

Twin Deficits and Saving-Investment Nexus in Pakistan: Evidence from Feldstein-Horioka Puzzle

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This paper tries to empirically examine the validity of Feldstein-Horioka puzzle in the presence of twin deficits for Pakistan over the period 1976 to 2010 using autoregressive distributed lag (ARDL)-bounds testing approach to cointegration. Our finding reveals a positive association between the current account balance and budget deficit in short-as well as in long-run. Toda-Yamamoto (1995) causality test also supports the existence of twin deficits. We also find a negative relationship between current account balance and investment in short-as well as in long-run. The long-run coefficient of investment is -0.75 which implies a high degree of capital mobility by rejecting the Feldstein-Horioka puzzle in case of Pakistan. However, the short-run coefficient of investment is negative but less than one (i.e. -0.46) which provides support for the moderate validity of Feldstein-Horioka puzzle but only in the short-run.

Introduction

Feldstein and Horioka (1980) find that changes in domestic investment are very sensitive to changes in domestic savings for OECD countries, which has launched a debate regarding the degree of financial integration and financial openness within the Industrialized Countries (Ho, 2003). A positive link between domestic investment relative of gross nation product (GNP) and domestic savings relative to GNP is interpreted as measure of international capital mobility. Dooley *et al.* (1987) and Feldstein and Bachetta (1989) and generally confirms the Feldstein-Horioka's findings of close associations between domestic

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savings and investment for industrial as well as developing countries. The results of Feldstein-Horioka's study showed that the saving retention coefficient, which measure the level of capital mobility in 21 member states of the Organization for Economic Cooperation and Development (OECD) was between 0.87 and 0.91, which proves relatively low capital mobility in these countries (Misztal, 2011). These results imply that 90 percent of savings in OECD member countries are used to finance domestic investment. Some evidence also supports a strong correlation between domestic savings and investment across OECD countries over time, indicating the implications of capital immobility which coins the Feldstein-Horioka puzzle (Ho, 2003). The of Feldstein-Horioka's (1980) research findings, which are contrary to economic theory, have to be referred to as "the mother of all puzzles" (Obsfeld and Rogoff, 2000, p. 9).

The other puzzle is associated with the positive associations between current account deficit and budget deficit — often known as twin deficits hypothesis.³ The concept of twin deficit is not a new one but it can be traced back to the early writings of Mundell-Fleming and Keynesian theories. According to the Mundell-Fleming framework, an increase in budget deficits will cause an increase in domestic interest rate above the world rate that, in turn, will cause capital inflows and exchange rate appreciation, leading to increase in the current account deficits (Marinheiro, 2008 and Burcu, 2011). On the other hand, according to Keynesian absorption theory, an increase in budget deficits would induces domestic absorption which would results an increase in import expenditures and decrease in export revenues through the loss of international competitiveness in the international market, causing deterioration of the current account deficits (Marinheiro, 2008). Thus, there exists a positive relationship between budget deficits and current account deficits— budget deficit causes current account deficit. Twin deficit issue is also associated to the degree of capital mobility and the Feldstein-Horioka puzzle. If domestic savings and investments are not highly correlated, then the budget deficits and the current account deficit

³ The term "twin deficit" was used to describe the concurrent US budget and trade deficits for the period 1981-1998- both of which having reached a record levels.

can be expected to move together in the same direction. In contrast, the Ricardian Equivalence Hypothesis (REH) due to Barro (1974) claims the absence of any relationship between budget deficit and current account deficit. In other words, REH predicts that current account deficit, interest rates and investment will not be affected by the changes in budget deficit (Burcu, 2011). It implies that tax increases would reduce the budget deficit but would not alter the trade deficit. In other words, the government tax-finance deficit policy does not affect private spending and national savings (Marinheiro, 2008).

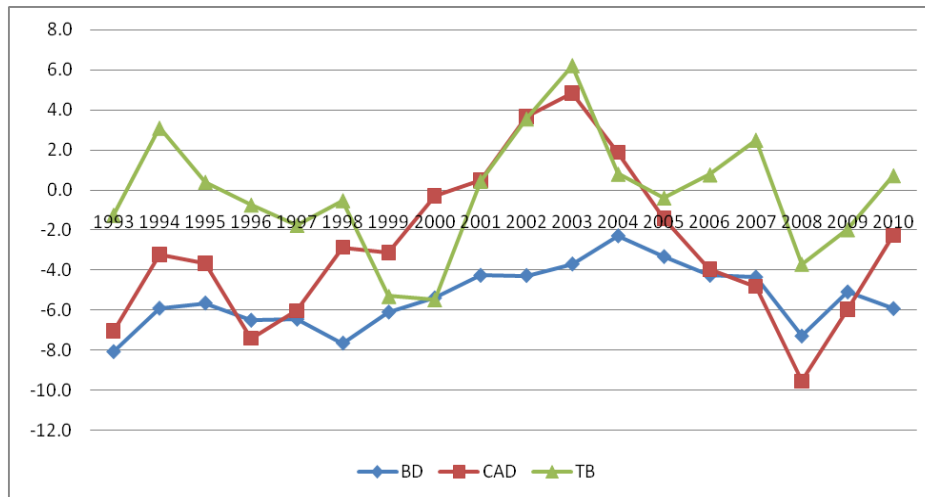
However, if the REH does not hold, then there is possibility for the existence of causal relationship between the current account deficit and the budget deficit. If the causality is running from current account to the budget deficit then deterioration in the current account balance results in to diminishing economic growth which, leads to deterioration in the budget balance. This implies that the government targeting the current account and uses budget deficit as an instrument to eliminate external imbalances (Marinheiro, 2008). When the causality is running from budget deficit to current account, then exchange rate, interest rate, income, savings, investment, exports and imports are dependent on the fiscal and monetary policies. Under this situation, attention should be focused to the exchange rate policy, monetary policy and export promotion policies (Marinheiro, 2008 and Hallwood and MacDonald, 2003). If the REH does not hold then there is also possibility that an increase in public borrowing is expected to decrease national savings. For a given amount of investment, this decrease in national saving leads to an increase in the current account deficit. It may be mentioned here that perfect capital mobility results into twin deficits in a non-Ricardian world. In other words, if the Feldstein-Horoika puzzle holds there is no possibility of twin deficits to coexist.

