International Research Journal of Finance and Economics
ISSN 1450-2887 Issue 177 January, 2020
http://www.internationalresearchjournaloffinanceandeconomics.com

IS-LM-BP Model for Lebanon: A Simple Empirical Analysis

Samih Antoine Azar
Corresponding Author, Full Professor
Faculty of Business Administration and Economics
Haigazian University, Beirut, Lebanon
E-mail: samih.azar@haigazian.edu.lb
Tel: +961 1 349230/1 extention 375

Ali Bolbol
Chief Economist, BLOM Bank, Beirut, Lebanon

Alexandre Mouradian
Head of Investor Relations
BLOMINVEST Bank, Beirut, Lebanon

Abstract

The paper develops a Mundell-Fleming IS-LM-BP model that is specific for the Lebanese economy. It is the first short-run macro model in the post-civil-war period that we know of that is run on a monthly basis, over the period from 2008 to 2018. The model is estimated using the Robust Least Squares methodology, and arrives at fairly interesting conclusions. On the fiscal side, government spending and taxation yield positive output results and are aligned with the model. So are changes in the pegged exchange rate that contribute positively to output but marginally to the balance of payments. On the other hand, monetary policy has interesting implications as far as its compressed effects on output and the balance of payments whereas remittances seem to have hardly any impact on the same. Also crucial are governance and structural reforms that are important in them selves and in making macro policies more effective.

JEL Classifications: C3; F10; O53

1. Introduction

The Mundell-Fleming model is perhaps the most well-known model in international macroeconomics. Not surprisingly, it has attracted a lot of applications and for good reasons – its predictions have come mostly true. We believe that the Lebanese economy fits into such applications, being a small, open economy with a fixed exchange rate regime. More important, it has undergone some important macroeconomic policy experiments, especially in the past three years. Notable among these was the expansionary fiscal policy in 2017 that raised public wages by more than 50%; the contractionary monetary policy in 2018 arising from higher international interest rates and an escalation in the risk premium; and the nullified impact of both policies on Lebanese income and output and their adverse consequences on interest rates and the balance of payments.[1].

[1] See Bolbol and Mouradian (2018) on the impact of these policies ala the Mundell-Fleming predictions.

Despite the relevance of the Mundell-Fleming model to Lebanon and the richness of the policy scene, there has hardly been a formal modelling of the economy along such lines and a proper estimation of these models along enough longitudinal time series. What we intend to do in this paper is to fill this gap. We develop and estimate a standard but meaningful Mundell-Fleming model for the Lebanese economy, and consider the various implications of policies and reforms that the economy can undertake. What makes the paper exceedingly interesting is that Lebanon could be undergoing these days (in 2019 onward) a structural break with its past, deciding on a new fiscal and monetary course to revitalize its moribund economy. And we believe that the implications of our model and its empirical conclusions can be a useful guide to policy makers as to the impact of the new policy agenda under consideration. One important conclusion of the paper is that monetary and fiscal policies will be a lot more effective, and the performance of the economy will be a lot sounder, if the policy agenda were to involve – even prioritize -- governance and institutional reforms.

The paper is structured as follows. Section 2 provides a concise literature review of the Mundell-Fleming model in both theory and empirics. Section 3 presents the model and its macroeconomic structure: the IS function reflecting goods market equilibrium; the LM function embodying money market equilibrium; and the BP function constituting external sector equilibrium. Section 4 represents the core of the paper: it reports on the methodology and data sources; it provides a summary of the descriptive statistics of the variables employed in the model; and it explains all the results from estimating the three simultaneous macro functions. Section 5 gives an evaluation of these results and the policy and reform implications that can be derived from them. Section 6 ends the paper with a succinct conclusion.

2. Brief Literature Review

The Mundell-Fleming model emerged independently from the original work of Mundell (Mundell, 1960) and Fleming (Fleming, 1962) as the model that gave a short-run international dimension to the closed IS-LM system[2]. Mundell, in addition, made some important contributions to the original model, the most celebrated of which are Mundell (1962) and Mundell (1963). Mundell (1962) postulated that, when capital is mobile and the exchange rate is pegged, a stable policy mix requires assigning fiscal policy to internal balance and monetary policy to external balance. And more specifically, Mundell (1963) showed that only fiscal policy affects output under fixed exchange rates, whereas monetary policy serves only to alter the level of international reserves; in contrast, fiscal policy might be dramatically weakened under floating rates. Also, expenditure-switching and expenditure-changing policies figure prominently in arriving at the short-run equilibrium.

The importance of the model did not only arise from making valuable extensions to it, but also from strengthening various elements in its structure. Notable among these is the inadequate rendition of monetary dynamics, which prompted primarily Johnson (Frenkel and Johnson, 1976) and Pollak, IMF, 1977) to pursue the monetary approach to the balance of payments. And building on the work of Tobin (1969), portfolio-balance approaches incorporating a broader spectrum of assets were also developed in the mid-1970s, producing useful models of the long-run behavior of monetary flows, current accounts, and goods prices[3]. Additionally, the rational expectations assumption figured prominently in the adjustments made to the Mundell-Fleming framework, as expressed notably in Dornbusch's (1976) landmark "overshooting" version. Another important adjustment was reflected in the intertemporal approach to the current account, in which saving and investment levels represent optimal forward-looking decisions[4]. As important, this approach provided a conceptual framework appropriate for thinking about the crucial policy issues of external balance, external sustainability, and equilibrium real exchange rates, as in Montiel (1999). Lastly, the Mundell-Fleming model proved to be

[2] See Bouhgton (2003) for the origin of the Mundell-Fleming model.
[3] See Obstfeld and Stockman (1985) for more on these models.
[4] See Obstfeld and Rogoff (1995) for an extensive survey of this approach.

a fertile ground to analyze future issues relating to insulation or the extent of openness, international pricing or the validity of the Law of One Price, the transfer problem, and the evidence on the pricing to market phenomenon[5].

