On the sustainability of the current account deficits:

Evidence from Turkey

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Abstract

The objective of this paper is to examine the long-run tendency of Turkish current account imbalances and to understand its behaviour over the 1992-2009 period. The intertemporal solvency model of Hakkio and Rush (1991) and Husted (1992) is employed which is based on the cointegrating relationship between exports and imports. Conventional time series methods do not consider structural breaks and the fractional dynamics of time series. *However, Turkish economy experienced some economic crises and policy changes within this period. Therefore the presence of structural changes in the series is taken into account in this study. The fractional integration method is also applied to analyze the sustainability of current account deficit in Turkey. The empirical evidence revealed that the current account deficit has mostly been unsustainable for the sample period and there has been much more need for policy actions to overcome the structural causes of the persistent deficit.*

Introduction

Large and persistent current account deficit (CAD) is one of the most debated issues among economists and policy makers in Turkey over 10 years, since Turkish economy experienced balance of payment crises more than one time during 2000s. A variety of economic crises in world showed that huge and unsustainable CAD and indebtedness together with matching of debts by short-run capital inflows are important triggers of these crises. This is also true for Turkey that the severity of the balance of payments crises faced through the 2000s pointed out a key role of having excessively large CAD and these deficits only occurred few times before. Moreover the CAD of Turkey is likely to improve its productive capacity, thus Turkey did not face a crisis in 2007 even if the ratio of the CAD to GDP exceeded the minimum threshold of 5% (Ogus-Binatli and Sohrabji, 2008b; 173 and Togan and Berument, 2007; 191).

An equal inflow of the essential funds from abroad serves to finance the current account deficit of a country. Therefore, intertemporal solvency or sustainability of CAD may be implied by the capability of a country to pay back its external debt in the long-run. It infers that the expected present discounted value of the future trade surplus must be equal to the present value of country's foreign debt (Trehan and Walsh, 1991; 208 and Milesi-Ferretti and Razin, 1996, 4-6). Namely, if the current stock of foreign debts does not converge to the present value of future trade balances, then debts of country will balloon and the CAD is not sustainable. Since it also refers to the present value of future external debt approaches zero in the long-run, the stationary CAD might guarantee a sustainable path of a country's foreign debts (Gulcan and Utkulu, 2006; 672).

Borrowing abroad to balance a country's deficit may not be feasible in the long-run as a result of running persistent foreign deficits, even if this kind of financing may be costless in the short-run (Dulger and Ozdemir, 2005, Kalyoncu, 2005). Since short-run imbalances in the current account serve a function of reallocating the capital among countries, they may not signal a fundamental problem (Kalyoncu, 2005; 1). However, protracted deficits may lead to certain

serious risks in some cases. The first one is the rise in the interest rates due to encourage the capital inflows unless there is a supply shock that causes to a decrease in the interest rates. Secondly, the growth of external debt creating high interest payments might lead to experience an excess debt burden in future (Hakkio, 1995; 11). Consequently, if these deficits are too persistent to sustain they might pose economic vulnerability which may result in a crisis with other factors such as low domestic savings (Milesi-Ferretti and Razin, 1996, 2).

A comprehensive framework for examining sustainability of the CAD is provided by Hakkio and Rush (1991) and Husted (1992). This model is concerned with the country's intertemporal solvency constraint based on the long-run path of the CAD. The intertemporal approach for exploring current account sustainability examines the long-run relationship between exports and imports. For this purpose, theoretical rationale of the intertemporal approach is established in two phases; examining of the cointegration between real exports and imports variables and determining whether slope coefficients obtained from long-run equations converge to one. If there is a long-run relationship between real exports and imports, it could be concluded that CAD is sustainable. In the second stage, the strong form of sustainability holds if slope coefficient is equal to one. Otherwise, the CAD is sustainable only in the weak form.

In this paper, a method in line with Husted (1992) is employed and a weak evidence of cointegration between real exports and imports for the 1992-2009 is found implying that the CAD of Turkey might not be sustainable as a whole. Since financial crises hit the economy during these periods, Zivot and Andrews (1992) unit root and Gregory and Hansen (1996) cointegration tests allowing for an endogenous break is used to investigate the long-run sustainability. Conventional methods of time series modelling assume that the series are either trend or difference stationary. Whereas fractionally integrated process seems to cover wide possibilities. A further step of empirical analysis therefore considers the fractional integration test of Geweke and Porter-Hudak (1983). Using cointegration methods, we conclude that the sustainability condition is not satisfied

for sample period, while structural breaks as policy actions and crises might reduce the current account imbalances at least in short-run.

This paper seeks to investigate whether the current account imbalances of Turkey are sustainable for the period of 1992-2009 and is organized as follows: the first part of the study gives a historical background of CAD in Turkey. Section two provides a background on intertemporal solvency framework of Husted (1992) by following Hakkio and Rush (1991). The recent literature on sustainability (or solvency) is described in section three which is followed by a section dedicated to the econometric methodology performed in the study. The data and empirical results are reported and discussed in section five. And finally, the last section summarizes and concludes.

1. Historical Background of Turkish Current Account Imbalances

In Turkey, the policy implementations based on CAD can be examined in two periods; pre-1980 and post-1980. The 1930-1980 period of Turkish economy was based on import substitution policy. In 1970-1980, Turkey specifically aimed to support the industrialization via protectionism; this period is characterized by a planned economy. In this period, Turkey tried to extend the domestic production of previously imported goods. The main purpose was to raise the domestic production capacity in capital goods manufacturing. Moreover, Turkey had a fixed exchange rate regime together with quantitative restrictions, and the exchange rate was overvalued (Voyvoda and Yeldan, 2001; 379, 380). Namely, pre-1980s is known as the period executed the import-substitution industrialization policies with a lack of competition with the purpose of decreasing the demand for imported goods. However, these trade regime policies ended with a foreign exchange crisis resulted from huge foreign deficits about 1.413 billion dollar experienced in the period 1977-1980 (Koska, 2001; 3).

The main characteristic of the post-1980 period was the export-oriented industrialization policy. It was based on the liberalization of foreign trade and capital movements, and floating

exchange regime. One of the pillars of the accumulation model in 1980-1988 period was to raise exports, resulted by a fall in domestic demand due to fact that wage increase lied below inflation rate during this period (Boratav and Yeldan, 2006; 423, 424). Yeldan et.al. (2000; 27) describe the post-1980s era in three cycles. The period of 1981-1987 was the first cycle, namely an outward-oriented period which lead to economic stagnation. Second oscillation was the period of 1989-1994 called as financial liberalization period and a financial crisis hit the economy in 1994. Between the years 1995-2000s, the economy was depended on short-run capital movements, caused 2000 economic crisis. Another important development in this period was the decision of Custom Union membership of Turkey in 1996 which led to a significant reduction in tariffs between EU and Turkey. Figure 3 showed that CAD to GDP ratio at the end of the 1993 was 14.2%. In the aftermath of the 1994 crisis, Turkish economy contracted by 6% and it fall to 4.2%.

During the period of 1990-2000, CAD was mainly balanced by short-run capital (hot money). So, the Turkish economy and growing current account imbalances gradually depended on the changes in the level and direction of short term capital inflows. Just within the last three decades, capital-flow reversals could indeed push Turkey into severe balance of payments crises. These crises faced in 1994, 2000 and 2001 pointed out the dangers related to the persistent deficits and changes in the direction of capital movements (Togan and Berument, 2007; 156). The Figure 3 reflects that CAD to GDP ratio reached a dramatic position before 2001 about 7% since the short-run capital inflow, overvaluation of Turkish lira and export rise encouraged a parallel process of import expansion (Oniş and Aysan, 2000; 120-21). The rising need of imported goods for economic expansion plays an increasingly crucial role under the large CAD and crises. Custom Union membership accompanied by elimination of import duties might also have contributed to large imbalances (Keyder, 2001; 38). Thereby, permanent CAD in Turkey could be considered as the Achilles' heel of the economy (Ikinci, 2008). The CAD to GDP ratio at the end of 2008 exceeded the 5% minimum threshold and reached to nearly 6%, and fall in 2009 because of global crisis. According to Figure 2 demonstrating Turkey's real exports and imports to GDP also

indicates that imports has grown steadily except crises periods when exports are relatively stable, which are about 35% and 15% in 2007 respectively.

