Policy Research Working Paper 8965

The World Bank Macro-Fiscal Model Technical Description

Andrew Burns
Benoit Campagne
Charl Jooste
David Stephan
Thi Thanh Bui

WORLD BANK GROUP
Macroeconomics, Trade and Investment Global Practice
August 2019

Policy Research Working Paper 8965

Abstract

This paper outlines the structure and economic foundation of the World Bank's macroeconomic and fiscal model (MFMod). MFMod consists of individual country models for 181 countries. The models are used by country economists within the World Bank's Macroeconomics, Trade and Investment Global Practice to (i) generate country forecasts and (ii) simulate various policies. Each model has a similar structure and functional form, with variation reflecting data availability and economic specialization (notably for oil exporters). Although the functional forms are similar, the parameters are country specific and estimated at the country level. Forecasts across countries are live-linked, with the export market growth of each country calculated as a trade-weighted average of imports of each of its trading partners. Remittance inflows and outflows are balanced across countries through a similar mechanism. Other cross-country linkages come through the real effective exchange rate and export and import prices, which are a function of world commodity prices and local cost considerations.

This paper is a product of the Macroeconomics, Trade and Investment Global Practice. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://www.worldbank.org/prwp. The authors may be contacted at aburns@worldbank.org.

The World Bank Macro-Fiscal Model Technical Description

Andrew Burns, Benoit Campagne, Charl Jooste, David Stephan, Thi Thanh Bui[1]

JEL Codes: C10, C50

Keywords: Economic modeling, Econometric specification

[1] The views in this paper reflect those of the authors and not necessarily that of the World Bank. For any queries reach out to aburns@worldbank.org. The above authors represent the team currently most active in model development, the current version of the model itself is a product of many years of work by a much larger group of people, within and without the Bank.

Introduction

The World Bank's Macroeconomic and Fiscal Model (MFMOD) is a structural econometric model, similar in basic formulation to the classic Klein- or Cowles Commission-type (Fair, 1992) models. Like Financial Programming (and Computable General Equilibrium) models (cf. Mikkelsen, 1998), structural models reproduce the flow of funds across the whole economy by mapping out the main identities of the national accounts, balance of payments, labor markets and financial sectors. In contrast to financial programming models, macrostructural models make a concerted effort to estimate the economic and behavioral determinants of economic variables. In models like MFMOD, these structural relationships are developed to be both consistent with economic theory and the observed dynamics of the economy. While such models fell into disfavor among some academic researchers, they continue to be widely used in ministries of finance (Rudebusch, 2002) and by professional forecasters. Moreover, noted academics (Clements and Hendry, 1999; Blanchard, 2018) argue that macroeconometric models are important tools for forecasting and policy analysis. Indeed, they are the preferred instrument for many tasks due to their ability to incorporate a detailed mix of judgement and the rich set of transmission channels they embody, which allows policy impacts on the broader economy to be followed at a deeper level of disaggregation than in other macroeconomic models (Saxegaard, 2017). Most recently, macro-structural models have enjoyed something of a resurgence among Central Banks. For example, recent reviews of forecasting and macroeconomic analysis for the Bank of England (Pagan, 2003) and the Reserve Bank of Australia (Pagan and Wilcox, 2016) recommend that these central banks supplement their existing tools with macro-structural models because of their ability to support a hybrid judgment and model-based forecasting process – versus less flexible but theoretically pure model-centric approaches. The European Central Bank has also recently returned to a macro-structural model as its main policy analysis tool (Constancio, 2017).

MFMOD is similar in structure and design to global models such as OECD's Interlink model (Richardson, 1998; Daalsgard, André, Richardson, 2001), the UN's Project Link model, the Federal Reserve's FRB/US model (Brayton, Laubach and Reifschnedier, 2014), and the ECB's multi-country model ECB-MC, as well as those used by the Congressional Budget Office in analyzing policy in the United States (CBO, 2013). A wide range of private-sector forecasters also use similar models (IHS Global Insight, DRI, Oxford Economics and a variety of investment banks).

MFMOD is currently estimated for 181 individual countries (developing and developed). Most parameters in the model are estimated using the error correction approach of Wickens and Breusch (1988). The equations' equilibrium or steady state conditions are derived to be consistent with economic theory. In contrast, short-run dynamics are data-driven, with estimated parameters reflecting the actual behavior of the economy (see accompanying paper on the calibration and estimation of MFMod (Burns et al., 2019)). As a result, the speed of adjustment of each country-specific model to its economically-determined long-term equilibrium as well as the steady-state to which each return depend mainly on the actual historical behavior of the economy. In contrast, in DSGE models, this steady-state is typically derived using micro-founded parameters which are often calibrated, notably when data are limited as in developing economies. In both DSGE and macro-structural models the overall time-variant equilibrium growth path of the economy is determined by potential output, which is calculated using the production-function methodology as a function of total factor productivity, the level of capital and labor.

This paper describes the May 2019 version of the model, used in the Spring 2019 forecasting round. The following section provides a technical overview of the model.

Supply Side Equilibrium

The core of each country model is a notion of potential output ($\tilde{Y}$):

$$\tilde{Y}_t = \tilde{A}_t \, L_t^{*\alpha} \, K_{t-1}^{1-\alpha} \tag{1}$$

$$L_t^* = \left((1 - U_t^*) * LFPR_t^* * POP_t^{1564}\right)$$

where $\tilde{A}$ is trend total factor productivity (TFP); L_t^* is structural employment; U_t^* is the natural rate of unemployment; $LFPR_t^*$ is the equilibrium labor force participation rate; LF_t^{1564} is the working age population; and K_{t-1} is the capital stock installed at the end of period and where t which represents time on an annual basis.[2] Trend TFP (see Box 1 for details on the calculation of trend TFP and the capital stock), the structural unemployment rate and structural labor force participation rate are all computed using an HP filter. To deal with the end-point problem, the historical time series are extended 15 years in the future using the average growth rate or level as appropriate, prior to running the filter, over the recent period.

In a subset of countries where employment and labor force participation data are unavailable the working-age population (15-64) is used as a proxy for trend employment. In these countries, because the labor input is larger, the level of the TFP measure will be smaller than it would have been if (unobserved) employment was used as the labor input. The growth rate of trend TFP will not be affected unless the unobserved trend employment to participation rate changes or the unobserved natural unemployment rate is changed.

[2] Unless otherwise noted, all variables are expressed in constant price terms. Levels of the variables are denoted by upper case letters while lower-case letters denote the log of levels (i.e. $c = \log(C)$). The first difference operator is Δ.

Over the forecast horizon, the growth rate of trend TFP, the natural rate of unemployment and the natural participation rate are assumed to be exogenous and are held constant at their latest estimated structural rates.

From the above equations, it follows that the only factors that will lead to changes in potential output are those that directly impact the capital stock, equilibrium employment or total factor productivity. Shocks to demand that do not affect these three factors do not affect potential output. Instead they will change the output gap (the difference between actual and potential GDP expressed as a percent of potential GDP) (see equation 2). The output gap measures the extent to which resources within the economy are under- or over-employed. Higher (lower) levels of demand will increase (lower) the output gap. A positive or negative output gap is the principle equilibrating force in the model. The output gap feeds back into the model via the Phillips curve through inflation. A positive (negative) output gap raises (reduces) inflationary pressures, which in turn reduce (increase) real incomes and decrease (raise) profits. The first effect serves to reduce aggregate demand, while the second induces additional investment and supply. Combined, these effects serve to progressively return the economy toward equilibrium, the level of potential output.

$$Y_t^{GAP} = \left(\frac{Y_t - \tilde{Y}}{\tilde{Y}}\right) 100 \qquad (2)$$

For oil-producing countries the production function is modeled using non-oil GDP rather than total GDP. In general, the non-oil GDP output gap is found to provide a better reflection of demand-sensitive inflationary pressures in oil-producing economies.

Box 1: Construction of the Supply Side in the Macro-Fiscal Model

In the absence of reliable data on the capital stock, the capital stock is estimated through a highly simplified implementation of the perpetual inventory method following Burns *et al.* (2014). The capital stock (*K*) at any given period is estimated by adding the fixed capital formation (*I*) (while also allowing for depreciation and scrapping of capital at a given rate (δ) over the previous period).

$$K_t = K_{t-1}(1 - \delta) + I_t$$

A problem with this formulation is that in the absence of an initial estimate of the capital stock this method will underestimate the capital stock in early periods, because implicitly at the beginning of the data period the capital stock is zero, whereas it is almost certainly much higher. To overcome this problem, later-period estimates of the capital stock (at which point the influence of the missing initial capital stock should be smallest) are used, in combination with

GDP data, to estimate an equilibrium capital-output ratio. This ratio is then used to estimate the capital stock at a given start-point using output data at t=0, allowing more accurate estimation of the capital stock during earlier periods.

$$K(0) \;=\; \frac{\sum_{i=1}^{t}(1-\delta)^{t-1}I_i}{\left(\frac{Y_t}{Y_0}-(1-\delta)^t\right)}$$

For most countries structural employment is derived as the product of the working-age population (15+), the equilibrium labor-force participation rate and (1-the natural rate of unemployment).

Once the capital stock and the labor force have been estimated, instantaneous total factor productivity (A_t) is calculated by inverting the production function using output data. Income shares (α) are taken from the estimates reported in the Penn World Tables.

$$A_t \;= \frac{Y_t}{\mathrm{K}_{\mathrm{t-1}}^{1-\alpha}\ \mathrm{L}_{\mathrm{t}}^{*\alpha}}$$

Trend TFP ($\tilde{A}_t$), and the time-varying natural unemployment rates are estimated using a Hodrik-Prescot Filter with smoothing parameter λ=100. In each case, the end-point problem is alleviated by extending the historical series to 2100 at the average level or growth rate of the most recent 10 years. Typically, the values of all three variables are set to the most-recent level of the estimated trend series.

GDP Demand Side

GDP by expenditure is the sum of its components:

$$\boldsymbol{Y_t \;=\; C_t + I_t + G_t + X_t - M_t + \Delta Inv_t + D_t} \tag{3}$$

The model's demand side breaks out private consumption (*C*), government consumption (*G*), investment (*I*), which is the sum of private investment (*IP*) and government investment (*IG*), exports (*X*) of goods and services imports (*M*) of goods and services, changes in inventories (ΔInv), and a variable for statistical discrepancy (*D*).