Empirically, the Mundell-Fleming model has attracted a lot of research[6]. Selectively, of these is Huh (1999) who estimated a quarterly model for Australia from 1973 to 1995, and found exogenous disturbances (e.g. world interest rates) to have significant effects on the endogenous variables (e.g. income), as predicted by the Mundell-Fleming model. Lee and Chinn (2006) worked with a quarterly model for the G-7 countries from 1979 to 2000, and obtained interesting results where temporary shocks play a larger role in explaining the variation in the current account, while permanent shocks play a larger role in explaining the variation in the real exchange rate. Ncube et al (2012) also worked with a quarterly model for South Africa from 1973 to 2007, and got results consistent with a small, open economy such that a US monetary stimulus shock leads to rand-dollar appreciation and to weak consumer price inflation. Born et al (2013) developed a semiannual model for the OECD countries from 1986 to 2011, and discovered that government spending multipliers are larger under fixed exchange rate regimes but there is little evidence for the monetary transmission channel. Finally, Corvic et al (2015) constructed a monthly model for Croatia from 2004 to 2012 and, though they found that coordinated measures of monetary and fiscal policies can stimulate economic growth without endangering price stability, it is structural reforms affecting the business climate and institutional quality that can eliminate the main constraints to economic growth – a conclusion that is valid for Lebanon.

Speaking of Lebanon, there is limited modelling literature on the country, perhaps because of the dearth of enough data, especially for quarterly or monthly real sector data. Of the limited available papers, Saleh and Harvie (2017) provided a detailed steady-state aggregate demand-aggregate supply annual model from 1970 to 2010 to study the impact of donor funding. They found that the greater the proportion of donor funding allocated to public capital expenditure (infrastructure-related projects), the larger the overall benefits to the economy in terms of output demand and production, external balances, budgetary deficit, and overall development of the private sector. More in the spirit of the Mundell-Fleming model, Araji et al (2015) developed a five-block model – macroeconomic, government, price, monetary and financial sector, and external – to study the effects of debt targeting in Lebanon, and discovered that debt repayments from future oil and gas revenues generate higher and more sustainable growth in the long run. But the model is based on 23 observations from 1992 to 2014, which is obviously too little. Bolbol and Mouradian (2018) modelled Lebanon's macroeconomic behavior in 2018 using the Mundell-Fleming model, and arrived at conclusions as predicted by the model on the effects of monetary and fiscal policies on income and interest rates. However, the analysis is mostly graphical and is restricted to 2018.

In this note, we believe as in Krugman (1995) that the Mundell-Fleming model "remains the work-horse for understanding international macroeconomics"; and as in Young and Darity (2004) that it is the "model of preference for both policy analysis and pedagogy". In the next section, we introduce a model that is both in the spirit and structure of the Mundell-Fleming model, and we believe that it is congenial for three reasons: first, it is parsimonious and simple, based on three equations only; it is a short-run model, running monthly from 2008 to 2018; and it is relevant, capturing quite well the Lebanese macro-economy and the effects of policy.

3. Model and Macro Structure

Since 1997, Lebanon has followed a monetary framework of fixing the exchange rate to the USD at 1507.5 LBP. And given that the Lebanese economy has always exhibited perfect capital mobility, then an important implication of this monetary arrangement is that the money supply becomes endogenous

[5] See Obstfeld (2001) for a survey of these issues.
[6] See Corvic et al (2015), Corsetti and Passineti (2001) for a brief tabulation of this research.

and the Central Bank loses ultimate control over it[7]; in addition, for a small open economy like Lebanon, the domestic interest rate is exogenously determined by the (US) world interest rate. Concurrently, a fixed exchange rate system means that the balance of payment is endogenous since the exchange rate can't adjust to bring about balance of payments equilibrium. As a result, our simple Mundell-Fleming model for the Lebanese economy has three endogenous or dependent variables: income as reflected in the IS function; money balances as reflected in the LM function; and the balance of payments as reflected in the BP function.

For a small open economy like Lebanon with a huge external sector, including remittances that are close to $8 billion a year, it is more appropriate when constructing the IS function to express it in terms of GNP. And for simplicity, we are going to abstain from net factor income, and we are going to express all net transfers as remittances since they dominate that category. As a result, GNP, Y, is equal to:

$$Y = C + I + G + NX + RM \quad (1)$$

Where, as is customary, C is personal consumption expenditures, I is private investment, G is government expenditures, NX is net exports of goods and services, and RM is remittances. As for the latter, we are going to assume that it is exogenous, since remittances have proven to be a very stable external inflow, regardless of the state of the economy and polity. As for the other variables, they are modelled as follows:

$$C = C\ (Y - T, R) \quad (2)$$

$$I = I\ (R, \Delta Y_{t-1}) \quad (3)$$

$$NX = NX\ (Y, E, Y_f) \quad (4)$$

Where in equations (2), (3), and (4), consumption is function of disposable income which is equal to income minus taxes, T; investment is function of the interest rate R and the change in lagged income in accordance with the accelerator principle[8]; and net exports is function of the exchange rate, E, which is the price of 1 unit of foreign currency in LBP (a higher E is equivalent to a depreciation in the LBP), national income Y, and foreign income, Y_f. As important, replacing equations (2), (3), and (4) in (1), gives us the reduced IS function as:

$$Y = Y\ (G, T, \Delta Y_{t-1}, Y_f, E, R, RM) \quad (5)$$

As to the LM function, we are going to adopt the standard formulation:

$$M/P = L\ (R, Y) \quad (6)$$

Where, as is common, real money balances M/P are function of the interest rate R and national income Y.

