The World Economic Forecasting Model at the United Nations

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Abstract:

The World Economic Forecasting Model (WEFM) was developed to allow the UN Development Policy Analysis Division to produce consistent forecasts for the global economy for use in its flagship publication, World Economic Situation and Prospects (WESP) and the WESP Update, and for the forecasts presented at annual meetings of Project LINK. The WEFM evolved from the original Project LINK programme, which started in the 1960s, and linked together individual country macro-models from up to 80 different countries in order to compute a joint global forecast. The WEFM is also used to produce alternative scenarios around the central forecast. Examples include the impact of a resurgence in the euro area debt crisis; a sharp adjustment in global energy prices; a fiscal stimulus coordinated among the largest economies; migration flows in Europe; conventional and unconventional monetary policy shocks; and a slowdown in trend productivity growth. The flexible model platform can be adapted to address a wide range of policy questions.

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1. Introduction

Under the mandate of the General Assembly, the UN Secretariat has been publishing annual assessments of macroeconomic trends in the world economy since the 1940s.[1] From the early 1970's on, the UN Secretariat has also been publishing short-term forecasts for the world economy, through cooperation with Project LINK.[2]

The LINK forecasting exercise was originally based on two major components: the expertise of some 100 economists from about 60 individual countries and several international organizations; and the LINK global modelling system consisting of some 80 individual country models, linked together through trade and other international linkages. A recent evaluation of the forecasting performance of the Project LINK exercise over the past three decades can be found in United Nations (2008).

In 2005, work on a new World Economic Forecasting Modelling (WEFM) was initiated to replace the old, mainframe-computer-based LINK model. The WEFM maintains the bottom-up modelling approach and a version of the international linkage mechanism of the original LINK system. The world economy is modelled as a collection of individual country models linked together through international trade and other international economic relations. However, the WEFM strives to make significant improvements over the previous LINK system in several respects.

In the old LINK system, individual country models differed considerably across countries in terms of model structure, size, and specification, as many of those models were built and maintained by the LINK national centres. The merit of these country specific features, however, also came with increasingly heavy burdens on the UN Secretariat to operate and maintain these models, as well as difficulties in the interpretation of different behavioural responses across countries. To reduce these burdens, the WEFM introduces a theoretical harmonization of the individual country models. While differences across model structures are allowed to capture, for example, distinct behavioural differences between developing economies, developed economies and major commodity exporters, there is a common core theoretical underpinning to each country model.

The WEFM comprises 176 individual country models linked together via a trade matrix that reconciles global export and import volumes and export and import prices (see Appendix A.3 for the full list of countries). The country models are characterized by a long run neo-classical

[1] The first publication of the World Economic Report was released in 1947. Over time, the Report was renamed the World Economic and Social Survey (WESS), which included a review of both macroeconomic trends and selected development issues. In 2000, the publication of World Economic Situation and Prospects (WESP) was separated from the WESS, to focus exclusively on short-term macroeconomic trends and emerging policy issues. All these of publications can be found at http://www.un.org/en/development/desa/policy/publications/index.shtml

[2] More information about Project LINK can be found at http://www.un.org/en/development/desa/policy/proj_link/index.shtml and at http://www.rotman.utoronto.ca/FacultyAndResearch/ResearchCentres/ProjectLINK

supply side and a short run Keynesian demand side. Households consume, save and supply labour; firms produce output, hire labour and invest; governments pursue fiscal policy by spending and taxing and monetary policy by setting the short term interest rate and exchange rate policy. Policy variables are modelled to follow rules according to country-specific situations, with flexible options for discretionary policy actions whenever necessary. The balance of demand and supply, together with global commodity and other imported prices, determine inflation. The 2016 vintage of the WEFM comprises a scaled-down model framework of approximately 60 variables per country.

Key behavioural equations are specified in a co-integration/error-correction framework. This has the advantage that the long run, as embodied in the co-integrating relations, can be modelled in a theoretically consistent manner while the short run can be modelled so as to best fit the data, with the error correction mechanism ensuring that the system moves towards the long run in the absence of shocks. As such, both policy analysis and forecasting can be encompassed in the same framework.

Section 2 of this document discusses the theoretical background underpinning the model equations in the WEFM, including the specification and estimation of key equations and specification of international linkages. Section 3 illustrates examples of how the WEFM is used for the simulation of scenarios. Section 4 discusses how the accuracy of the model can be assessed, while section 5 concludes with remarks on plans for further development of the WEFM. The Annex includes a full list of variables, country codes, and equations in a standard country model.

2. Model structure

The specification of the individual country models contained in the WEFM is founded on work originating in the United Kingdom at HM Treasury in the early 1980's, which was further refined and extended at the London Business School (LBS) and the National Institute of Economic and Social Research (NIESR)[3]. This style of prototype model is also utilized in the Oxford Economic Forecasting (OEF) model, while a simplified version was developed for use in the ESCB Multi-Country Model.[4]

The origins of this macromodelling framework were prompted by criticisms against large-scale macro models that had been levelled, first by Lucas (1976) and later by Sims (1982) that had effectively turned the economics profession against large-scale models (see Hall and Allen (1997)

[3] The LBS (later replaced by OEF), and the NIESR have been involved either as national modeling centers or experts in Project LINK for many years.

[4] The European System of Central Banks (ESCB) Multi-Country Model is described in: for Spain: (Willman & Estrada, 2002), France: (Boissay & Villetell, 2005), Netherlands: (Angelini, Boissay, & Ciccarelli, 2006), Germany: (Vetlov & Warmedinger, 2006), Italy: (Angelini, D'Agostino, & McAdam, 2006), Lithuania: (Vetlov, 2004), Greece: (Sideris & Zonzilos, 2005).

for discussion). The models that evolved from the work originating at HM Treasury attempted to address these concerns by making more use of economic theory and econometric techniques in the specification of the model: creating subsystems within the model with cross-equation restrictions that could then be embedded in a cointegration/error correction framework and estimated using system estimation to identify and test (see e.g. Johansen, 1988); introducing expectations, both rational[5] and adaptive; and introducing government policy rules. In addition, the emphasis in this approach was on attaining acceptable model properties, which in some cases led to the imposition of sensible restrictions and/or coefficient values, rather than relying exclusively on data-based estimates.

In the successive vintages of the WEFM, the flavour of this philosophy has been retained within a simplified context:

1. Long-run relationships are specified in line with standard macroeconomic theory, imposing cross equation restrictions where required.
2. Core behavioural relationships are specified as error-correction processes, and equations are estimated individually within a restricted environment.
3. Cointegrating relationships are estimated either as part of a 2-step process, applying dynamic OLS procedures to first identify the long-run equations and then fitting the dynamics around the cointegrating relationships, or by applying instrumental variable techniques in a single equation framework that jointly estimates the cointegrating relationships and the dynamics.[6]
4. Dynamic and static homogeneity properties are imposed in the price system where appropriate.
5. Expectations are modelled as an adaptive process.
6. Policy variables can be endogenized via rule-based processes.

The 2016 vintage of the WEFM retains many model features from the specification utilized for the ESCB multi-country prototype model, retaining the same mnemonics, but making some simplifications as well as introducing new developments.

2.1 Specification and estimation of the country models in the WEFM

The individual country models in the WEFM contain four sectors: households, firms, government and a foreign sector, which generate aggregate demand and supply for the economy. The sectors are linked together through behavioural relationships and accounting identities to ensure overall consistency of the system. This section presents the key features of some important equations in each block, while a complete set of all equations, including both behavioural equations and accounting identities, can be found in the Annex.

[5] Of the modelling approaches listed above, only the National Institute of Economic and Social Research models introduce rational expectations. See e.g. (Barrell, Sefton, & in't Veld, 1993) .

[6] Both of these techniques avoid the bias of the two-step procedure suggested by (Engle & Granger, 1987) arising in finite samples, as shown by (Stock & Watson, 1993).