Real Household Consumption

In the model, real private consumption is modeled as an error-correction equation (see Box 2) of real household disposable income and, when data are available, real financial wealth. The real interest rate also enters the consumption function and acts as a constraint on borrowing. If the economy overheats, rising interest rates constrain borrowing, which will reduce household consumption.

$$\triangle c_t = \alpha - \gamma\left[c_{t-1} - \beta ln\left(\frac{YD_{t-1} + TR_{t-1}}{\mathrm{P}^{\mathrm{C}}_{\mathrm{t-1}}}\right) - (1-\beta)ln\left(\frac{WEALTH_{t-2}}{\mathrm{P}^{\mathrm{C}}_{\mathrm{t-1}}}\right)\right] + \lambda \triangle ln\left(\frac{YD_t + TR_t}{\mathrm{P}^{\mathrm{C}}_{\mathrm{t}}}\right) + \theta \triangle ln\left(\frac{WEALTH_{t-1}}{\mathrm{P}^{\mathrm{C}}_{\mathrm{t}}}\right) - \gamma(i_t^{MP} - \pi_t) + \varepsilon_t^c \quad (4)$$

where c_t is private consumption; TR_t are government transfers and, if relevant, remittances; WEALTH is financial wealth of domestic agents; $\mathrm{P}^{\mathrm{C}}_{\mathrm{t}}$: the private consumption deflator, and TR_t other sources of household income (government transfers and remittances).

Disposable income is defined as labor income (net of direct taxes)

$$YD_t = W_t N - T_t^{Drct}$$

Where WN_t is the nominal wage bill in the economy (the sum of the government and private wage bills) and T_t^{Drct} are direct taxes. Income from capital is not directly measured but is subsumed in the wealth measure (which proxies for both income from wealth and consumption from changes in wealth). In the model, financial wealth is defined as the sum domestically-owned capital stock (foreign or resident) and domestically-owned bonds (foreign or resident). Yet, in the absence of data on both the location of ownership of assets and the decomposition of financial assets, wealth will be imperfectly proxied in the model as the sum of net foreign assets, the domestic capital stock and domestic government debt.[3]

In the long-run the coefficients on income and wealth are constrained to sum to unity. This constraint determines the long-run saving rate as a function of the ratio of wealth to income. In the short-run, the coefficients on labor income and wealth are unconstrained.

The consumption function illustrates the importance of prices in restoring equilibrium in the model. First, when consumer prices rise in the model, as in the case when the economy overheats (through a Phillips-curve mechanism described below), the real labor income and the real return on financial wealth are reduced. As such, consumption also decreases.

The real interest rate is derived from the household's first order condition and resembles the Euler equation that dictates intertemporal consumption choices. An increase in interest rates today, as for example through higher lending rates, will reduce consumption today.

[3] The idea of Ricardian equivalence, popularized in Barro (1974), suggests that public debt should not feature as net wealth for households because the gross asset of debt is offset by an equal liability of the future taxes that will have to be paid to service that debt (see Mankiw and Elmendorf (1999) for a theoretical and empirical review of the evidence for Ricardian equivalence). Others argue that in a world with overlapping generations, or myopia, distortionary taxes, or imperfect financial markets, an increase in debt will be perceived as an increase in wealth for some households resulting in increased consumption. The modeling here is agnostic on the debate, allowing for the possibility that Ricardian equivalence does not hold.

Box 2: Error-correction models

Error-corrections models are a standard way of modeling non-stationary but cointegrated variables *X* and *Y* (see for instance Wickens and Breusch, 1988). For instance, the consumption function shows the importance of prices in restoring equilibrium in the model. Consumer prices will rise in the model when the economy overheats (through a Phillips-curve mechanism described below) reducing real labor income and financial wealth and hence consumption. This relationship can be modeled using an error-correcting model (ECM), of which the simplest version is in the following form:

$$\Delta y_t = \alpha - \theta[y_{t-1} - x_{t-1}] + \beta\Delta y_{t-1} + \gamma\Delta z_t$$

Where lowercase variables are in log-terms. As such, the ECM relates the growth rate of variable *Y* to variable *X*, and some other variables *Z* that might not be cointegrated with *Y*. The term $[y_{t-1} - x_{t-1}]$ captures the long-run cointegrated relationship, while $\beta\Delta y_{t-1} + \gamma\Delta z_t$ measures the short-term impacts (here, autoregressive persistence and another variable).

The model is said to be error-correcting because it ensures that the long-term relationship between *Y* and *X* holds, i.e., the cointegrating relationship is always verified in the long-term. The cointegrated relationship is derived from the long run equation $y_{t-1} = x_{t-1} + v_t$, (which presents an elasticity of y with respect to x of 1) rewritten as $y_{t-1} - x_{t-1}$ because the expected value of v_t (the error term in the LR equation) is zero.

Written in a one period lag, the [...] expression measures the distance of the equation from equilibrium at *t-1*, and the parameter θ measures the speed of adjustment in the absence of additional shocks. Mathematically, θ must be between (0,1) for the equation to converge to the long-run. The inverse of θ approximates the speed of adjustment, for example with annual data, if θ=0.2 then it will take roughly five years for the gap to disappear.

The short-term parameters operate only in the moment and drop out when those variables reach a steady state (when Δy_{t-1} and Δz_t Δ converges to constant values) or play a temporary role as along the equilibrium balanced growth path of the model.

A final implication of this particular ECM form is that in the long term, the growth rate of Y will equal the growth rate of X or that the ratio of Y and X converge to a fixed point (for example household consumption will converge to a fixed share of GDP).

Government Consumption and Investment in the National Income Accounts

In the model, nominal government consumption in the *national income accounts* (NIA) is mapped to nominal public expenditures on wages and goods and services in the government accounts, while nominal investment in the NIA is mapped to nominal capital expenditures in the *fiscal accounts*.

For many developing countries the government spending aggregates in the national accounts do not equal government spending in the fiscal accounts (due to, for example, differences in accounting methodologies). The model allows for these historical differences to exist but forces the proportional gap between the two measures to be preserved in the forecast period by setting the rate of growth of nominal government spending in the national income accounts equal to the rate of growth of the government spending in the fiscal accounts over the forecast period.

In the model, real government consumption and investment as recorded in the NIA are set equal to the corresponding nominal government expenditures deflated by the corresponding deflator from the NIA.

Private Gross Fixed Investment

The stock of capital in the economy accumulates as follows: [4]

$$K_t = (1 - \delta_t)K_{t-1} + I_t \tag{5}$$

Dividing both sides by K_{t-1} gives

$$\frac{K_t}{K_{t-1}} = (1 - \delta) + \frac{I_t}{K_{t-1}}$$

And re-arranging

$$\frac{K_t}{K_{t-1}} - 1 + \delta = \frac{I_t}{K_{t-1}}$$

The assumption of a long-run balanced growth path implies that in the long-run the rate of growth of the capital stock will equal the rate of growth of output (g_t), or$\left(\frac{K_t}{K_{t-1}} - 1\right) = \frac{\Delta k_t}{k_{t-1}} = g_t$. Re-writing further gives:

$$g_t + \delta = \frac{I_t}{K_{t-1}}$$

$$K_{t-1} = \frac{I_t}{(\delta_t + g_t)} \tag{6}$$

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[4] Capital stock in the model represents total capital stock. However, one may also write capital stock as the sum of the private and the public capital stocks. The model response to a public investment shock will differ under various functional forms. In this model, an increase in public investment will crowd out public investment via changes in the cost of capital. If public capital stock, however, enters as a separate argument in the production function (see Baxter and King, 1993), then public capital stock acts as a technology shifter which crowds in private investment.

Using our production function, the demand for capital can be derived from the first-order conditions for profit maximization as:

$$K_{t-1} = \frac{(1-\alpha)P_t Y_t^*}{R_t} \tag{7}$$

Combining this condition with equation (7), investment in the long-run solves to:

$$I_t^* = \frac{(\delta_t + g_t)(1-\alpha)P_t Y_t^*}{R_t} \tag{8}$$

Notice that $(1-\alpha)P_t Y_t^* = GOS_t$ which is the gross operating surplus (our proxy for profits). Equilibrium investment therefore rises with an increase in equilibrium profits and expected growth $(\delta_t + g_t)$ while falling with a higher cost of capital (R_t).

Private investment is modeled with an error-correction form using the equilibrium condition in equation (9). In the short-term, deviations in investment from equilibrium are driven by movements in the real rental-rate of capital and short-run accelerator effects from changes in demand. The equation for private investment can thus be written as:

$$\Delta i_t^P = \gamma\left(i_{t-1} - \log\left(\frac{(\delta_{t-1} + g_{t-1})(1-\alpha)P_{t-1}Y_{t-1}^*}{R_{t-1}}\right)\right) + \alpha + \beta\Delta y - \theta\Delta log\left(R_t/{P_t}^I\right) \tag{9}$$

Where $R_t$is the user cost of capital and ${P_t}^I$ the private investment deflator; δ is the depreciation rate; and g is the growth rate of potential GDP.

The real rental rate evolves according to a user-cost of capital type formulation (see Jorgensen, 1996):

$$R_t = \frac{P_t^I(i_t^{MP} + oc_t^R + \delta_t - \pi_t)}{1 - \hat{\tau}^{DRCT}} \tag{10}$$

Where the user cost of capital R_t depends on the nominal interest rate (i_t^{MP}), the effective direct income tax rate ($\hat{\tau}^{DRCT}$) and ${P_t}^I$ the private investment deflator. The user cost also includes other costs oc_t^R a portmanteau for the equity premium but also other factors that affect the cost of capital, such as banking-sector regulations, banking-sector concentration and the cost of recovering collateral. In history, these costs are calculated as a residual to ensure that the user cost identity in equation (11) holds while in the forecast period the term is exogenous and is typically held constant at its most recent estimated value.

Exports of Goods and Services

Exports of goods and services depend on each country's trading partners' demand for imports and the competitiveness of that country's exports. In the model the growth rate of demand for domestic exports ($g_{XMKT}^{i,t}$) are proxied by the weighted sum of the growth rate of import demand from their trading partners ($\sum_{j \neq i} \omega_{ij} g_{M^{KD}}^{j,t}$). The size of the export market ($XMKT_{i,t}$) is then recomputed using this growth rate and normalizing it to the domestic export volumes in the base year 2010 (X_{2010}).

$$g_{XMKT}^{i,t} = \sum_{j \neq i} \omega_{ij} g_{M^{KD}}^{j,t} \qquad (11)$$

$$XMKT_{i,t} = (1 + g_{XMKT}^{i,t}) XMKT_{i,t-1} \text{ and } XMKT_{i,2010} = X_{2010}$$

where g_X is the growth rate of variable X, ω_{ij}: i the weight of country *j*'s share imports in the exports of the domestic economy (with the weights calculated using the average rates from COMTRADE data for 2009-11) and M_{tj}^{KD} : is the volume of country *j*'s total imports in constant price dollars at time t. We assume that small open economies are price takers. This implies that the price of domestic exports (P^x) corresponds to the world price (P^W) of the export basket. In this context, the decision to export or to sell domestically from the point of view of a local producer will depend on the relative price of the world price (P^W) and the domestic sale price P^C (an increase in P^C constitutes are reduction in the relative price of export goods and a movement downwards along the export supply curve). The price-maker variant of equation (13) expresses the price of exports relative to the world price (in this case proxied by the US price in local currency). For price-makers, an increase in the export price relative to the world price reduces export volumes.

