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TARGETING DEBT IN LEBANON: A STRUCTURAL
MACRO-ECONOMETRIC MODEL

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Abstract

Quality statistics on developing economies in the Arab region are rare, and their advanced analysis is rarer still. Even by these poor regional standards, Lebanon lags behind on account of tormented modern history, when economic indicators were not consistently collected or properly assessed under civil war, or among its various ethnic and religious groups including large refugee population. Measuring economic trends across time periods with different socio-political regimes represents a challenge itself. Yet, Lebanon is a strategically important country helping to mitigate political instability in the region, and newly could become one of the region's producers of natural gas and oil. Understanding of the Lebanese economic trends in the coming decade is thus crucial to domestic and regional policymakers, international monitors, and investors alike.

This paper lays out and estimates a structural macro-econometric model of the Lebanese economy to simulate the implications of accumulated debt changes on GDP and other economic indicators, and to project the growth–fiscal nexus for the six years following the last year for which national statistics are available, 2015–2020. To these ends, historical and up-to-date national accounts data for years 1992–2014 are painstakingly collected from individual government agencies, and economic framework with five macroeconomic blocks is constructed, namely: macroeconomic, government, price, monetary and financial sector, and external accounts blocks. In total 16 behavioral equations are estimated with the help of an additional 10 identity equations defining theoretical dependency among variables in order to impute missing variables and to bound model forecasts.

Simulations predict that additional deficits and more debt accumulation will deter growth, while fiscal consolidation using external sources of revenues such as natural gas receipts to partially pay-off government debt is growth promoting. Contingent on oil prices rising, we project that if resource revenues are solely used to pay off national debt– rather than being utilized as a collateral for additional borrowing – economic growth will likely be sustained. These results have important implications for the fiscal position and macroeconomic policy in Lebanon as well as other developing, potential resource-rich, open economies under transitional governance (such as Egypt), in the Arab region or elsewhere. These results could help highly indebted developing economies to envisage the benefit of debt repayment especially when debt servicing is crowding out other growth promoting government spending activities.

JEL Classifications: E27, E42, N15, O13, Q32

Keywords: macroeconomic framework, oil revenues, sovereign wealth funds, Lebanon, Arab region, MENA.

1. Introduction

The Lebanese economy is a small open economy with few restrictions on trade and capital flow, with a well-established banking sector, yet undeveloped financial sector. The economy is composed mainly of agriculture, banking, tourism, and other service industries. Investment climate suffers from issues including chronic political instability, lack of well-designed regulations and regulatory transparency, and high costs of investment including those due to red tape and security factors. Since its independence in 1943, Lebanon has experienced major political turmoil such as the influx of Palestinian refugees in 1948, civil war between 1975 and 1990, and conflicts with Israel in 1982, 1996, 2000 and 2006. The Lebanese economy is highly vulnerable to various sources of instability of endogenous (domestic) nature such as, most recently, economic paralysis under a political vacuum, and is subject to exogenous (regional and international) risks. The country's informal economy was estimated at around 30 percent of GDP even before the large influx of Syrian refugees starting in 2012.[1]

The Syrian crisis accelerated the economic downturn, putting more pressure on economic growth (figure 1) and on public services. Over the past four years Lebanon has accommodated over 1.2 million Syrian refugees in an open border policy, where Lebanon became the natural destination for many Syrians escaping violence and grave socioeconomic conditions. The refugee influx, the recovery from the recent conflict with Israel in 2006, and the poor economic conditions associated with corruption and lack of transparency have put a major strain on the Lebanese economy. Lebanese debt to GDP ratio reached 133 percent amounting to around $65 billion by the second quarter of 2014,[2] and over 139 percent, or $72 billion, by the second quarter of 2016, and that does not account for various exclusions that would raise the figure to above $74 billion.[3] Successive governments have attempted repeatedly to reduce public spending, but have failed, bringing about a long-lasting budget deficit. In 2009, budget deficit was down to six percent, but it increased again significantly in 2013 due to increased spending on education, health and general infrastructure in light of the Syrian crisis.[4] The country is encountering a grave fiscal imbalance, where public debt is constantly on the rise at an annual rate nearing 5 percent.

The situation is equally worrying at the micro level, in terms of the living conditions and finances of families. In 2011, unemployment was estimated at 11 percent with youth unemployment accounting for a large portion of it. If we take refugees into consideration unemployment figures inch toward 30 percent. Correspondingly, poverty rate rose significantly in 2014 as 170,000 citizens were pushed under the poverty line of two dollars per day.[5]

In light of these pressing economic problems, there is a surprising lack of research on their individual causes and interrelations, or offering their projections. This paper aims to contribute by laying out a macro-econometric framework of the Lebanese economy to simulate the implications of accumulated debt changes on GDP and other growth-promoting indicators, and to predict the growth–fiscal nexus for the six years following the period for which national statistics are available (2015–2020). The economic framework consists of five macroeconomic blocks simulating the effects of accumulated debt on national income and other economic indicators for the period under analysis and a six-year forecast window (1992–2014 and 2015–2020, respectively). Our study yields a number of fiscal and monetary policy recommendations.

The remainder of the paper is structured as follows: Section 2 provides an overview of the Lebanese economy. Section 3 introduces the identity and behavioral equations used to build

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[1] (International-Monetary-Fund, 2011, p. 45).
[2] (International-Monetary-Fund, 2011, p. 32).
[3] (Credit-Libanais-SAL, 2016, p. 4).
[4] (World-Bank, 2015, pp. 20-21).
[5] (International-Monetary-Fund, 2015, p. 43).

the five blocks of the structural macroeconomic model, and enumerates variables used in estimation. Section 4 presents the estimation and simulation results. Finally, section 5 discusses their policy implications and offers some concluding remarks.

2. Recent History of the Lebanese Economy

In the fifteen years prior to 1990 Lebanon was the stage of a devastating civil war that resulted in some quarter-million casualties, displacement or exodus of over a million residents, and vast destruction of industrial, public and residential infrastructure. Lebanon was left without productive capital, infrastructure, or skilled workforce. A $20 billion "Horizon 2000" reconstruction program was launched in 1993. Between 1993 and 1996, the Lebanese economy witnessed impressive recovery, with real GDP growth averaging 6 percent thanks to the national reconstruction program. However, economic growth lost momentum after 1996 and became subject to political turbulence that included minor episodes of internal conflict and major external conflict with Israel.

Lebanon continued to enjoy positive growth in all but two years (1997 and 1999), notably dipping in 2005 in the wake of the Rafic Hariri assassination, and in post-2010 years under the Syrian crisis. Since then, the country has stagnated with reported growth of two percent annually, high unemployment rate that reached 20 percent,[6] significant trade deficit, and high level of debt to GDP. Lebanon experienced one percent growth in 2015 and also expected to have dismal growth in 2016 due to its involvement in the Syrian civil war both through the large influx of refugees and through the direct and indirect political and military intervention of Lebanese political parties in Syria.[7]

GDP per capita has increased approximately by 70 percent in the past two decades (figure 2) to reach $7,068 in 2015. This is the highest among non-oil rich Arab countries and middle-income countries. Figure 2 shows that Lebanon's per capita income was equal to the Arab regional average (excluding Gulf Cooperation Council, GCC, nations) in 1990 at the end of the civil war. Since the reconstruction period that commenced in 1994 personal incomes advanced to surpass that of the middle-income countries as well as non-GCC Arab region.

2.1 Poverty and the labor markets

Even prior to the onset of the Syrian conflict, poverty in Lebanon was high. About 21 percent of the Lebanese population were living on less than $4 per day in 2008, and 8 percent were living on less than $2.40 per day.[8] Living conditions have also been subject to great regional disparities. Labor markets across Lebanon have suffered from skill mismatches, prevalence of low-productivity and low-quality jobs, and meagre job creation. Job creation rate was estimated at 2 to 3 times below the GDP growth rate.[9]

From the start of the Syrian crisis, Lebanon has followed a policy of open borders and free mobility of refugees, which has led to a large influx of refugees. Combined with inadequate labor laws and regulations, this has exacerbated the conditions in the Lebanese labor market and led to the deprivation among Lebanese families. Poverty headcount increased in 2014 by 170,000 people. Unemployment has reached nearly 30 percent when including Syrian refugees. The crisis has also pushed those who were vulnerable further down into poverty through downward pressures on wages in the formal and informal sectors.

By 2014, the escalating problems and the agenda of the Millennium Development Goals made poverty reduction among Lebanese households a priority for the Lebanese government. The government proposed to enhance social assistance packages through the National Poverty

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[6] (International-Monetary-Fund, 2014, p. 6).

[7] (World-Bank, 2013).

[8] (UNDP, 2009, p. 11).

[9] (International-Labor-Organization, 2014, p. 63; Robalino & Sayed, 2012).

Targeting Program (NPTP) by providing food assistance via an electronic-card food voucher system. The NPTP will be expanded further in the coming years conditional on the support from the Social Promotion and Protection Project (SPPP) financed by the World Bank. Beside the NPTP, Lebanese Parliament's Health Committee adopted a law in February 2015 to launch a package of poverty reduction measures over the coming five years. The World Food Program (WFP) is presently implementing the program for around 670,000 Syrian refugees in Lebanon. Its effectiveness is expected to be low due to a low degree of distribution of less than \$2 per person per day.

2.2 Public finance

Public expenditures have increased gradually since the end of the 1975–1990 civil war particularly due to postwar reconstruction efforts. The cost of rebuilding highways, schools, airports, seaports, housing, power stations and public buildings exceeded government revenues by about 50 percent.[10] Government expenditures increased nine-fold from 1990 to 2014 (and about 2.5 times from 2000 to 2014 alone). In 2012, government expenditures rose by 12 percent over the preceding year, and in 2013 they rose by another 23 percent over the 2012 value (figure 3). This drastic increase is linked to the impact of Syrian refugees. Their inflow was linked to an increase in the cost of public infrastructure of 454 million USD in 2014. For example, education costs rose by \$194 million and electricity costs rose by around \$500 million between 2012 and 2014 on account of the Syrian refugees.[11]

Decomposition of government total expenditure has not changed drastically over the years (figure 4).[12] 30–40 percent of total expenditures are allocated for debt service repayment. Debt service repayments are further expected to rise in the coming years because of the absence of a solid fiscal consolidation plan and low expected growth in government revenues. Figure 4 shows that the share of debt services is substantial and additional increases in debt will continue to crowd out other activities, including effective spending on productive activities. Salaries, wages and related benefits, health, education and capital expenditures account for approximately 45 percent of total expenditures (salaries, wages and related benefits account for one half of that), while outlays by Electricity Du Liban (EDL) add up to 10–17 percent. On average the Lebanese government allocates 13 to 20 percent of its total expenditures to military, 10 percent to health, and 7 percent to education (prior to the Syrian crisis).

Plotting capital expenditure alone, one can see that across all years, it adds up to less than 9 percent annually for the past decade. For a capital-scarce economy such as Lebanon, if one analyses the government decomposition of spending, it is obvious that fiscal policy is inefficient and ineffective as it is not directed toward investments on income-generating activities. Instead, it is mainly directed toward consumption spending and debt repayment. Lebanon requires additional investments in infrastructure, health and education to promote additional sustainable growth. Given this background, a change in government expenditures composition will be growth promoting, while progressing in the same direction might depress the productive role of fiscal policy. Unlike other government spending activities, capital expenditures are considered to be an important catalyst of growth – provided that we factor out corruption, underinvestment and/or misallocation of funds for investment projects.[13] Further, government capital spending usually enhance the social return on investments.

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[10] (Global-IDP-Database, 2003, p. 26).

[11] (World-Bank, 2013, p. 6).

[12] This graph starts only in 2009 because budget decomposition per expenditure category is unavailable for prior years.

[13](Devarajan, Swaroop, & Zou, 1996).

In contrast to government expenditures, public revenues steadily improved across recent years, mainly due to an increase in both direct and indirect tax revenues (figure 5).[14] Tax revenues are a significant source of income, representing 60 to 80 percent of total government revenues net of grants, and most of these revenues are collected from VAT consumption taxation.

Since 2001, the government turned its attention to fiscal measures through increasing gasoline taxes, reducing government expenditures and approving a value-added tax that became effective in February 2002. Also in 2002, the government put an emphasis on liberalizing and privatizing public utility sectors including telecommunications and electricity, with plans for selling the state-owned airline, Beirut port and water utilities. Despite all these efforts, the government failed to sell its stakes and the continued ownership kept adding to the government's gross debt-to-GDP ratio that reached 180 percent in 2006 and 133 percent in 2014, as some of the highest ratios in the world.[15]

Although total revenues have been improving and relying on a healthy tax base, government expenditures are increasing at a higher rate. Government spending grew at a rate nearly 1.5 times higher, causing the government to run successive deficits. As a result, the Lebanese debt position is rare by world standards with a total public debt greater than 134 percent of GDP in 2014 (figure 6), one of the highest debt ratios in the world. The government exerted various efforts to reduce its deficit and debt in general, but emergencies and crisis management activities led to additional unplanned spending that kept national debt rising steadily across the years. Since 2011, additional debt accumulation took a rising slope due to additional government spending on health, education and electricity services to cope with the worst refugee crisis since 1967.