For the empirical analysis of Feldstein-Horoika puzzle and twin deficits, Pakistan is more relevant country because Pakistan has faces a persistent high degree of budget and current account deficits since 1980. During the 1980s, average budget deficit was 7.1 percent of GDP, and reached its peak level of 8.5 percent 1993. After 1993 it was come down and reached its minimum level of 2.3 percent in 2004. It rises again and was reached to 6.3 percent in 2010. The current account balance of Pakistan

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remained in deficit during last three decades except for few years. The current account deficit which was 5 percent of GDP during the 1980s, reached to its peak level of 7.4 percent of GDP in 1996. It rises again in 2005 and was reached to 2.3 percent in 2010 before it touched a record level of 8 percent of GDP in 2008 (see Figure 1). Furthermore, in the late 1980s Pakistan was faced with high macroeconomic imbalances as a result of growing inefficiency and losses in the public sector. To restore business confidence and reduce inefficiency and losses, the government implemented a wide range of structural and institutional reforms in the early 1990s (Khan and Qayyum, 2006).⁴ As a result, the public spending has increased more than public revenues, leading to deterioration of budget deficits and balance of payment deficits. The increase in budget deficit has caused a sharp increase in internal and external borrowings. Moreover, increase in domestic interest rate puts downward pressure on domestic investment and economic growth. This situation has increased budget deficit even more by reducing tax revenues. Similarly, a persistent depreciation in Pak-rupee exchange rate has increased import bill as well as debt burden.

Figure 1: Trends of Current Account, Budget Deficits and Trade Balance (as % of GDP)



⁴ Detailed review of reforms can be seen in Khan and Khan (2007).

The correlation between current account deficit and budget deficit has important implications for developing countries like Pakistan. For example, a persistent large budget deficits causes indebtedness by borrowings domestically and internationally and increases burden on future generations (Hakro, 2009). Thus rising trade deficits is escalating budget deficits and current account balance cannot be remedied unless government would put in place appropriate policies which would address fiscal as well as balance of payments deficits.

In the context of Pakistan a number of studies have been carried out to examine the link between current account and budget deficits. For example, Burney and Yasmeen (1989), Zaidi (1995) and Burney and Akhtar (1992) have used ordinary least squares (OLS) technique to explore the link between current account deficit and budget deficit with other macroeconomic variables. The other studies, inter alia, by Kazimi (1992), Aqeel and Nishat (2000), Mukhtar *et al.* (2007), Hakro (2009) and Javid *et al.* (2011) have reported evidence supported to bi-directional causality between current account deficit and budget deficit. These studies have made significant contributions in determining causal link between budget deficit and current account deficit. However, to the best of our knowledge no attempt has so far made to test the twin deficit and Feldstein-Horioka hypothesis in the case of Pakistan. The present study fills up this gap.

The main purpose of this study is to examine the validity of twin deficit and Feldstein-Horioka puzzle for Pakistan using annual time series data for the period 1976 to 2010.

The rest of the paper is organized as follows. Section 2 reviews the existing literature on Feldstein-Horioka and twin deficit hypothesis. Theoretical and analytical framework is presented in section 3. Section 4 gives data description and econometric methodology. Section 5 discusses the estimation results while section 6 is devoted to conclusion.

2. Literature Review

There are two main strands of literature regarding the validity of Feldstein-Horioka's puzzle. These are substantial disagreement about the

implications of Feldstein-Horioka's (1980) hypothesis. The economists argued that the Feldstein-Horioka puzzle can be solved using intra-national regional data, which indicate that the saving retention coefficient is not related to the capital mobility across international borders, but within intra-national regions (Ho, 2003). The studies based on cross-sectional data during the 1980s find strong correlation between savings and investment which implies greater capital immobility at international level. Some studies (for example, Feldstein and Horioka (1983), Penati and Dooley (1984), Feldstein (1983), Obstfeld (1986), Haque and Montiel (1991), Dooley *et al.* (1987), Feldstein and Bacchetta (1989), Frankel (1991), Tesar (1991) and Mussa and Goldstein (1993) among others) suggest a strong correlation between savings and investment. Feldstein and Horioka (1980) find that sustained increase in domestic saving rate induce approximately an equal increase in domestic rate of investment. These estimates for the post-OPEC crisis period (1974-1979) implied that each extra dollar of domestic saving increases domestic investment by approximately 85 cents in a sample of 17 OECD countries. Vamvakidis and Wacziarg (1998) using the panel data for the period 1970-1993 and found a very high correlation between domestic saving and domestic investment for OECD economies. Coakley *et al.* (1998) tested the Feldstein-Horioka's view that a high saving-investment association across OECD countries. Their results show a strong cross-section association between saving and investment rates in OECD countries which implied low capital mobility.

The studies based on time series data (for example, Miller (1988), Ho (1999, 2000), Schneider (1999), Erden (2005), Kohler (2005), Grier *et al.*, (2007), Mastroiannis (2007), Murthy (2007) and Ozmen (2007), among others) reveals mixed results. Levy (2003, 2004) concluded that the investment-savings cointegrated in levels as well as into rates. The results indicate that during the period 1947-1987 the USA economy did not have much capital mobility. Khedhiri and Hebiri (2005) found the evidence of significant correlation between savings and investment, and thus no solution to the Feldstein-Horioka puzzle, despite the implications of international capital mobility in six countries such as Algeria, Egypt, Morocco, Saudi Arabia, Syria and Tunisia. Rao *et al.* (2008) found the Feldstein-Horioka puzzle exists in a weaker form with a reduced saving retention coefficient for 12 OECD countries.