The demand for exports is therefore modeled as:

$$\Delta x_t^x = \alpha - \theta^x \left[x_{t-1}^x - xmkt_{t-1} - \varepsilon_x ln\left(\frac{P_{t-1}^X}{P_{t-1}^C}\right) + \theta * trend \right] + \beta_2 \Delta(xmkt_t) + \varepsilon_{x2} \Delta ln\left(\frac{P_t^X}{P_t^C}\right) + \varepsilon_t^x \qquad (12)$$

Where the term in square brackets is the error correction term, which serves to move exports back towards steady-state levels over time. A homogeneity restriction on the export market variable is imposed to ensure that in the long-run and in the short-run, if relative prices are constant, that domestic exports grow in line with world demand. The homogeneity restriction is a strong assumption that has been violated for long periods of time in many countries, notably during the 1990s when structural changes in global trade patterns saw the export market shares of developing countries rise substantially.

To account for this a linear time-trend is included in the historical period, allowing for a variation in the long-term export share. Over the forecast period, the increment in the value of the time-trend is gradually lowered towards zero so that in the very long run equilibrium growth moves in line with global demand. For oil-exporting countries, exports are disaggregated into oil and non-oil exports. Non-oil exports are modeled in an identical way to total goods and services in equation **(13)**. For oil exports, it is assumed that countries are price takers on global markets and that they will export all production that is not consumed domestically. Therefore, real oil exports are determined by an identity as the difference between production (O_t) and apparent domestic consumption of oil (C_t^{oil}) (consumption of oil and changes in stocks). If the domestic country produces 10 bn barrels in a given year and stores or directly consumes 2 bn then 8 bn will be exported. Oil production is modeled as an exogenous variable, dictated by political and engineering factors.

Imports

Imports reflect both final and intermediate demand for goods and services (both consumption and capital goods) as well as the relative price of domestic goods compared to imported goods.

$$\Delta m_t = \alpha - \theta^m \left[m_{t-1} - y_{t-1}^{gde} + \varepsilon_m{}^{LR} ln\left(\frac{P_{t-1}^m}{P_{t-1}^C}\right) + \theta * trend \right] + \beta_2 \Delta y_t^{gde} - \varepsilon_m{}^{SR} \Delta ln\left(\frac{P_t^m}{P_t^C}\right) + \varepsilon_t^m \quad \textbf{(13)}$$

The term in square brackets represents the error correction term. A homogeneity restriction is imposed on domestic demand to ensure that in the long-run imports remain as a steady share of GDP (constant import-penetration ratio). The second term $\varepsilon_m{}^{LR} ln\left(\frac{P_{t-1}^m}{P_{t-1}^C}\right)$ accounts for changes in the relative price of imported to domestically produced goods. If domestic prices fall relative to import prices, then the import share will decline. As in the export equation, a linear time-trend is included in the long-run to account for historical changes in the share of imports in GDP that would violate the homogeneity restriction. In the short-run the coefficient on domestic demand (and similarly on the short-run relative price of imports to domestic goods) is freely estimated.

Inventories and the Statistical Discrepancy

While inventories do change in the historical period, forecasting changes in stock building is notoriously difficult. As a result, this variable is left exogenous with the advice that unless analysts have strong reasons to change it in the short-run they should hold both its nominal and real values as a constant share of GDP during the forecast period. Similarly, both the nominal and real statistical discrepancies are exogenous variables in the model and in the forecast period analysts are suggested to hold them constant as a share of GDP at the level of the most recent observation.

Price Determination

Inflation is modeled using a modified Phillips curve specification, incorporating both demand-pull (summarized by the output gap) and cost-push (derived from marginal costs) pressures. The key price in the model is the implicit deflator for gross domestic product at factor cost (p_t^{fcst}), which serves as a proxy for producer prices.

$$\triangle p_t^{fcst} = (1-\beta_1) \triangle p_{t-1}^{fcst} + \beta_1((1-\gamma_2)\pi_t^e + \gamma_2 \Delta mc_t) + \gamma_1 YGAP_t + e_t^p \tag{14}$$

Where π_t^e are inflation expectations; $YGAP_t$is the output gap; and mc_t is the marginal cost of production. In the model, expectations include both an implicit forward-looking component (which in the model is exogenous and equal to the historical average inflation rate or the central bank target rate) and a backward-looking component that incorporates a degree of stickiness in price changes. The weight of each component in the model is determined by the parameter β_1. Notice, however, that equation (15) is written in growth terms (no ECM terms) – this due to the existence of a price-wage loop where cointegration exists between wages and prices. In MFMOD, wages are written in ECM form, thus accounting for the common stochastic trend between the two variables.

Nominal marginal costs are determined by firms' cost minimizing behavior (derived from the production function):

$$mc = ln\left(\frac{1}{A}\right) + \underbrace{\ln\left(\left(\frac{1}{1-\alpha}\right)^{1-\alpha}\left(\frac{1}{\alpha}\right)^{\alpha}\right)}_{constant} + (1-\alpha)\ln\left(\underbrace{r}_{=MPK}\right) + \alpha\ln(\underbrace{w}_{=MPL}) \tag{15}$$

Where α is the labor share of income; W_t is the nominal wage rate; R_t is the nominal rental rate of capital and A_t is total factor productivity.

The output gap is included in the Phillips curve (equation 15) to account for short-run deviations from equilibrium to respond to demand pull pressures. Thus, any excess demand over supply will generate an increase in prices, which erodes real incomes and increases the cost of capital. Prices will continue to rise until the economy moves back into equilibrium (the output gap closes).

In the long-run, growth in marginal costs (mc) will equalize the growth in prices (see equation 16) as factor costs will also follow price inflation. In addition, the central bank interest rate rule will impose that growth in prices equalizes to expectations in the long-run. All in all, factor costs will therefore also grow along inflation (expectations) in the long-run. The output gap term also serves as a proxy for the time varying markup (see Gali (2005) for an exposition on how the output gap and the gap between the marginal rate of substitution and the marginal rate of capital are related).[5]

Relative Price Determination

The different demand side deflators (private and government consumption, and investment) are determined by a mix of the producer price and import prices.

The relative importance of each component in both the short- and long-runs is determined econometrically. In addition, effective indirect taxes (primarily tax on the sales of goods and services $\Delta\tau_t^{IDRCT}$) are also included. To account for both prices of locally produced and imported goods and services in the consumption basket, in equilibrium the private consumption deflator will grow at a rate equal to the weighted average of the rate growth of producer prices and imported goods plus any change in indirect tax rates (usually zero in equilibrium). The inclusion of the output gap proxies the markup of the retailer. The level of prices is indeterminate.

$$\Delta p_t^C = \alpha - \theta^c\left[p_{t-1}^c - \beta_1 p_{t-1}^{FCST} - (1-\beta_1)p_{t-1}^m + \log(1+\tau_{t-1}^{IDRCT})\right] + \beta_3 \Delta p_t^{FCST} + (1-\beta_3)\Delta p_t{}^m + \Delta\tau_t^{IDRCT} + \gamma Y_t^{GAP} + \varepsilon_t^{pc} \quad \textbf{(16)}$$

The investment and government consumption deflators are modeled in an identical fashion (albeit with different estimated coefficients) to the private consumer deflator in equation (17) thereby ensuring consistency across domestic deflators in the economy.

Keyfitz Prices

To determine export and import deflators, the model uses a weighted average of the global (USD) price ($Pcomm_j$) of 32 internationally traded commodities that each country imports and exports. The weights $w_j{}^X$ and $w_j{}^M$ are given by the share of each commodity in total domestic exports and imports of goods in the base period (the average observed between 2009-2011). These accounting constructs are called Keyfitz prices in the model. The Keyfitz prices for oil exporters exclude oil prices and oil exports from the Keyfitz price calculation given that the oil export deflator is directly a function of international oil prices.

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[5] One may compute the markup ($\boldsymbol{u}$) following Roeger (1995) by equating the primal Solow residual ($\boldsymbol{SR_t}$) with its dual ($\boldsymbol{DSR_t}$):

$$(u-1) = \frac{(\Delta y_t + \pi_t) - \alpha(\Delta w_t + \Delta l_t) - (1-\alpha)(\Delta r_t + \Delta k_t)}{[(\Delta w_t + \Delta l_t) + (\Delta r_t + \Delta k_t)]}$$

$$P_{i,t}^{xKey} = \sum_j w_{ij}^X \frac{Pcomm_j}{Pcomm_j^{2010}} \tag{17}$$

$$P_{i,t}^{mKey} = \sum_j w_{ij}^M \frac{Pcomm_j}{Pcomm_j^{2010}} \tag{18}$$

Changes in these Keyfitz prices reflect the change of import and export prices that would be observed if domestic prices for imported goods were equal to world prices in local currency and if these prices were fully passed through. These indices are used as inputs in the equations for import and export price deflators.

Import Deflator

In the model, the price of imported goods is a function of the world price of goods (proxied by our Keyfitz variable converted to local currency terms). The Keyfitz price does not include services. In the model, the price of imported services is proxied by domestic consumption price deflator on the assumption that imported services are priced to market. Overall, the import price of goods and services equation is expressed as:

$$\begin{aligned}\Delta p_t^M = \alpha - \theta\left[p_{t-1}^M - \sigma p_{t-1}^{mKey} e_{t-1} - (1-\sigma)\sigma p_{t-1}^C\right] + \beta\Delta\sigma p_{t-1}^{mKey} \\ + (1-\beta)\Delta p_t^C e_t + \varepsilon_t^M\end{aligned} \tag{19}$$

Where $p_t^{mKey} e_t$ is the import Keyfitz price expressed in local currency terms; and p_t^C is the consumer price. In both the short- and long-runs a restriction is imposed that the weight of the world and local prices sum to one. This means that if all prices rise by 1 percent in the model, the import price will also rise by 1 percent.

Export Deflator

Like the price deflator of imported goods and services, the export deflator of goods and services is a weighted average of world export goods (commodity) prices (P_t^{xKey}) and the domestic consumption price which proxies both cost pressures and the pricing of the export of services:

$$\begin{aligned}\Delta p_t^X = \alpha - \theta\left[p_{t-1}^X - \sigma p_{t-1}^{XKEY} e_{t-1} - (1-\sigma)\sigma p_{t-1}^C\right] + \beta\Delta\sigma p_{t-1}^{XKEY} \\ + (1-\beta)\Delta p_t^C e_t + \varepsilon_t^x\end{aligned} \tag{20}$$

Where $p_t^{XKEY} e_t$ is the export Keyfitz price expressed in local currency terms; and p_t^C is the price of domestic consumption. In both the short- and long-runs a restriction is imposed that the weight of the world and local prices sum to one. This means that if all prices rise by 1 percent in the model, the export price will also rise by 1 percent.