2. Quantitative Methodology

In the recent literature, there exist two major theory in assessing the intertemporal sustainability of the current account imbalances such as the intertemporal benchmark model (IBM) and intertemporal solvency model (ISM). The first model is based on the comparison the optimal consumption-smoothing current account and the actual consumption-smoothing current account series, and testing the variances of the both series (Ogus-Binatli and Sohrabji, 2006; 2, 3). However, current account sustainability is most commonly studied within the ISM developed by Hakkio and Rush (1991) and elaborated by Husted (1992). Following Hakkio and Rush (1991), Husted (1992) proposed a method to test sustainability based on testing the long-run comovement between real exports and imports. This model assumes a small open economy with a representative consumer and no government which produces and exports a single good, and starts with the budget constraint of an agent who is able to borrow and lend in international markets freely. The world rate of interest is given, and agents maximize lifetime utility subject to budget constraints (Husted, 1992; 160). The representative agent's current period budget-constraint in period t is given by:

$$C_t = Y_t + B_t - I_t - (1 + r_t)B_{t-1} \qquad (1)$$

where C_t, Y_t, I_t, B_t and r_t denote private current consumption, production, investment, international borrowing and world interest rate per period respectively. $(1+r_t)B_{t-1}$ is the initial external debt size (Husted, 1992; 160). Since the budget constraint must be satisfied in every period, it can be derived from forward iteration of the equation 1:

$$
\begin{aligned}
B_{t+1} &= -(Y_{t+1}\text{-}C_{t+1} - I_{t+1}) + (1 + r_{t+1})B_t \\
B_{t+2} &= -(Y_{t+2}\text{-}C_{t+2} - I_{t+2}) + (1 + r_{t+2})B_{t+1} \\
&= -(Y_{t+2}\text{-}C_{t+2} - I_{t+2}) + (1 + r_{t+2})(Y_{t+1} - C_{t+1} - I_{t+1}) + (1 + r_{t+1})B_t \\
&\vdots \\
B_{t+n} &= -(Y_{t+n}\text{-}C_{t+n} - I_{t+n}) + (1 + r_{t+n})(Y_{t+n-1}\text{-}C_{t+n-1} - I_{t+n-1})\text{-}..... \\
&- (1 + r_{t+n})(1 + r_{t+n-1}).....(1 + r_{t+2})(Y_{t+1} - C_{t+1} - I_{t+1}) \\
&+ (1 + r_{t+n})(1 + r_{t+n-1}).....(1 + r_{t+1})B_t
\end{aligned}
\qquad (2)
$$

Rewriting the relation 1, economy's intertemporal budget constraint may be expressed as:

$$B_t = \sum_{t=1}^{\infty} \delta_t TB_t + \lim_{n\to\infty} \delta_n B_{t+n} \qquad (3)$$

where TB_t, ($X_t - M_t = Y_t - C_t - I_t$), equation 3 represents the trade balance in period t, X_t and M_t are exports and imports respectively. δ_t, is equal to $\prod_{s-1}^{t} \beta_s$ where as $\beta_s = (1/1 + r_s)$ and defined the discount factor. The final term, $\lim \delta_n B_{t+n}$, is of prime importance in equation 3 implying that external debt should be equal to the sum of present value of future trade surplus (deficit), if country is solvent, assuming that the last term vanishes, which states transversality condition (Trehan and Walsh, 1991, Swada, 1994). Under this circumstance, a country's current stock of external debt has to be equal the present value of future trade balances to maintain solvency, and thus it has a sustainable current account deficit. If the last term is nonzero, for instance B_{t+n} is positive then the country is said to be "bubble-financing" of external debt and CAD is unsustainable (Husted, 1992; 160).

Assuming world interest rate is stationary with an unconditional mean of r, that is, exogenous in accordance with this economy's choices (Kalyoncu, 2005; 3), equation 3 might be rearranged. Thus, Husted (1992) transformed equation 1 into an empirically tractable formulation:

$$Z_t + (1+r)B_{t-1} = X_t + B_t \qquad (4)$$

As noted $Z_t = M_t + (r_t - r)B_{t-1}$, thus Hakkio and Rush (1991) and Husted (1992) rearranged the equation A.8 in appendix as:

$$M_t + r_t B_{t-1} = X_t + \sum_{j=1}^{\infty} \lambda^j \left[\Delta X_{t+j} - \Delta Z_{t+j} \right] + r \lim_{n \to \infty} \lambda^{n+1} B_{t+n} \qquad (5)$$

The left side of equation 5 states the spending on imports alongside interest payments (receipts) on net foreign debt (assets). By subtracting X_t from each side and multiplying the result by minus one, the left side of the equation 5 indicates the economy's current account (Husted, 1992; 161). Finally, following Hakkio and Rush (1991), Husted (1992) assume that X and Z are I (1) processes with the stationary error, ε_t and α reflects the drift parameters:

$$X_t = \alpha_1 + X_{t-1} + \varepsilon_{1t} \qquad (6)$$

$$Z_t = \alpha_2 + Z_{t-1} + \varepsilon_{2t} \qquad (7)$$

Thereby, equation 5 could be written as:

$$X_t = \alpha + MM_t - r \lim_{n \to \infty} \lambda^{n+1} B_{t+n} + \varepsilon_t \qquad (8)$$

where $MM_t = M_t + r_t B_{t-1}$, $\alpha = (a_2 - a_1)/r$ and $\varepsilon_t = \sum_{j=1}^{\infty} \lambda^j \left(\varepsilon_{2t+j} - \varepsilon_{1t+j} \right)$. By assuming that the limit term of equation 8 approaches to zero, Husted (1992) derives a standard regression format:

$$X_t = \alpha + \beta MM_t + \varepsilon_t \qquad (9)$$

The X_t and MM_t measures the exports of goods and services and the imports of goods and services plus net unilateral transfers and net interest payments respectively. Necessary condition for the economy to be satisfying its intertemporal budget constraint is that error structure should be stationary which means that if X_t and MM_t are non-stationary series, I (1) then act together in the long-run and weak form of sustainability holds. Since import rises faster than the export when slope coefficient is smaller than one, weak form does not guarantee the sustainability of the current

account deficit as a whole (Hakkio and Rush, 1991; 434). The sufficient condition for the intertemporal budget constraint established when e_t is stationary process together with the existence of a cointegrating vector, (1, -1). Such a relationship implies that current account deficit is strongly sustainable (Husted, 1992; 161, 162 and Baharumshah et.al., 2003; 473). To sum up, if there is a proof that β is equal to one such that exports and imports are cointegrated in the long-run then CAD is sustainable in strong form.

3. Literature Review

In the existing literature, one way to determine whether a country's CAD is sustainable is to test cointegrating relationship between exports and imports by implementing different forms of cointegration tests. Husted (1992) follows the framework developed by Hakkio and Rush (1991) and simply uses the long-run relationship between exports and imports with different forms such as real exports, real imports and their corresponding values deflated by income. In this respect, he observes U.S. trade flows over the past 25 years and his empirical findings suggest that the current account of US violates its intertemporal budget constraint in the long-run. Namely, there is no systematic link between exports and imports in U.S. However, an analysis with structural break in 1983 supports cointegration. In the beginning of the 1990s, cointegration analysis has received considerable attention in the recent applied literature on the sustainability of CAD, since cointegration is a necessary condition for solvency. There are major approaches to examine the sustainability or solvency condition such as Dickey and Fuller (1979) unit root test, Engle and Granger (1987) two-step and Johansen (1991) cointegration methods. In this manner, the concept of sustainability of CAD has been studied in recent years by a large literature. Some works focused on methodology of Husted (1992) such as Leachman and Thorpe (1998), Fountas and Wu (1999), Wu et.al.(2001), Baharumshah et.al. (2003), Herzer and Nowak-Lehmann (2005), Narayan and Narayan (2005), Cunado et.al. (2008) and Perera and Verma (2008).

