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Testing the twin-deficits hypothesis and Feldstein-Horioka puzzle in Egypt during the period 1974-2018

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Abstract

The purpose of this paper is to test the twin-deficits hypothesis and the Feldstein-Horioka puzzle in Egypt during the period 1974-2018. Feldstein and Horioka (1980) postulate that if there is perfect capital mobility, correlation between domestic investment and savings should be very low. The results of the study rejected of the twin-deficits hypothesis, which is based on the existence of a positive relationship between the two deficits extending from the budget deficit to the current account deficit. However, the results confirmed the opposite, which is the existence of a long-term relationship between the two deficits, in which the current account deficit creates a budget deficit. As for the Feldstein-Horioka puzzle, the results confirmed the rejection of this puzzle in Egypt, as a large proportion of domestic investment was financed from foreign sources in light of the liberalization of foreign capital flows in Egypt.

ملخص

الغرض من هذه الدراسة هو اختبار فرضية العجز المزدوج ولغز فيلدشتاين–هوريوكا في مصر خلال الفترة 1974–2018. تشير فرضية العجز المزدوج إلى وجود علاقة إيجابية على المدى الطويل بين عجز الحساب الجاري والعجز المالي بحيث يتسبب عجز الميزانية في خلق عجز في الحساب الجاري. بينما يفترض (1980) Feldstein–Horioka أنه إذا كان هناك حرية انتقال كاملة لرأس المال بين الدول فمن المتوقع أن يكون الارتباط بين الاستثمار المحلي والمدخرات منخفضًا للغاية حيث يتم تمويل الاستثمار المحلي بصفة أساسية من خلال أسواق المال الدولية. أظهرت نتائج الدراسة رفض فرضية العجز المزدوج التي تقوم على وجود علاقة إيجابية بين العجزين تمتد من عجز الميزانية إلى عجز الحساب الجاري. ولكن أكدت النتائج وجود عجز مزدوج "عكسي" بمعنى ان العلاقة طويلة الاجل بين العجزين يتسبب فيها عجز الحساب الجاري في خلق عجز في الموازنة. وبالنسبة للغز Feldstein–Horioka أكدت النتائج رفض هذا اللغز في مصر حيث أن نسبة كبيرة من الاستثمار المحلي تمول من مصادر أجنبية في ظل تحرير تدفقات رؤوس الاموال الأجنبية في مصر.

Introduction

Over the last four decades, Egyptian economy has suffered from high level of budget deficit and current account deficit that reached their peaks of 6% and 12% of GDP in 2016; respectively. To cover these dual deficits, the Egyptian government continued to accumulate debt domestically and internationally; that mounted to their peaks of 95% (in 2016) and 32% (in 2018) of GDP; respectively. Consequently, total outstanding public debt reached unsustainable levels of more than 100% of GDP and servicing such debt exceeded one third of government expenditure.

Accordingly, the Egyptian economy is a good candidate for testing twin-deficits hypothesis that postulates a positive causal relationship running from budget deficit to current account deficit. The Feldstein-Horioka puzzle is related to the role of international capital mobility and the positive relationship between budget deficit and the current account through the domestic and foreign sources of financing domestic investment.

The purpose of this paper is to test the twin-deficits hypothesis and the Feldstein-Horioka puzzle in Egypt, taking into consideration the impact of the fiscal dominance in Egypt during the period 1974-2018. The study will also test the possibility of structure breaks that could influence the long-run directional relationship between the budget deficits and current account deficits. Based on the results of these tests, policy recommendations will be proposed to support Egyptian policy makers in their efforts to reduce the two deficits.

The rest of this paper is divided into six parts; the first will give stylized facts about the internal and external imbalances in Egypt during the period 1974-2018 and the role of fiscal dominance in affecting the dynamics between the budget deficit and current account deficit. The second part will present the literature review and the third part will cover the theoretical background. In the fourth part data and methodology will be presented. The results of the empirical study are given in the fifth part and concluding remarks are given in the last part.

1. Egyptian internal and external imbalances during 1974-2018

Over the last four decades' Egyptian economy has suffered from high level of budget and current account deficits that reached unsustainable levels as ratio of GDP. As can be seen in Figure (1), overall budget deficit was relatively high during the 1970s and 1980s with an average of 13% and 22%; respectively. Current account deficit showed a similar relatively high ratio to GDP in the 1970s with an annual average of 11%; but in the 1980s-current account deficit decreases to an average of 4% of GDP, see Figure (1). This period had witnessed at least two shocks; i.e., the failure of the 1977's program with the IMF and the fall of Oil prices in 1982.

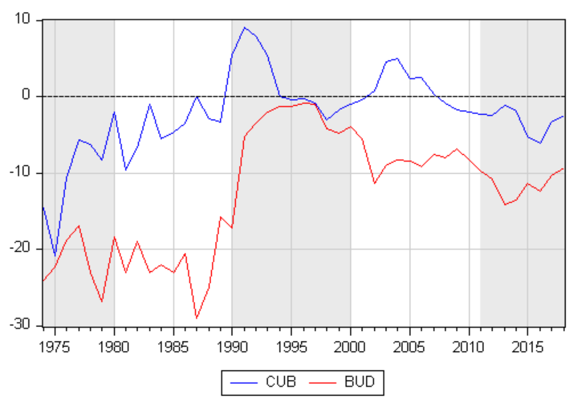
A third shock, although a positive one started in 1990 as Egypt undertook serious measures to convince the IMF of its readiness for the implementation of the more vigorous program of 1992. Despite the successful implementation of this program especially with respect to the reduction of budget deficit as a ratio of GDP (the average ratio was brought down to only 4% and the current account deficit turned to a surplus average 2% of GDP, a fourth shock was initiated from internal source in 1997 after the Luxor massacre and its sever negative effects on the foreign-currencies revenue from tourism. Such shock was directly reflected on current account deficit and its negative impact continued for several years ahead; current account deficit after this shock turned from surplus into deficit. Consequently, the average budget deficit ratio increased again to 7.8% of GDP during this period.

It is important to mention that in the 1992's program was considered as a regime change with respect to the dominance of the fiscal policy as the government moved from the monetization of its budget deficit through the central bank of Egypt (CBE) towards the issuance of government securities (T-bills and T-bonds) to finance the deficit from real resources.[1]

This regime shift had been a landmark change that did have its impact on the accumulation the government domestic debt and thereby the fiscal dominance. The absence of any ceiling on the ratio of public domestic debt to GDP allowed the Egypt government to accumulate enormous outstanding domestic debt LE 215 trillion about 71% of GDP in 1999.

A fifth shock, another regime change, can be observed in 2003 as the Egyptian government applied far-reaching efforts to establish a flexible foreign exchange system; within which banks were actively involved through the foundation of two important markets; i.e., the interbank foreign exchange market and the interbank money market. Stability in foreign exchange market and financial market encouraged large foreign capital inflows during this period. [2]

Figure (1) Egyptian Current Account and Budget Deficits as % of GDP 1974-2018



[1] See, Abed (2020) for more details about fiscal dominance and budget deficits in Egypt.
[2] See CBE 2004.

Global financial crises in 2008 considered as the sixth shock, which had its direct negative implications on the external deficit but also reflected on the budget deficit ratio to GDP as the Egyptian government initiated its first stimulus plan of LE 15.5b, about 1.5% of GDP to lessen the negative burden of the crises.(3) The average ratio of budget deficit to GDP increased again to 7.8% during this period. Because of the global financial crises, current account balance turn again into deficit gain with an average of 1.6% of GDP during the period 2008-2010.

The seventh shock during the period of the study was obviously the January 2011's revolution that brought about a great deal of political as well as economic instability this was reflected in a higher average budget deficit to GDP of 12% during the period 2011-2014. Current account deficit also showed an average of 2.1% to GDP during the same period. Despite the large foreign financial support from Arab countries, current account and budget deficit ratio to GDP continued to increase.

The last shock occurred in 2016, as the Egyptian government decided to borrow U.S. $12 billion to finance a three-years Extended Fund Facility (EFF) program with the IMF. The *letter of intent* presented by the Egyptian government entailed several policy measures:(4)

- Flotation of the Egyptian pound
- Reducing government subsidy of Energy products by raising its prices to the level of international levels.
- Replacing Sales-Tax system of 10% by Value-Added Tax (VAT) and raise its rate from 14% to 15%.

(3) This package oriented to the acceleration of infrastructure and utility projects in addition to a second plan of LE5.5b to accelerate the investment projects and export promotion. (Egyptian Ministry of finance, June 2009, pp.5-8).

(4) See, IMF (2017), pp. 45-57.

- Achieving a primary surplus of 2% of GDP to put public debt on sustainable path.

After the implementation of the free-floating system Egyptian pound lost more than 50% of its value and inflation hiked to all-time high level of %30 in 2017. The CBE decided for the first time to target the annual headline inflation rate of 13% with a range of ±%3 by raising overnight lending and borrowing rate to 19% to absorb excess liquidity in the market and discourage dollarization of the monetary system. Theses restrictive monetary and fiscal measures raised the cost of borrowing domestically relative to foreign sources to finance domestic investment.