After the 1980s, correlation between savings and investment has not supported the Feldstein-Horioka hypothesis because other macroeconomic variables have also contributed to the prevalence of relationship between saving and investment (Murphy, 1984 and Shahbaz *et al.*, 2010). These factors include current account solvency constraints, structure of financial sector, country size, exchange rate regime, endogenous shocks, etc. For example, “Coakley *et al.* (1996) argued that the saving retention coefficient is irrelevant to the analysis of the hypothesis of international capital mobility, but it instead useful as proxy for current account solvency. This is because, in the presence of a current account solvency constraint, the current account balance should be stationary and thus investment and saving rates are cointegrated with the unitary coefficient” (Ho, 2003, p. 388).. Similarly, Sachsida and Caetano (1999) corroborated the evidence that in the real side of the economy, Feldstein-Horioka hypothesis does not reflect capital mobility. They argued that coefficient of investment does not mean capital mobility, but just indicate substitutability relations between external and domestic savings. Sachsida and Caetano (2000) argued that the saving retention coefficient does not even reflect capital mobility, but explains variability between external and domestic savings. Murphy (1984) argued that the estimated saving retention coefficient is sensitive to country size. Dooley *et al.* (1987) predicts that the ratio of current account balance to GNP should be smaller for large countries. Ho (2003) examined the threshold effect of country size on the magnitude of saving retention coefficient for a panel of 23 OECD countries over the period 1961-1997. The evidence of this study indicates that saving retention coefficient increases as the relative GNP share becomes larger, which substantially supports the country-size argument. Fidrmuc (2003) who examined the twin deficits and the Feldstein-Hokiora hypothesis in a wide range of industrial countries including three new EU member states as well as selected emerging economies and transition economies over the period 1970-2001. The results of his study suggest a positive long-run relationship between the twin deficits. Furthermore, his findings also suggest that investment in some EU countries is financed by the international financial markets, implying that the Feldstein-Horioka hypothesis was less significant for EU countries. The Feldstein-Horioka puzzle is revisited by Caporale *et al.* (2003, 2005) by employing a variety of cointegration tests and concluded that despite

evidence supporting the Feldstein-Horioka puzzle, there is a considerable heterogeneity in the savings-investment association. Murthy (2007) examined the validity of Feldstein-Horioka for a panel of 14 Latin American and 5 Caribbean countries over the period 1960-2002. He finds that saving retention coefficient is relatively small indicating the rejection of Feldstein-Horioka hypothesis. He concluded that small saving retention coefficient therefore implying moderate capital mobility. Di Iorio and Fachin (2007) used bootstrap methods to study the Feldstein-Horioka hypothesis in 12 EU members between 1906 and 2002 and find that the saving retention coefficient for each of the countries was between 0.59 and 1.03. Marinheiro (2008) tested the validity of Ricardian equivalence and Feldstein-Horioka hypothesis for Egypt over the period 1971-2004. The results of this study do not support the Ricardian equivalence hypothesis. However, the study presents evidence in favour of high degree of capital mobility implying the rejection of Feldstein-Horioka hypothesis. Onafowara *et al.* (2011) analyzed the relationship between saving and investment in eight highly developed EU countries using ARDL and ECM techniques. The study finds cointegration between saving and investment in six of those countries. The results also showed that saving appears as significant determinant of investment for Netherlands and Great Britain, a reverse causality in Denmark, Germany and Luxembourg and bi-directional causality in Belgium and no causality between saving and investment in France and Italy. Shahbaz *et al.* (2010) have tested saving investment correlation for Pakistan over the period 1976-2006 and find weak correlation between saving-investment. Furthermore, the study suggests that in the presence of inadequate capital mobility, domestic investors have financed their investment projects from international markets. However, the study recommended that devaluation and inflation have stimulated investment activities and significantly contributed in closing the gap between domestic savings and investment.

The debate whether saving-investment co movements are indication of capital mobility is still inconclusive. The results of Feldstein-Horioka hypothesis based on cross-section data shows a strong association between saving and investment rates in OECD countries. The response of economists to the Feldstein-Horioka's view regarding a high correlation between saving-investment implicitly meaning low capital

mobility across OECD countries is much discussed. The long-run investment-saving correlation follows directly and this does not depend on the degree of international capital mobility, unless the budget constraint is removed. The studies based on time series data reveals that investment and saving are high cointegrated. However, debate over the point whether saving-investment co-movement as indication of the degree of capital mobility is still unresolved.

Regarding the external deficit and budget deficit nexus, many studies has been carried out. These studies can be categorized into three broad groups. The first group of studies (for example, Darrat (1988), Abell (1990a, b), Bachmen (1992), Rosenweigh and Tallman (1993), Cavallo (2005) and Erceg *et al.* (2005), among other) supports the twin deficit hypothesis. The second group of studies (Enders and Lee (1990), Miller and Russek (1989) and Kim (1995), among others) concludes against twin deficit hypothesis. The third group of studies, *inter alia*, by Anoruo and Ramchander (1998), Khalid and Teo (1999) and Alkswani (2000) supports the reverse causality running from current account to budget deficit. Fountas and Tsoukis (2000) examined the interactions between the current account, budget balances and the real interest rate as proxy of financial openness and found that in short run there is some evidence in favor of the twin deficits and current account targeting hypotheses.

In the context of Asian countries Baharumshah and Lau (2009) find evidence in favour of twin deficit hypothesis for Indonesia, Korea, the Philippines and Thailand, and evidence again the twin deficit hypothesis for Singapore and Japan. Makin and Narayan (2008) argued that current account deficit in the USA is strongly coincident with saving rate in East Asia, especially in the post-1997 period. Other studies, for example, Lau and Baharumshah (2006), Baharamshah *et al.*(2006) and Baharamshah and Lau (2007), among others failed to establish causality consensus results. Lau *et al.* (2010) revisited the twin deficit hypothesis in Asian 1997-cirisis affected countries. Empirical results suggest that causality runs from budget deficit to current account deficit for Malaysia, the Philippines and Thailand. For Indonesia and Korea the causality runs in the opposite direction, while a bi-directional causality exists for the Philippines. The study suggests that managing these deficits are indeed

important policy options in promoting macroeconomic stability and sustainability in the region.

