INP- EGYPT

MACRO-ECONOMETRIC MODEL

Documentation Paper

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FIRST EDITION

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DOCUMENTATION PAPER

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Table of Contents

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PREFACE

As part of its ongoing efforts to improve evidence-based policy development, the Institute of National Planning (INP) has developed a macro-econometric model to help in both forecasting and scenario analysis. Since 2022, the Modeling unit has initiated a prolonged, multi-year process to design, build, and validate the model. The modeling unit team has dedicated significant effort and focused work involving iterative model creation, comprehensive data curation, and multiple cycles of training and evaluation to ensure robustness. The creation and development of the model have necessitated substantial effort.

This document describes the INP-Egypt Macro-econometric Model's structure, theoretical foundations, and empirical application to economic analysis, forecasting, and policy evaluation. One of the model's most notable aspects is its rigorous econometric specification, which integrates economic theory and data-driven estimation methods.

I would like to express my thanks for the sustained dedication of the modeling team, led by Dr. Mariam Raouf, and I also extend my appreciation to all the Modeling unit team for their rigorous work across model design, data curation, estimation, and validation of the model. My sincere gratitude goes to the Arab Planning Institute (API) and the Joint Modeling Unit—particularly Prof. Belkacem Laabas—whose dedicated commitment and technical expertise have significantly contributed to the model's successful completion. I would also like to extend my gratitude to Prof. Sherine Alshawarby, for her fundamental technical and scientific support in developing the conceptual framework for the model.

This work also benefited from the valuable inputs and feedback of esteemed experts in the field of Econometrics, who attended two workshops that aimed to discuss the model theoretical foundations as well as the validation of its results. This expert feedback approach has strengthened the model's robustness, transparency, and relevance. The model structure allows for future updates, improvements and refinement as new data or analytical requirements arise.

Finally, we view this project as a step toward broader regional modeling, hoping that this document will assist other Arab countries in constructing robust macro-econometric models, and will foster partnerships between national teams, and development partners.

Sincerely

Dr. Ashraf El-Araby

1. Introduction

The use of large macro-econometric models, particularly structural ones, has long been integral to economic forecasting and policy analysis in both advanced and developing economies. These models, which typically involve the estimation of simultaneous equations grounded in economic theory, trace their origins to the pioneering work of Tinbergen (1939) and the Cowles Commission (see Fair, 1984). They are designed to capture the intricate interrelationships among different sectors of the economy, offering a comprehensive framework for understanding economic dynamics and assessing policy interventions.

Egypt's experience with large macro-econometric structural models has been characterized by sporadic efforts to comprehend and forecast the nation's economic dynamics. A limited number of researchers have employed simultaneous-equations methods to estimate macroeconomic models for Egypt. To the best of our knowledge, there are only two studies, albeit not available online, which date back to the 1990s. Thabet (1992) estimated the impact of alternative economic policies on economic growth using a basic macroeconomic model for the period 1960-1991. Al-Shawarby (1997) took a more ambitious approach, developing a large macro-econometric model following Fair (1984) to assess the impact of the Economic Reform and Structural Adjustment Program (ERSAP) implemented by the Egyptian government in collaboration with the IMF and World Bank in 1991. Al-Shawarby's model comprised 19 behavioral equations and 85 identities, utilizing 173 variables over the period 1967-1993. The behavioral equations were estimated using two-stage least squares (TSLS) or ordinary least squares (OLS).[1]

Since then, no significant attempts have been made to adopt such models, despite their robustness and comprehensiveness. This reluctance may stem from the models' large scale and extensive data requirements, which have deterred many researchers, as well as the lack of interest from academic and official policy institutions in developing and maintaining such models. Consequently, time series analysis, although valuable, has become more prevalent; however, it lacks the ability to capture the intricate structural relationships inherent in a full-scale macro-econometric model.

This paper presents a structural macro-econometric model constructed for Egypt, inspired by previous efforts while adapting to contemporary economic conditions and available data, thereby filling a gap in the existing literature. The proposed model, termed the "Egypt Macro-econometric Model" (EMM), is inspired by Fair's "US " model (2016) and is designed to be of a manageable size, appropriate given the limited coverage of national data and the relatively short time series for many key indicators.[2] The EMM aims to serve as the foundation for ongoing institutional efforts by the Modeling Unit team at the Institute of

[1] Since this is one of the authors' PhD theses, more detailed information about the model is provided, unlike Thabet's work which is not available online and hence less documented in this paper

[2] Many of the available time series for key macroeconomic indicators date back to the 1990s.

National Planning to build a comprehensive macro-econometric model for Egypt. While this version of EMM approximates the overall Egyptian economy in several important respects, certain features have been omitted (details to be listed with justifications). The EMM is not intended as a replacement for a comprehensive model but rather as a useful tool for understanding macroeconomic data.

1.1. Nature of the Report

It is important to note that this document is intended to outline the structure and components of the Egypt Macro-econometric Model (EMM). We have focused on developing the conceptual framework, including behavioral equations, exogenous variables, and a set of identities. We have also conducted checks on the identifiability of the proposed model and performed stationarity tests. This report has been shared with a group of experts to solicit feedback on the proposed approach and to guide the next steps in model development. Specific questions for expert input are highlighted within the report. Their comments and valuable feedback have been incorporated into the model whenever data and resources permitted.

Accordingly, two workshops were held at the Institute of National Planning, with the participation of many renowned and highly qualified experts in econometrics and economic modelling. The first workshop was held on 14 September 2024 (full lists of experts are in Tables A1 and A2 in the Annex). The discussions focused mainly on the conceptual structure of the model. The esteemed participants mentioned valuable feedback that we took into consideration in our model refinement process. They emphasized the importance of including real production as well as the monetary and fiscal aspects. This has been included in a comprehensive way in the model; a more detailed explanation will be provided in the subsequent sections. In addition, structural breaks in the times series should be accounted for, and this has been incorporated in the model through the addition of dummy variables that reflect the turning points, and/or crises; and/or structural breaks in the series.

However, other comments have been postponed being incorporated in upcoming versions of the Model. This is due to both data and time limitations. For example, the experts recommended including more disaggregation in the model, especially what is related to both sectoral and external trade disaggregation. Future versions of the model should incorporate the social protection dimension as well as the income distribution module. Experts also discussed the possibility of integrating the informal sector, because it affects both employment and wages, but this is highly restricted by data availability and the sectoral coverage in the statistical sources. Future versions could also entail the disaggregation of the international financial flows in Egypt, namely the workers' remittances, portfolio investment and foreign direct investment.

In October 2025, a second workshop took place, aiming to validate the preliminary results of the model (a full list of the experts who attended the validation workshop is provided in the Annex). The preliminary results for the estimation period (1998-2022) were presented, and forecasts up to the year 2040 were displayed. The main comments criticized the long forecasting horizon, suggesting that it would be preferable to conduct forecasts over a shorter time horizon, for example until 2030. They also suggested the possibility of applying other methodologies that overcome the challenge of short estimation periods, such as mixed-frequency modeling or generating quarterly data from the published annual data. However, not all experts agreed on this approach of data fabrication. They also proposed combining time series analysis with cross-sectional methods, in upcoming versions of the model. They also mentioned the importance of disaggregating the government revenues into indirect and direct taxes. The results of the model could also be tested by comparing the forecasts for two or three years beyond the estimation period. Moreover, it is essential to incorporate the transmission channels of shocks into the Egyptian economy, such as how the exchange rate affects the tourism revenues, the debt payments and subsidies in the fiscal budget.

1.2. Motivation and Objective

The motivation for this document is twofold. Firstly, there is an urgent need for a robust macro-econometric model to inform policy decisions in Egypt, particularly given the economic challenges the country faces. Secondly, the model has served as a training tool for the Modeling Unit team, equipping them with the skills to estimate and utilize such models, which have not been extensively adopted by any institution in Egypt.

1) The objective of this document is to describe the detailed structure and steps that were applied in order to construct a macro-econometric model for Egypt. This model will serve as a foundational tool for providing insights into the potential impacts of different economic policies and for offering a structured approach to predicting key economic variables. The construction and estimation of the EMM also provided the Modeling Unit team with valuable hands-on experience in estimating and applying macro-econometric models, which has enabled the unit team to acquire more advanced econometric techniques and capabilities in macro-modeling. Hence, the document describes the core structural relationships within the Egyptian economy that can be captured by a macro-econometric model.
2) In addition, this model will be used to provide reliable economic forecasts. It will also shed light on the practical challenges associated with estimating such a model in the context of Egypt, and on how the Modeling Unit team has managed to overcome them.

1.3. Value Added

The primary value of this document lies in its dual focus on practical application and capacity building. By constructing a macro-econometric model, this document provides a practical tool for immediate policy analysis and forecasting. Additionally, it lays the groundwork for a more comprehensive model, which can be developed over time as data and resources permit. This approach has ensured that the Modeling Unit team has gained valuable experience and that the broader academic and policy-making community in Egypt will benefit from more sophisticated economic analysis tools.

1.4. Structure of the Document

The rest of the document is structured as follows. Section 2 presents the theoretical framework underpinning the Egypt Macro-econometric Model (EMM). This section also explains how the model integrates both demand and supply-side components, drawing on a hybrid approach that combines theoretical and empirical perspectives. Section 3 outlines the methodology used in constructing the EMM, including the incorporation of theoretical restrictions, the endogenous treatment of monetary policy, and the comprehensive testing approach employed. In Section 4, we detail the construction of variables and the specification of identities, ensuring that the model accurately reflects the economic realities of Egypt. This section also lists the behavioral equations used in the model, along with their explanatory variables. Section 5 presents the estimated equations, providing the results of our empirical analysis, while Section 6 presents the estimated forecasts for the endogenous variables in the model until 2030, and evaluates the overall fit of the model, examining its predictive accuracy and reliability. Finally, Section 7 concludes and outlines directions for future research and model enhancement.

1.5. Theoretical Framework and Stylized Facts

The Egypt Macro-Econometric Model (EMM) incorporates both demand and supply-side components to comprehensively model the Egyptian economy. It features 41 endogenous variables and 40 exogenous variables, including predetermined (lagged) and dummy variables.

The demand side of the EMM comprises private consumption, private investment, exports of goods and services, and imports of goods and services. The model is based on Keynesian and New-Keynesian theories, guiding the relationships between variables across various equations. For example, households make decisions regarding consumption, labor supply, and money demand by solving their optimization problems. These theoretical principles are consistently applied throughout the model, in line with other reviewed econometric models.

The supply side of the EMM encompasses production, private sector employment, capital stock, and prices. The model emphasizes the real and price blocks to capture the dynamics of economic activities. These dynamics are modeled using a production function framework where firms make decisions on investment, production, and employment, which are crucial for understanding supply-side behavior.

By integrating both demand and supply-side elements, the EMM provides a comprehensive framework that captures the complex interactions within the Egyptian economy. The inclusion of both behavioral equations and theoretical foundations ensures that the model accurately reflects economic realities and policy impacts.

In addition, by assuming government consumption and investment spending to be exogenous, we include government interest payments as a crucial component of the fiscal sector. Interest payments by the government are significant as they impact both the demand and supply sides of the economy. On the demand side, interest payments represent a substantial portion of government expenditures, influencing aggregate demand and potentially crowding out other forms of spending. On the supply side, the burden of interest payments can affect the government's ability to invest in infrastructure and other productive activities, thereby influencing the overall economic capacity. Including interest payments in our EMM allows for a more comprehensive analysis of fiscal dynamics and their broader economic implications.

To comprehensively analyze the impact of monetary policy on various macroeconomic variables, our model includes behavioral equations for money demand and credit to the private sector. These equations are essential as they capture the dynamics of how monetary policy tools influence the economy. The money demand equation reflects the public's preference for holding cash versus other assets, which is crucial for understanding inflation and interest rate movements. Meanwhile, the-credit-to-the-private-sector equation captures the responsiveness of borrowing and lending activities to changes in monetary policy, providing insights into investment and consumption patterns. Including these behavioral equations ensures that the model accurately reflects the channels through which monetary policy affects overall economic activity.

We will not strictly adhere to any specific school of thought; instead, we will extensively utilize economic theory and empirical literature to model the macroeconomic variables, ensuring consistency with the behavior of these variables in Egypt from 1973-2023[3]. Consequently, the Egypt Macro-econometric Model (EMM) can be considered a hybrid model, integrating both theoretical and empirical coherence to a certain extent. In other words, as suggested by Hendry (2018) and others, the EMM combines "theory-driven" and "data-driven" approaches.

[3] - Data for the model variables was originally collected over the period 1973- 2023. However, due to data limitations, we were restricted by the availability of data, hence the estimation period for the model was set for 1998-2023.

A key feature of the EMM is its alignment with the stylized facts of the Egyptian economy, ensuring that the modeled relationships reflect the unique characteristics of Egypt's macroeconomic and real sector environments. Some of these distinctive features of the Egyptian economy are highlighted below:

- Egypt is a diversified economy with key sectors including agriculture, industry, and services. From 2007-2016, the service sector, including tourism and Suez Canal revenues, constituted an average of 53% of the total economy, while industry, including petroleum and natural gas, accounted for about 32%, and agriculture contributed roughly 15%. Egypt, like many other countries in the Middle East and North Africa (MENA) region, has a significant informal labor force. Approximately 50% of the labor force is employed in the informal sector, which poses challenges for economic policy and labor regulation.
- Unlike countries rich in natural resources, particularly oil, Egypt relies on a mix of taxes and other revenues for its budget, including income tax, value-added tax (VAT), and customs duties. Consequently, policymakers often consider tax policy as a crucial tool for economic adjustments and fiscal sustainability. Additionally, the country is a major recipient of remittances from Egyptians working abroad, which constitute a significant part of the national income.
- Egypt also boasts a rich cultural heritage, being home to iconic landmarks such as the Pyramids of Giza and the ancient city of Luxor. This historical and cultural wealth makes tourism a vital sector for the economy, contributing significantly to GDP and employment. Additionally, the Suez Canal plays a crucial role in international trade, further underscoring the importance of the service sector. The government's efforts to revive and expand the tourism industry, along with initiatives to enhance the business climate, are pivotal in driving economic growth and diversification. Accordingly, considering the significant impact of services, particularly tourism and the Suez Canal, on exports and the overall economy is essential.

2. EMM Methodology

The GDP identity is an important theoretical restriction to impose, which is not done in time series analysis and reduced form work. Using this identity, along with the estimated consumption and investment equations, allows the government spending multiplier to be computed by solving a simultaneous set of equations. This solution incorporates all the theoretical restrictions in the model and utilizes substantially more information than that obtained by directly estimating reduced form equations.

In this approach, all the exogenous and lagged endogenous variables are considered, not just a subset, as is usually done when reduced form equations are directly estimated. A similar argument can be made regarding the computation of tax and money multipliers. Incorporating these restrictions is likely to narrow the range of uncertainty around the multiplier estimates, meaning that dynamic scoring of various tax and spending proposals may not be as problematic as some suggest. When sensible theoretical restrictions are imposed, the range of uncertainty is relatively small.

In the Egypt Macro-econometric Model (EMM), monetary policy is endogenous. Interest rates affect consumption and investment, although these estimated effects may not be large enough to allow monetary policy to eliminate business-cycle fluctuations. This contrasts with the results of other DSGE models applied to Egypt, where monetary policy is often assumed to have the capacity to fully control the economy.

In the EMM, Egyptian exports and imports are endogenous, similar to the MC model of Fair (2013). Their equations have a significant effect on the properties of the model, such as the size of the government spending and tax multipliers.

The EMM comprises 15 equations that represent the behavioral aspects of the Egyptian macroeconomy and test the existence of specific economic relationships. These equations were first estimated individually using OLS to construct the system and determine the block structure. Once the full model was specified, it was re-estimated for the period 1998-2022 using 2SLS and subsequently 3SLS to improve efficiency and address biases arising from endogeneity.

Our empirical estimation and testing follow a structured "road map." Given that we use time series data; the first step is to examine the stochastic properties of the data through unit-root tests. For this analysis, we employ the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981) **(See Annex Table A3),** the Phillips-Perron (PP) test (Phillips and Perron, 1988) **(See Annex Table A4),** and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test (Kwiatkowski et al., 1992).

In cases where structural breaks are likely based on the nature of the data, we also utilize unit root tests with structural breaks. Specifically, we use the ADF with structural breaks (ADFBP), as developed by Perron

(1989), Perron and Vogelsang (1992a, 1992b), and Vogelsang and Perron (1998). We do not provide a detailed description of these tests here, as they are well-documented in the literature. For further details, readers can refer to the aforementioned references as well as Enders (2015), Perron (2006), Zivot and Andrews (1992), and Banerjee et al. (1992).

In order to validate the estimation of the behavioral equations and the entire model, we applied several tests, including tests of in-sample and out-of-sample forecasting quality. The significance of the parameters was examined, as well as residual tests **(see Annex Tables A5 and A6)**. In-sample performance tests were also conducted to approximate the historical data, and to test whether the model was able to generate the initial values of the data, with the smallest deviation between the estimated values and the actual values.

In a second step, we attempted to estimate the entire model that consists of 15 behavioral equations as a set of simultaneous equations, using the method of three-stages least squares (3SLS). This method usually takes endogeneity issues and disruption across equations for a specified time period into account, hence, 3SLS is the most often utilized estimation technique in the literature for a broad simultaneous-equations model (AlDakhil, 1998). In a system of simultaneous equations, this approach is used to estimate parameters, particularly when some of the variables are endogenous (correlated with the error term).

The goal of the 3SLS methodology is to estimate more efficient estimators than 2SLS alone by combining the concepts of 2SLS and seemingly unrelated regression. To estimate structural equation parameters, the 3SLS approach uses data from the variance-covariance matrix of the system disturbance terms. The 2SLS approach, on the other hand, estimates structural equation parameters independently and assumes that the error terms across equations and across time are independent. As a result, it may lose some information when the disturbance terms are not independent.

Three steps are involved in the implementation of the 3SLS estimate. First, in order to solve the endogeneity issue using instrumental variables, the 2SLS approach is applied to estimate each equation in the system. Second, the residuals are computed to estimate the variance-covariance matrix of the error terms across all equations and to capture the correlation between equations. Because the association between error terms across equations is addressed, the strength of the 3SLS method lies in predicting efficient parameters when compared to using only 2SLS. The estimated parameters are consistent, and the estimator converges to its true value as the sample size increases. Furthermore, the endogeneity problem is successfully resolved, particularly when the model is estimated using the simultaneous-equations method. See Ghosh (1991), Judge et al. (1985), and Greene (2017) for more thorough discussions.

3. Variable construction and identities

3.1. EMM's variables

All the variables of the EMM and their construction are listed in Table 1

Table 1 EMM's Variables in Alphabetical Order

Variable	Description
bca_$	Current Account Balance (BoP, current US$) million $
bcap_$	Capital Account Balance
bfac_$	BOP financial account in US$
bovr_$	Overall BOP balance
bserv_$	Services Balance
bt_$	Trade Balance
cg	Government consumption (wages and purchases of G&S)
cpi	Consumer Price Index (2010=100)
cpi_us	Consumer Price Index in US
dc	Total domestic credit
dcrdg	Domestic Credit to the government (net claims)
dcrdh	Domestic Credit to Household
dcrdpr	Domestic Credit to the private sector
dcrdpu	Domestic Credit to the public sector
dd	Demand deposits, nominal
debtg	Total government debt (domestic and foreign)
dts	Time and Savings deposits
efree	Economic Freedom
emp	Employment
empl	Total Employment
emplcapmas	Total Employment
emplg	Employment in the government sector
emplo	Employment their sectors
emplp	Employment in private sector
emplpb	Employment in the public sector
empo	Other Employment
eo_$	Errors and emissions
er	Nominal exchange rate (LCU per US$)
eu	EU ratification agreement
ex$	Total exports in US$
expendg	Government total expenditure
fdi	Foreign direct investment, net inflows (BoP, current US$)

Variable	Description
gdcp_gdp	
gdp	GDP at market price
gdpdef	GDP deflator (base year varies by country)
im_$	Total imports in US$
inf	Inflation rate
int	Nominal interest rate (lending)%
intpg	Interest Payment of the government debt
intw	Interest Rate World
invent	Real inventory
invg	Net investment in nonfinancial assets (current LCU)
invpb_gdp	Nominal public sector capital formation
kfdi	
kstock	
lf	Labor force
m0	Currency outside banks (current LCU, million)
m1	Money Supply M1
m2	Broad Money Supply
mr	Demand for Real Broad Money Balances
neo_$	Net errors and omission in BOP in US$
nfa_$	Net foreign assets in US$
nfa_lc	Net Foreign Assets - local currency
nfinc_$	Net Factor Income (US$)
nir_$	Net international reserves
ntaxr	Non-tax revenue
ofb	Overall Fiscal Balance
oilp	Brent Crude Oil Spot Price
othg	Other government expenditure items (current LCU)
partr	Labor force participation
pex	Exports price index
pim	Imports price index
pop	Total population
pop_14	Population under 14
rc	Total real consumption (constant LCU)
rcg	Real government consumption (constant LCU)
rcp	Real private Consumption expenditure (constant LCU)
rer	Real Exchange rate
revg	Government total revenue
rex	Real total exports of goods and services (constant LCU)
rexpendg	Real government total expenditure

