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# Macroeconomic Implications of Windfall Oil and Gas Revenues in Lebanon

## Jad Chaaban and Jana Harb

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## **Executive summary**

The potential for a major discovery of offshore hydrocarbon resources in Lebanon raises concerns about its macroeconomic implications, specifically the Dutch disease phenomenon. This paper first explores whether the Lebanese economy has already been experiencing a Dutch disease episode since the early 1990s due to massive sustained capital inflows fueled by regional petro-dollar income. Using macroeconomic annual data, we find that capital inflows have been accompanied by two Dutch disease symptoms: Real exchange rate appreciation and shrinkage of the manufacturing and agriculture sectors. The paper then explores the likely effects of a resource boom on the economy. Given current lax fiscal planning in Lebanon, it is assumed that resource wealth might translate into an expansionary fiscal policy. Using a Vector Error Correction model on monthly macroeconomic data, a rise in the budget deficit through Impulse Response Functions is simulated to forecast its impact on the economy. The result is that a permanent increase in the budget deficit by 1% leads, over a three-year forecast period, to a real exchange rate appreciation by 1%. Estimated results indicate that a resource boom in Lebanon will further exacerbate Dutch disease effects under an expansionary fiscal regime. The simulations of alternative policy options (such as the establishment of a sovereign wealth fund or investment in infrastructure) clearly demonstrate that economic growth would be achieved and the negative impacts of the resource curse avoided. The paper concludes by recommending economic policy measures that could be implemented in conjunction with the development of offshore hydrocarbon resources.

## Introduction

The diverse experience of resource-rich countries suggests that natural resource wealth is a mixed blessing. While some countries have been successful in transforming such wealth into sustained economic growth and development, many others have been cursed by it. It is common sense to believe that natural resource abundance could positively contribute to economic progress and poverty reduction. Yet, if not managed properly, riches accrued from natural resources are believed to have undesirable effects on resource-rich economies. These include what is referred to in the literature as 'Dutch disease'. This widely researched economic phenomenon links the increased exploitation and reliance on natural resources with the systematic decline in other economic sectors, specifically agriculture and manufacturing. Resource revenues typically inflate the value of local currency and make other non-resource exports less competitive. At the same time, the economy will be geared toward one sector that absorbs all the resources, labor, and attention of policymakers, which eventually reduces investments in other sectors of the economy. These symptoms are even more dangerous in countries with weak and corrupt institutions, non-democratic regimes, and weak financial systems (Van der Ploeg 2010).

The discovery of potential hydrocarbon resources off the shores of Lebanon raises concerns about the realization of Dutch disease within the economy. This paper seeks to forecast the potential implications of a resource boom in Lebanon on the economy, especially in light of an ongoing Dutch disease-like scenario within the Lebanese economy.

The paper first argues that Lebanon may have already been undergoing a Dutch disease episode since the early 1990s. The literature on Dutch disease has demonstrated that this phenomenon may also stem from other large sustained foreign exchange inflows such as foreign aid, remittances, and foreign direct investment, sourced mostly through petrodollar regional income from GCC countries. Since the end of its civil war, Lebanon has been receiving massive capital inflows every year. Using recent macroeconomic annual data, we show that the real exchange rate has appreciated over the past two decades and seems to be caused by substantial foreign inflows into the economy. This period has also been accompanied by a contraction of the agriculture and manufacturing sectors and a distortion of economic activity in favor of the financial and real estate investment sectors.

The paper then demonstrates that the likely effects of offshore hydrocarbon exploration on the Lebanese economy will be a worsening of current economic outcomes unless deep structural and public policy reforms are implemented. A natural resource boom is simulated by making the following underlying assumption: If appropriate policy

responses are not adopted, then the accrued oil and gas windfall revenues will lead to an expansionary fiscal policy through a rise in public spending in light of current fiscal planning, or lack thereof, in Lebanon. Thus, the likely impacts of the resource boom on the Lebanese economy are assessed by forecasting the implications of a rise in the budget deficit on the real and monetary sectors of the economy. Employing a simple time-series cointegration framework, we first estimate a Vector Error Correction model on monthly selected macroeconomic data in order to evaluate the long-run relations as well as short-run dynamics between fiscal and monetary outcomes. The impact of an increase in the budget deficit on these macroeconomic variables is then simulated through Impulse Response Functions by using the estimated parameters of the model. It is found that a permanent positive shock in the budget deficit—an exogenous increase of about 1 percentage point of budget deficit that is sustained over time—causes the real exchange rate to be about 1 percentage point higher at the end of a three-year forecast period. This permanent shock in budget deficit will also lead to an equivalent rise in inflation and decline in real GDP. The results from the estimated model indicate the presence of Dutch disease symptoms following a resource boom. We also simulate alternative policy scenarios to managing windfall revenues, such as the creation of a sovereign wealth fund or investments in infrastructure. These empirical simulations show through a simple macroeconomic adjustment model that fiscal and economic policies in the face of an oil boom play a substantial role in determining the impact of this boom on the economic structure of the country.

The rest of the paper is organized as follows: Section one reviews the related theory and evidence; section two evaluates economic performance in Lebanon in recent decades to assess whether there was already a case of Dutch disease; section three presents and estimates a dynamic model to forecast the impact of a resource boom on the economy; and section four concludes and presents some policy recommendations.

## **I Economics of Dutch disease: Theoretical overview and empirical evidence**

### **a Theoretical overview**

The term ‘Dutch disease’ originated in the 1970s to describe the shrinkage of the manufacturing sector and increasing unemployment in the Netherlands following the discovery of natural gas in the North Sea. Today, it is used to reference a phenomenon in which large inflows of foreign currency cause an appreciation of the real exchange rate and consequent loss of export competitiveness.

The theoretical framework for studying Dutch disease was first developed by Corden and Neary (1982) who analyzed the changes in an economy following a boom in the natural resource sector (such as a resource discovery or an increase in the international price of a commodity). Their model is a small open economy consisting of a natural resource sector, a non-resource tradables sector (traditionally agriculture and manufacturing), and a non-tradables sector (traditionally services). The price of tradable goods is set and fixed in the world market while that of the non-traded goods is flexible and domestically determined to attain supply and demand equilibrium in the non-tradables market. They break down the effects of the boom into two principal types: Resource movement effect and spending effect. In the short-run, reflected by the case where only labor is mobile between all sectors, these two effects combined lead to shrinkage of the non-resource tradables sector and appreciation of the real exchange rate (RER), where RER in this framework is defined as the relative price of non-tradables to tradables.

**Resource Movement Effect:** When the resource sector experiences a boom, its demand for labor increases, and is consequently drawn out of the other two sectors. Hence, employment declines in the non-resource tradables sector, which leads to a decline in output in that sector. This shift in labor from the rest of the economy to the booming sector is called direct de-industrialization. Similarly, output in the non-tradables sector falls but now the price of non-tradables must increase in order to eliminate excess demand and reestablish equilibrium in that market. Given that the price of tradables is fixed at the world price, then a rise in the price of non-tradables causes an appreciation of the RER.

