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İKTİSAT (İng.) BİLİM DALI

EN ROUTE TO IRREVERSIBLE DOLLARIZATION: A STUDY ON TURKEY

M.A. Thesis

AHMET REBİİ VATANSEVER

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Advisor: ASSOC. PROF. YASEMİN ÖZERKEK

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ÖZET

TERSİNE DOLARİZASYON YOLUNDA: TÜRKİYE ÜZERİNE BİR ARAŞTIRMA

Para ikamesi, gelişmekte olan ülkelerde yaygın olarak kullanılan bir terimdir. Örneğin, yüksek enflasyon dönemlerinde Rusya, Meksika, Arjantin ve Türkiye gibi gelişmekte olan ülkeler, yerli para birimlerini elinde tutmanın fırsat maliyeti nedeniyle döviz işlemlerinde bir değişiklik yaşamıştır. Bu dönemlerde yerli para birimi temel değer saklama ve hesap birimi ya da değer ölçüsü işlevlerinde yerini yabancı para birimlerine bırakmaya başlayacaktır. Ancak ekonomiyi etkileyen unsurlar düzelmeye başlayınca ikame süreci bir süre gerilese bile bir süre sonra yeniden artmaya başlamıştır. Bu çalışma, farklı dolarizasyon tanımları kullanarak Türkiye'de para ikamesi histerisi kavramını araştırmaktadır. Bu kalıcılığı test etmek için modele bir geçmiş dönemin maksimum değeri denilen ratchet değişkeni de eklenmiştir. Dağıtılmış Otoregresif (ARDL) Sınır Testini kullanarak, sonuçlarımız Türkiye'de bir ratchet etkisi veya histerisi olduğunu göstermektedir. Tüm ekonomi üzerinde ratchet etkisi olması, Merkez Bankası'nın para politikası yürütmesini zorlaştırmaktadır. Dolayısıyla dolarizasyonun düşürülmesi için etkin politikalara ihtiyaç duyulmaktadır. Ayrıca Türkiye ile ABD arasındaki politika faizi farkı ve beklenen para değer kaybı oranının ülkedeki dolarizasyon sürecinde önemli belirleyiciler olduğu tespit edilmiştir.

Anahtar Kelimeler: Para İkamesi, Dolarizasyon, Histeri, Ratchet Etkisi, Dağıtılmış Otoregresif (ARDL) Sınır Testi

ABSTRACT

EN ROUTE TO IRREVERSIBLE DOLLARIZATION: A STUDY ON TURKEY

Currency substitution is a term that is widely used in developing countries. For example, in periods of high inflation, developing countries such as Russia, Mexico, Argentina, and Turkey have experienced a change in their currency transactions because of the opportunity cost of holding domestic currencies. During these periods, the domestic currency will begin to be substituted with foreign currencies in its basic store of value and unit of account functions. But when factors affecting the economy began to improve, the substitution process remained in the country. This study searches for the persistence of currency substitution in Turkey using different dollarization definitions. We also add a ratchet variable into the model to test for this persistence. Using the Autoregressive Distributed Lag (ARDL) Bounds Test, our results suggest there is a ratchet effect or hysteresis in Turkey. Having a ratchet effect on the entire economy makes it difficult for the Central Bank to conduct monetary policy. Therefore, effective policies might be needed for the dollarization to be reduced. We also found that the policy rates differential between Turkey and the U.S. and the expected depreciation rate are significant determinants of the dollarization process in the country.

Keywords: Currency Substitution, Dollarization, Hysteresis, Ratchet Effect, Autoregressive Distributed Lag (ARDL) Bounds Test

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LIST OF ABBREVIATIONS

TL:	Turkish Lira
IMF:	International Monetary Fund
ARDL:	Autoregressive Distributed Lag
OLS:	Ordinary Least Squares
GMM:	Generalized Method of Moments
TurkStat:	Turkish Statistical Institute
OECD:	Organisation for Economic Co-operation and Development
CBRT:	The Central Bank of the Republic of Turkiye
NDI:	Narrow Dollarization Index
BDI:	Broad Dollarization Index
ED:	Expected Depreciation
PD:	Policy Rate Difference between Turkey and U.S.
CPI:	Consumer Price Index
ECM:	Error Correction Model
DRD:	Deposit Rate Difference between Turkey and U.S.
INT:	Interbank Rate Difference between Turkey and U.S.