Variable	Description
rgdp	Real GDP at Market Price
rgdpfc	Real GDP at factor cost (constant LCU)
rgdpmp	Real GDP at market price (constant LCU)
rgdpw	World RGDP
rim	Real Imports of goods and services (constant LCU)
rint	Real interest rate (lending)%
rinv	Real Gross capital formation (investment) (constant LCU)
rinvg	Real government capital formation (constant LCU)
rinvp	Real private capital formation (constant LCU)
rinvpb	Real public sector capital formation, including the mega projects investments (constant LCU)
rnindtax	Real net indirect tax (ind. Tax- subsides)
rtb	Real trade balance
rw	Real wages
sub	Government spending on subsidies, grants and social benefits
t_d	Total deposits
taxr	Tax revenue (current LCU)
tb$	Trade Balance (commodity) in US$
tbr	Treasury Bills Rate
tdcrd	Total domestic credit
un	
ur	Unemployment rate
w	Nominal wages
West_texas_intermediate_crude_oil_spot_price	Price of crude oil
wheatp	Wheat price
D09	Takes the value of 1 in 2009 and zero otherwise
D14	Takes the value of 1 in 2014 and zero otherwise
D15	Takes the value of 1 in 2015 and zero otherwise
D16	Takes the value of 1 in 2016, 2017, 2020, 2021, 2022 and zero otherwise
D17	Takes the value of 1 in 2017 and zero otherwise
D20	Takes the value of 1 in 2020 and zero otherwise
D22	Takes the value of 1 in 2022 and zero otherwise
D98	Takes the value of 1 in 1998 and zero otherwise
D99	Takes the value of 1 in 1999 and zero otherwise
D09	Takes the value of 1 in 2009 and zero otherwise

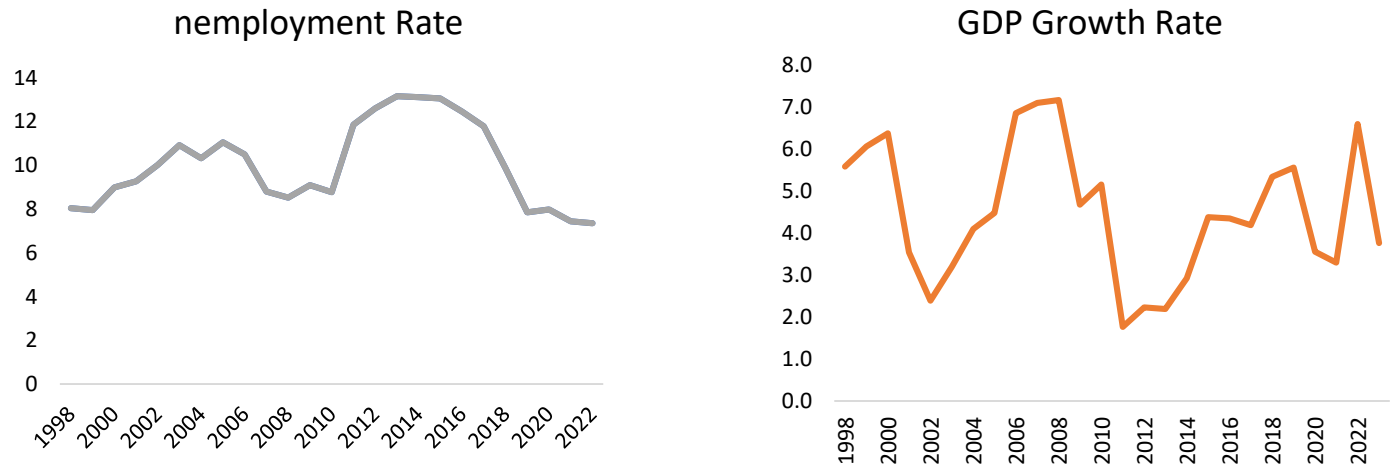
The gathering, updating, and maintenance of data is one of the most resource-intensive components of the Egypt Structural Macro Econometric Model, as they are in other macro econometric models. In econometric modeling, data is a crucial factor in establishing the statistical properties of relationships. In this regard, data availability is critical in establishing relationships between variables in time-series-based models. Macro-econometric models rely substantially on data, and attaining thorough findings is problematic, depending on the accuracy and timing of the data.

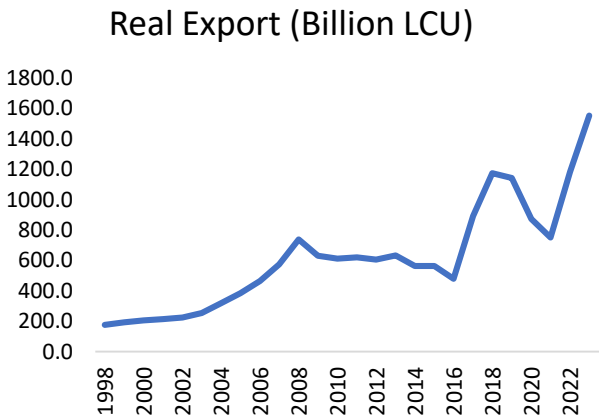
Our EMM model has 82 annual time-series variables. Some exogenous variables are dummy variables that indicate both long-term and transitory changes in relationships that data cannot explain (the distinction of variables by type is provided in the Annex Table A7). Policy considerations are also exogenous in the EMM.

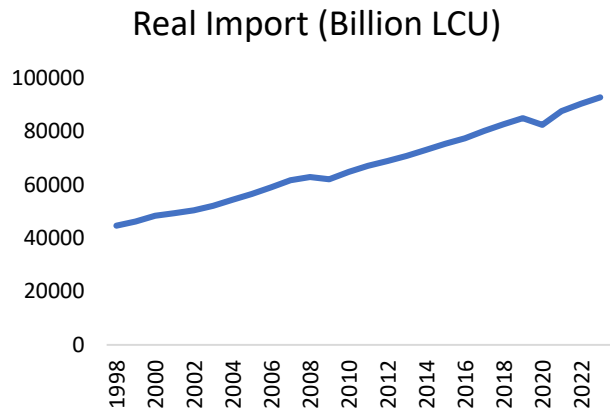
The data was acquired from several domestic and international sources. We collect the vast majority of domestic data from The Ministry of Planning, Economic Development, and International Cooperation (MOPEDIC), the Ministry of Finance (MoF), the Central Bank of Egypt (CBE) and the Central Agency for Public Mobilization and Statistics (CAPMAS).
The international largely derive from the databases of the World Bank, the United Nations, the International Monetary Fund, and the International Labour Organization.

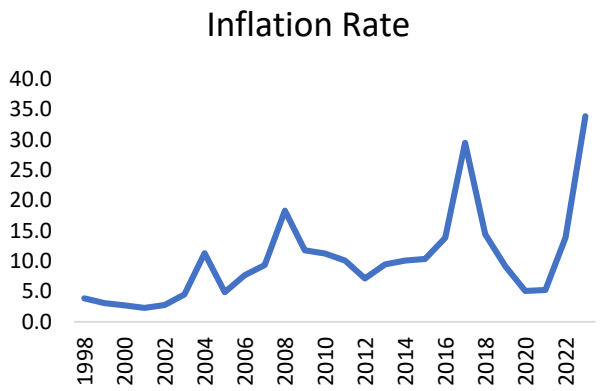
The EMM database contains statistics on the real economy, monetary and fiscal policy, the external sector, consumer and producer prices, the labor market, and the population. The database contains actual (2017 prices), nominal, index, and user-calculated variables. To enhance the understanding of these data, the following section presents a set of charts that illustrate the trends and evolution of the key Macroeconomic variables.

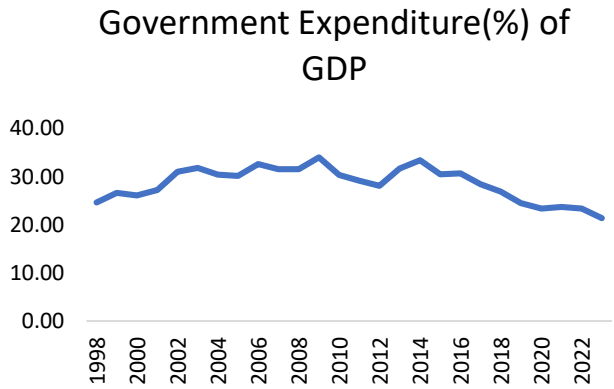
Figure 1 The Key Macroeconomic Variables

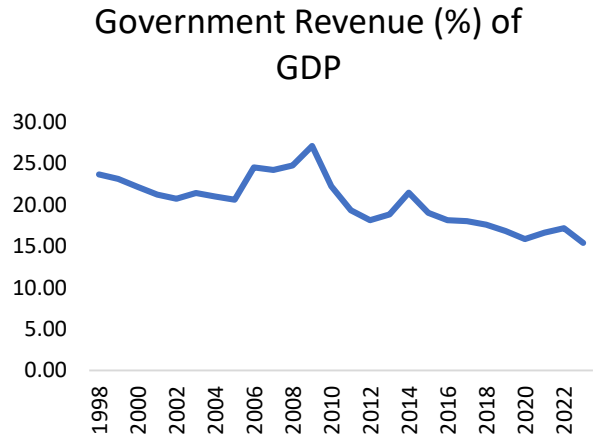


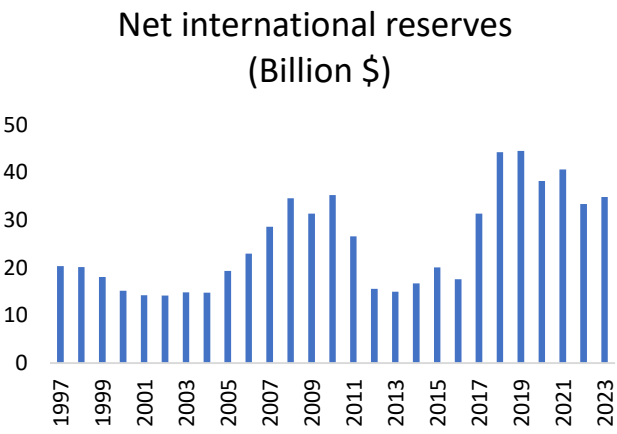












Source: The Database based on international and local resources.

3.2. Behavioral Equations

The model consists of 15 behavioral equations for private consumption, private investment, exports of goods, exports of services, imports of goods and services, production (RGDP at factor cost), employment in the private sector, interest payments on government debt, tax revenue, money demand, domestic credit to the private sector, domestic credit to the government sector, and net foreign assets. The list of behavioral equations is summarized in Table 2, and the specifications of these behavioral equations are discussed below.

Table 2 EMM's Behavioral equations

Eq.	LHS Variable	Explanatory Variables
1	RCP	RGDP, RCp lagged, RINT
2	RINVP	RGDP, (RINVPB/RGDP), RINT lagged, RINVP lagged
3	REX	RGDPW, FDI, RER lagged, REX lagged
4	RIM	RIM lagged, RER, RGDP
5	RGDPFC	RGDP lagged, KSTOCK, KSTOCK lagged, EMPL, EMPL lagged
6	MR	RGDPmp, RINT, MR lagged
7	DCRDG	OFB, M2, TBR, DCRDG lagged
8	DCRDPR	GDPMP, INT, DCRDG, T_D, DCRDPR lagged
9	NFA_$	BCA_$, NFA_$ lagged
10	CPI	CPI lagged, GDPDEF, GDPDEF lagged
11	GDPDEF	GDPDEF lagged, M2, M2 lagged, WHEATP, WheatP lagged, RC, RC lagged, RINV, RER, INT, W, W lagged, OILP lagged
12	LF	TREND, RW
13	EMPLP	EMPLP lagged, RGDP, RW, RW lagged
14	INTPG	DEBTG, INTPG lagged, INTW
15	TAXR	RGDP, GDPDEF

In standard macroeconomic modeling, the real block is commonly divided into two distinct components: aggregate demand and aggregate supply. According to the national income identity, final demand is represented by the sum of total consumption, total investment, exports, and imports. Specifically:

- Total consumption comprises both private and government consumption.
- Total investment includes private investment, public investment, and changes in inventory.

In the present framework, government consumption and public investment are treated as exogenous variables, reflecting policy-driven components that are not modeled endogenously. Accordingly, private consumption, private investment, and other demand-side variables—such as exports and imports—are estimated econometrically, based on historical data and relevant behavioral equations.

3.2.1. Private Consumption Function

Private consumption constitutes the most substantial and least volatile component of aggregate demand, and hence, of Gross Domestic Product (GDP) in Egypt. In the initial phase of model development, we draw on the Keynesian Absolute Income Hypothesis, incorporating current income as the primary determinant of consumption behavior. This foundational theory posits that consumption is closely tied to observable income flows, particularly in developing economies where liquidity constraints may restrict intertemporal smoothing.

To enrich the model further, we incorporate insights from the Life-Cycle and Permanent Income Hypotheses (Friedman, 1957), which suggest that consumers seek to smooth consumption over time based not only on current income but also on expected lifetime resources. In this context, the real interest rate emerges as a crucial explanatory variable. Its influence on consumption is nuanced: an increase in the real interest rate may dampen current consumption through the substitution effect—by incentivizing saving—but may also enhance it via the income effect, which improves consumers' effective purchasing power (IMF, 2013).

To account for behavioral dynamics such as adaptive expectations and habit formation, we introduce lagged private consumption as an additional regressor, following the methodological precedent established by Bolatbayeva et al. (2020). This specification allows the model to capture inertial consumption patterns and reflects empirical regularities observed in similar macro-econometric frameworks.

3.2.2. Private Investment Function

In accordance with the Accelerator Theory of Investment, a robust and positive relationship is posited between economic growth and investment activity, wherein increases in output stimulate higher levels of capital accumulation. To capture adjustment dynamics and investment frictions, we incorporate the lagged value of the dependent variable as an additional regressor, reflecting the gradual nature of investment responses to economic stimuli. This specification is empirically supported by studies such as Bolatbayeva et al. (2020) and BOĞA (2020), which emphasize the relevance of investment inertia and adjustment costs in macro-econometric modeling.

To assess the net effect of public investment on private investment—whether it induces crowding-in or crowding-out behavior—we incorporate public investment as an explanatory variable within the investment equation. This approach is informed by empirical investigations such as BOĞA (2020).

Despite its recognized significance as a key determinant of private investment, the business environment lacks a single, longitudinally consistent indicator that captures its multifaceted nature over an extended time horizon. While contemporary composite indices—such as the Economic Freedom Index, the Global

Competitiveness Index, and the Doing Business Index—have contributed substantially to empirical research, their availability is limited to post-mid-1990s data. Consequently, our model does not incorporate a dedicated variable to account for the business environment, due to constraints in historical coverage and data consistency.

3.2.3. Production Function

The estimation of production functions plays a pivotal role in elucidating the quantitative relationship between economic inputs and output. Despite criticism in the theoretical literature (such as Barro, 1990, 1991), neoclassical models are still used extensively to estimate macro-econometric models of both developed and developing countries, so we adopt the Cobb-Douglas production function—originally formulated by Cobb and Douglas (1928) and subsequently extended by Solow (1957)—as the empirical foundation for our analysis. To capture technological advancements and productivity growth over time, we incorporate a linear time trend into the model, along with capital and labor inputs. The function is expressed as follows:

$$Y_t = BA_t K_t^{\alpha} L_t^{\alpha-1}$$

Here, At denotes Total Factor Productivity (TFP), and B represents any normalizing constant. The shares of capital and labor are expressed as α and 1–α respectively, reflecting the assumption of constant returns to scale.

To construct the capital input series, we employ the perpetual inventory method following Nehru and Dhareshwar (1993), which estimates the capital stock as the cumulative sum of past investments adjusted for depreciation. This methodology has been widely applied in the literature (e.g., Al-Shafi'e, 2014; El-Baz, 2016; Sethi & Kaur, 2014; Shahin, 2011; Sinha, 2022).

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

Where K_t represents the capital stock at time t; I_t is calculated as the gross fixed capital formation or total investment in the current period; δ denotes the depreciation rate.

Two key assumptions underpin this estimation approach. First, the initial capital stock is assumed to be equivalent to twice the level of GDP, based on the average between the World Bank (2.6) and Penn World Table (1.29) estimates. Second, the depreciation rate for Egypt is fixed at 5%, as reported in the most recent release of the Penn World Tables (version 10.1).

For the labor input, we utilize total employment measured by the number of workers, a conventional proxy employed in numerous empirical studies (Bolatbayeva et al., 2020; Eita, 2018; Mankiw, Romer, & Weil, 1992).

This section examines the factors influencing Egypt's private consumption and investment and Production function from 1965 to 2022 using an econometric approach. The analysis involved stationarity testing using the Augmented Dickey-Fuller test, structural change detection using the Chow breakpoint test, and ARDL cointegration and dynamics using the Autoregressive Distributed Lag bounds testing approach. Results showed structural breaks in the consumption equation in years 1979 while Private investment function in years 1998,1999,2000,2009.

These consumption specifications will undergo several diagnostic tests to ensure their validity. Among competing models, the one that best explains aggregate consumption behavior for the Egyptian economy over the estimation period will be selected. (we can generalize in technique of the model)

3.2.4. External Trade Functions: Exports and Total Imports

The external sector behavioral functions in the proposed macroeconomic model represent exports and imports. For the export functions, we have chosen to separate them into two distinct functions: one for merchandise exports and another for service exports. This distinction is essential due to the unique characteristics and significance of each export type, as well as the potential for the same explanatory variables to impact them differently. By treating merchandise and service exports separately, we can more accurately capture the specific dynamics and responses of each sector to economic variables.

The equations are designed to incorporate both demand and supply-side factors, effectively linking the external sector to the real economy. They account for relative prices and global demand, ensuring a comprehensive analysis of how these variables influence export performance. This approach allows for a more nuanced understanding of the interplay between domestic production capacities, international competitiveness, and external market conditions.

The external sector equations in the proposed macroeconomic model are divided into exports and imports. For the export functions, we have chosen to separate them into two distinct functions: one for merchandise exports and another for service exports. This distinction is essential due to the distinct characteristics and significance of each export type in the case of Egypt, as well as the potential for the same explanatory variables to impact them differently. Treating merchandise and service exports separately enables us to more accurately capture the specific dynamics and responses of each sector to economic variables.

The import function, on the other hand, is modeled as a single aggregate function. This approach is justified by the relatively broad nature of import demand, which typically responds more uniformly to key determinants such as income, relative prices, and foreign reserves. Unlike exports, where the composition of goods and services can vary significantly in their economic behavior, imports are treated collectively to provide a comprehensive view of the external sector's demand side. However, we acknowledge that the same

explanatory variables might have varying effects on different types of imports, just as they do for different types of exports.

Looking ahead, future versions of the model may need to further refine these functions by disaggregating exports and imports based on their degree of processing. Specifically, we may develop distinct functions for exports categorized by fuel, raw materials, semi-finished, and finished goods, as well as for imports categorized by raw materials, intermediate goods, investment goods, and consumer goods. Such a detailed breakdown would enhance the model's ability to capture the varied responses of different types of trade flows to economic changes, providing a more granular and accurate analysis of the external sector.

Anyway, the equations for both exports and imports are designed to incorporate demand- and supply-side factors, effectively linking the external sector to the real economy. They account for relative prices and global demand, ensuring a comprehensive analysis of how these variables influence trade performance. This approach allows for a more nuanced understanding of the interplay between domestic production capacities, international competitiveness, and external market conditions.

In theory, exports depend on three main factors: the productive capacity within the country and the available supply of exportable goods; the price of exportable goods compared to similar products in importing countries; and world income, which serves as a proxy for global demand. The export demand function typically includes both income and price elasticities (Thirlwall, 1986).

The production capacity in the home country, usually measured by real GDP growth, is considered a key determinant of exports (Majeed and Ahmad, 2006; Raouf, 2024). World demand also plays a significant role in boosting exports, as highlighted by several studies (Majeed and Ahmad, 2006; Mirdala et al., 2020).

Furthermore, relative competition between exporters is essential in determining the value of exports. This competition is often measured by the ratio of export prices to the export prices of competing economies, adjusted by the exchange rate (Mirdala et al., 2020). Most studies use the real exchange rate or the real effective exchange rate to measure the relative prices of exports between domestic and international markets. In this regard, the devaluation of the local currency makes domestic exports cheaper and, hence, may lead to an increase in the quantity of exports (Chahir, 2018). A positive and significant relationship between devaluation and total exports has been observed by Raouf (2024), with a stronger response from service exports. Additionally, free trade agreements (FTAs) typically facilitate export access to international markets (Cardozo et al., 2020; Cestepe et al., 2014; Raouf, 2024).

According to the literature, we propose that the behavioral equations for exports should be determined by global demand (real world GDP), domestic productive capacity (real GDP at market prices), and the real exchange rate. For merchandise exports, we will also explore the inclusion of capital goods imports and transportation fees as additional explanatory variables. Additionally, dummy variables and trend variables will be tested in both equations to account for potential structural breaks and time-related effects.

Regarding the main drivers of import demand, several theories have been put forward, such as the imperfect-substitution theory, which emphasizes the importance of price and income. In contrast, the neoclassical theory, linked to the Heckscher-Ohlin framework, places greater emphasis on production costs relative to trading partners, highlighting the importance of relative prices (Elhamalawy, 2024). Many empirical studies have attempted to estimate the determinants of imports, including factors such as income or gross domestic product, available foreign reserves, exchange rate, exports, and inflation rate (Jiranyakul, 2013; Yahia, 2015; Baek, 2015; Hossain et al., 2019).

Overall, most studies have found that income and relative import prices are the key determinants of import demand, although the impact of these factors can vary from country to country (Nomfundo & Nicholas, 2020). For instance, research has shown that import demand in Egypt is influenced by gross domestic product, foreign reserves, relative prices, and exchange rates, both in the long-and short-term (Hossain et al., 2019; Khalil, 2013; Shehab, 2012; Ibrahim, 2017). Therefore, the total import's function may include domestic demand (real GDP at market prices), the real exchange rate, and foreign reserves. The use of dummy variables might also be considered to enhance the accuracy of the equation's results.

3.2.5. Monetary Aggregates Functions

We identify four behavioral functions related to monetary policy, reflecting both the supply and demand sides of money, as follows:

3.2.5.1. Demand for Real Broad Money Balances (MR)

Issues related to the demand for money and associated functions are of utmost importance in monetary economics. These factors significantly influence the focus and techniques of monetary policy, as well as the reliance on monetary aggregates in growth considerations. The stability of the function, the adjustment speed of actual-to-desired balances, and the relative importance of explanatory variables have been central themes in theoretical, methodological, and empirical literature. Despite extensive research, there remains significant debate over the appropriate form of the money demand function, particularly in the long run (Oluremi Ogun, 2020).