**Spending Effect:** A resource sector boom results in an increase in aggregate domestic income, which in turn increases aggregate demand for goods in an economy, including non-tradables. As in the previous case, the price of non-tradables must rise in order to restore market equilibrium, thus raising the level of output in that sector and leading to an appreciation of the RER.

The fall in supplied non-tradables due to the resource movement effect combined with the rise in demanded non-tradables due to the spending effect leads to a final equilibrium with an even higher non-tradables price level. This real appreciation causes demand for labor in that sector to increase and consequently wages to increase as well. The wage increase will now divert more labor away from the non-resource tradables sector and into the non-tradables sector, causing the latter to expand and the former to shrink. This effect on the non-resource tradables sector is called indirect de-industrialization. The overall decline in the output of non-resource tradables, rise in

domestic demand for these non-resource tradables due to the spending effect and inflexibility of their international price level, leads to an excess domestic demand that can only be satisfied by increasing imports, thus deteriorating the balance of trade.

In summary, a resource sector boom leads to an appreciation of the RER, i.e., a rise in the price of non-tradables relative to the price of tradables, as well as direct and indirect de-industrialization of the non-resource tradables sector, i.e., a fall in sectoral employment and output and a worsening of the balance of trade. The impact of the boom on the non-tradables sector, however, is ambiguous and depends on the relative magnitudes of the two principal effects.

#### **b Empirical overview**

The empirical evidence on the existence of Dutch disease due to increased foreign exchange inflows is mixed. For instance, Spatafora and Warner (1999) examine the impact of favorable terms-of-trade shocks in eighteen oil-exporting developing countries during the period 1965-1989. They find evidence of the spending effect with an appreciation of the real exchange rate and an expansion of the non-tradables sector. However, they find no support for the resource movement effect and no contractions in either the manufacturing or the agriculture sector. Hence, they conclude that Dutch disease effects are weak. Similarly, Harvey (1992) studies the economy of Botswana following the discovery of large diamond deposits and finds that it has not suffered from Dutch disease effects. Sala-i-Martin and Subramanian (2003) investigate the 'natural resource curse' in Nigeria and find that although Nigeria's economy has suffered from dismal performance, the adverse impacts following the discovery of oil are a result of waste and corruption stemming from weak institutions, rather than from Dutch disease.

Recent literature, however, has been pointing to the presence of Dutch disease effects stemming from resource windfalls. Ismail (2010) derives from a static model and then empirically tests structural implications of Dutch disease in oil-exporting countries due to a permanent increase in oil prices. Using disaggregated manufacturing sector data for ninety countries over the period 1977-2004, he finds strong evidence for the existence of Dutch disease where a 10% increase in the size of oil windfalls decreases value added and output across manufacturing by 3.4% and 3.6% respectively. Brahmhat et al. (2010) create a Dutch disease measure by comparing the actual size of the tradables (manufacturing and agriculture) sector to a constructed counterfactual size—i.e., what the size of the tradables sector would have been in the absence of natural resources. Using the Chenery-Syrquin norm to estimate the counterfactual, they create this Dutch



disease measure for all resource- and non-resource-rich countries during the period 1975-2005. They find that, on average, resource-rich countries have a tradables sector that is lower than the norm by approximately 15 percentage points of GDP.

From a slightly different angle, Harding and Venables (2013) study the impact of foreign exchange windfalls on trade and balance of payments outcomes. Using panel data on forty-one resource exporters for the period 1970-2006, they find that non-resource exports are crowded out by natural resource exports where on average, one extra dollar of resource revenue decreases non-resource exports by 75 cents and increases non-resource imports by 25 cents. Their findings show that out of all tradables, manufacturing are the most susceptible to this crowding-out effect—compared to agriculture, food, or services. In addition, this impact is greater in higher income countries and in countries with stronger institutions, which could partly be due to the fact that manufacturing makes up a larger share in total non-resource exports in these countries.

In addition to resource booms, other foreign currency inflows such as Foreign Direct Investment (FDI), foreign aid, and remittances have been shown to induce Dutch disease effects. For instance, to examine whether and what capital inflows cause an appreciation of the real exchange rate, Lartey (2007) develops and estimates static and dynamic autoregressive distributed lag real exchange rate models using data for sixteen sub-Saharan African countries for the period 1980-2000. The study finds evidence of Dutch disease effects due to increases in the inflow of both FDI and Official Development Assistance (ODA) with a 1% increase in each of the FDI and ODA inflows in a given year causing an appreciation of the real exchange rate by about 0.05% and 0.1% in the following year, respectively. Similarly, Rajan and Subramanian (2009) find that aid inflows have adverse effects on the manufacturing sector's relative size and growth through the appreciation of the real exchange rate. Estimating a Dynamic Stochastic General Equilibrium model of a small open economy and using data for El Salvador, Acosta et al (2009) find evidence of Dutch disease effects due to an increase in remittances where the latter causes a fall in labor supply and an increase in demand for non-tradable goods, thus leading to a real exchange rate appreciation and a reallocation of labor from the tradables to the non-tradables sector. Magud and Sosa (2010) review the large empirical literature on Dutch disease and find that overall the evidence points to its existence whereby increased foreign exchange inflows (natural resource booms, sustained foreign aid, remittances or capital inflows) cause a real exchange rate appreciation, factor reallocation, as well as a reduction in manufacturing output and exports.

c **Development implications of Dutch disease**

A large body of the literature on natural resource booms has debated whether these booms are effectively a blessing or a curse. An increase in natural resource windfalls could have many positive effects on an economy such as higher national income, higher consumption of goods, and greater capabilities to invest in public goods, among others. On the other hand, when a resource boom or more generally a surge in foreign exchange inflows is not managed properly, then the negative indirect effects could very well outweigh the direct positive effects of these windfalls on economic growth and development.

A strand of this literature argues that Dutch disease does not only hamper the growth of the non-resource tradables sector but also that of the entire economy, based on the proposition that the tradables sector is typically the source of special growth-enhancing qualities such as learning-by-doing, increasing returns to scale production, and other positive externalities (Brahmbhatt et al. 2010, Rajan and Subramanian 2005). Hence, when a natural resource boom depresses the manufacturing sector, it also depresses the productivity and profitability of investments and ultimately slows long-term growth (Sachs and Warner 1999, Gylfason 2000). For instance, Sachs and Warner (1999) developed a model to study the impact of a resource boom on growth and showed that the former can negatively impact the latter through Dutch disease effects when the tradables sector depicts increasing-returns-to-scale (IRS). However, when IRS production is in the non-tradables sector, a resource boom could lead to higher growth. Testing their model empirically on seven countries from Latin America, Sachs and Warner find that resource booms most of the time are associated with declining GDP per capita, although the channels through which this works might not be limited exclusively to Dutch disease. Similarly, looking at eighty-six countries for the period 1965-1998, Gylfason (2001) finds that economic growth and natural resource abundance are inversely related, where a 10% point increase in natural resource abundance from one country to another is associated on average with a 1% point decrease in per capita GNP growth per year. Magud and Sosa (2010), on the other hand, conclude otherwise. They examine whether Dutch disease has adverse effects on long-term growth by reviewing the theoretical and empirical literature. They do not find strong conclusive evidence suggesting that the tradables sector (manufacturing) enjoys said special growth-enhancing qualities. Consequently, they conclude that Dutch disease does not necessarily reduce overall economic growth because the beneficial effects stemming from the positive wealth effect could potentially outweigh the adverse effects of the disease.