In Pakistan's case regarding the validity of twin deficit hypothesis debate is incomplete. Studies *inter alia*, by Shabbier and Ahmed (1994) find that budget deficit have strong positive and significant direct effect on inflation and indirect effect on inflation via money supply. Naqvi and Khan.(1989) find the deficits exerts only indirect effect induced by changes in money supply. Siddiqui (1990) find two-way causality between money supply and inflation, which may be due to common link with deficits (Hakro, 2009). Other studies such as Gupta (1992), Jones and Khiliji (1988), Biliquees (1985) and Kemal (1991) showing mixed results. Hakro (2009) tested the causal link between twin deficit and other macroeconomic variables for Pakistan using quarterly data over the period 1948Q1-2005Q4. His results confirm the causality link of budget deficit running from budget deficit to prices to interest rate to capital flow to exchange rate and to trade deficits. The results also suggest the reduction in the budget deficit might help to control the level of prices. Furthermore, minimum government intervention and a balanced budget could restore the imbalances and a measure of confidence in international trade is also recommended by this study. Javid *et al.* (2011) investigated the impact of government budget deficit shocks on the current account balance and other macroeconomic variables for Pakistan over the period 1960-2009. Based on structural vector autoregressive method the results suggested that expansionary fiscal policy shocks improve the current account balance and depreciates the exchange rate. Furthermore, a rise in domestic saving and a fall in investment contributed to the improvement in the current account. The study also suggests that co-movements in fiscal deficits and current account deficits supported the Ricardian's view.

3. Twin Deficits and the Feldstein-Horioka Puzzle:A Theoretical Consideration

It is well documented in the literature that under the assumption of perfect capital mobility, domestic saving is not necessarily related to domestic investment. However, much of the empirical evidence is based on the cross-section data of 16 OECD countries for the period 1960–

1974 provides supportive evidence that domestic investment and national saving have strong correlation. This empirical finding is known as the Feldstein-Horioka (1980) puzzle. According to this puzzle, the relationship between national savings and domestic investment can be treated as a measure of international capital mobility. Under perfect capital mobility, investment is not controlled by domestic saving but only by the accessibility of funds in the international fully integrated capital market. Saving in each country reacts to the worldwide opportunities for investment, while investment in a country can be financed by the international pool of funds. The important factor of concern for investors should be the rate of return. In closed economies, domestic savings are used to finance investment; however, in open economies a part of investment may be financed by foreign savings. Therefore, savings (S) and investment (I) could move independently of each other. Alternatively, the high investment-saving (I - S) correlation suggests that capital might not be fully mobile across international borders. (Levy 2004)⁵

3.1 An Analytical Framework for Twin Deficits and Feldstein-Horioka Puzzle

Feldstein and Horioka (1980) proposed an assessment of the degree of capital mobility by measuring the correlation between investments and savings. They estimated cross section regressions of the form:

$$\left(\frac{I}{Y}\right)_t = \alpha + \beta \left(\frac{S}{Y}\right)_t + \varepsilon_t \quad (1)$$

Where $\frac{I}{Y}$ is the ratio of gross domestic investment to gross national product (GNP), $\frac{S}{Y}$ is the ratio of national saving to GNP and $\varepsilon_t \sim iid.N(0, \sigma^2)$. The value of β should be close to zero if the international capital mobility is perfect. In contrast, the size of β should

⁵ See Levy (2004) for further details.

be large if capital is immobile. Such relationships between share of investment to GDP and share of saving to GDP, or some of their variants such as, first differences of these have been essential for many countries. Equation (1) is called Feldstein-Horioka regressions where β is the Feldstein-Horioka coefficient representing the saving-investment association.

3.2 Importance of Feldstein-Horioka Puzzle

The degree of capital mobility plays an important role in financial decisions. Its importance can be judged in following perspectives:

1. The effect of fiscal policy crucially depends on the extent of capital mobility.
2. The cost of adjustment to external shocks gets reduced via the access of an economy to capital markets.
3. Capital mobility determines the rate at which incomes converge to long-run equilibrium path.
4. Perfect capital mobility is often assumed to hold in macroeconomic models and exchange rate models (Levy, 2004).

The twin deficit hypothesis has a clear link with the Feldstein-Horioka puzzle since the later is concerned with the source of financing the external deficit. The causality between external balance and fiscal balance stresses the role of private investment. Fidrmuc's (2003) regression model encompasses both the twin deficit hypothesis and the Feldstein-Horioka puzzle. The model makes no difference between net exports and current account balance.

The starting point for the explanation of twin deficits and domestic savings-investment correlation is provided by the national income identity (Miller, 1988). Following Fidrmuc (2003) and Bagnai (2006) the public sector may meet its financial needs through domestic and international financial markets. Rearranging the national income identity, we obtain the following relation:

$$X_t - M_t = Y_t - (C_t + G_t) - I_t = S_t - I_t \quad (2)$$

This identity implies that the trade balance which is defined as the difference between exports (X) and imports (M) must be equal the difference between national savings, defined as output (Y) less total consumption ($C + G$) and investment (I). It provides a link between the external balance and saving-investment decisions. Hence, an increase in domestic investment has a negative impact on the external trade balance. On the other hand, policies that reduce (public or private) consumption are expected to have a positive impact on the external balance via increased national savings. National savings can be subdivided into private saving (S^p) and public saving (S^g). The latter corresponds to the budget balance and equal to the difference between tax revenues (T) and government expenditures (G). Private savings are defined as the disposable income minus private consumption (C). Thus equation (2) can be rewritten as:

$$X_t - M_t = (Y_t - T_t - C_t) + (T_t - G_t) - I_t = S^p + S^g - I_t \quad (3)$$