It is clear that debt increases drastically while the growth rate of total income is weak. This sheds light on how non-sustainable the Lebanese sovereign debt is evolving to become over time. While the Lebanese government has run a primary budget surplus in several recent years (of 2.5 percent of GDP in 2014), fiscal deterioration is expected to worsen in the following years due to the lack of sound fiscal planning.[16] Outlook regarding public debt is thus dim, and the debt is expected to only worsen in the coming years, dampening prospects of respectable economic growth.

Lebanese debt in foreign currency is relatively high (figure 7). Over the years external debt continuously increased, starting at 5.05 trillion Lebanese pounds in 1994 and rising to 89.79 trillion in 2015. Nearly 50 percent of it is in foreign currency. Calvo and Mishkin (2003) argued that a high dollarization rate motivates governments to keep local currency from devaluation.[17] However, indebtedness in foreign currency exposes the economy to foreign exchange risks, hence making the financial system susceptible to shocks in the long run.

The domestic and regional situation along with low oil prices and low global growth, will put additional pressure on the Lebanese economy growth. Given these circumstances, adding to public debt will keep increasing future risks and vulnerabilities, due to the rise of interest rates and the interdependence between the banking system and government debt. This will reduce investment and increase the risk of a sudden financial crash in the long run, in case of sovereign default. This unique debt position for a small country such as Lebanon requires a fast and urgent structural transformation in government revenues and expenditures. A drastic adjustment strategy is required to widen the tax base and increase compliance from the revenue side, and change the composition of expenses while prioritizing among pro-growth activities on the

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[14] (World-Bank, 2014).

[15] (International-Monetary-Fund, 2010; 2015, p. 32).

[16] (International-Monetary-Fund, 2015).

[17] (Calvo & Mishkin, 2003).

expenses side. It is worth noting that we do not model how government spending should be repositioned, but we claim that any effort should start by a reduction in national debt to boost growth.

2.3 Money, capital markets, exchange rates and prices

The choice of exchange rate regime should be compatible with the economic conditions in a given country. The fundamental underpinning of any macroeconomic framework (MF) is the choice of monetary stance. This includes the choice over currency, money stock and exchange rate regime. Typically, there are a number of exchange rate regime options that a country's MF could follow. The presence of natural resources and the types of potential economic and political shocks significantly influences the choice. Exchange rate regime might involve a freely floating exchange rate, managed float, crawling band, fixed peg, currency board, dollarization, or an outright monetary union with other states. Choosing the optimal monetary regime is the responsibility of an accountable monetary authority that processes a massive stock of information to formulate its short-term and long-term objectives including a well-designed policy rule aimed at improving economic performance and mitigating economic shocks. The objectives of sound monetary policy include inflation targeting, economic growth, employment promotion, currency and price stability, interest rate management, and facilitation of liquidity and inter-bank flows of money. The availability of natural resources presents another challenge for a sound monetary policy, as illustrated by the so-called Dutch disease hypothesis.[18]

Jeffrey Frankel (1999) concluded that "*no single currency regime is right for all countries at all times.*"[19] The *de facto* exchange rate regime should fit the circumstances and objectives of the domestic economy. It should be consistent with the country's dollarization rate, the level of debt and inflation among other factors. Since the end of a destructive civil war, Lebanon has experienced a radical change in its monetary policy. At the end of 1992, the Lebanese Central Bank (Banque du Liban, BDL) decided to adopt a *stabilization policy* that involved fixing its exchange rate regime. This regime officially started to apply in 1997. The US dollar was defined to equal 1500–1515 Lebanese Pounds, including a ± 0.5 percent band. Although BDL was adopting a *de facto* fixed exchange rate regime, *de jure* regime had been that of a floating exchange rate for more than 30 years. In Lebanon, the presence of a high dollarization rate (mainly due to weak trust in local currency, high historic inflation, and small size of the economy), high budget deficit, high level of external debt, high balance of payment deficit, and political instability make a flexible exchange rate regime unsustainable. Fixed exchange rate regime was more robust to potential shocks. The choice of a fixed exchange rate regime likely protected the country from financial crises similar to those in Argentina and Thailand in the 1990s.

The *de facto* fixed exchange rate regime has helped to stabilize prices. After 1996, annual inflation rate fell from more than 100 percent to 5 percent. According to Central Administration of Statistics, between 2008 and 2015, the Lebanese inflation rates averaged 2.55 percent reaching an all-times high 11.10 percent in October of 2012 and a record low of -4.67 percent in September of 2015. During the past two years, inflation was on average 0 percent.[20] The decline in inflation rates is mainly due to domestic factors and lower imported inflation.

While Banque du Liban enjoys substantial independence from the government, in the past decade exceptional fiscal circumstances have forced it to provide public financing, which sends a signal that its mandate to safeguard price stability, and public-finance prudence may be constrained.[21] Moreover, the country's managed exchange rates, limited financial-market

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[18](Lartey, 2008).

[19] (Frankel, 1999).

[20] (Central-Administration-of-Statistics, 2012, 2015).

[21] (International-Monetary-Fund, 2005, p. 6).

orientation, and limited labor-market coordination are all conducive to more active fiscal policy, and thus to the risk of debt accumulation (Kalinowski and Hlasny, 2017).

In Lebanon, savings instruments denominated in US dollars are presumed to carry lower financial risks and are more popular with lenders. This lead commercial banks to offer higher interest rates on deposits denominated in Lebanese Pounds in order to compensate depositors for currency risks. The spread between foreign-currency deposit rates and the rates prevailing in international markets also attracts more capital to the country. Finally, the accumulated deposits and stimulated liquidity in local currency help to restore credibility of local currency, mitigating the long history of poor reliability during the civil war era.

Regardless of the interest rate spread, arbitrage opportunities between domestic and international interest rates do not materialize due to several reasons. First, the interdiction of nonresidents to borrow in domestic currency reduces their ability to short the currency. Second, forwards and other financial derivatives are absent in Lebanon where all types of speculations are strictly controlled by the BDL on a daily basis.

Since the end of the civil war, Lebanon has had a well performing banking sector, which has been contributing to economic stability and growth. Aside from the banking system, the financial system is under-developed, and the availability of liquid assets is very limited. Traded securities can be counted on one hand. Major economic activities are financed solely by debt, rather than by public markets, venture capital or other sources of financing. Banks represent more than 30 percent of the Beirut Stock Exchange's (BSE) market capitalization. Four banks (Audi, BLOM, Byblos and Bank of Beirut) and Solidere, a property company, constitute the majority of the BSE. Solidere alone accounts for 60 percent of market capitalization.[22]

2.4 External sector

External accounts have the assigned goals of maintaining sustainable trade balance, current account resilience, and management of capital inflow and outflow. Since 1994, the Lebanese external sector has remained in deficit. Imports of goods and services were as high as eight times those of exports (figure 8). In a country such as Lebanon, weak economic growth associated with substantial political shocks put pressure on the country's external accounts, mainly the current account. Theoretically, a current account corresponds to the total value of net trade (Exports – Imports). Current account deficit can be thought of as the financing of a country's imports by excessive borrowing from abroad. From a national income identity point of view, current account is expressed as a function of a nation's savings minus investment. For a capital-poor country such as Lebanon, a current account deficit may reflect relative abundance of investment opportunities compared to available savings. However, imports and public debt have contributed significantly to the current account deficit which has lasted for more than two decades even as net factor income has been positive.

Between 2010 and 2014, both export and import growth rates deteriorated, especially after the closure of the borders between Syria and Jordan that led to a drastic increase in transportation cost of Lebanese exports to Arab markets.[23] Aside from trade transit through Syria, Syrian imports from Lebanon also dropped by nearly 45 percent. The decrease in exports contributed to higher unemployment rates and poverty, lower government revenues and a slowdown in economic activity. Syrian refugees have pushed up demand for imports of consumption goods. Furthermore, imports of industrial machinery increased by 13 percent in 2012 as Lebanon began to replace some industries in Syria. Despite the deficit in the balance of payments, foreign exchange reserves in Lebanon remained at a comfortable level to cover between 10 to 16 months of imports between 2002 and 2015 (figure 9). Lebanon's international reserves to

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[22] (Credit-Libanais-SAL, 2014).
[23] (Food-and-Agriculture-Organization, 2014; World-Bank, 2015, p. 24).

GDP ratio is one of the highest worldwide, with the ratio of international reserves minus gold to GDP around 70 percent.[24]

Foreign capital inflow, ostensibly the main driver of domestic demand, has contributed to the appreciation of the real exchange rate, which helped accumulate additional foreign reserves. Net foreign transfers declined from 18.3 to 13.2 percent of GDP between 1997 and 2005, and rose again dramatically from 17.2 to 27.7 percent between 2007 and 2010.

If one looks at GNI per capita,[25] inflows of migrants' remittances inflows exceeded $6.6 billion dollars in 2015 (figure 10). These inflows contribute significantly to family incomes throughout the country. Most of these remittances trickle in from North America, Australia and the GCC countries.[26] Between 2010 and 2015 around two-thirds of remittance inflows were coming from the Arab states. Remittances in Lebanon play a crucial role to maintaining a high reserve of foreign currency. Unfortunately, gathering accurate data on remittances is very difficult and different sources provide different numbers for the same years. We attempted to incorporate remittances in our macro-econometric framework explicitly, but due to data inconsistency across various sources and the limited number of consistent observations, we ultimately opted to omit this factor.

2.5 Natural gas reserves and reserves revenue management

Lebanon is expected to become a producer of natural gas by 2020. Lebanese reserves are estimated at 25 trillion cubic feet,[27] a modest volume by international standards. The extraction of natural gas is expected to affect positively electricity production, manufacturing, transportation, public investment, as well as individuals' incomes and general national growth. The analysis presented in this paper aims to make some predictions regarding the likely effects of natural gas extraction on Lebanon's economic affairs and on the country's macroeconomic framework, conditional on the conditions of extraction and on the management of proceeds. While there are no gas extraction or revenue data available for our perusal, information on other external factors and shocks affecting the country's fiscal accounts can be used to infer the implications of gas extraction under alternative scenarios regarding the volume, timing and disbursement of revenues.

3. Model and Data

Following the UN resolution, A/RES/70/1 of 2015, all member countries are tasked to pursue their Sustainable Development Goals (SDGs), as successors to the Millennium Development Goals of 2000. The eighth goal among the SDGs is to "promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all." This emphasizes the importance of sustainable policy planning and preparation of a sound macroeconomic framework. Macroeconomic models are useful in this respect, as they help to evaluate the dynamic evolution of national economies under various simulation scenarios.

For the Lebanese economy, to our knowledge, macroeconomic models have not been estimated, due to institutional capacity constraints and problems with historic data collection. The model proposed on the following pages should be viewed in this perspective, as a primer and an early model subject to data limitations and subject to the fast-changing non-steady state nature of the Lebanese economy.

This macroeconomic model serves an important role, as it may provide validation for the country's development plan, which could safeguard long-term sustainability and credibility of

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[24] (World-Bank, 2014, p. 10).

[25] GNI per capita (formerly GNP per capita) is the gross national income, converted to U.S. dollars. Data on GNI are missing from the following analysis due to poor availability of data for the Arab world and middle-income countries.

[26] (Ghobril, 2012, p. 372).

[27] (Jarmuzek, Mesa Puyo, & Nakhle, 2014).

the plan (among businesses, investors, financial markets, and the international community), enhance independence, stability and predictability of macro-economic policies, and facilitate policy responsiveness (through flexible and effective responses to changes in socio-economic and political circumstances). Hence, our macroeconomic model aims to serve multiple purposes, and strives to satisfy a number of properties. First, the model must be applicable. Second, it must be flexible so as to allow modifications along multiple dimensions. Third, the model must be transparent so that policy makers will understand the connections and dynamics within the model and the implications of the model for their policy work.