A natural resource boom entails more specialization in the resource

sector and less specialization in the non-resource tradables sector through the Dutch disease phenomenon. This, combined with the fact that prices in the world market are more volatile for primary commodities, makes the economy more susceptible to fluctuations, which in turn creates uncertainty for investors and consequently discourages investment and depresses growth (Papyrakis and Gerlagh 2004, Van der Ploeg and Poelhekke 2009). Moreover, if natural resources are a major source of income, then volatility in their prices will lead to volatility in revenues and hence volatility in government spending, which further increases macroeconomic volatility and as a result worsens growth performance (Van der Ploeg and Poelhekke 2009). Furthermore, volatility in government spending induces volatility in the real exchange rate through the spending effect of Dutch disease (Brahmbhatt et al. 2010). Volatility in the real exchange rate further reduces investment and productivity in the non-resource tradables sector, thus amplifying Dutch disease effects (Gylfason et al. 1999). More generally, real exchange rate volatility can hamper long-term productivity growth in the entire economy, especially in countries with weak financial development (Aghion et al. 2006). Servén (2002) empirically tests the relationship between uncertainty in the real exchange rate and private investment and finds that the former significantly and negatively impacts the latter. Moreover, this impact is much larger in countries with a higher degree of trade openness and weaker financial systems.

Natural resource booms could further hinder economic growth through inhibiting investment in human capital. By decreasing the scale of the manufacturing sector, a resource boom (if not coupled with local investments in skilled labor within the resource industry) discourages investment in high-quality education since manufacturing has a higher demand for a high-skilled labor force compared to the expanding resource sector. Hence, both demand and returns to education fall, thereby impeding future growth of any sectors that demand a high-skilled labor force as well as impeding technological diffusion (Gylfason et al. 1999, Papyrakis and Gerlagh 2004).

## **II Lebanon's economic performance in recent decades: Was there already Dutch disease?**

There is substantial evidence that the Lebanese economy has been benefiting from massive foreign inflows, originating mostly from expatriates in the GCC, in addition to transfers from GCC governments and private sector entities. For this, a clear link has been established between petrodollar income in the GCC and foreign transfers in the country, either through direct budgetary aid, bank deposits, or foreign direct investments (Berthelemy et al. 2007, Finger and Hesse 2009).

The objective of this section is to explore the determinants of RER appreciation in the Lebanese economy in the wake of these transfers, which indirectly point to the impact of oil and gas revenue on the Lebanese economy, through the indirect channels of capital transfers highlighted above. To this end, we compile and evaluate macroeconomic annual data spanning the following fields and variables, for the years 1993-2011:

Macroeconomic indicators:

- Real GDP growth in percentage (%) (REAL\_GDP—source: United Nations Conference on Trade and Development [UNCTAD]).
- Real Exchange Rate y-o-y change % (RER—based on IMF and Consultation and Research Institute [CRI] inflation data).
- Inflation: y-o-y change in consumer prices % (INFL—source: CRI).

Foreign inflows:

- Bank deposits of non-residents/GDP % (DEP—source: Banque du Liban [BDL]).
- Migrants' remittances/GDP % (REMIT—source: UNCTAD).
- Foreign Direct Investment inflows/GDP % (FDI—source: UNCTAD).
- Trade deficit/GDP % (TD—source: UNCTAD).

Monetary and fiscal variables:

- Money supply: Money and quasi-money M2/GDP % (M2—source: BDL).
- Public sector revenues/GDP % (REV—source: Ministry of Finance [MoF]).
- Public sector expenditure/GDP % (EXP—source: MoF).
- Public Deficit/GDP % (DEF—source: MoF).

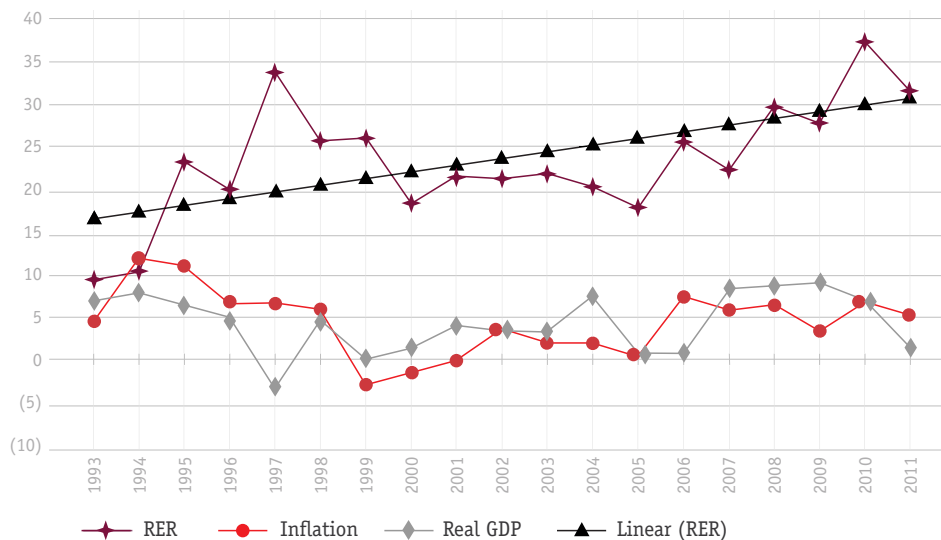
Sectoral composition of production:

- Agricultural value added as share of GDP % (VA\_A—source: UNCTAD).
- Industrial value added as share of GDP % (VA\_M—source: UNCTAD).
- Services value added as share of GDP % (VA\_S—source: UNCTAD).

Main findings:

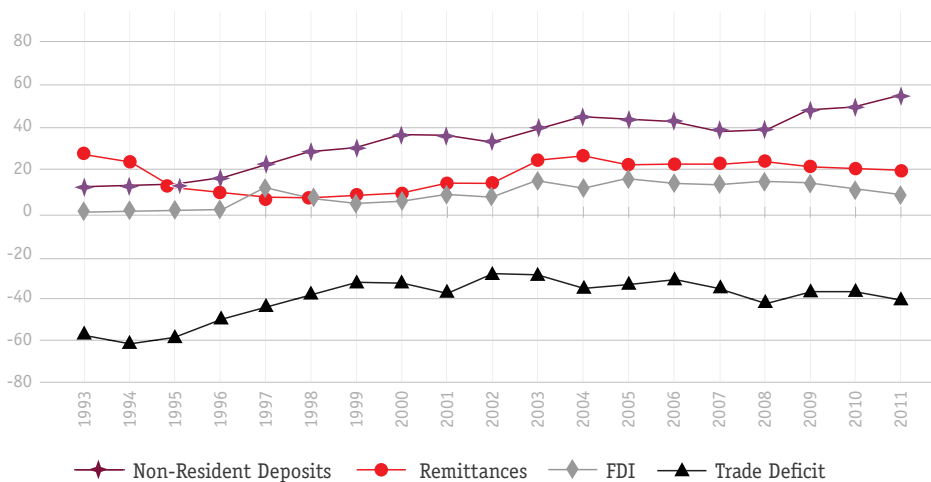
The annual data confirms that the real exchange rate appreciated during the past two decades. Data for 1993-2011 show fluctuations around a clear upward trend. Inflation and real GDP growth also fluctuated near an annual average of 4.5% (figure 1).