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CHAPTER 1: INTRODUCTION

Currency substitution is the concept of the replacement of foreign currency over a domestic currency that could be used as a store of value, unit of account, and medium of exchange and is usually the ultimate consequence of high inflation (Calvo and Vegh, 1992)[1]. For example, in inflationary periods developing countries such as Russia, Mexico, Argentina, and Turkey have experienced changes in their monetary transactions. The literature has shown that in inflationary periods, the level of currency substitution is likely to increase because of the opportunity cost of holding domestic money. In turn, currency substitution begins with foreign currency substituting the domestic currency as a "store of value" (Calvo and Vegh, 1992). Therefore, currency substitution has been given a special interest in emerging markets. However, studies also describe dollarization as the foreign currency used as a unit of account and store of value[2]. The clear distinction between the two is that currency substitution mostly refers to the foreign currency being used as a "medium of exchange"[3]. As a result, currency substitution can be called the last step of the dollarization process.

To know the dollarization within the country, we need to know the foreign currency demand in the country. However, measuring the amount of foreign currency circulating in the country is difficult. Using a proxy for the calculation of currency substitution can be useful to give a broad understanding of the dollarization process. For instance, dollarization can be measured as dividing foreign currency deposits by total deposits, in which total deposits include TL and foreign currency (dollar) deposits. However, other definitions are used for dollarization as well[4]. These definitions only give a broad understanding of the foreign currency demand (currency substitution) in the country. Therefore, it can be said that dollarization ratios are used as an indicator of currency substitution (Calvo and Vegh, 1992).

Turkey is a country with high inflation, especially after 1970[5]. To overcome such imbalances, the Government of Turkey put precautions and reform programs after the 1970s in accordance with the IMF. However, even after these programs, high inflation rates continued and increased the demand for foreign

[1] There are other definitions for currency substitution as well. In the next section, this subject will be explained in more detail.

[2] In the literature this is called de facto or unofficial currency substitution.

[3] Some countries might decide to change their currency as a whole. This is called official or de jure currency substitution.

[4] More information can be found in the literature review section of the study.

[5] Calvo and Vegh (1992), Clements and Schwartz (1993), Feige (2003), Kamin and Ericsson (1993), Ortiz (1983), and Shinkevich and Oomes (2002) give information on dollarization in other countries.

currency. In turn, the Turkish lira started to lose its monetary functions over foreign currencies. This means that the people aimed to minimize the loss they experienced in the face value of money by converting their economic assets into foreign currency (Sarıöz, 2021)[6]. It is difficult to avoid dollarization in countries with such conditions. After the 2001 economic crisis in Turkey, with the stand-by agreement with IMF introducing several structural reforms, the Turkish economy started to recover. For example, at the end of this program, inflation decreased from double-digit figures, which lasted three decades, to single-digit figures. However, the literature on currency substitution shows that even after stabilization is achieved, de-dollarization did not occur; it continued to exist in the economy. The existence of dollarization in the economy is most likely to be a case of a hedging strategy against political tension, uncertainty, inflation, and a lack of confidence in the state of the economy. People will learn how to live with a domestic currency that loses its basic functions and high levels of inflation over time (Selcuk, 1997). This hedging strategy will create additional fixed costs arising from the change from domestic to foreign currency. When substitution costs are paid for, people have little incentive to switch back to domestic currency. These concepts unite under a single notion called Hysteresis or Ratchet Effect[7].

A "ratchet" is explained as a part of a machine, a device, that allows movement only in one direction. For instance, if a ratchet is in motion, it will prevent movement in the opposite direction. Moreover, in economic models, the ratchet effect is measured by a ratchet variable. It is a common practice to model the ratchet variable with the past peak values of the dependent or the independent variable. These past peak values will act like a mechanical ratchet that prevents the reversal. In economic models that include a ratchet variable, it is presumed that the explanatory variables will affect the dependent variable asymmetrically (Mongardini and Mueller, 2000). For instance, *ceteris paribus*, when the domestic currency depreciates, the opportunity cost of holding domestic currency increases; therefore, the foreign currency demand increases. However, when the opposite happens, the foreign currency demand decreases to a lesser extent.