3.1 Background of macroeconomic modeling

Modern macroeconomic models rely on the estimation of behavioral equations using empirical data, and simulation of policy variables of interest in order to offer policy recommendations. Over the past eighty years, Keynesian, new Keynesian and new classical schools of thought have in turn focused on analyzing output fluctuations, employment and price levels through changes in monetary and fiscal factors. Keynes and Hicks proposed the Investment Saving – Liquidity Preference Money Supply (IS-LM) model to link various facets of the economy in a single framework. Tinbergen, and later Klein and Goldberger introduced dynamics to the model, and advanced empirical macro-econometric approaches to operationalize Keynes's theory. New classical economists such as Phelps, Tobin and Goodhart contributed micro-foundations to the modelling of employment, money demand and inflation, stressing the strategic interaction between policymakers and economic actors, and the delicate relationship between economic policy and macroeconomic outcomes. Barro and Gordon, and Lockwood, Miller and Zhang considered time-consistency and credibility of monetary policy.

To estimate these macroeconomic models, various specifications of computable general equilibrium (CGE) models have been deployed.[28] Although CGE models are appealing for their analysis of distributional and trade issues, they have limitations in regard to structural modeling and therefore analysis of macroeconomic policy systems (Hall 1995). Static CGE models can provide only a snapshot of the macro economy, assuming steady state. Even recent development of the dynamic CGE models cannot adequately capture the dynamics of the adjustment process, which is the core of formal macro-econometric modeling.

3.2 Model overview and data

The following macro-econometric model for Lebanon, based on the Mundell-Fleming model for small open economies with fixed exchange rates, includes five macroeconomic blocks: macroeconomic, government, price, monetary and financial sector, and external accounts blocks. These five blocks consist of estimable behavioral equations, and additional identity relations defining theoretical dependency among variables in order to impute missing variables and to bound model forecasts. In total, the model is made up of 16 behavioral equations and 10 identity relations estimated jointly as a system of equations. In forecasting and simulations, predicted values are identified as those providing the best fit to behavioral equations while satisfying identity relations both in the sample and in the forecast window, under a shrinkage principle (Copas, 1983).

The widely-used rule of thumb in estimating macro-econometric models of similar complexity is to use at least thirty observations, and to obtain a ratio of observations to covariates of at least 10:1 on average, and not less than 6:1. Among the five blocks in our model, only the monetary and price blocks have more than thirty observations at their perusal. Monetary and price information is publicized by the BDL on a monthly or weekly basis for the past 30 years. Other data sources including the World Bank, International Monetary Fund's International Financial Statistics (IMF-IFS), the Lebanese Central Administration of Statistics (CAS) and

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[28] (Thurlow & van Seventer, 2002).

the Lebanese Ministry of Finance (MF) report data on a yearly basis, which in Lebanon amounts to 23 observations for years 1992–2014. Table A1 in the annex reports variable definitions, summary statistics and data sources. The sample size of 23 observations suggests that we may include two to three covariates (for a ratio of 12:1 or 8:1), and not more than four (ratio of 6:1), in our estimable equations.

The following sections present the individual model blocks with their constituent estimable behavioral equations and identity relations. The estimable equations from across all five model blocks are fitted using the ordinary least squares method. The specific functional forms are selected with the objective to approximate the true underlying data generating processes behind each behavioral response, using predictions from macroeconomic theory, but also limitations on the availability of variables and observations.

Parameter consistency and efficiency are the specific goals. To these ends, model variables are checked for non-stationarity, strong dependence (or, persistence), and theoretical violations of sequential exogeneity ($E(u_t/x_s)=0$ for all $t>s$) (Engle, Hendry and Richard, 1983). Model residuals are tested for evidence of dynamics, including autocorrelation of various orders and heteroskedasticity, to prevent inefficiency and issues for inference.

Model variables are thus selected in view of their theoretical as well as statistical properties. The vast majority of the included economic variables are first-differenced to facilitate the consistency as well as efficiency properties of the estimator. The fact about first-differencing will not be discussed explicitly below, but all equations will indicate whether first-differenced versus level variables are used. This form is conditional on the stationarity of the series used. Finally, most economic variables are used in logarithmic form for its favorable properties – unless it is specifically mentioned that variables are in level form (in equations 4, 12 and 21), and with the exception of binary indicators.

3.3 Macroeconomic block

Macroeconomic block tracks the performance of the real aggregate economy. The block consists of four estimable behavioral equations: for aggregate supply, private consumption, accumulated wealth and private investment. Four supplementary identity relations are used to derive real GDP, real GDP growth rate, and gross national income.

The first behavioral equation is a high-level function of aggregate unemployment in the Lebanese economy (UE_t).[29] Unemployment is made a function of real GDP in the previous year, state fragility index, and a binary indicator for year 1997 accounting for the fixing of LBP exchange rates.

$$\Delta UE_t = f(\Delta Y_{t-1}^r, \Delta Fragility_t, Y1997_t) \qquad (1)$$

In this expression, unemployment, real GDP and state fragility index are included in logarithmic form, which is ignored in the representation above (as well as in all following equations) for brevity. The specification of this equation reflects the view that outcomes of economic growth in Lebanon are experienced with a lag. The second behavioral equation is that of private consumption, made a function of wealth in period t (W_t), lending interest rate lagged by one year (i_{t-1}) and an indicator for the year when Raffic Hariri was assassinated, 2005.[30]

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[29] One limitation with regards to unemployment data is that they come from ILO estimates, which are different from national estimates. The IMF uses different unemployment estimates. Regressions in this study rely on the ILO estimates, which are available for all years, 1992–2014.

[30] We have estimated this equation also without first-differencing, and controlled for previous-period consumption in agreement with the habit persistence utility hypothesis. Indeed, a strong, highly persistent relationship was found. Because of the persistence, the equation was re-estimated in the first-differenced form. One can also add remittances inflow to affect consumption, however the due to availability of data the variable was dropped.

$$\Delta C_t = f(\Delta W_t, \ \Delta i_{t-1}, \ Hariri_t) \tag{2}$$

Wealth in our model is modeled as a function of a one-year lag of government total debt (D_{t-1}) and indicators for year 1994 and the period under the Syrian war. Accumulated wealth is thought to be negatively related to government debt. The negative impact of high national debt in previous periods on wealth stems from the Ricardian equivalence hypothesis. It is assumed that individuals will perceive higher debt as future taxes.

$$\Delta W_t = f(\Delta D_{t-1}, \ Y1994_t, \ Syria_t) \tag{3}$$

Private investment is made a function of lending interest rate i_t, economic risk in year t, and a dummy indicator for year 1994 where the reconstruction process started taking effect in Lebanon. Here the lending rate and the index of economic risk are used in their level, rather than logarithmic, form.

$$\Delta I_t = f(i_t, \ risk_t, \ Y1994_t) \tag{4}$$

In our model, we consider government expenditures G_t as exogenous.[31] The reason behind this is the explicit manner of public spending in Lebanon. The Lebanese government did not pass a budget since 2005. The issue arose in 2005 after several calls of opponent political parties to review expenditures since 1992. Due to this issue, most government spending was targeted toward recurrent expenditures. It is worth noting from previous sections, and particularly from figure 4.1, that capital spending in Lebanon is the lowest among all government expenditure categories. As mentioned earlier deficits are usually contributing only to government consumption, rather than to investment.

The macroeconomic block further relies on the declaration of several identity relations that are used to impute missing variables, and to constrain model projections. Equation 5 is an identity equation deriving real GDP, Y_t^r, using the deflator method from nominal GDP, Y_t.

$$Y_t^r = \frac{Y_t}{Deflator} \tag{5}$$

Real GDP is also related to its components as a sum of net exports, private investment, private consumption and government expenditures[32]:

$$Y_t^r = Ex_t - Im_t + I_t + C_t + G_t \tag{6}$$

Real growth of output can be written as

$$\frac{\dot{Y}_t^r}{Y_{t-1}^r} = 100 \times \left(\frac{Y_t^r}{Y_{t-1}^r} - 1\right) \tag{7}$$

where $\frac{\dot{Y}_t^r}{Y_{t-1}^r}$ represents the growth rate of output. Finally, gross national income shall be defined as the sum of gross domestic product (Y_t) and net income from abroad ($NIFA_t$).

$$GNI_t = Y_t + NIFA_t \tag{8}$$

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[31] In a previous version of our model, government capital expenditures were treated as behaviorally dependent on budget deficit, but the equation was omitted from the current model for conceptual reasons (indeterminate direction of causality, and inappropriate inference). The results of that equations were as follows: $\widehat{\Delta GCE} = \underset{(0.183)}{-0.493^{**}} \times \Delta BD_t + \underset{(0.440)}{0.336} \times Y1996_t - \underset{(0.417)}{0.200} \times Y2006_t + \underset{(0.091)}{0.034}$. N=22, R²=0.29, F=2.44*, DW=1.99. Change in government capital expenditure is thus found to be related negatively and significantly to change in budget deficit, in agreement with expectations.

[32] To evaluate the quality of our real national income data and correlations among variables, we have also performed the following regression, even though clearly this specification is not appropriate conceptually $\widehat{\Delta Y^r} = 0.004 + 0.92 \times \Delta C + 0.26 \times \Delta I - 0.56 \times \Delta Im + 0.13 \times \Delta Ex + 0.11 \times \Delta G$. Reassuringly, all coefficients have the expected signs, and all are significant at 1 percent significance level. R² = 0.97, Pr(F)=0.00, DW=1.76.

3.4 Government block

Government block tracks the evolution of government revenues, expenditures, budget deficits and claims on government by lenders. The total revenue of the government in period t (GTR_t) is a sum of all collected non-tax receipts (NTR_t) and tax revenues (TR_t). NTR_t is mostly made up of revenues from telecommunications, Casino Du Liban and Middle East Airlines. TR_t includes mainly value added taxes (VAT) and customs revenues.

$$GTR_t = NTR_t + TR_t \qquad (9)$$

Tax revenues are modeled as related to aggregate private consumption and to an indicator for the 2002 introduction of the value added tax, YVAT t.

$$\Delta TR_t = f(\Delta C_t, Y_{VAT\ t}) \qquad (10)$$

Due to the high level of public debt, government interest payments GIP_t account for up to 40 percent of the Lebanese budget. Government interest payments can be modeled as a function of the stock of debt at time t (D_t). Adding a dummy for 1994 affected interest payment negatively due to country's ability to entrench stability after the civil war and capability to borrow at lower interest yields in international markets.

$$\Delta GIP_t = f(\Delta D_t,\ Y1994_t) \qquad (11)$$

Foreign debt (FD_t) in a year is modeled as a function of LBP–USD exchange rate and government budget deficit, both lagged by one year, and an indicator for the Paris 2 talks that facilitated additional low cost borrowing and major donation. The effect of exchange rate is crucial in this regression. Our analysis show that any devaluation might reduce the ability of Lebanon to borrow internationally.

$$\Delta FD_t = f(\Delta ER_{USD\ t-1},\ BD_{t-1},\ Paris2_t) \qquad (12)$$

Finally, claims on government include all loans to governmental institutions net of deposits. We use the first lag of COG_{t-1} and budget deficit BD_{t-1} to assess the claims on government. An indicator for the Paris 1 talks is included.

$$\Delta COG_t = f(\Delta COG_{t-1}, \Delta BD_{t-1},\ Paris1_t) \qquad (13)$$

3.5 Prices block

Modeling prices is an important aspect that central banks and economic actors utilize to form their expectations about the state of the economy and monetary policy. In our analysis we derive prices implicitly using one behavioral equation and one identity relation.

The identity relation for GDP deflator at time *t*, $P_{def\ t}$, consists of dividing nominal GDP (Y_t) by real GDP (Y_t^r):

$$P_{def\ t} = Y_t/Y_t^r \qquad (14)$$

This identity equation is important as it links the demand side with the supply side.

To complete the prices block we model inflation, using the consumer price index in period *t* (CPI_t), as a function of previous inflation and consumption expenditures. Consumption spending is thought to drive the Lebanese economy and price swings are consumption induced. Since modeling additional drivers of inflation such as money laundering and remittances is difficult, using private consumption as a proxy for all these determinants of inflation appears most appropriate. Year-1997 indicator is added for completeness to account for the shocks induced by the introduction of the exchange rate peg which encountered a drastic reduction in inflation.

$$\Delta CPI_t = f(\Delta CPI_{t-1}, \Delta C_t,\ Y1997_t) \qquad (15)$$

3.6 Monetary and financial sector block

The monetary and financial sector block models the supply and demand for money in the economy, the holding of domestic and foreign assets, and claims on the private sector, proxying for the sector's indebtedness. Our analysis takes narrow or liquid money, $M1$, as exogenous. However, the effective demand for quasi-broad money, $M2$, which is thought to depend on the stock of net foreign and domestic assets, is modeled behaviorally as a function of net foreign assets, nominal GDP and lending rate (both lagged by one year).

$$\Delta M2_t = f(\Delta Y_{t-1},\ \Delta NFA_t,\ \Delta i_{t-1}) \tag{16}$$

Quasi-broad money $M2_t$ is expected to move positively with Y_{t-1}. Growth of broad money in Lebanon depends on the business cycle, where a slow growth in output reflects a slow growth in $M2$. Quasi-broad money is often used as a signal for the level of spending in the economy. Since broad money depends on individuals' asset portfolios, we add NFA to our equation, as well as the lending rate lagged by one year, i_{t-1}. $M2_t$ is expected to move positively with NFA_t, and negatively with i_{t-1}.