Leachman and Thorpe (1998) apply the conventional cointegration method to Australia to test for external solvency. Their findings support the sustainability of CAD. Fountas and Wu (1999) used advanced time series techniques of Zivot and Andrews (1992) and Gregory and Hansen (1996) to investigate the issue of the sustainability in US. They demonstrate that the current account position of US is unsustainable when structural changes are incorporated endogenously. Wu et.al. (2001) adopt the panel integration and cointegration tests of Kao and Chiang (1998) applied to G-7 countries data and find evidence of cointegration between exports and imports. Baharumshah et.al. (2003) look at the case of Indonesia, Malaysia, Philippines and Thailand by performing Gregory and Hansen (1996) methodology which allows for structural break. The comparison of the sustainability of CAD prior and post crisis periods is the main aim of Baharumshah et.al. (2003) concluding that the trade balance is not stationary in these countries except Malaysia and therefore persistent current account imbalances may contribute to crisis in the four ASEAN countries. These results also illustrate that large currency depreciations result in holding the solvency condition after crisis. Narayan and Narayan. (2005) analyze the long-run relationship between exports and imports in 22 least developed countries by bounds test approach of Pesaran et.al. (1996) and provide a comparison between the current account performances of these underdeveloped countries. Their results point out that only six countries' CAD seems to be sustainable. Herzer and Nowak-Lehmann (2005) examine the pattern of the sustainability in Chile by applying Perron (1989), Zivot and Andrews (1992) and Gregory and Hansen (1996) tests and find that Chile's current account is sustainable with helping of policy implementations though crises. Perera and Verma (2008) find empirical supports that trade balance is not sustainable in Sri Lanka and also highlight that Sri Lanka's current policies might be ineffective by considering similar structural break methods. Compared to other other works on sustainability, Cunado et.al. (2008) exploits fractional integration test since conventional unit-root tests have low power when the root is not close to unity. Cunado et. al. (2008) also employ fractional integration methods by Robinson (1994) together with structural breaks for US. They use nominal and real exports and

imports and their corresponding values deflated by GNP. The results indicate that the differenced series are stationary and the current accounts are sustainable with long memory behaviour.

Numerous studies focused on the sustainability of Turkish CAD such as: Bahmani-Oskooee and Domac (1995), Utkulu (1999), Kalyoncu (2005), Yucel and Yanar (2005), Akdis et.al. (2006), Ogus-Binatli and Sohrabji (2006), Yamak and Korkmaz (2007), Erbaykal and Karaca (2008), Polat (2008), Ogus-Binatli and Sohrabji (2008a), Ogus-Binatli and Sohrabji (2008b), Ongan (2008), Peker (2009) and Azgun and Ozbey (2009). The sustainability of CAD is tested in most of the papers on Turkey by the context of Husted (1992). The only study applied the intertemporal benchmark model of Ghosh and Ostry (1995) to Turkey is Ogus-Binatli and Sohrabji (2006) which finds no evidence of sustainability of current account imbalances in Turkey as a whole, but there is a change in current account position after 2001 crisis. In previous studies, the most prevalent methods are conventional unit root tests such as Dickey and Fuller (1979) test, Engle and Granger (1987) and Johansen (1991) cointegration methods. However, some of them consider the presence of structural changes and employ Perron (1989), Zivot and Andrews (1992) unit root tests and Gregory and Hansen (1996) cointegration method.

Using dummy variables for structural breaks in 1973 and 1980 respectively, Bahmani-Oskooee and Domac (1995) and Utkulu (1999) test the sustainability of current account for Turkey. Bahmani-Oskooee and Domac (1995) document support for external deficit sustainability only if dummy variable is introduced in the cointegration regression. However, the findings of Utkulu (1999) are not consistent with the evidence from Bahmani-Oskooee and Domac (1995) even if it is considered the structural change by methodology of Perron (1989). Using monthly data for the period 1992-2009 (finishing at February), Azgun and Ozbey (2009) apply Johansen (1991) cointegration method by taking into account the crisis in 2001 as an exogenous structural change. However, their empirical evidence does not confirm the sustainability since the long-run relationship in the current account series has disappeared after post crisis period. Following the

Engle and Granger (1987) cointegration method, Akdis, Peker and Gormus (2006) does not confirm the long-run convergence of real exports and imports. Subsequently, Yamak and Korkmaz (2007) and Erbaykal and Karaca (2008) apply Wald test to examine whether slope coefficient approaches one and conclude that the behaviour of the current account deficit is only weakly consistent with its intertemporal budget constraint. Ongan (2008) considerably departs from other studies since he analyzes the contribution of the tourism sector to the sustainability of CAD. His results indicate that the sustainability does not hold in spite of the importance of tourism receipts. Using monthly data for the period 1992-2007, Peker (2009) analyze the current account sustainability by utilizing the cointegration method of Johansen (1991) and his finding support the weak sustainability of CAD since slope parameter does not approach to one.

These studies generally find that CAD is unsustainable with a few exceptions such as: Bahmani-Oskooee and Domac (1995), Kalyoncu (2005), Gormus (2006), Yamak and Korkmaz (2007), Erbaykal and Karaca (2008) and Peker (2009). But all provide evidence for weak form of sustainability in Turkey except Kalyoncu (2005). However, these findings may be misleading since most of studies ignore the possible conclusion of structural breaks on sustainability. Bahmani-Oskooee and Domac (1995) and Utkulu (1999) are the studies that take into account an exogenous choice of the changes. On the other hand, Erbaykal and Karaca (2008), Ogus-Binatli and Sohrabji (2008a) and Polat (2008) analyze the sustainability by considering structural break in an unknown date. Using Zivot and Andrews (1992) and Gregory and Hansen (1996) methods, Ogus-Binatli and Sohrabji (2008a) and Polat (2008) find an unsustainable CAD in Turkish economy. Only first Gregory-Hansen model considering break in mean of Ogus-Binatli and Sohrabji (2008) supports a long-run convergence between exports and imports. Therefore, they apply Dynamic OLS (DOLS) proposed by Stock and Watson (1993). This provides evidence in favour of weak sustainability and they conclude that structural breaks may improve the current account position of Turkey at least in short-run.

Besides, Ogus and Sohrabji (2008b) consider the framework suggested by Milesi-Ferretti and Razin (1996) employing structural features such as external debt as well as macroeconomic indicators like fiscal sustainability. They highlight the importance of outside factors not being under control of Turkey on the current account imbalances and find that Turkey may not be able to sustain these persistent current account deficits. Consequently, this paper extends the long-run analysis of sustainability by applying the fractional integration method of Geweke and Porter-Hudak (1983) for Turkey. This is motivated by the fact that conventional time series methods have been considerably criticized by researchers because of a priori restrictions about the order of integration of series. This issue emphasized by Cunado et.al. (2008). Another potential problem related to investigating sustainability of CAD in Turkey is structural changes accompanied by policy actions, crises etc. Therefore, Zivot-Andrews (1992) unit root tests and Gregory-Hansen (1996) cointegration method allowing one endogenous structural break are exploited.

4. Econometric Methodology

Testing the existence of long-run relationship among series has been widely based on employing various cointegration tests such as two-stage residual based procedure of Engle and Granger (1987) and system-based approach of Johansen (1991). Granger (1986) points out that if the variables in regression model are integrated in same order then there might be cointegration. Engle and Granger (1987) formulate a two-step procedure for cointegration which determines each series order of integration in the first step. Dickey and Fuller (1979) and Kwiatkowski et.al. (1992) provide different tests in practice, known generally as Augmented Dickey Fuller (ADF) and KPSS. The null hypothesis in KPSS test is that the series are level stationary or I(0), whereas the series are specified to be non-stationary under the null hypothesis of ADF. The KPSS test is often utilized in the possibility of the fact that series are neither trend nor difference stationary, that is, fractionally integrated (Karlaftis and Vlahogianni, 2009; 449).

After all, if both of the series are integrated of same order then the second step involves estimating the long-run relationship in equation 9. ADF test is conducted on residuals, ε_t, from equation 9 to test whether the series, X_t and MM_t, are cointegrated:

$$\Delta\varepsilon_t = \alpha\varepsilon_{t-1} + \sum_{i=1}^{m} \beta_i \Delta\varepsilon_{t-i} + u_t \qquad (10)$$

where α, β and u_t reflect the estimated parameters and error term respectively. Using the t statistics of α, if ε_t is found to be stationary, the series are said to be cointegrated. Subsequently, Engle and Granger (1987; 266, 267) emphasize that if the series are cointegrated, then error correction presentation exists. However, Engle-Granger (EG) cointegration method assume that there must be at least one causal relationship in cointegrated system such that one of the series should be weakly exogenous (Engle and Granger, 1987; 259). Thus, EG method may give a consistent estimate if there is only one cointegrating vector of β. Johansen (1991; 1553) provides a multivariate extension of EG cointegration method without imposing a priori causal ordering. The model performs trace and maximum eigenvalue test statistics using maximum likelihood to determine the number of cointegrating vector (r). The null hypothesis that there is at most r cointegrating vector is tested against the alternative of full rank in the trace statistics:

$$-T\sum_{i=r+1}^{n} In(1-\lambda_i) \qquad (11)$$

where T is the number of observations and λ are the eigenvalues. Under the null hypothesis of r cointegrating vectors against the alternative of r+1 cointegrating vectors, the maximum eigenvalue statistics is as follows (Johansen and Juselious, 1990; 177-178):

$$-TIn(1-\lambda_{r+1}) \qquad (12)$$

Whereas Pesaran et.al. (1996) indicate that conventional cointegration tests produce consistent results as long as all variables have same order of integration. The Bounds test by Pesaran et.al. (1996) might provide a comparison among conventional cointegration tests in

coexistence of stationary and non-stationary variables in the long-run equation. The first stage is estimating of Autoregressive Distributed Lag (ARDL) as follows:

$$\Delta X_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta X_{t-i} + \sum_{i=0}^{n} \alpha_2 \Delta MM_{t-i} + \alpha_3 X_{t-1} + \alpha_4 MM_{t-1} + u_t \qquad (13)$$

The second phase is to test whether all estimated coefficients of lagged level variables equal to zero (H_0: $\alpha_3=\alpha_4=0$) and compute Wald or F statistics. The upper bound critical value states that all regressors are I(1). If the F statistics is greater than upper bound then the null of no cointegration could be rejected. When it lies below the lower level assuming that they are all I(0), there is no evidence of cointegration. Provided that the F statistics is within band, we need to check the order of integration for series to make an exact inference about cointegration (Pesaran et.al., 1996; 290).