The core behavioural equations are implemented in a cointegration/error correction framework. Long run equilibrium relationships between a series y* and a vector of series $\mathbf{x}_i$ are theoretically grounded, and expressed as a cointegrating relationship (equation (1)). This is embedded in an error correction framework, which explains short-run dynamics, and may include additional stationary variables, $\mathbf{z}_i$, (equation (2)).

$$\log(y_t^*) = \alpha_0 + \sum \alpha_i \log(x_{it}) \tag{1}$$

$$\Delta\log(y_t) = \varphi_0 - \beta(y_{t-1}-y^*_{t-1}) + \sum\varphi_i(L)\Delta\log(x_{it}) + \sum\delta_i(L)z_{it} + u_t \tag{2}$$

Where $\varphi_i(L)$ is the usual lag operator.[7] In practise lags are never more than 2 periods, as the WEFM is an annual model.

The error correction framework allows the model to adjust towards a stable dynamic equilibrium. As the speed of adjustment may be slow in some countries and some markets, additional adjustment mechanisms are incorporated as necessary to ensure that a stable dynamic equilibrium can be achieved.

Cointegrating relationships are estimated either as part of a 2-step process, applying dynamic OLS procedures to first identify the long-run equations and then fitting the dynamics around the cointegrating relationships, or by applying instrumental variable techniques in a single equation framework that jointly estimates the cointegrating relationships and the dynamics. Constrained estimation techniques are employed, to ensure that all estimated parameters lie within theoretically plausible boundaries and that the model produces a coherent outlook for the future, which takes precedence over explaining the past. This allows us to estimate equations for each country individually, to capture as many idiosyncratic behaviours as possible. In some cases panel estimation methods are adopted, where common elasticities across countries are imposed for global consistency (e.g. in the trade system).

2.1.1 The Supply Side

A properly specified supply side of the economy is crucial to the overall properties of the model. From an economic point of view, the supply side determines the long run growth path of the economy including the evolution of potential output. The relationship between aggregate demand and potential output determines the state of the cycle, while turning points are identified as changes in direction of the gap between the two. Information on the state and direction of the economy provide crucial reference points for policymakers to determine the direction and stance of macroeconomic policies.

The supply side is underpinned by a general underlying production function that maps the factor inputs to final output, thereby representing the productive capacity of an economy. Starting with a general underlying production function allows us to avoid imposing a common production

[7] Throughout this paper, log refers to the natural logarithm.

technology, such as the Cobb-Douglas or Constant Elasticity of Substitution production functions, across all countries. With two factors of production the generalised form can be expressed as:

$$YFT = f(K_t, L_t, T_t) \tag{3}$$

where *YFT* is potential output, *K* is the desired capital stock, *L* is potential labour input and *T* indicates the state of technology, or total factor productivity (TFP). Totally differentiating this equation with respect to time, and assuming perfect competition in factor markets and a homothetic production function, the growth rate of potential output can be expressed as the sum of the growth rates of each input, weighted by their relative factor share, plus the growth in TFP:

$$\Delta\log(YFT_t) = \theta_{K_t}\Delta\log(K_t) + \theta_{L_t}\Delta\log(L_t) + \Delta A_t \tag{4}$$

Where θ_{K_t} is the share of output accruing to capital, θ_{L_t} is the labour share and ΔA_t is the growth rate of TFP.[8] Under the assumption of constant returns to scale, $\theta_{L_t} = (1 - \theta_{K_t})$, from which we can derive the well-known growth accounting decomposition:

$$\begin{aligned}\Delta\log(YFT_t) &= \Delta\log(L_t) + \Delta\log(YFIT\_TREND_t) \\ &= \Delta\log(L_t) + \theta_{K_t}\Delta\log(k_t) + \Delta A_t\end{aligned} \tag{5}$$

where *YFIT_TREND* is trend labour productivity and *k* is capital per unit of labour input (*K/L*). Equation (5) decomposes potential output growth into the contribution from potential labour input and trend labour productivity, which can in turn be decomposed into TFP growth and the rate of capital deepening.

Equation (5) forms the basis of the supply-side trajectory for each country within the WEFM. For the purpose of constructing a forecast baseline, potential labour input (*L*) evolves with labour force projections (*LFN*), while trend labour productivity growth is modelled as a simple error correction from recent productivity trends towards an exogenous trend rate of growth. In scenario studies the trend rate of labour productivity can be endogenized, and linked to factors that determine capital deepening (e.g. investment propensity) and/or TFP growth (e.g. infrastructure or rate of innovation). The simplified structure of this approach allows us to avoid the need for an explicit capital stock, for which there is very limited data for most developing countries.

In order to allow for the potential for market imperfections that may impede the feedbacks between external demand and domestic supply, especially in developing countries and those with fixed exchange rate regimes, an explicit link between export growth and potential output is incorporated into the model equation for potential output:

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[8] The growth rate of TFP is defined as: $\Delta A_t = \frac{f_{T_t} T_t}{Y_t}\Delta\log(T_t)$

$$\Delta\log(YFT_t) = \alpha\left[\Delta\log(LFN_t) + \Delta\log(YFIT\_TREND)\right] + (1-\alpha)\Delta\log(XTR_t) \quad (6)$$

where *XTR* is the volume of exports of goods and services. The weight, *α*, is estimated for each country, and tends to be 0.9 or higher.

Labour force projections are modelled as a function of projections for the population aged 15+ from the United Nations Population Division and labour force participation. The model equation for labour force participation projections incorporates an automatic stabilising relationship, to ensure that trend labour productivity growth does not drift too far from actual average labour productivity growth:

$$LRX_t = LRX_{t-1} + 0.2 * \begin{bmatrix} \Delta\log(Labourproductivity)_{3yr\_ave,t-1} \\ -\Delta\log(YFIT\_TREND)_{t-1} \end{bmatrix} * 100 \quad (7)$$

A similar adjustment mechanism is incorporated into the trend labour productivity equation:

$$\begin{aligned} \Delta\log(YFIT\_TREND)_t &= 0.8 * \Delta\log(YFIT\_TREND)_{t-1} + 0.2 * PROD \\ &+ 0.2 * \left[\Delta\log(Labourproductivity)_{3yr\_ave,t-1} - \Delta\log(YFIT\_TREND)_{t-1}\right] \end{aligned} \quad (8)$$

where *PROD* is an exogenous setting for the long-run trend rate of productivity growth. As a starting assumption, this is set to 4% per annum for least developed economies, 2% per annum for high-income countries and 3% per annum for all others. This initial setting is adjusted by country experts as part of the process of constructing a forecast baseline. In scenario studies this exogenous setting can be endogenised as described above.

2.1.1 Aggregate demand

In the short run, output is determined by demand, which can deviate from the potential level of supply. The deviations are measured by the output gap (*YGA*), which is defined as the ratio of actual to potential output. GDP (*YER*) is modelled as an identity relationship, summing the components of expenditure (private consumption (*PCR*), investment (*ITR*), government consumption (*GCR*), stockbuilding (*SCR*), exports (*XTR*) less imports (*MTR*)). The derivation of exports is computed as part of the global linkage system of the WEFM, and is discussed in section 2.2.

Household optimization and private consumption

The dynamic specification of private consumption follows the assumption that at least a fraction of households in any economy are credit constrained, and thus their consumption will mainly depend on their disposable income in the current period. This weight is estimated for each country, and in scenario studies can be endogenized to experiment with shocks to borrowing constraints or shifts in inequality. The remaining households are assumed to have access to credit, and can partially smooth their consumption over their life cycle. For this share of households, current consumption expenditure in driven by population growth, maintaining a constant rate of consumption per capita for households with access to borrowing. In the short-term, households are also allowed to respond to an inflation 'surprise', whereby if inflation turns out lower than expected, a fraction of these windfall gains will be spent on current consumption, while unexpectedly high inflation will lead to spending cutbacks. This stabilising mechanism ensures that inflation and inflation expectations have a tendency to converge.