Next we add an equation modeling net foreign assets as a function of real gross domestic product, government budget deficit, and indicators for year 1994 and for the periods under the Syrian war:

$$\Delta NFA_t = f(\Delta Y_t^r,\ \Delta BD_t,\ Y1994_t,\ Syria_t) \tag{17}$$

Equation 18 then provides a measure of quasi-liquid money Mq as the difference between quasi-broad and liquid money.

$$Mq_t = M2_t - M1_t \tag{18}$$

Lending interest rate is made a behavioral function of government total debt D and its two lags, and an indicator for the Paris 1 agreement. Lending rate is used in its level and non-differenced (rather than logarithmic and first-differenced) form.

$$i_t = f(\Delta D_t,\ \Delta D_{t-1},\ \Delta D_{t-2},\ Paris1_t) \tag{19}$$

Claims on the private sector in a year, ΔCPS_t, are modeled as a function of their two-year lagged value, CPS_{t-2}, as per the following behavioral equation.

$$\Delta CPS_t = f(\Delta CPS_{t-2}) \tag{20}$$

Finally, net domestic credit NDC_t is modeled through a behavioral equation as a function of its one-year lag, NDC_{t-1}, and government total debt D_t. The relation of both regressors is positive and significant.

$$\Delta NDC_t = f(\Delta NDC_{t-1},\ \Delta D_t) \tag{21}$$

3.7 External accounts block

The external accounts block models the state of the country's trade in real goods and services with its partners, the country's trade balance and capital account. The level of imports in Lebanon is thought to be related to what the country is exporting, since Lebanon imports most of the raw materials and intermediate goods for its exports. Imports are thus modeled as a function of exports. Imports are also thought to depend on the exchange rate between the Lebanese Pound and the US Dollar. Finally, an indicator for year 1997 is added, because it was during that year that a *de facto* exchange rate was locked with only a small band of variation. This year also saw a trade shock associated with a renewed conflict with Israel.[33]

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[33] Further, disaggregation of the balance of trade of Lebanon revealed that Lebanon's imports are dominated by imports of refined oil, and other commodities mainly from China. However, accounting for the price of oil and LBP-RMB exchange rate did not yield significant effects, and these controls were dropped from the equation. Oil prices do not appear to significantly

$$\Delta Im_t = f(\Delta Ex_t, \Delta ER_{USD\ t},\ Y1997_t) \tag{22}$$

Similarly, exports are modeled as a function of imports lagged by one year to account for a time delay in response to the import of raw resources and intermediate goods, before value-added goods can be exported. The binary indicator for year 1997 is again added for consistency with the equation for imports.

$$\Delta Ex_t = f(\Delta Im_{t-1},\ Y1997_t) \tag{23}$$

Next we define the country's capital account as a sum of its trade balance in year t (TB_t) and net income from abroad ($NIFA_t$).

$$CA_t = TB_t + NIFA_t \tag{24}$$

In this identity equation, we use the absolute values of CA_t and TB_t. In addition to linking exports and imports, the following identity equations are intended to link external accounts with the rest of our macroeconomic-framework blocks:

$$TB_t = |Ex_t - Im_t| \tag{25}$$

$$BoP_t = NFA_t - NFA_{t-1} \tag{26}$$

4. Results

This section presents the main results of our analysis. First, results of the estimation of the system of reduced-form equations are reported. Estimated coefficients, standard errors, and selected measures of fit for all model equations are shown in table 1. For measures of fit, equation R-squared (R^2), Wald test statistic (F), and Durbin-Watson statistic (DW) for first-order autocorrelation in residuals are shown.[34]

Second, projections of variables of interest are made to years 2015–2020 under several policy scenarios. These results are presented in table 2 and displayed graphically in figure 11.

4.1 Estimation results

4.1.1 Macroeconomic block

The results for equation 1 reveal that change in unemployment depends negatively on lagged change in real GDP, and positively on change in the index of economic fragility. The negative and significant relation between the percentage change in growth and unemployment is consistent with a view that economic growth has a lagged but strong effect on employment. This equation achieves good fit statistically in terms of R^2 and model F-statistic, and residuals do not suffer from any unaccounted-for dynamics.

The results for equation 2 confirm the expected relationships that the change in aggregate consumption is related positively to change in wealth W_t and negatively to lagged change in lending rate i_{t-1}. Nominal income (Y_t) was not significant in determining consumption and was consequently dropped from the regression. One possible explanation is that Lebanon is a consumer economy and C_t adds up to more than Y_t across most years. Another explanation is that consumption in Lebanon is driven by either accumulated wealth or external remittances. Equation 2 exhibits a high degree of fit on account of the strong relationship between consumption and wealth. This is not a result of a persistent spurious relationship between consumption and wealth, since the two variables are in first differences and in logarithmic form, which limit the effects of spurious secular trends on estimates. Consumption varies with different intervals and magnitude than wealth. Equation 2 can thus be interpreted as showing

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affect imports in Lebanon, since this commodity is considered a necessity for electricity production (no substitutes such as water or nuclear power in Lebanon), private consumption (absence of efficient transportation) and production.

[34] Other commonly reported statistics including Akaike and Schwarz information criteria were monitored, but are not reported here since equations in table 1 are not nested, and there are no benchmarks to compare the statistics to.

that economic actors base their consumption strongly on their lifetime income, which is highly related to their accumulated wealth. Equation residuals also show good properties of having little dynamics in them. (Durbin Watson of 1.86 is comfortably in the region of non-rejection of zero autocorrelation.)

Equation 3 shows that change in aggregate wealth is associated negatively with change in government debt. Equation 4 shows that, consistent with macroeconomic literature, change in investment is negatively and significantly related to lending rate i_t. Further, using the International Country Risk Guide (ICRG) database to measure economic risk, we find that the economic risk rating (the higher the better) affects investment positively and significantly, as expected.[35]

4.1.2 Government block

The results of equation 10 indicate that change in government tax revenues TR_t in Lebanon is related positively with change in aggregate consumption C_t. This positive relation is intuitive as revenues from consumer value-added taxes (VAT) are considered as one of the main components of government revenues. Similarly, in year 2002, change in the VAT regime resulted in an increase in government tax revenues, as the marginally significant coefficient on the binary indicator $Y_{VAT\,t}$ confirms.

Equation 11 shows that both change in total government debt, and real GDP growth rate are related strongly positively to the change in government interest payments GIP_t. The results for equation 12 suggest that change in foreign debt is related negatively to change in the LBP-USD exchange rate and positively to government budget deficit. These regression results confirm an assertion that devaluation in a currency will have a negative effect on credibility in foreign borrowing. Finally, the results for equation 13 reveal that change in claims on government COG_t is related positively to lagged changes in itself (COG_{t-1}) and in government budget deficit (BD_{t-1}) as anticipated in the absence of foreign fiscal interventions. The coefficient on COG_{t-1} is close to unity, implying high persistence in the growth of claims on government and little repayment of government obligations.

4.1.3 Prices block, and monetary and financial sector block

The results of equation 15 show that change in consumer price index is associated with lagged changes in it and with change in aggregate consumption, just as macroeconomic theory predicts. A one percent increase in consumption is predicted to raise consumer prices by 0.39 percent, a large effect. A one-percentage point higher inflation in one year is predicted to raise inflation in the following year by 0.45 points.

In equation 16, as expected, change in quasi-broad money ($M2_t$) is estimated to be related positively to lagged change in aggregate output, Y_{t-1}, positively to change in net foreign assets, but negatively to lagged change in lending rate (marginally significant). This last result can be explained using demand-size arguments that economic agents reduce their demand for liquid money when lending rates rise. Equation 17 indicates that change in net foreign assets NFA_t

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[35] Beside equations estimated here, we have considered adding an equation for aggregate demand Y_t as a function of consumption, investment, net exports and government spending (similar to the identity equation 6 here). This equation was eventually removed for fear of its misspecification. Linking this equation for demand with equations 2–4, the effects of exports, consumption and investment on total output were positive and mostly significant. These results agreed with macroeconomic theory and suggested that the economic cycle is heavily dependent on consumer spending, as this affects aggregate demand the most. One surprising results involved the effect – negative – of government capital expenditures on aggregate demand. Capital investment typically leads to output growth. However, many developing countries encountered a negative relation between government investments and output growth (Robinson and Torvik 2004). This is a result of misallocation of investments into "white elephant" projects and effectively underinvestment, which usually leads to negative social surpluses. This type of projects may be common in Lebanon, as our evidence suggested.

is related positively to real GDP growth, and negatively to change in government budget deficit as would be anticipated.

Equation 19 models lending rate i_t as a second-order distributed lag model of change in government debt. Lending rate is found to be related strongly positively to contemporaneous change in debt, as well as to its two lags. The one-year lag effect is the strongest as well as the most significant. Given that the Lebanese government is the largest borrower from the country's banking sector, the loans lead to a crowding out effect by constraining the available loanable funds and increasing interest rates to private-sector investors. This typically affects negatively long run investment.

In the next equation (equation 20), we find a positive significant relationship between the change in the claims on the private sector (CPS_t) and their second lag, but the effect is of a small magnitude. A one percentage point increase in prior claims on the private sector is expected to increase future claims by 0.16 percentage points, suggesting that the claims are repaid rapidly. The final equation in this block, equation 21, shows that the change in net domestic credit is related positively to its lag as well as to the change in government debt. The magnitudes of these impact propensities show a medium degree of propagation over time.

4.1.4 External accounts block

The last block of our macro-econometric framework model relates Lebanese national imports and exports to each other and to exchange rates. In equation 22, imports are found to be strongly positively linked to contemporaneous exports, and negatively to the LBP-USD exchange rate. Equation 23 shows that the Lebanese imports are strong determinants of Lebanese exports in the following year. These results are as expected and point to a lagged response in exports of processed goods to imports of raw materials, which themselves respond to changing exchange rates with a time lag.[36,37]

4.2 Projection and simulation

As Lebanon prepares to become a natural-resource extracting economy, we should evaluate the implications of natural-resource rents for the country's fiscal position. Existing theory and evidence from other countries (Elbadawi and Selim (2016) lead to several predictions. The anticipated economic benefits of gas extraction to national investment, national wealth and economic growth will only accrue if the authorities adhere to the Extractive Industries Transparency Initiative global standards along with satisfactory fiscal and price rules. Under active extraction of nonrenewable natural resources, the list of macroeconomic-framework objectives should be extended to the use of natural resources and revenues from them. These objectives vis-à-vis natural-resource extraction should include macro-fiscal stability, fiscal sustainability (especially in countries with short-lived reserves), and growth enhancing expenditures. For example, expenditures might follow scaling up criteria, especially in countries subject to absorption and institutional-capacity constraints. To attain these objectives in resource-rich countries, a fiscal rule shall also include provisions for appropriate expenditures, resource prices (such as the long term moving-average criteria), and/or a sovereign wealth fund (SWF). The expenditure provision should clearly state the limit and the nature of government spending, where any adjustments to the limit should reflect the absorptive

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[36] While the specification for exports reported here does not control for exchange rates, our alternative specifications revealed that a stronger dollar facing the Lebanese pound would result in a lagged increase in exports during 1992–2014. This and additional control variables were omitted here to keep the model parsimonious.

[37] Equations 12, 13 and 25 have Durbin-Watson statistics greater than 2, showing some evidence of negative autocorrelation in residuals (insignificant). This may indicate that the regression specifications in first differences have introduced autocorrelation to model residuals. Still, these specifications are believed to be more robust to other issues with model variables and residuals, including strong dependence, and the small negative autocorrelations are weaker than the positive autocorrelations in the specifications in levels.

capacity of the economy – higher limits of spending are typically set for human and physical capital accumulation and debt repayment rather than for current spending.

Allocating resource revenues in a SWF is a conservative and prudent strategy in natural-resource rich countries, as it mitigates volatility in the stock and price of natural resources, and may prevent excessive current spending in countries with bad public financial management and little economic diversification. Such countries should place their resource rents in funds, such as more efficient financial markets, and consume only the interest income accrued. This guarantees a minimum level of income even after resource revenues become depleted. The SWF should clearly stipulate the volume of capital inflow–outflow of resource revenues, and the level of allowed public borrowing against the fund.