Lastly, in the case of the BP function, note that the balance of payments is equal to:

$$BP = CA + KA \quad (7)$$

Where CA is the current account and KA is the capital account, where CA is equal to NX +RM as in equation (1); for KA, we are going to model it as follows:

$$KA = KA\ (R - R_f, Y) \quad (8)$$

Where $R - R_f$ is the excess of domestic interest rate over the foreign (US) interest and it acts as a determinant of portfolio capital flows; and national income Y as a determinant of FDI flows. Note that, since $R = R_f$ + risk premium, and assuming that the risk premium is λ, then $R - R_f = \lambda$. As a result, equation (8) becomes:

---

[7] This is the (in)famous "Impossible Trinity" in the sense that an economy can have a fixed exchange rate system and perfect capital mobility, but not control over the money supply. See Boughton (2003).

[8] See the classic paper by Samuelson (1939).

$$KA = KA(\lambda, Y) \quad (9)$$

Given that RM is exogenous, and NX is a function of E, Y, and Y_f, then equation (7) becomes:

$$BP = BP(\lambda, Y, Y_f, E, RM) \quad (10)$$

Hence, the three equations (5), (6), and (10) represent, respectively, the IS-LM-BP functions and constitute the simultaneous equations system for our three dependent variables Y, M, and BP. Specifically, equation (5) determines Y from its corresponding exogenous or independent determinants. Replacing then the determined Y in (6) and (10) determines M and BP in a similar fashion. In other words, Y is determined in the real sector and M and BP are determined, respectively, in the financial and external sectors.

In the next section, this simultaneity will be mirrored by our estimation process. We will estimate first equation (5), and then use the forecasted values for Y in equations (6) and (10) to estimate M and BP respectively.

4. Model Estimation and Results

4.1. Methodology and Data Sources

The econometric procedure is by Robust Least Squares which has the advantage of accounting for outliers in the data in the dependent and all independent variables. Moreover, the standard errors are adjusted for autocorrelation and heteroscedasticity through the Huber Type I algorithm. All variables are expressed in log form, unless otherwise indicated, so the estimated coefficients are elasticities; and all are measured in USD, except for the Lebanese money stock M2, and its growth rate. Also, all variables are in nominal terms, since we assume – according to surveys and empirical evidence – that money illusion is both widespread and significant in decision making[9]. Besides, this is perhaps more valid in Lebanon because the exchange rate peg to the USD reinforces the perception of a stable purchasing power.

The sources of the data are as follows. The US real disposable personal income, as a proxy for world or foreign demand, is retrieved from the web site of the US Federal Reserve Bank of St Louis. It is adjusted to nominal income using, from the same source, the Consumer Price Index for all Urban Consumers. For Lebanese data, the coincident indicator, a measure of real national output, the money stock M2 (currency plus current and time deposits in LBP), the weighted-average interest rate on time deposits in LBP and that on time deposits in USD, the Euro exchange rate against the LBP (a higher rate is equivalent to a depreciation in the LBP), the balance of payments, and remittances, are all recovered from the web page of the Banque du Liban (BDL), the Central Bank of Lebanon. The Coincident Indicator is adjusted to nominal national output using the Lebanese CPI. Government taxes and expenditures are extracted from the website of the Ministry of Finance. The Credit Default Swap (CDS) on Lebanese Eurobonds is our measure of the risk premium and is obtained from the website of Bloomberg. The data is form January 2008 to November 2018, i.e. around 130 monthly observations. Since our model is a short run one, then using eleven years of monthly observations is quite satisfactory.

4.2. Descriptive Statistics

Table (1) provides for descriptive statistics of the concerned variables. The frequency of the series is monthly. In nominal monthly terms, the average growth rate is 0.653%, or 7.831% per annum, a figure which is reasonable. In this case, the maximum and the minimum are not informative. Although the median is higher than the mean, which is a characteristic of negative skewness, there is evidence that the series follows a normal i.i.d. distribution, because the actual p-value of the Jarque-Bera normality statistic is high at 0.184.

[9] See Ackerlof et al (2000).

Table 1: Descriptive Statistics

	Lebanon's monthly nominal output index	**Lebanon's monthly growth rate in the nominal output index (%)**	**LBP-deposit interest rate (%)**	**USD-deposit interest rate (%)**	**Lebanon's monthly government spending (USD million)**	**Lebanon's monthly tax revenues (USD million)**
Mean	249.6742	0.652551	5.979692	3.230692	901.1142	567.3429
Median	258.8967	1.014495	5.580000	3.135000	880.7721	500.1725
Maximum	345.1105	11.75337	7.970000	4.900000	1855.912	1628.163
Minimum	149.2636	-10.24267	5.370000	2.750000	387.7771	254.9022
Std. Dev.	49.44589	4.487509	0.693000	0.429662	274.6577	195.2921
Skewness	-0.226242	-0.048842	1.111536	1.323691	0.853211	1.559661
Kurtosis	2.269413	2.843657	2.662698	4.622127	4.315458	8.142655
Jarque-Bera	4.000207	0.184087	27.38572	52.21627	25.33925	197.4665
Probability	0.135321	0.912066	0.000001	0.000000	0.000003	0.000000
Observations	130	130	130	130	131	131