If a change in disposable income is sustained, this will eventually feed into the permanent income assessments of households, and in the long-run a simple Keynesian relationship between disposable income and consumption is modelled.

$$\begin{aligned}\Delta \log(PCR_t) &= \varphi_0 - \beta\left[\log(PCR_{t-1}) - \log(RPDI_{t-1})\right] \\ &+ \varphi_1 \Delta \log(RPDI_t) + (1-\varphi_1)\Delta \log(POP_t) + \delta_1\left[INFL_t - INFL^e{}_{t-1}\right]\end{aligned} \quad (9)$$

where *PCR* is the volume of private consumption, *RPDI* is real personal disposable income, *POP* is population, *INFL* is inflation and the superscript *e* designates expectations one period ahead.

Real personal disposable income is adjusted to capture tax rates and terms-of-trade impacts on income.

Firm behaviour and investment

Investment in WEFM is modelled via a simple accelerator model, that links investment to terms-of-trade adjusted GDP. The terms-of-trade adjustment allows the model to capture the impact, for example, of a drop in commodity prices on investment in the commodity sector where appropriate. The lagged dependent variable allows for persistence, to capture the highly cyclical nature of investment.

$$\begin{aligned}\Delta \log(ITR_t) &= \varphi_0 - \beta\left[\log(ITR_{t-1}) - \log(GDI_{t-1})\right] + \varphi_1 \Delta \log(GDI_t) \\ &+ \varphi_2 \Delta \log(ITR_{t-1})\end{aligned} \quad (10)$$

where *ITR* is the volume of gross fixed capital formation and *GDI* is gross domestic income or terms of trade adjusted GDP. In scenario studies, this equation can be expanded to include additional measures that affect investment and the user cost of capital, such as uncertainty, borrowing costs, corporate tax rates, depreciation and credit constraints.

Government consumption

Government consumption is a policy variable, and would generally be set exogenously as part of the process of constructing a forecast baseline, in line with current government spending plans. Where no spending plans are available, and in scenario studies, a simple model equation is applied, which broadly maintains the share of government spending in aggregate demand. For this purpose, the growth rate of government consumption spending is modelled as a weighted average of potential output growth and terms-of-trade adjusted GDP growth. The weights are estimated for each country:

$$\Delta \log(GCR_t) = \varphi_1 \Delta \log(YFT_t) + (1-\varphi_1)\Delta \log(GDI_t) \quad (11)$$

where *GCR* is the volume of government consumption expenditure, which feed directly into both the GDP identity and the government budget balance.

Inventories

The data for the variable denoted as inventory accumulation or stockbuilding in WEFM is calculated as the residual on the national accounting identity. This means that it also captures any discrepancies between the income, product and expenditure sides of the national accounts, chain-basing residuals and other exceptional factors not explicitly included in the main expenditure components. As such, it should not be strictly interpreted as the net contribution to the inventory stock. WEFM adopts a very simple model, that has stockbuilding error correct towards a constant share of GDP. That share depends on demographic developments, as strong population growth requires extra inventories to cope with the expected rise in demand.

$$SCR_t = SCR_{t-1} - \beta\left[SCR_{t-1} - \left(\Delta\log(POP_t) + 0.024\right)YER_{t-1}\right] \quad (12)$$

where *SCR* is the volume of inventory accumulation and *YER* is real GDP.

Imports

The import demand function is specified by following the traditional "imperfect substitute" framework. Under the assumption that imports are not perfect substitutes for domestic goods (Goldstein and Khan, 1985), real import demand is determined by expenditure by households, firms, the government sector and external sector, and by the price of imports relative to domestically produced goods and services. The oil price is excluded from the price of imports, as it tends to be highly volatile, while the price elasticity of oil demand is usually very low. Filtering out noise caused by the volatility of oil prices allows for more reliable estimates of the price effects on real import demand.

The import demand function is defined as:

$$\Delta\log(MTR_t) = \varphi_0 - \beta\begin{bmatrix}\log(MTR_{t-1}) - \alpha_1\log(WER_{t-1}) \\ -\alpha_2\log\left(\dfrac{MTDNO_{t-1} * EXR_{t-1}}{YED_{t-1}}\right)\end{bmatrix} + \varphi_1\Delta\log(XTR_t) \quad (13)$$
$$+\varphi_2\Delta\log(PCR_t) + \varphi_3\Delta\log(ITR_t) + +\varphi_4\Delta\log(GCR_t)$$

where *MTR* is the volume of imports of goods and services, *WER* is total final expenditure, defined as GDP plus imports, *MTDNO* is the non-oil import price deflator in US$, *EXR* is the exchange rate, and *YED* is the GDP deflator. The speed of pass-through of the components of total final expenditure is allowed to differ across expenditure components. The long-run income elasticity is restricted to fall between 1 and 1.2, to allow for further globalisation while ensuring long-run stability of the model (Hong, 1999).

2.1.3 Labour market and prices

Unemployment rate

Labour markets in the current vintage of the WEFM are modelled as a simple Okun-style relationship that links the unemployment rate to GDP growth.

$$\Delta URX_t = \alpha_1 \Delta URX_{t-1} + \alpha_2 \Delta \log(YER)_t + \alpha_3 \Delta \log(YER)_{t-2} + \alpha_0 \qquad (14)$$

where *URX* is the unemployment rate.

Ongoing research will develop a full labour market model for employment and wages that is consistent with the underlying production function of the economy, allowing the wage to be determined as a bargaining process between employees and employers.

GDP deflator and consumer prices

The GDP deflator (*YED*) is the driving price variable of the WEFM model. Dynamics are driven by lagged consumer prices, import prices and inflation expectations, while the mark-up of price over costs is modelled as a function of the output gap.

$$\begin{aligned} &\Delta \log(YED)_t = \alpha_1 \Delta \log(HIC)_{t-1} + \alpha_2 \Delta \log(MTD)_t + (1-\alpha_1-\alpha_2) INFL^e{}_{t-1} \\ &+ \alpha_3 \log(YGA/100+1)) \end{aligned} \qquad (15)$$

where *HIC* is the headline consumer price index (harmonized where available), *MTD* is the import price deflator and *YGA* is the output gap.

Consumer prices then error correct towards inflation in the GDP deflator. The lagged dependent variable allows for some persistence in the deviation between the price indices.

$$\begin{aligned} &\Delta \log(HIC)_t = \phi_0 + \beta[\log(HIC)_{t-1} - \log(YED)_{t-1}] \\ &+ \phi_1 \Delta \log(YED)_t + (1-\phi_1) \Delta \log(HIC)_{t-1} \end{aligned} \qquad (16)$$

Dynamic homogeneity is imposed on the price system to ensure long-run consistency of the model.

2.1.4 Trade prices and the current account

Trade prices are decomposed into the global price of oil and the price of all other traded goods and services. The global price of oil is set exogenously as an input into the baseline forecasting procedure. The deflators for total exports of goods and services (*XTD*) and imports of goods and services (*MTD*) are modelled as a simple weighted average of the global oil price (*POILU*) and a non-oil deflator (*XTDNO$* or *MTDNO$*), which captures the price of all non-oil exports/imports in US$.

$$XTD_t = (\alpha_1 XTDNO\$ + (1-\alpha_1) POILU) * EXR \qquad (17)$$

$$MTD_t = \left(\beta_1 MTDNO\$ + (1-\beta_1)POILU\right) * EXR \tag{18}$$

where *EXR* is the exchange rate. The weights (α_1 and β_1) are calibrated for each country from historical trade patterns. They are generally fixed at a constant level for the forecast baseline, but can also have a time-varying setting, allowing the model to capture a decreasing or increasing weight of oil in a country's trade composition.