The traditional classical theory of money, as proposed by Irving Fisher, emphasizes income as the sole determinant of money demand. This theory, operating within a full-employment framework, assumes that velocity and output remain constant. Consequently, its inferences regarding price-level determination, money demand, and aggregate spending are primarily applicable to the short run (Loef, Hans E.; Monissen, Hans G., 1999; Oluremi Ogun, 2020).

Keynesian theories, on the other hand, are generally short-run models based on the assumption of underemployment equilibrium. Typically expressed in real terms, the liquidity preference function in these models highlights the crucial roles of real income and interest rates in explaining variations in money

demand. However, the inherent instability of this function is linked to fluctuations in income velocity (Oluremi Ogun, 2020).

Demand for real money may be modeled to reflect the three basic purposes for holding cash balances - transactions, precautionary and speculative. Output and prices are prominent among the variables that define transactions and precautions motives while interest rate differentials capture returns to alternative investment openings for money (Central Bank of Nigeria, 2010).

Output can be represented by real gross domestic product as a proxy for real income. Prices include inflation rate (INF), the real lending rate (RI) and the nominal exchange rate (NER) as proxies for opportunity cost of holding money. (Geoffrey Ducanes, et al, 2005; Oluremi Ogun, 2020 and Manamba Epaphra, 2017).

In our model, real balances (money demand) and certain monetary aggregates—such as net foreign assets (NFA) and domestic credit— are explained through behavioral equations and accounting identities. No explicit policy rule (e.g., a Taylor rule) is specified to guide interest rate setting; hence, interest rates are treated as exogenous.

In our model, tThe demands for real broad money (MR) may be determined by several key factors: real GDP at market prices (RGDPmp), serving as a proxy for income, the real interest rate (RINT) and the real exchange rate (RER), which together capture the opportunity cost for holding money. The lagged value of the demand for real broad money (MR (t-1)) is also included to account for inertia or persistence in money demand. the inflation rate is not explicitly included, as it is implicitly reflected in other variables. This approach reflects both traditional and modern theories of money demand, emphasizing the importance of income, interest rates, and inflation expectation in determining money balances.

In the current specification, the policy interest rate is treated as an exogenous variable, reflecting the institutional features of monetary policy in Egypt during the sample period. Frequent regime changes, shifts in exchange rate arrangements, and multiple policy objectives have limited the applicability of a stable policy rule. Under these conditions, estimating a conventional Taylor-type reaction function would likely produce unstable and misleading results. Therefore, treating the interest rate as exogenous allows the model to capture key macroeconomic transmission mechanisms without imposing unrealistic behavioral assumptions.

3.2.5.2. Broad money supply (M2)

Broad money supply (M2) represents one of the core components in monetary analysis and is determined by the combined influence of several sources of liquidity expansion within the banking system. In our model, M2 is decomposed into three behavioral components consistent with the consolidated balance-

sheet identity of the central bank and the commercial banking system. The first function corresponds to domestic credit to the private sector, serving as a key driver of economic activity through the financing of consumption and investment. The second function reflects domestic credit extended to the government, indicating the impact of fiscal policy on the money stock. The third function pertains to net foreign assets, which represent the interaction between the domestic economy and the external sector through the trade balance and capital flows. (Central Bank of Nigeria, 2010; IMF, 2005).

Through these three functions, changes in the money supply can be explained, and its structural determinants at the macroeconomic level better understood.

3.2.5.2.1. Domestic Credit to the Private Sector (DCRDpr)

Domestic credit to the private sector (DCRDpr) is modeled as a function of nominal GDP at market prices (GDPMP), the nominal interest rate (INT), domestic credit to the government (DCRDg), total deposits (T_D), and the lagged value of private sector credit (DCRDpr (t-1)). This formulation aligns with the literature that highlights the role of income, interest rates, and government borrowing in shaping private sector credit availability. For instance, Bernanke and Blinder (1988) emphasize that credit markets significantly influence aggregate demand, with GDP and interest rates playing crucial roles in determining credit flows. Similarly, Islam (2022) finds that output and the lending rate act as income and price variables for credit to the private sector.

3.2.5.2.2. Domestic Credit to Government (DCRDg)

Fry (1995) discusses how government borrowing can crowd out private sector credit, affecting overall credit availability and influencing interest rates in the economy. Barro (1979) adds that government borrowing directly impacts public debt levels, which in turn affects financial market dynamics, particularly through interest rates. Alesina and Perotti (1996) provide empirical evidence from OECD countries showing how fiscal adjustments and government borrowing can have significant macroeconomic effects, particularly on interest rates and credit markets.

Therefore, the domestic credit extended to the government (DCRDg) is modeled in EMM as a function of the broad money supply (M2), representing the liquidity base for credit allocation; the treasury bill rate (TBR), which reflects the returns on alternative investment opportunities for deposit money banks (DMBs) and is therefore expected to have a negative relationship with credit to government; the Overall Fiscal Balance (OFB), serving as a proxy for the credit demand by all tiers of government, and the lagged value of government credit (DCRDg (t-1)), capturing the dynamic behavior of fiscal borrowing over time. (Central Bank of Nigeria, 2010; Oluremi Ogun, 2020).

This formulation captures the dynamic interaction between government borrowing and the broader financial market, emphasizing the influence of interest rates and fiscal policy.

3.2.5.2.3. Net Foreign Assets (NFA_$):

Lane and Milesi-Ferretti (2001) highlight the importance of foreign assets and liabilities in determining a nation's external wealth, with trade balance and international reserves being key components in this context. Obstfeld and Rogoff (1995) discuss the intertemporal approach to analyzing the current account, emphasizing how exports, imports, and exchange rates interact to influence a country's net foreign assets (NFA) position. Edwards (2004) further elaborates on the role of financial openness and external trade in determining net foreign assets, particularly during periods of economic instability. (Oluremi Ogun, 2020).

In the long run, NFA is typically modeled as a linear function of the trade balance, while short-run variations are influenced by factors such as net factor income from abroad, the exchange rate, and short-run changes in the trade balance (Ducanes et al., 2005).

Based on this theoretical framework, the NFA function in the applied macroeconomic model (EMM) is specified using the current account balance (which includes exports, imports, net factor income, and current transfers) and the lagged value of NFA (NFA_{t-1}), as these variables reflect the primary channels through which net foreign assets accumulate or decline.

Although alternative variables—such as the exchange rate and international reserves—were initially considered. However, their inclusion did not yield statistically significant results within the contemporaneous structural framework of the model. Consequently, the specification was limited to variables that directly capture the interaction between the external sector and NFA, ensuring both theoretical coherence and empirical reliability.

In all the behavioral equations, the inclusion of a lagged dependent variable as an explanatory variable is intended to capture the persistence or inertia in the behavior of the dependent variable. This approach also allows the model to reflect dynamic relationships, where the effects of independent variables may unfold over time rather than manifesting immediately.

3.2.5.2.4. Monetary Policy Identities:

$$NFA\_LC = NFA\_\$ * ER$$

Net Foreign Assets in local currency (NFA_LC) are calculated by multiplying Net Foreign Assets in US dollars (NFA_$) by the exchange rate (ER).

$$M2 = MR * CPI * 0.01$$

Broad money supply (M2) is calculated by multiplying the Demand for Real Broad Money Balances (MR) by the consumer price index (CPI), scaled by 0.01.

$$M0 = M2 - DTS - DD$$

The monetary base (M0) is calculated by subtracting both time and savings deposits (DTS) and demand deposits (DD) from the broad money supply (M2).

$$M1 = M2 - DTS$$

Narrow money (M1) is calculated by subtracting time and savings deposits (DTS) from broad money Supply (M2).

$$T\_D = DTS + DD$$

Total deposits (T_D) are the sum of time and savings deposits (DTS) and demand deposits (DD).

$$TDCRD = DCRDPR + DCRDG + DCRDH + DCRDPU$$

Total domestic credit (TDCRD) is composed of the aggregate credit allocated to the private sector (DCRDPR), the government sector (DCRDG), the household sector (DCRDH), and public sector (DCRDPU).

3.2.6. Fiscal Functions

Fiscal policy theory offers numerous guidelines to lead optimal budgetary policy; however, these principles are rarely adhered to in real-world scenarios. The constantly evolving legislative framework for fiscal expenditure and revenue reactions makes estimating equations that capture these dynamics particularly challenging. While unknown changes in regulations can bias parameter estimates, many such changes are endogenous, driven by shifts in fiscal conditions and economic performance (Burns et al., 2019). As a result, few macroeconomic models include detailed fiscal behavioral equations. For instance, the World Bank Macro-Fiscal Model highlights that analysts often choose to remove or re-specify these equations when exploring alternative rules or fiscal strategies. Exogenizing spending variables when studying planned expenditures or adjusting revenue functions to account for new tax rates or regulations is a common practice.

The fiscal component in macro-models is typically structured into three key areas: government expenditure, government revenue, and the relationship between fiscal balance and debt (Burns et al., 2019; Hasanov et al., 2020). Implicit tax rates, which distort the corresponding real or nominal variables, are used to simulate government revenues. On the expenditure side, government outlays include government consumption, investments, transfers, subsidies, other expenses, and interest payments, where the latter are endogenously determined. These interest payments depend on the level of debt and the risk premium. The government deficit, which adds up to the entire amount of government debt, is defined as the difference between total expenditure and total revenue (Jelić, O. N., & Ravnik, R., 2021).

Accordingly, our model incorporates **two fiscal behavioral equations**: one for interest payments and another for tax revenues. **Interest payments** are modeled by the overall amount of general government debt, global interest rates, and the lagged growth in interest payments. Meanwhile, **tax revenues** are modeled by their primary drivers: tax base and tax rate (Burns Benoit et al., 2019).

Additionally, the model incorporates a set of fiscal identities that determine the total general government balance, which in turn affects the current level of general governmental public debt (Jelić &

Ravnik, 2021) and the relationship between fiscal balance and debt (Burns et al., 2019; Hasanov et al., 2020). These identities begin by defining total government expenditure as the sum of five spending components, namely: government consumption; interest payments; subsidies and other transfers; net investment in non-financial assets; and other expenses. Government consumption is the sum of two components: compensation of employees and goods and services expenses. It then defines total government revenue as the sum of tax and non-tax revenues. Another identity contains the government's budget balance, which is the difference between the total revenue and the total expenditure. To account for inflation, the identities include the calculation of real government expenditures. They also contain the government debt, which is composed of both domestic general government debt and foreign debt after converting it to local currency. The prior debt stock is also adjusted by the current period fiscal balance, where a fiscal deficit adds to the debt and a surplus reduces it. This identity provides a comprehensive view of how a government's debt stock changes over time due to its fiscal performance.

3.2.7. Price and GDP Deflator equations

Understanding the behavior and underlying drivers of inflation is essential for building a robust macroeconomic model, particularly in countries like Egypt where domestic price dynamics are shaped by a complex interplay of internal structural constraints and external shocks. Over the past two decades, Egypt has experienced recurrent episodes of high and volatile inflation, driven by several factors: persistent monetary expansion, exchange rate misalignments, large-scale energy subsidy reforms, and vulnerability to global food and energy price shocks. These developments have heightened the need for accurate modeling of inflation, not only for analytical purposes but also to guide monetary and fiscal policy formulation.

The theoretical and empirical literature on price modeling covers a wide spectrum. On one end, there are **structural macro-econometric models**, which embed inflation equations within a larger, multi-equation framework that links the real, monetary, external, fiscal, and labor sectors of the economy. These models are particularly suited for policy simulations and medium-term forecasting, as they ensure internal consistency between various economic blocks. On the other end, there are **empirical inflation-focused studies**, which isolate the determinants of price movements using econometric techniques such as ARDL, VAR, or VECM. While less comprehensive in scope, these studies offer valuable insights into short- and medium-term inflation dynamics and the transmission mechanisms of shocks, such as those originating from exchange rates or commodity prices.

The Prices Block constitutes a core component of the macro-econometric model for the Egyptian economy, reflecting the importance of inflation dynamics in both economic analysis and policy formulation. Egypt's inflationary environment is shaped by a complex combination of structural rigidities and cyclical pressures—ranging from domestic monetary expansion, administered pricing schemes, and real demand fluctuations to exchange rate volatility and exposure to global commodity price shocks, particularly in energy and food

markets. Accurate modeling of these dynamics is essential for ensuring the robustness of macroeconomic forecasts, the validity of policy simulations, and the credibility of inflation-targeting frameworks.

Within this model, the Prices Block consists of two key behavioral equations representing the evolution of the **Consumer Price Index (CPI)** and the **GDP Deflator (GDPDEF)**, each capturing a distinct layer of domestic price formation. The CPI serves as the main nominal anchor for monetary policy, while the GDP deflator plays a critical role in deflating nominal aggregates throughout the national accounts framework.

Specification of Price Equations

4.2.7.1 Consumer Price Index (CPI)

The CPI equation is specified in a log-linear Autoregressive Distributed Lag (ARDL) framework, which allows for the simultaneous estimation of both short-run dynamics and long-run equilibrium relationships. The aggregate CPI is computed as a weighted average of twelve major consumption categories following CAPMAS classifications. This approach maintains coherence with household expenditure patterns and allows for potential disaggregation of inflation analysis to a more granular level. The weights used ensure representativeness in line with actual consumption behavior, which is essential for inflation targeting and social protection analysis.

The inclusion of lagged CPI terms captures inflation inertia and expectations-driven price setting, consistent with the expectations-augmented Phillips Curve. Contemporaneous and lagged values of the GDP deflator are introduced to reflect upstream cost-push pressures from producer prices. The specification implies a long-term cointegration relationship between consumer prices and producer costs, suggesting that CPI gradually aligns with changes in the GDP deflator. This theoretical construct is supported by empirical evidence from Elhamalawy et al. (2024), which emphasizes the persistence of inflation and the critical role of monetary transmission variables in explaining price behavior in Egypt.

$$LOG(CPI) = C + LOG(CPI(-1)) + LOG(CPI(-2)) + LOG(GDPDEF) + LOG(GDPDEF(-1))$$

3.2.7.1. GDP Deflator

The GDP deflator equation is modeled using an ARDL approach in first differences to accommodate non-stationarity in price levels. It incorporates both demand-side and cost-push drivers of inflation. The monetary base (M2) captures liquidity effects and the monetarist transmission of inflation, while real consumption and real investment represent demand-side influences stemming from domestic economic activity. Nominal wages and the domestic interest rate are included to reflect unit labor cost dynamics and monetary policy stance, respectively.

To account for external price pressures and imported inflation, the equation includes the real exchange rate (RER) and international prices of key commodities such as oil and wheat. The exchange rate reflects Egypt's exposure to the exchange rate pass-through - ERPT (Helmy et al. (2018), while global energy and food prices directly impact cost structures across key sectors. This structure is aligned with the imported inflation

hypothesis and verified by studies such as Abdelraouf et al. (2019) and Mohieldin et al. (2025). The latter highlights the asymmetric impact of exchange rate movements—where depreciations exert inflationary pressure, while appreciations offer limited relief—and points to the limited effectiveness of conventional policy tools like interest rates under high inflation. These findings underscore the need for fiscal prudence and exchange rate stability in managing inflation expectations.

DLOG(GDPDEF) = C + DLOG(GDPDEF(-1)) + DLOG(M2) + DLOG(M2(-1)) + DLOG(WHEATP) + DLOG(WHEATP(-1)) + DLOG(RC) + DLOG(RC(-1)) + LOG(RINV) + LOG(RER) + LOG(INT) + DLOG(W) + DLOG(W(-1)) + DLOG(OILP(-1))

Given the institutional context of Egypt's administered fuel pricing regime and gradual subsidy reforms, energy prices are modeled as exogenous. While this limits the short-term endogeneity of energy costs, it enables the simulation of policy scenarios involving subsidy rationalization or price liberalization. Sector-specific composite energy price indices are constructed based on the weighted consumption of fuel types in utilities, manufacturing, and transport, and are linked to the corresponding sectoral deflators to incorporate energy cost effects in the broader price system.

3.2.7.2. Accounting Identities and Linkages

The Prices Block is anchored by a set of fundamental accounting identities that ensure internal consistency and link real and nominal sectors. Nominal GDP at market prices (GDPMP) is defined as the product of real GDP and the GDP deflator, adjusted for indexing:

$$GDPMP=GDP\times GDPDEF\times 0.01$$

Real interest rates (RINT) are derived by adjusting nominal rates for inflation:

$$RINT = INT - \Delta \log(CPI) \times 100$$

and the real exchange rate (RER) captures the relative price of domestic goods to foreign goods:

$$RER = ER \times \frac{CPIUS}{CPI}$$

These identities provide a coherent framework linking domestic price dynamics with external conditions and monetary policy instruments. The Prices Block integrates theory-driven structures with empirically validated specifications tailored to the Egyptian context, embedding the main channels through which monetary aggregates, global prices, domestic costs, and institutional factors influence inflation. By incorporating lagged inflation, policy rates, and international variables, the block allows the model to consistently translate real sector activity into nominal outcomes and simulate the effects of fiscal expansions, exchange rate adjustments, and supply-side shocks. This integrated structure provides a robust analytical tool for policymakers to evaluate inflationary pressures and implement credible macroeconomic policies.

3.2.8. Labor Demand

Over time, economists have developed various models to explain the behavior of labor demand, from classical and neoclassical theories to more recent developments incorporating imperfect competition, search frictions, and technological change. According to the World Bank, equilibrium labor demand is determined by producer real wages adjusted for productivity growth. Estimating labor supply and labor demand functions has been extensively discussed in the literature. According to economic theory, the need for labor arises from the demand for the products and services that labor produces. The demand for labor is thus treated as a dependent variable influenced by key determinants such as wages, output, and productivity (Bashier and Wahban, 2013). Early studies on homogenous labor demand up to the 1980s mainly focused on how labor costs affect unemployment, assuming constant output elasticities (e.g., Lichter et al., 2012; Kirkpatrick, 1982; Symons and Layard, 1984).

Later studies estimated elasticities with varying output (Ashenfelter and Ehrenberg, 1975; Freeman, 1975), while the 1990s brought attention to labor heterogeneity divided into nationality (immigrants vs. citizens) and occupational categories (skilled vs. unskilled). The study of employment, unemployment, and their causes has produced a significant body of empirical work in Egypt (Assaad 2008; Assaad et al. 2000; Awad 2003; Nassar 2011; Radwan 2002; Ibrahim 2013; Hassan and Sassanpour 2008; Dessus and Suwa-Eisenmann 1999). These works primarily examine the supply side of the labor market using either macro-level time series or micro-level survey data. This study focuses on labor supply and demand using macroeconomic data on employment, wages, and GDP.

Determinants of Labor Demand

- In this model, we use lagged real wages and lagged real GDP as the main determinants of private labor demand. We focus our analysis on the labor demand for the private sector.
- **Wages and Productivity**: According to MFMOD (World Bank's macroeconomic and fiscal model), wages adjust to balance labor market supply and demand. In the long run, nominal wages reflect worker productivity, although in the short run wage adjustment is slower and affected by price changes and productivity shocks (Hasanov et al., 2020).
- **Neoclassical Framework**: The neoclassical theory posits that labor demand is derived from marginal productivity. A profit-maximizing firm hires labor until real wages equal the marginal product of labor. With diminishing returns to labor, the demand curve is downward sloping (Ehrenberg & Smith, 2017). Firms face both substitution (capital-labor trade-off) and scale (cost-induced output change) effects, especially in the short run when capital is fixed (Hamermesh, 1993).
- **Efficiency Wage Models**: These models suggest that firms may pay above-market wages to enhance productivity and reduce costs related to monitoring, turnover, and hiring. The Shapiro-Stiglitz model

(1984) argues that higher wages reduce shirking. Akerlof and Yellen (1986) suggest that higher wages improve worker quality and retention.

- **Wage Elasticity**: Numerous studies have shown a negative relationship between wages and employment. Hamermesh (1993) found that a 10% wage increase could reduce employment by 1-3% in developed countries. In developing countries like Indonesia, effects vary by firm size (Rama, 2001).
- **GDP**: Macroeconomic conditions, particularly business cycles, influence aggregate labor demand. Empirical studies show that labor demand is highly cyclical and sensitive to fluctuations in GDP. It has been shown by Blanchard and Katz (1992) that in the U.S., there are regional imbalances in employment due to the impacts of macroeconomic shifts, and that they persistently alter labor demand. Following up in the context of the 2008 financial crisis, Chodorow-Reich (2014) demonstrated how employment levels differed between credit-restricted firms with access to bank credit and those without access via bank lending exposure.

Modeling Labor Demand in Egypt This study utilizes the prior literature to build a model for labor demand within a broader simultaneous equations' framework for Egypt, drawing on macroeconomic data and a dynamic adjustment specification. Understanding the drivers of labor demand in Egypt is crucial for policymaking, particularly in designing interventions that balance employment growth with wage dynamics and productivity gains. The model presented here integrates theory and empirical evidence to explain private sector employment, serving as part of a larger macroeconomic framework.

Behavioral Equation for Private Employment (Empl_p)

$$DlogEmpl\_p = \beta_0 + \beta_1 DlogRGDP_t + \beta_2 Dlog\ RW_t + \beta_3 DlogRW_{t-1} + \beta_4 DlogEmpl_{p(t-1)} + \beta_5 D20$$

Model Identities

$$EMPL = MPLp + EMPLg + EMPLother$$
$$LF = Employed - Unemployed\ \ still$$
$$LF = PARTR/100 * (POP - POP014)$$
$$U = LF - Empl$$
$$UR = U / LF * 100$$
$$RW = Wages/CPI$$

3.3. Identities

EMM comprises 27 identities, as shown in Table 3, all expressed in Egyptian Pounds, unless otherwise mentioned. Equation I-1 defines GDP at market price as consumption plus investment plus exports minus imports, all in real terms. GDP at market price is approximately, but not exactly, nominal disposable income. Equation I-2 defines real net indirect taxes as the real GDP at market prices minus the real GDP at factor cost

(production). Equation I-3 defines total consumption as the sum of private and government consumption. Equation I-4 defines real investment as the sum of real investment of the private, public, and government sectors and the change in inventory.