Exchange Rates

In MFMOD different economies follow different exchange rate regimes: pegged (where the value of the currency is set to follow directly the exchange rate of another country); floating (where the exchange rate is determined by market forces); and mixed regimes like managed float regimes; and crawling peg regimes. In countries where the exchange rate is (at least partially) determined by market forces, the equilibrium exchange rate evolves according to the uncovered interest parity condition. In such a setting, capital will flow in (out) of the country to the extent that there the domestic interest rate exceeds (is less than) the foreign risk-free interest rate (the US rate in our setting). The change in the exchange rate is written as:

$$log(e_t) = \alpha + log(e_{t-1}) + log\left(\frac{(1 + i_t^{foreign})}{(1 + i_t^{domestic})}\right) \tag{21}$$

In economies with a floating exchange rate, differences between domestic and foreign inflation will transmit to the exchange rate via the monetary policy reaction (either a Taylor rule or a money supply rule, where interest rates become a behavioral equation reflecting the estimated parameters of money demand).

In economies with fixed regimes the exchange rate is linked directly to the appropriate base currency. In this context, the UIP condition will become the monetary policy rule (instead of the Taylor rule described *infra*) as the central bank is now constrained to adjust its main policy rate according to changes in the world interest rate to ensure that the peg holds (independence of the central bank is foregone).

Depending on the degree of management in a mixed regime's float, the currency may be either exogenous or endogenous following an estimated relationship that approximates the rule in place.

Real and Nominal Effective Exchange Rates

Real and nominal effective exchange rates (REER and NEER) are calculated using the trade-weighted average of each countries' bilateral-exchange rates (deflated by the consumer price deflator in the case of REERs). Trade weights are given by the average of the share of partner countries in the bilateral import and export matrices using weights calculated from COMTRADE data as described above for the export market variable.

$$NEER_{i,t} = 100 \sum_{j \neq i} \omega_{ij} \frac{E_j^{IDX}}{E_i^{IDX}}$$

$$REER_{i,t} = 100 \sum_{j \neq i} \omega_{ij} \frac{\frac{E_j^{IDX}}{P_{C_j}^{IDX}}}{\frac{E_i^{IDX}}{P_{C_i}^{IDX}}}$$

where ω_{ji}: country *I*'s share in country *j*'s total imports and the real exchange rate for each country is defined as taking each nominal exchange rates and deflating by the consumer price deflator of each country:

$$E^{IDX} = {}^{E}\!/_{E^{base\ year}}$$

$$P_C^{IDX} = \frac{P_C}{P_C^{base\ year}}$$

Labor Market

Labor Supply

Labor supply is determined by the participation rate ($LFPR_t$), which is assumed to follow a simple autoregressive process, trending toward the structural participation rate discussed earlier in the section on supply-side equilibrium:

$$LFPR_t = \rho\, LFPR_t^* + (1-\rho)\, LFPR_{t-1}.^6$$

Employment

In the short-run the level of employment is determined by short-run changes in demand and supply of labor, where equilibrium labor demand is determined by producer real wages adjusted for productivity growth. The change in the output gap measures the degree to which temporary or short-term workers fill in excess demand by firms to manage production over the economic cycle. Finally, employment growth is corrected for steady-state growth of the labor-force.

$$\triangle l_t = \beta_1[l_{t-1} - l_{t-1}^*] + \beta_2 \triangle YGAP_t + \beta_2 \left(\triangle \log\left(\frac{W_t}{P_t}\right) - \triangle \log\left(\frac{Y_t^*}{L_t^*}\right) \right) + \triangle l_t^* \qquad (22)$$

[6] This assumes that labor supply is inelastic to wages net of taxes. Alternatively, one may write out the marginal rate of substitution between leisure and consumption which renders the labor supply condition. The labor supply elasticity in this case would be at the extensive margin. The marginal rate of substitution and the marginal product of labor then jointly determine the non-accelerating wage rate of unemployment.

Wages

In the model wages adjust to equilibrate supply and demand in the labor market. In the long-run, when the unemployment rate is equal to its structural rate, nominal wages will grow in line with the marginal product of labor.

In the short-run, some persistence is allowed in wage growth (in a similar vein to consumer prices) with the estimated pass-through of consumer prices and productivity gains into nominal wages typically being less than one. This pass-through is determined by the parameter γ.

In the short-run, when unemployment is higher (lower) than its structural rate, the growth in wages will fall (rise) by the parameter β_1.

$$\Delta w_t = c + \theta \left(w_{t-1} - \underbrace{\underbrace{mpl_{t-1}^*}_{real} - p_{t-1}^c}_{nominal\ MPL} \right) + \gamma \Delta w_{t-1} + (1-\gamma)(\Delta p_t^C + (\Delta y_t^* - \Delta l_t^*)) + \beta_1 (UNR_t - UNR_t^*) \tag{23}$$

Where $mpl_t^* = \log\left(\alpha \frac{Y_t^*}{L_t^*}\right)$.

Fiscal Accounts

The level of disaggregation of the fiscal accounts in the model is based on the availability of data and is generally based on GFS 2014 definitions. Some of the fiscal data are available only for a relatively brief period (2010 to 2017), which makes econometric identification of parameters difficult. In some of these cases, coefficients drawn from the literature or expert judgment were imposed. In countries where the national authorities follow a different accounting scheme and where data are available, they are used.

The theoretical basis for the modeling of government spending is less well established than for firm and household behavior. Fiscal policy theory provides for many kinds of rules to govern an optimal fiscal policy, but seldom are these rules observed in practice. Estimating equations that describe how fiscal spending and revenues react to economic events is particularly difficult as the legislative basis for those reactions is constantly changing. While such “regime changes” if unidentified would bias parameter estimates, in many cases the changes in rules often are induced by changes in economic performance and/or fiscal conditions and may therefore be themselves endogenous.

The equations (reaction functions) estimated in the model and discussed below are not prescriptive, rather they reflect the behavior of government spending on average over the estimation period. As such they must be used with care, especially in cases where important regime change has occurred. Often, when analyzing fiscal policy or alternative rules, the analyst will want to exclude these equations (or re-specify them), for example by exogenizing spending variables when analyzing a spending proposal or altering revenue functions when new tax rates or rules are being contemplated.

Government Expenditure

Total government expenditure is divided between nominal government consumption of goods and non-factor services (G_t^{GS}), government compensation of employees (G_t^{COE}), acquisition of non-financial capital (I_t^G), transfers (G_t^{TRN}), other expenditure (G_t^{OTH}) and cost of financing (G_t^{COF}).

$$G_t \ = \ G_t^{GS} + I_t^G + +G_t^{COE} + G_t^{TRN} + G_t^{OTH} + G_t^{COF} \qquad (24)$$

In the long-run, government expenditures on goods and services (which includes the wage bill) and in capital goods are assumed to grow at the same pace as nominal GDP, while in the short-term some persistence of expenditure is allowed (controlled by the parameter β_3). For example, the equation for expenditure on goods and services is:

$$\Delta g_t^{GS} \ = \ \beta_1 \ + \ \beta_2\left[g_{t-1}^{GS} - y_{t-1}^N\right] \ + \ \beta_3 \Delta g_{t-1}^{GS} + (1-\beta_3)\Delta y_t^N + \varepsilon_t^{GS} \qquad (25)$$

Government cost of finance G_t^{COF} is a simple function of the debt level and the effective interest rate paid on the debt. Going further, on a case by case basis, the potential pro- or counter-cyclicity of fiscal policy can be considered by also introducing the output gap into equation 27, although in general this is not done in the standard MFMod model.

For countries that have domestic and foreign debt servicing variables, the cost of financing is then the sum of those variables. The historical cost of finance rate INT_t is computed as the effective interest paid on the debt, that is the ratio of current interest payments (G_t^{COF}) to previous period debt (DBT_{t-1}), ie. $INT_t = G_t^{COF}/DBT_{t-1} * 100$. On the forecasting horizon, the cost of financing is expressed as an identity equal to an interest rate differential (spread) (INT_t^{DIFF}) on a base rate. For external debt, we use the United States Treasury Bill rate (INT_t^{USA}) for the base rate. For domestic debt, the cost of financing assumes a spread relative to the domestic monetary or lending interest rate.

$$DBT_t = DBT_t^n + DBT_t^f$$

$$G_t^{COF} = DBT_{t-1}\, INT_t \qquad (26)$$

$$INT_t = \frac{INT_t^{For} * Debt_t^{For} + INT_t^{Dom} * Debt_t^{Dom}}{Debt_{t-1}^{Dom} + Debt_{t-1}^{For}} \qquad (27)$$

$$INT_t^{For} = INT_t^{USA} + INT_t^{DIFF,\ External} \text{ (for external debt)} \qquad (28b)$$

$$INT_t^{Dom} = INT_t^{domestic} + INT_t^{DIFF,\ Domestic} \text{ (for domestic debt)} \qquad (29c)$$

Government Revenue

Government revenues are divided (depending on data availability) between direct taxes (T_t^{Drct}), taxes on goods and services (T_t^{Idrct}), social insurance contributions (T_t^{Soc}), taxes on international trade (T_t^{Cust}), grants (T_t^{Grant}) and other revenue (T_t^{Oth}).

$$R_t = T_t^{Drct} + T_t^{Idrct} + T_t^{Soc} + T_t^{Cust} + T_t^{Grant} + T_t^{Oth} \qquad (30)$$

Direct tax revenues, social security contributions and indirect taxes are mapped to their relevant tax bases. In the case of indirect taxes, the tax base is assumed to be total consumption, for direct revenues (such as personal and corporate income tax) it would be nominal GDP or the wage bill depending on the nature of the tax; for social security contributions the tax base is the wage bill (average wage multiplied by employment); and the base for taxes on international trade is nominal imports. For each tax, an effective rate (τ^k) of tax is calculated, defined as revenue divided by the assumed base. Thus, for *k* = *Drct, Idrct, Soc, Cust*, we can express the evolution of fiscal revenues as:

$$T_t^k = \tau^k TB_t^K \qquad (31)$$

In the projection period, the effective rate is held constant (approximating a business as usual scenario). As a result, tax revenues simply grow at the rate of the tax base (TB). However, the analyst can change the effective tax rate to simulate the impacts of alternative tax-policy scenarios. This tax rate can also be endogenized on a case by case basis to consider the potential pro- or counter-cyclicality of fiscal policy. For all other revenues, a simple assumption is made that they grow at the rate of nominal GDP.