In 2016, budget deficit and current account deficit increased to reach their peaks 12% and 6% of GDP; respectively. Table (1) shows that total outstanding public debt accumulated to unsustainable high levels of 111% of GDP and servicing such debt reached about 20% of GDP annually.

Beyond the EFF program, Egyptian government decided to reduce imports by raising custom duties on large numbers of imported products and putted quantitative restrictions on others;(5) despite the IMF's warning about the feasibility of these trade restrictions in solving the external deficit problem in Egypt.(6) Although, one can observe from Figure (2) that current account deficit and budget deficit started to decrease together as a ratio of GDP to 3% and 9% in 2018.

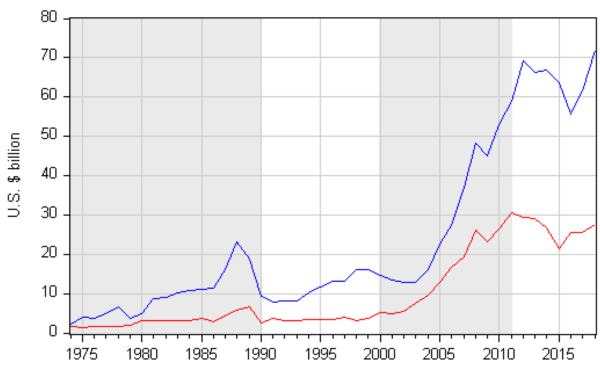
Current account deficit is originated from the chronic balance of trade deficit and the widening gap between Egyptian imports and exports of goods. As can be observed from Figure (2), Egyptian merchandise exports

(5) There was a tariff rate increase from 40% in 2016 to 60% in 2017 that affected 53% of all tariff lines. For more details about the increase in custom duties, see WTO (2018, pp: 48-49).

(6) See IMF (2016), press conference about these trade restrictions applied by the Egyptian government. The argument was that according to the WTO rules Egypt has the right to impose restrictions on the imported products that exhibited a sudden surge in its imports.

demonstrated relatively low and stable level during the 1980s and 1990s. Despite the increase in exports over the period 2000-2011, Egyptian imports continued to increase at a faster rate so that the coverage ratio of exports to imports average 40% during the period 2011-2018.

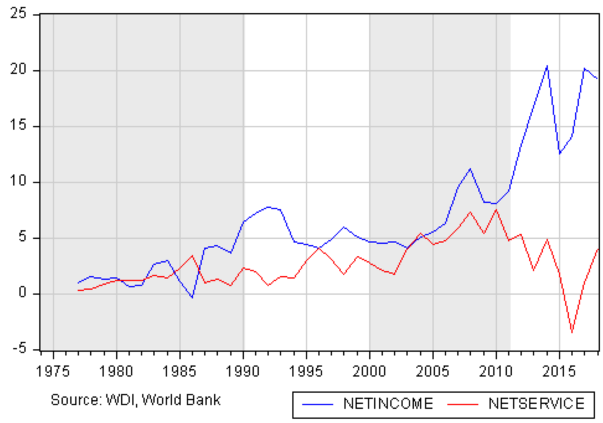
Figure (2) Egyptian Imports and Exports 1974-2018



Source: WDI, World Bank.

Although, net transfers and net services were in surplus during the period of the study and compensated for the large deficit in balance of trade, they suffer from high volatility as can be shown from Figure (3). Instability in net transfers, especially worker's remittances, are caused by fluctuations in oil prices. Net services, such as tourism and Suze Canal fees, are considered demand driven and more sensitive to security issues and instability in international trade.

Figure (3) Egyptian Net Income and Net Transfers 1977-2018



Source: WDI, World Bank

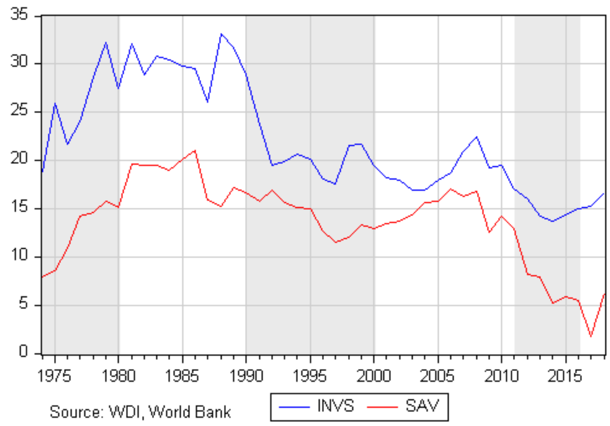
The dependency of Egyptian government on these unstable sources of foreign currency was usually reflected in instability in the budget deficit. Given the inability to raise enough tax revenue, a current account deficit is expected to reduce government revenue and would cause a budget deficit. A current account surplus will be reflected in higher government revenue and would decrease budget deficit.

We can conclude that despite the eight different shocks that stroked the Egyptian economy, whether from domestic or external sources, budget deficit and current account deficit reacted in the same direction; i.e., together down in the case of positive shocks and together up in the case of negative shocks.

The rest of this part will deal with the relationship between domestic saving and investment in Egypt during the period of the study. This relationship is critical for testing Feldstein-Horioka puzzle, which postulates that a weak relationship between domestic investment and saving is an indication of a high degree of capital mobility that allows domestic investment to be financed by foreign sources.

As can be shown from Figure (4) there was always a gap in financing domestic investment from domestic savings over the whole period of the study. During the second half of the 1970s and the 1980s' domestic saving covered 47% and 63% of domestic investment; respectively. The average domestic investment increased from 25% to 30% of GDP during this period and domestic savings also increase from 12% to 18% of GDP.

Figure (4) Egyptian Saving and Investment as % of GDP 1974-2018



Source: WDI, World Bank

During the 1990s the sever restrictive monetary and fiscal measures included in the stabilization program had a negative impact on both domestic investment and saving. Average domestic investment and saving decreased to 20% and 13% of GDP; respectively. The coverage ratio of domestic investment by domestic saving increased to 69% in this period.

In the early 2000s, one can observe the rebound of domestic investment and saving that continued up to global financial crises that reversed the positive trend. The average domestic investment decreased to 19% of GDP whereas average domestic saving increased to 16% of GDP. The impact of 2011's revolution had a strong negative shock on average domestic investment and saving that fell to 15% and 6% of GDP; respectively. The gap between domestic investment and saving was the largest as the later covered only 47% of the former. Finally, the recovery of domestic investment was in 2014 earlier than that of domestic savings that started to rebound in 2017.

To summarize, the behavior of domestic investment and saving demonstrated a positive relationship, with a different lag of response to shocks, over the period of the study. The domestic investment was never fully financed by domestic savings, which means that foreign sources were used to fill the financing gap.

2. Literature Review

The interest in the study of the twin-deficits hypothesis started in the U.S.A in 1980s as current-account deficits increased in response to the increase in budget deficit Normandin (1999). European countries also faced the twin-deficit problem in the 1990s Edwards (2001). Abbas, et.al, (2010) investigated the relationship between fiscal policy and the current account for large number of diversified group of developed, emerging and low-income countries, twin-deficit hypothesis was confirmed but far less than one-for-one. In average, a reduction in fiscal deficit by 1 percentage point of GDP is associated with a reduction in current account deficit by 0.2–0.3 percentage point of GDP.

Despite of the wide spreading of cases of twin-deficits especially in developing countries, especially those with high ratio of fiscal deficits of GDP, there is no consensus about the directional relationship between the two deficits whether in developed or developing countries. Empirical studies showed conflicting results about the direction of the causal relationship and the validity of Feldstein-Horioka puzzle, Fidrmuc (2003) compared between the behavior of OECD's countries and European transition economies.

In the following we will survey the previous studies related to testing the validity of twin-deficits hypothesis and Feldstein-Horioka puzzle applied to Egypt.

Khalid and Wee (1999) tested the directional causal between budget and current account deficits for a sample of some developed and developing countries, Egypt included during the period 1957-1992. The authors used Engle and Granger (1987) and Johansen and Juselius (1990) cointegration methods. The results indicated that for Egypt and Mexico there was a long-run relationship between budget deficit and current account deficit the twin-deficit was confirmed as the causality test showed that budget deficit Granger cause current account deficit. For the other countries, they observed that a 'reverse' twin-deficit was expected when debt to GDP was high.

Marinheiro (2008) tested the validity of twin-deficits hypothesis, the Ricardian Equivalence and Feldstein-Horioka puzzle for Egypt over the period 1977-2003. The results of the study rejected the twin-deficits hypotheses in favor of a weak evidence of 'reverse' twin-deficits running from current account to budget deficit. No support was found for the Ricardian equivalence hypothesis, and Feldstein-Horioka hypothesis was also rejected in favor of high degree of capital mobility.

Hashemzadeh and Wilson (2010) tested the twin-deficits in 12 middle eastern countries, Egypt included. Using SVAR model, the results rejected the hypothesis of twin-deficits in Egypt in favor of a reversed twin-deficits during the period 1981-2003.