Table 3 EMM's Identities

#	Type of identity	LHS Variable	RHS Variables
1	Real sector Identities	GDPMP	GDP * GDPDEF * 0.01
2		KSTOCK	KSTOCK(-1) * 0.95 + RINV
3		RGDP	RC + RINV + REX - RIM
4		RC	RCP + RCG
5		RINV	RINVP + RINVPB + INVENT
6	External block Identities	RTB	REX - RIM
7		TB$	(REX * PEX - RIM * PIM) / ER
8		BCA_$	TB$ + NFINC_$
9		BOVR_$	BCA_$ + BCAP_$ + EO_$
10		NIR_$	NIR_$(-1) + BOVR_$
11	Monetary Aggregates Identities	NFA_LC	NFA_$ * ER
12		M2	MR * CPI * 0.01
13		M0	M2 - DTS - DD
14		M1	M2 - DTS
15		T_D	DTS + DD
16		TDCRD	DCRDPR + DCRDG + DCRDH + DCRPU
17	Fiscal block Identities	OFB	REVG - EXPENDG
18		REVG	TAXR + NTAXR
19		EXPENDG	CG + INVG + SUB + INTPG + OTHG
20		REXPENDG	(EXPENDG / CPI) * 100
		DEBTG	DEBTG(-1) -OFB
21			
22	Labor block Identities	EMP	EMPLP + EMPO
23		UN	LF - EMP

24		UR	UN/LF *100
25	Price block Identities	RINT	INT - DLOG(CPI) * 100
26		RER	ER * CPI_US / CPI

For the estimated results of all behavioral equations, we conducted all the relevant statistical tests to ensure their statistical fit, and many of these tests are shown in the Annex. However, the discussion of the results of each equation, and the assessment of their strengths and weaknesses, will be presented in an upcoming analytical report that will also focus on checking consistency with economic theory and consistency with economic reality.

The following figure provides a transparent representation of how behavioral equations in the real, fiscal, monetary, external, labor, and price blocks are linked through identities to form a closed and internally consistent macroeconomic system. While behavioral equations govern economic dynamics, identities ensure consistency and sectoral balance across the model.

Figure 1 Model Flowchart

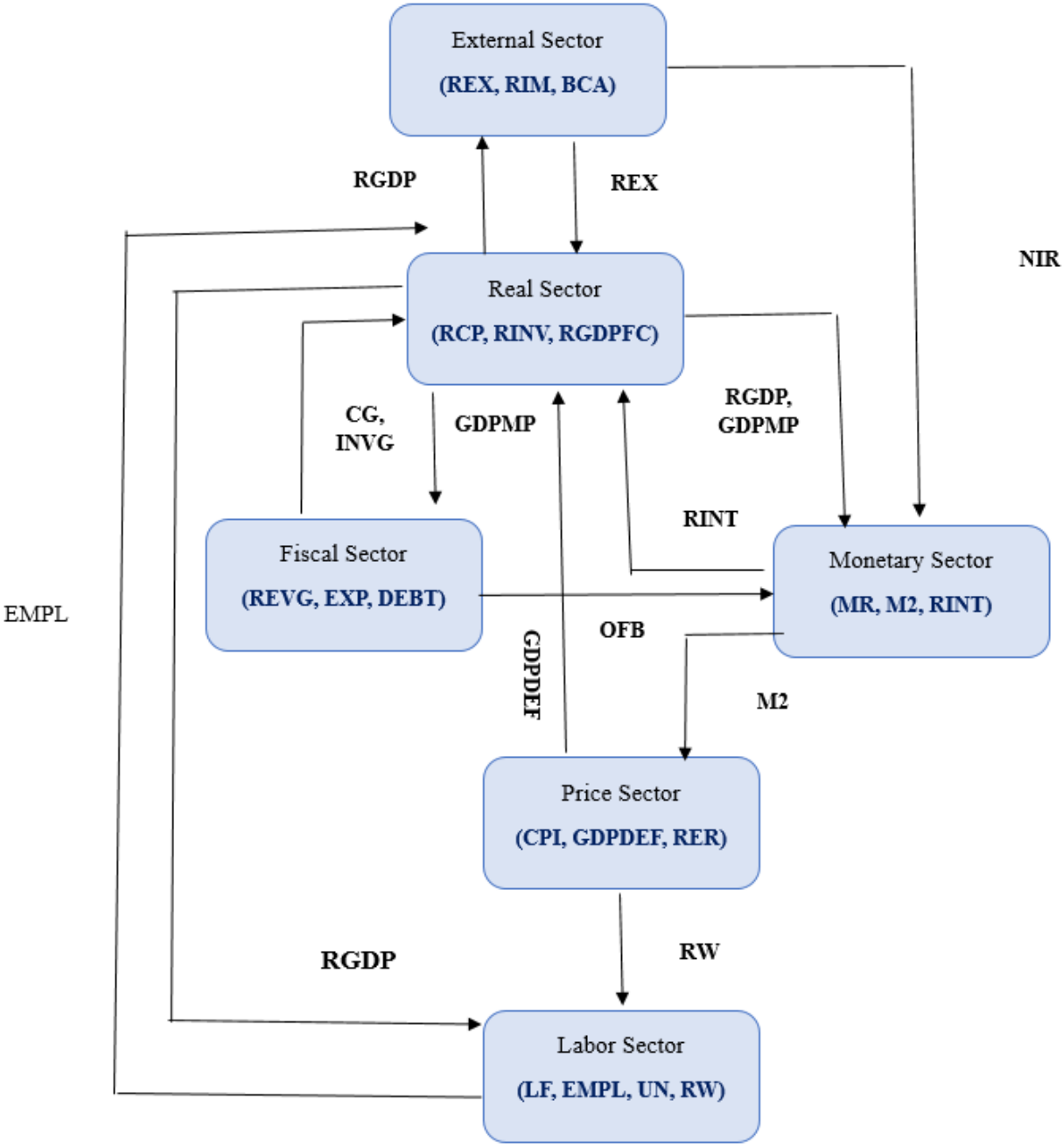
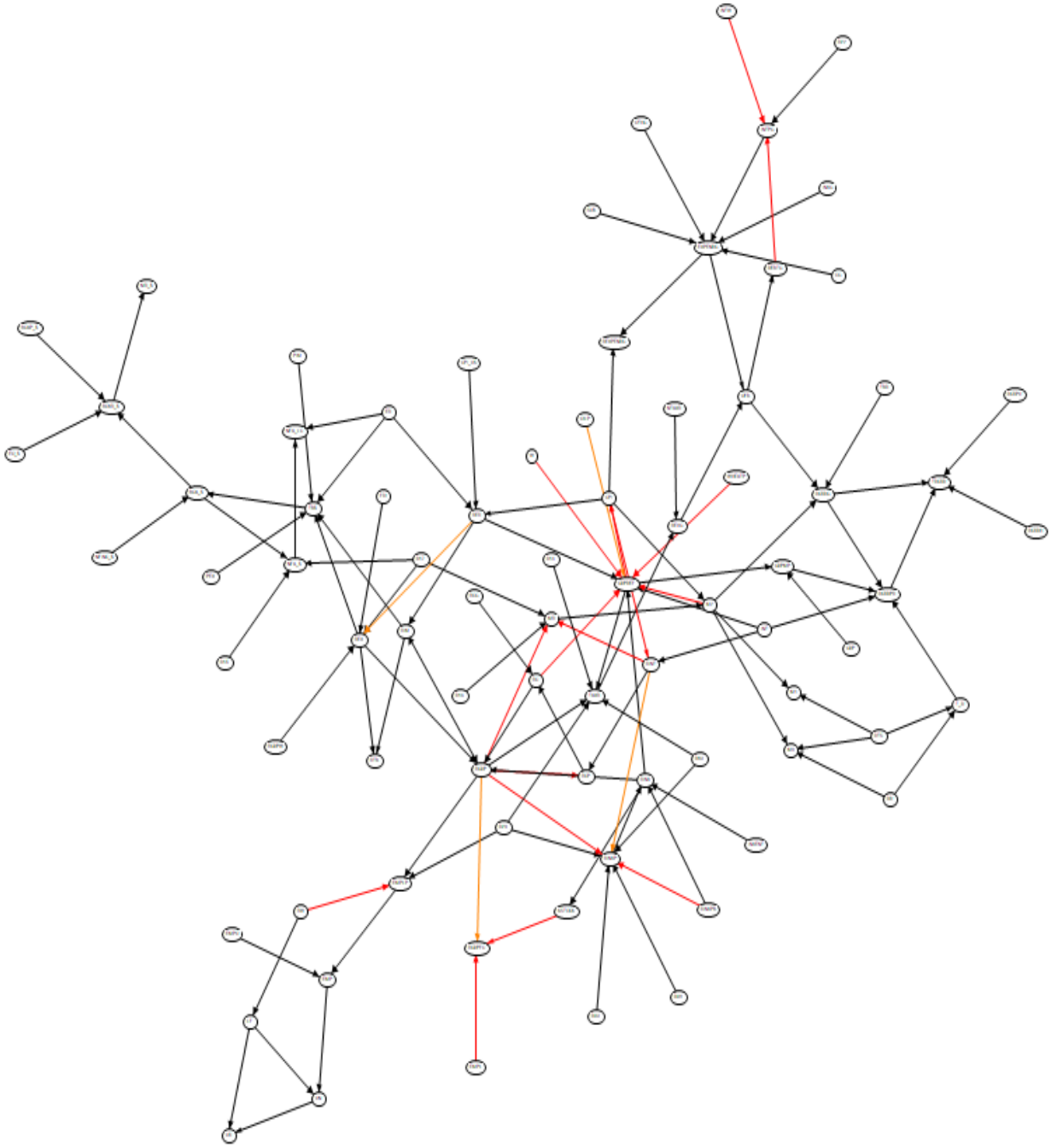


Figure 2 Dependency Graph



4. Model Solution

In this step the dynamic model is solved in a deterministic type of simulation, simultaneously with the identities (Estimation results is in Table A6 in the Annex):

DLOG(RCP) = 0.022 + 0.141*DLOG(RGDP) + 0.329*DLOG(RCP(- 1)) - 0.00003*RINT

DLOG(RINVP) = -0.186 + 5.96*DLOG(RGDP) - 0.111*DLOG(RINVPB/RGDP) - 0.257*DLOG(RINVP(- 2)) + 0.009*D(RINT(- 1)) - 0.624*D98 - 0.4758*D20 - 0.345*D09 + 0.375*D99

LOG(REX) = -11.122 + 0.581*LOG(RGDPW) + 0.064*LOG(FDI) + 0.547*LOG(RER(- 1)) + 0.636*LOG(REX(- 1)) + 0.432*D17

LOG(RIM) = 0.806*LOG(RIM(- 1)) + 0.472*LOG(RER) + 0.290*LOG(RGDP) - 4.00

LOG(RGDPFC) = 1.146*LOG(RGDP(- 1)) + 0.198*LOG(KSTOCK) - 0.41*LOG(KSTOCK(- 1)) + 0.0149*LOG(EMPL) + 0.470*LOG(EMPL(- 1)) - 0.30*LOG(EMPL(- 2)) - 1.06

LOG(EMPLP) = 0.2048*LOG(EMPLP(- 1)) + 0.584*LOG(RGDP) + 0.0171*LOG(RW) + 0.0129*LOG(RW(- 1)) - 0.023*D20 - 4.182

DLOG(INTPG) = 0.082 - 0.419*D22 + 0.242*DLOG(DEBTG) + 0.319*DLOG(INTPG(- 1)) + 0.060*DLOG(INTW)

DCRDG = -35533.20 - 0.000001*OFB + 0.000001*M2 - 12947.7*TBR + 0.08*DCRDG(- 1)

DCRDPR = -12748.34 - 0.069*GDPMP + 7328.058*INT + 0.01026*DCRDG + 0.0000003*T_D + 0.382*DCRDPR(- 2)

DLOG(GDPDEF) = 0.0017*DLOG(GDPDEF(- 1)) - 0.287*DLOG(M2) + 0.331*DLOG(M2(- 1)) - 0.02289*DLOG(WHEATP) + 0.0288*DLOG(WHEATP(- 1)) + 0.4311*DLOG(RC) + 0.15047*DLOG(RC(- 1)) + 0.0927*LOG(RINV) + 0.0569*LOG(RER) + 0.1526*LOG(INT) + 0. 0000141*DLOG(W) + 0.014*DLOG(W(- 1)) - 0.002*DLOG(OILP(- 1)) - 2.97

NFA_$ = 120+ 561*D15 + 43286205307.9*D17 + 0.93*BCA_$ + 1.003*NFA_$(- 1)

LOG(LF) = 14.90 + 0.017*@TREND + 0.133*LOG(RW)

DLOG(MR) = 0.045 - 0.26*D17 - 0.48*DLOG(RGDP) + 0.0019*D(RINT) + 0.49*DLOG(MR(- 1)) + 0.08*D16

TAXR = 20289900139.6 + 0.109*RGDP*GDPDEF*0.01 - 44624207904.54*D20 + 19782833620.58*D09 + 70431550718.05*D14

LOG(CPI) = 0.628*LOG(CPI(- 1)) + 0.02*LOG(CPI(- 2)) + 0.84*LOG(GDPDEF) - 0.5189*LOG(GDPDEF(- 1)) + 0.557

INSTRUMENTS

INST C LOG(M2(-1)) LOG(rcp(-1)) LOG(RGDP(-1)) LOG(RCP(-2)) LOG(INVPB_GDP(-1)) LOG(RINVP(-1)) LOG(RINVP(-2)) LOG(RGDPFC(-1)) LOG(rinv(-1)) log(empl(-1)) LOG(INTPG(-1)) LOG(DEBTG(-1)) D(T_D) LOG(TBR) LOG(TBR(-1)) D(DCRDG(-1)) LOG(DCRDPR(-2)) LOG(DCRDPR(-3)) D(EX_$) D(IM_$) D(ER) D(NFA_$(-2)) LOG(M2D(-1)) LOG(M2/CPI(-2)) LOG(RGDPW) FDI LOG(REX(-1)) LOG(RIM(-1)) LOG(NIR_$)

IDENTITIES

GDPMP = GDP * GDPDEF * 0.01

KSTOCK = KSTOCK(-1) * 0.95 + RINV

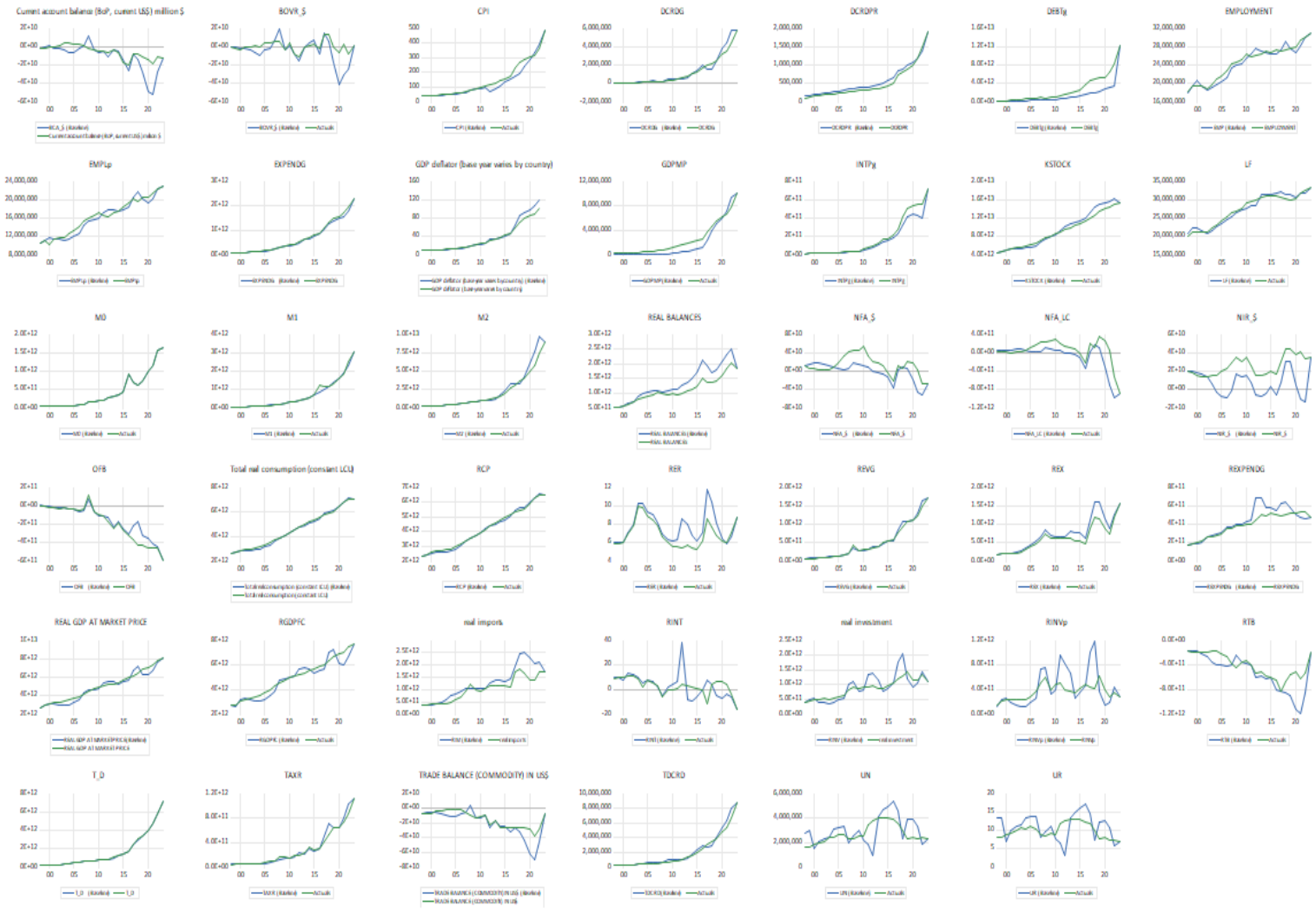
RGDP = RC + RINV + REX - RIM

```
RC  = RCP  + RCG

RTB  = REX  - RIM

RINV  = RINVP  + RINVPB  + INVENT

EMP  = EMPLP  + EMPO

@IDENTITY UN  = LF  - EMP

UR  = UN  / LF  * 100

OFB  = REVG  - EXPENDG

REVG  = TAXR  + NTAXR

EXPENDG  = CG  + INVG  + SUB  + INTPG  + OTHG

RINT  = INT  - DLOG(CPI)  * 100

RER  = ER  * CPI_US  / CPI

TB$  = (REX  * PEX  - RIM  * PIM)  / ER

BCA_$  = TB$  + NFINC_$

BOVR_$  = BCA_$  + BCAP_$  + EO_$

@IDENTITY NIR_$  = NIR_$(-1)  + BOVR_$

NFA_LC  = NFA_$  * ER

M2  = MR  * CPI  * 0.01

M0  = M2  - DTS  - DD

M1  = M2  - DTS

T_D  = DTS  + DD

REXPENDG  = (EXPENDG  / CPI)  * 100

TDCRD  = DCRDPR  + DCRDG  + DCRDH  + DCRPU

DEBTG  = DEBTG(-1)  - OFB
```

5. Overall Fit of the Model

5.1. Root Mean Squared Errors

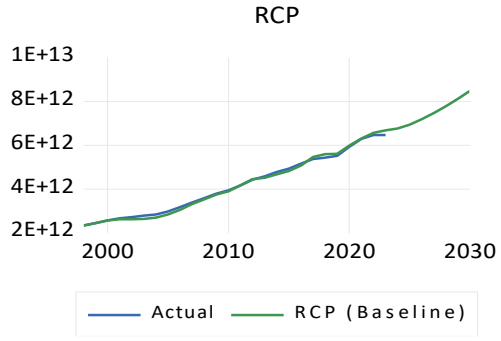
In this section, we examine and discuss the ex-post (within-sample) forecasts. The forecast errors were evaluated using RMSE and RMSPE tests.

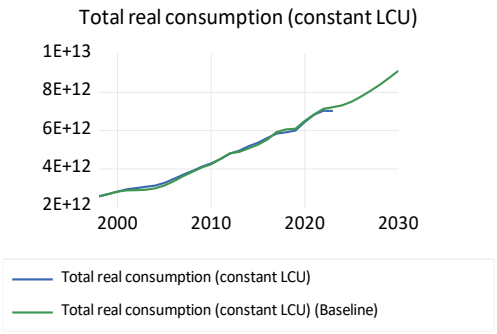


6. Ex-ante Forecast (2024-2030)

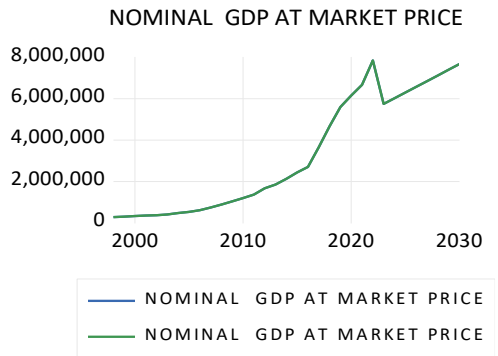
We run the model for an in-sample forecast to approximate the historical time path of the endogenous variables; the pattern of the series is identified to determine whether it exhibits a linear trend, or exponential form, or a volatile pattern. We then forecast the path of exogenous variables until 2030. The baseline forecast relies mainly on projections of exogenous variables using trends and autoregressive processes. Afterwards, we ran the whole model from 1998 until 2030, so that the model calculates the forecasted path of the endogenous variables within the model. Efforts to reduce the deviations between the actuals and the baseline were conducted according to the best-used methodologies. Hence, the models solution over 2024-2030 was also adjusted using a convergence (con) adjustment method to align the baseline with historical trends.