Equation (3) motivates to test for the long-run relationship between the current account balance (CAB) which is proxied by ($X - M$), the budget deficit (BD) which is proxied by fiscal balance ($T - G$) and total investment (INV). Following Fidrmuc (2003) the variables expressed as share of GDP as:

$$CABY_t = \beta_1 + \beta_2 BDY_t - \beta_3 INVY_t + \beta_4 DUM_{01} + u_t \quad (4)$$

Where $CABY$, BDY and $INVY$ are respectively current account balance as percent of GDP, budget deficit as percentage of GDP and investment as percentage of GDP. To account for changes in current account balance from deficit to surplus after 9/11 shocks, we introduced a dummy variable DUM_{01} which takes the value one for 2001-2003 and zero otherwise.⁶ Equation (4) provides a useful link between

⁶ To account the impact of exchange rate regime we introduced two dummy variables, 1982-2000 for managed floating exchange rate regime and from 2000 to onward for flexible exchange rate regime. However, our preliminary indicates insignificance of these variables. Therefore, we left out these dummies from the analysis.

$CABY$, BDY and $INVY$. We expect $\beta_2 > 0$ and $\beta_3 < 0$. It implies that budget deficit and investment worsens the current account balance. If an economy is perfectly integrated with the world market, then the coefficients of both variables are equal to unity. In this case, the budgetary as well as investment expenditures are financed by the world financial market. However, according to Feldstein and Horioka (1980) a large portion of domestic investment is still financed from domestic savings. If the Feldstein-Horioka puzzle is there, the coefficient β_3 is significantly lower than unity. Likewise, a negative β_2 coefficient leads to the rejection of the twin deficit hypothesis.⁷ Empirical research shows that existence of long-run relationship between budget deficit and current account deficit, and investments in developed economies is considered as one of the six main empirical puzzles in the modern macroeconomics (Obsfeld and Rogoff, 2000). In the present era of globalization and internationalization flow of goods and services and factors of production and free mobility of capital enables the effective allocation of capital regardless of existing state borders. Therefore, the size of the investment in any open economy cannot be limited by the size of domestic savings (Francesca and Stefano, 2010).

4. Methodology and Data Description

We used the autoregressive distributed lag (ARDL) modeling approach to cointegration to estimate twin deficits and Feldstein-Horioka hypothesis. Although, there are some other approaches to estimating cointegration relationships, such as Engle and Granger (1987) and Johansen (1991). However, these approaches requires that underlying series be integrated in the same order. The ARDL avoids the pre-testing of unit roots and the classifications of variables into I (1) or I (0). Empirically, we started with a general model that included 3 lags of all first differenced variables and one lag of levels variables and it was estimated by OLS method. Then we eliminated the statistically insignificant differenced variables following general-to-specific (GETS)

⁷ These specifications are used for Pakistani data and resemble those adopted by Marinheiro (2008) for analysis of Egypt data. Only the proxy variable of wealth is excluded from model.

methodology. The most parsimonious conditional unrestricted error-correction model (UECM) for twin deficits and Feldstein-Horioka is given by⁸

$$\Delta CABY_t = c + \pi_1 \Delta BDY_t + \pi_2 \Delta INVY_t + \pi_3 \Delta INVY_{t-1} + \delta_1 CABY_{t-1} + \delta_2 BDY_{t-1} + \delta_3 INVY_{t-1} + DUM_{01} + \eta_t \quad (5)$$

The coefficients δ 's are the long-run parameters and c is the drift term and dummy variable DUM_{01} that equals one from 2001-2003 and zero otherwise. This capture the 9/11 shocks on current account balance. The current and lagged values of differenced variables are used to model the short-run dynamics. The bounds test for the existence of level relationships between $CABY_t$, BDY_t and $INVY_t$ have the following hypotheses:

$$H_0 : \delta_1 = \delta_2 = \delta_3 = 0,$$

and alternative hypotheses are correspondingly given by:

$$H_1 : \delta_1 \neq \delta_2 \neq \delta_3 \neq 0$$

The ARDL framework allows for testing the presence of long-run relationships among the variables under investigation by employing F-statistic (Felipe *et al.*, 2011). The F -statistic has a non-standard distribution, which depends on the unit root properties of the data that is whether variables included in the UECM are I (0) or I (1), and the number of independent variables. Pesaran *et al.* (2001) provide the critical values of the upper bound and lower bound for the F-test to be used to determine cointegration under various assumptions. If the calculated F-stat lies above the upper bound values, the hypothesis of no cointegration can be rejected and vice versa.

⁸ We have tried various specifications by using different lag length and intercept and trend terms. We specify most parsimonious specifications throughout the study. For the selection of parsimonious model we use PcGets software.

If there is an evidence of cointegration between $CABY_t$, BDY_t and $INVY_t$, then one can proceed further using autoregressive distributed lag (ARDL) specification of equation (4) on the basis of lag selection criteria such as the Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC).⁹ The most parsimonious ARDL representation based on general-to-specific methodology is given by :

$$CABY_t = \gamma_1 CADY_{t-1} + \gamma_2 BDY_t + \gamma_3 INVY_t + DUM_{01} + \omega_t \quad (6)$$

The long-run coefficients can be obtained as:

$$\beta_k = \left(\frac{\gamma_n}{1 - \gamma_1} \right)$$

With $k = 1, \dots, 3$ and $n = 2, \dots, 3$.

