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 By: Cambridge Econometrics

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Documentation on food demand scenarios in 70 world regions, 2010-2060, based on FAO data.

This note provides an overview of how FAO data is sourced and processed to be used within the E3ME food equations.

The data for the E3ME food equations is taken from FAO, which captures detailed food supply data and for the purpose it is being used for, at the country level. The data produces forecasts up to 2060 under 2 different scenarios. This data is processed and converted to match the E3ME classification of food categories and regions. The growth rates of the food use data in the Business As Usual scenario are applied to the E3ME food projections.

# Source

The FAO data is downloaded from here: <http://www.fao.org/faostat/en/#data>

And a sample can be seen below:



The data provides projections for two different scenarios: (i) baseline, based on FAO projections, and (ii) food\_tax, a scenario with additional taxes on soy demand in China and Brazil, increasing linearly from 2% in 2025 to 10% by 2030 and held constant thereafter.

The following description is adapted from the same source (<http://www.fao.org/faostat/en/#data>):

The Food Balance Sheet (FBS) presents a comprehensive picture of the pattern of a country's food supply during a specified reference period. The food balance sheet shows for each food item - i.e. each primary commodity and a number of processed commodities potentially available for human consumption - the sources of supply and its utilization. The total quantity of foodstuffs produced in a country added to the total quantity imported and adjusted to any change in stocks that may have occurred since the beginning of the reference period gives the supply available during that period. On the utilization side a distinction is made between the quantities exported, fed to livestock, used for seed, put to manufacture for food use and non-food uses, losses during storage and transportation, and food supplies available for human consumption. The per capita supply of each food item available for human consumption is then obtained by dividing the respective quantity by the related data on the population. Data on per capita food supplies are expressed in terms of quantity and - by applying appropriate food composition factors for all primary and processed products - also in terms of caloric value and protein and fat content.

The FBS are compiled every year by FAO, mainly with country-level data on the production and trade of food commodities. Using these data and the available information on seed rates, waste coefficients, stock changes and types of utilization (feed, food, processing and other utilization), a supply/utilization account is prepared for each commodity in weight terms. The food component of the commodity account, which is usually derived as a balancing item, refers to the total amount of the commodity available for human consumption during the year. Besides commodity-by-commodity information, the FAO FBS also provide total food availability estimates by aggregating the food component of all commodities including fishery products. From these values and the available population estimates, the per person dietary energy and protein and fat supplies are derived and expressed on a daily basis. In the FBS, production data refer only to primary products while data for all other elements also include processed products derived there from, expressed in primary commodity equivalent.

# Processing

The processing of the data has the following steps:

1. The data is filtered to use “Food use”, and the “Business As Usual” scenario.
2. Volume in 1000 tonnes and values in millions USD selected.
3. The FAO “CountryName” column is converted to E3ME region specification.
4. FAO data is for 2012, 2030, 2035, 2040, 2050, and so a linear interpolation is used to complete the missing data.
5. The growth rate of the disaggregated food demand equations is matched to FAO volume projections from 2013 onwards (the disaggregation of the food sectors is shown in table 1).
6. The growth rate of the disaggregated food prices from 2013 is set to grow with value/volume FAO projections.
7. Total food demand (for all food categories) is the sum of the disaggregated food demands.
8. The average food price is calculated as the weighted average of the disaggregated food prices and disaggregated food demand.

In addition, the material demand for food is set to grow at the same rate as total food demand. And the material demand for feed is set to grow with total feed use (volume in 1000 tonnes, in the business as usual scenario), so this is also processed.

# Food Demand and Material Demand in E3ME

There are two steps to the food demand estimation in E3ME. Total food demand is firstly estimated at an aggregate level and then a separate estimation is used to determine food demand by food type. The two-step approach improves the stability of the food demand equations, as the disaggregated food demand results are based on less robust and sometimes volatile data, and so are scaled to match results from the aggregate equation.

In E3ME, aggregate and disaggregate food demand variables are a measure of final demand and therefore the measures include food waste during the production process. Data for food demand and food prices is taken from FAO Food Balances.

In both the aggregate and disaggregate equations, the key explanatory variables are real incomes and relative prices. Although the key explanatory variables included in the disaggregate equations are similar to those included in the aggregate equations, there are some subtle differences in the two specifications.