	Monthly foreign (US) nominal output index	**Monthly Foreign (US) nominal output growth**	**Monthly Remittances (USD million)**	**Monthly Balance of payments (USD million)**	**LBP Sovereign Credit default swap (5 years) in basis points**	**Lebanon's monthly money stock M2 (LBP billion)**
Mean	29605.89	0.003147	216.3922	19.44154	430.0945	64146.51
Median	28992.74	0.003765	222.3350	-37.80000	420.3600	66594.40
Maximum	36988.29	0.052714	420.1600	1787.800	800.0000	83808.10
Minimum	24486.22	-0.057327	-73.91000	-1810.400	251.0000	24957.80
Std. Dev.	3615.848	0.008577	77.53168	573.5395	102.7613	15804.44
Skewness	0.271537	-1.275758	-0.469096	0.439251	1.251792	-0.784242
Kurtosis	1.928413	28.94673	4.183875	3.822944	5.572624	2.797905
Jarque-Bera	7.877611	3681.941	12.35955	7.848774	69.80096	13.65120
Probability	0.019471	0.000000	0.002071	0.019754	0.000000	0.001086
Obervations	131	130	130	130	130	131

The average nominal output index stands at 249.67, with a maximum at 345.11 and a minimum at 149.24. In fact, if one takes the geometric growth rate between the extremes, i.e. between the maximum and the minimum, we get 7.762%, a figure which is almost identical to the average growth rate of 7.831%. If we assume that the range between the maximum and the minimum is +/-2 standard deviations, the predicted standard deviation is (345.11-149.24)/4=48.97. The actual standard deviation is very close at 49.46. This is evidence for a symmetric and bell-shaped distribution. In fact, the Jarque –Bera normality test has an actual p-value of 0.135 which fails to reject the null hypothesis of normality. Unfortunately, the remaining 10 series do not have normal i.i.d. distributions.

The weighted average interest rate on time deposits in LBP stands at 5.980%, and the weighted average interest rate on time deposits in USD in the Lebanese banking system is 3.231%. The average margin is 2.749%, or 274.9 basis points. This compares with an average Credit Default Swap (CDS) rate of 430.095 basis points, which includes the sovereign risk, and thus takes into consideration yields on Lebanese Eurobonds, which are much higher than the deposit rates.

Lebanese government expenditures had an average of $901.11 million, while taxes had an average of $567.34 million, creating an average budget deficit of 37%, which is in major part due to payments for salaries of civil servants, to the subsidies to the electricity provider utility firm, and to the service of the public debt. More informative are the budget deficits at the maxima and at the minima. These are, respectively, 12.3% and 34.3%. The yearly average estimates of government spending and of tax revenues are, respectively, $10.81 and $6.81 billion, which implies that the additional indebtedness of the public sector has been on average $4.0 billion.

The measure of foreign output is taken to be the US nominal disposable personal income, a series which is chosen because it is reported by monthly values. The values represent an index of real output multiplied by the US Consumer Price Index (CPI). Nominal US growth is measured as 0.315%, or 3.776% per annum, figures that are also representative of the reality of nominal growth in the US. In fact, if one takes the geometric growth rate between the extremes, i.e. between the maximum and the minimum, we get 3.784%, a figure which is almost identical to the average growth rate of 3.776%.

Lastly, four series in Table (1) need clarification. First, the balance of payments has a maximum surplus of $1.787 billion, and a maximum deficit of $1.810 billion. This balance is muted because of capital inflows: portfolio and direct investments plus remittances from the Lebanese working abroad. The latter, as the second series, contributed an average of $216.39 million, a maximum of $420.16 million, and a minimum of -$73.91 million. The minimum is surprisingly negative.

The third series is the rate of the Credit Default Swap on Lebanese sovereign borrowing in USD in the market. The minimum rate is 251 basis points, while the maximum is 800 basis points. The volatility is elevated at 102.76 basis points. Internationally, these are rates for bonds below investment grade, if not junk bonds. There is evidence of positive skewness: high rates are more probable than low rates. A test of significance provides a t-statistic of +2.936, which rejects the null hypothesis of no skewness.

The last of the series is the level of the money stock M2. This is the only series that is measured in LBP. Focusing on its growth rate, the average growth rate of M2 is a monthly 0.9045%, or a 10.853% per annum. The standard deviation is high at a monthly rate of 4.9174%, or 17.0344% per annum. If one deducts the nominal growth rate of output of 7.831% annually from the average annualized mean of M2 of 10.853%, we get 3.019%, which represents the short run fall in velocity of circulation of money during the period.