Turkey engaged in structural changes accompanied by IMF programs, crises in 1994, 2000 and 2001 during the sample period. These may potentially be an important issue in terms of results of conventional time series methods. Therefore, the unit root test of Zivot and Andrews (1992) and cointegration methodology by Gregory and Hansen (1996) is also used. Perron (1989) analyzes the power of unit root tests in the presence of structural breaks causing changes in the regression parameters and t statistics, and conclude that conventional unit root tests often lead to the spurious results in favour of unit root in case of breaks (Perron, 1989; 1388-89). Zivot and Andrews (1992; 252, 253, 254) carry out tests of the unit root hypothesis against the alternative of stationary with a break in unknown time instead of framework allowing an exogenous break proposed by Perron (1989). The proposed test performs the following equations:

Model A: Break in Level

$$X_t = \mu + \beta t + \delta X_{t-1} + \gamma DU_t + \sum_{i=1}^{k} \eta_i \Delta X_{t-i} + \varepsilon_t \qquad (14)$$

Model C: Break in Both Level and the Rate of Growth

$$X_t = \mu + \beta t + \delta X_{t-1} + \gamma DU_t + \theta DT_t + \sum_{i=1}^{k} \eta_i \Delta X_{t-i} + \varepsilon_t \qquad (15)$$

Model A only considers one unspecified possible break in the mean. But, structural changes in both mean and trend can be detected by Model C. The break date, TB, is selected to minimizes one-sided t-statistic for testing δ=1 in equation 14 and 15. The dummy variables are DU_t and DT_t corrsponding to a break in mean and trend at time TB respectively such that DU = 1 if t > TB, and zero otherwise, DT approaches (t-TB) if (t>TB) and zero otherwise (Zivot and Andrews, 1992; 254).

The possibility of structural changes in the cointegrating relationship is not incorporated in conventional cointegration tests. However, Gregory and Hansen (1996; 103) address that conventional cointegration test has low power in rejecting null in the presence of breaks in cointegrating relationship and outline a framework to test cointegration by allowing a break at an unknown time. In a nutshell, Gregory-Hansen (GH) procedure is an extension of the EG residual based cointegration method with a structural shift determined endogenously. Three models of GH considering shift in intercept (16), in trend (17) and in both (18) in the cointegrating relationship are as follows:

Model 1: Level shift (C)

$$X_t = \mu_1 + \mu_2 \phi_{1\tau} + \alpha^T MM_t + e_t \qquad t=1,2,...,n \qquad (16)$$

Model 2: Level shift with trend (C/S)

$$X_t = \mu_1 + \mu_2 \phi_{1\tau} + \beta t + \alpha^T MM_t + e_t \qquad t=1,2,...,n \qquad (17)$$

Model 3: Regime shift (C/T)

$$X_t = \mu_1 + \mu_2 \phi_{1\tau} + \alpha_1^T MM_t + \alpha_2^T MM_t \phi_{1\tau} + e_t \qquad t=1,2,...,n \qquad (18)$$

where e_t is the residual, τ implies the break date and $\phi_{t\tau}$ is dummy variable such that $\phi_{t\tau}=1$ *if* $t>\tau$ and 0 otherwise. The cointegration equations for all possible break dates in the sample are estimated to find the break time where ADF, $Z_\alpha(\tau)$ or $Z_t(\tau)$ statistics, calculated by following MacKinnon (1991), are minimized. The null hypothesis of no cointegration is tested against an alternative that there may be cointegration with one break (Gregory and Hansen, 1996; 100).

Conventional unit root and cointegration tests even if they consider structural breaks are criticized for making a clear distinction between *I*(0) and *I*(1) processes of the series (Geweke and Porter-Hudak, 1983; 222). To address this limitation, Cunado et.al. (2008) employ the fractional integration test to examine sustainability of CAD for different country cases. Consider a time series, X_t, following autoregressive fractionally integrated moving average process of order *d* (ARFIMA (*p*,*d*,*q*)):

$$(1-L)^d \phi(L) X_t = \varphi(L) u_t \qquad u_t \sim iid(0,\sigma^2) \qquad (19)$$

where *L* denotes the lag operator and *d* is long memory parameter. $\phi(L)=1-\phi_1 L-\ldots..\phi_p L^p$ and $\varphi(L)=1-\varphi_1 L-\ldots..\varphi_q L^q$ are polynomials with stable roots. Fractional differencing operator, $(1-L)^d$, is defined as follows for all real *d*:

$$(1-L)^d = \frac{\sum_{k=0}^{a} \Gamma(k-d) L^k}{\Gamma(-d)\Gamma(k+1)} \qquad (20)$$

where $\Gamma(.)$ reflects the generalized factorial function or standard gamma function. For fractionally integrated series, d is not an integer (Hosking, 1981; 166-168). Testing the statistical significance of the differencing parameter, d, allow the investigating of a fractional order of integration. The null hypothesis of d=1 is tested versus the alternative d<1 and the estimated d values are used for inference purposes. If the order of integration, d, is bigger than zero, X_t is said to have long memory. If d<0.5, X_t is covariance stationary and mean reverting, that is, the effects of shocks decay in the long-run. If 0.5<d <1, X_t displays no longer covariance stationary, but is still mean

reverting. But, d>1 reflects nonstationarity and non mean reversion. When - ½ < d < 0, X_t exhibits stationary and is said to have short memory (Granger and Joyeux, 1980; 21 and Hosking, 1981; 169). Cunado et.al. (2008; 5) argue that fractional differencing parameter, d, plays critical role on understanding mean reverting property and the impact of shock on an economic variable. In case of a variable having unit root, (d=1), any shock will have a permanent effect such that the impact of a shock is known to be persist forever. If d <1, any shock is transitory, that is, it slowly dies out. There is less need for policy implementations, since the variables will in any case revert to its mean sometimes in the future.

There exist some parametric and semi-parametric techniques such as Geweke and Porter-Hudak (1983), Li and McLeod (1986), Fox and Taqqu (1986) and Sowell (1992). Geweke and Porter-Hudak (GPH) test is applied for estimating and testing fractional differencing parameter, *d,* in this paper. Geweke and Porter-Hudak (1983) develop a semi-parametric method carried out on the first differences of the series. In the GPH test, deriving the spectral density of X_t makes it possible to estimate the fractional integration parameter:

$$f_X(\omega) = \left|1 - \exp(-i\omega)\right|^{-2(d-1)} f_u(\omega) \qquad (21)$$

where $f_u(\omega)$ reflects the spectral density function of u_t, which is a stationary process. Taking logarithms of equation 21, the following equation can be obtained:

$$\ln(I(\omega_j)) = \ln(f_u(0)) - (d-1)\ln(4\sin^2(\omega_j/2)) + \ln((I(\omega_j)/f_X(\omega_j)) \qquad (22)$$

where $\varpi_j = 2\pi j/T(j = 1.....T-1)$ indicates the Fourier frequencies of the sample. $I(\omega_j)$ is the periodogram of X_t at frequency ω_j. $I(\omega_j)$ is calculated as follows:

$$\ln(I(\omega_j)) = \frac{1}{2\pi}\sum_{k=-T+1}^{T-1}\gamma_j e^{-i\omega_j k}, i^2 = -1 \qquad (23)$$

where γ_j is order j auto covariance of sample series. The differencing parameter, *d,* which is also known as the long memory parameter, can be estimated consistently by the least squares estimation of equation 24:

$$\ln(I(\omega_j)) = \beta_0 + \beta_1 \ln(4\sin^2(\omega_j / 2)) + e_t \qquad j = 1.....J \qquad (24)$$

where β_0, T and J are constant, the number of observations of sample series and spectral ordinates respectively. The e_t from equation 24 is asymptotically iid and the theoretical asymptotic variance of e_t is equal to $\pi^2/6$ (Cheung and Lai, 1993; 107). Geweke and Porter-Hudak (1983; 125, 126) indicate that the least squares estimate of β_1 is a consistent estimator of 1-d under some regularity conditions on g(T) satisfied by T^λ for $0 < \lambda < 1$. Hypothesis test related to the value of d could be performed by the t statistics of the regression coefficient. If the least squares estimate is significantly different from zero then an evidence of long memory may exist. Cheung and Lai (1993; 108-109) observe that although conventional tests fail to prove comovement among series, the GPH test may find evidence of fractional cointegration. The null hypothesis of a unit root (d=1) is tested against the alternative of fractional integration (d<1) by GPH test. If equilibrium errors follow a fractionally integrated processes then series are fractionally cointegrated.