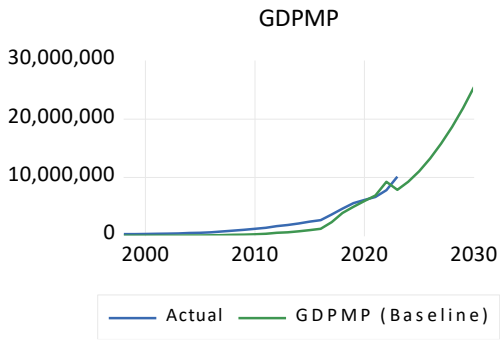
1- Consumption

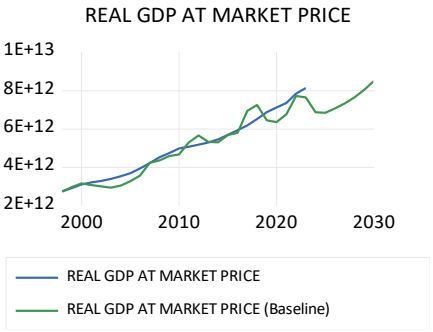


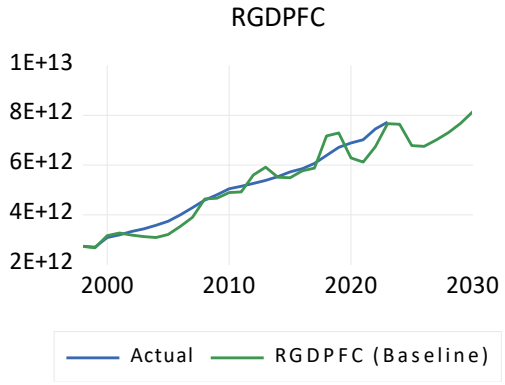


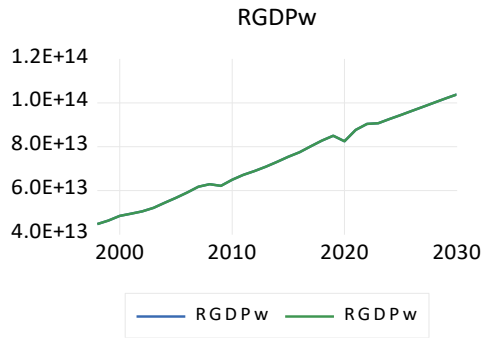
2- GDP



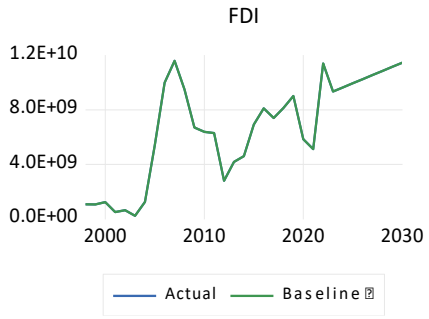


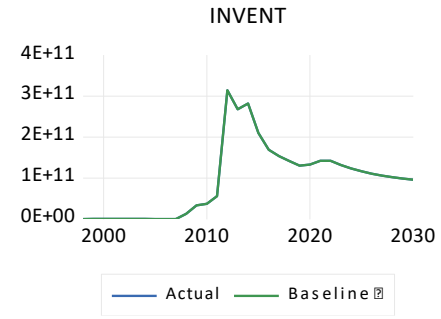


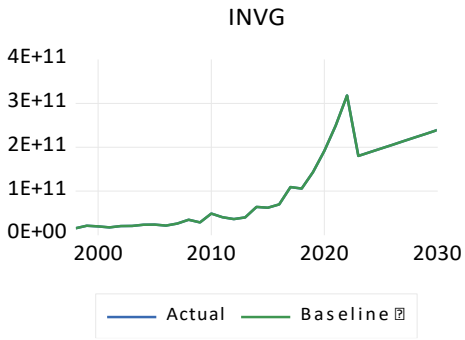


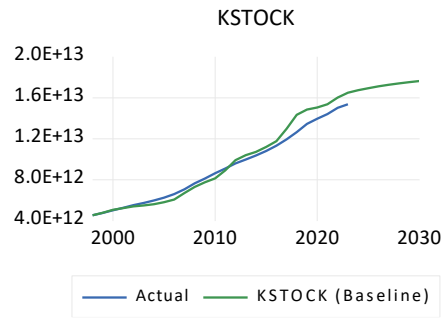


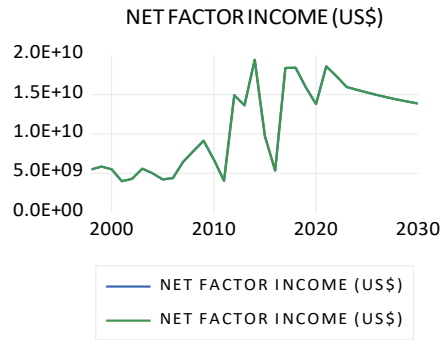
3- Investment

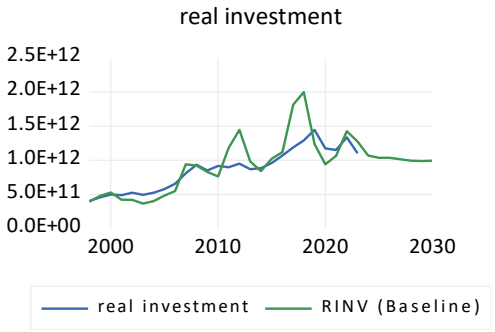


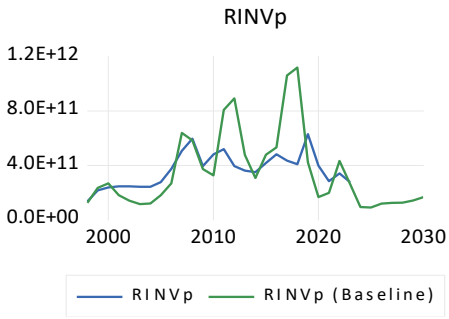


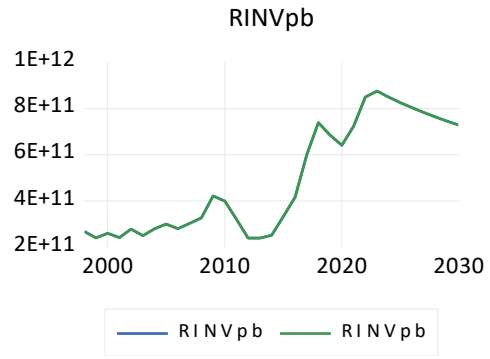




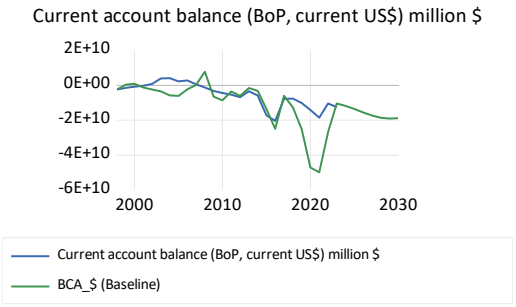

NET FACTOR INCOME (US$)
2.0E+10
1.5E+10
1.0E+10
5.0E+09
0.0E+00
2000
2010
2020
2030
NET FACTOR INCOME (US$)
NET FACTOR INCOME (US$)

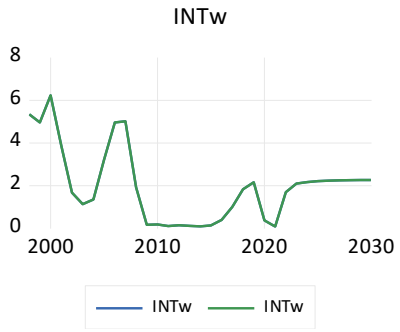

real investment
2.5E+12
2.0E+12
1.5E+12
1.0E+12
5.0E+11
0.0E+00
2000
2010
2020
2030
real investment
RINV (Baseline)

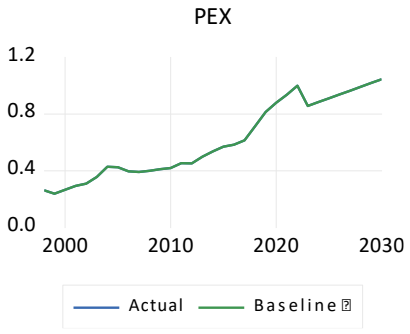

RINVp
1.2E+12
8.0E+11
4.0E+11
0.0E+00
2000
2010
2020
2030
RINVp
RINVp (Baseline)

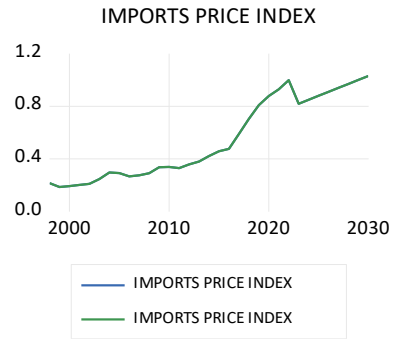

RINVpb
1E+12
8E+11
6E+11
4E+11
2E+11
2000
2010
2020
2030
RINVpb
RINVpb

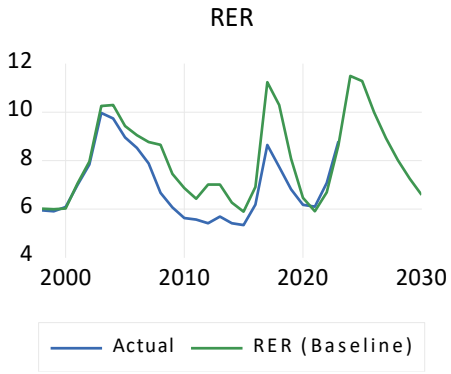
4- Trade

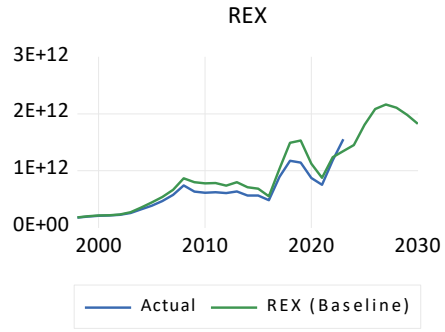

Current account balance (BoP, current US$) million $
2E+10
0E+00
-2E+10
-4E+10
-6E+10
2000
2010
2020
2030
Current account balance (BoP, current US$) million $
BCA_$ (Baseline)

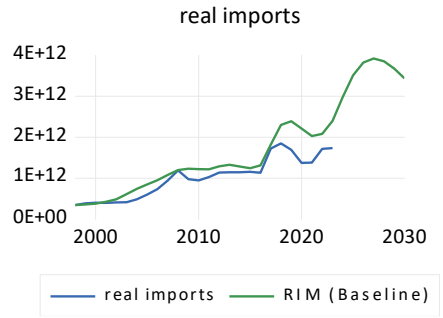

INTw
8
6
4
2
0
2000
2010
2020
2030
INTw
INTw

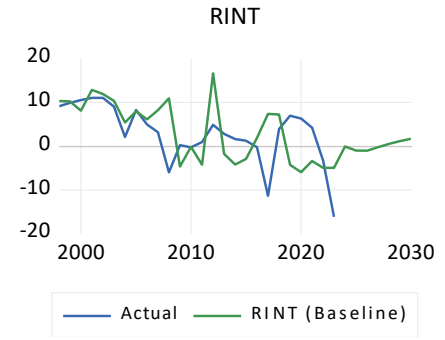

PEX
1.2
0.8
0.4
0.0
2000
2010
2020
2030
Actual
Baseline

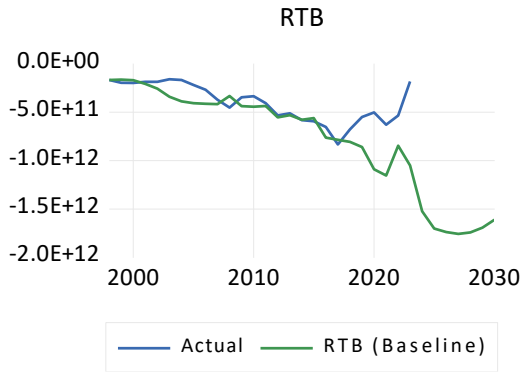

IMPORTS PRICE INDEX
1.2
0.8
0.4
0.0
2000
2010
2020
2030
IMPORTS PRICE INDEX
IMPORTS PRICE INDEX

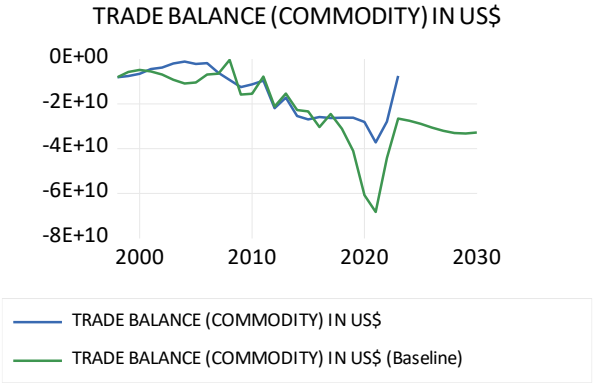




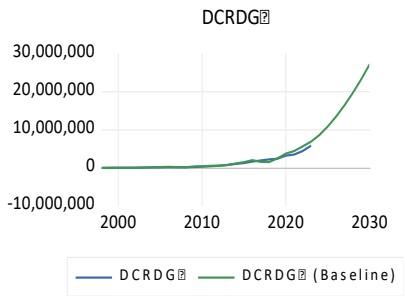


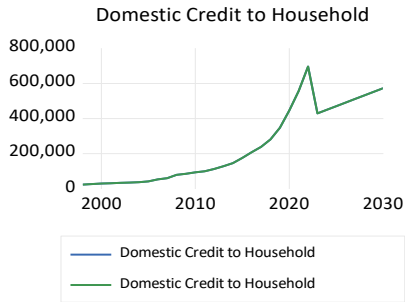


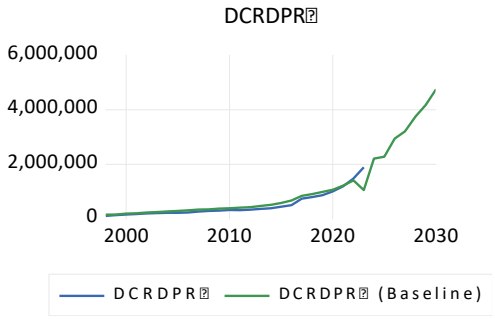


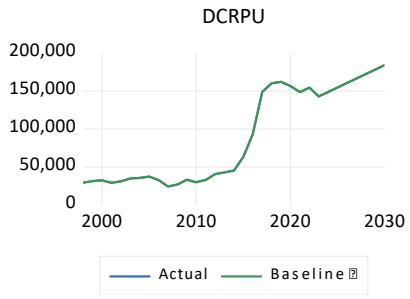


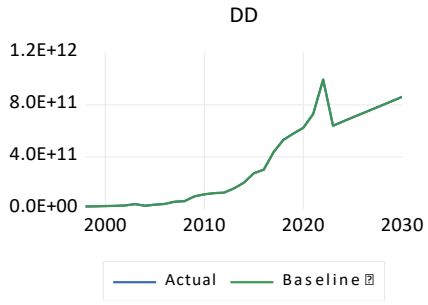
5- Monetary Policy

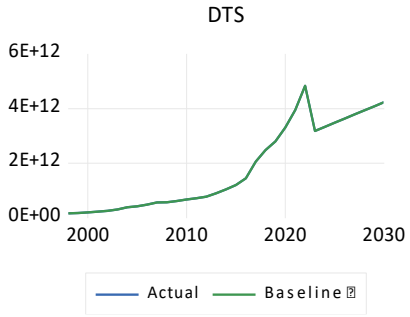


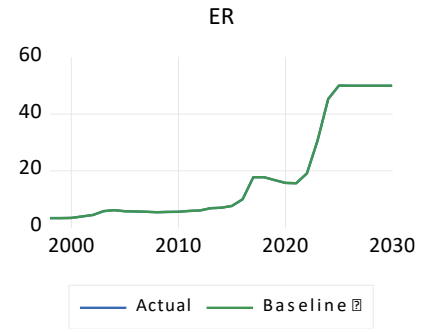


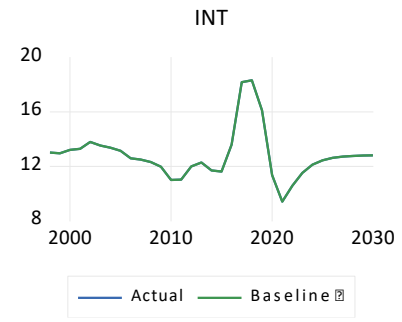

DCRDPR
6,000,000
4,000,000
2,000,000
0
2000
2010
2020
2030
DCRDPR
DCRDPR (Baseline)

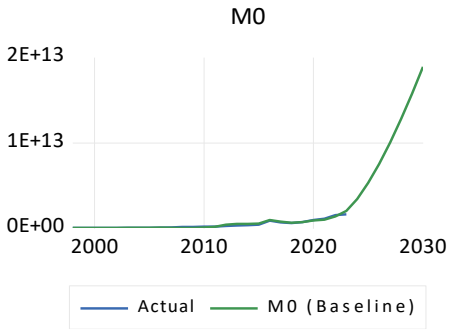

DCRPU
200,000
150,000
100,000
50,000
0
2000
2010
2020
2030
Actual
Baseline

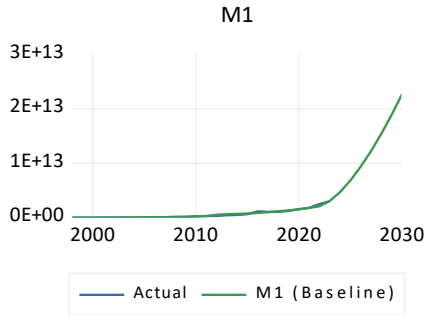

DD
1.2E+12
8.0E+11
4.0E+11
0.0E+00
2000
2010
2020
2030
Actual
Baseline

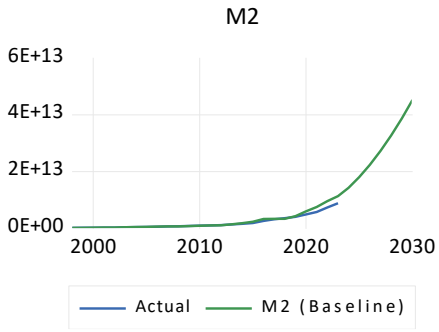

DTS
6E+12
4E+12
2E+12
0E+00
2000
2010
2020
2030
Actual
Baseline

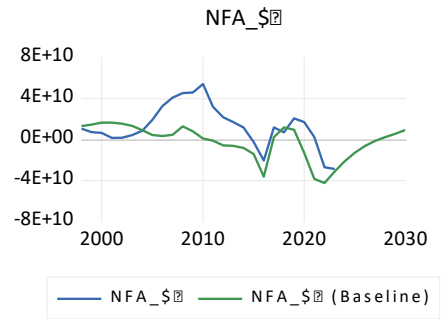

ER
60
40
20
0
2000
2010
2020
2030
Actual
Baseline

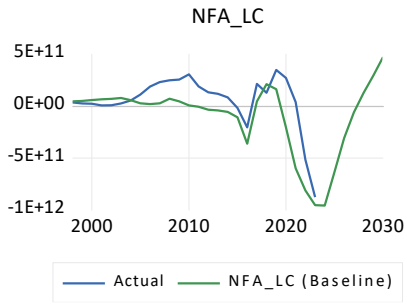

INT
20
16
12
8
2000
2010
2020
2030
Actual
Baseline

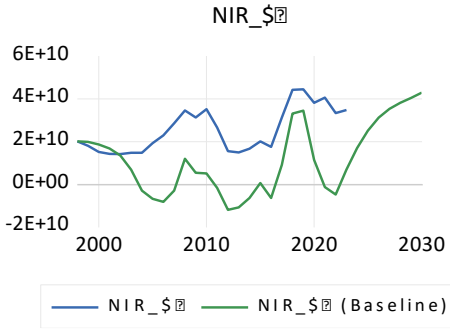

M0
2E+13
1E+13
0E+00
2000
2010
2020
2030
Actual
M0 (Baseline)

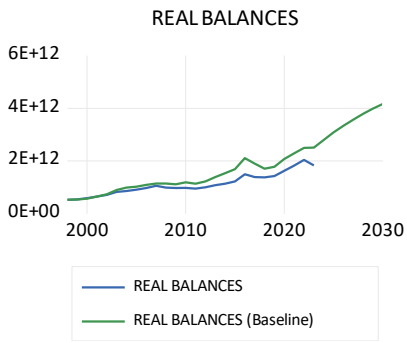

M1
3E+13
2E+13
1E+13
0E+00
2000
2010
2020
2030
Actual
M1 (Baseline)

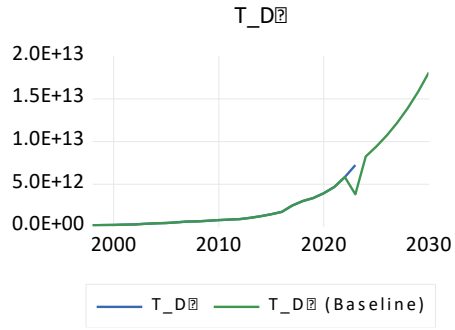

M2
6E+13
4E+13
2E+13
0E+00
2000
2010
2020
2030
Actual
M2 (Baseline)

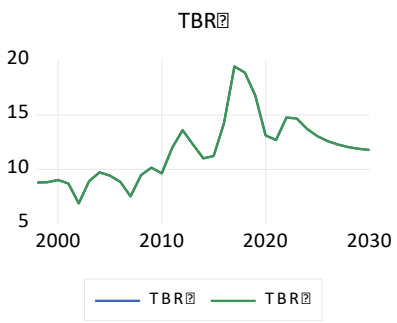

NFA_$
8E+10
4E+10
0E+00
-4E+10
-8E+10
2000
2010
2020
2030
NFA_$
NFA_$ (Baseline)