Figure 1 Annual variation in real exchange rate (RER), inflation, and real GDP



RER appreciation, a typical symptom of Dutch disease, seems to be caused by substantial foreign inflows into the Lebanese economy. Nonresident deposits grew at an average annual rate of 8%, up from 12% of GDP in 1993 to 55% in 2011. Remittances and foreign direct investment increased at a slower rate (below 5% annual growth), and the trade deficit narrowed until 2002 and then started an upward trend, reaching almost 40% of GDP in 2011 (figure 2).

Figure 2 Annual variation in non-resident deposits, remittances, FDI, and trade deficit



A simple correlation analysis shows that nonresident deposits and FDI are strongly positively correlated with the real exchange rate in the Lebanese economy. Real GDP growth seems to be correlated with remittances, confirming the high dependence of the economy on private consumption (table 1).

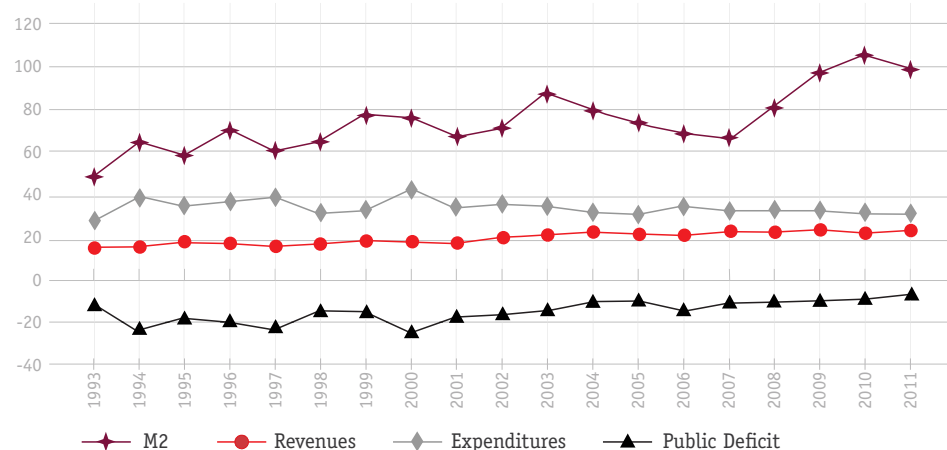
Table 1 **Macroeconomic correlation matrix**

	Non-Resident Deposits	Remittances	FDI	Trade Deficit	RER	Inflation	Real GDP
Non-Resident Deposits	1.0000						
Remittances	0.3105	1.0000					
FDI	0.7970*	0.3675	1.0000				
Trade Deficit	0.7527*	-0.0302	0.7226*	1.0000			
RER	0.5454*	-0.2386	0.5404*	0.3876	1.0000		
Inflation	-0.4427*	0.1433	-0.2918	-0.6730*	0.0145	1.0000	
Real GDP	-0.0868	0.4950*	-0.1229	-0.3756	-0.2353	0.3785	1.0000

\* Results are significantly different from zero at the 10% level

The symptoms of Dutch disease in Lebanon also seem to appear in the monetary and fiscal fields. Money supply has substantially increased over the past two decades as a clear response to increased deposits and higher needs for domestic financing of consumption (figure 3).

Figure 3 **Annual variation in M2, revenues, expenditures, and public deficit**



Simple correlation relationships show for the data at hand that RER and money supply (M2) are strongly positively correlated, confirming that Dutch disease-type mechanics are at work. The public sector deficit seems to be only correlated with M2, also confirming the linkages between lax fiscal policy and monetary expansion (table 2).

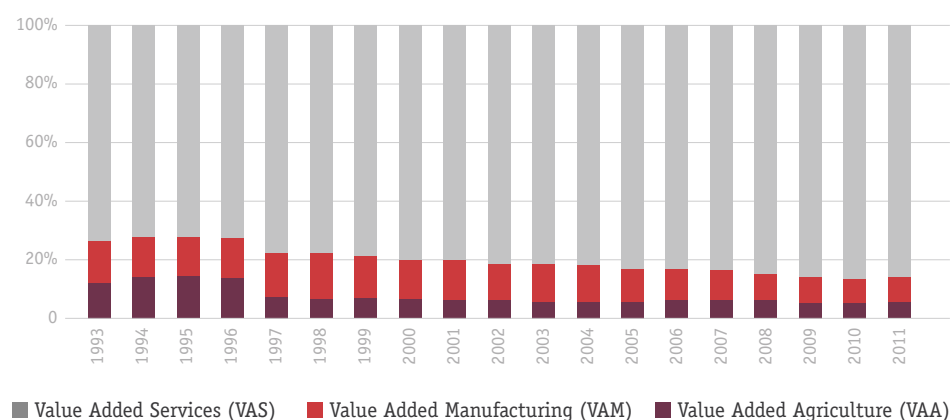
Table 2 Correlation matrix real exchange rate (RER), inflation, M2, and public deficit

	RER	Inflation	M2	Public Deficit
RER	1.0000			
Inflation	0.0145	1.0000		
M2	0.6022*	-0.2702*	1.0000	
Public Deficit	0.2855	0.2855	0.4744*	1.0000

\* Results are significantly different from zero at the 10% level

Lastly, the resource movement effects of Dutch disease affecting the Lebanese economy can clearly be seen by examining the sectoral allocation of value added. Agricultural and manufacturing value added as a share of GDP have decreased by 3% annually over the period 1993-2011, while the value added of the services sector has increased by 1% on an annual basis, reaching more than 80% in 2011 (figure 4).

Figure 4 Annual variation in sector-level value added



The correlation matrix in table 3 confirms a strong relationship between RER and value added.

Table 3 Correlation matrix, RER and VA by sector

	RER	VAS	VAA	VAM
RER	1.0000			
VAS	0.6124*	1.0000		
VAA	-0.5525*	-0.8797*	1.0000	
VAM	-0.5027*	-0.7767*	0.4116*	1.0000

\* Results are significantly different from zero at the 10% level

The above analysis has demonstrated using recent macroeconomic data from Lebanon that the country is already suffering from symptoms of Dutch disease, namely through massive sustained foreign inflows received every year (Chami et al. 2003, Chaaban 2009). The impact of these inflows (remittances, non-resident bank deposits, and foreign direct investment) on the real and monetary sectors of the economy was explored using simple descriptive statistics. The next section integrates these findings to better forecast the potential implications of an oil and gas revenue boom, in light of ongoing 'Dutch disease' within the Lebanese economy.