5. Empirical Analysis

5.1. Data

All Turkish data are quarterly, seasonally adjusted through moving average method and begins in 1992:1 and ends in 2009:1. The variables used in the empirical analysis are real exports (X_t), real imports (MM_t), real exports and imports as a percentage of GDP donated as X_t/Y_t and MM_t/Y_t. The measure of real exports and imports includes exports of goods and services and imports of goods and services plus net transfer payments and net interest payments respectively. All data are expressed in Turkish liras, deflated by producer price index (PPI) to measure the

variables in real terms and taken from the Electronic Data Delivery System by Central Bank of the Republic of Turkey.

5.2. Empirical Results

Following Husted (1992), real exports and imports and their corresponding values deflated by GDP are used to examine whether sustainability of CAD in Turkey holds. The first stage of the EG cointegration method is to determine the order of integration by performing unit root tests. Although, there are a number of unit root tests in the literature, ADF and KPSS tests are applied to series for different models and lag lengths. Table 1 reports the results of the unit root tests. The null hypothesis of a unit root in ADF could not be rejected for any of the variables in level. The only exception is MM_t with trend such that the null hypothesis could reject at 10% significance level. Subsequently, ADF test is performed on the first differences and the findings indicate that all the variables analyzed are integrated order one.

Table 1. Results of Unit Root Tests

		X_t		MM_t		X_t/Y_t		MM_t/Y_t	
		Trend	Without trend	Trend	Without trend	Trend	Without trend	Trend	Without trend
ADF	Level	-2.2879 (3)	1.3778 (6)	-3.2580*** (1)	-0.7733 (3)	-2.7291 (0)	-2.0801 (0)	-2.0459 (0)	-2.3361 (0)
	First difference	-6.2443* (5)	-5.9688* (5)	-5.8821* (2)	-5.9618* (2)	-6.3903* (2)	-6.3364* (2)	-4.8976* (4)	-3.3749* (0)
KPSS	Level	0.2662* (4)	1.0697* (6)	0.1365*** (5)	1.0159* (6)	0.1460** (5)	1.0215* (6)	0.1410 (5)	0.7451* (6)
	First difference	0.1680** (20)	0.2525 (23)	0.0890 (10)	0.1089 (10)	0.8709* (6)	0.2226 (19)	0.1038 (13)	0.2826* (10)

Note: * , ** and *** denote the rejection of the null hypothesis at 1%, 5% and 10% significance level respectively; Maximum lags were set at 8 and numbers in parenthesis are optimum number of lags determined through AIC; critical values are based on MacKinnon (1991). In KPSS test, numbers in parenthesis are the truncation lag and selected to Bartlett Kernel.

But KPSS test allowing for trend does not yield consistent results with the fact that most of the macroeconomic series are said to have a unit root (Nelson and Plosser, 1982). The KPSS test results indicate that the null hypothesis of stationarity is significantly rejected for all the variables in their levels with two exceptions. For MM_t/Y_t, the KPSS test could not reject null in both level and first difference with trend. Table 1 also shows that KPSS test failed to reject the null

hypothesis of stationarity for MM_t with trend when differentiated. It is possible to rely on structural breaks or the dichotomy between I(1) and I(0) in conventional methods (Perron, 1989, 1990, 1997, Karlaftis and Vlahogianni, 2009; 449). In the remainder of the paper, we allow for structural changes and fractional order of integration.

In particular, variables might actually be I(0) with structural break whereas conventional unit root tests will fail rejecting the null hypothesis. The null of unit root is therefore tested against the alternative hypothesis of stationarity with a break in mean and trend by Zivot and Andrews (ZA) unit root test and results are presented in Table 2. The null hypothesis may be rejected for most of the variables indicating that the series under examination are likely to be I(0). The only exception is MM_t/Y_t in both models. Additionally, the null of unit root could not be rejected at 5% significance level in model C of MM_t namely; there is not a permanent effect of the structural changes on imports. In broad sense, it could depend on the assumption of order of integration in conventional methods including ZA unit root test. According to Table 2, the corresponding breaks mainly occur in 2000, 2004 and 2006 respectively the years when severe crisis in 2000 hit the economy, the policies proposed by IMF were implemented to overcome the conclusions and the Turkish economy began to grow faster after crisis.

Table 2. Results of Zivot-Andrews Unit Root Tests

	X_t		MM_t		X_t/Y_t		MM_t/Y_t	
	A	**C**	**A**	**C**	**A**	**C**	**A**	**C**
TB	2006-1	2000-3	2004-1	1998-1	2006-3	2000-4	2006-4	2005-4
δ	-0.6522**	-0.8360*	-0.4053**	-0.3733	-0.4038*	-0.4635*	-0.5455	-0.5983
θ	-	34.9693*	-	-424.4143***	-	3.4350*	-	2.0561
γ	440.5406*	118.7786	498.6836*	-3.5722	-3.0633*	-0.1243*	-4.5017*	-0.6022**
k	3	1	1	1	0	2	8	8

Note: *, ** and *** denote the rejection of the null hypothesis at 1%, 5% and 10% significance level respectively. The critical values obtained from Zivot and Andrews (1992; 256, 257). Maximum lags were set at 8, k corresponds to lag length used in the test for each series and selected through the AIC. Minimum t statistics of the related coefficients are given in parenthesis.

ADF, KPSS and ZA unit root tests do not yield consistent results, but they assume a strict distinction of I(0) and I(1), whereas GPH test does not. Therefore, whether series have long

memory are tested via GPH test. The GPH test is carried out on the first differences of the series and the results are given in Table 6. Geweke and Porter-Hudak (1983) recommend using 0.5 as the most appropriate value of λ. However, a range from 0.50 to 0.60 is reported to have better performance by most researchers (Cheung and Lai, 1993). In this study, GPH test is performed for all values of λ between 0.45 and 0.65 to avoid subjective choice. According to Table 3, if λ is smaller than 0.50, then d is statistically significant for X_t and MM_t at 5% significance level. This implies that these series might have long memory. Namely, these series might be fractionally integrated. If λ is within the range of 0.45 and 0.55, then the null hypothesis could be rejected for all variables except X_t/Y_t and MM_t/Y_t, that is, d is statistically different from one, and thus an evidence of long memory may exist for X_t and MM_t. If λ equals 0.50, the only variable might be fractionally integrated is X_t. X_t/Y_t displays nonstationary process since d is not statistically significant for all values of λ. However, MM_t/Y_t might exhibit long memory provided that λ is larger than 0.55.

Table 3. Results of Geweke and Porter-Hudak Test

	λ	0.45	0.50	0.55	0.60	0.65
$\mathbf{X_t}$	d	1.2211	1.1347	0.7589	1.3917	1.4850
	t statistics	(2.5540)**	(3.7254) *	(3.3137) *	(3.4062) *	(3.8830) *
$\mathbf{MM_t}$	d	0.5694	0.2291	0.7780	1.6370	1.5767
	t statistics	(1.9549)**	(0.7740)	(2.1723) **	(4.1397) *	(5.4147) *
$\mathbf{X_t/Y_t}$	d	-1.6355	-0.4869	-0.6125	0.3783	0.6079
	t statistics	(-1.0103)	(-0.3793)	(-0.8240)	(0.6090)	(1.1439)
$\mathbf{MM_t/Y_t}$	d	-0.1720	-0.9250	-0.5680	1.2395	0.8961
	t statistics	(-0.2206)	(-1.3024)	(-1.3753)	(1.6816)**	(1.7006) **

Note: Numbers in parenthesis are corresponding t statistics. * and ** denote the rejection of the null hypothesis at 1% and 5% significance level respectively. λ denotes the power associated with the Fourier transforms (T^{λ}). The null hypothesis of $d = 1$ is tested against the alternative of $d < 1$.