The results of our macro-econometric model allow us to evaluate some of these predictions and to comment on policy recommendations. The main pathway in which natural gas extraction affects our model is through government revenues, which can be used for productive uses including debt reduction, or non-productive uses such as government consumption or corruption.

4.2.1 Debt-repayment scenarios

The model described in previous sections implicitly makes several policy recommendations in regard to the future effect of natural-gas extraction. It can be used to assess the effect of debt consolidation driven by natural-resource revenues on growth and on other macroeconomic indicators. Our analysis considers three debt-repayment scenarios:

Scenario 1 assumes that the government takes the initiative to reduce public debt by 4 percent for the upcoming 6 years. Debt repayment in this model is assumed to come from natural gas receipts, assuming that the Lebanese government will start collecting natural gas receipts in 2015, equal to the amount of debt repayment.

Scenario 2 assumes no debt repayment, and no debt increase. This scenario implicitly assumes balanced budget over the coming six years including repayment of interest on outstanding debt, but no new revenues from gas extraction or other sources. Alternatively, this scenario can be viewed as resulting from gas extraction where revenues are siphoned off to nonproductive uses (government consumption) that do not involve debt easing.

Scenario 3 assumes that the government will accumulate additional debt at a rate of 4 percent per year, a business as usual scenario for Lebanon.

Results of these three alternative scenarios are presented in figure 11. Namely, the predicted effects on the following variables are reported: Real GDP, private consumption, private investments, lending interest rate i, government interest payment, wealth, government tax revenues, net domestic credit and employment.

According to the three scenarios, Lebanon will experience different growth paths in economic activities between 2015 and 2020. However, the most interesting aspect is that the rebound in economic growth that is projected to occur in future years is made dependent solely on the level of the country's debt management. Looking at Y_t^r for Scenario 1 (GDPR in figure 11), our results reveal that in 2015 economic growth will be at 1.77 percent if the government took the initiative and decreased debt by 4 percent. Between 2016 and 2018 real income will increase on average at 3.5 percent annually, and growth will stabilize below 2 percent between 2019 and 2020. The expected growth after 2018 is contingent on government's restructuring of the composition of government spending and the overall political and economic situation in Lebanon and neighboring countries. A zero growth in debt scenario (scenario 2) will result in economic growth at 1.8 percent between 2016 and 2018, and an average economic growth of 1.5 percent between 2019 and 2020. Looking at scenario 3, if the government keeps spending

at the same levels similar to recent years, debt will grow at 4 percent annually and economic growth will be 1.05 percent in 2015. Using this business as usual scenario to predict economic growth in 2015 adds credibility to our model since our results mimic the actual growth figures of the Lebanese national accounts and the World Bank. Additional debt accumulation will reduce growth to 0.6 percent in 2016 and to negative growth in 2017. According to Scenario 3 future economic growth could stabilize at less than 1 percent between 2018 and 2020.

Since consumption is the main driver of demand, output growth and consumption growth follow the same path in all three scenarios. Scenario 1 reveals that consumption will grow on average at the rate of 3 percent between 2015 and 2018 and then stabilize at 1 percent. Scenario 2 reveals that consumption will grow at an average rate of 0.9 percent between 2015 and 2018 and then stabilize at 0.5 percent during 2019–2020. However, growth will be -0.39 percent in 2015, -0.5 percent in 2016 and 1.5 percent in 2017 using the business as usual scenario (scenario 3). Stemming from the Ricardian equivalence hypothesis, wealth in our model is heavily affected by national debt. Looking at figure 11, one can see that wealth took a downturn in 2011 and was declining on an annual basis. In our model, we show that wealth could grow at 0.3 percent annually if the government decided to gradually repay debt (scenario 1). However, wealth will decrease at a -2.8 percent rate if debt keeps growing in future years at a 4 percent rate.

Investments will grow at a rate lower than 1 percent in scenario 1 and would experience negative growth in scenarios 2 and 3. Despite the debt accumulation issue, investment growth is related to internal socio-political instability, and on neighboring countries' political stability. Using the business as usual scenario, negative growth is exacerbated in scenario 3 and might reach annual growth of up to -4 percent by 2020. Lending interest rate on the other hand will increase if debt increases (scenario 3) and will decrease when debt decreases (scenario 1). Our simulation results show that the lending interest rate will drop to 4.5 percent by 2020 if debt repayment takes place (scenario 1), but it might climb to 8.5 percent if debt keeps growing at the same rate as in previous years (scenario 3).

Since almost 40 percent of government expenditures is debt service repayment, government block variables such as government interest payment will be heavily affected by debt repayment. We show that debt interest payment will drop at a 7.5 percent rate in case of debt repayment occurs, however it will grow at a 3.64 percent in case of additional debt accumulation. In case of debt repayment, government tax revenues will grow at an average rate of 5 percent between 2015 and 2018 and stabilize at a rate of 1.8 percent between 2019 and 2020. Looking at the business as usual scenario government tax revenues will decrease by 4.2 percent between 2015 and 2018. This drop in revenues could be blamed on the drop in consumption due to lower VAT tax collection. Furthermore, the drop in imports and exports tariff revenues along with a significant drop in transit tariff revenues (due to the blockage of the Syrian-Jordanian borders) will contribute to a downturn in government tax receipts.

According to our model simulation results, unemployment is projected to increase in all three scenarios. This is due to the absence of strong economic growth, political stability, promising labor policies and tight regulations governing the foreign residents' employment status. All these factors contributed to high unemployment and lowered the government's capabilities to create jobs and most importantly boost youth employment. Recent figures showed youth unemployment in Lebanon at 35 percent for year 2014 if one includes unemployed refugees at the age between 15 and 24. In addition, lack of educational quality created a gap between the supply and the demand for labor. Our analysis shows that unlike other economic outcomes, unemployment will continue growing in Lebanon due to a number of the above-mentioned deficiencies. Additional economic growth will help tame the steep growth in unemployment but not reduce unemployment rate per se. Our model reveals that additional debt repayment

(scenario 1) will not reduce unemployment, but will keep it at 6 percent between 2015 and 2020. On the other hand, additional debt accumulation (scenario 3) will increase unemployment significantly to 8 percent in 2020. It is worth noting that these figures do not include unemployment in the informal sector and among refugees.

Net domestic credit is made a function of government debt since the Lebanese government is the greatest borrower domestically. This gives the banking sector additional incentives to issue only high collateralized loans to the private sector and to be highly susceptible to government debt rating. We show that net domestic credit increases if additional debt continues rising, and decreases if additional debt reduction efforts are undertaken. Scenario 1 shows that net domestic credit will grow at less than one percent if the government pays off 4 percent of its debt annually, however domestic credit will grow at an average rate of 5 percent between 2015 and 2020 if the government keeps borrowing at the business-as-usual rate annually.

5. Concluding Remarks and Policy Recommendations

This paper aimed to estimate the effect of sovereign debt repayment on economic growth in Lebanon. We assumed that this debt repayment might come from natural gas receipts without modeling any price rule for natural gas. The model relied on an empirical approach using a system of ordinary least-squares regressions paired with identity equations. Inference from the model was conducted by imposing alternative shocks on a key endogenous variable, national debt, and observing how the shock propagated itself through the model to economic growth and other endogenous economic outcomes. Our analysis shows the importance of debt repayment to generating higher and more sustainable growth in the long run. We also show that it is possible to have a fiscal restructuring plan and achieve potentially higher growth rates in future years.

As was conceded upfront, this macro-econometric model suffers from several limitations related to data availability. Lebanese macroeconomic data are complicated to collect and some time series are short, and subject to inconsistencies for reasons such as collection by different parties in different time periods. However, the paper relied on all data that are presently available, and all data series were used carefully to construct a tractable model capable of simulating policy alternatives.

Second limitation involves a realization that economic growth in a country such as Lebanon depends on the progress of its institutional and structural reforms. Unfortunately, in this model we do not model this aspect explicitly. We model macroeconomic developments only, under the assumption that policy and external factors are held unchanged. For example, the extent of the poverty reduction measures launched by the Lebanese Parliament's Health Committee recently is yet unclear, just as it is unclear what emergencies will arise requiring response. These emergency programs may put additional stress on the government's budget in the short run and economic sustainability in the long run.

With this said, our estimates of the behavioral and identity equations are thought to be valid in its consistency and robustness properties, provided that other developments in the economy that were not considered explicitly are not systematically strongly related to the modeled variables. On the other hand, our simulation forecasts are correct only if the system of behavioral and identity equations is fully specified, and covers all the main economic processes governing the Lebanese economy presently and in the coming years. Now, to the extent that other developments in the economy are not systematically related to the covariates in our model, our predictions may be viewed as central (albeit noisy) estimates in whose vicinity true values of the economic outcomes should lie. Our model can therefore inform about the expected effect of debt consolidation on economic growth even when the ceteris paribus condition does not hold precisely. Similarly, we can evaluate the predictive power of our model under fairly broad sets of conditions.

Another limitation is that our model and its predictions do not account for the informal sector or its growth. Since the informal sector contributes approximately 30 percent of total economic activity in Lebanon,[38] this affects the interpretation of our results to a substantial degree. However, no consensus exists regarding characteristics of the informal sector, so this sector cannot be modeled reliably. We can merely surmise that the informal sector is evolving at a similar pace as the formal sector that is explicitly modeled here, in which case our forecasts may hold, and inference to the informal market may be attempted. Under the other extreme scenario that the informal sector evolves according to a vastly different, orthogonal, pattern, our estimates remain valid for the formal sector and may be consistent for the overall economy, but forecast errors may be large. Our point forecasts may differ significantly from the true outcomes when accounting for the informal sector.

To evaluate consistency of our model, we have estimated all time-series to year 2015. Reassuringly, our analysis provides comparable economic growth figures as those recently published by the Lebanese banking sector.

Our study yields a number of important policy recommendations. Namely, a debt consolidation strategy should include a thorough revision of government expenditures; public funds should be re-allocated to growth-promoting activities; and debt reduction is an important step toward economic growth. Additional deficits would deter growth, while fiscal consolidation, mainly the reduction of debt using any source of revenues (including natural gas revenues) would be growth-promoting in the long term. The strategy should be to gradually decrease budget deficit and government debt, while increasing the tax base to advance government revenues, apply structural reforms and avoid misallocation of expenditures in non-income generating projects.

Since the end of the Lebanese civil war, the Lebanese economy has been severely affected by internal political issues, and external geopolitical issues from neighboring countries. Recently the economy started to deteriorate at a fast pace with huge fiscal imbalances and no presence of any rescue plan. Higher debt is significantly contributing to the recent slowdown in economic activity that directly connects to lower government revenues. Moreover, our analysis brought evidence that debt accumulation crowds out loanable funds and pushes up interest rates. Our model suggests that reaching a budget surplus is required and this should not happen through reducing of productive activities. Lebanese government should secure a sustainable path for its outstanding debt to pursue higher growth.