In countries where the legal tax rate τ^{leg} is known, tax revenues can be decomposed by taking account of the tax base (TB_t) multiplied by a coverage rate (θ), which summarizes information on rebates, avoidance, evasion and exemptions. The coverage rate will vary with the output gap to capture the role of automatic stabilizers:

$$\theta_t^k = \beta_1 + \beta_2 Y_t^{GAP}$$

We can thus rewrite equation (31) as:

$$T_t^k = \tau^{leg,k} \theta_t^k TB_t^k = \tau^{leg,k}(\beta_1 + \beta_2 Y_t^{GAP}) TB_t^k$$

Fiscal Balances and Debt

The fiscal block includes several key fiscal indicators, which are derived from modeled revenue and expenditure variables and simple identities.

The overall government balance (BB_t) is an identity derived by subtracting total expenditure from total revenues.

$$BB_t = R_t - G_t \quad (32)$$

The total financing requirement (FRT) is equal to the negative of the overall balance, which may be met through a combination of local and foreign bonds and / or reduction in gross assets.

$$FRT_t = -BB_t \quad (33)$$

The government may then decide how much new debt to issue locally (FFD_t) and abroad (FFF_t):

$$FRT_t = FFD_t + FFF_t \quad (34)$$

Domestic (DBT_t^D) and foreign debt (DBT_t^F) are then equal to the previous stock of debt plus the new financing:

$$DBT_t^D = DBT_{t-1}^D + FFD_t \quad (35)$$

$$DBT_t^F = DBT_{t-1}^F + FFF_t \quad (36)$$

In addition, the stock of debt may change due to debt revaluation and other discrepancies, that arise either because of "below the line expenditures" or liabilities that are realized (such as contingent liabilities). As such, an additional 'revaluation' term is included to account for this. Historically it is calculated as:

$$DBT_t^{Reval} = DBT_t - DBT_{t-1} + BB_t \tag{37}$$

In the forecast period the revaluation term is exogenous.

The primary balance (BB_T^{PRM}) is an identity derived by subtracting total government expenditure net of interest payments from total revenues.

$$BB_T^{PRM} = R_t - (G_t - G_t^{COF}) \tag{38}$$

Balance of Payments

Current Account

The current account of the balance of payments in the model is expressed in US dollar terms (CD). The current account balance (BN_{CA}^{CD}) is the sum of: i) the trade balance (BN_{GNFS}^{CD}); and ii) the balance for factor service incomes and transfers (remittances, government interest payments and all other non-trade flows) (BN_{FST}^{CD}).

$$BN_{CA}^{CD} = BN_{GNFS}^{CD} + BN_{FST}^{CD} \tag{39}$$

The USD value of exports and imports of goods and services as recorded in the balance of payments are determined in the model entirely by the value of import and exports (volumes times prices) from the national income accounts expressed in USD (multiplied by the exchange rate), after accounting for historical differences between the NIA and BOP measures of exports and imports. Historically, the same-currency value of exports (and imports) in the national accounts do not exactly equal the value of exports (and imports) in the balance of payments accounts due to differences in accounting methodologies. The model preserves these historical differences and keeps the ratio of BOP and NIA differences in the forecast period constant by forcing the growth rate of the nominal exports and imports of goods and services in the balance of payments to be identical to the exchange rate adjusted growth rate of nominal exports and imports calculated in the national income account block during the forecast and simulation period.

$$X_{GNFS,t}^{BOP,CD} = X_{GNFS,t}^{NIA,CD} * \left[\frac{X_{GNFS,t=last\ historical\ value}^{BOP,CD}}{X_{GNFS,t=last\ historical\ value}^{NIA,CD}}\right] \tag{40}$$

$$M_{GNFS,t}^{BOP,CD} = M_{GNFS,t}^{NIA,CD} * \left[\frac{M_{GNFS,t=last\ historical\ value}^{BOP,CD}}{M_{GNFS,t=last\ historical\ value}^{NIA,CD}} \right] \tag{41}$$

The balance for factor service incomes and transfers is the sum of remittances, government interest payments on external debt, and other balances.

$$BN_{FST}^{CD} = BN_{REMT}^{CD} + \frac{G_t^{COF}}{e_t} + BN_{OTH}^{CD} \tag{42}$$

The remittance balance is the difference between remittance inflows (BX_{REMT}^{CD}) and outflows (BM_{REMT}^{CD}).

$$BN_{REMT}^{CD} = BX_{REMT}^{CD} - BM_{REMT}^{CD} \tag{43}$$

Remittance inflows (BX_{REMT}^{CD}) are determined by income growth of the remitter. Nominal income growth in each remittance-sending country (*j*) is weighted by the population of migrants from the modeled economy (country i) living in country j as a share of the total number of emigrants from country i. Higher nominal income growth in countries where emigrants reside therefore leads to higher remittance inflows to the modeled economy, and vice versa. The calculation of the growth of potential remittance inflows is as follows:

$$g_{REMT_{IN_{it}}} = \sum_{j \neq i} \omega_{ij} g_{Y_{tj}^{CD}} \tag{44}$$

where ω_{ij} is country *j*'s share in the number of total emigrants from country i and Y_{tj}^{KD}: is the country *j*'s nominal GDP in current dollars in time t and g_X denotes the growth rate of variable X.

The rate of growth of actual remittances may differ from the values that derive from the above accounting identity and therefore actual remittances are estimated in a simple equation relating actual remittances to the rate of growth this weighted average of incomes in remitting countries:

$$\triangle \log(BX_{REMT}^{CD}) = \beta_1 + \beta_2 \triangle \log(REMT_{IN}) \tag{45}$$

Changes in remittance outflow (BM_{REMT}^{CD}) are treated more simply and assumed to grow in line with nominal GDP (in USD terms) of the home country.

Government interest payments on external debt are determined in the fiscal section of the model (while being converted into USD for the balance of payments).

Finally, the all "other balances" category includes factor services and aid flows and is modeled to grow in line with nominal GDP (in USD terms).

Capital and Financial Account

The financial and capital account is comprised of the Capital Account Balance (${BF_{KACC}}^{CD}$), Foreign Direct Investment (${BF_{FDI}}^{CD}$), Portfolio (${BF_{PF}}^{CD}$) and Other Financial Account (${BF_{OTH}}^{CD}$) flows.

$$BF_{FINX}^{CD} \;=\; BF_{KACC}^{CD} + BF_{FDI}^{CD} \;+\; BF_{PF}^{CD} \;+\; BF_{OTH}^{CD} \qquad \textbf{(46)}$$

In the current model, the capital account, FDI and Portfolio Investment are assumed to grow in line with nominal GDP (in USD).

All Other Financial Investments are split into the amortization and disbursement of external debt of the private and public sectors. The net external financing of the government sector is determined in the fiscal sector while private financing grows in line with nominal GDP. The residual other financial investment also grows in line with nominal GDP.

Overall Balance of Payments and Change in Reserve Assets

The overall balance of payments position is calculated as follows:

$$BOP_t \;=\; BN_{CA,t} \;+\; BF_{FINX,t} + NEOM_t \qquad \textbf{(47)}$$

where $NEOM_t$refers to the net errors and omissions of the Balance of Payments.

The external financing of the Balance of Payments position is through change in reserve assets.

$$BF_{RA,t} = \; -BOP_t \qquad \textbf{(48)}$$

For some countries, the external financing of the BOP is further disaggregated into changes in reserve assets and the net use of IMF credits.

Monetary Policy

Monetary policy for economies that follow an inflation targeting regime is expressed via a Taylor rule that relates the central bank policy rate to inflation expectations, deviations from target, and output deviations from potential. This interest rate acts on the government bond interest rate, which consequently affects consumption and investment decisions. Thus, as prices operate above target, the central bank acts to stabilize inflation. Also, when the economy overheats, the central bank moves to cool it down:

$$i_t^{MP} = \rho i_{t-1}^{MP} + (1-\rho)\left[r^n + \pi^{tar} + \beta_1(\pi_t - \pi^{tar}) + \beta_2 Y_t^{gap}\right] + \varepsilon_t^{i^{MP}} \qquad \textbf{(49)}$$

Where i_t^{MP} is the central bank monetary policy rate, ρ is a parameter that governs the persistence of monetary policy decisions, $(r^n + \pi^{tar})$ is the natural real rate of interest plus the inflation target. In the model the inflation target π^{tar} and inflation expectations π_t^e are assumed to be equal.

Other domestic interest rates in the model, such as government interest payments on domestic debt and lending/borrowing rates that form part of the cost of capital calculation, are assumed to move in line with movements in the monetary policy rate. While changes in the two rates are assumed equal in the forecasting period, the levels may remain different due to spreads between the different rates (which are assumed exogenous and typically held constant throughout the forecast period).

For non-inflation targeting countries the main monetary policy tool is money supply, where the interacting interest rates yield a money demand equation. The money demand (m_t^d) equation in the model is standard, with money demand expressed as an increasing function of real incomes and a decreasing function of the interest rate:[7]

$$m_t^d - p_t = \alpha - \omega i_t + \sigma y_t + \varepsilon_t^{m^d} \tag{50}$$

Real money demand thus varies positively with domestic demand, negatively with current interest rates. An increase in aggregate demand shifts the money demand curve upwards reflecting higher borrowing. An increase in contemporaneous interest rates constitutes a market tightening policy and hence a fall in credit extension and a decline in money demand. The velocity of money is an identity and calculated as: $V_t = \frac{P_t Y_t}{M_t^s}$, where in equilibrium money supply equals money demand ($M_t^s = M_t^d$). Since money is used as an instrument, the interest rate becomes a reaction function instead, where an implicit interest rate response can be computed. The interest rate moves with the output gap and deviations of inflation growth from target money supply growth:

$$i_t = r^n + \pi^{tar} + \frac{1-\omega}{\omega}(\pi_t - \bar{u}) + \frac{\sigma}{\omega} Y_t^{gap} + \varepsilon_t^i$$

Where $\bar{u}$ is the target money supply growth rate and σ and ω are the behavioral parameters in equation (50).

Production Accounts

Real Sectoral Value-Added

7 McCallum (2012) argues that instead of stipulating a money demand equation one may want to close the model with a money rule: $\Delta m_t = c + c_1 m_{t-1} + c_2 YGAP_t + c_3 \Delta p_t + e_t$.

In the absence of data on sectoral factor inputs and costs from which cost minimizing supply decisions could be modeled, forecasts in the production block are driven by the model's demand side (expenditure accounts). In most countries in MFMOD, GDP at factor costs consists of agriculture (AGR_t), industry (IND_t) and services (SRV_t, that might include a statistical discrepancy on the value-added side).

In the model GDP at factor prices (Y_t^{FCST}) is determined by an identity as GDP at market prices (Y_t^{MKTP}) less indirect taxes and subsidies (NID_t):

$$Y_t^{FCST} = Y_t^{MKTP} - NID_t \tag{51}$$

Net indirect taxes and subsidies are exogenous in the model, with the advice to hold them constant as a share of GDP in the forecast period.