The order of integration, d, is not different from one for X_t/Y_t and MM_t/Y_t, when λ is between 0.45 and 0.55 implying that is no longer stationary. Additionally, it is larger than 0.5 for other values of λ meaning that MM_t/Y_t displays non-stationary. For all values of λ, the integration level of X_t and MM_t are slightly different from one that indicates evidence of long memory. As λ falls down, the estimate of differencing parameter might be slightly smaller than one for X_t and MM_t proposing that are not stationary, but mean reverting. For all of these four series, GPH test

results indicate evidence of non-stationary. But order of integration is very sensitive to range of λ. To conclude, order of integration of variables to GPH test is consistent with ADF.

Given these conclusions, long-run relationship between real exports and imports is tested to EG two-stage, Johansen method and Bounds test as well as GH methods. Table 4 summarizes the results of EG, Johansen and Bounds tests for two regressions considering different measurement of exports and imports. It could be compared the findings of traditional tests by Bounds test provided being differ order of variables to various tests. The ADF, eigenvalue and trace value statistics allow soundly not rejecting the null hypothesis of no cointegration at all significance level for these two models. In a similar vein, the computed F statistics lies below the lower bound (I(0)) in Bounds test supporting to no comovement in both specifications. Consequently, there exists a strong evidence supporting the CAD in Turkey is unsustainable for the sample period.

Table 4. Results of Engle-Granger, Johansen and Bounds Cointegration Tests

Panel 1: Static Long-Run Regression			
$X_t = \alpha+\beta MM_t$		$X_tY_t = \alpha+\beta MM_tY_t$	
α	β	α	β
-313.8005	0.7018*	-1.0195	0.6711*

Panel 2: Results of Cointegration Tests				
ADF				
-2, 9977 (1)			-1.3655 (4)	
Eigenvalue and Trace Statistics				
Null and Alternative Hypothesis	r=0 r=1	r≤1 r=2	r=0 r=1	r≤1 r=2
Eigenvalue	6.5426	0.8745	10.3829	4.6389
Trace Value	7.4172	0.8745	15.0219	4.6389

Bounds Test			
F statistics	I(0)	I(1)	F statistics
2.5052	4.94	5.73	4.4334

Note: * denotes the rejection of the null hypothesis at 1% and 10% significance level respectively. Critical value is based on MacKinnon (1991). The long-run regressions are estimated by fully modified Phillips-Hansen method to eliminate endogeneity bias. Maximum lags were set at 8, optimum lag length used in the test for each tests selected through the AIC and given in parenthesis for EG test. In Johansen test of first and second models, the optimum lag length is 6 and 1 respectively. Since there is no evidence of cointegration, the error correction model is not estimated. I(0) and I(1) indicates the critical values at 5% significance level (Pesaran et.al., 2001). The optimum lag length is 5 and 1 in Bounds test respectively. Models include constant and no trend.

But conventional cointegration tests do not consider the structural breaks introducing spurious unit root behaviour in the cointegrating relationship such that the hypothesis of no cointegration is failed to reject. It is therefore utilized from GH test and its findings are given in Table 5. The results from GH test are inconclusive. An evidence of cointegration is only found in two of six cases at 1% significance level to ADF test. This implies that series might move together in the long-run as a whole when it is allowed for structural changes. All significant break dates are estimated to occur in 1995 and 2000 to ADF test statistics. This is not a surprising result indicating that there might be a permanent shift in current account position in Turkey because of policy actions as well as crises.

Table 5. Results of Gregory-Hansen Cointegration Tests

		ADF	TB	Z_t^*	TB	Z_α^*	TB
X_t and	C	-4.4179***	2001-1	-3.6451	2001-2	-29.7709	2001-3
MM_t	C/T	-5.6923*	1995-2	-5.0463**	2005-4	-39.8342***	1995-3
	C/S	-4.3867	2004-1	-3.6341	2000-3	-30.4101	2000-3
X_t/Y_t and	C	-5.2154*	2000-1	-4.4900***	2000-3	-33.4899	2000-3
MM_t/Y_t	C/T	-4.9165***	2000-3	-4.5398***	2000-3	-34.1798	2000-3
	C/S	-4.8150***	2001-3	-4.4404	2000-3	-33.0025	2000-3

Note: The table reports the minimum t-statistics. Critical values are based on Gregory and Hansen (1996; 109). TB corresponds break years with the quarter. *, ** and *** denote the rejection of the null hypothesis at 1%, 5% and 10% significance level respectively.

Conventional cointegration tests including GH tests may display that the series are not cointegrated in case of the fact that the residuals might be shown to be fractionally integrated (Shepton, 2002; 322). Thus, fractional cointegration may provide supporting evidence in favour of long-run relationship, if traditional cointegration tests fail to reject the null of no cointegration. When error term follows a long memory stationary process, two series are said to be fractionally cointegrated (Cheung and Lai, 1993; 104). The GPH test is performed for range of λ from 0.45 to 0.65 and on the first differences of the disturbances. The results are reported in Table 6 indicating that there is no evidence for the sustainability of CAD in Turkey to both models, since d is not statistically significant for 0.45 and 0.55 range of λ. When λ is larger than 0.55, d is statistically different from one in both models. However, disturbances is not said to have long memory since d

dramatically exceeds 0.5 pointing that series are not fractionally cointegrated in the long-run. Consequently, the differencing parameter is not statistically significant from zero, namely, the error term obtained from equation 9 is said to be non-stationary and non-mean reverting. Such point shows that the sustainability of the CAD in Turkey is failed to GPH test as well. In the light of all results, we could conclude that CAD in Turkey is persistent and the structural changes accompanied by policy actions and crises having a possible improvement impact on the current account position might be ineffective. Therefore, lack of cointegration supports fundamental policy problems for Turkey (Perera and Verma, 2008; 90).

Table 6. Results of Geweke and Porter-Hudak Fractional Cointegration Test

	λ	0.45	0.50	0.55	0.60	0.65
X_t and	d	0.3798	0.2538	1.0045	1.3545	1.3963
MM_t	T statistics	(0.2199)	(0.2345)	(1.4740)**	(3.2419)*	(4.8140)*
X_t/Y_t and	d	0.5495	0.2139	0,4564	0,9516	0,9243
MM_t/Y_t	T statistics	(0.1960)	(0.1210)	(0.4815)	(1.5756)***	(2.1292)**

Note: Numbers in parenthesis are corresponding t statistics. * , ** and *** denote the rejection of the null hypothesis at 1%, 5% and 10% significance level respectively. λ denotes the power associated with the Fourier transforms (T^{λ}). The null hypothesis of $d = 1$ is tested against the alternative of $d < 1$.

6. Conclusion

Conventional and advanced time series techniques by merging the Husted (1992) procedure have been conducted in this paper to examine sustainability of CAD in Turkey. Under quarterly data from 1992 to 2009, real exports and imports and their corresponding values as a percentage of GDP were used in this analysis. From empirical findings, one could conclude that there is not a long-run relationship between real exports and imports so that the CAD is growing without bound over time. The analysis has been carried out using the ZA, GPH unit root and EG, Johansen, Bounds, GH, fractional cointegration tests, since sample period involves lots of crises and policy implementations resulting in failures and the strict I(0)/I(1) distinction is assumed by conventional methods.

In the first part of the empirical analysis, various unit root tests that also include ZA allowing one unknown break and GPH avoiding the I(0)/I(1) dichotomy unit root tests have been employed. The conventional unit root test results do not provide consistent conclusions, but fractional integration allows a comparison among findings. The GPH test results indicate that all series might be non-stationary. Real exports and imports series might be mean reverting though covariance non-stationary. Additionally, structural changes in ZA unit root test accompanied by crises experienced and policies implemented in 2000s might show instantaneous impacts to the imports and the ratio of imports to GDP. On the basis of these results, it has been proceed to test whether CAD in Turkey satisfy its intertemporal budget constraint in the long-run by proceeding the EG, Johansen, Bounds, GH and GPH version of fractional cointegration tests ignoring strict distinction on integration level of the disturbances.