Finally the short-run dynamic coefficients for the optimal ARDL can be obtained by estimating the following error-correction model.

$$\Delta CABY_t = \phi_0 + \sum_{i=1}^k \phi_{1i} \Delta CABY_{t-i} + \sum_{i=0}^k \phi_{2i} \Delta BDY_{t-i} + \sum_{i=0}^k \phi_{3i} \Delta INVY_{t-i} \quad (7)$$

$$+ \lambda ec_{t-1} + \rho_t$$

Where ec_{t-1} is error correction term and λ is the speed of adjustment towards the long-run equilibrium after a shock.

The study is based on the annual data covering the period from 1976-2010. Current account balance is calculated by taking the difference between exports and imports. Fiscal balance is calculated as total revenues minus total expenditures. Gross fixed capital formation is used as proxy of investment. Data on these variables are retrieved from the World Bank's *World Development Indicators*. Data on GDP is taken

⁹ However, Pesaran and Shin (1999, p. 3) noted that ARDL based on SBC performed slightly better than ARDL based on the AIC (also see Khan and Qayyum, 2009).

from International Monetary Fund's *International Financial statistics (IFS)* CD-ROM 2011. All variables are expressed as percentage of GDP in order to account for their share in the economy.

5. Empirical Results and Their interpretation

This study is based on the annual data over the period 1976-2010. The analyzed period is of particular interest because there were significant changes in the Pakistan's exchange rate regime, financial sector reforms are also undertaken during this period and the most important event (i.e. 9/11) also happened during this time.

Before estimating the twin deficits and Feldstein-Horioka hypothesis, the stationarity properties of the data were checked using Augmented Dickey Fuller (ADF) test. The results of ADF test are reported in Table 1.

Table 1: Augmented Dickey Fuller Test

Variable	Levels	First Difference	Conclusion
$CABY_t$	-3.1043 (1)*	-4.5918 (1)*	I(0)
BDY_t	-2.0507 (1)	-4.2040 (1)*	I(1)
$INVY_t$	-3.1285 (0)*	-5.5006*	I(0)

Note: The 5 percent critical value of ADF is -2.9446. Figures in brackets indicate number of lags, while *indicate significant at the 1 percent level of significance.

It is evident from the ADF test that the current account balance as percentage of GDP ($CABY_t$) and ratio of investment as percentage of GDP ($INVY_t$) are stationary at their levels, whereas budget deficit as percentage of GDP (BDY_t) is non-stationary at its levels and stationary at its first difference. This means that $CABY_t$ and $INVY_t$ are integrated of order zero i.e.. I (0) and BDY_t is integrated of order one, i.e. I (1). These mixed results of ADF test justifies the use of autoregressive distributed lag (ARDL) method of cointegration.

5. 1 Cointegration Analysis: Bounds Test of Cointegration

We follow a three-step procedure of the ARDL method to estimate equation (4). In the first step, we have estimated equation (5) by OLS for examining the existence of long-run relationship between $CABY_t$, BDY_t and $INVY_t$. The optimal lag length for UECM is selected of order 1 based on SBC. The F-test is calculated by imposing zero restrictions on the lag level variables. The calculated $F_{CABY}(CABY_t | BDY_t, INVY_t, DUM_{01})$ was equal to 9.7316 is higher than the upper bound of critical values (i.e. 4.3495) at the 5 percent level of significance. Therefore, we reject the null hypothesis of no cointegration among $CABY_t$, BDY_t and $INVY_t$.¹⁰

Having found the long-run relationship between $CABY_t$, BDY_t and $INVY_t$, the second step is to estimate ARDL equation (6). The estimated results are presented by equation (8) (t-values in parenthesis):

$$CABY_t = 0.3851 CABY_{t-1} + 0.2897 BDY_t - 0.4585 INVY_t + 4.0382 DUM_{01}$$

$$(2.6005)^* \quad (3.4964)^* \quad (-1.8034)^{**} \quad (3.1626)^*$$

$$\bar{R}^2 = 0.6012 \quad DW = 2.03 \quad D - h = -0.17 \quad F = 17.59 [0.000]^*$$

Bounds Test :

	<i>F - calculated</i>	<i>F - Upper bounds (95 %)</i>	<i>F - Lower bound (95 %)</i>	(8) 11
<i>F - stat :</i>	9.7361	3.0650	4.3495	
<i>W - stat :</i>	29.2082	9.1950	13.0485	

Diagnostic Test :

$$SC - \chi^2(1) = 0.0290 [0.865] \quad FF - \chi^2(1) = 0.1251 [0.724]$$

$$NO - \chi^2(2) = 4.5829 [0.101] \quad Het - \chi^2(1) = 0.0013 [0.971]$$

¹⁰ Results of this step are available to the authors and can be obtained upon request.

¹¹ * and ** indicate significance at the 1 percent and 5 percent level of significance. The diagnostic test include serial correlation test (SC), function form (FF), normality (NO) and test for heteroscedasticity (Het), all are distributed to chi squares. Numbers in [.] indicates p-values.

It can be seen from the results reported by equation (8) that all the variables are significant. The coefficient of current account balance lagged by one year exerts positive and significant effect on current account balance. Budget deficit and investment exerts positive and negative effects on current account balance. However, the magnitude of these coefficients is less than that of expected values of twin deficit and Feldstein-Horioka hypothesis. The dummy variable to account for 9/11 effects on current account balance is positive and significantly affecting $CABY_t$.