For most countries we would expect a positive relationship between food demand and real incomes at an aggregate level (with a de-coupling of this relationship as incomes grow above a certain point when the desired level of food consumption is reached), however, at the disaggregate level, the relationship is not necessarily positive, and this restriction is not imposed. For example, as incomes grow, there may be substitution from some cheaper or more basic food types (such as rice and cereals) towards more expensive food types (such as meat and fish). To capture these price-induced substitution effects, the price term in the disaggregated food demand equation is the ratio of the price for the particular food commodity in question to that of the average food prices.

The material demand equations are a function of economic activity, material prices and technology measures. There is also a term in the equation to account for the changing share of imports in consumption. It is assumed that all material consumption meets intermediate demands (i.e. materials are used as part of the production process and not bought by households directly). A relatively small number of sectors produce the materials: agriculture and fishing produce food and feed; the forestry sector produces forestry; and other mining produces all mineral categories.

# E3ME Classification

The food categories within the FAO data are more detailed and are aggregated to the classification used within E3ME, which is shown in table 1 below.

|  |
| --- |
| Table : E3ME food classification |
| 1 Cereals               | 8 Rapeseed              | 15 Fish                |
| 2 Rice                  | 9 Other oil crops       | 16 Dairy               |
| 3 Potatoes              | 10 Sugar crops          | 17 Fruit               |
| 4 Other roots           | 11 Poultry             | 18 Vegetables          |
| 5 Maize                 | 12 Pork                | 19 Other               |
| 6 Soy                   | 13 Beef                |  |
| 7 Sunflower             | 14 Other meat & animal prod. |  |

**Table 2: E3ME-FAO converter**

|  |  |
| --- | --- |
| E3ME | FAOSTAT |
| 1 Cereals               | Barley |
| 1 Cereals               | Millet |
| 1 Cereals               | Sorghum |
| 1 Cereals               | Wheat |
| 1 Cereals               | Other cereals |
| 2 Rice                  | Milled rice |
| 3 Potatoes              | Potatoes |
| 3 Potatoes              | Sweet potato and yams |
| 4 Other roots           | Cassava |
| 4 Other roots           | Other roots and tubers |
| 5 Maize                 | Grain maize |
| 6 Soy                   | Soybeans |
| 6 Soy                   | Soya oil |
| 7 Sunflower             | Sunflower seed oil |
| 7 Sunflower             | Sunflower seed |
| 8 Rapeseed              | Rapeseed oil |
| 8 Rapeseed              | Rapeseed and mustard seed |
| 9 Other oil crops       | Other oilseeds |
| 9 Other oil crops       | Olive oil |
| 9 Other oil crops       | Palm kernel oil |
| 9 Other oil crops       | Palm fruit oil |
| 9 Other oil crops       | Coconuts oil |
| 9 Other oil crops       | Cottonseed oil |
| 9 Other oil crops       | Groundnut oil |
| 9 Other oil crops       | Sesame seed oil |
| 9 Other oil crops       | Oilcrops, nes, oil |
| 10 Sugar crops          | Processed sugar |
| 10 Sugar crops          | Sugar beet |
| 10 Sugar crops          | Sugar cane |
| 11 Poultry             | Poultry meat |
| 12 Pork                | Pigmeat |
| 13 Beef                | Beef and veal |
| 14 Oth.meat&anim prod. | Sheep and goat meat |
| 15 Fish                | Fish |
| 16 Dairy               | Raw milk |
| 17 Fruit               | Bananas |
| 17 Fruit               | Citrus fruits |
| 17 Fruit               | Other fruits |
| 17 Fruit               | Olives |
| 17 Fruit               | Plantains |
| 18 Vegetables          | Other vegetables |
| 18 Vegetables          | Dried pulses |
| 19 Other               | Coconuts |
| 19 Other               | Cocoa beans |
| 19 Other               | Coffee, green |
| 19 Other               | Groundnuts |
| 19 Other               | Sesame seed |
| 19 Other               | Tea |
| 19 Other               | Other crops |