Ahmad, et.al, (2015) examined the relationship between the fiscal deficit and the current account deficit using the threshold cointegration approach using quarterly data for nine African countries during the period 1980:1-2009:4, Egypt included. The results indicated that Egypt, Morocco, Nigeria and Tanzania, had a positive threshold cointegration relationship between the current account deficit and the fiscal deficit. This positive relationship supports the twin-deficits hypothesis.

Helmy and Zaki (2015) tested the twin-deficits hypothesis and the Feldstein-Horioka paradox in Egypt using quarterly data of the period 2002-2014. They Applied Granger causality test and an error-correction model to investigate the short-run and long-run relationship between current account deficit and budget deficit. The results of the study rejected the twin-deficits hypothesis in favor to the 'reverse' twin-deficits and partially rejected Feldstein-Horioka puzzle.

Helmy (2018), started with testing the twin-deficits hypothesis and the cointegration between current account deficit and fiscal deficit during 1975-2014, but the results of the study rejected the hypothesis between the two deficits. Then, the focus of the study turned to test a modified version of twin-deficits in which the causal relationship between budget deficit and the balance of trade deficit to be tested. The results of the modified version also rejected the causal relationship running from budget deficit to balance of trade deficit in favor of a reverse one.

The survey of the previous studies revealed conflicting results with respect to the validity of twin-deficits hypothesis that can be attributed to different time periods and different specification of adjusting process. It is worth noting that all the previous studies applied to Egypt overlooked the fact that the variables involved suffered from structural breaks caused by multiple external as well as internal shocks. As demonstrated in the first part of this study there are at least eight major shocks over the period 1974-2018. Depending exclusively on traditional stationarity-tests, such as Augmented Dickey-Fuller test (ADF) and Phillips-Perron test, would provide inaccurate results because these methods disregard structural breaks.

Using Granger causality requires that variables involved are stationary in their levels, so if they are stationary in the first difference, it is advisable to use Toda and Yamamato (1995) causality test. Having variables with different integration order because one variable is stationary with structure break, it is not advisable to use Engle and Granger nor Johansen and Juselius for testing for cointegration, rather using Autoregressive Distributed Lag (ARDL) methodology introduced by Pesaran, et.al. (2001).

The accuracy and validity of testing for causality and cointegration between current account deficit and budget deficit are very sensitive not only to their order of stationarity but also to the precise identification of the structural shocks. In our study we are going to use the appropriate stationarity test that can internally identify the structural breaks for each variable involved.

For examples of previous studies that took into consideration these critical empirical issues in testing for twin-deficits refer to Altintas and Taban (2011) for Turkey, Khan and Saeed (2012) for Pakistan, Suresh and Gauta (2015) for India, Özer, et.al. (2018) for Montenegro, Umer and Aneja (2019) for China, and Handoyo, et.al. (2020) for Indonesia.

3. Theoretical analysis

Twin-deficits hypothesis suggests a positive relationship over the long-run between the current account deficit and the fiscal deficit. This causal relationship between the two deficits are supposed to run from fiscal deficit to current account deficit. This relationship can be derived from national accounts framework, in which income, Y, is defined as the sum of consumption, C, investment, I, government expenditure, G, and net exports of goods and services, (X – IM) in eq. (1)

$$Y = C + I + G + (X - IM) \qquad (1).$$

By rearranging eq. (1) to link fiscal balance to the difference between investment and saving in eq. (2)

$$(X - IM) = Y - C - G - I = (S - I) \qquad (2),$$

where S is national saving. According to eq. (2) the gap between saving and investment is related to the current account balance. If $I > S$ then this will be reflected in current account deficit $IM > X$ and vice versa. To link current account to budget balance, we need to separate between private saving, S^p, and government saving, S^g. S^p is defined as the difference between disposable income and consumption (Y - T - C); and S^g is defined as the difference between taxes and government expenditure (T- G) as in eq.3.

$$(X - IM) = (S^p - I) + (T - G) \qquad (3),$$

assuming that I is fully financed by S^p, current account balance will be related to fiscal balance. If there is a budget deficit ($G > T$) this will be reflected in current account deficit ($IM > X$), and vis versa. If I and S^p are not equal, a current account deficit could be caused by an increase in I, a decrease in S^p, and/or an increase in the budget deficit. If the current account deficit is attributed to an increase in investment, the country is then raising its capital stock more quickly and therefore raising its future output. However, if the current account deficit reflects lower private savings or larger budget deficit, the country is borrowing abroad or running down its foreign assets to sustain or raise consumption (Kenen, 2000: pp. 285-286)

It is important to stress that all these equations are just identities, there are no explanations about the channels through which budget deficit will cause current account deficit. There are two main approaches to explain the chains of causality of the twin-deficits, the Keynesian approach and Mundell-Fleming approach.[7] According to the Keynesian absorption theory, an increase in budget deficit would increase domestic absorption and

(7) Mundell (1963) and Fleming (1961).

thereby raise the demand for imports and bring about current account deficit (Keynes, 1936).

Alternatively, the Mundell-Fleming approach argues that an increase in budget deficit would put upward pressure on domestic interest rate, encouraging foreign capital inflows that would cause an appreciation of domestic currency and thereby decreasing the competiveness of exports that cause current account deficit. The impact of extended fiscal deficit on current account deficit in the U.S. explained by Ball and Mankiw (1995) and Dudley and McKelvey (2004) based on the negative impact of the former on domestic savings that increases domestic interest rate and leads to appreciation of domestic currency which in turn causes current account deficit.

Feldstein and Horioka (1980) argue that the causal relationship between the budget deficit and the current account deficit (i.e., the twin-deficits) depends on the degree of international capital mobility and the source of financing domestic investment. They also postulate that if there is perfect capital mobility, correlation between domestic investment and savings should be very low. Thus, eq. (3) will show current account and budget deficits moving together in the same direction. In this case, financing of domestic investments will not be constrained by domestic savings. Globally, savings should move from one country to another according the relative rate of return. Feldstein-Horioka Puzzle was observed in many developed countries with high correlation between domestic investment and savings despite their high level of integration in global financial markets with perfect capital mobility. In this case, the current account deficit and the budget deficit will move in different directions and the twin-deficits hypothesis may be rejected.

To test for the validity of Feldstein-Horioka Puzzle, Feldstein and Horioka (1980) proposed estimating a liner regression between investment and saving as a ratio of GDP:

$$I_{yt} = a + \beta S_{yt}^{p} + \varepsilon_t \qquad (4),$$

where I_{yt} and S_{yt}^{p} are the ratio of investment and private saving to GDP, respectively. $\beta > 0$ is the measure of international capital mobility and $\varepsilon_t \sim iid.N(0,\sigma^2)$. In the case of perfect capital mobility $\beta \approx 0$, and the higher the value of β the lower the level of capital mobility.

Fidrmuc (2003) introduced a version of eq. (3) to test for both twin-deficits hypothesis and Feldstein-Horioka Puzzle, in the following equation:

$$(X_{yt} - IM_{yt}) = \beta_0 + \beta_1\left(T_{yt} - G_{yt}\right) + \beta_2 I_{yt} \ (5),$$

where the left-hand side is the current account and in the right-hand side are the budget deficit and investments (all variables are measured as a ratio of GDP). To confirm the validity of twin-deficits hypothesis, budget deficit parameter should be positive $\beta_1 > 0$ and investment parameter should be negative, $\beta_2 < 0$. Twin-deficits hypothesis will be rejected if the parameter of the budget balance is negative, $\beta_1 < 0$.

Assuming that the country is perfectly integrated into global financial markets, parameters of budget deficit and investment should equal one, $\beta_1 = \beta_2 = 1$. If the investment parameter is significantly less than one, $\beta_2 < 1$, this means that a large part of investment is financed by domestic savings and is considered as a confirmation of Feldstein-Horioka Puzzle.(8)

A modified version of eq. (5) will be used in our study to test the validity of both the twin-deficits hypothesis and the Feldstein-Horioka Puzzle. Following Olanipekun (2012) the proposed equation will include in

(8) This puzzle has been confirmed by the research of Obstfeld and Rogoff (2000) for developed and emerging economies.

the right-hand side domestic private saving in addition to the budget deficit and investment as in the following:

$$(X_{yt} - IM_{yt}) = \beta_0 + \beta_1\left(T_{yt} - G_{yt}\right) + \beta_2 I_{yt} + \beta_3 S_{yt}^{p} \text{ (6),}$$

where β_3 is the parameter of private savings which is expected to have positive relationship with current account balance. Therefore, the value of this parameter should be positive $\beta_3 > 0$. Conditions for the acceptance or rejecting of twin-deficits hypothesis and Feldstein-Horioka Puzzle are the same as explained in eq. (5).

Twin-deficits hypothesis is not the only theoretical explanation of the long-run association between budget deficit and current account deficit. Summers (1988) introduced the ‘reverse’ twin-deficits or the so-called ‘current account targeting’ which is a unidirectional reverse causality running from the current account deficit to the budget deficit. As explained by Reisen (1989), Khalid and Teo (1999), this type of causality is taking place in developing countries with high dependency on external funds and commodity-based exports.