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[38] (International-Monetary-Fund, 2011, p. 45)

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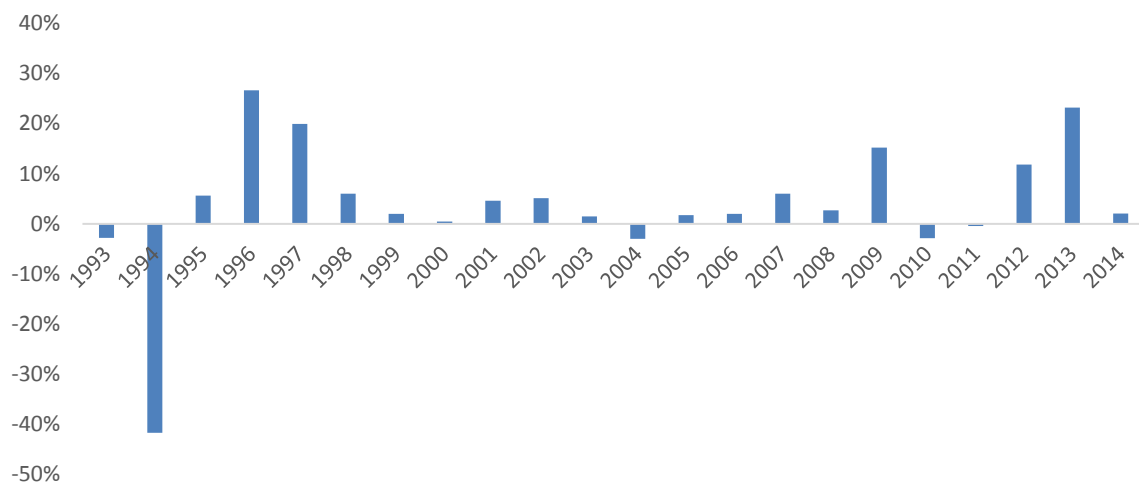**Figure 1: GDP Growth Rate, 1992–2014 (%)**
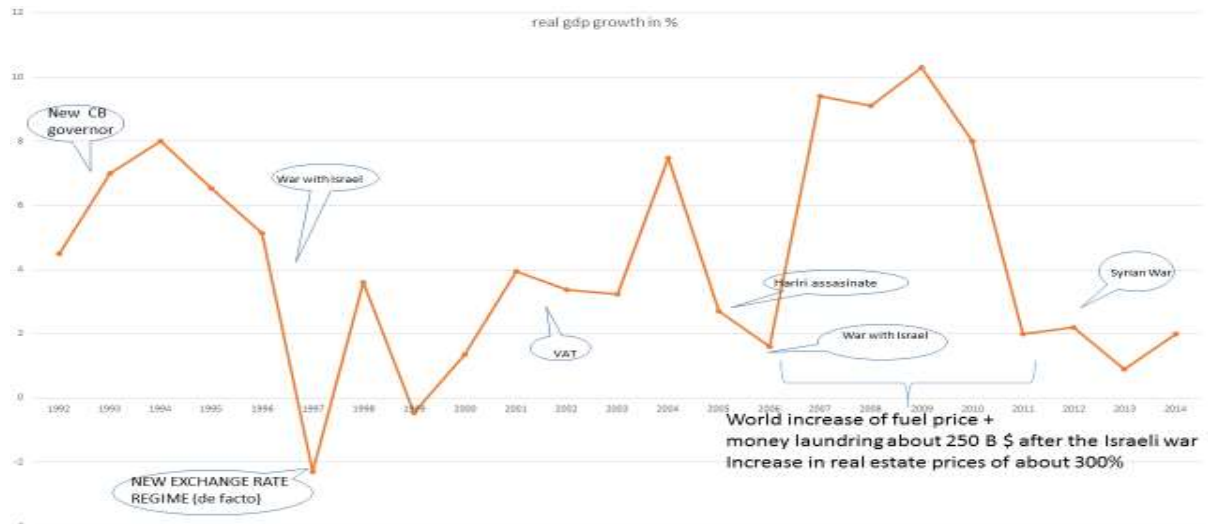
Source: Authors' analysis of World Bank's World Development Indicators data.

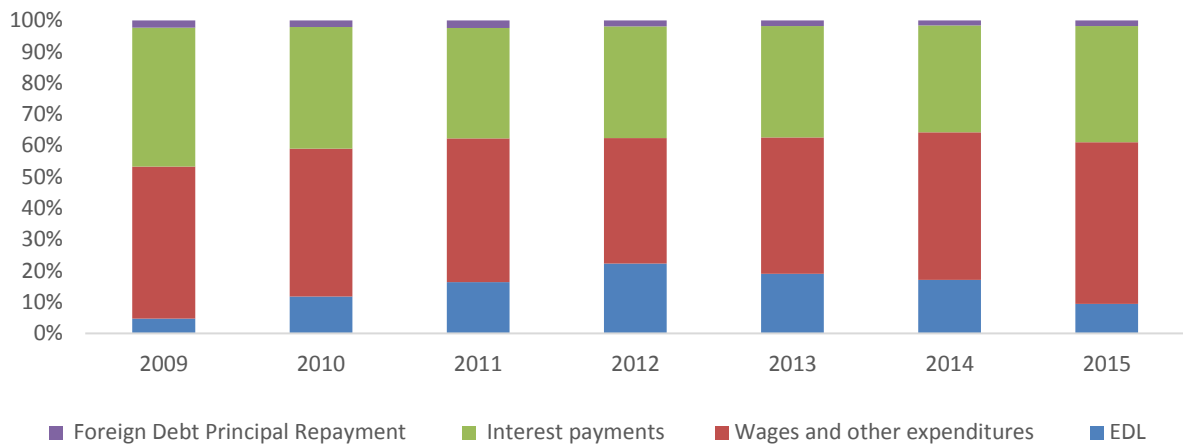**Figure 2: GDP Per Capita between 1990–2015 (Constant US$)**
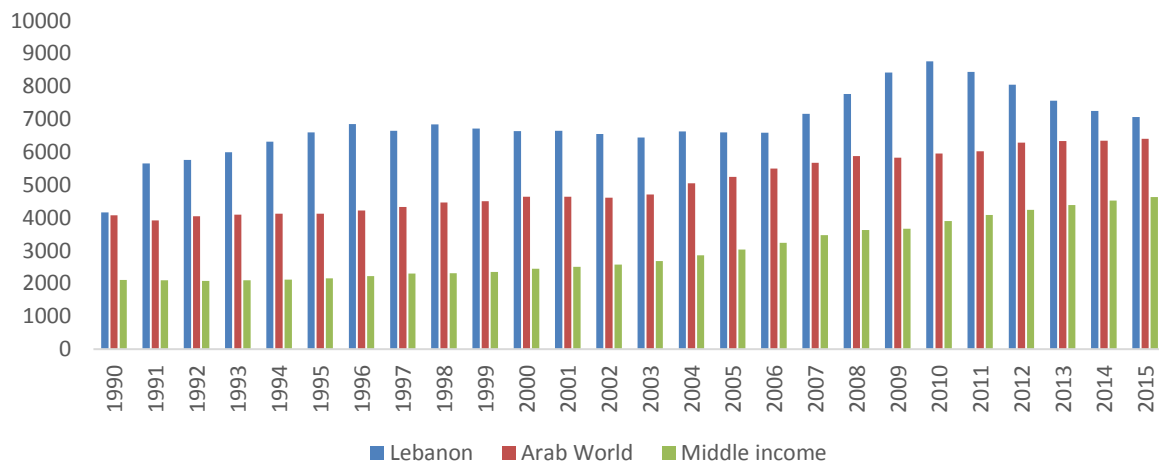
Source: Authors' analysis of World Bank's World Development Indicators data.

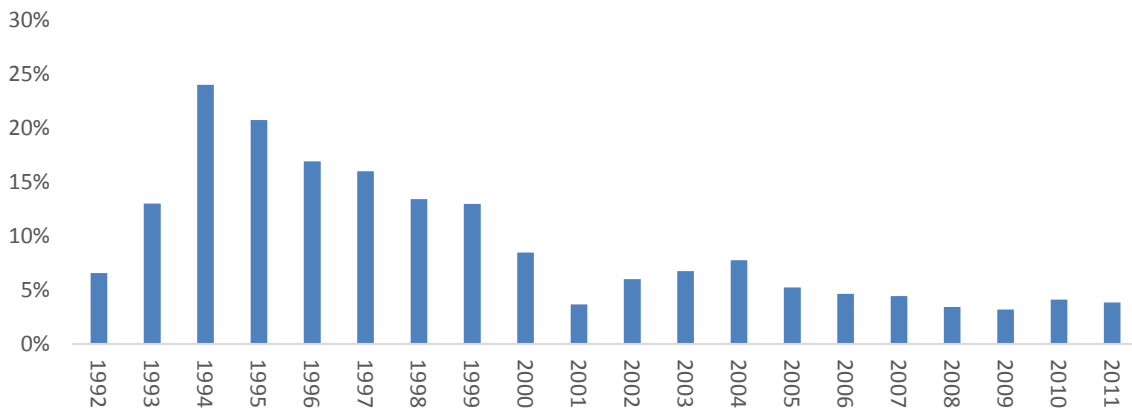**Figure 3: Annual Growth Rate of Government Total Expenditures, 1993–2014 (%)**

Source: Authors' analysis of World Bank's World Development Indicators data.

Figure 4: Composition of Government Total Expenditures, 2009–2015 (%)

Legend: ■ Foreign Debt Principal Repayment   ■ Interest payments   ■ Wages and other expenditures   ■ EDL

Source: Authors' analysis of data from Ministry of Finance, Lebanon.

Figure 4.1: Capital Expenditures as Share of Total Expenditures, 2009–2015 (%)

Figure 5: Government Revenue and Total Expenditure, 2000-2013 (LBP billions)
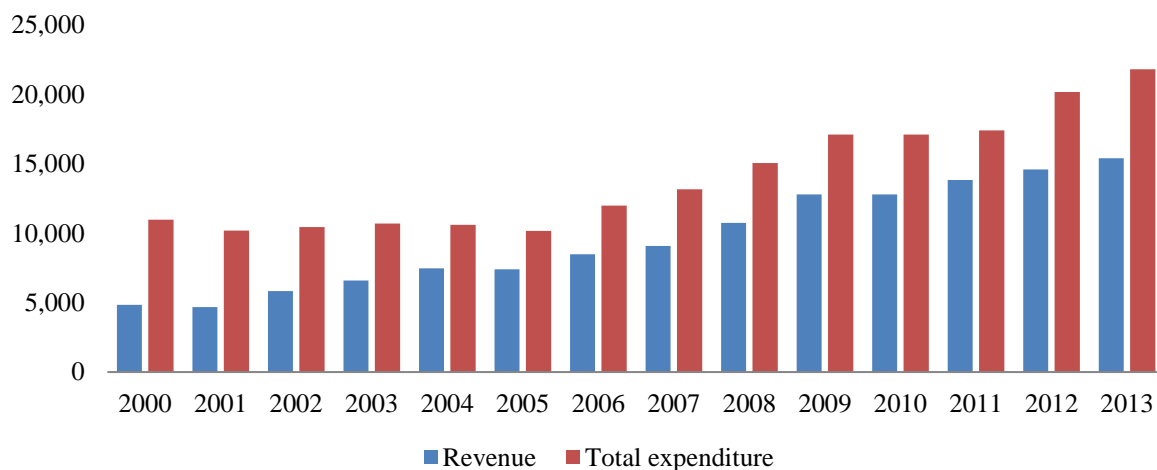
Source: Authors' analysis of IMF data; IMF projections for years after 2011.

Figure 6: Total Debt (LBP billion) and Debt to GDP (%), 1992–2014
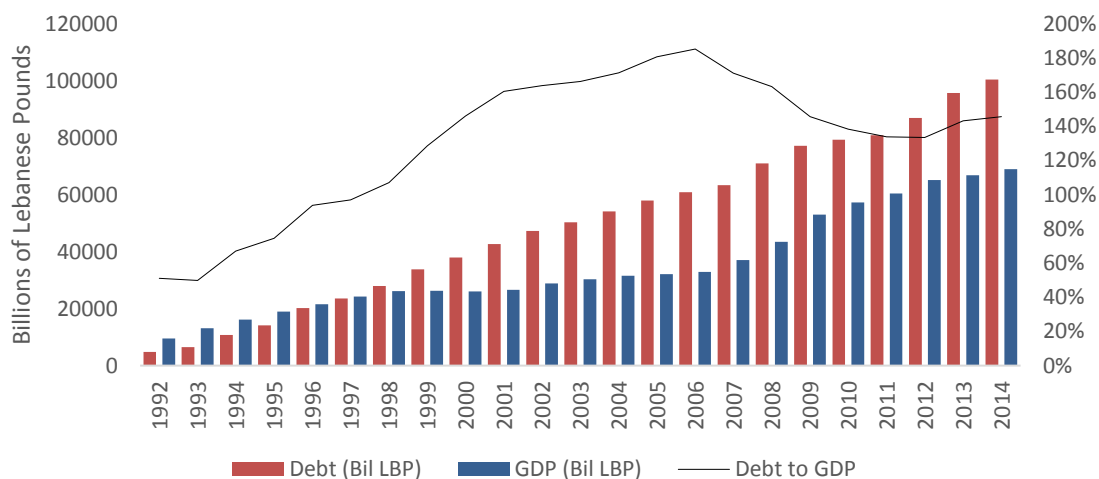
Source: Authors' analysis of data from World Bank's World Development Indicators and Central Bank of Lebanon.