Non-oil export prices error correct on a weighted average of domestic prices and global prices (*CXUD*). Short-term and long-term weights are estimated for each country, which allows the model to capture the pricing power of each economy. The impact on the current account balance from various shocks is sensitive to these elasticities.

$$\begin{aligned}\Delta \log(XTDNO) = \phi_0 - \beta &\begin{bmatrix} \log(XTDNO)_{-1} - \alpha_1 \log\left(\frac{YED}{EXR}\right)_{-1} \\ -(1-\alpha_1)\log(CXUD)_{-1} \end{bmatrix} \\ + \phi_1 \Delta \log\left(\frac{YED}{EXR}\right)_t &+ (1-\phi_1)\Delta \log(CXUD)_t \end{aligned} \tag{19}$$

Global prices and non-oil import prices are determined as part of the international linkages system, as described in section 2.2.

The current account balance is modelled as an identity relationship that sums net trade in US dollars with a residual category that captures primary and secondary income flows. Ongoing research will split remittance flows and official development assistance flows out of this residual category, so that they can be analysed independently.

2.1.5 Government policy instruments

The WEFM includes a simple set of government policy instruments, which allows the model to be used to address a range of policy questions.

Fiscal policy instruments

The government budget balance (*GLN*) is defined as an identity relationship that sums total government revenue (*GGR*), government consumption spending and a residual category that captures all other spending (*GOTH*). Ongoing research will split government interest payments from this residual category to ensure the appropriate feedbacks are in place between the government deficit, government debt stock and interest rates to undertake sustainability analysis. In scenario studies, additional fiscal instruments can be introduced as needed.

$$GLN_t = GGR_t - GCR_t * YED_t - GOTH_t \tag{20}$$

The growth rate of total government revenue is modeled as a weighted average between GDP growth and export growth (in nominal prices). These weights are estimated for each country, to capture the export sensitivity of government revenue in each country.

$$\Delta\log(GGR)_t = \alpha\Delta\log(YEN)_t + (1-\alpha)\Delta\log(XTN)_t \tag{21}$$

The residual category of other government expenditure is modelled in line with GDP growth.

$$\Delta\log(GOTH)_t = \Delta\log(YEN)_t \tag{22}$$

The government deficit flows onto the government debt stock. This equation can be elaborated to include a money stock, in order to capture the role of money issuance in financing the deficit (demand debt). Future work will distinguish between debt denominated in domestic and foreign currency, to assess the sensitivity of the fiscal position to an exchange rate shock.

$$GDN_t = GDN_{t-1} - GLN_t \tag{23}$$

A fiscal policy rule can be introduced to ensure that the deficit and debt stock return to sustainable levels after any shock. This generally takes the form of a feedback loop between the deficit or debt stock on the tax rate, so that a deviation from the targeted level of the debt or deficit initiates an automatic adjustment in the tax rate. The feedback can also take the form of a risk premium that widens with the size of the government debt to GDP ratio.

Monetary policy instruments

In the absence of capital controls, uncovered interest parity means that monetary authorities can control either an interest rate or an exchange rate, but not both. Bilateral exchange rates against the US$ are modeled for all countries within WEFM. Country models distinguish between:

- countries that use the US$ as legal tender (ECU, SLV, PAN, TLS, USA, ZWE) or where the national accounts in UNSD are denominated in US$ (LBR)
- countries that use the euro as legal tender (MNE, euro area)
- countries with fixed or heavily stabilised exchange rate regimes
- countries with a fairly stable rate of crawl against another currency
- countries with floating exchange rate regimes

Countries with floating exchange rate regimes are modelled via the policy interest rate differential relative to the United States and, where appropriate, movement in the oil price. The WEFM adopts a rule-of-thumb relationship that associates a 1 percentage point rise in interest rates relative to the United States with a 5 per cent appreciation against the US$. Where interest rate data is not available, this relationship is proxied via the differentials in expected inflation or an explicit inflation rate target where appropriate.

Oil exporting countries with floating exchange rate regimes also include an estimated relationship between the exchange rate and the oil price. When the oil price rises, the currency of oil exporters can be expected to appreciate.

In scenario studies, an explicit exchange rate risk premium can be introduced, which can be endogenously related to the current account balance or other measures.

A short-term policy interest rate is included in the WEFM where the data is available. When producing the forecast baseline, this is treated as an exogenous policy instrument. In scenario studies, the interest rate can be endogenized to follow a monetary policy rule, such as a simple Taylor specification (McCallum, 1999). The short-term interest rate is determined by two "gaps", namely, the inflation gap and the output gap. The inflation gap measures the distance between the actual inflation rate and its target level. The output gap gauges the deviation of output from its potential level. The standard equation applied is of the form:

$$STI_t = 0.7 * STI_{t-1} + 1 * (INFL_t - INFT_t) + 0.2 * 100 * \log(YGA)_t + a \qquad (24)$$

where STI is the policy interest rate, INFL is actual inflation INFT is targeted inflation, and YGA is the output gap. The lagged dependent variable allows for persistence in the level of the interest rate, which will converge on the country-specific steady state rate of *a* over time. All parameters can be modified for the purpose of simulation studies in order to test sensitivity of the model to these assumptions.

Ongoing research will introduce a long-term interest rate into the model, to allow for the appropriate modelling of government interest payments and links to longer-term borrowing costs.

2.2 International trade linkages in the WEFM

Individual models in the WEFM are linked together by bilateral trade sensitivities. In the history of Project LINK, a number of approaches have been experimented to modelling bilateral trade, based on the following principles: (1) the exports of a country should be equal to the sum of the bilateral imports of its trade partners, (2) world total exports should be equal to world total imports at the global level (allowing for the historical statistical discrepancy), and (3) the import deflator of a country should be linked to the export prices of its trade partners.

The WEFM model for world trade volumes and prices is founded on an underlying bilateral trade matrix that captures bilateral trade flows between all countries modelled within the WEFM system at a point in time. The trade flows cover exchanges in both goods and services, and where necessary separate adjustments are made for trade in petroleum and petroleum products.

<u>Export volumes</u>

The volumes of exports and imports of goods and services are determined by foreign and domestic demand, respectively, and by competitiveness as measured by relative prices or relative costs. Import demand is the driving force of world trade within the WEFM. Exports from each country depend on a weighted average of import demand in its trading partners, and also on any shift in competitiveness which may affect the country's export market share. If demand for imports in country J rises, and relative export prices in all countries remain unchanged, we would expect exports from all countries to rise proportionally to their historical share of country J's exports. In this very simple scenario, export shares would remain constant in both value and volume terms. However, as soon as export prices are allowed to diverge across countries, an explicit assumption must be made on the sensitivity of trade volumes and values to relative prices. The basic model for exports within the WEFM is based on the following relationship:

$$XTR_{i,t} = \left(WDR_{i,t}\right)\left(\frac{XTDNO_{i,t}}{CXUD_{i,t}}\right)^{d1} \tag{25}$$

Where *XTR* is the volume of exports of goods and services, *WDR* is a country-specific global import demand variable, *XTDNO* is non-oil export prices, and *CXUD* is non-oil global trade prices. Oil prices are excluded from the relative export price measure, as they tend to be volatile, while the elasticity of demand for oil tends to be very low. The relative price elasticity, *d1*, must fall between the boundaries of -1, which is equivalent to imposing constant value shares on trade for all countries, and 0, which is equivalent to imposing constant volume shares on trade for all countries. While both of these assumptions are convenient for ensuring that world export and import volumes balance, neither is necessarily a very good description of reality, as shifts in global competitiveness do generally lead to a partial – but not full – substitution away from countries where trade prices are higher. Global panel estimates of the price elasticity of exports point to an average long-run global price elasticity of about -0.4, with an elasticity of about -0.3 in the short-run.