In contrast, Barro (1974,1985) presented the Ricardian-Equivalence hypothesis which claims that no causal relationship between fiscal and current account deficits. He argued that reducing government taxes, will increase the budget deficit but it would have no impact on the current account deficit. This is because private agents will not increase their consumption, as Keynesians expect, rather they offset the increase in their disposable income by raising their savings. Thus, expansionary fiscal policy would have no impact on aggregate demand and the current account deficit will not be affected. Private agents’ response to the tax-cuts is motivated by their full anticipation of the government’s future increase in taxes, especially if they perceive that fiscal policy is unsustainable.

To conclude the theoretical analysis of the study has four different hypotheses. First, the twin-deficits hypothesis based on Keynesian and Mundell–Fleming approaches that postulate positive causality running from budget deficit to current account deficit. Second, the Feldstein-Horioka puzzle presented by Feldstein and Horioka (1980) that claims high correlation between domestic saving and investment despite the high level of capital mobility. Third, the reverse twin-deficits hypothesis proposed by Summers (1988) that suggests a causal relationship running from current account deficit to budget deficit. Fourth, the Ricardian-Equivalence hypothesis proposed by Barro (1974, 1985) that argues that budget deficit and current account deficit are causal independent.

4. Data and Methodology

The data set in this study covered the period 1974-2018 with 45 annual observations of current account deficit as a ratio of GDP (CUD), budget deficit as a ratio of GDP (*BUD*), domestic saving as a ratio of GDP (*SAV*), and domestic investment as a ratio of GDP (*INV*). The source of *CUD, SAV* and *INV* is the WDI, World Bank. [9] Only *BUD* is collected from the Egyptian Ministry of Finance.

4.1 Testing for long-run relationship

Based on the theoretical analysis in part 2 of the study, the function that will be used for testing the twin-deficits hypothesis and the Feldstein-Horioka Puzzle will be as follows:

$$CUD = f(\overset{(+)}{BUD}, \overset{(-)}{INV}, \overset{(+)}{SAV}) \qquad (7)$$

[9] *INV* is defined as gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. *SAV* Gross savings are calculated as gross national income less total consumption, plus net transfers. Data are in current U.S. dollars (WDI, World Bank)

CUD is expected to have positive relationship with *BUD* and *SAV* and negative relationship with *INV*. As can be shown from Table (2) the correlation between *CUD* and *BUD* is positive and moderate, 0.57, which is consistent the twin-deficits hypothesis which postulates positive association between the two deficits. There is negative correlation between *INV* and *CUD* and *BUD* with relatively higher correlation with BUD, -0.66, than that with *CUD*, -0.27. This negative correlation is also consistent with the theoretical claim that higher investment will increase current account deficit. Finally, *SAV* is found positively correlated with *CUD* and *INV* and negatively with *BUD* are also consistent with the theoretical expectation.

To test for the hypothesis of a 'reverse' twin-deficits, we need to specify a second equation in which BUD will be the dependent variable and *CUD, INV and SAV* are the independent variables.

$$\overset{}{BUD} = f(\overset{(+)}{CUD}, \overset{(+)}{INV}, \overset{(-)}{SAV}) \qquad (8)$$

BUD is expected to have positive relationship with *BUD* and *INV* and negative relationship with *SAV*.

After the preliminary examination of correlation, the next step is to test the stationarity of CUD and its regressors to determine the appropriate econometric method for the regression of the model.

Table (2) Correlations Between the Model's Variables

	CUD	BUD	INV	SAV
CUD	1	0.5702	-0.2595	0.2661
BUD	0.5702	1	-0.6666	-0.1910
INV	-0.2595	-0.6666	1	0.6943
SAV	0.2661	-0.1910	0.6942	1

Source: calculated by the Author.

Given the several internal and external shocks, analyzed in part 1, that hit the Egyptian economy over the 45 years of our sample, methods of testing for stationarity should take into consideration the identification of structural shocks. The accuracy and validity of testing for causality and cointegration between CUD and its explanatory variables are very sensitive not only to their order of stationarity but also to the accurate identification of the structural shocks. Using only traditional tests for stationarity, that ignore structural breaks, would certainly weaken the validity of the empirical analysis.

Therefore, in this study we are going to use, in addition to traditional test, stationarity tests that can identify internally the structural breaks, i.e., Zivot and Andrew (1992) which tests for possible single structural break.

As can be shown in Table (3a), the results of the traditional ADF test indicate that all four variables are found non-stationary in the level but are stationary in the first difference; i.e., they are integrated of order one I(1). Although, the results of using Zivot and Andrew (1992) test, indicated in Table (3b) that all variables are stationary with structural breaks at their level I(0), with the exception of *SAV* which is found stationary at first difference I(1). In this case of having a mix of I(0) and I(1), conventional cointegration methods; e.g., (Johansen-Juslius, 1990) and (Engle-Granger, 1987), are not applicable as they require that all variables should have the same integration order either I(0) or I(1). Accordingly, the best econometric method to estimate the long-run relationship is the Autoregressive Distribution Lag (ARDL) developed by (Pesaran and Shin, 1999) and (Pesaran, Shin, and Smith, 2001).

ARDL method has several advantages of simplicity and high performance. Whereas the conventional cointegration methods estimate the long-run relationships using a system of equations, ARDL is using only one single equation for cointegration. For better dynamic performance, ARDL allows for having different lags for dependent and explanatory variables, which is impossible for conventional methods. ARDL method is also found more robust and performs better for a small sample size of data; therefore, it is suitable for our data of 45 observations.

The general specification of ARDL(p,q) is as follows:

$$y_t = a_0 + \sum_{i=1}^{p} a_{1i} y_{t-i} + \sum_{j=1}^{q} \gamma_j X_{t-j} + \varepsilon_t, \qquad (7)$$

where y_t is the dependent variable, X_t is a vector of the dynamic explanatory variables which and ε_t is the error term that should be normally distributed with zero mean and constant variance $\varepsilon_t \sim N(0, \sigma^2)$, p and q are the number of lags for dependent and explanatory variables; respectively.

To test for whether there is long-run relationship (cointegration) between y_t and X_t we need to perform the "Bounds Testing" using the following equation:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta y_{t-i} + \sum_{j=1}^{q} \omega_j \Delta X_{t-j} + \theta_0 y_{t-1} + \theta_1 X_{t-1} + \vartheta_t, \quad (8)$$

where β_1, and ω are the parameters of the short-run relationship; θ_0 and θ_1 are the parameters of long-run relationship. There will be cointegration between y_t and X_t if the null hypothesis,

H_0: $\theta_0 = \theta_1 = 0$ is rejected against the alternative H_1: $\theta_0 \neq \theta_1 \neq 0$.

(Pesaran et al., 2001) provide lower and upper bounds on the critical values for the asymptotic distribution of the F-statistic. There are three possibilities of the cointegration test; first, there will be no cointegration if the computed F-statistic lays below the lower bound. Second, if the F-statistic exceeds the upper bound, there will be cointegration. Third, the test will be inconclusive if the F-statistic lays between the lower and upper bounds.

If the cointegration between y_t and X_t is confirmed, we can estimate the error correction model using the following equation:

$$\Delta y_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta y_{t-i} + \sum_{j=1}^{q} \omega_j \Delta X_{t-j} + \varphi_0 \, ECM_{t-1} + \vartheta_t, \quad (9)$$

where, ECM_{t-1} is derived from the lagged value of the error term (μ_{t-1}) of the flowing long-run relationship:

$$y_t = a_0 + \sum_{j=1}^{q} \gamma_j X_t + \mu_t, \quad (10)$$

$$ECM_{t-1} = \mu_{t-1} = y_{t-1} - \sum_{j=1}^{q} \gamma_j X_{t-1}, \quad (11)$$

and $\varphi_0 < 0$ is the parameter of the error correction model ECM_{t-1} that measures the speed of adjustment from any shocks in the short-run back towards the long-run.

4.2 Testing for short-run causality

Based on the results of the stationarity tests that investigate the possibility of structural breaks, we found mix cases of order I(0) and I(1). Accordingly, Granger-causality test is not applicable to such cases because it requires that variables should be stationary in their level. Using Toda and Yamamato (1995) causality test would help to overcome this problem.

Toda and Yamamoto (1995) propose an improved Granger-causality test procedure which makes testing for causality parameter valid irrespective of the integration or cointegration properties of the time series under consideration. Assuming a Vector-Autoregressive model for two variables X and Y in their levels as follows:

$$Y_t = a + \sum_{i=1}^{k} \beta_i Y_{t-i} + \sum_{j=k+1}^{k+d_{max}} \beta_j Y_{t-j} + \sum_{i=1}^{k} \delta_i X_{t-i} + \sum_{j=k+1}^{k+d_{max}} \delta_j X_{t-j} + \vartheta_{1t} \quad (12)$$

$$X_t = a + \sum_{i=1}^{k} \lambda_i X_{t-i} + \sum_{j=k+1}^{k+d_{max}} \lambda_j X_{t-j} + \sum_{i=1}^{k} \theta_t Y_{t-i} + \sum_{j=k+1}^{k+d_{max}} \theta_j Y_{t-j} + \vartheta_{2t} \quad (12)`.$$

The method involves using a modified Wald statistic for testing the significance of the VAR(k) parameters, where k is the optimal lag order. Essentially, the improved procedure entails the determination of the maximal order of integration of the series in the model, i.e., d_{max}, and intentionally over-fit the underlying model with additional d_{max} lags. So that the VAR order becomes p = k + d_{max}. Since k is assumed to be the optimal lagged length, the coefficients of additional lags (d_{max}) are expected to be zero and therefore can be ignored. Toda and Yamamoto (1995) proved that such procedure will guarantee the asymptotic χ^2 distribution of the Wald statistic. (10)

We can test the directional causality between X and Y through the following:

In eq. (12) the null hypothesis that changes in X does not Granger cause changes in Y is as follows:

$$H_0: \delta_i = 0, (i = 1 \ to \ k)$$
$$H_1: \delta_i \neq 0, (i = 1 \ to \ k)$$

(10) For the rational and the prove of this procedure refer to Toda and Yamamoto (1995, pp. 230-233).