### III Dynamic model of windfall oil and gas revenues

The discovery and extraction of oil and gas off the shores of Lebanon would ultimately translate into a boom in revenues for the government, which under current conditions, including a lack of fiscal planning, could easily translate into an uncontrolled expansionary budget policy. Yet, this should not always be the case, as the government can opt, like in other successful oil revenue management models, to create a sovereign wealth fund to boost local financial reserves and smooth spending. It could also opt for an ambitious energy substitution program with massive upgrades in electricity generation infrastructure by shifting from import-dependent fuel oil production to cheaper and cleaner natural gas produced locally. In this section, we seek to model and simulate the impact of an increase in public revenues following oil and gas exploration on the Lebanese economy, using a simple time-series model applied on monthly available macroeconomic data. We focus on the following variables that will be included in the analysis:

- **Budget Deficit:** Defined in this section as public expenditures minus revenues. We apply a moving average based on an annual sliding scale smoothing for the budget deficit monthly data, in order to capture year-on-year delays in expenditure (as per the Lebanese public fiscal decision-making process). This is obtained from the Ministry of Finance.
- **Money Supply:** Defined as a money and quasi-money M2 measure as provided by the central bank.
- **Real GDP:** Real GDP is computed monthly by applying the trend in BDL's monthly Coincident Indicator (CI) to annual real GDP data from the International Monetary Fund World Economic Outlook Database. For instance, Jan 2003 real GDP = annual 2003 real GDP x (share of coincident indicator for Jan 2003/Total coincident indicator for the whole 2003 year). The resulting series is then smoothed for seasonality.
- **Trade Deficit:** Defined as imports minus exports. Seasonal smoothing is applied to monthly data to filter seasonal effects. This data is obtained from the central bank.



- **Inflation CPI:** Defined as change (m-o-m) in the Consumer Price Index (CPI) compiled by the Consultation and Research Institute (CRI).
- **Real Exchange Rate RER:** RER is computed by using the monthly US CPI for all urban consumers with 1982-84 as the base, obtained from the Federal Reserve Bank of St. Louis. The Lebanese CPI index is also used with Jan 1997 as the base month, in addition to the nominal exchange rate from BDL. RER is computed by rescaling all variables and dividing them by the initial value (i.e., that of Jan 1997).

Table 4 summarizes the main variables used in the analysis.

Table 4 **Summary statistics for main macroeconomic variables used**  
(Monthly data, 1997-2013)

Variable	Number of				
	Observations	Mean	Std. Dev.	Min	Max
BD: Budget Deficit (Bill. LBP)	195	198	78	43	362
M2: Money Supply (Bill. LBP)	192	32,933	17,519	13,901	68,749
RGDP: Real GDP (Bill. LBP)	192	2,837	639	2,104	4,058
TD: Trade Deficit (Bill. LBP)	189	1,183	530	584	2,414
CPI: Inflation CPI (base=100 Jan97)	190	127	20	104	169
RER (base=100 Jan97)	190	105	7	92	120

Due to the non-stationarity of all variables<sup>1</sup>, we employ a cointegration framework by estimating a Vector Error Correction model (VECM) that aims to capture any long-run relationships between the time series, along with corresponding short-term dynamics (Johansen 1995). We perform Johansen cointegration tests to determine the presence and number of cointegrating relationships, and sequential modified LR tests to determine the appropriate lag structure for short-term dynamics (test results in Appendix 1).

As in similar models used by Lartey (2008) and Ball et al. (2013), the VECM econometric model takes the following reduced form:

$$X_t = r(L)X_t + ce_n + u_t$$

Where  $X_t$  is a 6x1 vector of dependent and endogenous variables with

$$X_t = [\Delta \ln(BD)_t, \Delta \ln(M2)_t, \Delta \ln(RGDP)_t, \Delta \ln(TD)_t, \Delta \ln(CPI)_t, \Delta \ln(RER)_t]$$

$r(L)$  is a matrix polynomial in the lag operator,  $ce_n$  is the error correction term (lagged one period) derived from the cointegrating vector (estimated using the Johansen procedure), and  $u_t$  is the model error. The above model is estimated using 4 lag structures (as shown by

<sup>1</sup>

Test results available upon request.

the LR test in Appendix 1) and rank = 2 of cointegrating relationships (as shown by the Johansen test). The results obtained with Stata 12 on a sample of 184 monthly data show an overall good fit with most parameter estimates jointly significant (full results in Appendix 2).

The model's estimates are then used to simulate the impact of various macroeconomic scenarios which could occur following the development of local oil and gas industries. We focus on the following options:

- **Increase in budget expenditures:** In this first scenario, the government engages in immediately spending additional revenues from oil and gas. This translates in our framework to a rise in the budget deficit (BD), as public expenditures are increased following the accrual of oil and gas revenues and therefore the budget deficit is assumed to increase. We therefore simulate the impact of an increase in BD on other macroeconomic variables.
- **Increase in money supply:** In the second scenario, the government creates a sovereign wealth fund that ultimately avoids spending all windfall revenues on general public expenditures, and instead contributes to increasing financial assets over time. This is proxied through a gradual increase in money supply (M2) within our modeling framework.
- **Increase in infrastructure and power investments:** Under the third and last scenario, we assume that the government engages in a series of public investments that lower the cost of transportation and energy, and therefore boost local production. This is assumed to generate a positive exogenous shock to real GDP (as in Narayan and Smyth, 2009), and therefore we proxy the above scenario by an increase in our variable RGDP.