4.3. Regression Results

4.3.1. The Mundell-Fleming IS Function

The function that determines the Mundell-Fleming IS curve is as given in equation (5). The dependent variable is nominal output, Y. Since we are estimating essentially a short run model, prices can be assumed to be highly sticky and quasi fixed, meaning that nominal output is in reality the same as real output. The expected sign of the partial derivatives of the IS curve is above each variable, and the empirical results are reported in Table (2) and are as follows:

$$Y = Y\left(\overset{+}{G}, \overset{-}{T}, \overset{+}{\Delta Y_{t-1}}, \overset{+}{Y_f}, \overset{+}{E}, \overset{-}{R_d}, \overset{+}{RM}\right)$$

Table 2: The IS Function

Dependent Variable: LOG(national output) Method: Robust Least Squares Sample (adjusted): 2008M01 2018M11 Included observations: 131 after adjustments Method: MM-estimation Huber Type I Standard Errors & Covariance				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**P-value**
Constant	-14.33705	1.593515	-8.997125	0.0000
LOG(government spending)	0.081984	0.021058	3.893212	0.0001
LOG(tax revenues)	0.038079	0.018432	2.065960	0.0388
LOG (foreign or US income)	1.484297	0.078822	18.83101	0.0000
Lagged growth rate	0.442010	0.120565	3.666149	0.0002
LOG(LBP/Euro)	0.186929	0.085096	2.196676	0.0280
Remittances	-3.70E-05	7.82E-05	-0.473740	0.6357
LOG(LBP interest rate)	-0.417887	0.050022	-8.354020	0.0000

	Robust Statistics		
R-squared	0.745547	Adjusted R-squared	0.731066
Rw-squared	0.943696	Adjusted Rw-squared	0.943696
Akaike information criterion	157.6704	Schwarz information criterion	181.6524
Deviance	0.337150	Scale	0.048615
Rn-squared statistic	1499.735	Prob. (Rn-squared stat.)	0.000000
	Non-robust Statistics		
Mean dependent variable	10.10045	S.D. dependent variable	0.214211
S.E. of regression	0.058496	Sum squared residuals	0.420885

- G: It is government expenditures, and of course it has a positive impact on Y as predicted by the Keynesian consumption multiplier. The coefficient is positive as expected: a 1% increase in government spending increase output by 0.082%. The coefficient is highly significant statistically with a t-statistic of 3.893 and an actual two-sided p-value of 0.0001.
- T: As tax revenues, it is expected to have a negative impact on Y because taxes are naturally a drag on spending. However, surprisingly, the coefficient on this variable is positive and carries a t-statistic of 2.066, which has a two-tailed p-value of 0.0388. A 1% increase in tax revenues increases growth by 0.038%, which is almost half the effect of government spending. If one considers that taxes would have been saved any way, and since taxes are spent mostly for consumption purposes, then taxes are likely to be redirected from saving towards autonomous consumption and thus increase output by the consumption multiplier. By implication, the marginal propensity to consume can be estimated to be 0.50, and the consumption multiplier to be 2.0.
- ΔY_{t-1}: Not in log form, the lagged growth rate of the nominal output must have a positive influence as predicted by the accelerator theory. The coefficient has the correct sign and is highly significant statistically (t-statistic: 3.666, with a p-value of 0.0002). The inverse of the coefficient (1/0.44201=2.262) can be shown to be an estimate of the capital/output ratio, and its magnitude is reasonable.
- Y_f: As a proxy for world income, the US personal disposable income should have a positive impact via its positive effect on exports which spur growth. The coefficient has the expected sign and is highly significant statistically with a t-statistic of 18.831: a 1% increase in foreign output increases growth by 1.484%, a value higher than +1. Such a value indicates that domestic growth is very sensitive to foreign income perturbations, a standard implication for a small country like Lebanon.
- E: The exchange rate or LBP per one Euro, LBP/Euro. Since Europe is Lebanon's major trading partner, this rate would capture the impact of trade-weighted exchange rate changes[10]. It ought to have a positive impact because an increase in E means a depreciation of the domestic currency which will encourage exports, discourage imports, and add to output. The coefficient has the correct sign and the required statistical significance (t-statistic of 2.197 that has a p-value of 0.028) with an elasticity of 0.187: a 1% depreciation of the domestic currency leads to higher output by 0.187%[11].
- R_d: The interest rate, as measured by the weighted-average rate on LBP term deposits. The impact should be negative because of its inverse relationship to investment, therefore to output. The estimate of the coefficient, which is also elasticity, is -0.4179, it is highly statistically significant (t-statistic of -8.354, with a p-value near zero). A 1% increase in R_d, i.e. from 5% to 5.05%, leads to a decrease in output by 0.42%.

[10] The rest of the major trade partners are Arab countries, especially the Gulf countries, who peg their exchange rates to the USD, and China who, to a large extent, does the same.

[11] In other words, exchange rate depreciations impact *Y* through improvements in the current account, which in technical terms implies that the Marshall-Lerner condition holds in the short run.

- RM: Not in log form, remittances should carry a positive sign, because they are mostly spent on consumption which is generally the main driver of output. The actual sign of the impact is negative contrary to expectations, but is also very small. A one million US dollars increase in remittances decreases output by 0.0037%. However, this coefficient, besides having the wrong sign, is statistically insignificant, so little inference can be attempted.

4.3.2. The Mundell-Fleming LM Function

The function that determines the Mundell-Fleming LM curve is as determined by equation (6). Unlike other variables, we adhere with tradition and express LBP money balances in real terms, M2/P. Similarly, the expected sign of the partial derivatives is above the variable, and the following results are as recorded in Table (3):

$$M2/P = L\left(\overset{-}{R_d}, \overset{+}{R_f}, \overset{+}{Y}\right)$$

Table 3: The LM Function

Dependent Variable: LOG(M2/P) Method: Robust Least Squares Sample (adjusted): 2008M01 2018M11 Included observations: 131 after adjustments Method: MM-estimation Huber Type I Standard Errors & Covariance				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**P-value**
Constant	4.476330	0.649541	6.891529	0.0000
LOG(fitted national output)	0.509107	0.098292	5.179551	0.0000
LOG(LBP interest rate)	-0.791588	0.128247	-6.172371	0.0000
LOG(USD interest rate)	0.543597	0.103513	5.251490	0.0000
	Robust Statistics			
R-squared	0.551210	Adjusted R-squared		0.540609
Rw-squared	0.820878	Adjusted Rw-squared		0.820878
Akaike information criterion	176.6510	Schwarz information criterion		190.1716
Deviance	0.660550	Scale		0.062212
Rn-squared statistic	486.8747	Prob. (Rn-squared stat.)		0.000000
	Non-robust Statistics			
Mean dependent variable	6.497537	S.D. dependent variable		0.221155
S.E. of regression	0.151447	Sum squared residuals		2.912900