One of the difficulties of adopting a global trade model based on equation (24) is that the global balance of exports and imports is approximately maintained, but not strictly maintained if global prices diverge across countries. In order to correct for this, an additional adjustment system is introduced and any discrepancy is allocated to exports in proportion to the country's share of world trade:

$$XTR_{i,t} = \left[\left(WDR_{i,t}\right)\left(\frac{XTDNO_{i,t}}{CXUD_{i,t}}\right)^{d1}\right] WLD\_XADJ^{e1}{}_{t} \tag{26}$$

where

$$WLD\_XADJ_t = \frac{\frac{\left(\sum_i XTR_{i,t-1}\right)}{\left(\sum_i MTR_{i,t-1}\right)}}{\frac{\left(\sum_i XTR_{i,t-2}\right)}{\left(\sum_i MTR_{i,t-2}\right)}} \tag{27}$$

and *e1* is a speed of adjustment (<0,>-1).

The global import demand variable (*WDR*) is constructed as a weighted sum of other countries' imports, which ensures approximate balance in global trade:

$$WDR_{i,t} = \sum_j \frac{MTN_{ji}}{MTN_j} MTR_{j,t} \tag{28}$$

While the non-oil global trade price is defined as:

$$CXUD_j = \sum_{i \neq j} \frac{XTNNO_i}{\sum_{k \neq j} XTNNO_k} XTDNO_i \tag{29}$$

And non-oil import prices are defined as a weighted average of export prices from the rest of the world:

$$MTDNO_i = \sum_j \frac{MTNNO_{ij}}{\sum_k MTNNO_{ik}} XTDNO_j \qquad (30)$$

Deriving import prices directly from the export prices in the rest of the world ensure consistency in world trade prices. This in turn ensures that so long as export and imports are balanced in volume terms, the ratio of the value of exports to the value of imports will also remain close to its historical level.

A nominal effective exchange rate equation is also derived from the bilateral trade matrix, and can be applied on a daily, monthly or annual basis. The derivation is described in a separate note.

3. Model properties

Below we indicate some of the WEFM model properties through a small selection of simulations studies that illustrate the sensitivities of forecasts for the major global regions to some of the key underlying assumptions of the forecast.

3.1 Oil price scenario

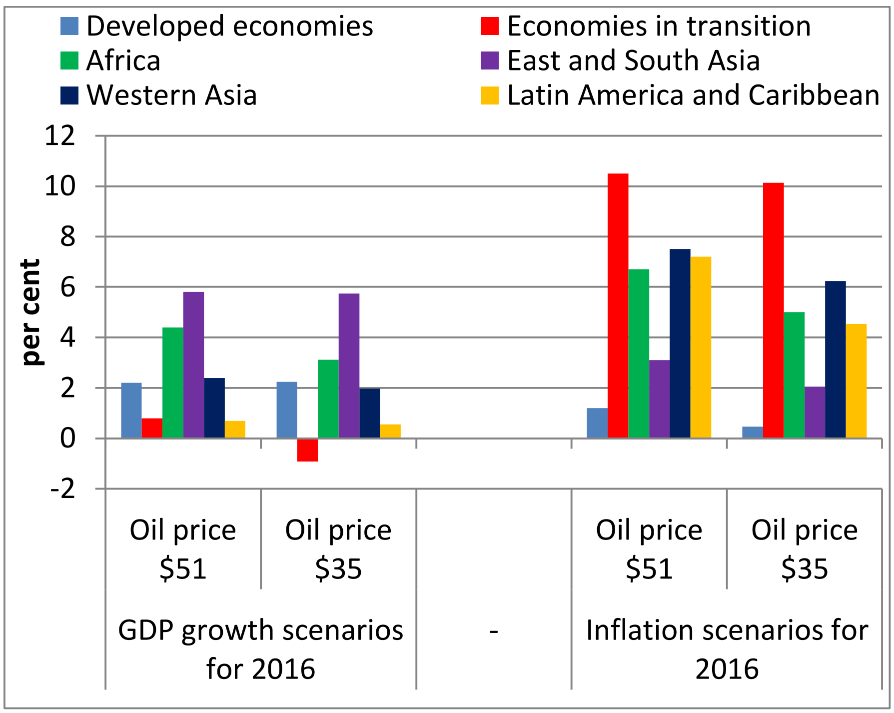
The dramatic decline in the price of oil from October 2015 to early 2016 had a significant impact on regional economic prospects. The impact on individual economies depends on a wide range of factors, such as the share of national income derived from oil production; the oil intensity of production and consumption; the share of government revenue derived from fuel taxes and the oil sector; the share of government expenditure on energy subsidies; the pass-through of the international oil price to the domestic price level; as well as the cyclical position of the economy before the shock. Regional sensitivities reported in the *WESP 2016*[9] suggest that if the oil price remains at an average of $35 pb throughout 2016, the Commonwealth of Independent States (CIS) economies would remain in recession in 2016, while GDP growth in Africa could slow compared to the modest growth of 3.7 per cent achieved in 2015 (figure 1). GDP growth in Western Asia would also slow by at least 0.5 percentage points relative to a scenario with an average oil price of $51 pb. The impacts could be even larger if the loss of oil revenue prompts significant cuts in government spending, as explored in *World Employment and Social Outlook: Trends 2016*.[10] The impact on fuel-importing economies would be more modest, as the positive effects of low oil prices on real income would at least partially offset lost exports to the fuel-exporting economies.

[9] See Appendix to Chapter 1.

[10] See *World Employment and Social Outlook: Trends 2016*, Appendix D, International Labour Office, Geneva, 2016.

The sharp drop in oil prices also increases the likelihood of deflation in many countries. In general, prices in developed economies tend to be less sensitive to the oil price than in developing economies, largely reflecting the level and structure of taxation on energy usage. Nonetheless, given the low inflation environment already prevailing, average inflation in the developed economies would be expected to fall to close to zero in 2016 if the oil price hovers at about $35 pb throughout the year, exacerbating deflationary expectation. In several East Asian countries, including China, Philippines, Indonesia and Thailand, consumer price sensitivity to the oil price has historically been relatively strong,[11] suggesting that inflation is likely to remain at low levels in the region this year.

Figure 1. Regional outlooks under different oil-price scenarios



Source: World Economic Situation and Prospects Monthly Briefing No. 87.

3.2 Migration in Europe[12]

During the first 10 months of 2015, more than 800,000 refugees and migrants arrived in the European Union (EU), nearly 82 per cent via Greece and nearly 18 per cent via Italy, with the remaining 0.8 per cent via Spain and Malta. At least 3,455 refugees and migrants lost their lives in tragic circumstances in the Mediterranean Sea during their journeys. The main country of

[11] See WESP Monthly Briefing No. 77, April 2015

[12] The authors would like to acknowledge the contribution of Willem Van Der Geest to this section.

origin is the Syrian Arab Republic (35 per cent), with Afghanistan, Eritrea and Iraq accounting for at least another 17 per cent.

During the last quarter of 2015, arrivals accelerated sharply, with the total number of refugees and migrants entering the EU in 2015 estimated to exceed 1 million persons—a dramatic increase over the 5 preceding years, during which the EU-28 countries received a total of 1.8 million asylum applications. Between 2010 and 2014, Germany received nearly a quarter of all asylum applications in the EU-28, with France and Italy together receiving another quarter of these applications. However, in response to decisions taken by the German Government on humanitarian grounds, it is estimated that the number of persons seeking asylum in Germany by the end of 2015 rose to approximately one million.

In 2014, some 362,850 persons received asylum in Germany with a total public expenditure outlay of €2.4 billion. The increased asylum support will lead to additional public expenditure in Germany to the tune of €20 billion during 2015-17, and possibly even more, taking into account indirect expenditures on education, security and accommodation.