If H_0 is rejected, then X Granger cause Y and if H_0 is not rejected then X doesn't Granger cause Y.

In eq. (12)`, the null hypothesis that changes in Y doesn't Granger cause changes in X is as follows:

$$H_0: \theta_i = 0, (i = 1 \; to \; k)$$

$$H_1: \theta_i \neq 0, (i = 1 \; to \; k)$$

If H_0 is rejected, then Y Granger cause X and if H_0 is not rejected Y does not Granger cause X.

5. Empirical Results

5.1 The empirical results of the ARDL Current Account Model

The ARDL equation to be estimated for CUD model is specified as:

$$CUD_t = a_0 + \sum_{i=1}^{p} a_{1i} CUD_{t-i} + \sum_{j=1}^{q1} \gamma_{1j} BUD_{t-j} + \sum_{j=1}^{q2} \gamma_{2j} INV_{t-j} + \sum_{j=1}^{q3} \gamma_{3j} SAV_{t-j} + \varepsilon_t \qquad (13)$$

The first step in estimating ARDL model is lag selection using different information criteria. Table (4) shows the best number of lags according to all criteria is 6, but 1 lag according to Schwarz information criterion SIC.

Table (4) VAR Lag Order Selection Criteria

VAR Lag Order Selection Criteria						
Endogenous variables: CU2 BD2 INVS SAV						
Exogenous variables: C DUM90 DUM02 DUM95 DUM88						
Sample: 1974 2018						
Included observations: 35						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-372.6396	NA	65703.71	22.43655	23.32532	22.74335
1	-287.4454	126.5742	1310.698	18.48259	20.08238	19.03484
2	-271.7094	19.78235	1473.476	18.49768	20.80848	19.29537
3	-257.6556	14.45538	2028.712	18.60889	21.63071	19.65202
4	-233.1215	19.62726	1835.182	18.12123	21.85407	19.40980
5	-200.8600	18.43513	1470.337	17.19200	21.63585	18.72602
6	-87.53414	38.85460*	22.62233*	11.63052*	16.78539*	13.40998*
* indicates lag order selected by the criterion						
LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

The estimates of ARDL inflation model are reported in Table (5) shows that with a maximum of 6 lags, the selected model according to SIC method is ARDL (1, 0, 1, 0), the lag structure assigned for the variables *CUD*, *BUD*, *INV*, and *SAV*; respectively. It also indicates the high explanatory power of the model as the adjusted R-Square equals 0.82. Table (6) shows that the null hypothesis of no-cointegration between CUD and its determents can be rejected at 1% significant level as the value of F-statistic (6.81) is higher than the upper critical value bounds (5.61), which means that there is a long-run relationship between CUD an all the dynamic regressors.

Table (5) ARDL Estimation of Current Account Model				
Sample (adjusted): 1975 2014				
Included observations: 40 after adjustments				
Maximum dependent lags: 4 (Automatic selection)				
Model selection method: Schwarz criterion (SIC)				
Dynamic regressors (4 lags, automatic): BUD INV SAV				
Fixed regressors: DUM90 DUM02 DUM95 DUM88 C				
Number of models evalulated: 500				
Selected Model: ARDL(1, 0, 1, 0)				
Note: final equation sample is larger than selection sample				
White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance				
Variable	Coefficient	Std. Error	t-Stat.	Prob.*
CUD(-1)	0.562424	0.099298	5.663991	0.0000
BUD	-0.017389	0.057928	-0.300185	0.7661
INV	-0.993233	0.201867	-4.920243	0.0000
INV(-1)	0.672937	0.181420	3.709281	0.0008
SAV	0.414841	0.185839	2.232264	0.0332
DUM90	7.423589	0.961010	7.724780	0.0000
DUM02	0.655254	0.477951	1.370965	0.1806
DUM95	-0.580861	0.560582	-1.036176	0.3084
DUM88	5.605864	1.932401	2.900984	0.0069
C	0.008819	1.749992	0.005039	0.9960
R-squared	0.861850	Mean dependent var		-1.714058
Adjusted R-squared	0.820405	S.D. dependent var		5.304326
S.E. of regression	2.247903	Akaike info criterion		4.670191
Sum squared resid	151.5920	Schwarz criterion		5.092410
Log likelihood	-83.40381	Hannan-Quinn criter.		4.822852
F-statistic	20.79500	Durbin-Watson stat		2.063906
Prob(F-statistic)	0.000000			
*1% significant, **5% significant, ***10% significan				

Table (6) Estimation of Long-run Parameters				
Variable	Coefficient	Std. Error	t-Stat.	Prob.
BD2	-0.039739	0.134136	-0.296262	0.7691
INVS	-0.731978	0.280420	-2.610296	0.0140*
SAV	0.948045	0.348337	2.721629	0.0107*
EC = CU2 - (-0.0397*BUD - 0.7320*INV + 0.9480*SAV)				
F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	**6.8076**	10%	2.72	3.77
k	3	5%	3.23	4.35
		2.5%	3.69	4.89
		1%	**4.29**	**5.61**
*1% significant, **5% significant, ***10% significant				

Table (7) Estimation of Error Correction Model of CUD				
ARDL Error Correction Regression				
Dependent Variable: D(CUD)				
Selected Model: ARDL(1, 0, 1, 0)				
Case 3: Unrestricted Constant and No Trend				
Sample: 1974 2018				
Included observations: 40				
ECM Regression				
Case 3: Unrestricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Stat.	Prob.
C	0.008819	0.358598	0.024593	0.9805
D(INV)	-0.993233	0.138078	-7.193283	0.0000*
DUM90	7.423589	2.200629	3.373394	0.0021*
DUM02	0.655254	2.173385	0.301490	0.7651
DUM95	-0.580861	2.173536	-0.267243	0.7911
DUM88	5.605864	2.456426	2.282122	0.0297**
CointEq(-1)	-0.437576	0.079952	-5.472979	0.0000*
R-squared	0.705503	Mean dependent var		0.317327
Adjusted R-squared	0.651958	S.D. dependent var		3.633000
S.E. of regression	2.143291	Akaike info criterion		4.520191
Sum squared resid	151.5920	Schwarz criterion		4.815744
Log likelihood	-83.40381	Hannan-Quinn criter.		4.627054
F-statistic	13.17591	Durbin-Watson stat		2.063906
Prob(F-statistic)	0.000000			
*1% significant, **5% significant, ***10% significan				

The estimated parameters of the long-run relationship are shown in Table (6), they indicate that *BUD* parameter is found insignificant at 1% level and its sign is inconsistent with the apriori expectations, as twin-deficits hypothesis expects positive relationship between *BUD* and *CUD*. Accordingly, the twin-deficits hypothesis is rejected in Egypt in the long-run. The estimated parameters of *INV* and *SAV* are significant at 1% with the right expected sign, negative and positive; respectively. An increase in *INV* (*SAV*) is expected decrease (increase) *CUD*. The estimated parameter of *INV* indicates that 73% of domestic investment is financed from foreign sources, which means that Egyptian economy has high degree of capital mobility and therefore Feldstein-Horioka Puzzle is rejected in this case. Interestingly, changes in *SAV* are having more impact on *CUD* of the same changes in

INV, as the long-run parameter of the former is higher than that of the later. According to eq. (13)`, a 1% increase in *SAV* is expected to increase *CUD* 0.95% while a 1% decrease in *INV* is expected to increase *CUD* by 0.73%.

The estimated long-run equation is as follows:

$$CUD = -0.0397\, BUD - 0.732\, INV + 0.9480\, SAV \qquad (13)'.$$

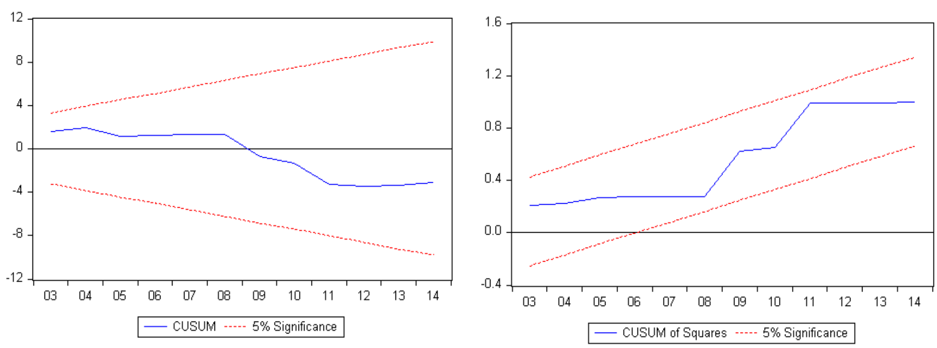
The estimation of ECM and the short-run relationship between CUD and its determinants are presented in Table (7). It indicated that in the short-run the only factor that have impact on *CUD* is the change *INV* is found statically significant at 1%. The error correction parameter is found significant at a 1% level and its value is negative (-0.44), which means that about 44% of any short-run shock will be corrected with relatively high speed of adjustment in one year.