- R_d: The impact of R_d is as expected negative, with the estimated elasticity coefficient at -0.7916 and a t-statistic of -6.1724 that has an actual p-value near zero. This is because a higher Rd is driven by either a higher world (US) interest rate or a higher risk premium. But either of these drivers will lead people to switch from LBP to USD, and BDL will have to accommodate that switch to maintain the exchange rate peg. The result will be lower domestic money balances M2 and a leftward shift in the LM function.
- R_f: The interest rate on USD term deposits in Lebanese banks and it is added here to enrich the formulation. It has also the expected impact, and its coefficient or elasticity at 0.5436 is highly significant statistically with a t-statistic of 5.2515 and a p-value near zero. A higher R_f will invite more USD capital inflows that BDL will have to absorb so as to maintain the exchange rate peg, thus increasing domestic money balances in the process[12]. Interestingly, the elasticity of each of Rd and R_f has an absolute value less than one, making them inelastic and the slope of

[12] In fact, this is what happened between 2007 and 2011. Lebanon maintained relatively higher R_f, which in the context of the international financial crisis and its aftermath induced huge capital inflows to the safe Lebanese banking sector that BDL had to absorb and increase its foreign reserves by more than $12 billion in the process.

the LM curve rather steep[13]. This means that M2 is not very responsive to interest rate changes and the resulting or required adjustments in money balances will not be big and nor will be the corresponding reduction in output[14.]

- Y: Another support for the LM function comes from the coefficient on the nominal output, which is 0.5091, and is economically insignificantly different from 0.5, and has the same significance as the USD interest rate elasticity. As important, it is the fitted nominal output derived from the IS function, as postulated by the model developed in Section 3.

4.3.3. The Mundell-Fleming BP Function

Lastly, the Mundell-Fleming BP function was derived previously as equation (10). The dependent variable is the balance of payments, defined per BDL terminology as the change in the net foreign assets of the banking system, and it is in millions of USD and not in log form. As before, the expected sign of the partial derivatives is above the variables, and the estimated results are reported in Table (4):

$$BP = BP\left(\overset{-}{Y}, \overset{+}{Y_f}, \overset{+}{E}, \overset{+}{RM}, \overset{-}{CDS}\right)$$

- Y: It is the fitted nominal output as estimated from the IS function. As expected, Y carries a negative coefficient. A 1% increase in national output deteriorates the balance of payments by 34.01 million of USD. The coefficient is statistically significant with an actual t-statistic of -3.4496, and an actual p-value of 0.0006. The negative sign is consistent with the absorption theory of exchange rate determination: higher absorption leads to more imports and worsens BP.

Table 4: The BP Function

Dependent Variable: Balance of payments BP Method: Robust Least Squares Sample (adjusted): 2008M03 2018M11 Included observations: 129 after adjustments Method: MM-estimation Huber Type I Standard Errors & Covariance				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**P-value**
C	-31846.58	17999.36	-1.769318	0.0768
LOG(fitted national output)	-3401.021	985.9152	-3.449609	0.0006
LOG(foreign or US income)	4772.107	1843.129	2.589133	0.0096
Remittances	-1.004903	0.636975	-1.577617	0.1147
LOG(Euro/LBP)	0.254410	0.362287	0.702232	0.4825
LOG(Credit Default Swap)	-852.3439	233.2779	-3.653771	0.0003
	Robust Statistics			
R-squared	0.202427	Adjusted R-squared		0.170006
Rw-squared	0.324267	Adjust Rw-squared		0.324267
Akaike info criterion	132.7002	Schwarz criterion		152.8935
Deviance	25706091	Scale		455.7980
Rn-squared statistic	47.49524	P-value: (Rn-squared stat.)		0.000000
	Non-robust Statistics			
Mean dependent variable	15.38527	S.D. dependent variable		573.9005
S.E. of regression	524.8653	Sum squared residuals		33884482

13 Interestingly, the classic papers by Baumol (1952) and Tobin (1956) predict that the absolute value of the interest elasticity of money ought to be 0.5.

14 Note that in a closed IS-LM model, this result tends to make monetary policy more effective.

- Y_f: The coefficient on Yf is also as expected: a 1% increase in foreign output increases BP by 47.72 million USD. The coefficient is statistically significant with a t-statistic of 2.5891, and with an actual p-value 0.0096. The positive sign is consistent with traditional approaches to the balance of payments whereby higher world output generates more exports and improves BP.
- E: The coefficient on E is as expected positive but is far from being statistically significant. It was expected that an increase in this rate, which is a depreciation of the domestic currency, should improve the trade account and benefit the balance of payments. However, the depreciation of the domestic currency may have lowered the confidence in the economy, hurting the capital account.
- RM: Its coefficient is perversely estimated to be negative, not positive as it should be; but it is, nevertheless, statistically insignificant. One would expect that more remittances would enhance BP. However, more remittances may have increased absorption. This theoretical ambiguity of the sign may have driven the variable to be statistically insignificant.
- CDS: The coefficient on CDS is as expected negative: a 1% increase in this rate (4.3 basis points on average) creates a deficit of -$8.523 million. A higher risk premium will undoubtedly discourage the foreign financial/FDI inflows and thus deteriorate the BP. Therefore the variable carries the expected sign, and has a t-statistic -3.6538 with an actual p-value of 0.0003.