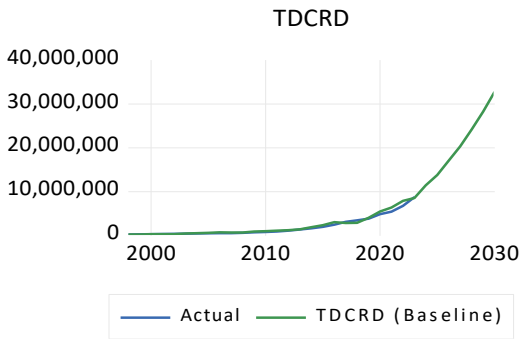

NFA_LC
5E+11
0E+00
-5E+11
-1E+12
2000
2010
2020
2030
Actual
NFA_LC (Baseline)


NIR_$
6E+10
4E+10
2E+10
0E+00
-2E+10
2000
2010
2020
2030
NIR_$
NIR_$ (Baseline)

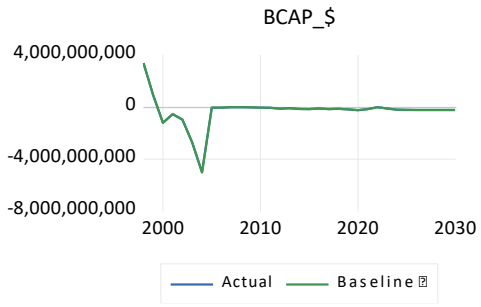

REAL BALANCES
6E+12
4E+12
2E+12
0E+00
2000
2010
2020
2030
REAL BALANCES
REAL BALANCES (Baseline)

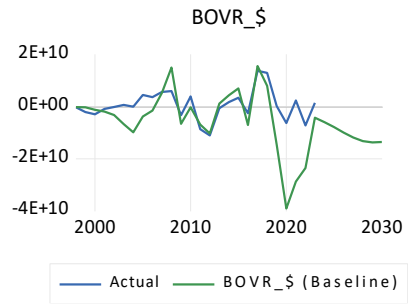

T_D
2.0E+13
1.5E+13
1.0E+13
5.0E+12
0.0E+00
2000
2010
2020
2030
T_D
T_D (Baseline)

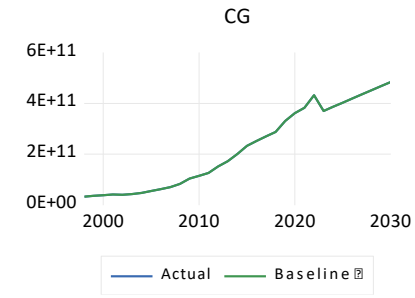

TBR
20
15
10
5
2000
2010
2020
2030
TBR
TBR

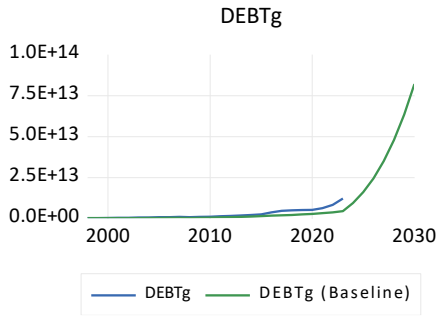

TDCRD
40,000,000
30,000,000
20,000,000
10,000,000
0
2000
2010
2020
2030
Actual
TDCRD (Baseline)

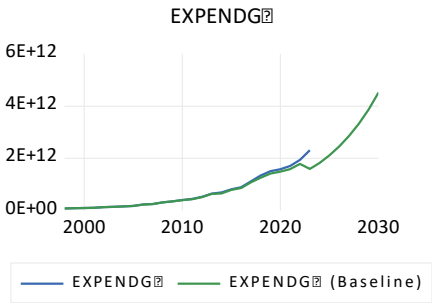
6- Fiscal

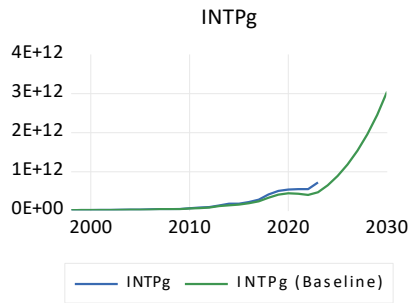

BCAP_$
4,000,000,000
0
-4,000,000,000
-8,000,000,000
2000
2010
2020
2030
Actual
Baseline

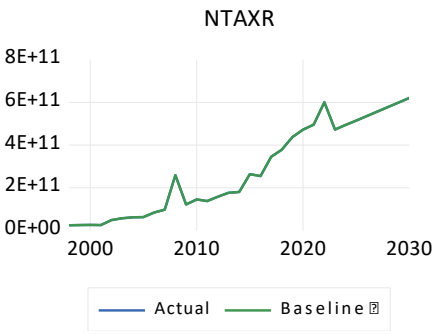

BOVR_$
2E+10
0E+00
-2E+10
-4E+10
2000
2010
2020
2030
Actual
BOVR_$ (Baseline)

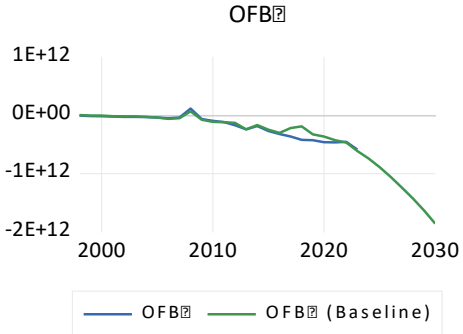

CG
6E+11
4E+11
2E+11
0E+00
2000
2010
2020
2030
Actual
Baseline

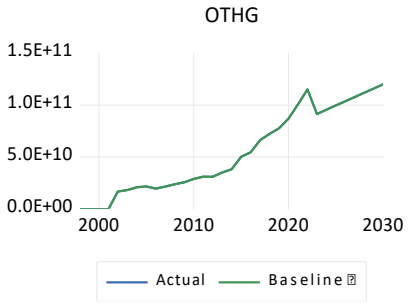

DEBTg
1.0E+14
7.5E+13
5.0E+13
2.5E+13
0.0E+00
2000
2010
2020
2030
DEBTg
DEBTg (Baseline)

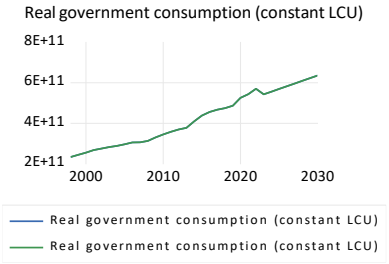

EXPENDG
6E+12
4E+12
2E+12
0E+00
2000
2010
2020
2030
EXPENDG
EXPENDG (Baseline)

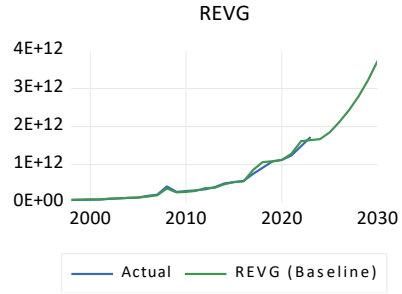

INTPg
4E+12
3E+12
2E+12
1E+12
0E+00
2000
2010
2020
2030
INTPg
INTPg (Baseline)

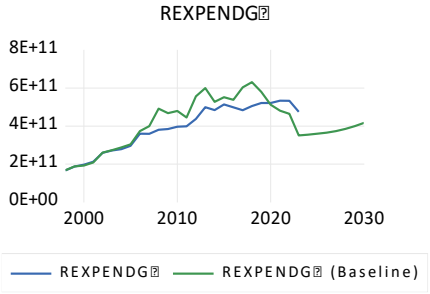

NTAXR
8E+11
6E+11
4E+11
2E+11
0E+00
2000
2010
2020
2030
Actual
Baseline

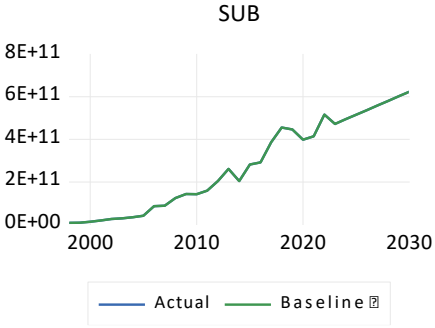

OFB
1E+12
0E+00
-1E+12
-2E+12
2000
2010
2020
2030
OFB
OFB (Baseline)

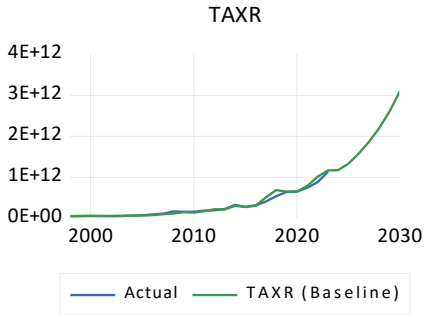

OTHG
1.5E+11
1.0E+11
5.0E+10
0.0E+00
2000
2010
2020
2030
Actual
Baseline

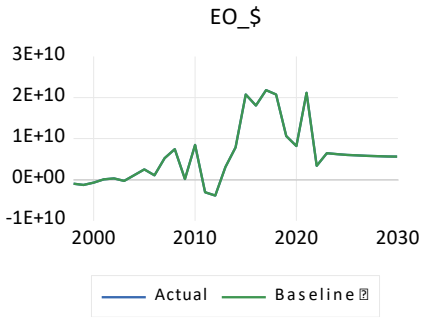

Real government consumption (constant LCU)
8E+11
6E+11
4E+11
2E+11
2000
2010
2020
2030
Real government consumption (constant LCU)
Real government consumption (constant LCU)


REVG
4E+12
3E+12
2E+12
1E+12
0E+00
2000
2010
2020
2030
Actual
REVG (Baseline)

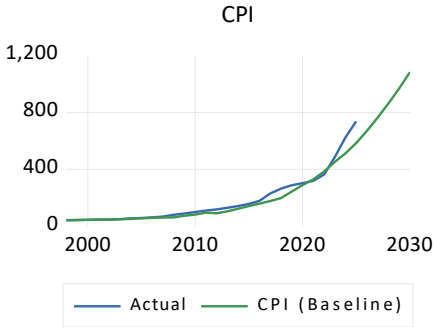

REXPENDG
8E+11
6E+11
4E+11
2E+11
0E+00
2000
2010
2020
2030
REXPENDG
REXPENDG (Baseline)

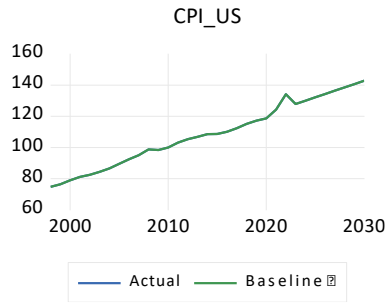

SUB
8E+11
6E+11
4E+11
2E+11
0E+00
2000
2010
2020
2030
Actual
Baseline

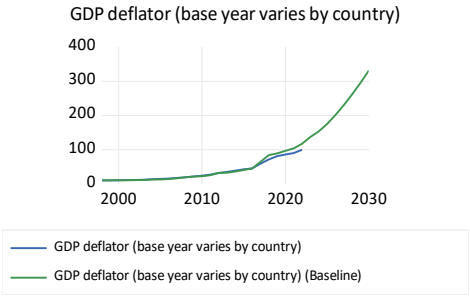

TAXR
4E+12
3E+12
2E+12
1E+12
0E+00
2000
2010
2020
2030
Actual
TAXR (Baseline)

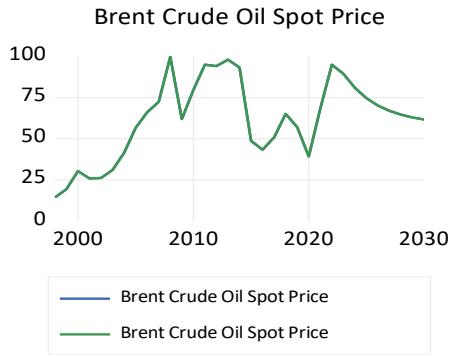

EO_$
3E+10
2E+10
1E+10
0E+00
-1E+10
2000
2010
2020
2030
Actual
Baseline

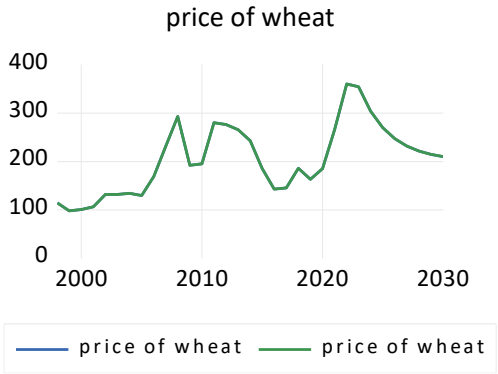
7- Prices


CPI
1,200
800
400
0
2000
2010
2020
2030
Actual
CPI (Baseline)

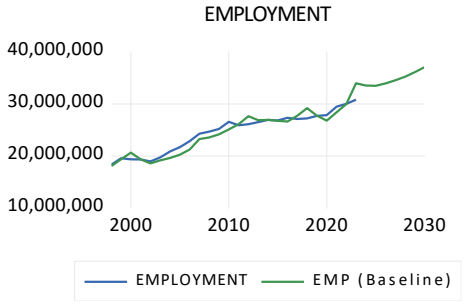

CPI_US
160
140
120
100
80
60
2000
2010
2020
2030
Actual
Baseline

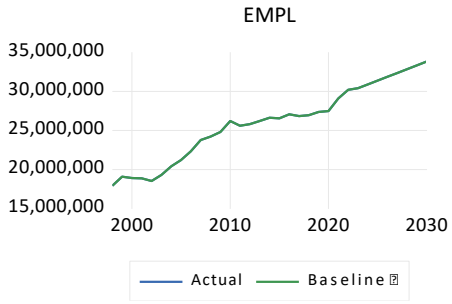

GDP deflator (base year varies by country)
400
300
200
100
0
2000
2010
2020
2030
GDP deflator (base year varies by country)
GDP deflator (base year varies by country) (Baseline)

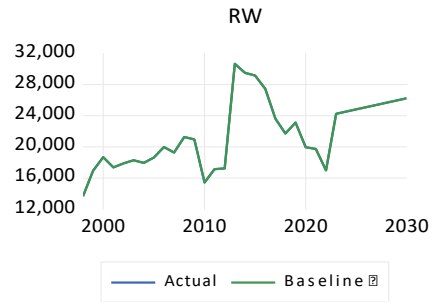

Brent Crude Oil Spot Price
100
75
50
25
0
2000
2010
2020
2030
Brent Crude Oil Spot Price
Brent Crude Oil Spot Price

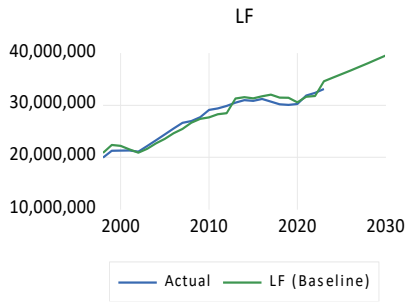

price of wheat
400
300
200
100
0
2000
2010
2020
2030
price of wheat
price of wheat

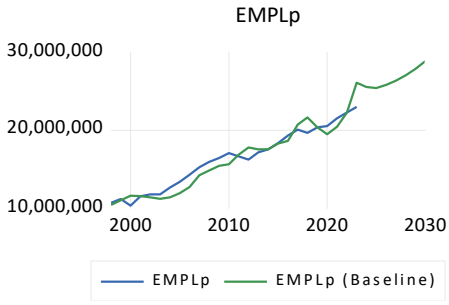
8- Labor

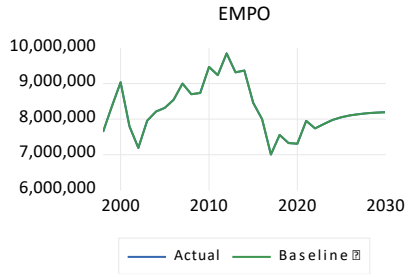

EMPLOYMENT
40,000,000
30,000,000
20,000,000
10,000,000
2000
2010
2020
2030
EMPLOYMENT
EMP (Baseline)

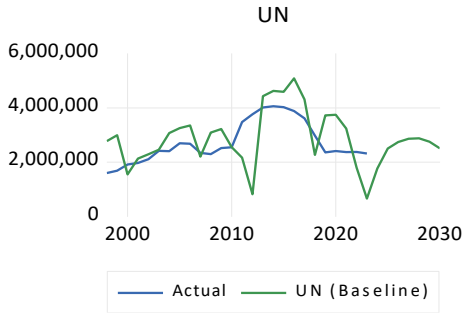

EMPL
35,000,000
30,000,000
25,000,000
20,000,000
15,000,000
2000
2010
2020
2030
Actual
Baseline

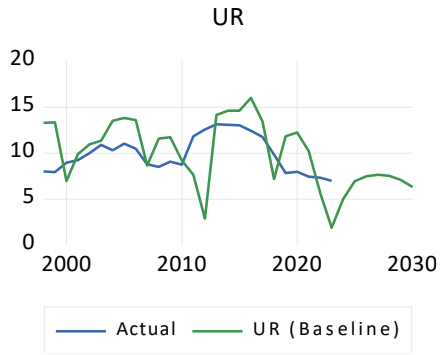

RW
32,000
28,000
24,000
20,000
16,000
12,000
2000
2010
2020
2030
Actual
Baseline


LF
40,000,000
30,000,000
20,000,000
10,000,000
2000
2010
2020
2030
Actual
LF (Baseline)


EMPLp
30,000,000
20,000,000
10,000,000
2000
2010
2020
2030
EMPLp
EMPLp (Baseline)

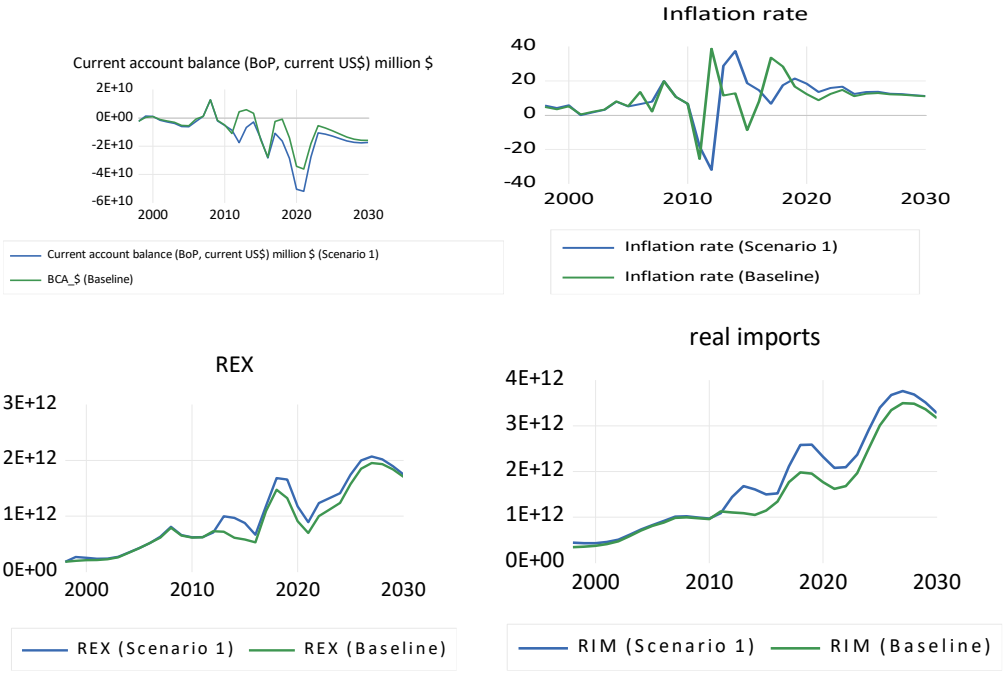

EMPO
10,000,000
9,000,000
8,000,000
7,000,000
6,000,000
2000
2010
2020
2030
Actual
Baseline


UN
6,000,000
4,000,000
2,000,000
0
2000
2010
2020
2030
Actual
UN (Baseline)


UR
20
15
10
5
0
2000
2010
2020
2030
Actual
UR (Baseline)

7. Policy Simulation

We introduced a policy simulation in the model, by changing the nominal exchange rate, to see its repercussions on the whole economy as well as on selected endogenous economic variables, also during the period 1998-2030 as follows:



In an upcoming analytical report, we will investigate how policy evaluation is conducted using dynamic multipliers and dynamic elasticities, as well as the difference between temporary and permanent shocks.

Conclusion

This report has documented the specification, estimation, and application of the macro-econometric model developed for macroeconomic analysis, forecasting, and simulation exercises. The model combines theoretically grounded behavioral equations with empirically estimated relationships, ensuring internal consistency across sectors and coherence between short-run dynamics and long-run equilibrium. The model's structure allows for the systematic analysis of policy transmission channels and shock propagation mechanisms.

However, several limitations should be acknowledged. The model relies on historical data and stable behavioral relationships, which may be challenged by structural breaks or non-linear responses during periods of exceptional economic shocks. Data revisions, and identification constraints may also affect the robustness of simulation results. As a result, outcomes should be interpreted within confidence intervals and assessed alongside sensitivity analyses and alternative model-based approaches.

This modeling framework provides a robust and flexible tool for quantitative economic analysis and constitutes a solid basis for further methodological development and applied research.

Overall, the macro-econometric model provides a sound analytical basis for informing policy discussions, supporting scenario analysis, and strengthening evidence-based decision-making, while acknowledging the uncertainty inherent in macroeconomic projections.

Future work will focus on strengthening the model's empirical and analytical performance. Key priorities include regular re-estimation to incorporate new data and enhanced treatment of structural breaks and non-linear dynamics. Extensions to improve sectoral detail longer time-series data might be further explored. Continued collaboration with partner institutions will support methodological innovation, data improvements, and ongoing validation, ensuring that the model remains a robust and relevant tool for applied macroeconomic research.