The earlier studies provide enough information on the reasons and effects of currency substitution in Turkey; however, these studies do not investigate the hysteresis nature of currency substitution. Therefore, we think there is still room for studying the hysteresis nature of currency substitution in Turkey. For example, even after stabilization was achieved after the 2002 stand-by agreement by IMF, the level of dollarization maintained its course despite falling inflation and appreciating domestic currency. Therefore, this study aims to shed light on the irreversibility behavior of dollarization and its persistent state in Turkey.

[6] According to Selcuk (1997), foreign exchange deposits are strong substitutes for the Turkish Lira.

[7] Hysteresis and ratchet effect are used interchangeably.

The data consist of the years between 1990 and 2016, in which Turkey experienced high inflation levels, depreciation against other currencies, and a lack of confidence in the economy. In this research, factors affecting dollarization are tested with ARDL Bounds Test put forward by Pesaran et al. (2001), and we try to find evidence of hysteresis or ratchet effect in the country.

The rest of the study is as follows: Chapter 2 provides information on the differences between currency substitution definitions and the hysteresis nature of dollarization. Chapter 3 summarize the studies made in the currency substitution literature. Chapter 4 analyzes the journey of the Turkish economy from the republic's proclamation to the current dates. Chapter 5 is where the data and the methodology are explained. Chapter 6 is our empirical results, and Chapter 7 is the final chapter of this research.

CHAPTER 2: CURRENCY SUBSTITUTION AND HYSTERESIS

In this section, we will examine the concepts of currency substitution and its hysteresis nature. We thoroughly discuss the differences between the currency substitution definitions and then continue to explain the irreversibility of currency substitution.

2.1. Definitions of Currency Substitution

When discussing currency substitution, most economists explain it as the domestic currency losing its medium of exchange function (Alami, 2001). However, it is likely that only the other two functions of money, store of value and unit of account, are used to substitute the domestic currency. Therefore, there is confusion in the definition of currency substitution. For instance, according to Cuddington (1983), currency substitution is using a foreign currency rather than a domestic currency, indicating the loss of the medium of exchange function of money. Similar to the previous author, Kumamoto and Kumamoto (2014) describe currency substitution as domestic currency losing its medium of exchange function.

Likewise, Calvo and Vegh (1992) explain the process of dollarization beginning with the store of value, foreign currency substituting the domestic currency in the means of assets. Eventually, some prices, such as real estate, cars, and other vital items to the public, are quoted under the foreign currency, indicating the domestic currency losing the function of unit of account. The last stage of the dollarization process in which the domestic currency loses the medium of exchange function of money is called currency substitution.

Selcuk (1994) describes currency substitution as replacing domestic currency in its traditional roles with foreign currencies. On the other hand, Sturzenegger (1997) explains it as using a stable foreign currency for transaction purposes. Similar to Sturzenegger (1997), Valev (2010) describes currency substitution as using foreign currency in transactions. In addition, Elkhafif (2003) and Kheng (2020) explain it as using foreign currency as the legal tender, money that can be used legally and received by the law[8]. Elkhafif (2003) defines "partial dollarization" as the domestic currency partially substituted with foreign currencies and full dollarization as the currency substitution[9]. According to the author, under full dollarization, monetary authorities lose their functions, and partial dollarization weakens the power of monetary authorities over

[8] For example, Turkey uses Turkish Lira as the legal tender.

[9] Elkhafif (2003) declare that full dollarization is an extreme case dollarization.

markets. But some authors only deal with certain aspects of money. For example, Kim (1985) and Handa (1988) purely focus on the store of value of money in their analyses.

On the other hand, Ramirez-Rojas (1985) declared that in some countries, if the threshold of holding a foreign currency for simply tourism and international trade has been crossed, there will be severe declines in the demand for domestic currency. Therefore, the author explains currency substitution as the country's residents' demand for foreign fiat money. Also, Krueger and Ha (1995) introduce a new term entitled "co-circulation", which addresses the use of two or more currencies within the economy. For example, the authors explain that a co-circulating currency could be used as store of value as well as medium of exchange. However, according to Giovanni and Turtelboom (1992), the definitions for currency substitution explain only a little and are stuck in the narrow to broad functions of money. The authors cast doubt on the use of "substitution" and choose to differentiate between substitutability and the concept of substitution because substitutability does not imply substitution or vice versa. Lastly, Mueller (1994) distinguishes between currency substitution and dollarization. For example, according to the author, currency substitution implies a well-behaved, symmetrical and reversible substitution process. This means substitution can go both ways; domestic currency to foreign currency and foreign currency to domestic currency. However, the author declares that dollarization implies an asymmetrical process; the demand for foreign currency rises when the local currency depreciates but falls to a lesser extent when the local currency appreciates (Mueller, 1994).