5. Evaluation and Policy Implications

The model estimated in the previous section was a standard Mundell-Fleming model where the IS function determines output and the LM and BP functions determine money and the balance of payments. By and large, all the results conform to the implications of the model, and make the Mundell-Fleming an appropriate framework to analyzing macroeconomic policy in Lebanon. Below is an evaluation of the results with the attendant policy implications.

First, fiscal policy is quite effective, as would be expected for a small open economy with a pegged exchange rate and perfect capital mobility. What is pleasantly surprising is the positive effect of tax revenues on national output. This is most likely explained by the limited tax burden in Lebanon, with a tax yield that is only 16% of GDP and an extent of tax evasion that is more than $4 billion annually[15]. So a more efficient and a higher yielding tax system – which reflects a better governed and a less corrupt national economy – is supportive of more income and output.

Second, monetary policy is theoretically not effective in the context of the Lebanese monetary framework. This implication, however, seems to have been diluted empirically, since the results generate small or inelastic interest rate elasticities that reduce the changes in the adjusting money balances needed to maintain the exchange rate peg and reduce the corresponding fall in output. One possible reason for such an outcome is probably domestic bias and/or credibility of BDL policies. This was somehow reflected in the experience of 2017-2018, where interest rates increased by more than 4% -- driven by higher US rates and a higher risk premium -- but M2 fell only marginally[16].

Third, trade-weighted exchange rate changes tend to affect output but not the balance of payments[17]. Depreciations positively affect output but leave the balance of payments intact. This implies that, though they enhance the trade account, depreciations tend to deteriorate the capital account, thus nullifying the impact on the balance of payments. An important policy implication here is that Lebanon's exchange rate policy of pegging to the USD has not denied trade-weighted exchange rate changes from benefiting income and output, while at the same time has contributed to balance of payments stability.

[15] See Bolbol and Mouradian (2017) for more on Lebanon's fiscal issues.
[16] It fell from 79,828 billion LBP to 76,828 billion LBP
[17] Azar et al (Forthcoming) arrive at a similar result in that E has no effect on the Lebanese trade and current accounts.

Fourth, remittances occupy an elevated position in Lebanese economic discourse, but their impact seems to be at best neutral[18]. Higher remittances seem to create dependency, to have an adverse effect on incentives, and to increase absorption, thus resulting in insignificant effects on output and the balance of payments. This result should cause a turnaround concerning the role of remittance transfers in Lebanese policy making, in the sense of relying less on them and more on capital inflows, especially FDI. Such a shift in course calls surely for steady real sector reforms and reforms to the investment and business climate.

Fifth, the risk premium is a strong determinant of the Lebanese balance of payments, and it is driven by political instability and large public deficits and debt[19]. Towards the end of 2018, it reached up to 8% (800 basis points) as measured by the CDS, and the balance of payments scored accordingly a significant deficit of $4.8 billion. Though 2018 was perhaps an unusual year, it is however indicative of the urgent need to maintain political stability in the country and to undertake very serious fiscal reforms.

Sixth and last, it is apparent that macro policy is not enough in Lebanon to ignite growth and maintain monetary and exchange rate stability. Equally or even more important are governance and institutional reforms that will no doubt have positive spillover effects on the benign conduct and effects of macro policy.

6. Conclusion

In the context of the Lebanese macroeconomic policy framework, comprehensive research relating to the Mundell-Fleming model is scarce. The paper attempts to build on, and contrast with, existing studies to highlight the gist of policy prioritization. The findings of the paper point out to the hybrid nature of the local fiscal and monetary policies in approaching the Mundell-Fleming model. On the fiscal side, government spending and taxation yield positive output results and are aligned with the model. So are changes in the pegged exchange rate that contribute positively to output but marginally to the balance of payments. On the other hand, monetary policy has interesting implications as far as its compressed effects on output and the balance of payments whereas remittances seem to have hardly any impact on the same.

The gap in fiscal policy with regards to tax evasion, the ineffectiveness of momentary policy in affecting output through the pegged exchange rate and remittances sources, the drain in the balance of payments associated with the higher political risk premium and the overall absence of a sound macroeconomic policy, all point out to a fundamental need for the adoption of a statewide structural reform agenda.

Structural reforms is a much visited term that has been repeatedly raised for the past two decades –including in the numerous papers of the current authors-- and it is nowhere more pertinent than the current dire economic times plaguing the country. The literature is vivid with examples indicating the importance of these reforms in boosting economic growth. For it is considered the building block of proper governance that in turn instigates trust in the system and buffers adverse exogenous factors. Ironically, Lebanon is endowed with the human resources that can bring on this reform whether through the successful diaspora and/or the seasoned political class. It remains to be seen if the current state of affairs has put politicians on their feet to draft a sustainable set of reform legislations that will serve well for the future generation of the country and provide a success model for research material.

[18] This result is corroborated at cross-country level by Chami et al (2008), who argue that remittances bring benefits but they also bring costs too.