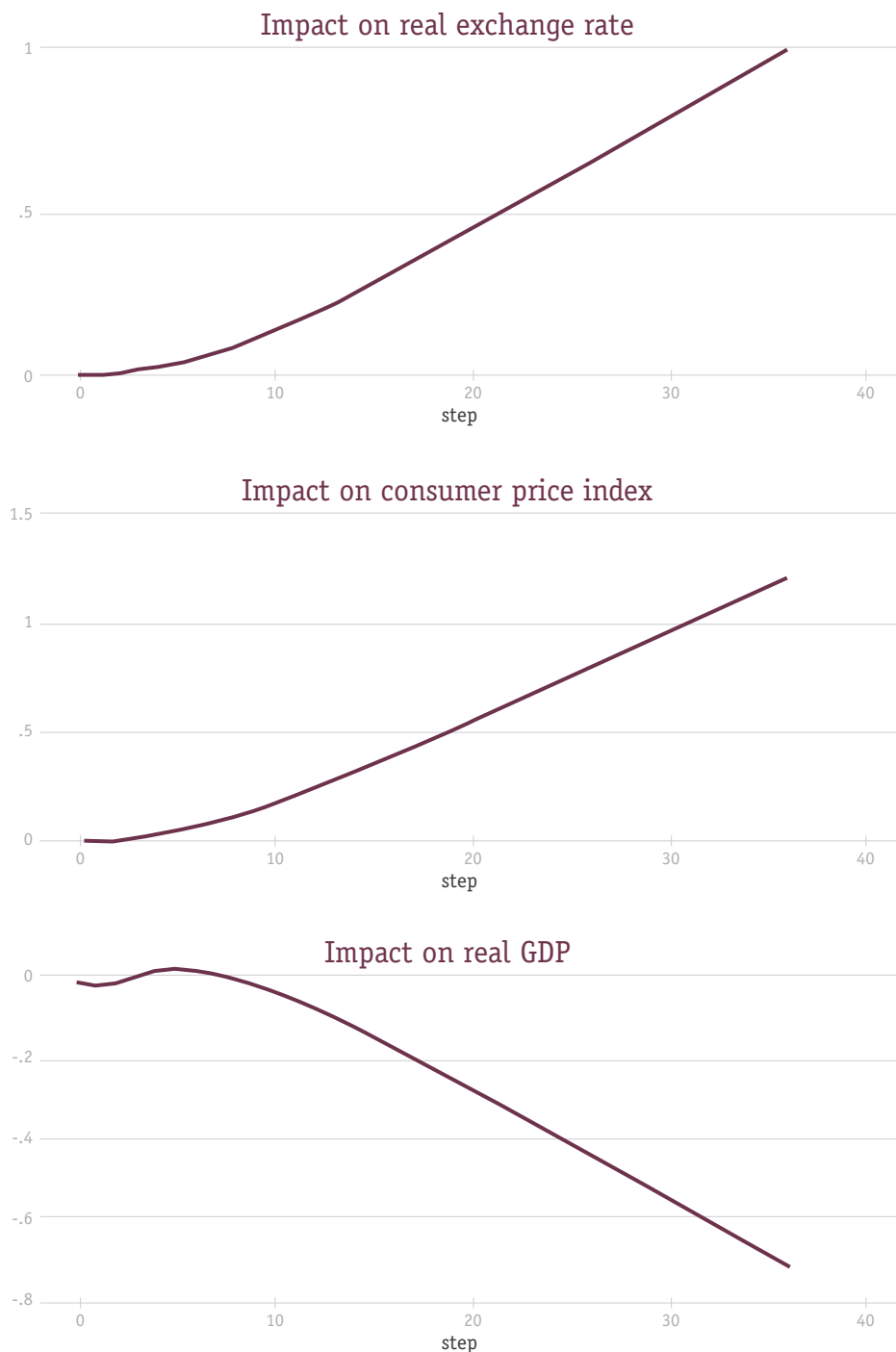
In the simulations we focus on variables of immediate interest: Real exchange rate, real GDP, and inflation (CPI). The increases in BD, M2, and RGDP are simulated through Impulse Response Functions (IRFs), commonly used with VAR and VECM models to simulate the dynamic impacts of one variable on others within an integrated model.

Figure 5 shows the cumulative impulse response of increasing public expenditure (increase in BD) on RER, CPI, and RGDP. An expansionary fiscal policy through a rise in BD clearly causes a rise in RER and inflation (CPI) and a decline in RGDP. The cumulative impulse responses show the sum of IRFs over a period of thirty-six months (x-axis). Every IRF causes a 1% increase in BD, and we can observe from figure 5 that with three years of the forecast period this increase will be matched by an equal decrease in real GDP and a real exchange rate appreciation with a similar magnitude.

This first simulation confirms the Dutch disease theory associated with fiscal expansion following a resource boom (Usui, 1997). An

increase in budget expenditure mainly on non-tradables (such as services and construction sectors) causes an increase in demand for non-tradable products and services, which results in inflationary pressures and real currency appreciation. This in turn contracts the non-resource tradables sector and causes a decline in GDP.

Figure 5 **Cumulative Impulse Response of an increase in budget deficit**

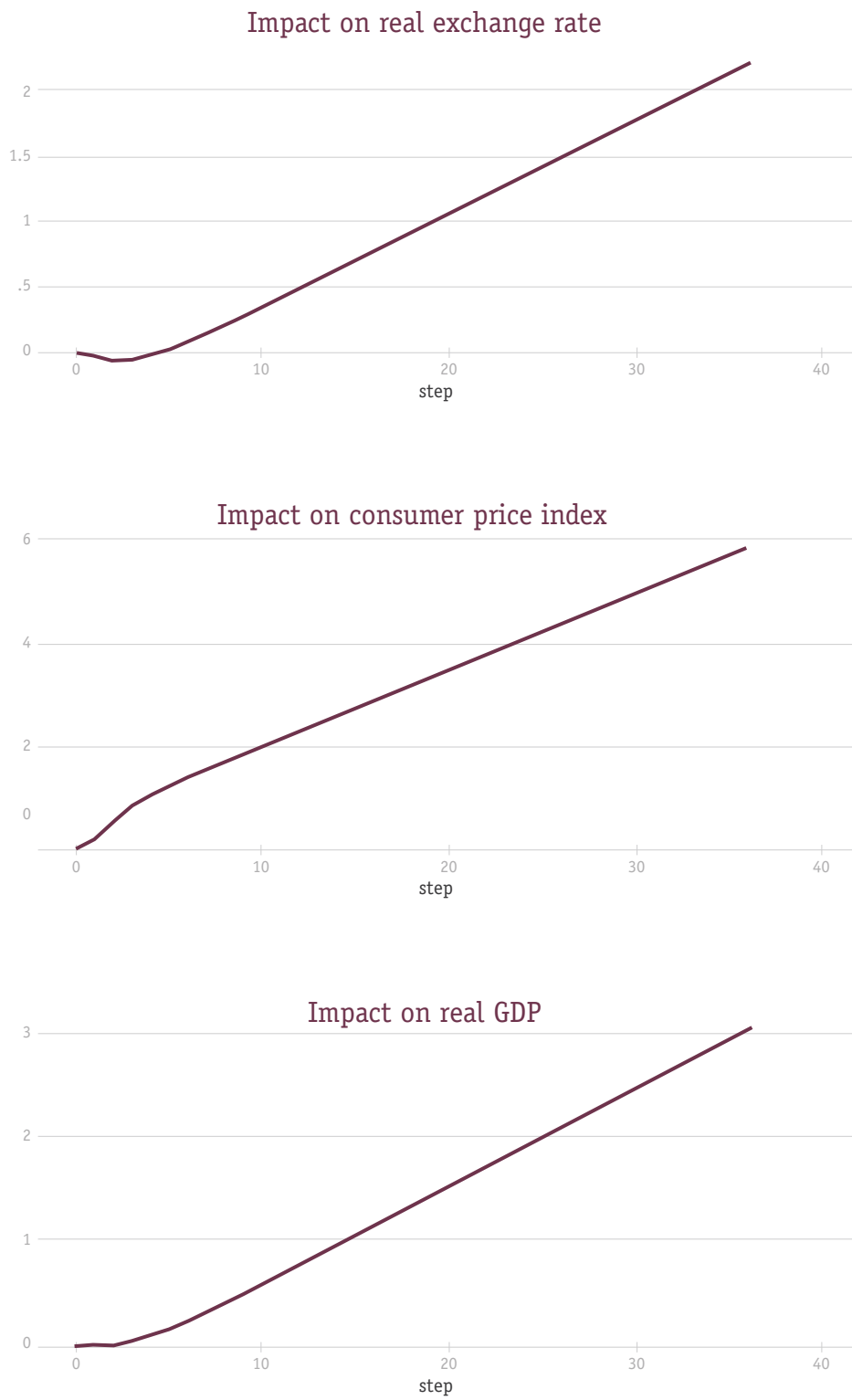


Graphs by irnfame, impulse variable, and response variable

The second and third simulations (figures 6 and 7) show that the alternative policy options of a sovereign wealth fund or an increase in investments in infrastructure (proxied through an exogenous increase in real GDP) would engender a positive macroeconomic effect as real GDP would increase in these two simulations. Notice, however, that these two scenarios also induce an increase in local inflation (CPI) and RER, but these changes are overruled by forecasted economic growth. The above three simulations clearly point to rejecting outright expenditure expansion as a recommended policy option, and going instead for more long-term and balanced policy options which have been proven to work in other countries, such as the creation of a sovereign wealth fund and investment in infrastructure that lowers production costs and boosts competitiveness.