The long-run coefficients can be obtained from the estimated equation (8). The long-run coefficient of budget deficit is 0.4711 (calculated as $0.2897/1-0.3851=0.4711$) and the long-run investment coefficient is -0.7457 (calculated as $-0.4585/1-0.3851=-0.7457$). The corresponding normalized long-run parameter estimated from equation (8) is as follows:

$$CABY_t = 0.4711 BDY_t - 0.7457 INVY_t + 6.5675 DUM_{01} \quad (9)$$

(6.2537)* (-1.5233)*** (3.5624)*

The result reported in equation (9) confirms a positive association between the budget deficit and current account deficit. The positive coefficient of budget deficit in relation with current account deficit leads to acceptance of the twin deficits hypothesis. Our results suggest that a rise in budget deficit by one percent of GDP worsens current account balance by 0.47 percent of GDP. Furthermore, result also reveals that investment exerts negative and significant impact on current account balance. An increase in investment by 1 percent of GDP improves current account balance by 0.75 percent. The dummy variable to account for 9/11 effects on the current account balance is positively and significantly affecting current account balance. All the variables appear in equation (10) have expected signs. These results support the validity of twin deficit hypothesis and rejection of Feldstein-Horioka puzzle for Pakistan. The coefficient of $INVY_t$ is less than unity which implies that domestic investment needs are to partially financed on the world financial markets. It also implies that Pakistan is not perfectly integrated

to world market and about $\frac{3}{4}$ of its investment is financed through external funds (foreign savings). This reason for this situation could be that the capital flows are limited during 1976-1990 because of heavy controls. However, Pakistan launched financial sector reforms since 1990 to dismantle controls on financial sector, trade and payments system. The results reported in equation (10) rejects the validity of Feldstein-Horioka hypothesis in the case of Pakistan.

Finally, to examine the short-run behaviour of current account balance, budget deficit and investment, we have estimated an error-correction model and equation (10) reports the result (t-values are in parenthesis):

$$\Delta CABY_t = 0.2897 \Delta BDY_t - 0.4587 \Delta INVY_t + 4.0382 \Delta DUM_{01} - 0.6149 ec_{t-1}$$

$$(3.4964)^* \quad (-1.8034)^{**} \quad (3.1626)^* \quad (-4.1520)^*$$

$$ec_t = CABY_t - 0.47107 * BDY_t + 0.74571 * INVY_t - 6.5675 DUM_{01} \quad (10)$$

$$\bar{R}^2 = 0.43 \quad F = 9.1610 [0.000]^* \quad DW = 2.03$$

The short-run parameters presented in equation (10) also in line with long-run parameters presented by equation (9) in terms signs and significance. However, the size of the parameters is small compared to the long-run estimates of the variables. The budget deficit and investment produces positive and negative influence on current account balance in the short-run. The coefficient of budget deficit is 0.29 which implies that an increase in budget deficit by one percent of GDP deteriorates current account balance by 0.29 percent of GDP in the short-run. The positive and significant association between budget deficit and current account deficit again confirms the validity of twin deficit in the short-run in the case of Pakistan. Similarly, investment exerts negative influence on current account balance in the short-run. The coefficient of investment is -0.46 which is less than unity implying that in the short-run about 0.46 percent of Pakistan's investment is financed by foreign savings. This result provides a weak support for the Feldstein-Horioka hypothesis in the case of Pakistan in the short-run. The positive coefficient of the dummy variable suggest that 9/11 event significantly deteriorates current account balance in Pakistan. The error-correction coefficient is negative and significant. The magnitude of error-correction

term is -0.61 which suggest that the deviation from the long-term $CABY_t$ path is corrected by 61 percent over the following year. To check the appropriateness of the results cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares recursive residuals (CUSUMSQ) stability test is carried out. The plots of stability test suggest that the estimated parameters lie within the 5 percent critical bound, thus not violating the structural stability (see appendix).

On the whole, the above results existence of cointegration which confirm the long-run relationship among current account balance, budget deficit and investment in the case of Pakistan. Our findings support the validity of twin deficits both in short-as well as kin long-run. Similarly, we got no support for the validity of Feldstein-Horioka hypothesis in the long run but weak support in the short-run. The validity of Feldstein-Horioka hypothesis implies that Pakistan's economy is well integrated into the world economy and government borrowings could be financed through international financial markets.

5.1 The Multivariate Granger Causality Test

To determine the direction of causality we employ multivariate Granger causality test. Since the ADF unit root test suggested that current account balance and budget deficit is integrated of order one (i.e. I (1)) and investment is integrated of order zero (i.e. I (0)). Therefore, we examine causality with Toda and Yamamoto (1995) approach. The Toda—Yamamoto approach fits a vector auto regressive model in the levels of the variables thereby minimizing the risks associated with the possibility of wrong identification of the order of cointegration of the series (Mavrotas and Kelly, 2001). Following Altgintas and Taban (2011) we specify the following two variables VAR model:

$$\begin{aligned}
 Y_t &= \alpha + \sum_{i=1}^k \beta_i Y_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \beta_j Y_{t-j} + \sum_{i=1}^k \delta_i X_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \delta_j X_{t-j} + \omega_{1t} \\
 X_t &= \alpha + \sum_{i=1}^k \lambda_i X_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \lambda_j X_{t-j} + \sum_{i=1}^k \theta_i Y_{t-i} + \sum_{j=k+1}^{k+d_{\max}} \theta_j Y_{t-j} + \omega_{2t}
 \end{aligned}
 \tag{11}$$

Where k is the number of lags and d_{\max} represents the maximum cointegration level of the variables entered in to the model. The main idea of this method is to increase the number of lags in the VAR model in accordance with the maximal cointegration relationship based on the F -stat. If $\delta_i \neq 0$ in equation (11), X_t Granger causes Y_t . Similarly, if $\theta_i \neq 0$ in equation (11), Y_t Granger causes X_t . Table 2 reports the results of Toda-Yamamoto causality.

Table 2: Toda-Yamamoto Causality Results

Model	Lag length ($k + d_{\max}$)	$F - stat$	p-value	Decisions	Direction of causality
$CADY_t = f_1(BDY_t)$	2	3.1364	0.0590**	Reject H_0	$BDY_t \rightarrow CADY_t$
$BDY_t = f_2(CADY_t)$	2	1.1421	0.3336	Accept H_0	$CADY_t$ does not cause BDY_t
$INVY_t = g_1(CADY_t)$	2	0.6947	0.5068	Accept H_0	$CADY_t$ does not cause $INVY_t$
$CADY_t = g_2(INVY_t)$	2	0.8027	0.4572	Accept H_0	$CADY_t$ does not cause $INVY_t$
$BDY_t = h_1(INVY_t)$	2	1.3456	0.2767	Accept H_0	$INVY_t$ does not cause BDY_t
$INVY_t = h_2(BDY_t)$	2	2.2549	0.1236	Accept H_0	BDY_t does not cause $INVY_t$

Note: * indicate significant at the 5 percent level of significance.