The results from four cointegration tests conclusively support that intertemporal budget constraint does not hold, that is, there is an evidence of permanently growing current account imbalances in Turkey. Considering GH test results, structural breaks accompanied by crises, booms and policy actions in Turkey during 1990s and 2000s might improve the current account

position in the long-run to three of eighteen cases in different tests. However, like conventional test results, the GPH test findings reinforce that equilibrium errors display non-stationary and non-mean reverting process to large extent. As a result, although there is an evidence of a relationship between exports and imports in Turkey resulted by improvements on current account position of policy actions and crises, imports' spending is probably growing more rapidly than exports' gains. This is consistent with the findings from other studies. Our analysis led to the following important conclusions. First, a strong evidence is found, supporting that the CAD in Turkey is persistent for a sample period. Second, crises leading to devaluation and decreasing purchasing power and policy actions as structural changes might not feasible to enhance the chance of sustainable deficits in the long-run since the domestic production and exports are increasingly depended on imported inputs in Turkey. Policies imposed on exports and imports might therefore be less efficient to achieve sustainability without overcoming structural problems.

Appendix: Intertemporal Solvency Model (ISM)

Solving $Z_t + (1+r)B_{t-1} = X_t + B_t$ by forward substitution, it could be obtained:

$$\begin{aligned}
B_t &= Z_t - X_t + (1+r)B_{t-1} \\
B_{t+1} &= Z_{t+1} - X_{t+1} + (1+r)B_t \\
&= Z_{t+1} - X_{t+1} + (Z_t - X_t) + (1+r)^2 B_{t-1} \\
&\cdot \\
&\cdot \\
&\cdot \\
B_{t+n} &= \sum_{j=0}^{n} (1+r)^{n-j}(Z_{t+j} - X_{t+j}) + (1+r)^{n+1} B_{t-1}
\end{aligned} \tag{A.1}$$

From the relation A.1, the following equations are derived as:

$$\begin{aligned}
B_{t-1} &= \sum_{j=0}^{n} (1+r)^{-j-1}(X_{t+j} - Z_{t+j}) + (1+r)^{-n-1} B_{t+n} \\
B_{t-1} &= \sum_{j=0}^{n} \lambda^{j+1}(X_{t+j} - Z_{t+j}) + \lambda^{n+1} B_{t+n}
\end{aligned} \tag{A.2}$$

where $\lambda = 1/(1+r)$. As n approaches infinity:

$$B_{t-1} = \sum_{j=0}^{n} \lambda^{j+1}(X_{t+j} - Z_{t+j}) + \lim_{n\to\infty} \lambda^{n+1} B_{t+n} \tag{A.3}$$

Equation A.3 could be rewritten as:

$$B_{t-1} = \lambda(X_t - Z_t) + \lambda^2(X_{t+1} - Z_{t+1}) + \lambda^3(X_{t+2} - Z_{t+2}) + \ldots + \lim_{n\to\infty} \lambda^{n+1} B_{t+n} \tag{A.4}$$

Equation A.4 could be further manipulated to get:

$$\begin{aligned}
B_{t-1} &= \lambda(X_t - Z_t) + \lambda^2(X_{t+1} - Z_{t+1}) - \lambda^2(X_t - Z_t) + \lambda^2(X_t - Z_t) \\
&\quad + \lambda^3(X_{t+2} - Z_{t+2}) - \lambda^3(X_{t+1} - Z_{t+1}) + \lambda^3(X_{t+1} - Z_{t+1}) + \ldots + \lim_{n\to\infty} \lambda^{n+1} B_{t+n} \\
&= \lambda(X_t - Z_t) + \lambda \sum_{j=1}^{\infty} \lambda^j (\Delta X_{t+j} - \Delta Z_{t+j}) + \lambda \sum_{j=1}^{\infty} \lambda^{j+1} (\Delta X_{t+j} - \Delta Z_{t+j}) + \lim_{n\to\infty} \lambda^{n+1} B_{t+n}
\end{aligned} \tag{A.5}$$

Using the equation A.3, equation A.5 reduces to:

$$B_{t-1} = \lambda(X_t - Z_t) + \lambda \sum_{j=1}^{\infty} \lambda^j (\Delta X_{t+j} - \Delta Z_{t+j}) + \lambda B_{t-1} + (1-\lambda) \lim_{n\to\infty} \lambda^{n+1} B_{t+n} \tag{A.6}$$

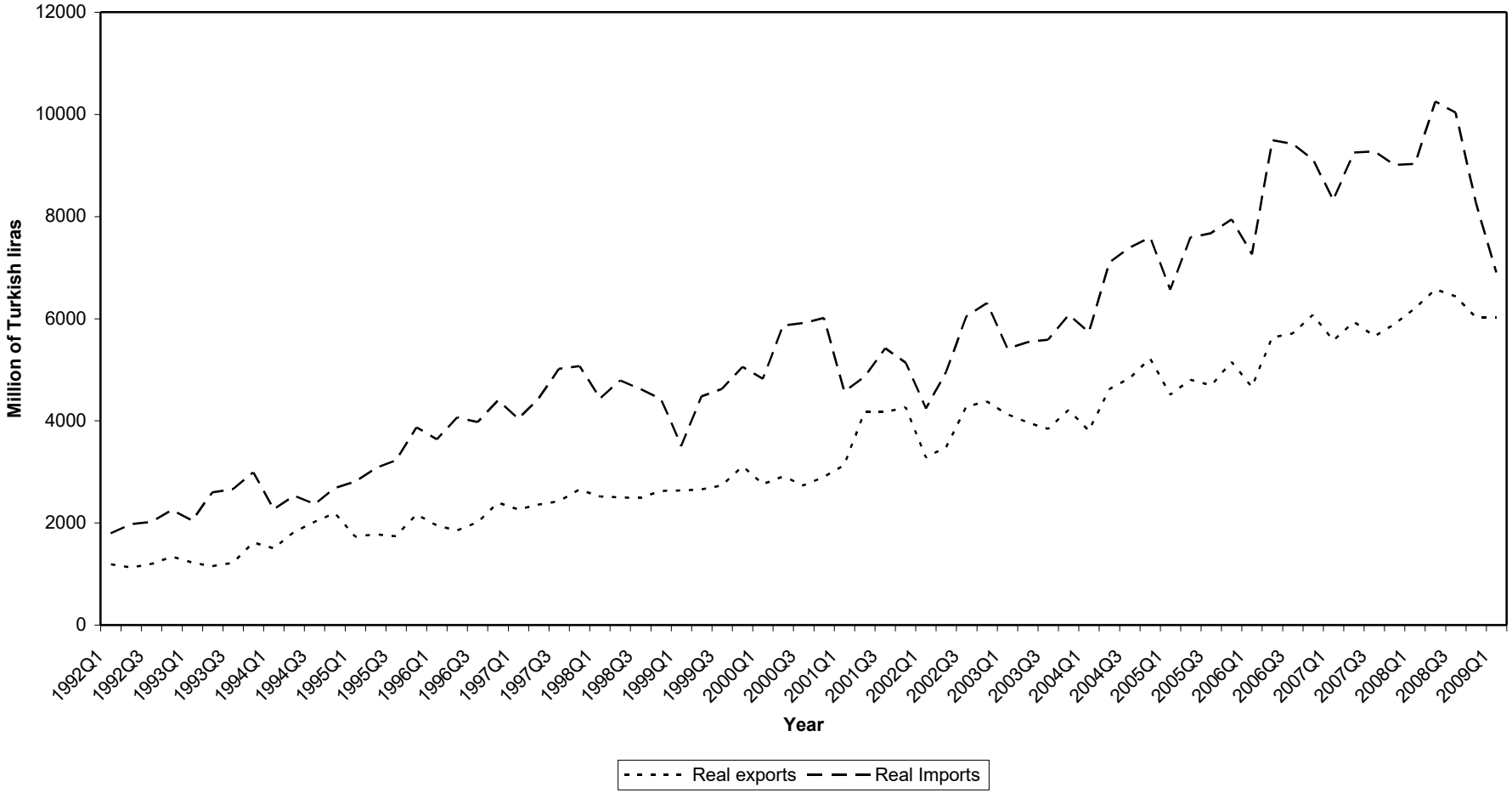
The equation A.5 could be transformed into:

$$\frac{1-\lambda}{\lambda} B_{t-1} = (X_t - Z_t) + \sum_{j=1}^{\infty} \lambda^j (\Delta X_{t+j} - \Delta Z_{t+j}) + \frac{(1-\lambda)}{\lambda} \lim_{n \to \infty} \lambda^{n+1} B_{t+n} \qquad (A.7)$$

Given that $\lambda = 1/(1 + r)$, Δ is the first difference operator and taking Z_t left side, the equation A.3 could be rewrite as (Ogus-Binatli and Sohrabji, 2008a; 9-11):

$$Z_t + rB_{t-1} = X_t + \sum_{j=1}^{\infty} \lambda^j (\Delta X_{t+j} - \Delta Z_{t+j}) + r \lim_{n \to \infty} \lambda^{n+1} B_{t+n} \qquad (A.8)$$