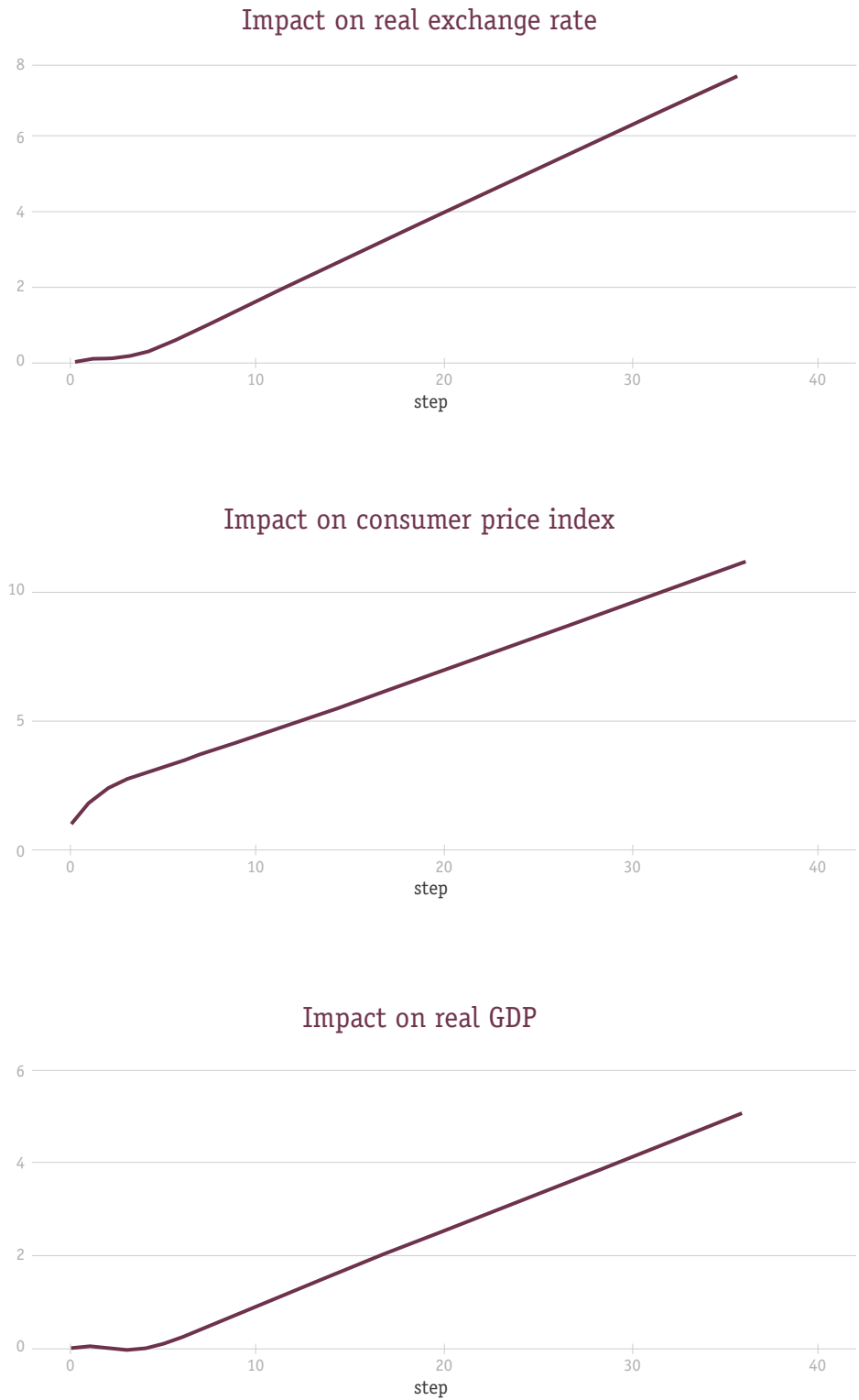
These simulations, although provided here as illustrative of the various policy options available for the Lebanese government to manage its hydrocarbon revenues, clearly show that the level and composition of public expenditure matter when trying to avoid the resource curse. As shown above, the budget expansion following increased hydrocarbon revenues does not necessarily induce the tradables sector to shrink (and therefore inducing a decline in real GDP), as long as the government spends these revenues to strengthen, either directly or indirectly, the tradables sector (like manufacturing and services exports). The empirical findings here also show that adopting a typical expansionary fiscal policy, with a focus on spending more on non-tradables sectors such as construction and services, including higher personnel expenditures, would lead to upward pressure on the real exchange rate. However, by adopting better public financial management and a set of clearly defined and transparent fiscal rules (Elbadawi and Gelb 2010, Schmidt-Hebel 2012), the Lebanese government could avoid the resource curse and invest in the long-term welfare of its citizens. The necessity of adopting a set of fiscal rules aimed at the sustainability of public debt, controlling the size of government, and the contribution to cyclical stability becomes of central importance here (Schmidt-Hebel 2012).

Figure 6 Cumulative Impulse Response of an increase in money supply



Graphs by irnfame, impulse variable, and response variable

Figure 7 Cumulative Impulse Response of an increase in real GDP



Graphs by irnfame, impulse variable, and response variable

## IV Conclusions and policy recommendations

The underperformance of most resource-rich economies is attributed to policy failure in mitigating the potential associated risks of a natural resource boom, one of which is Dutch disease. There is considerable empirical evidence that confirms the theoretical predictions of the Dutch disease phenomenon: In the wake of a natural resource boom, the resulting sudden increase in income leads to increased domestic demand that puts inflationary pressure on the economy and eventually inflates the value of local currency; the traditional export sectors contract while returns to human capital and investments in education decline, potentially harming economic growth.