Table (8) shows the results of post regression diagnostic tests of the residuals of the estimated ARDL (1,0,1,0). Using Breusch-Godfrey Serial Correlation LM-test statistic for the problem of serial correlation revealed that the null hypothesis of no-serial correlation cannot be rejected with the p-value of 0.6306 indicates that the residuals are not serially correlated. The results of testing for heteroscedasticity of the residuals showed that the null hypothesis of no-heteroscedasticity cannot be rejected with the p-value of 0.3531 which indicates that the distribution of the errors is homoscedastic. The Jarque-Bera test of normality indicated that the residuals of the estimated model are normally distributed as the null hypothesis cannot be rejected at the p-value of 0.7322.

Table (8) Post-Regression Test of CUD Model			
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.1626	Prob. F(9,30)	**0.3531**
Obs*R-squared	10.3434	Prob. Chi-Square(9)	0.3234
Scaled explained SS	6.9047	Prob. Chi-Square(9)	0.6470
Serial Correlation LM Test: Breusch-Godfrey			
F-statistic	0.2362	Prob. F(1,29)	**0.6306**
Obs*R-squared	0.3232	Prob. Chi-Square(1)	0.5697
Normal Distribution Test: Jarque-Bera			
Jarque-Bera Statists			0.6233
Probability			**0.7322**

Results of testing for parameter stability using the cumulative sum of the recursive residuals CUSUM test are shown in Figure (5), indicates that the cumulative sum and cumulative sum of squares are located between the 5% critical values which means no structure breaks in the regression model of CUD and the parameters of the model are stable over time.

Figure (5) Stability Test of ARDL Model of



The results of estimating ARDL current-account model indicate that twin-deficits hypothesis is rejected in Egypt during the period of the study. The value of the estimated parameter of budget-deficit ratio to GDP is found insignificant and doesn’t even have the expected positive sign as proposed by twin-deficits hypothesis. Although, domestic saving and investment are having long-run significant relationship with current account-deficit ratio of

GDP, domestic-saving ratio to GDP is having relatively higher effect on current account than investment ratio to GDP. The Feldstein-Horioka Puzzle is also rejected as high ratio of domestic investment is financed from foreign sources which indicates high capital mobility in Egypt that allow investors to have access to international financial markets.

5.2 The empirical results of the ARDL Budget Deficit Model

The ARDL equation to be estimated for BUD model is specified as:

$$BUD_t = a_0 + \sum_{i=1}^{p} a_{1i} BUD_{t-i} + \sum_{j=1}^{q1} \gamma_{1j} CUD_{t-j} + \sum_{j=1}^{q2} \gamma_{2j} INV_{t-j} + \sum_{j=1}^{q3} \gamma_{3j} SAV_{t-j} + \varepsilon_t \qquad (14)$$

The first step in estimating ARDL model is lag selection using different information criteria. As long as we use the same variables the number of lags will be as before 6 lags according to the majority of information criteria, but 1 lag according to Schwarz information criterion SIC.

The estimates of ARDL budget deficit model are reported in Table (9) show that with a maximum of 6 lags, the selected model according to SIC method is ARDL (3, 4, 4, 3), the lag structure assigned for the variables *BUD, CUD, INV,* and *SAV*; respectively. It also indicates the very high explanatory power of the model as the adjusted R-Square equals 0.98. Table (10) shows that the null hypothesis of no-cointegration between *DUD* and its determents can be rejected at 1% significant level as the value of F-statistic (27.49) is higher than the upper critical value bounds (5.61), which means that there is a long-run relationship between *BUD* an all the dynamic regressors.

The estimated parameters of the long-run relationship are shown in Table (10), it indicates that *CUD* parameter is found significant at 1% level and its positive sign is consistent with the apriori expectations, as the reverse twin-deficits hypotheses expects positive relationship between *BUD* and *CUD* (the relationship proceeds from *CUD* to *BUD*). Accordingly, the 'reverse' twin-deficits hypothesis cannot be rejected on the long-run. The estimated parameters for *INV* and *SAV* are significant at 1% with the right expected sign, positive and negative; respectively.

The estimated long-run equation is as follows:

$$BUD = 6.2250\, CUD + 4.0808\, INV - 5.3042\, SAV \qquad (14)`.$$

In the long-run, an increase in *INV* (*SAV*) is expected to increase (decrease) *BUD*. Based on the estimated long-run parameters in eq. (14)`, a 1% increase in *CUD* is expected to increase *BUD* by 6.2%. Whereas, 1% increase (decrease) in *INV*(*SAV*) is expected to increase *CUD* by 4.4% (5.3%). Consequently, to support fiscal consolidation in Egypt (reducing budget deficit to GDP ratio) policy makers should target reducing current account deficit by reducing balance of trade deficit, preferably by promoting exports, and stimulating net services and net transfers. Raising private saving ratio to GDP would help to reduce budget deficit by providing more domestic sources for financing investment. What is crucial here is to try to raise private saving faster than the increase in private investment because this will narrow the domestic financing gap.

Table (9) ARDL Estimation of Current Account Model

Dependent Variable: BD2
Method: ARDL
Sample (adjusted): 1978 2018
Included observations: 41 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Schwarz criterion (SIC)
Dynamic regressors (4 lags, automatic): CU2 INVS SAV
Fixed regressors: DUM91 DUM87 DUM02 DUM01 C
Number of models evaluated: 500
Selected Model: ARDL(3, 4, 4, 3)
White-Hinkley (HC1) Heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Stat.	Prob.*
BD2(-1)	0.3217	0.0875	3.6777	0.0016*
BD2(-2)	-0.0163	0.0847	-0.1922	0.8496
BD2(-3)	0.4590	0.1107	4.1460	0.0005*
CU2	0.3176	0.1151	2.7593	0.0125*
CU2(-1)	0.0620	0.1126	0.5507	0.5883
CU2(-2)	0.5966	0.1596	3.7382	0.0014*
CU2(-3)	0.2965	0.1343	2.2079	0.0397**
CU2(-4)	0.1938	0.1201	1.6145	0.1229
INVS	0.1147	0.1596	0.7189	0.4809
INVS(-1)	0.4268	0.1904	2.2412	0.0371**
INVS(-2)	0.0555	0.2459	0.2256	0.8239
INVS(-3)	0.9196	0.1837	5.0052	0.0001*
INVS(-4)	-0.5553	0.1194	-4.6513	0.0002*
SAV	-0.4848	0.1824	-2.6579	0.0155**
SAV(-1)	0.0869	0.3187	0.2727	0.7880
SAV(-2)	-0.3969	0.3264	-1.2163	0.2388
SAV(-3)	-0.4549	0.1673	-2.7193	0.0136*
DUM91	1.7495	1.3010	1.3447	0.1945
DUM87	-9.9307	1.0099	-9.8328	0.0000*
DUM02	-4.7042	0.5295	-8.8843	0.0000*
DUM01	-2.2603	0.7244	-3.1204	0.0056
C	-3.4208	1.2214	-2.8008	0.0114*
R-squared	0.9885	Mean dependent var		-11.91676
Adjusted R-squared	0.9757	S.D. dependent var		7.938974
S.E. of regression	1.2365	Akaike info criterion		3.566451
Sum squared resid	29.049	Schwarz criterion		4.485929
Log likelihood	-51.1120	Hannan-Quinn criter.		3.901274
F-statistic	77.6180	Durbin-Watson stat		2.117591
Prob(F-statistic)	0.000000			

*1% significant, **5% significant, ***10% significant

Table (10) Estimation of Long-run Parameters of BUD Model				
Variable	Coefficient	Std. Error	t-Stat.	Prob.
CUD	6.2250	1.309681	4.7531	0.0001*
INV	4.0808	1.242292	3.2849	0.0039*
SAV	-5.3054	1.430799	-3.7079	0.0015*
EC = BD2 - (6.2250*CUD + 4.0808*INV -5.3054*SAV)				
F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	**27.4999**	10%	2.72	3.77
k	3	5%	3.23	4.35
		2.5%	3.69	4.89
		1%	4.29	5.61
*1% significant, **5% significant, ***10% significant				