In the end, it is challenging to define currency substitution. However, as in the literature, we think that examining the substitution process and its possible causes will provide a better understanding of the mechanics of currency substitution and foreign exchange demand. We also go beyond the traditional currency substitution literature and address a specific nature of currency substitution; called hysteresis. In the next section, we explain the hysteresis nature of currency substitution in detail.

2.2. Hysteresis Nature of Currency Substitution

According to Shahin and Freiha (2005), currency substitution literature is divided into two parts. Early studies examined the reasons behind currency substitution and its causes. For example, when there is a decrease in the inflation level or the domestic currency appreciates, there will be a reduction in foreign currency demand. The second group of studies examines the state of currency substitution after the reversal of the factors that have caused it. This group of studies assumes that in the process of financial innovations (switching to foreign currencies), there are some "fixed costs" associated with changing the demand for foreign currency. Moreover, if the threshold of fixed costs is breached, then the residents of the country

have little incentive to switch back their holdings to domestic currency, indicating irreversibility. This irreversibility is named hysteresis or ratchet effect.

The ratchet effect is a notion that explains the asymmetry in the reversal process that is attributed to the fixed costs of developing new monetary techniques to avoid high inflation. These new monetary techniques, also named financial innovations, include; rapid switching between demand deposits and savings deposits in domestic currency, the evolution of high-yielding or indexed money substitutes, efficient use of overdrafts, the application of portfolio optimization methods, and flight into foreign currency assets (Mueller, 1994). Once the threshold of fixed costs is crossed, if there is no significant decline in inflation or depreciation rate, then residents of the country have little incentive to switch back to domestic currency. This asymmetric behavior is attributed to the ratchet effect, acting as a mechanical "ratchet" representing the irreversible state of the demand for both domestic and foreign currencies.

Following Valev (2010), the ratchet effect literature focuses on two sub-categories: expected depreciation of the domestic currency and network externalities. Expected depreciation indicates that foreign currency will be preferred because it will be more reliable in the case of instability. Furthermore, even after the economy becomes stable, foreign currency continues to be used because agents remember past economic fluctuations and act accordingly. On the other hand, network externalities occur when the benefits for a given agent of holding a certain currency increase with the use of this currency by other agents (Shinkevich and Oomes, 2002). For instance, if the use of foreign currency is accustomed, people will choose the one that is mostly used in the economy. Moreover, even if the economy gets stabilized, the use of foreign currency will not stop. This means that foreign currency has taken root in the economy's core. According to Feige and Dean (2004), if network externalities are sufficiently large in the economy, some countries might decide to dollarize their economies fully. These two factors, network externalities and depreciation expectations trigger the ratchet effects. However, there have been disputes about which one affects substitution more. For example, it has been stipulated that network effects should not substantively affect deposit substitution (Calvo and Vegh, 1992; Ize and Yeyati, 2003), while they should affect the extent of currency substitution.

Moreover, we assume that economic agents prefer to use foreign currency because it will be more dependable in the case of an economic disturbance. Therefore, in this study, we only deal with the side of expected domestic currency depreciation through the ratchet effect. To compute the ratchet effect, we create a "ratchet variable". This variable is modelled as the past peak values of the independent or the dependent variable. For example, past peak values of inflation, depreciation rate, and dollarization ratio itself are

widely used ratchet variables in the literature. When this variable is found to be a significant explanatory factor, it is interpreted as evidence for the ratchet effect.