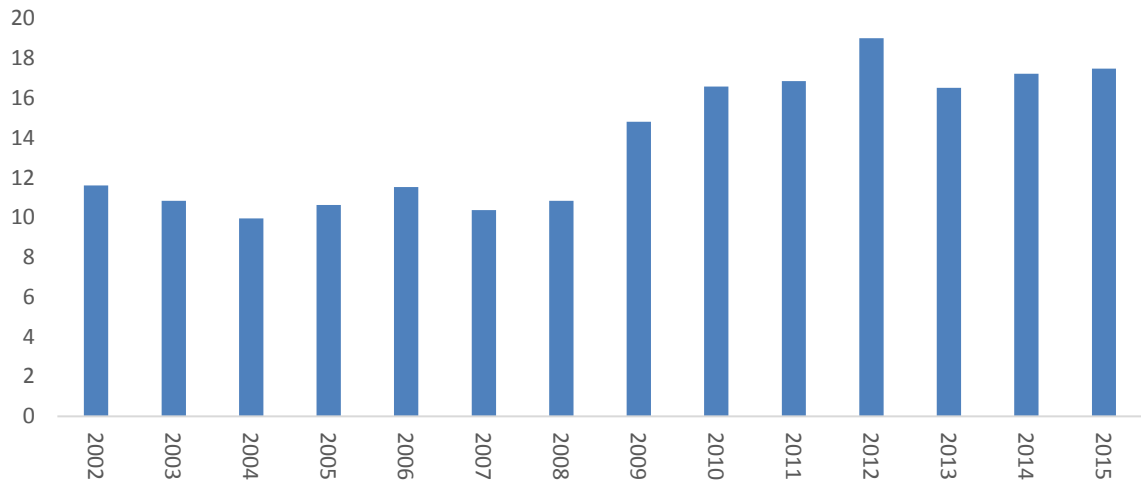**Figure 7: Composition of Lebanese Public Debt, 2005–2015 (LBP billion)**
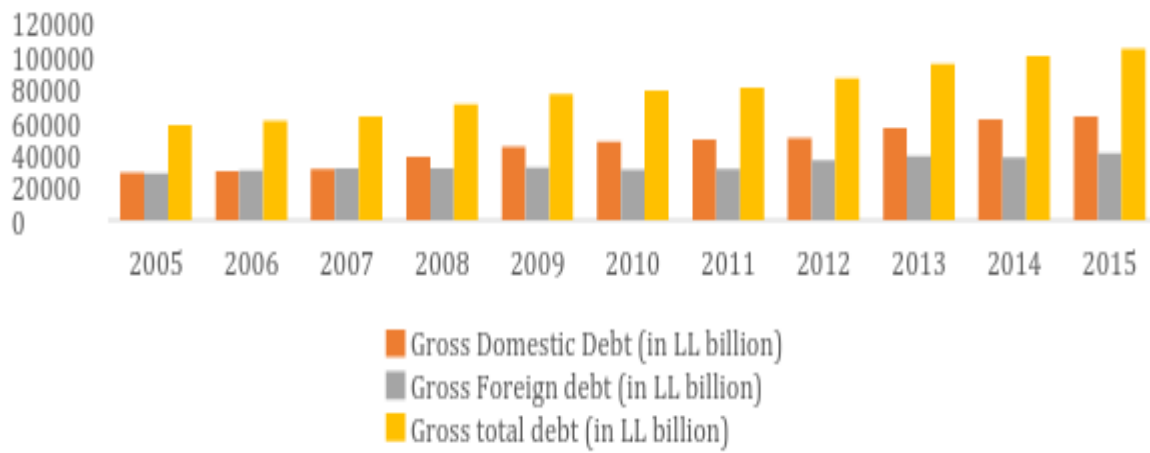
Source: Authors' analysis of data from Central Bank of Lebanon.

Figure 8: Imports and Exports of Goods and Services (US$ mil. at Constant 2005 price)
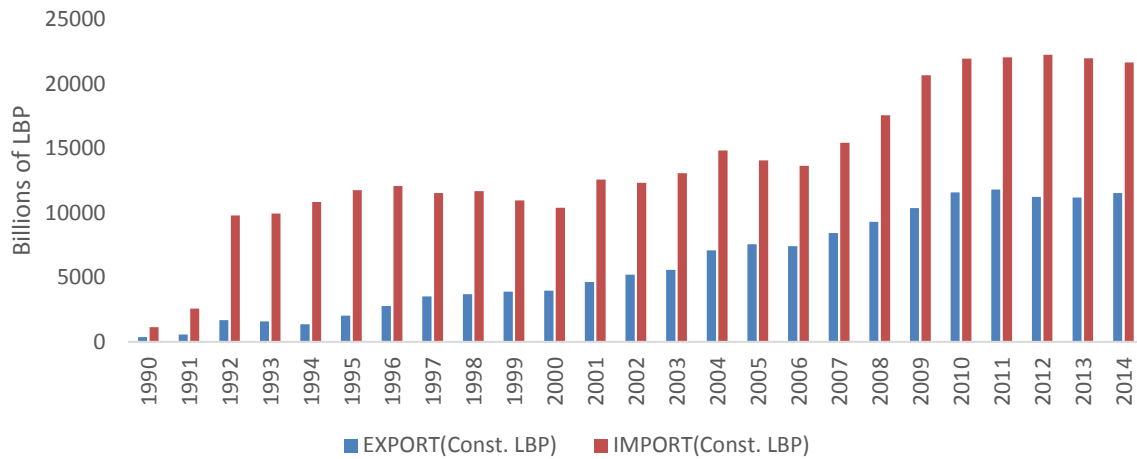
Source: Authors' analysis of World Bank's World Development Indicators data.

**Figure 9: Foreign Exchange Reserves (months of imports)**

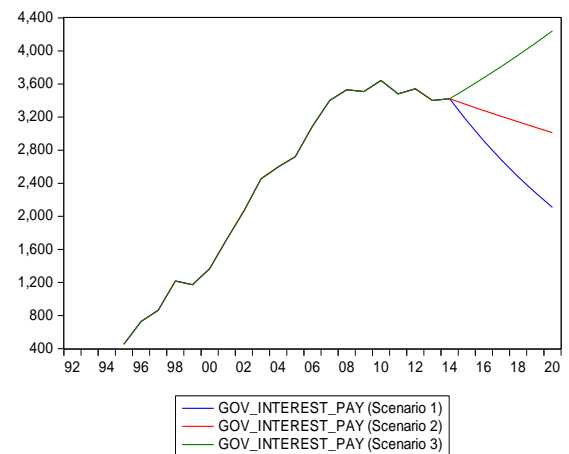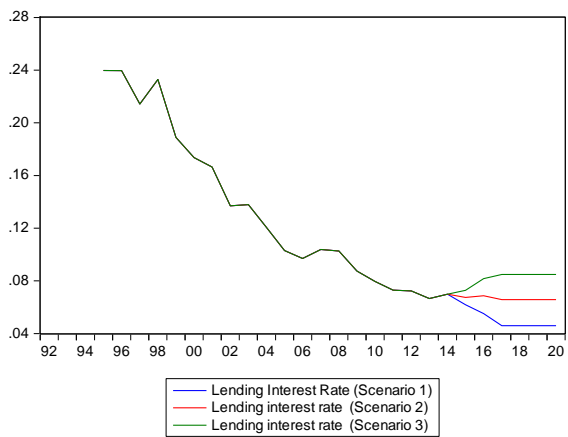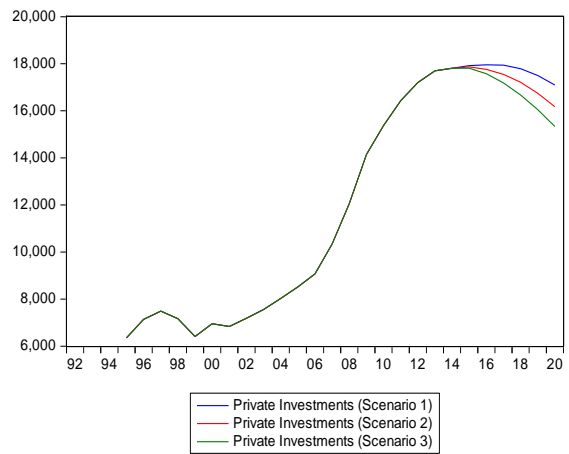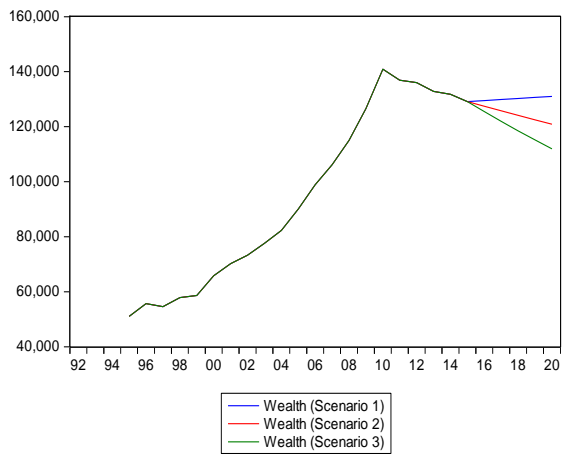Source: Authors' analysis of World Bank's World Development Indicators data. Reserves expressed in terms of the number of months of import of goods and services they could pay for [Reserves/(Imports/12)].

Figure 10: Remittances from Abroad
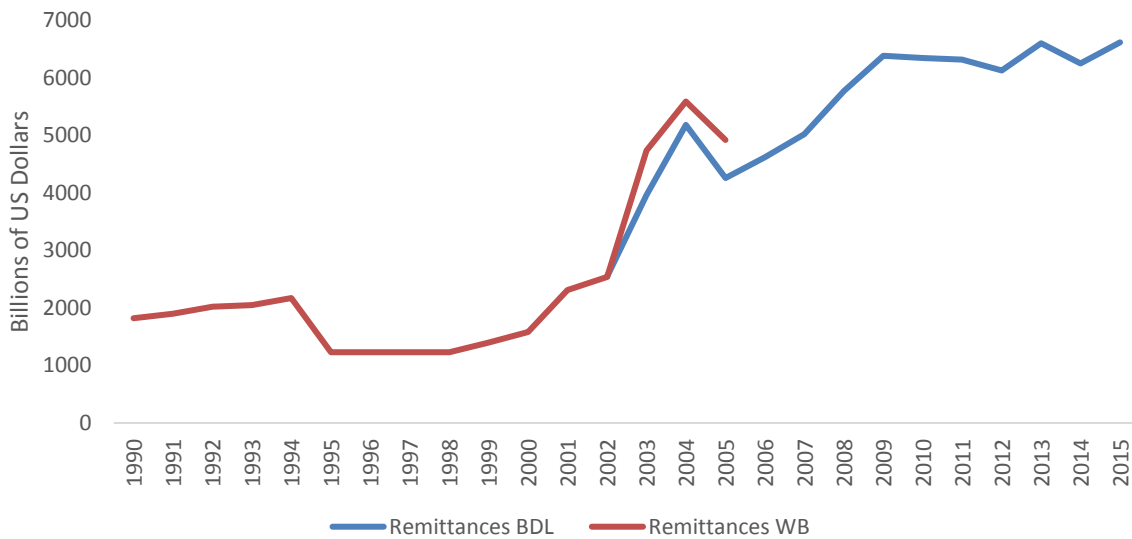
Source: Authors' analysis of Banque du Liban and World Bank estimates.

Figure 11: Simulation Results
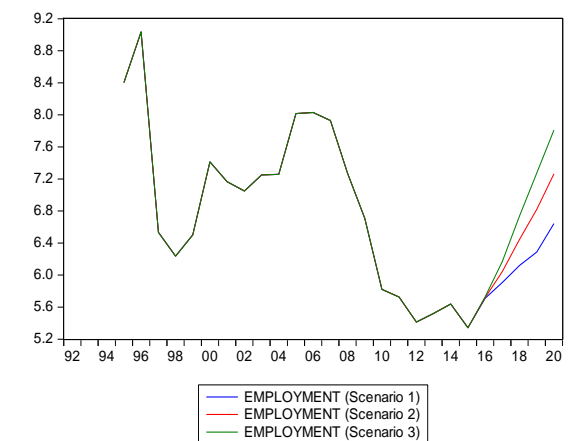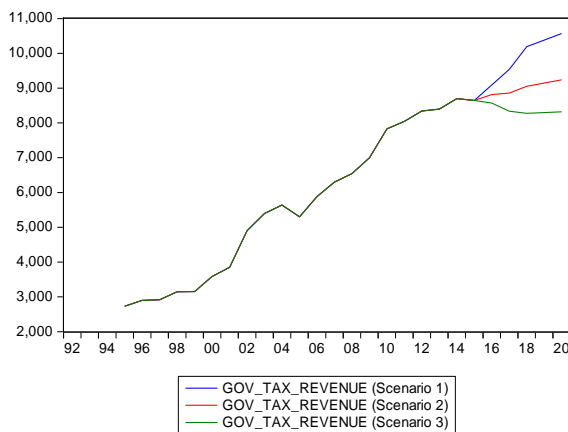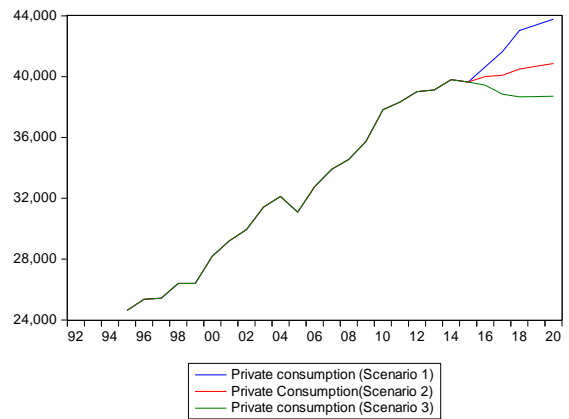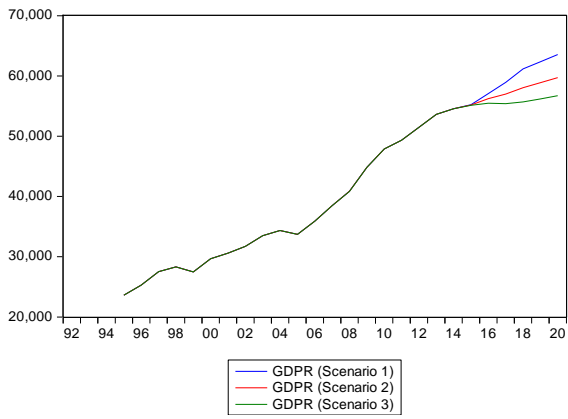
Note: The lines show in-sample forecasts (1992–2014) and out-of-sample forecasts (2014–2020) for one of three considered scenarios.

