countries of the world, made periodically available by the International Monetary Fund (IMF).
The remarkable detail by country and by product allows to achieve two important results:

- useful information at a very disaggregated product level;
- gradual growth of the robustness of the predictions, as you go up in level of aggregation [1].

The Demand Model is accompanied by a **Competitiveness Model**, which can produce a forecasting scenario for the exports of different countries, based on their ability to compete in international markets.
The combination of the two models allows:

- to produce accurate forecast scenarios, covering all the actual international trade flows;
- to produce *what-if* scenarios, taking into account factors of uncertainty on the exogenous variables. This potential is particularly important in the case of long-term forecast scenarios, in which uncertainty on the assumptions regarding the exogenous variables might be significant.

This document is organized into two parts. The first part describes the data sources used to develop the forecasting models. The second part describes the econometric models of demand and competitiveness used to build the Forecast database.

[1] The statistical theory indicates as the aggregation of forecasts independent of each other allows you to get an *ex-ante* prediction error on the aggregate less than or equal to the sum of the prediction errors of individual components.

The Data Sources

The endogenous variables

The endogenous variables refer to the database Ulisse, developed by StudiaBo that provides information on the endogenous variables at the base of the econometric models hereafter considered. Ulisse is a database on annual flows of world trade, containing, at different product levels, the trade exchanges within 150 countries.
Database Ulisse is built from the following data sources:

Eurostat Comext : the monthly database produced by Eurostat on foreign trade of the EU countries (http://epp.eurostat.ec.europa.eu/);

UN Comtrade : the annual database produced by the United Nations Statistics Division on foreign trade of UN countries (http://comtrade.un.org/db/);

UN Monthly Comtrade : the monthly database produced by the United Nations Statistics Division on foreign trade of UN countries (http://comtrade.un.org/monthly/);

U.S. Census Bureau - db UsaTrade : monthly foreign trade flows of U.S. companies (https://usatrade.census.gov/).

For further details of the methodological approach in the construction of database Ulisse, please refer to the relevant methodological note.

The exogenous variables

The database of the exogenous variables is constructed from the information provided by the International Monetary Fund (IMF) and the U.S. Bureau of Labor Statistics (USBLS).
From IMF the following variables are collected:

- time-series of Gross Domestic Product (GDP) in dollars of the 150 countries considered;
- time-series of Gross Domestic Product (GDP) in dollars worldwide;
- time-series of World Trade in dollars;
- time-series of GDP per-capita in dollars of the 150 countries considered.

From USBLS it is collected the time-series of hourly labour costs in different countries.

The Econometric models

The Demand Model

The forecasts on imports of different markets are made from the development of a **Demand Model**, which estimates the relationship between imports of each product by the relevant market and the macroeconomic dynamics of the market.
Formally, the model consists of two equations. The first one is given by the following identity:
$AGD_t = \Delta \ln(WT_t) - \Delta \ln(GDP_t)$ where:

WT_t: is the total World Trade at time *t*;

GDP_t: is the total Gross Domestic Product of world economy at time *t*;

AGD_t (Acceleration of Global Demand) is a variable that attempts to capture acceleration and deceleration of world trade, compared to the dynamics of the global gross domestic product. It reflects a variety of phenomena, including the following:

1. the opening process of the various markets to international trade;
2. the specialization process in the production of different countries;
3. the greater amplitude, with respect to the total economic cycle, of inventories and fixed investment cycles.

The second equation is a behavioural equation:
$\Delta \ln(M_{i,t}) = \alpha_i + \beta 1 \Delta \ln(GDP_{i,t}) + \beta 2(AGD_t) + \epsilon_{i,t}$
where:

$M_{i,t}$: are the imports of *i-th* market at time *t*;

$GDP_{i,t}$: is the Gross Domestic Product of the *i-th* market at time *t*;

$\beta 1$: measures the elasticity of imports to changes in GDP and it is assumed to be constant for different markets. Basically, this coefficient tends to characterize a product, by measuring the speed with which its imports tend to develop in relation to the growth of the overall economy;

$\beta 2$: measures the different behaviour of the market in question in relation to global processes of opening of the world economy to foreign trade. This coefficient takes values close to 1;

α_i: is the parameter that captures the structural peculiarities associated to *i-th* market.