According to Toda-Yamamoto causality test budget deficit causes current account deficit and current account does not causes budget deficit. This confirms our earlier results of the existence of twin deficits hypothesis with causality running from budget deficit to current account

deficits. Furthermore, we find no causality between investment and current account and budget deficit and investment.

5.1 Policy Implications

We find supportive results for the validity of twin deficit hypothesis for Pakistan over the period 1976-2010. The two deficits appear to be tied up by a statistically significant relation in the case of Pakistan. Large budget deficit leads to higher current account balance both in short-run as well as in long-run. This twin deficit is eroded in the long-term and appears to be relatively small in the short-run. There are various channels through which budget deficit influences current account deficit in an economy like Pakistan. First, an increase in budget deficit induces upward pressure on interest rate which leads to capital inflows and an appreciation of exchange rate, leading to increase in current account deficit. Second, an increase in budget deficit would induce domestic absorption, and hence increase in imports worsens current account balance (Marinheiro, 2008). Third, budget deficit increases domestic and external borrowings. Domestic borrowing leads to a credit squeeze through higher interest rate which, in turn, crowds out private investment and consumption. External borrowing leads to a current account deficit and appreciation of the real exchange rate creates balance of payments crisis or external debt crisis. High budget deficit also deteriorates current account balance through inflation rate (Easterly and Schmidt-Hebbel, 1993). Furthermore, when taxation revenues are not enough to cover government expenditures, an increase in public expenditure can cause budget deficit. Therefore, fiscal discipline is helpful to stabilize current account balance. To this end, there is need to coordinate and implement monetary, fiscal and exchange rate policies to promote macroeconomic stability and sustainability. Furthermore, there is also need to increase tax-GDP ratio through rationalization of tax system. Export promotion could be another policy option that the authority could pursue.

Another important finding of this study is the negative relationship between investment and current account deficit. This finding does not support the validity of Feldstein-Horioka hypothesis. This implies that Pakistan's economy is integrated to the world economy. The result could be due to the adoption of economic liberalization policies of the

government of Pakistan since 1990. Therefore, there is need of further liberalization to strengthen the integration between domestic financial markets to the rest of the world.

Toda-Yamamoto causality result also supports the causal relationship between budget deficit and current account deficit with the causality running from budget deficit to current account deficit. No evidence of causality between either investment and current account deficit or investment and budget deficit has been observed.

6. Conclusions

This study examines the validity of the twin deficits and Feldstein-Horioka hypothesis for Pakistan over the period 1976-2010 using ARDL-bounds testing cointegration methodology. The validity of twin deficits hypothesis has strong policy implications, and closely linked to the Feldstein-Horioka hypothesis. It is widely believed that if the twin deficits hypothesis is valid, the appropriate policy option could be the fiscal discipline to correct current account deficit. The results reveal the existence of long-run relationship between current account balance, budget deficit and investment. The presence of cointegration between the variables implies that current account balance, budget deficit and investment are moving jointly. The positive association between budget deficit and current account deficit implies that Pakistan has a twin deficits problem. Budget deficits worsen current account deficits in the short-run as well as in the long-run. The causality runs from budget deficit to current account deficits in short-run as well as in long-run. Furthermore, our findings do not support the validity of the Feldstein-Horioka hypothesis in the long-run but lend weak support in the short-run. This is because Pakistan's economy is integrated to the world economy, though; the degree of international capital mobility is not perfect. Domestic investment particularly, public sector investment has largely depends on domestic savings as well as foreign borrowings and foreign economic assistance has always played an important role in financing the national development programmes. Our results suggest that $\frac{3}{4}$ of domestic investment is financed through external sources. Thus, the historical relationship between domestic investment and saving is very poor in

Pakistan. As such, the empirical results do not support the validity the Feldstein-Horioka puzzle in case of Pakistan in the long-run.

The evidence of twin deficits and non-existence of Feldstein-Horioka hypothesis in the case of Pakistan is also verified by Toda-Yamamoto causality test.

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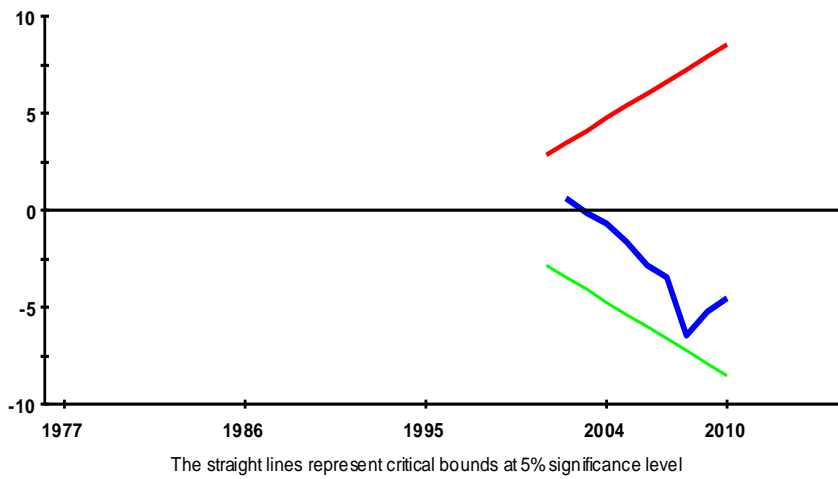
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Appendix

Plot of Cumulative Sum of Recursive Residuals



Plot of Cumulative Sum of Squares of Recursive Residuals