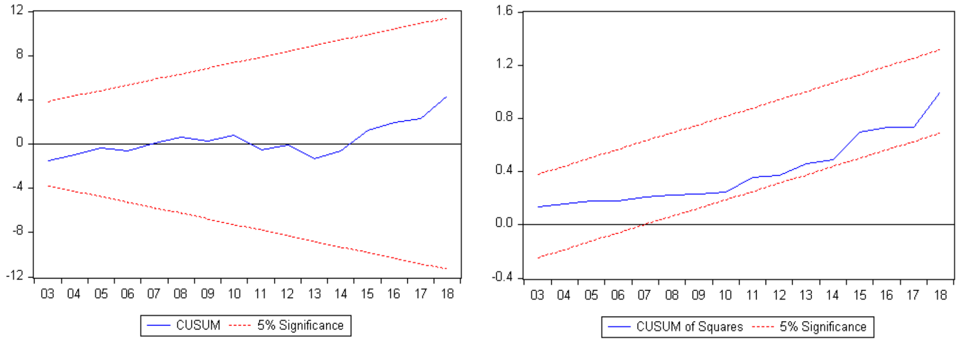
Table (11) ARDL Error Correction Regression of BUD Model				
Dependent Variable: D(BD2)				
Selected Model: ARDL(3, 4, 4, 3)				
Case 3: Unrestricted Constant and No Trend				
Sample: 1974 2018				
Included observations: 41				
ECM Regression				
Case 3: Unrestricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Stat.	Prob.
C	-3.420848	0.376807	-9.078504	0.0000*
D(BUD(-1))	-0.442752	0.070461	-6.283649	0.0000*
D(BUD(-2))	-0.459033	0.075676	-6.065761	0.0000*
D(CUD)	0.317590	0.090407	3.512878	0.0023*
D(CUD(-1))	-1.086898	0.136336	-7.972183	0.0000*
D(CUD(-2))	-0.490281	0.082566	-5.938079	0.0000*
D(CUD(-3))	-0.193818	0.085356	-2.270698	0.0350**
D(INV)	0.114736	0.126776	0.905034	0.3768
D(INV(-1))	-0.419800	0.129182	-3.249692	0.0042*
D(INV(-2))	-0.364304	0.110707	-3.290718	0.0038*
D(INV(-3))	0.555300	0.110468	5.026800	0.0001*
D(SAV)	-0.484806	0.142903	-3.392566	0.0031*
D(SAV(-1))	0.851948	0.170676	4.991609	0.0001*
D(SAV(-2))	0.454950	0.140736	3.232647	0.0044*
DUM91	1.749506	1.920273	0.911071	0.3737
DUM87	-9.930744	1.406650	-7.059852	0.0000*
DUM02	-4.704267	1.228108	-3.830499	0.0011*
DUM01	-2.260330	1.271172	-1.778147	0.0914***
CointEq(-1)	-0.235579	0.020874	-11.28574	0.0000*
R-squared	0.950998	Mean dependent var		0.182671
Adjusted R-squared	0.910905	S.D. dependent var		3.849691
S.E. of regression	1.149086	Akaike info criterion		3.420110
Sum squared resid	29.04875	Schwarz criterion		4.214204
Log likelihood	-51.11225	Hannan-Quinn criter.		3.709275
F-statistic	23.71996	Durbin-Watson stat		2.117591
Prob(F-statistic)	0.000000			
*1% significant, **5% significant, ***10% significant				

The estimation of ECM and the short-run relationship between BUD and its determinants are presented in Table (11). It indicates that, with exception of D(*INV*), all determinants are highly significant at different lags. The error correction parameter is found significant at a 1% level and its value is negative (-0.24), which means that about %24 of any short-run shock will be corrected with relatively lower speed of adjustment over the next one year.

Table (12) shows the results of post regression diagnostic tests of the residuals of the estimated ARDL (3,4,4,3). Using Breusch-Godfrey Serial Correlation LM-test statistic for the problem of serial correlation revealed that the null hypothesis of no-serial correlation cannot be rejected with the p-value of 0.5960 indicates that the residuals are not serially correlated. The results of testing for heteroscedasticity of the residuals showed that the null hypothesis of no-heteroscedasticity cannot be rejected with the p-value of 0.2033 which indicates that the distribution of the errors is homoscedastic. The Jarque-Bera test of normality indicated that the residuals of the estimated model are normally distributed as the null hypothesis cannot be rejected at the p-value of 0.1151.

Table (12) Post-Regression Test of BUD Model			
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.465128	Prob. F(21,19)	0.2033
Obs*R-squared	25.34727	Prob. Chi-Square(21)	0.2324
Scaled explained SS	8.755086	Prob. Chi-Square(21)	0.9910
Serial Correlation LM Test: Breusch-Godfrey			
F-statistic	0.712617	Prob. F(4,15)	0.5960
Obs*R-squared	6.547120	Prob. Chi-Square(4)	0.1618
Normal Distribution Test: Jarque-Bera			
Jarque-Bera Statists			4.3246
Probability			0.1151

Figure (6) Stability Test of ARDL Model



Results of testing for parameter stability using the cumulative sum of the recursive residuals CUSUM test are shown in Figure (6), indicates that the cumulative sum and cumulative sum of squares are located between the 5% critical values which means no structure breaks in the regression model of BUD and the parameters of the model are stable over time.

The results of estimating ARDL budget-deficit model indicate that there is a long-run significant positive relationship between current-account deficit as a ratio of GDP and budget-deficit ratio to GDP; this relationship proceeds from the former to the later. Accordingly, the ‘reverse’ twin-deficits hypothesis cannot be rejected in Egypt during the period of the study. Therefore, targeting current account would help reducing budget deficit in the short-run and the long-run. Investment ratio to GDP and saving ratio to GDP are also having a long-run significant cointegration with budget-deficit ratio to GDP; with a relatively higher impact of changes in saving to GDP ratio on budget-deficit than that of changes in investment to GDP ratio. The error-correction parameter is relatively small that makes the process of correction slow.

5.3 Testing for short-run causality between *CUD, BUD, INV and SAV*

Based on the results of the stationarity tests that investigate the possibility of structural breaks, we found mix cases of order I(0) and I(1). Accordingly, Granger-causality test is not applicable to such cases because it requires that variables should be stationary at their levels. To solve this problem, the test of Toda and Yamamato (1995) will be used.

The results of Toda-Yamamato causality test are given in Table (13). In section A of this Table the hypothesis that *BUD* does not Granger cause *CUD* cannot be rejected, which means that twin-deficits is rejected in Egypt during the period 1974-2018. In section B, the hypothesis *CUD* does not Granger cause *BUD* is rejected at 1% significant level, which means that there is a ‘reverse’ twin-deficits or a case of ‘current account targeting’ in Egypt during the period 1974-2018. These results are consistent with those obtained by Marinheiro (2008), Hashemzadeh and Wilson (2010), Helmy and Zaki (2015) and Helmy (2018).

From sections A and C in Table (13), with respect to changes in investment and their impacts on *CUD* and *BUD*, the results of causality tests show that there is a bidirectional causality between investment and current account deficit, but a unidirectional causality from investment to budget deficit at 1% significant level.

From sections A and D, savings have unidirectional causality running from savings to budget deficit and investment at 1% significant level and to current account at 10% significant level.

Table (13) Toda-Yamamato Causality Tests			
VAR Granger Causality/Block Exogeneity Wald Tests			
Sample: 1974 2018			
Included observations: 39			
A. Dependent variable: CUD			
Excluded	Chi-sq	df	Prob.
BUD	5.330473	5	0.3769
INV	14.22518	5	0.0142*
SAV	10.41135	5	0.0644***
All	27.34947	15	0.0260
B. Dependent variable: BUD			
Excluded	Chi-sq	df	Prob.
CUD	105.7496	5	0.0000*
INV	69.08827	5	0.0000*
SAV	75.36699	5	0.0000*
All	186.7309	15	0.0000*
C. Dependent variable: INV			
Excluded	Chi-sq	df	Prob.
CUD	14.05301	5	0.0153*
BUD	8.808494	5	0.1170
SAV	19.28307	5	0.0017*
All	35.09941	15	0.0024
D. Dependent variable: SAV			
Excluded	Chi-sq	df	Prob.
CUD	3.048243	5	0.6925
BUD	6.836030	5	0.2331
INV	4.833300	5	0.4366
All	25.53258	15	0.0432

*1% significant, **5% significant, ***10% significant

The rejection of the twin-deficits hypothesis can be explained by the weak impact of budget deficit on domestic interest rate under fiscal dominance of monetary policy.[11] In addition, the CBE's reluctance to raise its policy rate because of the fear of worsening public debt sustainability limits the impact of fiscal deficit on current account deficit. On the other hand, monetary policy is leaned towards maintaining foreign exchange rate stability and this reduces the impact of foreign capital inflows on the appreciation of domestic currency.

[11] See, Abed (2020).

Finally, the rejection of the twin-deficits hypothesis and the inability to reject the ‘reverse’ twin-deficits by Toda-Yamamato causality tests confirm the results obtained from the ARDL cointegration analysis. Furthermore, the impact of domestic saving an investment on both current account deficit and budget deficit are consistent with the results acquired from ARDL short-run and long-run analysis.