Using the United Nations World Economic Forecasting Model, preliminary simulations indicate that the macroeconomic impact of this sizable additional outlay of €20 billion is relatively modest. The additional public expenditure is likely to reduce the budget surplus by 0.1 to 0.2 per cent of GDP, while the current-account surplus would decline by 0.2 per cent of GDP. The projected impact on the GDP growth of Germany would be small but positive at close to 0.1 percentage points during 2016 and 2017, reflecting that the increased expenditure primarily stimulates aggregate domestic demand.

The simulations also indicate that real wage growth would slow down in response to the increased labour supply, assuming that about half of the asylum applications will be granted and that a sizeable share of these will meet the challenges of social integration and entering the labour market. These results are similar to those published by the European Commission (2015, box I.1).

According to the baseline forecast, government debt in Germany was due to fall by 8.4 per cent of GDP between 2014 and 2017. But because of the influx of refugees and migrants, it is more likely to fall by 8.0 per cent, as Germany may pay off a smaller share of its debt than it might have done without the influx.

Table 1. Estimated impact of the influx of refugees and migrants in Germany*

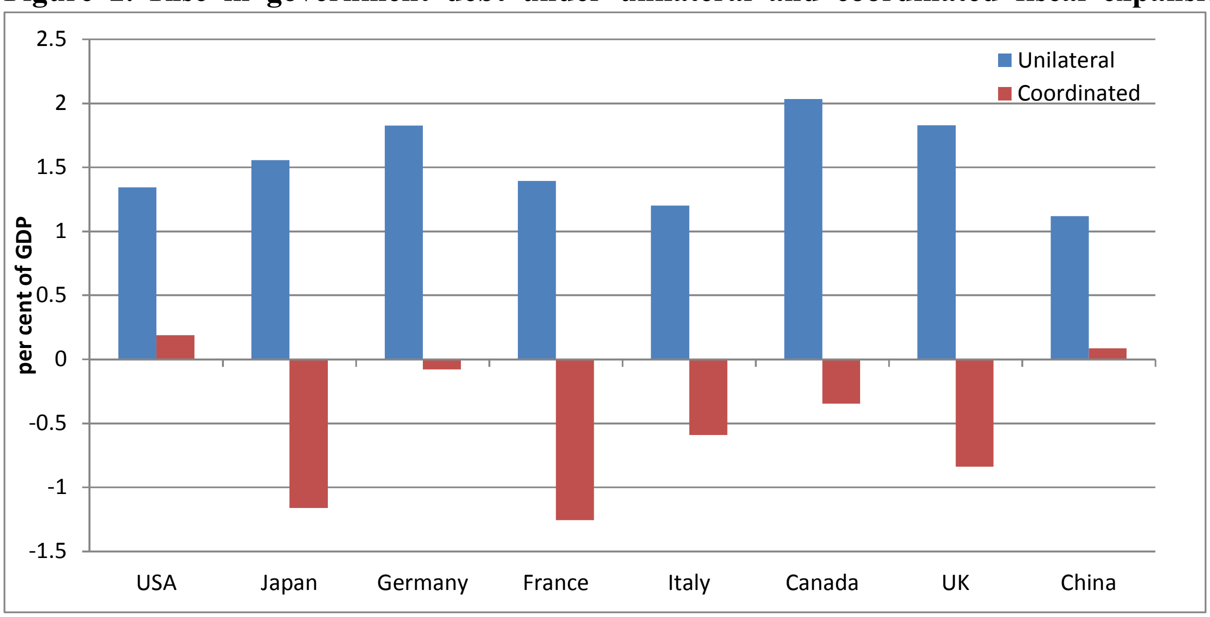
	2015	**2016**	**2017**
Extra-government spending (billions of euros)	7.6	7.8	4.6
GDP growth (percentage point)	0.07	0.08	0.1
Government budget balance (percentage of GDP)	-0.12	-0.23	-0.11
Current account (percentage of GDP)	-0.1	-0.22	-0.24

*Changes relative to the WESP 2016 Baseline scenario
Source: World Economic Situation and Prospects 2016

3.3 Fiscal expansion

A more robust fiscal stance, especially if coordinated among the largest economies, could provide a much needed impetus to the global economy. Countries that have sufficient fiscal space and face low borrowing costs should raise fiscal expenditures, in particular by expanding public investment in infrastructure, research and development and other areas that can lift potential growth. From a global perspective, the most effective strategy would be a coordinated fiscal stimulus by a group of large developed and emerging economies, similar to the G20 agreement on coordinated stimulus measures in 2009. This would ensure that a maximum number of countries in all regions benefit from the positive spillover effects, thus helping to raise the global multiplier. In a simulation exercise, an increase in fiscal expenditures of 1 per cent of GDP in the G7 countries and China could raise world gross product growth from 2.4 to 3.8 per cent this year. The spillovers to developing countries would be significant, allowing growth in the LDCs to reach 5.7 per cent, compared to a baseline projection of 4.8 per cent. Compared to a stimulus that is introduced unilaterally in a single country, a coordinated stimulus would, for the most part, offset the costs of the expansion, as a result of the global spillovers of growth between countries (figure 2). If the fiscal spending were directed towards capacity-raising investment, the net impact on government debt would be even smaller.

Figure 2. Rise in government debt under unilateral and coordinated fiscal expansions



Source: World Economic Situation and Prospects update as of mid-2016

Note: An expansion of government spending by 1 per cent of GDP in year one is gradually withdrawn over the next 10 years. The unilateral scenarios are conducted in one country at a time, while the coordinated scenario is conducted for all eight countries simultaneously.

4. Assessing model accuracy

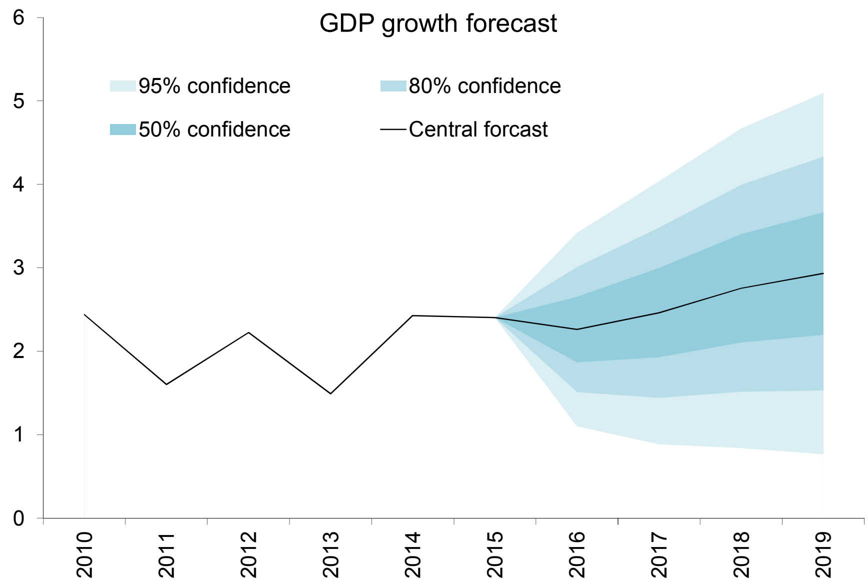
Any macroeconomic model is subject to a considerable margin of error. In order to qualify the point estimates of the forecasts produced by the model, it is important to have an understanding of the magnitude of this error. The methodology that is adopted to assess the accuracy of the WEFM forecasts is through stochastic forecasting. Stochastic forecasts allow the modeller to move way from forecasting a single point for each endogenous variable in the model at each point in time, towards projecting a distribution of outcomes for each observation. A standard, or deterministic, forecast works under the assumption that stochastic equations (all equations that are not identity relationships) hold exactly over the forecast period. Stochastic forecasts, by contrast, allow for unexpected shocks in the future, based on the assumption that the size of these shocks will be of a similar magnitude to those observed in the past.