[19] At end 2018, the deficit to GDP ratio was more than 10% and the debt to GDP ratio more than 150%.

References

[1] Ackerlof, G. et al. 2000. “Near-Rational Wage and price Setting and the Long-Run Phillips Curve”. Brookings papers on Economic Activity, 1.

[2] Azar, et al. Forthcoming. “Empirical Analysis of Merchandise Trade Deficit and the Current Account: Lebanon”. Lebanese Science Journal.

[3] Baumol, W. J. 1952. "The Transactions Demand for Cash: An Inventory Theoretic Approach". Quarterly Journal of Economics. 66 (4).

[4] Bolbol, A. and Mouradian, A. 2017. ”A Note on the Productivity of Post-War Lebanese Public debt, 1993-2016”. Association of Banks in Lebanon (ABL) Monthly Bulletin, No. 11/2017.

[5] Bolbol, A. and Mouradian, A. 2018. ”Explaining Recent Economic Developments and Policies in Lebanon: A Brief Theoretical Note”. Unpublished Manuscript: available upon request from the authors.

[6] Born, B. et al. 2013. “Exchange rate regimes and fiscal multipliers”. Journal of Economic Dynamics and Control, 37.

[7] Boughton, J.M. 2003. “On the Origins of the Fleming-Mundell Model”. IMF Staff Papers Vol. 50, No. 1.

[8] Chami, R. et al. 2008. “Macroeconomic Consequences of Remittances’, IMF Occasional paper, No. 259.

[9] Ćorić, Y. et al. 2015. “Monetary and fiscal policy mix in a small open economy: the case of Croatia, Economic”. Research-Ekonomska Istraživanja, 28:1.

[10] Corsetti, G., and Passineti, P. 2001. “Welfare and macroeconomic interdependence”. Quarterly Journal of Economics, 116.

[11] Dornbusch, R. 1976. “Expectations and Exchange Rate Dynamics,” Journal of Political Economy, Vol. 84 (December).

[12] Frenkel, J. A., and Johnson, H.G. eds. 1976. The Monetary Approach to the Balance of Payments (London: Allen & Unwin).

[13] Fleming, J. M. 1962. “Domestic Financial Policies under Fixed and under Floating Exchange Rates”. IMF Staff Papers, Vol. 9, (November).

[14] Huh, H. S. 1999. “How well does the Mundell-Fleming model fit Australian data since the collapse of Bretton Woods?”. Applied Economics, 31.

[15] International Monetary Fund. 1977. The Monetary Approach to the Balance of Payments: A Collection of Research Papers by Members of the Staff of the International Monetary Fund. (Washington: IMF).

[16] Krugman, P. 1995, “What Do We Need to Know about the International Monetary System?” in Understanding Interdependence: The Macroeconomics of the Open Economy, ed. by Peter B. Kenen (Princeton, New Jersey: Princeton University Press).

[17] Lee, J., and Chinn, M. D. 2006. “Current account and real exchange rate dynamics in the G7 countries”. Journal of International Money and Finance, 25.

[18] Montiel, P. J. 1999. “Determinants of the Long-Run Equilibrium Real Exchange Rate,” in Exchange Rate Misalignment: Concepts and Measurement for Developing Countries, ed. by Lawrence E. Hinkle and Peter J. Montiel. (Washington: World Bank).

[19] Mundell, R. 1960. “The Monetary Dynamics of International Adjustment under Fixed and Flexible Exchange Rates”. Quarterly Journal of Economics, Vol. 74 (May).

[20] Mundell, R. 1962. “The Appropriate Use of Monetary and Fiscal Policy Under Fixed Exchange Rates”. IMF Staff Papers, Vol. 9, (March).

[21] Mundell, R. 1963, “Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates”. Canadian Journal of Economics and Political Science, Vol. 29 (November).

[22] Ncube, M. et al. 2012. “How are the US financial shocks transmitted into South Africa? Structural VAR evidence”. African Development Bank Group Working Paper Series No. 157. Obstfeld, M. 2001. “International Macroeconomics: Beyond the Mundell-Fleming Model”. IMF Staff Papers Vol. 47, Special Issue.

[23] Obstfeld, M, and Rogoff, K. 1995. “The Intertemporal Approach to the Current Account” in Handbook of International Economics, Vol. 3, ed. by Gene M. Grossman and Kenneth Rogoff (Amsterdam: North-Holland).
[24] Obstfeld, M. and Stockman, C. 1985. “Exchange-Rate Dynamics” in Handbook of International Economics, Vol. 2, ed. by Ronald W. Jones and Peter B. Kenen (Amsterdam; New York: North-Holland).
[25] Salim, A. et al. 2015. Targeting debt in Lebanon: A structural macro-econometric model. Economic and Social Commission for Western Asia (Beirut, Lebanon).
[26] Saleh, A.S and Harvie. C. 2017. “Investigating the impact of donor funding: a case study on Lebanon”. EuroMed Journal of Business, May.
[27] Samuelson, P. A. 1939. Interactions between the multiplier analysis and the principle of acceleration. The Review of Economics and Statistics, 21(2), 75-78.
[28] Tobin, J. 1956. "The Interest Elasticity of the Transactions Demand for Cash". Review of Economics and Statistics. 38 (3).
[29] Tobin, J. 1969. “A General Equilibrium Approach to Monetary Theory”. Journal of Money, Credit and Banking, Vol. 1 (February).
[30] Young, W. and Darity, W. 2004. “IS-LM-BP: An inquest”. History of Political Economy, 36 (Supplemant 1).