6. Concluding remarks:

The long-run relationship between budget deficit and current account deficits has been attracting the attention of researchers and policymakers in developed, emerging, and developing countries since the early 1980s when the hypothesis of twin-deficits introduced for the first time. Egypt is no exception, especially with its high level of deficits in both the government budget and current account. In the globalization of financial markets, more countries are filling their financial gap, between domestic savings and investments, through foreign resources. This phenomenon is related to the twin-deficits hypotheses as argued by the Feldstein-Horioka puzzle. As the Egyptian economy is becoming more open to international capital markets, it is important to test the validity of both theories in Egypt over the last 45 years. During the period of the study 1974-2018, the Egyptian economy faced several internal and external shocks. Accordingly, Zivot and Andrews (1995) test was used to test for stationarity with possible structural breaks of the four variables involved; i.e., current account, government budget, private saving, and private investment. Guided by the results of stationarity, which indicated a case of mixed order of I(0) and I(1), we used the ARDL method introduced by Pesaran, et.al (2001).

In this study, we used a modified version of the equation formulated by Fidrmuc (2003) to include private saving and investment in the determination of the long-run cointegration and short-run causality between the two deficits. The empirical results of the ARDL-current-account model rejected the twin-deficits hypothesis that postulates a positive relationship between the two deficits running from budget deficit to current account deficit. The results also indicated the rejection of the Feldstein-Horioka puzzle as the private investment was found significantly cointegrated with the current account deficit with 73% of investment financed from foreign sources.

The results of estimating the error-correction parameter indicated that in the short-run private investment was the only variable that has an impact on the current account with a speed of correction of 44% of any short-run shock over the next year.

To test for a ‘reverse’ twin-deficit hypothesis which postulates a positive relationship between the two deficits running from current account deficit to budget deficit, we estimated an ARDL-budget-deficit model. The results confirmed the existence of a long-run significant relationship between the two deficits in which the budget deficit depends on changes in the current account deficit. Private savings and investment were also found significantly cointegrated with the budget deficit; with a positive impact of investment and negative impact of saving on the budget deficit. The estimated error-correction parameter indicted that current account deficit, private saving, and investment are having a short-run relationship with budget-deficit but the speed of correction after any short-run shock is relatively slow as 24% of the shock will be corrected over the next year.

Finally, to test for the causal directional relationship between the two deficits and private saving and investment, we used Toda and Yamamoto (1992) causality test because the variables involved were not stationary at their levels. The results of causality indicated that budget deficit does not Granger cause the current account, but current account deficit does Granger cause the budget deficit. These results confirm the conclusions obtained from the ARDL-regression of cointegration and error-correction parameters which ascertain the rejection of the twin-deficits hypothesis and the confirmation of a ‘reverse’ twin-deficits in Egypt during the period of the study.

The results of the causality tests between investment and saving and the two deficits revealed interesting relations that could be useful for policymaking. The causality test indicated a bidirectional causality between investment and current account, and unidirectional from investment to the budget deficit. Results of causality tests related to private saving indicated three unidirectional causality from saving to investment, to current account deficit, and to the budget deficit.

The rejection of the twin-deficits hypothesis can be explained by the weak impact of budget deficit on domestic interest rate under fiscal dominance of monetary policy. In addition, the CBE’s reluctance to raise its policy rate because of the fear of worsening public debt sustainability limits the impact of fiscal deficit on current account deficit. On the other hand, monetary policy is leaned towards maintaining foreign exchange rate stability and this reduces the impact of foreign capital inflows on the appreciation of domestic currency.

The confirmation of the ‘reverse’ twin-deficits can be explained by the heavy dependency of Egyptian government on unstable sources of foreign exchange revenues, i.e., the net services of tourism and Suez-canal fees and the net transfers of worker remittances. Any sudden decrease in one or all of these sources will be reflected directly in budget deficit.

Based on the results obtained from the empirical analysis, policymakers in Egypt should target the current account deficit to support fiscal consolidation in Egypt (reducing the budget deficit to GDP ratio) at the less distorting cost of raising taxes. Targeting current accounts should involve multiple dimensions by reducing the balance of trade deficit, preferably by promoting exports, stimulating net services, and net transfers. In addition, policymakers should encourage raising the private saving ratio to GDP, this would help to reduce the budget deficit by providing more domestic resources for financing investment. It is crucial here to try to raise private savings faster than the increase in private investment because this will narrow the domestic financing gap. This would require also reducing the crowding-out effect caused by the large share of the government in the domestic credit market. Supporting private investment, in the short-run and long-run, is important because of its effect on reducing the current account deficit. Given that the twin-deficits hypothesis is rejected in Egypt, insisting on targeting fiscal consolidation at the expense of private investment will not reduce the current account deficit rather it would backfire and raise the budget deficit through the 'reverse' twin-deficit.

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Appendix

Table (1) Egyptian Total Debt to GDP ratio (2001-2018)

	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Total Debt %GDP	103%	116%	126%	131%	133%	117%	104%	86%	84%	82%	84%	81%	93%	92%	98%	111%	118%	110%
Domestic Debt %GDP	76%	85%	91%	94%	101%	90%	79%	67%	67%	67%	71%	70%	78%	80%	85%	95%	90%	78%
Foreign Debt %GDP	27%	31%	34%	37%	32%	27%	25%	19%	17%	15%	13%	11%	15%	12%	13%	16%	28%	32%

Source: WDI, World Bank

Table (3a) Augmented Dickey-Fuller Unit-root Test								
	level				**First Difference**			
Exogenous	**Constant**		**Constant & Trend**		**Constant**		**Constant & Trend**	
ADF test statistic	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•
critical values	-2.9754	0.0451	-2.7630	0.2181	**-7.5366***	0.0000	**-7.8886***	0.0000
1% level	-3.5885		-4.1809		-3.5925		-4.1865	
5% level	-2.9297		-3.5155		-2.9314		-3.5181	
10% level	-2.6031		-3.1883		-2.6039		-3.1897	
Null Hypothesis: CUD has a unit root, Result of Integration Order I(1)								
ADF test statistic	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•
critical values	-1.8862	0.3356	-1.8889	0.6433	**-7.8063***	0.0000	**-7.7709***	0.0000
1% level	-3.5885		-4.1809		-3.5925		-4.1865	
5% level	-2.9297		-3.5155		-2.9314		-3.5181	
10% level	-2.6031		-3.1883		-2.6039		-3.1897	
Null Hypothesis: BUD has a unit root, Result of Integration Order I(1)								
ADF test statistic	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•
critical values	-1.5374	0.5056	-3.7692	0.0279	**-8.2899***	0.0000	**-8.1627***	0.0000
1% level	-3.5885		-4.1809		-3.5925		-4.1865	
5% level	-2.9297		-3.5155		-2.9314		-3.5181	
10% level	-2.6031		-3.1883		-2.6039		-3.1897	
Null Hypothesis: **INV** has a unit root, Result of Integration Order **I(I)**								
ADF test statistic	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•
critical values	-1.3422	0.6015	-2.7113	0.2373	**-6.6767***	0.0000	**-7.2704***	0.0000
1% level	-3.5885		-4.1809		-3.5925		-4.1865	
5% level	-2.9297		-3.5155		-2.9314		-3.5181	
10% level	-2.6031		-3.1883		-2.6039		-3.1897	
Null Hypothesis: SAV has a unit root, Result of Integration Order I(1)								

•MacKinnon (1996) one-sided p-values.
*1% significant, **5% significant, ***10% significant

Table (3b) Zivot and Andrews Unit-root Test with Structural Break						
	Break in the Intercept		**Break in the Trend**		**Break in the Intercept & Trend**	
	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•
Z-A Statistic	-3.52	0.0061	**-4.3492*****	0.0023	-4.6247	0.0630
1% level	-5.34		-4.80		-5.57	
5% level	-4.93		-4.42		-5.08	
10% level	-4.58		-4.11		-4.82	
Chosen break Point	1990		**1992**		1990	
Null Hypothesis: CUD has a unit root with a structural break, I(0)						
	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•
Z-A Statistic	**-8.5247***	0.0001	-2.9797	0.0948	**-6.3215***	0.0001
1% level	-5.34		-4.80		-5.57	
5% level	-4.93		-4.42		-5.08	
10% level	-4.58		-4.11		-4.82	
Chosen break Point	**1991**		1995		1991	
Null Hypothesis: **BUD** has a unit root with a structural break, **I(0)**						
	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•
Z-A Statistic	**-5.3685***	0.0001	-3.7745	0.0900	**-5.3962****	0.0014
1% level	-5.34		-4.80		-5.57	
5% level	-4.93		-4.42		-5.08	
10% level	-4.58		-4.11		-4.82	
Chosen break Point	**1991**		2004		1991	
Null Hypothesis: INV has a unit root with a structural break, I(0)						
	t-Stat.	Prob.•	t-Stat.	Prob.•	t-Stat.	Prob.•
Z-A Statistic	-3.773153	0.0131	-3.294556	0.0577	-3.4817	0.0012
1% level	-5.34		-4.80		-5.57	
5% level	-4.93		-4.42		-5.08	
10% level	-4.58		-4.11		-4.82	
Chosen break Point	2011		2010		2004	
Null Hypothesis: SAV has a unit root with a structural break, I(1)						

•MacKinnon (1996) one-sided p-values.
*1% significant, **5% significant, ***10% significant