In order to estimate a complete distribution of outcomes for each variable, a Monte Carlo approach is applied, where the model is solved multiple times, applying a randomly selected shock to each stochastic model equation in each time period. While this method provides only approximate results, as the number of repetitions is increased, the results should approach their true values. Generally one thousand repeated scenarios is adequate to derive a close approximation of the actual distribution.

There are two main approaches for generating the pool of shocks from which the random selection is drawn for each equation. Both relate to the historical errors on the model equations. The first approach is based on an assumption that future shocks will be normally distributed, and are drawn from a standard normal distribution, adjusted for the variance of historical shocks on the model equation over a defined sample period. Cross-equation covariance in errors are preserved, based on a covariance matrix estimated from the historical equation errors. This means that if there is a consistent relationship between, for example, the error on household consumption and on employment, this relationship will be maintained in the stochastic forecasts. The second approach applies a 'bootstrapping' method, where the shocks are drawn from the actual sample of historical errors on each model equation. Cross-equation covariance in errors are preserved by applying a 'time-slice' from the pool of historical shocks to the model – for example if 2001 is selected, the historical shock from 2001 on all model equations will be applied. The bootstrapping approach may be more appropriate in cases where the historical equation errors do not seem to follow a normal distribution, for example if the shocks appear asymmetric or appear to contain more outlying values than a normal distribution would suggest. However, if the historical sample is small, this approach may provide only a rough approximation to the true underlying distribution of potential shocks.

In practice the bootstrapping method is generally applied in the assessment of the WEFM model forecasts. However, a thorough analysis would compare the outcome from both methodologies. Figure 3 illustrates an example forecast for GDP growth, including the confidence intervals derived from stochastic forecasts.

Figure 3. GDP growth forecast with forecast confidence intervals



Source: WEFM model stochastic forecast

5. Further research

Several of the areas of ongoing research have been highlighted throughout the discussion of the model structure above. These model enhancements will improve the capacity of the WEFM to produce forecasts and analyse a wider range of alternative scenarios. In addition to this ongoing programme of work, the model can be readily extended for the purpose of specific studies in order to address a range of question.

The current programme of work is centred on:

- developing a set of satellite models that link the macro projections to simple models of poverty and emissions
- ensuring that the commodity price channels are fully integrated into the models
- developing high-frequency forecasting models for countries that have quarterly national accounts (about 80 out of 177 countries), which will be linked via bridging equations to the main WEFM model
- developing a full labour market model for employment and wages that is consistent with the underlying production function of the economy, allowing the wage to be determined as a bargaining process between employees and employers
- developing a model of government interest payments to allow debt sustainability analysis and to assess the sensitivity of the fiscal position to an exchange rate shock
- elaborating the international linkages in the model, through models of remittance flows, official development assistance and capital flows.

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Annex: Model codes and variable list

A.1 Example set of forecasting model equations

Note that some equation structures differ across countries, to reflect, for example, different exchange rate regimes. See A.2 below for variable definitions. The following notation is used:

log: natural logarithm
dlog: change in natural logarithm
(-1): indicates variable is lagged 1 period
@elem(X , 2012) : indicates the average value of variable X in the year 2012
parameters a-z indicate country-specific values, whereas common values applied to all countries are explicitly indicated

YER = PCR + GCR + ITR + SCR + XTR - MTR

dlog(PCR) = a1 + a2 * (log(PCR(-1)) - log(RPDI(-1))) + a3 * dlog(RPDI) + (1 - a3) * dlog(POP) + a4 * (dlog(HIC) - log(INFT / 100 + 1))

dlog(GCR) = b1 * dlog(YFT) + (1 - b1) * dlog(GDI)

dlog(ITR) = c1 + c2 * (log(ITR(-1) / GDI(-1))) + c3 * dlog(GDI) + c4 * dlog(ITR(-1))

SCR = SCR(-1) - 0.05 * (SCR(-1) - (log(POP / POP(-1)) + 0.024) * YER(-1))

dlog(XTR) = dlog(WDR) + (1 - OXS) * (-0.28 * dlog(XTDNO$ / CXUD) + - 0.06 * dlog(XTDNO$(-1) / CXUD(-1)) + - 0.06* dlog(XTDNO$(-2) / CXUD(-2))) + log(XTR_ADJ)

dlog(MTR) = d1 + d2 * (log(MTR(-1)) - (d3 * log(WER(-1)) + d4 * (log(MTDNO(-1) / YED(-1))))) + d5 * dlog(XTR) + d6 * dlog(PCR) + d7 * dlog(ITR) + d8 * dlog(GCR)

MTR$ = MTR$(-1) * MTR / MTR(-1)

WER = YER + MTR

GDI = YER - XTR + MTR + XTN / ((YEN - XTN + MTN) / (YER - XTR + MTR)) - MTN / ((YEN - XTN + MTN) / (YER - XTR + MTR))

RPDI = GDI*(1-TAXR)

$WDR_i = \Sigma_j [e_{ij} * MTR\$_j]$

YEN = YER * YED

XTN = XTD * XTR

MTN = MTD * MTR

XTD = EXR / @elem(EXR , 2012) * ((1 - OXS) * XTDNO$ + OXS * WLD_POILU / @elem(WLD_POILU , 2012)) * @elem(Xtd , 2012)

MTD = EXR / @elem(EXR , 2012) * ((1 - OMS) * CMUD + OMS * WLD_POILU / @elem(WLD_POILU , 2012)) * @elem(MTD , 2012)

dlog(XTDNO$) = - dlog(EXR) + f1 + f2 * (log(XTDNO$(-1) * EXR(-1)) - (f3 * log(YED(-1)) + (1. – f3) * log(CXUD(-1) * EXR(-1)))) + f4 * dlog(YED) + (1.0 - f4) * dlog(CXUD * EXR)

dlog(MTDNO) = dlog(CMUD) + dlog(EXR)

$CXUD_{i,t} = CXUD_{i,t-1} * \{ \Sigma_j [g_{ij} * (XTDNO\$_{j,t} / XTDNO\$_{j,t-1}] \}$

$CMUD_{i,t} = CMUD_{i,t-1} * \{ \Sigma_j [h_{ij} * (XTDNO\$_{j,t} / XTDNO\$_{j,t-1}] \}$

EXR = EXR(-1) * ((INFT - USA_INFT) / 100 + 1)

$log(EFEX_i) = - log(EXR_i / @elem(EXR_i , "2012")) + \Sigma_j [k_{ij} * log(EXR_j / @elem(EXR_j , "2012"))]$

STI = 0.7*STI(-1) + ((HIC/HIC(-1)-1)*100 – INFT) + 0.2*LOG(YGA)*100 + A

OXS = OXS(-1)

OMS = OMS(-1)

CAN = BTN + CANOTH

CANRATIO = CAN * EXR / YEN * 100.

BTN = (XTN - MTN) / EXR

CANOTH = CANOTH(-1)

dlog(YFT) = m1 * (dlog(LFN) + dlog(YFIT_TREND)) + (1 - m1) * dlog(XTR)

YGA = (YER / YFT - 1) * 100

dlog(YFIT_TREND) = 0.8 * dlog(YFIT_TREND(-1)) + 0.2 * (TFP) + 0.2 * (log((YER(-1) / LNN(-1) / (YER(-4) / LNN(-4)))^(1 / 3)) - dlog(YFIT_TREND(-1)))

LRX = LRX(-1) + 0.2 * (log((YER(-1) / LNN(-1) / (YER(-4) / LNN(-4)))^(1 / 3)) - dlog(YFIT_TREND(-1))) * 100

d(URX) = n1 * d(URX(-1)) + n2 * (YER / YER(-1) - 1) * 100 + n3 * (YER(-2) / YER(-3) - 1) * 100 + n4

LFN = POP15 * LRX / 100

LNN = (1 - URX / 100) * LFN

PRO = YER / LNN

TFP = TFP(-1)

NAIRU = NAIRU(-1)

dlog(YED) = p1 * dlog(HIC(-1)) + p2 * dlog(MTD) + (1-p1-p2) * log(INFT / 100 + 1) + p3 * log(YGA / 100 + 1)

dlog(HIC) = q1 + q2 * (log(HIC(-1)) - log(YED(-1))) + q3 * dlog(YED) + (1 - q3) * dlog(HIC(-1))

INFT = INFT(-1)

GLN = GGR - GCR * YED - GOTH

GLNRATIO = GLN / YEN * 100.