References

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Annex

Table A1

Attendance List - Workshop
"Egypt Macro-econometric Model"

Wednesday, 18 September 2024

No.	Name	Position / Affiliation
1	Prof. Ibrahim El-Eissawy	Professor at Macroeconomic Policies Center
2	Prof. Gouda Abdel-Khaleq	Professor of Economics, Faculty of Economics and Political Science, Cairo University
3	Prof. Soheir Abu El-Ainen	Professor at Macroeconomic Policies Center
4	Prof. Mahmoud Abu-ElOyoun	Former Governor, Central Bank of Egypt
5	Prof. Ahmed Kamaly	Professor of Economics, The American University in Cairo
6	Prof. Alaa El-Shazly	Professor of Economics, Faculty of Economics and Political Science, Cairo University
7	Prof. Hala Abu- Ali	Head of Economics Department, Faculty of Economics and Political Science, Cairo University
8	Dr. Ibrahim Badawi	Executive Director, Economic Research Forum
9	Dr. Nihal El-Megharbel	Member of the Egyptian Senate

11	Dr. Menshawy Badr	Assistant Professor of Economics, Sadat Academy for Management Sciences
12	Dr. Amr Ragab	Assistant Professor of Economics, School of Business Administration, Nile University
14	Dr. Mamdouh Abdel Mawla	Assistant Professor of Economics, Faculty of Economics, Menoufia University
15	Dr. Mai Mosallamy	–Central Bank of Egypt
16	Dr. Noha Sami	Associate Professor of Economics, Faculty of Economics and Political Science, Cairo University
17	Prof. Walid Abd-Mawlah	Deputy Director General, Arab Planning Institute - Kuwait
18	Prof. Belckasem El-Abbas	Chief Advisor, Arab Planning Institute - Kuwait
19	Dr. Moez El-Obaidi	Technical Office Advisor - Arab Planning Institute - Kuwait
20	Dr. Nawaf Abo-Shamala	Technical Office Advisor - Arab Planning Institute - Kuwait

Table A2

List of Experts

Validation Results Workshop

Tuesday, 14 October 2025

Prof. Gouda Abdel-Khaleq	Professor of Economics- Faculty of Economics and Political Science - Cairo University
Prof. Ibrahim El-Eissawy	Professor at Macroeconomic Policies Center
Prof. Ahmed Kamaly	Professor of Economics - American University in Cairo
Prof. Hala Abu-Ali	Head of Economics Department - Faculty of Economics and Political Science - Cairo University
Prof. Mahmoud Abu-ElOyoun	Former Governor of the Central Bank of Egypt
Dr. Noha Sami	Associate Professor of Economics - Faculty of Economics and Political Science - Cairo University
Dr. Menshawy Badr	Assistant Professor of Economics - Sadat Academy for Management Sciences (SAMS)
Prof. Walid Abd-Mawlah	Deputy Director General, Arab Planning Institute - Kuwait
Prof. Belckasem El-Abbas	Chief Advisor, Arab Planning Institute - Kuwait
Dr. Moez El-Obaidi	Technical Office Advisor - Arab Planning Institute - Kuwait
Dr. Nawaf Abo-Shamala	Technical Office Advisor - Arab Planning Institute - Kuwait
Dr. Amr Ragab	Assistant Professor of Economics, School of Business Administration, Nile University
Mr. Alaa Abdel-Rahman	Ministry of Finance

Ms. Nadine Abdel-Raouf	Ministry of Planning
Dr. Ahmed Ashour	Ministry of Planning

Table A3: Unit Root Test Results (Augmented Dickey-Fuller (ADF))

	With Constant & Trend			Without Constant & Trend				With Constant & Trend			Without Constant & Trend			Integration Conclusion	t-Statistic at second difference	Prob. At second difference
Variables: At Level	t-Statistic	Prob.		t-Statistic	Prob.		Variables: At First Difference	t-Statistic	Prob.		t-Statistic	Prob.				
BCA_$	-2.0472	0.5485	n0	-0.1147	0.6343	n0	d(BCA_$)	-5.6914	0.0005	***	-5.8184	0.0000	** *	I(1)		
BCAP_$	-2.9088	0.1766	n0	-2.9321	0.0051	***	d(BCAP_$)	-5.3402	0.0012	***	-5.4848	0.0000	** *	I(1)		
BOVR_$	-3.3559	0.0805	*	-5.9787	0	***	d(BOVR_$)	-6.0338	0.0002	***	-6.2897	0.0000	** *	I(0)/I(1)		
CG	0.4357	0.9983	n0	12.4843	1	n0	d(CG)	-4.9267	0.0029	***	1.6834	0.9741	n 0	I(1)		
CPI	3.2027	1	n0	4.1857	0.9999	n0	d(CPI)	-3.14	0.1192	n0	2.5261	0.9959	n 0	I(2)	-4.242235	0.0133
CPI_US	-1.2467	0.8778	n0	1.3077	0.9473	n0	d(CPI_US)	-0.7545	0.9569	n0	0.6369	0.8472	n 0	I(2)	-4.139991	0.0166
DCRDG	5.0784	1	n0	8.0897	1	n0	d(DCRDG)	0.029	0.9943	n0	3.7738	0.9998	n 0	I(1) according to PP		
DCRDH	17.0571	0.9999	n0	1.984	0.9866	n0	d(DCRDH)	2.0599	1	n0	5.985	1	n 0	I(2)	-4.005964	0.0220

														I(2)	-	0.0487
									0.430				n		3.61648	
DCRDPR	3.6326	1	n0	8.3927	1	n0	d(DCRDPR)	-2.2768	3	n0	-0.1578	0.6191	0		9	
		0.523			0.758				0.241					I(1)		
DCRPU	-2.0948	6	n0	0.2792	8	n0	d(DCRPU)	-2.7079	9	n0	-2.4205	0.0177	**			
														I(2)	-	0.0014
									0.993			0.999	n		5.24381	
DD	4.9081	1	n0	5.9042	1	n0	d(DD)	-0.0001	8	n0	3.5944	7	0		9	
														I(2)	-	0.0010
									0.784			0.993	n		5.3948	
DDBETG	3.3436	1	n0	5.804	1	n0	d(DDBETG)	-1.5477	6	n0	2.31	2	0		49	
														I(2)	-	0.0010
									0.921			0.997	n		5.42479	
DEBTG	3.5791	1	n0	5.1606	1	n0	d(DEBTG)	-1.0261	8	n0	2.7932	8	0		1	
														I(2)	-	0.0027
									0.960			0.998	n		4.95823	
DTS	6.2404	1	n0	16.1885	1	n0	d(DTS)	-0.7134	8	n0	3.0206	7	0		2	
		0.783			0.999			-	0.007			0.003	**	I(1)		
EMP	-1.5502	6	n0	3.8055	8	n0	d(EMP)	4.4864	8	***	-3.0781	5	*			
					0.999				0.023			0.010		I(1)		
EMPL	-1.5228	0.794	n0	4.0339	9	n0	d(EMPL)	-3.9799	2	**	-2.6475	3	**			
												0.002	**	I(1)		
EMPLP	-2.6236	0.2737	n0	4.3601	1	n0	d(EMPLP)	-5.3544	0.0011	***	-3.1753	7	*			
		0.619			0.616								**	I(1)		
EMPO	-1.9094	8	n0	-0.1653	5	n0	d(EMPO)	-5.1774	0.0017	***	-5.2883	0	*			
					0.078				0.000				**	I(1)		
EO_$	-3.0305	0.1441	n0	-1.7318	9	*	d(EO_$)	-5.9956	3	***	-6.3365	0	*			
									0.036			0.002	**	I(1)		
ER	-1.4307	0.826	n0	1.6843	0.9741	n0	d(ER)	-3.7577	7	**	-3.2686	2	*			

													I(1)			
								0.934			0.999	n	according			
EXPENDG	3.4567	1	n0	5.8034	1	n0	d(EXPENDG)	-0.944	3	n0	3.7794	8	0	g to PP		
														I(1)		
					0.950		d(FDEBTG_FC		0.124				n	according		
FDEBTG_FC	-2.5142	0.319	n0	1.3421	5	n0	)	-3.114	8	n0	-1.3011	0.1732	0	g to PP		
		0.998			0.999		d(FDEBTG_LC		0.056			0.056		I(1)		
FDEBTG_LC	0.5188	7	n0	4.2373	9	n0	)	-3.5397	6	*	-1.8947	7	*			
									0.064				**	I(1)		
FDI	-3.0855	0.1311	n0	0.0089	0.6761	n0	d(FDI)	-3.4733	4	*	-3.5481	0.001	*			
														I(2)	-	0.000
									0.999			0.999	n		7.41787	0
GDP	5.6787	1	n0	5.0395	1	n0	d(GDP)	1.3138	9	n0	3.2628	3	0		9	
					0.999							0.999	n	I(1)		
GDPDEF	3.7627	1	n0	3.8215	8	n0	d(GDPDEF)	-3.3478	0.0817	*	3.3472	4	0			
														I(2)	-	0.000
									0.999			0.999	n		7.41787	0
GDPMP	5.6787	1	n0	5.0395	1	n0	d(GDPMP)	1.3138	9	n0	3.2628	3	0		9	
		0.004			0.503								**	I(0)		
INT	-4.7041	8	***	-0.4663	1	n0	d(INT)	-5.1041	0.002	***	-5.258	0	*			
		0.623			0.663							0.086		I(1)		
INTPG	-1.9026	3	n0	-0.0279	9	n0	d(INTPG)	-3.0268	0.145	n0	-1.6849	5	*			
		0.085			0.058							0.000	**	I(0)		
INTW	-3.3239	4	*	-1.8828	1	*	d(INTW)	-4.5306	0.0071	***	-4.444	1	*			
		0.619							0.002				**	I(1)		
INVENT	-1.9097	6	n0	-0.7824	0.367	n0	d(INVENT)	-5.0338	3	***	-5.1921	0	*			
														I(2)	-	0.000
													n		7.38885	0
INVG	4.7608	1	n0	8.4602	1	n0	d(INVG)	2.9897	1	n0	4.8219	1	0		4	

					0.995				0.057			0.691	n	I(1)			
KSTOCK	-1.7239	0.7102	n0	2.4986	6	n0	d(KSTOCK)	-3.5302	7	*	0.0572	8	0				
		0.809			0.985							0.020		I(1)			
LF	-1.4802	3	n0	1.9693	6	n0	d(LF)	-3.4932	0.062	*	-2.3647	2	**				
									0.003			0.914	n	I(1)			
M0	-0.0859	0.9921	n0	5.2002	1	n0	d(M0)	-4.8643	4	***	1.0225	4	0				
									0.096			0.998	n	I(1)			
M1	1.7094	1	n0	6.4605	1	n0	d(M1)	-3.257	6	*	3.0693	9	0				
														I(2)	-	0.8715	
									0.998				n	accordin	1.27219		
M2	6.5952	1	n0	16.1037	1	n0	d(M2)	0.4098	2	n0	7.0292	1	0	g to PP	3		
		0.989			0.999				0.034					I(1)			
MR	-0.18	8	n0	4.0702	9	n0	d(MR)	-3.7916	3	**	-2.3976	0.0187	**				
		0.920							0.030			0.000	**	I(1)			
NFA_$	-1.0314	9	n0	-1.1793	0.2111	n0	d(NFA_$)	-3.8451	7	**	-3.7598	6	*				
		0.918							0.053			0.000	**	I(1)			
NFA_LC	-1.0472	3	n0	-1.5357	0.1147	n0	d(NFA_LC)	-3.5694	4	*	-3.7924	5	*				
		0.014			0.995				0.000				**	I(0)			
NFINC_$	-4.1917	8	**	2.4712	3	n0	d(NFINC_$)	-5.7752	4	***	-5.2513	0	*				
		0.000			0.648				0.080				**	I(0)			
NIR_$	-6.1718	2	***	-0.0738	4	n0	d(NIR_$)	-3.3559	5	*	-5.9787	0	*				
		0.986			0.999								**	I(1)			
NTAXR	-0.29	3	n0	3.8926	9	n0	d(NTAXR)	-8.2218	0	***	-5.5286	0	*				
		0.494			0.895				0.000				**	I(1)			
OFB	-2.1504	7	n0	0.8956	4	n0	d(OFB)	-6.72	1	***	-5.8448	0	*				
		0.599			0.700				0.005				**	I(1)			
OILP	-1.9482	9	n0	0.0844	5	n0	d(OILP)	-4.6375	6	***	-4.7233	0	*				
		0.999										0.569	n	I(1)			
OTHG	0.8266	5	n0	6.3922	1	n0	d(OTHG)	-4.3287	0.011	**	-0.294	7	0				

		0.969			0.993				0.098				n	I(1)		
PEX	-0.6124	1	n0	2.3165	3	n0	d(PEX)	-3.2474	3	*	-1.5341	0.115	0			
					0.992								n	I(1)		
PIM	-0.325	0.985	n0	2.2911	9	n0	d(PIM)	-3.2381	0.1	*	-1.3741	0.153	0			
		0.899							0.002			0.834	n	I(1)		
RC	-1.1472	8	n0	4.614	1	n0	d(RC)	-5.0711	1	***	0.578	4	0			
		0.994							0.020			0.891	n	I(1)		
RCG	0.0518	7	n0	9.6134	1	n0	d(RCG)	-4.0476	2	**	0.8739	8	0			
		0.838											n	I(1)		
RCP	-1.3903	7	n0	4.605	1	n0	d(RCP)	-5.1695	0.0017	***	0.5097	0.8187	0			
		0.305			0.638				0.096			0.001	**	I(1)		
RER	-2.5461	4	n0	-0.102	7	n0	d(RER)	-3.2582	4	*	-3.4154	5	*			
		0.997							0.000			0.292	n	I(1)		
REVG	0.3501	8	n0	5.1884	1	n0	d(REVG)	-5.5298	8	***	-0.9592	2	0			
					0.998				0.000				**	I(0)		
REX	-4.3123	0.0114	**	2.882	2	n0	d(REX)	-5.6034	6	***	-4.681	0	*			
					0.997				0.000			0.000	**	I(1)		
REXPENDG	-1.4247	0.828	n0	2.7333	4	n0	d(REXPENDG)	-5.6138	6	***	-3.7762	6	*			
														I(2)	-	0.0262
		0.992			0.996							0.796	n		3.92184	
RGDP	-0.0567	8	n0	2.5507	1	n0	d(RGDP)	-2.1402	0.5	n0	0.4192	4	0		7	
														I(1)		
		0.543							0.009			0.502	n	accordin		
RGDPFC	-2.0573	2	n0	9.2693	1	n0	d(RGDPFC)	-4.3768	9	***	-0.4669	8	0	g to PP		
		0.090							0.002				n	I(0)		
RGDPW	-3.2944	2	*	6.8525	1	n0	d(RGDPW)	-4.9454	8	***	-0.2606	0.582	0			
		0.003			0.994							0.000	**	I(0)		
RIM	-4.8134	8	***	2.3987	4	n0	d(RIM)	-5.1075	0.002	***	-4.2263	2	*			
		0.091							0.000				**	I(0)		
RINT	-3.2858	6	*	-2.3277	0.022	**	d(RINT)	-6.0407	2	***	-6.2702	0	*			

		0.098			0.957			-	0.003			0.000	**	I(0)		
RINV	-3.2445	8	*	1.4224	2	n0	d(RINV)	4.9008	1	***	-4.5535	1	*			
					0.992								n	I(1)		
RINVP	-0.325	0.985	n0	2.2911	9	n0	d(RINVP)	-3.2381	0.1	*	-1.3741	0.153	0			
		0.699			0.967				0.021					I(1)		
RINVPB	-1.7476	2	n0	1.5712	8	n0	d(RINVPB)	-4.0146	6	**	-2.6202	0.011	**			
		0.547			0.752				0.006			0.000	**	I(1)		
RTB	-2.0486	7	n0	0.2567	5	n0	d(RTB)	-4.6011	1	***	-4.6219	1	*			
		0.657			0.588				0.002				**	I(1)		
RW	-1.8347	3	n0	-0.2442	1	n0	d(RW)	-5.0821	1	***	-5.0515	0	*			
					0.995				0.002			0.828	n	I(1)		
SUB	-0.8626	0.945	n0	2.4885	5	n0	d(SUB)	-4.972	7	***	0.5517	5	0			
														I(2)	-	0.5738
				14.863					0.999			0.999	n	accordin	1.99861	
T_D	5.6523	1	n0	5	1	n0	d(T_D)	1.4402	9	n0	4.2196	9	0	g to PP	7	
									0.007			0.993	n	I(1)		
TAXR	3.3917	1	n0	4.6455	1	n0	d(TAXR)	-4.4926	7	***	2.3229	4	0			
		0.308											**	I(1)		
TB$	-2.5389	4	n0	1.4579	0.96	n0	d(TB$)	-7.0172	0	***	-6.4673	0	*			
									0.022			0.000	**	I(0)		
TBR	-4.2667	0.0131	**	1.6588	0.972	n0	d(TBR)	-4.0515	9	**	-4.6052	1	*			
														I(2)	-	0.6145
													n	accordin	1.91970	
TDCRD	5.55	1	n0	7.6349	1	n0	d(TDCRD)	1.6989	1	n0	4.4467	1	0	g to PP	7	
		0.785			0.606				0.103			0.003	**	I(1)		
UN	-1.5445	8	n0	-0.1941	2	n0	d(UN)	-3.2193	4	n0	-3.0516	8	*			
		0.084			0.530				0.037			0.000	**	I(0)		
UR	-3.331	3	*	-0.3977	2	n0	d(UR)	-3.7482	4	**	-3.6247	8	*			
					0.985				0.001			0.035		I(1)		
W	-1.9071	0.621	n0	1.9633	4	n0	d(W)	-5.3369	2	***	-2.1114	7	**			

		0.338			0.843							0.001	**	I(1)
WHEATP	-2.4697	6	n0	0.6189	4	n0	d(WHEATP)	-3.4452	0.068	*	-3.3438	8	*	

Notes:

a: (*)Significant at the 10%; (**)Significant at the 5%; (***) Significant at the 1% and (no) Not Significant

b: Lag Length based on SIC

c: Probability based on MacKinnon (1996) one-sided p-values.

Table A4: Unit Root Test Results (Phillips-Perron (PP))

	With Constant & Trend			Without Constant & Trend				With Constant & Trend			Without Constant & Trend				
Variables: At Level	t-Statistic	Prob.		t-Statistic	Prob.		Variables: At First Difference	t-Statistic	Prob.		t-Statistic	Prob.		Integration Conclusion	
BCA_$	-2.5673	0.2965	n0	-0.8549	0.3356	n0	d(BCA_$)	-5.0823	0.0021	***	-4.5185	0.0001	***	I(1)	
BCAP_$	-2.7009	0.2444	n0	-2.8479	0.0063	***	d(BCAP_$)	-8.3833	0	***	-6.434	0	***	I(0)	
BOVR_$	-3.3838	0.0764	*	-3.5516	0.001	***	d(BOVR_$)	-9.5743	0	***	-10.1908	0	***	I(0)	
CG	3.224	1	n0	12.6452	1	n0	d(CG)	-5.8089	0.0004	***	0.6388	0.8476	n0	I(1)	
CPI	0.312	0.9975	n0	8.7793	1	n0	d(CPI)	-2.8813	0.1846	n0	0.1878	0.7323	n0	I(2)	-3.888296 0.0281
CPI_US	-0.7385	0.9584	n0	6.8137	1	n0	d(CPI_US)	-0.7457	0.9577	n0	1.191	0.9354	n0	I(2)	-3.968588 0.0238
DCRDG	2.8885	1	n0	10.1428	1	n0	d(DCRDG)	-5.0334	0.0023	***	0.7348	0.867	n0	I(1)	

															-4.07008	0.0192
DCRDH	16.1252	1	n0	14.8864	1	n0	d(DCRDH)	2.6709	1	n0	8.903	1	n0	I(2)	3	
									0.4303			0.8637			-10.13697	0.0000
DCRDPR	5.949	1	n0	8.3927	1	n0	d(DCRDPR)	-2.2768		n0	0.7181		n0	I(2)		
		0.7963							0.2419							
DCRPU	-1.5165		n0	1.0352	0.9161	n0	d(DCRPU)	-2.7079		n0	-2.4205	0.0177	**	I(1)		
															-3.845106	0.0307
												0.9548				
DD	7.1008	1	n0	14.667	1	n0	d(DD)	-1.6263	0.7531	n0	1.392		n0	I(2)		
															-4.07666	0.0190
		0.9996							0.5798			0.7268				
DDBETG	0.8461		n0	5.0311	1	n0	d(DDBETG)	-1.9871		n0	0.1694		n0	I(2)		
		0.9999							0.6145						-2.976557	0.0046
DEBTG	1.209		n0	5.9447	1	n0	d(DEBTG)	-1.9197		n0	0.0946	0.7037	n0	I(2)		
									0.9946						-6.592128	0.0001
DTS	6.7186	1	n0	15.0515	1	n0	d(DTS)	0.0444		n0	5.0194	1	n0	I(2)		
					0.9998				0.0074			0.0045				
EMP	-1.7224	0.7109	n0	3.6777		n0	d(EMP)	-4.485		***	-2.9848		***	I(1)		
		0.6973			0.9998				0.0235			0.0103				
EMPL	-1.7517		n0	3.7526		n0	d(EMPL)	-3.9751		**	-2.6475		**	I(1)		
												0.0035				
EMPLP	-2.6236	0.2737	n0	4.6466	1	n0	d(EMPLP)	-5.3544	0.0011	***	-3.0782		***	I(1)		
		0.6198							0.0010							
EMPO	-1.9094		n0	-0.151	0.6215	n0	d(EMPO)	-5.1956		***	-5.3035	0	***	I(1)		
					0.0789				0.0003							
EO_$	-2.9979	0.1523	n0	-1.7318		*	d(EO_$)	-5.9956		***	-6.3365	0	***	I(0)		
					0.9687				0.0532			0.0019				
ER	-1.6022	0.763	n0	1.586		n0	d(ER)	-3.5717		*	-3.3131		***	I(1)		