For the agricultural and industrial sectors, each sector grows in line with potential GDP in the long-run. In the short-run growth is driven as an empirically estimated function of growth in gross domestic expenditure and exports as follows. For $i = AGR_t, IND_t$:

$$\triangle y_t^i = \beta_1\left(y_{t-1}^i - y_{t-1}^*\right) + \beta_2 \triangle log(GDE_t + X_t) + (1 - \beta_2) \triangle y_{t-1}^i \tag{52}$$

The service sector is modeled as a balancing identity to ensure that GDP measured at producer prices is equal to GDP at market prices minus net taxes on production.

$$SRV_t = Y_t^{FCST} - AGR_t - IND_t \tag{53}$$

Sectoral Value-Added Deflators

Price deflators for each production sector are modeled to converge to the overall production deflator. In the short-run, prices are mapped to the overall deflator with some persistence, governed by the parameter β_2.

$$\triangle p_t^i = \beta_1\left[p^i{}_{t-1} - p_{t-1}^*\right] + \beta_2 \triangle p_{t-1}^i + (1 - \beta_2) \triangle p_t^* \tag{54}$$

Concluding Remarks

The MFMod system is a macro-structural model of the global economy comprised of 184 separate country models. In general, the functional forms of individual equations in the model are comprised of two parts, a long-run equilibrium condition consistent with economic theory and a short-run component that is more idiosyncratic and reflective of real-world (as opposed to theory-world) dynamics. While functional forms are similar across countries, parameters are estimated at the country-level to reflect observed behavior.

The MFMod system is the product of many years of work by a large and ever-changing team of economists at the World Bank. As such, it is very difficult to ascribe intellectual ownership of the model to any one group of individuals. The authors of this paper represent the current generation of model authors, but the model itself reflects the work of many others.

The MFMod model serves not only as the main forecasting tool at the World Bank, but also as the starting point of the many customized models the modeling team builds for both internal and external clients. Not only are these models informed by the thinking and the decisions that went into MFMod, but so too MFMod benefits from the innovations that go into these models.

Like any model, MFMod is a living and changing entity. No model is ever finished. The documentation here describes the version of the model used in the forecasting round ending April 4, 2019. Areas for future work include: a more systematic evaluation of theoretical parameters and the basis for their imposition; improvements in the mechanism by which changes in sector-level value added are mapped back to the changes in the demand side; a more comprehensive accounting of income from capital and wealth in consumer demand; introduction of pro- and/or counter-cyclical behavior in government revenue and expenditure equations; and introduction of endogenous mechanisms by which the accumulation of domestic debt and external financing conditions influence domestic conditions, notably interest rates.

References

Barro, R. J. (1974). Are government bonds net wealth? Journal of Political Economy, 82(6), pp. 1095-1117.

Brayton, F., Laubach, T. and Reifschneider, D. (2014). The FRB/US Model: A tool for Macroeconomic Policy Analysis. FRB: Fed Notes: 2/6/2015.

Blanchard, O. (2018). On the future of macroeconomic models, Oxford Review of Economic Policy, Volume 34, Issue 1-2, Spring-Summer, Pages 43–54

Burns, A., Janse Van Rensburg, T., Dybczak, K. and Bui, T. (2014). Estimating potential output in developing countries. Journal of Policy Modelling, 36(2014), pp. 700-716.

Burns, A., and Jooste, C. (2019). Estimating and calibrating MFMod: A panel data approach to identifying the parameters of data poor countries in the World Bank's structural macro model. Forthcoming.

Clements, M.P. and Hendry, D. (1999). Forecasting non-stationary economic time series. The MIT press, Cambridge, MA.

CBO. (2013). How CBO Analyzed the Macroeconomic Effects of the President's Budget. A CBO Paper. July 2013. Available at: https://www.cbo.gov/publication/42972.

Constancio, Vitor. (2017). Developing Models for Policy Analysis in Central Banks. Speech. Downloaded Sept. 24, 2016 from http://www.ecb.europa.eu/press/key/date/2017/html/ecb.sp170925.en.html

Daalsgard, T., André, C. and Richardson, P. (2001). Standard Shocks in the OECD Interlink Model. OECD Economics Department Working Papers. No. 306. OECD Publishing.

Fair, R.C. (1992). The Cowles Commission Approach, Real Business Cycle Theories, and New Keynesian Economics. NBER Working Paper Series. No, 3990.

Gali, J. Gertler, M. and Lopez-Salido, J.D. (2005). Markups, gaps, and the welfare costs of business fluctuations. Economics Working Papers 836, Department of Economics and Business, Universitat Pompeu Fabra

Jorgensen, D. (1996). Investment – Vol. 2: Tax policy and the cost of capital. MIT Press. URL: http://mitpress.mit.edu/catalog/item/default.asp?sid=1C99FCC8-C26B-4CC6-BE21-CA1CDAFDE8AF\&ttype=2\&tid=8190

Mankiw NG, & D. Elmendorf D. (1999). Government Debt. In Handbook of Macroeconomics. North Holland.

McCallum, B.T. (2012). The role of money in New-Keynesian models. Central Bank of Peru Working Paper No October 2012.

Mikkelsen, J.G. (1998). A model for financial programming. IMF Working Paper WP/98/80. International Monetary Fund.

Pagan, Adrian R. (2003) Report and Modelling and Forecasting at the Bank of England. Bank of England Quarterly Bulletin, Spring.

Pagan, A. and Wilcox, D. (2016) External Review- Reserve Bank of Australia Group Forecasts and Analysis.

Richardson, P. (1998). The structure and simulation properties of OECD's INTERLINK model, OECD Economic Studies, No. 10.

Rudebusch, G. D. (2002). Macroeconomic Models for Monetary Policy. FRBSF Economic Letter, Number 2002-11, April 19.

Roeger, W. (1995). Can imperfect competition explain the difference primal and dual productivity measures? Estimates for U.S. manufacturing. *Journal of Political Economy,* 103, pp. 316-330.

Saxegaard M. (2017). The Use of Models in Finance Ministries – An Overview. Finansdepartementet, Arbeidsnotat 2017/1.

Wickens, R.M. and Breusch, T.S. (1988). Dynamic specification, the long-run and the transformation of reformed regression models. The Economic Journal, 98, pp. 189-205.

Appendix A: Conversions and Identities

This section presents additional equations used in the model for required conversions and balances. The equations presented here are used for presentation and calculation of output variables, using the behavioral and economic forecasting variables discussed above. Throughout, the following superscripts are used to denote currency and volume units.

KD: constant US dollars, using a 2010 base year

CD: current US dollars

KN: constant local currency unit

CN: current local currency unit.

Balance of Payments

Merchandise exports and imports in the balance of payments grow in line with the growth rate of overall goods and services trade allowing for a non-unity elasticity.

$$\triangle \log(BX^{CD}_{MRCH}) = \alpha^{X}_{MRCH} \triangle \log(BX^{CD}_{GNFS}) \tag{55}$$

$$\triangle \log(BM^{CD}_{MRCH}) = \alpha^{M}_{MRCH} \triangle \log(BM^{CD}_{GNFS}) \tag{56}$$

Non-factor service exports and imports in the balance of payments are calculated as the residual when merchandise exports and imports are subtracted from total exports and imports.

$$BX^{CD}_{NFSV} = BX^{CD} - BX^{CD}_{MRCH} \tag{57}$$

$$BM^{CD}_{NFSV} = BM^{CD} - BM^{CD}_{MRCH} \tag{58}$$

GDP in dollar term

GDP, expressed in current US dollars, is calculated in terms of current local currency units divided by the US dollar exchange rate.

$$Y^{CD} = {Y^{CN}}/{e^{US}} \tag{59}$$

GDP expressed as constant dollars is calculated from GDP in constant local currency units, using a local currency price deflator (base year 2010) and the US exchange rate in 2010.

$$Y^{KD} = \frac{Y^{KN}}{e^{US}} \tag{60}$$

Per capita GDP in constant dollar or local currency unit terms is calculated simply by dividing output in constant dollar or local currency unit terms by the population.

$$y^{KN} = {Y^{KN}}/{POP} \tag{61}$$

Appendix B: Data

For the most part, variable mnemonics in MFMOD follow the protocols of the World Bank World Development Indicators database.[8] Typically, each variable is comprised of 14 characters:

CCCAAMMMNNNNUC

CCC is the three letter ISO mnemonic for the country – AUS for Australia.

AA refers to the major accounting framework from which the variable is derived.

i.e. NY – National income accounts

NE – National expenditure accounts

NV _Value added accounts

BX – Balance of payments exports

GG – General government fiscal accounts

BF – Balance of Payments Financial Account

MMM refers to the major category for that variable, for example GDP for gross domestic product or CON for consumption

NNNN refers to the minor category that describes that variable, i.e.

MKTP – market prices

FCST -factor cost

PRVT – private

GOVT – government

TOTL = total

POTL – potential

Etc.

U indicates the unit of measure,

K for volumes or constant prices

C for values or current prices

X for prices, interest rates or tax rates

C indicates the currency in which the unit is expressed

N – for local currency

D – for dollars

P – for PPPs

[8] https://datahelpdesk.worldbank.org/knowledgebase/articles/201175-how-does-the-world-bank-code-its-indicators

Appendix C: Detailed Variable List

Mnemonics	Variable Description
BFBOPTOTLCD	Overall Balance of Payments
BFCAFCAPTCD	Capital Account Balance, US$ mn
BFCAFFFDICD	Net Foreign Direct Investment, US$ mn
BFCAFFINTCD	Financial Account Balance, US$ mn
BFCAFFINXCD	Financial Account (excluding reserves) Balance, US$ mn
BFCAFFPFDCD	Net Portfolio Investment, Debt, US$ mn
BFCAFFPFECD	Net Portfolio Investment, Equity, US$ mn
BFCAFFPFTCD	Net Portfolio Investment, US$ mn
BFCAFFSRCCD	BOP Financing Sources
BFCAFNEOMCD	Net Errors and Omissions, US$ mn
BFCAFOOTHCD	Net Other Other Investment (Other Investment less Net Govt Ext. Borrowing)
BFCAFOTHRCD	Net Other Investment, US$ mn
BFCAFRACGCD	Change in Reserve Assets, US$ mn
BFCAFTOTLCD	Capital and Financial Account Balance, US$ mn
BFFINAGOVCD	External Govt Amortization
BFFINAOTHCD	Non-Government Amortization
BFFINCABDCD	Current Account Deficit
BFFINDGOVCD	External Govt Disbursements
BFFINDOTHCD	Non-Government Disbursement
BFFINFGAPCD	External Financing Gap
BFFINIMFCCD	IMF Credit (NET)
BFFINMLTACD	Medium and Long-term Debt Amortization (Excl. IMF)
BFFINMLTAGCD	Medium and Long-term Debt Amortization (Govt)
BFFINMLTAPCD	Medium and Long-term Debt Amortization (Private)
BFFINMLTDCD	Medium and Long-term Debt Disbursements (excl. IMF)
BFFINMLTDGCD	Medium and Long-term Debt Disbursements (Govt)
BFFINMLTDPCD	Medium and Long-term Debt Disbursements (Private)
BFFINNEOMCD	Net Errors and Omissions, US$ mn Gross External Borrowing
BFFINNETDCD	Net Foreign Financing, USD$ mn
BFFINOTHRCD	Net All Other BOP Financing Flows
BFFINOTSRCD	Other Short-term Capital Outflows
BFFINREQMCD	BOP Financing Requirement
BFFINSRCSCD	BOP Financing Source of Funds
BFFINSRTACD	Short-term Debt Amortization
BFFINSRTDCD	Short-term Debt Disbursements
BFFINTGOVCD	Net External Financing Govt (USD)
BFFINTOTACD	Short and Medium-LT Debt Amortization
BFFINTOTDCD	Short and Medium-LT Debt Disbursements
BMFSTCABTCD	Imp., Factor Services and Transfers (BOP), US$ mn
BMFSTINTECD	Imports, External Debt Interest Payments
BMFSTOTHRCD	Imp., Other Factor Services and Transfers (BOP), US$ mn
BMFSTREMTCD	Imp., Remittances (BOP), US$ mn
BMGSRGNFSCD	Imp., GNFS (BOP), US$ mn