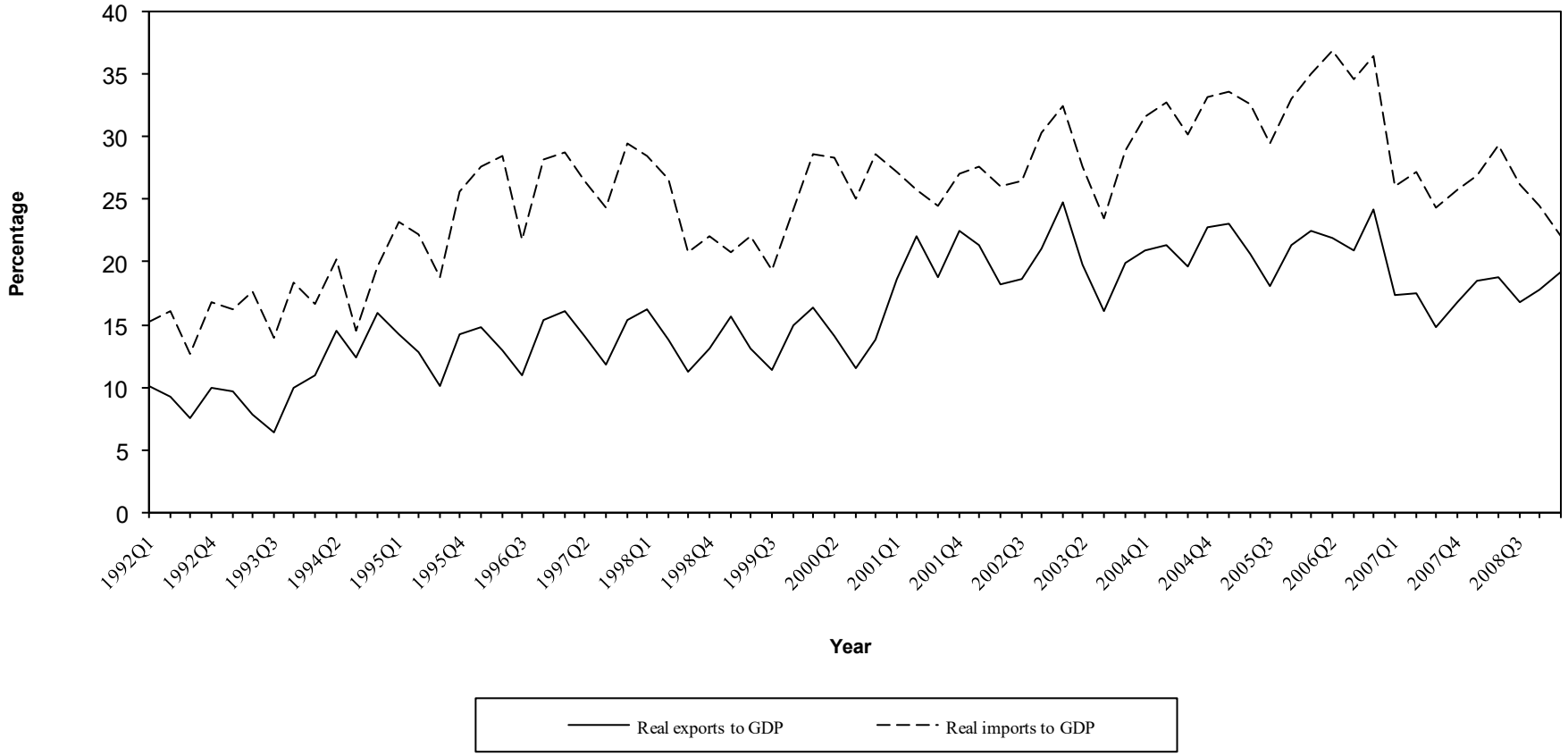
Figure 1: Turkey's real exports and imports, 1992:1-2009:1.



Notes: Exports include goods and services. Imports include goods and services as well as net interest payments and net transfer payments. All series are expressed in Turkish liras. The series are deflated by producer price index (PPI).

Source: Central Bank of Turkey

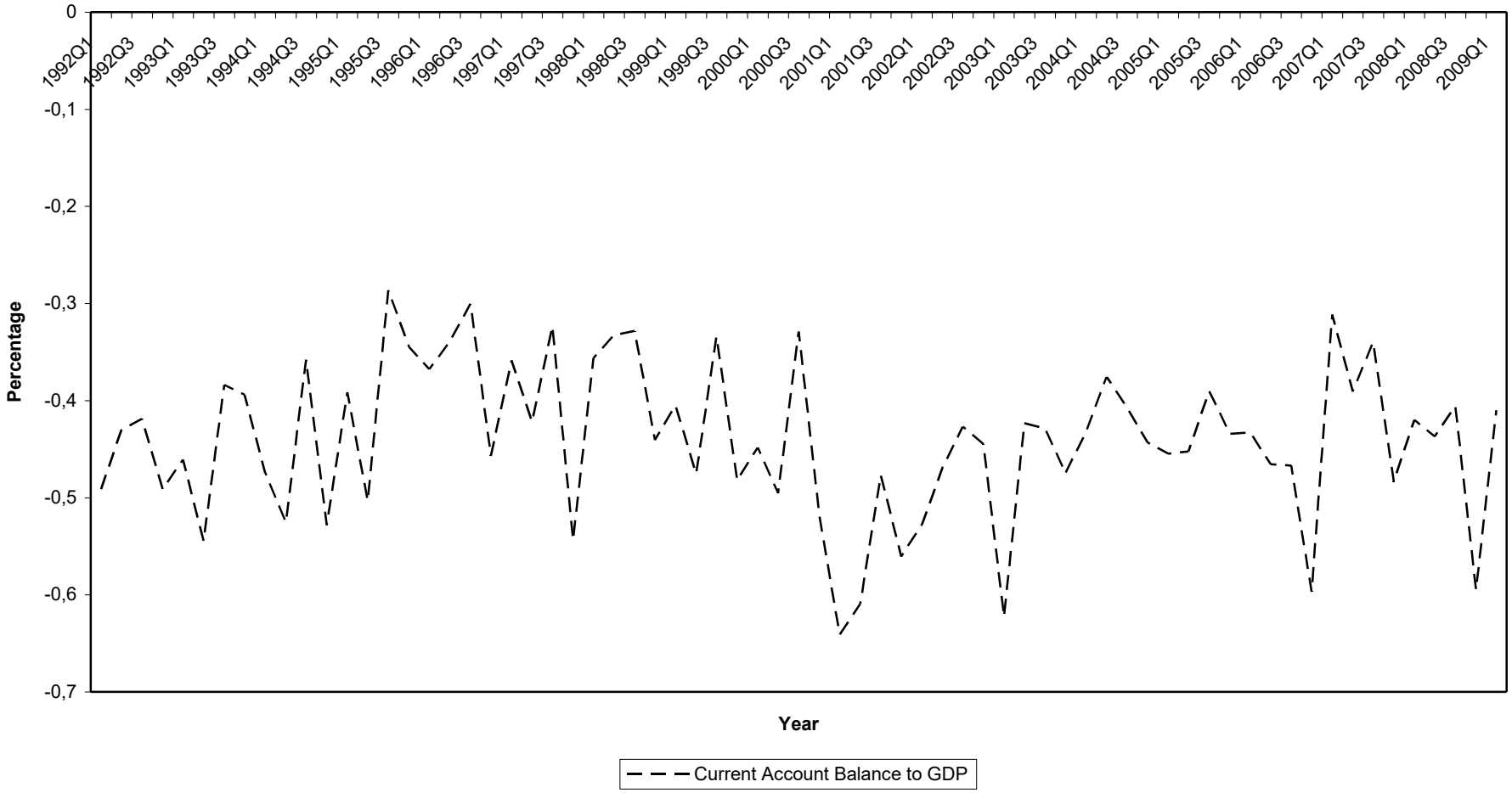
Figure 2: Turkey's real exports and imports as a ratio of GDP, 1992:1-2009:1.



Notes: Exports include goods and services. Imports include goods and services as well as net interest payments and net transfer payments. All series are expressed in Turkish liras. The series are deflated by producer price index (PPI).

Source: Central Bank of Turkey.

Figure 3: Turkey's real current account balance to GDP ratio, 1992:1-2009:1.



Note: Current account includes trade balance of goods and services, net investment income and net unilateral transfers. The series are deflated by producer price index (PPI). The series are negative; it implies a current account deficit.

Source: Central Bank of Turkey.

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