**Table 3: E3ME regions**

|  |  |
| --- | --- |
| E3ME Regions | Aggregate Region Constituents |
| 1 Belgium |  |
| 2 Denmark |  |
| 3 Germany |  |
| 4 Greece |  |
| 5 Spain |  |
| 6 France |  |
| 7 Ireland |  |
| 8 Italy |  |
| 9 Luxembourg |  |
| 10 Netherlands |  |
| 11 Austria |  |
| 12 Portugal |  |
| 13 Finland |  |
| 14 Sweden |  |
| 15 UK |  |
| 16 Czech Rep. |  |
| 17 Estonia |  |
| 18 Cyprus |  |
| 19 Latvia |  |
| 20 Lithuania |  |
| 21 Hungary |  |
| 22 Malta |  |
| 23 Poland |  |
| 24 Slovenia |  |
| 25 Slovakia |  |
| 26 Bulgaria |  |
| 27 Romania |  |
| 28 Norway |  |
| 29 Switzerland |  |
| 30 Iceland |  |
| 31 Croatia |  |
| 32 Turkey |  |
| 33 Macedonia |  |
| 34 USA |  |
| 35 Japan |  |
| 36 Canada |  |
| 37 Australia |  |
| 38 New Zealand |  |
| 39 Russian Fed. |  |
| 40 Belarus | Belarus |
| 41 China |  |
| 42 India |  |
| 43 Mexico |  |
| 44 Brazil |  |
| 45 Argentina |  |
| 46 Colombia |  |
| 47 Rest of Latin America | BoliviaChileCosta RicaCubaDominican RepublicEcuadorEl SalvadorGuatemalaGuyanaHaitiHondurasNicaraguaPanamaParaguayPeruPuerto RicoSurinameTrinidad and TobagoUruguayVenezuela |
| 48 Korea |  |
| 49 Taiwan |  |
| 50 Indonesia |  |
| 51 Rest of ASEAN | Brunei DarussalamCambodiaLaosMyanmarPhilippinesSingaporeThailandVietnam |
| 52 Rest of OPEC ex Venezuela | IranIraqKuwait |
| 53 Rest of World | AfghanistanAlbaniaAmerican SamoaAndorraAnguillaAntigua and BarbudaArmeniaArubaAzerbaidjanBahamasBahrainBangladeshBarbadosBelizeBermudaBhutanBosnia-HerzegovinaBritish Virgin IslandsCayman IslandsCocos (Keeling) IslandsCook IslandsDominicaEast Timor (Timor-Leste)Falkland IslandsFijiGeorgiaGibraltarGrenadaGuamHoly SeeHong KongIsraelJamaicaJordanKirghizstanKiribatiLebanonLiechtensteinMacauMaldivesMarshall IslandsMicronesia, Federated states ofMoldovaMonacoMongoliaMontenegroMontserratNauruNepalNetherlands AntillesNew CaledoniaNiueNorfolk IslandsNorth KoreaNorthern Mariana IslandsOccupied Palestinian TerritoryOmanPacific Islands (Palau)PakistanPapua New GuineaPitcairnQatarSaint HelenaSaint Kitts and NevisSaint LuciaSaint Vincent and the GrenadinesSamoaSan MarinoSerbiaSolomon IslandsSri LankaSvalbard and Jan Mayen IslandsSyriaTadjikistanTokelauTongaTurkménistanTurks and Caicos IslandsTuvaluUnited States Virgin IslandsUzbekistanVanuatuYemen |
| 54 Ukraine |  |
| 55 Saudi Arabia |  |
| 56 Nigeria |  |
| 57 South Africa |  |
| 58 North Africa OPEC | AlgeriaLibya |
| 59 Central Africa OPEC | AngolaCongoEquatorial GuineaGabon |
| 60 Malaysia |  |
| 61 Kazakhstan |  |
| 62 Rest of North Africa | MoroccoSudanTunisiaWestern Sahara |
| 63 Rest of Central Africa | CameroonCentral African RepublicChadSao Tome and Principe |
| 64 Rest of West Africa | BeninBurkina FasoCabo VerdeCôte d'IvoireGambiaGhanaGuineaGuinea-BissauLiberiaMaliMauritaniaNigerSenegalSierra LeoneTogo |
| 65 Rest of East Africa | BurundiComorosDjiboutiEritreaEthiopiaMauritiusRwandaSeychellesSomaliaSouth SudanUnited Republic of TanzaniaUganda |
| 66 Rest of South Africa | BotswanaEswatiniLesothoMadagascarMalawiMozambiqueNamibiaZambiaZimbabwe |
| 67 Egypt |  |
| 68 Dem. Rep. Congo |  |
| 69 Kenya |  |
| 70 UAE |  |