The model is specified as part of the *panel data* methodological approach, which tries to account for both the individual and of the temporal variability using all the available observations. The assumption adopted is that of a *fixed-effects* model, in which the individual effects $alpha_i$ are deterministic.
The reason for this choice depends on the fact that individuals in our sample are not extracted from a population but, on the whole, constitute themselves the population of interest. In addition, fixed-effects models are of the *bias reducing* type, because the omission of relevant variables, characterized by prevalent individual variability, is made up for by the inclusion of fixed effects. This latter statistical fact is particularly important when, as in this case, the list of explanatory variables may not describe all possible determinants.
The functional form of the model is linear in the logarithms. In addition, the log levels of the variables of interest are transformed into first differences.

The Competitiveness Model

For the forecasts on exports by individual countries towards different markets a **Competitiveness Model** has been developed, which reflects the variation of market shares of the different competitors. In this type of models imports from a country are calculated starting from the total imports of the market and on the basis of an assessment of the dynamics of the market shares held by the country concerned, representative of its ability to compete in that market.

Formally, for each flow, the estimated model consists of two equations. The first equation expresses the effects of the competitiveness of a country on its market share:

$MS_{i,j,t} = 1/[1 + exp(\phi_i + \gamma 1(time) + \gamma 2(ICOSi,t))]$ where:

$MS_{i,j,t}$: is the market share on the *j-th* market owned by the *i-th* exporter, at the time *t*;

$ICOS_{i,t}$: is an index of relative labour cost of the *i-th* exporter, which measure its relative competitiveness. Is is constructed as the ratio between the labour cost of the *i-th* exporter and the labour costs of competitors, calculated as a weighted average, with weights proportional to the value of exports of each of them.

$time$: is a time series that represents the years;

ϕ_i: is the parameter that captures the "structural" level of market share of the *i-th* exporter in different markets;

$\gamma 1$: represents the rate at which the exporters of the product concerned tend to gain or lose share on international trade;

$\gamma 2$: is the parameter that captures the competitiveness effect, measured in terms of the index of relative labour cost.

The second equation links the *i-th* country's exports to the total imports of the market, through the share held by this:

$M_{j,i,t} = MS_{i,j,t} * M_{j,t}$

where:

$M_{j,i,t}$: are the imports of the *j-th* market from the *i-th* exporter at time *t*;

$Q_{i,j,t}$: are the market shares held by *i-th* exporter on the *j-th* market at time *t*;

$M_{j,t}$: are the total imports of *j-th* market at time *t*.

As for the demand model, also for the Competitive Model the estimate is made using the *panel data* methodological approach. For the same reasons mentioned above the assumption adopted is that of a *fixed-effects* deterministic model. The functional form of the model is a logistic function that well describes economic phenomena characterized firstly by a latency period, followed by a development phase and then by a period of "maturity", which therefore tends to a saturation level.

The two equations above allow to formulate a forecasting scenario of exports by country, from the dynamics of the total imports in the various markets and the evolution of competitiveness, measured in terms of labour costs. Of course, with regard to the total imports of each market, the forecast scenario is the result of the demand model described in the previous section.

As for the labour cost, it refers to the relationship between this and the GDP per capita of different countries, contained in the IMF forecasting scenarios. This relationship is always estimated using a fixed-effects panel data model and a functional form expressed in logarithms. In symbols :

$\ln(COS_{i,t}) = \alpha_i + \beta 1 \ln(GPR_{i,t})$

where:

$COS_{i,t}$: represents the hourly labour cost of the *i-th* country;

$GPR_{i,t}$: represents the GDP per capita of *i-th* country;

α_i: is the parameter that captures the specificities characterizing the different countries (in terms of the labour market);

$\beta 1$: is the parameter that captures the relationship between GDP per capita and hourly labour costs.

Frequency of updates

The Forecast database is updated periodically along a year, with the following relevant timing:

1. this update is characterized by a pre-estimate of trade flows data for the previous year;
2. this update is characterized by using the Spring forecasting scenario of the International Monetary Fund;
3. this update is characterized by the final estimate of foreign trade flows for the previous year and a forecast for the current year that takes into account the intra-year information acquired;
4. this update is characterized by using the Fall forecasting scenario of the International Monetary Fund and an estimate for the current year that takes into account the intra-year information acquired.