BMGSRMRCHCD	Imp., MRCH (BOP), US$ mn
BMGSRNFSVCD	Imp., NF SERV (BOP), US$ mn
BMOTHCACD	Imp., Other Current Account, US$ mn
BNCABFLGPCD	Current Account Balance (local definition - IMF), US$ mn
BNCABFLGPCD_	Current Account Balance (local definition - IMF), % of GDP
BNCABFLGPCN	Current Account Balance (local definition - IMF), LCU
BNCABFUNDCD	Current Account Balance, US$ mn
BNCABFUNDCD_	Current Account Balance (% of GDP)
BNCABFUNDCN	Current Account Balance, LCU
BNCABLOCLCD	Current Account Balance (local definition), US$ mn
BNCABLOCLCD_	Current Account Balance (local definition), % of GDP
BNCABLOCLCN	Current Account Balance (local definition), LCU
BNFSTCABTCD	Net Exp., Factor Services and Transfers., GNFS (BOP), US$ mn
BNFSTOTHRCD	Net Exp., Other Factor Services and Transfers (BOP), US$ mn
BNFSTREMTCD	Net Exp., Remittances (BOP), US$ mn
BNGSRGNFSCD	Net Exp., GNFS (BOP), US$ mn
BNGSRMRCHCD	Net Exp., MRCH (BOP), US$ mn
BNGSRNFSVCD	Net Exp., NF SERV (BOP), US$ mn
BNOTHCACD	Net Exp., Other Current Account, US$ mn
BXFSTCABTCD	Exp., Factor Services and Transfers (BOP), US$ mn
BXFSTOTHRCD	Exp., Other Factor Services and Transfers (BOP), US$ mn
BXFSTREMTCD	Exp., Remittances (BOP), US$ mn
BXGOILMRCHCD	Exp., Oil Exports (BOP), US$ mn
BXGSRGNFSCD	Exp., GNFS (BOP), US$ mn
BXGSRMRCHCD	Exp., MRCH (BOP), US$ mn
BXGSRNFSVCD	Exp., NF SERV (BOP), US$ mn
BXNOILMRCHCD	Exp., Non-Oil Exports (BOP), US$ mn
BXOTHCACD	Exp., Other Current Account, US$ mn
EXTLSHAREXN	Share of New Debt that is Externally Issued
FIRESTOTLCD	Reserve Assets, US$ mn
FMLBLBASECN	Base Money
FMLBLCRNGCN	Credit to Non-Government
FMLBLMTWOCN	Nominal Base Money (Mil. LCU)
FMLBLMTWOKN	Real Base Money (Mil. Real LCU)
FMLBLPOLYXN	Key Policy Interest Rate
FPCPITOTLXN	Consumer Price Index
GDPFCSTCAPCD	GDP Factor Cost per capita
GDPPCKD	GDP per capita, 2000 US$ mn
GDPPCKN	GDP per capita, 2005 LCU mn
GGBALCYCLCD	General Government Revenue, Cyclical Balance USD
GGBALCYCLCN	General government cyclical balance (millions of LCU)
GGBALEXGRCN	Government Balance, excl. grants
GGBALOTHRCN	General Government Revenue, Additional Financing Requirements
GGBALOVRLCD	General Government Revenue, Deficit, US$ mn
GGBALOVRLCD_	General Government Revenue, Overall Balance (% of GDP, USD)

GGBALOVRLCN	General Government Revenue, Deficit, LCU mn
GGBALPREXCN	General Government Revenue, Primary Balance, excl grants
GGBALPRIMCD	General Government Revenue, Primary Balance, USD
GGBALPRIMCN	General Government primary balance, millions of local curency units
GGBALSTRLCD	General Government Revenue, Structural Balance (USD)
GGBALSTRLCN	General government structural balance (millions of LCU)
GGDBTDOMTCN	General government gross domestic debt millions lcu
GGDBTEXTLCD	General government gross debt external debt millions USD
GGDBTEXTLCN	General government gross debt external debt millions lcu
GGDBTTOTLCD	General Government Gross Debt (USD)
GGDBTTOTLCN	General government gross debt millions lcu
GGDBTVALDCN	Government debt revaluation (LCU), domestic
GGDBTVALECN	Government debt revaluation (LCU), external
GGDBTVALTCN	Government debt revaluation (LCU)
GGEXPCAPTCN	General government expenditure on capital expenditure (millions lcu)
GGEXPCRNTCN	General government Current Expenditures (millions lcu)
GGEXPCYCLCN	Cyclical component of general government expenditures (millions LCU)
GGEXPGNFSCN	General government expenditure on goods and services (millions lcu)
GGEXPINTDCN	General government interest payments on domestic public debt (millions lcu)
GGEXPINTECD	General government interest payments on external public debt (millions USD)
GGEXPINTECN	General government interest payments on external public debt (millions lcu)
GGEXPINTPCN	General government interest payments on public debt (millions lcu)
GGEXPKINVCN	General Government Capital Investments (millions LCU)
GGEXPKTRNCN	General Government Capital Transfers (millions LCU)
GGEXPOTHRCN	General government expenditures, other (includes transfers), (millions LCU)
GGEXPSTRLCN	Structurally adjusted general government expenditures (millions LCU)
GGEXPTOTHCN	General Government Expenditure, All Other Current Transfers
GGEXPTOTLCN	General government total expenditure (millions lcu)
GGEXPTOTSCN	General Government Expenditure, Other Social Transfers (millions LCU)
GGEXPTPNSCN	General Government Expenditure, Pensions (millions LCU)
GGEXPTRNSCN	General Government Expenditure, Current Transfers (millions LCU)
GGEXPTSOCCN	General Government Expenditure, Social Assistance (millions LCU)
GGEXPWAGECN	General government expenditure on compensation expenditure (millions lcu)
GGFINDOMTCN	General Government Net Domestic Financing (millions LCU)
GGFINDOTHCN	General Government, Other Domestic Financing (millions LCU)
GGFINDPRVCN	General Government, Domestic Financing from Privatization (millions LCU)
GGFINEAMTCN	General Government, Amortization External (millions LCU)
GGFINEAMTXN	General Government, Amortization External Rate
GGFINEDSBCN	General Governent, Disbursement External (millions LCU)
GGFINEOTHCN	General Government Revenue, Other External Financing (millions LCU)
GGFINEXTLCN	General Government Revenue, Net External Financing (millions LCU)
GGFINFGAPCN	Government Financing Gap (millions LCU)
GGFINREQMCN	Government Financing Requirement (millions LCU)
GGFINTOTLCN	Total Financing (External and Domestic) (millions LCU)
GGREVCOMMCN	General Government Revenue, Commodity Related Revenues (millions LCU)

GGREVCOMMXN	Commodity Revenue Tax Rate
GGREVCYCLCN	Cyclical component of General government revenues (millions LCU)
GGREVDRCTCN	General government revenues, direct taxes (millions LCU)
GGREVDRCTXN	Direct Revenue Tax Rate
GGREVGNFSCN	Taxes on Goods and Services (millions LCU)
GGREVGNFSXN	Goods and services Tax Rate
GGREVGRNTCN	General Government Revenue, Grants, LCU (millions LCU)
GGREVIDRTCN	General government revenues, indirect taxes (millions LCU)
GGREVIDRTXN	Implied Indirect Average Tax Rate
GGREVNONTCN	General Government Revenue, Non-Tax Revenues (millions LCU)
GGREVNONTXN	Non-Tax Revenue Rate
GGREVOTHRCN	General government revenues, other (includes privatization), (millions LCU)
GGREVOTHRXN	Other Revenue Rate
GGREVSSOCCN	General Government Revenue, Social Security Contributions (millions LCU)
GGREVSSOCXN	Social Security Contributions Tax Rate
GGREVSTRLCN	Structurally adjusted General government revenues (millions LCU)
GGREVTAXTCN	General Government Revenue, Total Tax Revenue (millions LCU)
GGREVTAXTXN	Tax Revenue Rate
GGREVTOTHCN	General Government Revenue, Other Taxes (millions LCU)
GGREVTOTHXN	General Government Revenue, Other Taxes Rate
GGREVTOTLCN	General government revenues, total (millions lcu)
GGREVTOTLXN	Implied Average Tax Rate
GGREVTRDECN	General Government Revenue, Trade Traxes (millions LCU)
GGREVTRDEXN	Trade Taxes Rate
INTR	Implicit interest rate in government debt (percentagte points)
INTRDDIFF	Domestic Interest Rate Spread Over Policy Rate
INTRDIFF	Differentital between local and US implicit interest rate
INTRDXN	Implicit interest rate in government domestic debt (percentagte points)
INTREDIFF	External Interest Rate Spread Over Policy Rate
INTREXN	Implicit interest rate in government external debt (percentagte points)
INTRXN	Interest Rate (Implicit)
LMEMPSTRLCN	Structural Employment
LMEMPTOTLCN	Employment
LMLBFTOTLCN	Labor Force (15+)
LMPRTTOTLCN	Participation Rate
LMUNRSTRLCN	Unemployment Rate, Structural
LMUNRTOTLCN	Unemployment Rate
NECONGOVTCD	Govt. Cons., US$ mn
NECONGOVTCN	Govt. Cons., LCU mn
NECONGOVTKD	Govt. Cons., 2000 USD mn
NECONGOVTKN	Govt. Cons., 2000 LCU mn
NECONGOVTXD	Implicit USD defl., Govt. Cons., 2000 = 1
NECONGOVTXN	Implicit LCU defl., Govt. Cons., 2000 = 1
NECONPRVTCD	Pvt. Cons., US$ mn
NECONPRVTCN	Pvt. Cons., LCU mn