		0.999		10.343					0.051							
EXPENDG	1.2256	9	n0	6	1	n0	d(EXPENDG)	-3.5846	9	*	0.1209	0.7119	n0	I(1)		
FDEBTG_FC	-0.2966	0.986	n0	2.566	0.996	n0	d(FDEBTG_FC)	-3.2225	0.102 9	n0	-2.2898	0.024	**	I(1)		
FDEBTG_LC	0.5188	0.998 7	n0	3.7853	0.999 8	n0	d(FDEBTG_LC)	-3.5397	0.056 6	*	-1.734	0.078 5	*	I(1)		
		0.568			0.613				0.374							
FDI	-2.0081	9	n0	-0.174	4	n0	d(FDI)	-2.3911	8	n0	-2.5618	0.0127	**	I(1)		
									0.457						-	0.002
GDP	2.068	1	n0	9.5555	1	n0	d(GDP)	-2.2224	7	n0	1.5282	0.965	n0	I(2)	3.182380	7
														I(1)		
		0.995							0.108					according		
GDPDEF	0.0838	1	n0	8.3891	1	n0	d(GDPDEF)	-3.1942	2	n0	-0.1753	0.6129	n0	to ADF		
									0.457						-	0.002
GDPMP	2.068	1	n0	9.5555	1	n0	d(GDPMP)	-2.2224	7	n0	1.5282	0.965	n0	I(2)	3.182380	7
		0.452										0.002				
INT	-2.2325	6	n0	-0.6677	0.4177	n0	d(INT)	-2.7482	0.2276	n0	-3.1501	9	***	I(1)		
		0.941			0.997				0.481			0.086				
INTPG	-0.891	4	n0	2.7451	5	n0	d(INTPG)	-2.1765	2	n0	-1.6849	5	*	I(1)		
		0.441							0.186			0.004				
INTW	-2.2537	9	n0	-1.9004	0.056	*	d(INTW)	-2.8748	6	n0	-2.9842	5	***	I(0)		
		0.534							0.002							
INVENT	-2.0742	4	n0	-0.7724	0.3714	n0	d(INVENT)	-5.0337	3	***	-5.1915	0	***	I(1)		
												0.600			-	0.000
INVG	12.7438	1	n0	9.7242	1	n0	d(INVG)	-2.7834	0.2156	n0	-0.2091	8	n0	I(2)	14.81368	0
														I(1)		
		0.835												according		
KSTOCK	-1.4022	1	n0	15.6288	1	n0	d(KSTOCK)	-3.1648	0.1141	n0	0.35	0.7783	n0	to ADF		
		0.884			0.998							0.020				
LF	-1.2198	1	n0	3.0133	7	n0	d(LF)	-3.4932	0.062	*	-2.3647	2	**	I(1)		

										0.002			0.002		
M0	1.5089	1	n0	10.9207	1	n0	**d(M0)**	-4.9597	7	***	-3.2536	2	***	I(1)	
														I(1)	
				10.964								0.466		according	
M1	4.4437	1	n0	6	1	n0	**d(M1)**	-3.2325	0.101	n0	-0.5542	8	n0	to ADF	
															- 0.020
									0.999						4.03021 9
M2	6.2059	1	n0	16.1037	1	n0	**d(M2)**	1.0741	8	n0	4.6762	1	n0	I(2)	5
					0.999				0.034			0.023			
MR	-0.4891	0.9771	n0	4.0702	9	n0	**d(MR)**	-3.7916	3	**	-2.2947	7	**	I(1)	
		0.856			0.154				0.031			0.000			
NFA_$	-1.3278	9	n0	-1.3696	2	n0	**d(NFA_$)**	-3.8261	9	**	-3.7425	6	***	I(1)	
		0.870			0.086				0.053						
NFA_LC	-1.275	8	n0	-1.6855	4	*	**d(NFA_LC)**	-3.5692	5	*	-3.2946	0.002	***	I(0)	
		0.016						-							
NFINC_$	-4.1443	4	**	-0.2066	0.6017	n0	**d(NFINC_$)**	14.8075	0	***	-7.2003	0	***	I(0)	
		0.480			0.604				0.076						
NIR_$	-2.1771	9	n0	-0.1979	8	n0	**d(NIR_$)**	-3.3838	4	*	-3.5516	0.001	***	I(1)	
		0.944													
NTAXR	-0.8688	2	n0	4.7156	1	n0	**d(NTAXR)**	-8.9255	0	***	-5.547	0	***	I(1)	
		0.553			0.951										
OFB	-2.0372	7	n0	1.3527	4	n0	**d(OFB)**	-7.1343	0	***	-5.8398	0	***	I(1)	
		0.569			0.759				0.006						
OILP	-2.0071	4	n0	0.2804	2	n0	**d(OILP)**	-4.6021	1	***	-4.6942	0	***	I(1)	
		0.999													
OTHG	0.895	6	n0	6.5875	1	n0	**d(OTHG)**	-4.3261	0.0111	**	-1.5744	0.1067	n0	I(1)	
														I(1)	
														according	
PEX	0.3381	0.9977	n0	4.9322	1	n0	**d(PEX)**	-3.1749	0.112	n0	-1.4343	0.1377	n0	to ADF	

PIM	0.5117	0.9987	n0	5.4854	1	n0	d(PIM)	-3.2207	0.1032	n0	-1.1637	0.2163	n0	I(1) according to ADF		
RC	-1.0069	0.9249	n0	13.3618	1	n0	d(RC)	-4.1197	0.0173	**	-1.0336	0.263	n0	I(1)		
RCG	0.0091	0.994	n0	9.3211	1	n0	d(RCG)	-3.9548	0.0245	**	-0.7484	0.382	n0	I(1)		
RCP	-1.214	0.8855	n0	12.147	1	n0	d(RCP)	-4.0167	0.0215	**	-1.1213	0.2309	n0	I(1)		
RER	-1.9454	0.6013	n0	-0.1737	0.6135	n0	d(RER)	-3.3025	0.0889	*	-3.4555	0.0013	***	I(1)		
REVG	1.4659	0.9999	n0	16.66	1	n0	d(REVG)	-5.6213	0.0006	***	-2.2738	0.0249	**	I(1)		
REX	-2.6539	0.262	n0	1.9248	0.9842	n0	d(REX)	-2.4395	0.3523	n0	-2.7693	0.0077	***	I(1)		
REXPENDG	-1.343	0.8526	n0	2.7646	0.9976	n0	d(REXPENDG)	-6.0861	0.0002	***	-3.7947	0.0005	***	I(1)		
RGDP	-0.0421	0.993	n0	11.291	1	n0	d(RGDP)	-2.2348	0.4515	n0	0.8445	0.8869	n0	I(2)	-3.68439	0.0003
RGDPFC	-2.1098	0.5158	n0	9.2693	1	n0	d(RGDPFC)	-4.3779	0.0099	***	-0.488	0.4943	n0	I(1)		
RGDPW	-3.1531	0.1164	n0	14.5161	1	n0	d(RGDPW)	-12.1026	0	***	-2.4419	0.0169	**	I(1)		
RIM	-2.7862	0.2146	n0	2.0239	0.9872	n0	d(RIM)	-3.8877	0.0281	**	-3.3285	0.0018	***	I(1)		
RINT	-3.2858	0.0916	*	-2.2579	0.0258	**	d(RINT)	-7.3442	0	***	-7.0956	0	***	I(0)		
RINV	-3.3256	0.0851	*	2.2772	0.9927	n0	d(RINV)	-4.9801	0.0026	***	-4.5695	0.0001	***	I(0)		

RINVP	0.5117	0.9987	n0	5.4854	1	n0	d(RINVP)	-3.2207	0.1032	n0	-1.1637	0.2163	n0	I(1) according to ADF		
RINVPB	-0.9297	0.9363	n0	1.8397	0.9811	n0	d(RINVPB)	-3.098	0.1283	n0	-2.702	0.009	***	I(1)		
RTB	-2.1828	0.478	n0	0.4456	0.8031	n0	d(RTB)	-4.6088	0.006	***	-4.5954	0.0001	***	I(1)		
RW	-1.9066	0.6212	n0	-0.2343	0.5917	n0	d(RW)	-5.0821	0.0021	***	-5.0515	0	***	I(1)		
SUB	-1.8757	0.6368	n0	4.1369	0.9999	n0	d(SUB)	-6.1579	0.0002	***	-3.6249	0.0008	***	I(1)		
T_D	8.4778	1	n0	16.3294	1	n0	d(T_D)	0.34	0.9977	n0	5.5319	1	n0	I(2)	-4.690719	0.0050
TAXR	5.2957	1	n0	21.2021	0.9999	n0	d(TAXR)	-4.4479	0.0085	***	-1.5764	0.1063	n0	I(1)		
TB$	-2.5389	0.3084	n0	0.6885	0.8579	n0	d(TB$)	-7.0172	0	***	-6.3922	0	***	I(1)		
TBR	-2.6456	0.2652	n0	0.3535	0.7793	n0	d(TBR)	-3.1775	0.1124	n0	-3.2953	0.0021	***	I(1)		
TDCRD	7.9677	1	n0	19.0436	0.9999	n0	d(TDCRD)	-2.7571	0.2245	n0	2.368	0.9941	n0	I(2)	-27.58149	0.0000
UN	-0.9851	0.9283	n0	-0.1041	0.6379	n0	d(UN)	-3.1899	0.1091	n0	-3.0179	0.0041	***	I(1)		
UR	-1.2002	0.8886	n0	-0.4299	0.5176	n0	d(UR)	-3.7222	0.0394	**	-3.5988	0.0009	***	I(1)		
W	-1.9184	0.6152	n0	1.906	0.9835	n0	d(W)	-5.3341	0.0012	***	-4.36	0.0001	***	I(1)		
WHEATP	-1.9476	0.6002	n0	0.5306	0.8236	n0	d(WHEATP)	-3.2965	0.0896	*	-3.1821	0.0027	***	I(1)		

Notes:

a: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1% and (no) Not Significant

b: Lag Length based on SIC

c: Probability based on MacKinnon (1996) one-sided p-values.

Table A5: Ramsey's F-Test for Diagnostic checks of the Model

Variable	Ramsey's F-Test	P-value	Decision
Current account balance (BoP, current US$) million $	0.43	0.66	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
BOVR_$	0.53	0.60	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
CPI	7.14	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
DCRDG	2.56	0.10	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
DCRDPR	11.88	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
DEBTg	4.59	0.02	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
EMPLOYMENT	22.42	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
EMPLp	22.44	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
EXPENDG	18.10	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.

FDEBTG_LC	0.27	0.77	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
GDP deflator (base year varies by country)	34.81	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
GDPMP	195.65	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
INTPg	1.73	0.20	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
KSTOCK	102.77	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
LF	8.94	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
M0	5.02	0.02	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
M1	2.52	0.10	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
M2	3.57	0.05	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
REAL BALANCES	2.62	0.10	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
NFA_$	12.37	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
NFA_LC	7.25	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
NIR_$	2.62	0.10	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
OFB	4.92	0.02	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
Total real consumption (constant LCU)	48.82	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.

RCP	47.08	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
RER	7.69	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
REVG	4.79	0.02	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
REX	2.37	0.12	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
REXPENDG	1.77	0.19	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
REAL GDP AT MARKET PRICE	22.39	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
RGDPFC	14.06	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
real imports	0.09	0.92	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
RINT	5.84	0.01	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
real investment	4.02	0.03	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
RINVp	1.42	0.26	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
RTB	0.48	0.63	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
T_D	0.10	0.90	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
TAXR	3.15	0.06	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
TRADE BALANCE (COMMODITY) IN US$	12.78	0.00	The null hypothesis is rejected, meaning there is significant evidence of misspecification.

TDCRD	5.44	0.01	The null hypothesis is rejected, meaning there is significant evidence of misspecification.
UN	0.33	0.72	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.
UR	0.41	0.67	The null hypothesis is not rejected, meaning the model's functional form is likely adequate and there is no significant evidence of misspecification.

Table A6: System Residual Normality Tests for Diagnostic Checks

Component	Skewness	Chi-sq	df	Prob.
1	0.240058	0.240115	1	0.624123
2	0.484089	0.976424	1	0.323083
3	0.733225	2.240081	1	0.134474
4	-0.21123	0.185915	1	0.666339
5	-1.40858	8.267102	1	0.004037
6	-2.30255	22.09065	1	2.60E-06
7	0.183864	0.140858	1	0.70743
8	-0.10241	0.0437	1	0.834414
9	0.157981	0.103991	1	0.747092
10	-0.20681	0.178206	1	0.672919
11	0.665591	1.845878	1	0.174264
12	-0.24039	0.240789	1	0.623637
13	-0.065	0.017603	1	0.89445
14	0.315248	0.414088	1	0.519902
15	0.20448	0.174217	1	0.67639
Joint		37.15962	15	0.001199
Component	**Kurtosis**	**Chi-sq**	**df**	**Prob.**
1	3.079302	0.006551	1	0.935492

2	2.047671	0.944719	1	0.331067
3	3.210749	0.046266	1	0.829693
4	3.260435	0.070653	1	0.790389
5	6.4424	12.34387	1	0.000442
6	9.979895	50.74889	1	1.05E-12
7	2.547001	0.213758	1	0.643838
8	2.321055	0.480173	1	0.488344
9	2.467446	0.295431	1	0.586761
10	2.596104	0.169929	1	0.680175
11	3.510107	0.271052	1	0.602627
12	2.20645	0.65596	1	0.41799
13	2.661318	0.119485	1	0.729594
14	3.173279	0.031277	1	0.859624
15	2.049436	0.941221	1	0.331964
Joint		67.33923	15	1.32E-08

Component	Jarque-Bera	df	Prob.
1	0.246666	2	0.883969
2	1.921143	2	0.382674
3	2.286346	2	0.318806
4	0.256568	2	0.879604
5	20.61097	2	3.34E-05
6	72.83954	2	1.52E-16
7	0.354616	2	0.837522
8	0.523872	2	0.76956
9	0.399422	2	0.818967
10	0.348135	2	0.84024
11	2.11693	2	0.346988
12	0.896749	2	0.638665
13	0.137087	2	0.933753

14	0.445365	2	0.800369
15	1.115438	2	0.572513
Joint	104.4989	30	3.57E-10

Table A7: Type of Variables Inserted in the Model

Variable	Type (endogenous/exogenous)
BCA_$	endogenous
BCAP_$	exogenous
BOVR_$	endogenous
CG	exogenous
CPI	endogenous
CPI_US	exogenous
DCRDG	endogenous
DCRDH	exogenous
DCRDPR	endogenous
DCRPU	exogenous
DD	exogenous
DEBTG	endogenous
DTS	exogenous
EMP	endogenous
EMPL	exogenous
EMPLP	endogenous
EMPO	exogenous
EO_$	exogenous
ER	exogenous
EXPENDG	endogenous
FDI	exogenous
GDP	exogenous

GDPDEF	endogenous
GDPMP	endogenous
INT	exogenous
INTPG	endogenous
INTW	exogenous
INVENT	exogenous
INVG	exogenous
KSTOCK	endogenous
LF	endogenous
M0	endogenous
M1	endogenous
M2	endogenous
MR	endogenous
NFA_$	endogenous
NFA_LC	endogenous
NFINC_$	exogenous
NIR_$	endogenous
NTAXR	exogenous
OFB	endogenous
OILP	exogenous
OTHG	exogenous
PEX	exogenous
PIM	exogenous
RC	endogenous
RCG	exogenous

RCP	endogenous
RER	endogenous
REVG	endogenous
REX	endogenous
REXPENDG	endogenous
RGDP	endogenous
RGDPFC	endogenous
RGDPW	exogenous
RIM	endogenous
RINT	endogenous
RINV	endogenous
RINVP	endogenous
RINVPB	exogenous
RTB	endogenous
RW	exogenous
SUB	exogenous
T_D	endogenous
TAXR	endogenous
TB$	endogenous
TBR	exogenous
TDCRD	endogenous
UN	endogenous
UR	endogenous
W	exogenous
WHEATP	exogenous

Table A8: Type of Variables Inserted in the Model

System: M3SLS
Estimation Method: Three-Stage Least Squares
Date: 02/10/26 Time: 00:11
Sample: 1998 2022
Included observations: 25
Total system (balanced) observations 375
Linear estimation after one-step weighting matrix

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	0.022064	0.008870	2.487533	0.0134
C(2)	0.141155	0.144419	0.977400	0.3292
C(3)	0.329328	0.125016	2.634293	0.0089
C(4)	-3.18E-05	0.000441	-0.072039	0.9426
C(6)	-0.186790	0.052462	-3.560456	0.0004
C(7)	5.962078	1.113379	5.354940	0.0000
C(8)	-0.111199	0.124588	-0.892540	0.3729
C(9)	-0.257440	0.064003	-4.022290	0.0001
C(10)	0.009256	0.003462	2.673646	0.0079
C(11)	-0.624174	0.079611	-7.840309	0.0000
C(12)	-0.475885	0.086830	-5.480646	0.0000
C(13)	-0.345868	0.085408	-4.049583	0.0001
C(14)	0.375449	0.080958	4.637579	0.0000
C(15)	-11.12268	4.831578	-2.302081	0.0221
C(16)	0.581792	0.201970	2.880581	0.0043
C(17)	0.064021	0.019203	3.333888	0.0010
C(18)	0.547980	0.070917	7.727034	0.0000
C(19)	0.636039	0.074036	8.590925	0.0000
C(20)	0.432168	0.084813	5.095557	0.0000
C(21)	0.806149	0.126034	6.396272	0.0000
C(22)	0.472280	0.099203	4.760753	0.0000
C(23)	0.290651	0.225966	1.286262	0.1994
C(24)	-4.002296	3.471901	-1.152768	0.2500
C(25)	1.146378	0.191987	5.971131	0.0000
C(26)	0.198513	0.383995	0.516968	0.6056
C(27)	-0.410894	0.333913	-1.230540	0.2195
C(28)	0.014913	0.122215	0.122020	0.9030
C(29)	0.470596	0.180086	2.613177	0.0094
C(30)	-0.300950	0.130812	-2.300637	0.0221
C(31)	-1.063623	0.846279	-1.256823	0.2098
C(32)	0.204877	0.145135	1.411634	0.1591
C(33)	0.584866	0.112496	5.198996	0.0000
C(34)	0.017188	0.033942	0.506387	0.6130
C(35)	0.012934	0.035772	0.361582	0.7179
C(36)	-0.023021	0.027028	-0.851742	0.3951
C(37)	-4.182005	0.985742	-4.242494	0.0000
C(38)	0.082227	0.041892	1.962820	0.0506
C(41)	-0.419127	0.106407	-3.938886	0.0001
C(42)	0.242090	0.170746	1.417839	0.1573
C(43)	0.319006	0.139542	2.286087	0.0230
C(44)	0.060685	0.020116	3.016714	0.0028
C(45)	-35533.18	64617.78	-0.549898	0.5828
C(46)	-1.15E-06	2.40E-07	-4.767414	0.0000
C(47)	5.17E-07	5.78E-08	8.932121	0.0000
C(48)	-12947.78	6657.256	-1.944912	0.0528
C(49)	0.083573	0.118444	0.705595	0.4810
C(50)	-12748.22	27420.57	-0.464914	0.6423
C(51)	-0.069316	0.014408	-4.811009	0.0000

C(52)	7328.048	1636.595	4.477619	0.0000
C(53)	0.010268	0.020180	0.508796	0.6113
C(54)	2.61E-07	1.78E-08	14.65783	0.0000
C(55)	0.382235	0.078949	4.841523	0.0000
C(56)	0.001753	0.107345	0.016332	0.9870
C(57)	-0.287236	0.093695	-3.065661	0.0024
C(58)	0.331036	0.117460	2.818276	0.0052
C(59)	-0.022897	0.024761	-0.924747	0.3559
C(60)	0.028860	0.027104	1.064795	0.2879
C(61)	0.431200	0.303255	1.421908	0.1561
C(62)	0.150478	0.318813	0.471996	0.6373
C(63)	0.092798	0.025591	3.626262	0.0003
C(64)	0.056914	0.044234	1.286654	0.1993
C(65)	0.152665	0.041646	3.665789	0.0003
C(66)	1.40E-05	0.029867	0.000470	0.9996
C(67)	0.014017	0.031345	0.447188	0.6551
C(68)	-0.002059	0.018279	-0.112655	0.9104
C(69)	-2.979661	0.719655	-4.140400	0.0000
C(70)	1.20E+09	2.55E+09	0.472046	0.6373
C(71)	5.62E+09	5.66E+09	0.992389	0.3218
C(72)	4.33E+10	7.55E+09	5.733371	0.0000
C(73)	0.934180	0.218452	4.276366	0.0000
C(74)	1.003348	0.082030	12.23155	0.0000
C(78)	14.90255	0.303905	49.03691	0.0000
C(79)	0.017635	0.001252	14.08223	0.0000
C(80)	0.133375	0.032687	4.080396	0.0001
C(81)	0.045419	0.024587	1.847266	0.0657
C(82)	-0.262052	0.037084	-7.066518	0.0000
C(83)	-0.483842	0.435408	-1.111237	0.2674
C(84)	0.001992	0.002140	0.930534	0.3529
C(85)	0.490254	0.191551	2.559396	0.0110
C(86)	0.087474	0.020166	4.337706	0.0000
C(87)	2.03E+10	3.14E+09	6.466033	0.0000
C(88)	0.109174	0.000883	123.6328	0.0000
C(89)	-4.46E+10	7.36E+09	-6.061798	0.0000
C(90)	1.98E+10	7.06E+09	2.802185	0.0054
C(91)	7.04E+10	6.26E+09	11.25943	0.0000
C(92)	0.628452	0.168680	3.725706	0.0002
C(93)	0.024175	0.117247	0.206187	0.8368
C(94)	0.843644	0.107413	7.854184	0.0000
C(95)	-0.518976	0.156798	-3.309826	0.0011
C(96)	0.557444	0.270352	2.061917	0.0401

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