In light of the recent discovery of potential offshore hydrocarbon resources in Lebanon, it is crucial to investigate the possibility of a Dutch disease realization, especially given the detrimental consequences this discovery could have on the Lebanese economy. This paper sought to do exactly that. First, our work examines whether the Lebanese economy is already suffering from Dutch disease through massive sustained foreign exchange inflows that have been injected into the economy since the beginning of the 1990s, as a result of channeling of petrodollars into the economy. We find that these inflows have been accompanied by a real exchange rate appreciation as well as contraction of the agriculture and manufacturing sectors, thus indicating the presence of Dutch disease symptoms. Second, our work empirically investigates the impacts of a potential resource boom on the Lebanese economy by simulating a rise in the budget deficit within a cointegrated model of real and monetary indicators, in addition to simulating other more advantageous policy options. The main objective was to determine whether an expansionary fiscal policy would result in real exchange rate appreciation. We estimated a VECM on monthly available macroeconomic data and employed Impulse Response Functions for the simulation. The results show that a permanent increase in the budget deficit by 1 percentage point causes an equal appreciation in the real exchange rate over a three-year forecast period. The results also found adverse impacts on the economy shown by a decline in real GDP. The simulations also clearly showed that economic growth would be achieved through alternative policy options such as a sovereign wealth fund or investments in infrastructure. In summary, results have shown that a resource boom in Lebanon will further exacerbate Dutch disease effects if the country adopts an expansionary fiscal policy, and this could be avoided by adopting best-practice forward looking economic policies.

Despite the gloomy picture these findings paint, the Dutch disease outcome could be avoided if the appropriate policy adjustments are implemented in conjunction with the development of offshore

hydrocarbon resources. The successful experiences of a few resource-rich countries have been largely attributed in the literature to their success in managing resource wealth and its associated risks. The optimal response that takes advantage of the boom while mitigating its potential negative implications includes a set of fiscal, monetary, exchange rate, and structural reform policies.

Based on the findings in this paper, we can see that the fiscal policy a government adopts is critical to determining the actual outcome of the boom. Consequently, choosing an appropriate fiscal policy is a central and necessary policy response for avoiding Dutch disease (Van der Ploeg and Venables 2011). Two principal decisions need to be made when designing a fiscal policy response. First, it should be determined how much a government should spend from its resource revenues over time. Second, it should be determined what the government will spend its resource revenues on. Adopting a revenue sterilization policy and accumulating foreign exchange reserves can constrain the spending effect of Dutch disease and as a result curb real exchange rate appreciation. In that respect, the government must resist pressures to enjoy all the windfall revenues in the short run and recklessly expand its budget expenditure. On the contrary, it must commit to saving part of the revenue proceeds every period in order to attain a permanent wealth increase (Usui 1997). Deciding how much to save versus how much to spend, though, is not as straightforward. On the one hand, the resource bonanza liberates the (especially, developing) government from its budget constraints and provides a unique opportunity to spend on development and poverty reduction programs. On the other hand, the spending effect of Dutch disease must be constrained in order to shield the economy from adverse impacts. The optimal fiscal rule is one that strikes a balance between these two objectives. This, however, requires that the government has strict fiscal discipline (Brahmbhatt et al. 2010), which in turn necessitates political reforms that encourage transparency and accountability in the decision-making process.

As for how the windfall revenues should be allocated, the government must be careful not to spend the wealth in a way that increases the domestic aggregate demand for non-tradable goods and services and consequently appreciates the real exchange rate. In that respect, the government must direct its spending toward the non-resource tradables sectors through subsidizing outputs and/or inputs (Usui 1997) or investing in physical and human capital to enhance productivity in these sectors (Brahmbhatt et al. 2010). In this case, a budget expansion would not necessarily lead to shrinkage of the non-resource tradables sectors. Another desirable response would be to use part of the wealth to repay Lebanon's enormous foreign debt, thereby reducing the absorption of the revenues into the domestic economy.



Key to the above analysis and recommendations is the political economy and institutional setup, especially the role and proper functioning of fiscal institutions. To the extent that the economy is poorly managed and the political economy favors non-transparent and distributive modes of resource allocation, oil- and gas- related rents might lead to a resource curse (Elbadawi and Soto 2012). Within this context, public financial management in Lebanon, as part of the wider scope of financial governance in the country, lacks sufficient transparency in public spending as a result of the absence of a viable system of checks and balances on the state's financials. As is apparent in the controversies concerning the discussion of proposed budget laws, there are several weaknesses in the management and control of public finances. Literature mainly attributes these weaknesses to the lack of specialized support and the shortage in relevant staff resources, all of which hamper the quality of budget work for the executive and budget oversight for the legislative (World Bank 2005, Gaspard 2006). The burden of public debt on public expenditures greatly narrows down the range of possible parliamentary amendments to budget laws. In turn, this straining fiscal environment accentuates the underlying weaknesses in the overall control environment that follows budget execution and verification.

## Appendix

### 1. Lag order selection and cointegrating rank for VECM model

For a given lag  $p$ , the LR test compares a VAR with  $p$  lags with one with  $p - 1$  lags. The null hypothesis is that all the coefficients on the  $p$ th lags of the endogenous variables are zero. To use this sequence of LR tests to select a lag order, we begin by looking at the results of the test for the model with the most lags, which is at the bottom of the table. Proceeding up the table, the first test that rejects the null hypothesis is the lag order selected by this process. An “\*” appears next to the LR statistic indicating the optimal lag in the result table below (obtained in Stata 12).

#### Selection-order criteria

Sample: 1998m6 - 2013m9

Number of obs = 184

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	885.722				2.8e-12	-9.56219	-9.5197	-9.45736
1	2345.09	2918.7	36	0.000	5.4e-19	-25.0336	-24.7362*	-24.2998*
2	2390.97	91.752	36	0.000	4.9e-19*	-25.141*	-24.5886	-23.7781
3	2423.37	64.796	36	0.002	5.1e-19	-25.1018	-24.2945	-23.11
4	2457.05	67.364*	36	0.001	5.2e-19	-25.0766	-24.0144	-22.4558

Endogenous: bd m2 cpi rer rgdp td1

Exogenous: \_cons

In the output below, we use *vecrank* in Stata 12 to determine the number of cointegrating equations using Johansen’s multiple-trace test method. The “\*” by the trace statistic at  $r = 2$  indicates that this is the value of  $r$  selected by Johansen’s multiple-trace test procedure.

#### Johansen tests for cointegration

Trend: constant

Number of obs = 186

Sample: 1998m4 - 2013m9

Lags = 2

rank	maximum parms	LL	eigenvalue	trace statistic	5% critical value
0	42	2339.5069	.	117.0669	94.15
1	53	2362.998	0.22322	70.0847	68.52
2	62	2377.1793	0.14143	41.7222*	47.21
3	69	2389.8256	0.12714	16.4296	29.68
4	74	2396.6437	0.07069	2.7934	15.41
5	77	2398.0314	0.01481	0.0180	3.76
6	78	2398.0404	0.00010		

## 2. Estimation results of the VECM model

### Vector error-correction model

Sample: 1998m6 - 2013m9

No. of obs = 184

AIC = -25.11042

Log likelihood = 2444.159

HQIC = -24.16146

Det(Sigma\_ml) = 1.17e-19

SBIC = -22.76911

Equation	parms	RMSE	R-sq	chi2	P>chi2
D_bd	21	.114778	0.1668	32.43713	0.0528
D_m2	21	.026721	0.4030	109.3717	0.0000
D_cpi	21	.013098	0.2243	46.84294	0.0010
D_rer	21	.013289	0.1771	34.85943	0.0293
D_rgdg	21	.027646	0.2331	49.24528	0.0005
D_td1	21	.082014	0.4116	113.3183	0.0000

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