NECONPRVTKD	Pvt. Cons., 2000 USD mn
NECONPRVTKN	Pvt. Cons., 2000 LCU mn
NECONPRVTXD	Implicit USD defl., Pvt. Cons., 2000 = 1
NECONPRVTXN	Implicit LCU defl., Pvt. Cons., 2000 = 1
NEER	Nominal Exchange Rate (Trade Weighted)
NEEXPGNFSCD	Exp., GNFS (NIA), US$ mn
NEEXPGNFSCN	Exp., GNFS (NIA), millions LCU
NEEXPGNFSKD	Exp., GNFS (NIA), 2000 US$ mn
NEEXPGNFSKN	Exp., GNFS (NIA), 2000 LCU mn
NEEXPGNFSXD	Exp., GNFS (NIA), US$ Deflator (2010=1)
NEEXPGNFSXN	Exp., GNFS (NIA), LCU Price defl. 2000 = 1
NEEXPGOILCN	Exp., Oil (NIA), millions LCU
NEEXPGOILKN	Exp., Oil (NIA), 2000 LCU mn
NEEXPGOILXN	Exp., Oil (NIA), LCU Price defl. 2000 = 1
NEEXPNOILCN	Exp., Non-Oil (NIA), millions LCU
NEEXPNOILKN	Exp., Non-Oil (NIA), 2000 LCU mn
NEEXPNOILXN	Exp., Non-Oil (NIA), 2000 Deflator
NEGDETOTTKD	Gross Domestic Expenditure (GDE), USD
NEGDETOTTKN	Gross Domestic Expenditure (GDE), LCU
NEGDETTOTCN	Total demand, current LCU
NEGDETTOTKN	Total demand, constant LCU
NEGDIFGOVCN	Public Fixed Domestic Inv., LCU mn
NEGDIFGOVKN	Public Fixed Domestic Inv., LCU constant price
NEGDIFGOVXN	Public Fixed Domestic Inv., deflator
NEGDIFPRVCN	Private Fixed Domestic Inv., LCU mn
NEGDIFPRVKN	Private Fixed Domestic Inv., LCU constant price
NEGDIFPRVXN	Private Fixed Domestic Inv., deflator
NEGDIFTOTCD	Fixed Domestic Inv., US$ mn
NEGDIFTOTCN	Fixed Domestic Inv., LCU mn
NEGDIFTOTKD	Fixed Domestic Inv., 2000 USD mn
NEGDIFTOTKN	Fixed Domestic Inv., 2000 LCU mn
NEGDIFTOTXD	Fixed Domestic Inv., USD Price defl., 2000 = 1
NEGDIFTOTXN	Fixed Domestic Inv., LCU Price defl., 2000 = 1
NEGDIKGOVKN	Capital stock, Government LCU
NEGDIKPRVKN	Capital stock, Private LCU
NEGDIKSTKKD	Capital stock, USD
NEGDIKSTKKN	Capital stock, LCU
NEGDISTKBCD	Change in stock, USD mn
NEGDISTKBCN	Change in stock, LCU mn
NEGDISTKBKD	Change in stock, 2000 USD mn
NEGDISTKBKN	Change in stock, 2000 LCU mn
NEGDISTKBXN	Change in stock, LCU Price defl., 2000 = 1
NEGDITOTLCD	Gross Domestic Inv., USD mn
NEGDITOTLCN	Gross Domestic Inv., LCU mn
NEGDITOTLKD	Gross Domestic Inv., 2000 USD mn

NEGDITOTLKN	Gross Domestic Inv., 2000 LCU mn
NEGDITOTLXN	Gross Domestic Inv., LCU Price defl., 2000 = 1
NEIMPGNFSCD	Imp., GNFS (NIA), USD mn
NEIMPGNFSCN	Imp., GNFS (NIA), LCU mn
NEIMPGNFSKD	Imp., GNFS (NIA), 2000 US$ mn
NEIMPGNFSKN	Imp., GNFS (NIA), 2000 LCU mn
NEIMPGNFSSCCN	Inter SACU imports
NEIMPGNFSXD	Imp., GNFS (NIA), USD Price defl. 2000 = 1
NEIMPGNFSXN	Imp., GNFS (NIA), LCU Price defl. 2000 = 1
NEKRTTOTLCN	Rental Rate of Capital (Derived)
NEWRTTOTLCN	Implicit Wage Rate (Total Wage Bill / Employment)
NVAGRTOTLCN	Value Added Agriculture Local Currency units Values
NVAGRTOTLKN	Value Added Agriculture Local Currency units Volumes National base year
NVAGRTOTLXN	Value Added Agriculture Local Currency units Implicit Price deflator
NVGDPNOILCN	Non-Oil GDP, Local Currency
NVGDPNOILKN	Non-Oil GDP, Local Currency Volumes
NVGDPNOILXN	Non-Oil GDP, Deflator
NVINDNOILCN	Value Added Non-Oil Local Currency units Values National base year
NVINDNOILKN	Value Added Non-Oil Local Currency units Volumes National base year
NVINDNOILXN	Value Added Non-Oil Local Currency units Deflator
NVINDTOTLCN	Value Added Industry Local Currency units Values
NVINDTOTLKN	Value Added Industry Local Currency units Volumes National base year
NVINDTOTLXN	Value Added Industry Local Currency units Implicit Price deflator
NVOILCONSKN	Domestic Oil Consumption
NVOILPRODKN	Oil Production
NVOILTOTLCN	Value Added Oil Local Currency units Values National base year
NVOILTOTLKN	Value Added Oil Local Currency units Volumes National base year
NVOILTOTLXN	Value Added Oil Local Currency units Deflator
NVSRVTOTLCN	Value Added Services Local Currency units Values
NVSRVTOTLKN	Value Added Services Local Currency units Volumes National base year
NVSRVTOTLXN	Value Added Services Local Currency units Implicit Price deflator
NYGDPDISCCD	GDP Disc., USD mn
NYGDPDISCCN	GDP Disc., LCU mn
NYGDPDISCKD	GDP Disc., 2000 USD mn
NYGDPDISCKN	GDP Disc., 2000 LCU mn
NYGDPFCSTCD	GDP Factor Cost USD
NYGDPFCSTCN	GDP Factor Cost Local Currency units Values
NYGDPFCSTKN	GDP Factor Cost Local Currency units Volumes National base year
NYGDPFCSTXN	GDP Factor Cost Local Currency units Implicit Price deflator
NYGDPGAP_	Output Gap (% of Potential GDP)
NYGDPMKTPCD	GDP, Market Prices, US$ mn
NYGDPMKTPCN	GDP, Market Prices, LCU mn
NYGDPMKTPCP	Model Param. NYGDPMKTPCP
NYGDPMKTPKD	GDP, Market Prices, 2000 US$ mn
NYGDPMKTPKN	GDP, Market Prices, 2000 LCU mn

NYGDPMKTPKP	Model Param. NYGDPMKTPKP
NYGDPMKTPXD	GDP, Marker Prices, USD Price defl., 2000 = 1
NYGDPMKTPXN	GDP, Marker Prices, LCU Price defl., 2000 = 1
NYGDPPOTLKD	Potential Output, 2000 US$ mn
NYGDPPOTLKN	Potential Output, constant LCU
NYGDPTFP	Total factor productivity
NYTAXNINDCN	Net Indirect Taxes Local Currency units Values
NYTAXNINDKN	Net Indirect Taxes Local Currency units Volumes National base year
NYTAXNINDXN	Net Indirect Taxes Local Currency units Implicit Price deflator
NYYWBTOTLCN	Total Wage Bill
NYYWBTOTLCN_	Labor Share of Income
PANEUATLS	Official exchange rate (LCU per EURO, period avg)
PANEUATLSK	Official exchange rate, Real (LCU per EURO, period avg)
PANUSATLS	Exchange rate LCU / US$
PANUSATLSK	Official exchange rate, Real (LCU per US$, period avg)
PMKEY	Keyfitz Price Imports
PSTAR	Marginal Cost of Production
PXKEY	Keyfitz Price Exports
PXKEYEX	Keyfitz Export Price Excl. Oil
REER	Real Exchange Rate (Trade Weighted)
REMT_IN	Remittances Inflow Indicator
REMT_OUT	Remittances Outflow Indicator
SPPOP1564TO	Labor force (15-64)
SPPOPTOTL	Population (mn)
SPPOPWORK	Population 15+
TOT	Terms of Trade
VELOCITY	Velocity of Money
WLDFALUMINUM	Price of aluminum (USD)
WLDFBANANA_US	Price of banana (USD)
WLDFBEEF	Price of beef (USD)
WLDFCOAL_AUS	Price of coal (USD)
WLDFCOCOA	Price of cocoa (USD)
WLDFCOFFEE_COMPO	Price of coffee (USD)
WLDFCOPPER	Price of copper (USD)
WLDFCOTTON_A_INDX	Price of cotton (USD)
WLDFCRUDE_PETRO	Price of oil (USD)
WLDFGOLD	Price of gold (USD)
WLDFGRNUT_OIL	Price of groundnut (USD)
WLDFIRON_ORE	Price of iron ore (USD)
WLDFISTL_JP_INDX	Price of steel (USD)
WLDFLEAD	Price of lead (USD)
WLDFLOGS_MYS	Price of logs (USD)
WLDFMAIZE	Mai price of ze (USD)
WLDFNGAS_EUR	Price of natural gas (USD)
WLDFNICKEL	Price of nickel (USD)

WLDFORANGE	Price of orange (USD)
WLDFPALM_OIL	Price of palm oil (USD)
WLDFPLYWOOD	Price of plywood (USD)
WLDFRICE_05	Price of rice (USD)
WLDFRUBBER1_MYSG	Price of rubber (USD)
WLDFSAWNWD_MYS	Price of sawnwood (USD)
WLDFSILVER	Price of silver (USD)
WLDFSORGHUM	Price of sorghum (USD)
WLDFSOYBEAN_MEAL	Price of soybean (meal) (USD)
WLDFSOYBEAN_OIL	Price of soybean (oil) (USD)
WLDFSOYBEANS	Price of soybeans (USD)
WLDFSUGAR_WLD	Price of sugar (USD)
WLDFTEA_AVG	Price of tea (USD)
WLDFTIN	Price of tin (USD)
WLDFTOBAC_US	Price of tobacco (USD)
WLDFWHEAT_US_HRW	Price of wheat (USD)
WLDFWOODPULP	Price of woodpulp (USD)
WLDFZINC	Price of zinc (USD)
MUV	Price of manufacturing goods (USD)
XMKT	Weighted Trading Partner Demand