TAXR = TAXR(-1)

dlog(GGR) = r1 * dlog(YEN) + (1 - r1) * dlog (XTN) + dlog(TAXR)

GOTH = GOTH(-1) * YEN / YEN(-1)

A.2 Variable list

BTN	Trade Balance (US$)
CAN	Current Account Balance (US$)
CANOTH	Other items for CAN (= CAN - BTN)
CANRATIO	Ratio of current account balance to GDP (%)
CMUD	Country-specific non-oil import price (US$)
CXUD	Global trade prices (US$)
EFEX	Effective exchange rate
EXR	Exchange rate (national currency / US$)
GCR	General government final consumption expenditure, Constant prices, National Currency
GDI	Gross domestic income (terms of trade adjusted), Constant prices, National Currency
GDN	Gross government debt, National Currency
GDNRATIO	Government debt % GDP
GGR	General government revenue, National Currency

GLN	General government net lending (fiscal balance)
GLNRATIO	Fiscal balance % GDP
GOTH	Government other spending, National Currency
HIC	Consumer Price Index
INFT	Inflation target or expected inflation (not necessarily explicit)
ITR	Gross fixed capital formation (including Acquisitions less disposals of valuables), Constant prices, National Currency
LFN	Labour Force
LNN	Employment
LRX	Participation ratio
MTD	Deflator for Imports of Goods and Services, National Currency
MTDNO	Non-oil import price deflator, National Currency
MTN	Imports of goods and services, Current prices, National Currency
MTR	Imports of goods and services, Constant prices, National Currency
MTR$	Imports of goods and services, Constant prices, US$
NAIRU	Nairu
OMS	Oil share of imports
OXS	Oil share of exports
PCR	Household consumption expenditure (including Non-profit institutions serving households), Constant prices, National Currency
PRO	Productivity
RPDI	Real personal disposable income, Constant prices, National Currency
SCR	Real Inventory Change (plus national accounts residual)
STI	Central bank policy rate
TAXR	Average economy-wide tax rate
TFP	Long-run trend productivity growth rate
URX	Unemployment Rate (%)
WDR	Country-specific global demand
WER	Total final expenditure, Constant prices, National Currency
XTD	Deflator for Export of Good & Services, National Currency
XTDNO$	Non-oil export price deflator (US$)
XTN	Exports of goods and services, Current prices, National Currency
XTR	Exports of goods and services, Constant prices, National Currency
YED	Deflator for GDP, National Currency
YEN	Gross Domestic Product (GDP), Current prices, National Currency
YER	Gross Domestic Product (GDP), Constant prices, National Currency
YFIT_TREND	Technology trend (trend productivity)
YFT	Capacity output, Constant prices, National Currency
YGA	Output gap

A.3 Country list

This list includes some countries that are not yet fully integrated into the WEFM, but which are targeted for inclusion in 2016.

Country	ISO Code
Afghanistan	AFG
Albania	ALB
Algeria	DZA
Angola	AGO
Argentina	ARG
Armenia	ARM
Australia	AUS
Austria	AUT
Azerbaijan	AZE
Bahamas	BHS
Bahrain	BHR
Bangladesh	BGD
Barbados	BRB
Belarus	BLR
Belgium	BEL
Belize	BLZ
Benin	BEN
Bhutan	BTN

Bolivia (Plurinational State of)	BOL
Bosnia and Herzegovina	BIH
Botswana	BWA
Brazil	BRA
Brunei Darussalam	BRN
Bulgaria	BGR
Burkina Faso	BFA
Burundi	BDI
Cabo Verde	CPV
Cambodia	KHM
Cameroon	CMR
Canada	CAN
Central African Republic	CAF
Chad	TCD
Chile	CHL
China	CHN
Colombia	COL

Comoros	COM
Congo	COG
Costa Rica	CRI
Côte D'Ivoire	CIV
Croatia	HRV
Cuba	CUB
Cyprus	CYP
Czech Republic	CZE
Democratic Republic of the Congo	COD
Denmark	DNK
Djibouti	DJI
Dominican Republic	DOM
Ecuador	ECU
Egypt	EGY
El Salvador	SLV
Equatorial Guinea	GNQ
Eritrea	ERI
Estonia	EST
Ethiopia	ETH
Fiji	FJI
Finland	FIN
France	FRA
Gabon	GAB
Gambia (Islamic Republic of the)	GMB
Georgia	GEO
Germany	DEU
Ghana	GHA
Greece	GRC
Guatemala	GTM
Guinea	GIN
Guinea Bissau	GNB
Guyana	GUY
Haiti	HTI
Honduras	HND
Hong Kong Special Administrative Region of China	HKG
Hungary	HUN
Iceland	ISL
India	IND
Indonesia	IDN
Iran (Islamic Republic of)	IRN
Iraq	IRQ
Ireland	IRL
Israel	ISR
Italy	ITA
Jamaica	JAM
Japan	JPN
Jordan	JOR
Kazakhstan	KAZ
Kenya	KEN
Kiribati	KIR
Kuwait	KWT
Kyrgyzstan	KGZ
Lao People's Democratic Republic	LAO
Latvia	LVA
Lebanon	LBN
Lesotho	LSO
Liberia	LBR
Libya	LBY
Lithuania	LTU
Luxembourg	LUX
Madagascar	MDG

Malawi	MWI
Malaysia	MYS
Maldives	MDV
Mali	MLI
Malta	MLT
Mauritania	MRT
Mauritius	MUS
Mexico	MEX
Mongolia	MNG
Montenegro	MNE
Morocco	MAR
Mozambique	MOZ
Myanmar	MMR
Namibia	NAM
Nepal	NPL
Netherlands	NLD
New Zealand	NZL
Nicaragua	NIC
Niger	NER
Nigeria	NGA
Norway	NOR
Oman	OMN
Pakistan	PAK
Panama	PAN
Papua New Guinea	PNG
Paraguay	PRY
Peru	PER
Philippines	PHL
Poland	POL
Portugal	PRT
Qatar	QAT
Republic of Korea	KOR
Republic of Moldova	MDA
Romania	ROU
Russian Federation	RUS
Rwanda	RWA
Samoa	WSM
Sao Tome and Principe	STP
Saudi Arabia	SAU
Senegal	SEN
Serbia	SRB
Sierra Leone	SLE
Singapore	SGP
Slovakia	SVK
Slovenia	SVN
Solomon Islands	SLB
Somalia	SOM
South Africa	ZAF
Spain	ESP
Sri Lanka	LKA
Sudan	SDN
Suriname	SUR
Swaziland	SWZ
Sweden	SWE
Switzerland	CHE
Syrian Arab Republic	SYR
Taiwan Province of China	TWN
Tajikistan	TJK
Thailand	THA
the former Yugoslav Republic of Macedonia	MKD
Timor-Leste	TLS
Togo	TGO
Trinidad and Tobago	TTO
Tunisia	TUN

Turkey	TUR
Turkmenistan	TKM
Uganda	UGA
Ukraine	UKR
United Arab Emirates	ARE
United Kingdom of Great Britain and Northern Ireland	GBR
United Republic of Tanzania	TZA
United States of America	USA
Uruguay	URY
Uzbekistan	UZB
Vanuatu	VUT
Venezuela, Bolivarian Republic of	VEN
Viet Nam	VNM