Table 1: Estimation Results

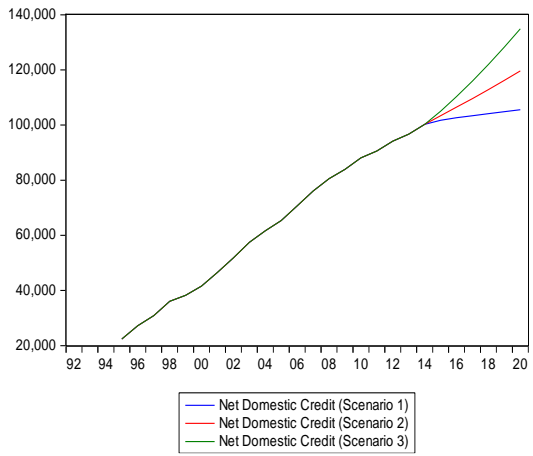| Eq.	Y	Estimated functional forms (βX)	N, R^2, F, DW
Macroeconomic block (N=21, 1994–2014)			
1	ΔUE	$\underset{(0.620)}{-1.555} \times \Delta Y^r_{t-1} + \underset{(0.282)}{0.613^{**}} \times \Delta Fragility_t - \underset{(0.087)}{0.303^{***}} \times Y1997_t + \underset{(0.032)}{0.085^{**}}$	21, 0.57, 7.49***, 1.91
2	ΔC	$\underset{(0.008)}{0.254^{***}} \times \Delta W_t - \underset{(0.007)}{0.135^{***}} \times \Delta i_{t-1} - \underset{(0.003)}{0.082^{***}} \times Hariri_t + \underset{(0.001)}{0.008^{***}}$	21, 0.99, 787.37***, 1.86
3	ΔW	$\underset{(0.153)}{-0.394^{**}} \times \Delta D_{t-1} + \underset{(0.071)}{0.210^{***}} \times Y1994_t - \underset{(0.042)}{0.125^{***}} \times Syria_t + \underset{(0.026)}{0.112^{***}}$	21, 0.52, 6.17***, 2.05
4	ΔI	$\underset{(0.364)}{-0.749^{**}} \times i_t + \underset{(0.008)}{0.018^{**}} \times \text{risk}_t + \underset{(0.112)}{0.075} \times Y1994_t - \underset{(0.187)}{0.317^*}$	22, 0.31, 2.75*, 2.11
Government block (N=21, 1994–2014)			
10	ΔTR	$\underset{(0.592)}{1.949^{***}} \times \Delta C_t + \underset{(0.101)}{0.193^*} \times Y_{VAT\,t} + \underset{(0.030)}{0.002}$	22, 0.43, 7.03***, 2.11
11	ΔGIP	$\underset{(0.579)}{1.455^{**}} \times \Delta D_t - \underset{(0.08)}{0.021}$	22, 0.29, 3.89**, 2.34
12	ΔFD	$\underset{(1.245)}{-2.665^{**}} \times \Delta ER_{USD\,t-1} + \underset{(0.039)}{0.129^{***}} \times BD_{t-1} - \underset{(0.049)}{0.186^{***}} \times Paris2_t - \underset{(0.322)}{0.786^{**}}$	21, 0.81, 23.73***, 2.39
13	ΔCOG	$\underset{(0.162)}{1.141^{***}} \times \Delta COG_{t-1} + \underset{(0.023)}{0.149^{***}} \times \Delta BD_{t-1} + \underset{(0.026)}{0.051^*} \times Paris1_t - \underset{(0.038)}{0.057}$	21, 0.83, 28.47***, 1.90
Prices block (N=21, 1994–2014)			
15	ΔCPI	$\underset{(0.189)}{0.451^{**}} \times \Delta CPI_{t-1} + \underset{(0.188)}{0.388^{**}} \times \Delta C_t + \underset{(0.032)}{0.039} \times Y1997_t + \underset{(0.011)}{0.006}$	21, 0.45, 4.69**, 1.75
Monetary and financial sector block (N=20, 1995–2014)			
16	$\Delta M2$	$\underset{(0.026)}{0.055^{**}} \times \Delta Y_{t-1} + \underset{(0.205)}{0.469^{**}} \times \Delta NFA_t - \underset{(1.047)}{1.801^*} \times \Delta i_{t-1} + \underset{(0.035)}{0.026}$	21, 0.41, 3.98**, 1.61
17	ΔNFA	$\underset{(1.151)}{2.846^{**}} \times \Delta Y^r_t - \underset{(0.091)}{0.167^*} \times \Delta BD_t - \underset{(0.219)}{0.411^*} \times Y1994_t - \underset{(0.085)}{0.077} \times Syria_t - \underset{(0.058)}{0.038}$	22, 0.48, 3.88**, 1.91
19	i	$\underset{(0.043)}{0.137^{***}} \times \Delta D_t + \underset{(0.028)}{0.195^{***}} \times \Delta D_{t-1} + \underset{(0.033)}{0.153^{***}} \times \Delta D_{t-2} - \underset{(0.008)}{0.055^{***}} \times Paris1_t + \underset{(0.010)}{0.121^{***}}$	20, 0.97, 157.24***, 1.53
20	ΔCPS	$\underset{(0.073)}{0.163^{**}} \times \Delta CPS_{t-2} + \underset{(0.012)}{0.038^{***}}$	20, 0.17, 4.97**, 1.97
21	ΔNDC	$\underset{(0.102)}{0.268^{**}} \times \Delta NDC_{t-1} + \underset{(0.122)}{0.398^{***}} \times \Delta D_t + \underset{(0.015)}{0.021}$	21, 0.65, 18.97***, 2.06
External accounts block (N=21, 1994–2014)			
22	ΔIm	$\underset{(0.031)}{0.215^{***}} \times \Delta Ex_t + \underset{(0.211)}{-0.817^{***}} \times \Delta ER_{USD\,t} + \underset{(0.020)}{-0.135^{***}} \times Y1997_t + \underset{(0.004)}{0.013^{***}}$	22, 0.77, 27.03***, 2.19
23	ΔEx	$\underset{(0.649)}{2.030^{***}} \times \Delta Im_{t-1} + \underset{(0.112)}{0.019} \times Y1997_t + \underset{(0.031)}{0.020}$	21, 0.40, 5.97***, 2.39

Note: Time subscripts omitted for clarity of presentation unless time lags are used. All (non-binary) economic variables are in logarithmic form except for lending rate (eq.4 & 16) and economic risk (eq. 4). Coefficients are significant at *p<0.10; **p<0.05; ***p<0.01%, two-sided *t*-tests. Regular standard errors are in parentheses.

Annex: Variable Definitions

Macroeconomic block		**Mean (SD)**
UE	Aggregate unemployment (percentage)	7.60 (0.90)
Y	Nominal GDP (Nominal Values)	38,834.00 (20,208.38)
Y^r	Real GDP – gross value added by all resident producers plus product taxes minus subsidies excluded from product value; constant 2005USD purchasers' prices [bil LBP]	34,668.40 (10,825.00)
C	Private consumption –final consumption expenditure; market value of all goods & services, including durable products & imputed rent for owner-occupied dwellings, payments & fees to governments for permits & licenses; excludes dwellings; also includes expenditures of nonprofit institutions serving households	30,465.30 (5,954.00)
I	Private investment – Gross fixed capital formation in private sector	8,851.00 (3,686.30)
GCE	Governmental capital expenditure	753.50 (329.30)
GNI	Gross National Income	29,347.50 (11,672.30)
W	Wealth – net foreign assets plus currency in circulation minus domestic debt	81,843.00 (34,967.90)
NIFA	Net income from abroad – net labor, property & entrepreneurial income components of System of National Accounts; Labor income covers compensation to nonresident workers; Property & entrepreneurial income covers ownership of foreign fin claims (interest, dividends, rent, etc.) and nonfin property income (patents, copyrights, etc.)	-220.70 (1,161.58)
Government block		
GTR	Government total revenues – tax & non-tax	7,130.00 (3,065.00)
TR	Tax revenues – compulsory transfers to central gov for public purposes, excluding fines, penalties & most social security contributions; refunds and corrections of erroneously collected tax revenue are treated as negative revenue	5,699.80 (2,622.20)
NTR	Non-tax revenues – gov total minus tax revenue	2,929.50 (1,582.00)
GTP	Government total payments – interest & non-interest payment	10,157.00 (2,788.90)
GIP	Government interest payments	3,370.60 (2,110.20)
GNI	Government non-interest payments – final consumption expenditure; all government current expenditure for purchase of goods & services & employee compensation, including most expenditures on national defense & security, excluding government military expenditures from government capital formation	6,379.30 (1,679.07)
D	Government stock of debt – direct fixed-term contractual obligations, including domestic & foreign liabilities such as currency, money deposits & securities	46,821.40 (23,478.90)
BD	Budget deficit – government total expenditure minus total revenue	2,640.80 (1,385.50)
COG	Claims on government – loans to central gov. institutions net of deposits	28,658.90 (19,984.90)
T-Bill	Treasury bills (Percent)	9.53 (5.50)
tbr	Treasury bills interest rates (percent)	*18.70 (0.12)*
Prices block		
CPI	Consumer price index – changes in the cost to the avg consumer of acquiring a basket of goods & services; Laspeyres formula used (Percent)	1.14 (0.31)
Pdef	GDP implicit deflator – GDP in current local currency / GDP in constant local currency (Percent)	113.00 (27.00)
Monetary and financial sector block		
M1	Narrow/liquid money	3,968.80 (1,922.20)
M2	Quasi broad money – Net foreign & net domestic assets	26,448.50 (14,188.53)
M3	Broad money	68,487.99 (34,932.70)
Mq	Quasi-liquid money	23,249.10 (12,972.80)
CPS	Claims on the private sector – gross credit from fin. system to individuals, enterprises, nonfan. public entities excluded under net domestic credit & fin. institutions excluded elsewhere	28,784.70 (13,383.90)
NFA	Net foreign assets – foreign assets held by monetary authorities & deposit money banks, less foreign liabilities	27,875.20 (13,257.30)
NDA	Net domestic assets	2,035.50 (9,414.05)
i	Lending interest rate – bank rate usually meeting short- & medium-term financing needs of private sector (percent)	15.40 (8.50)
External accounts block		
Im	Imports – Value of all goods & market services received from the rest of the world; merchandise, freight, insurance, transport, travel, royalties, license fees & other services, such as communication, construction, financial, information, business, personal & government services; excludes compensation of employees, investment income & transfer payments	17,214.60 (4,025.10)
Ex	Exports – value of all goods & market services provided to the rest of the world	7,474.40 (3,878.00)
TB	Trade balance – external balance on goods & services equals exports of goods and services minus imports of goods and services	-8,502.50 (1,495.00)
ER	Exchange rate	1,535.30 (74.99)
rD	Debt interest rate (percent)	6.6 (2.90)
CA	Current account balance is the sum of net exports of goods and services, net primary income, and net secondary income.	4,205.20 (2,372.50) 1,081.90 (4,351.90)
BOP	Balance of Payment calculated as: BoP = NFA – NFA (-1)	

Notes: Time subscripts omitted for clarity of presentation. All variables are in constant Lebanese pounds unless mentioned otherwise.