CHAPTER 3: LITERATURE REVIEW

The literature on currency substitution is studied extensively in developing countries. For example, Russia, Mexico, and Argentina are countries that are known to have high inflation and dollarization rates. However, data limitations on the stock of foreign currency circulating in the economy are a great obstacle because it makes it harder to differentiate between asset and currency substitution. Nonetheless, using an indicator for currency substitution can be useful to give us a broad understanding. However, Calvo and Végh (1992) discuss the issues of using such proxies, shed light on developing countries as a whole, and give an introduction to currency substitution. Moreover, the authors rather give a sceptical look at using proxy data for dollarization. For example, authors argue that using M2 money supply and foreign currency deposits might be capturing asset substitution rather than currency substitution. Also, according to the authors, even if the data were capturing the effects of asset substitution, there would be specification problems due to hysteresis. Authors conclude that econometric tests can only be used for testing the "importance" of dollarization. However, most authors use dollarization indices based on foreign currency deposits. For instance, Doguwa (2016) crates a ratchet variable and applies it to Nigeria. The author found a short-run ratchet effect in place for Nigeria in both narrow and broadly defined currency substitution models; however, there is no such effect in the long run. Ponomarenko (2015), on the other hand, uses the deposit dollarization index and attempts to find an equilibrium point for deposit dollarization in Russia. The study suggests that if the threshold of deposit dollarization is exceeded and exchange rates are stable, there will be convergence to a higher equilibrium level. Additionally, Corsen (2011), using OLS and GMM, studied the route of dollarization in Curaçao and generated five different regressions. Unlike other studies, however, the author adds additional variables such as government deficit, the balance of payments, and two ratchet variables to capture confidence in the national currency's stability. The study found hysteresis in Curaçao and gave suggestions about the economic policies that can be taken.

Clements and Schwartz (1993) search for irreversibility in the currency substitution process in Bolivia. The authors suggest that residents in Bolivia are indeed adaptive to the changes in expected depreciation and interest rate differences. However, they conclude that "inertial" factors are far more important because inertia suggests an asymmetry in currency substitution. In addition, Shahin and Freiha (2005) tested for hysteresis in the Middle East and North African countries, choosing Egypt and Lebanon as case studies. They have concluded that Egypt has successfully reversed currency substitution; however, the latest occurrences have caused the re-emergence of dollarization, indicating it was only a temporary process. On the other hand, Lebanon has shown the characteristics of hysteresis in its currency substitution

process. Even though expectations of inflation and depreciation rate decreased, the dollarization ratio did not diminish by the anticipated amount.

Most studies continue to employ proxies that are widely used in the literature. However, some authors took alternative approaches to the calculation of dollarization. For instance, Kamin and Ericsson (1993) take into account the problems in Argentina and create a new type of measurement for currency in circulation based on recorded U.S. dollar flows. They found that Argentina's residents hold more foreign currency than generally believed; there is a ratchet effect in motion in Argentina, and a decrease in the demand for pesos reflects substitution into dollars. The authors agree with the former study and assert that using dollar deposits in analyzing currency substitution could be misleading because they are subject to short-run trends. Following Kamin and Ericsson (1993), Shinkevich and Oomes (2002) developed a model in which they used the recorded flows of U.S. dollar currency between the USA and Russia (Currency and Monetary Instrument Reports). The authors reached the same conclusion; using foreign currency deposits to create an index undermines the importance of dollarization. In addition, they take a further step and take network externalities into account. In light of network externalities, the authors develop a new theoretical model. Observing multiple steady-states in their model, the authors suggest that observed hysteresis could indicate a "phase transition" from a low to a high level of stable state-state. Finally, their paper ends with a summary affirming the non-existence of dollarization hysteresis in Russia.

Mongardini and Mueller (1999), on the other hand, used daily data of foreign currency flows through foreign exchange bureaus to compare with foreign currency deposits and found in the Kyrgyz Republic, there is a ratchet effect but only in the case of deposits. However, they also warn that results should be approached with caution because of the impact of the Russian crisis, and results only explain a small percentage of the currency substitution. In addition, Feige et al. (2003) created two dollarization indices; a broad dollarization index that includes the recorded flows of U.S. dollar currency between the USA and South American countries and the conventionally used dollarization index. The authors declare that the common way of calculating dollarization underestimates the extent of currency substitution in every South American country, and Argentina has the highest per capita holdings of the U.S. dollar. Moreover, the authors search for network externalities in Argentina and conclude that the high levels of dollarization reached a threshold that made dollarization irreversible.

There are authors that research network externalities as well. For example, Reding and Morales (2004) searched for hysteresis in Bolivia, a Latin American country with high dollarization rates. The authors declare that their analysis indicates hysteresis; dollarization did not show characteristics of reversal.

However, according to the authors, the variables chosen for explaining hysteresis in Bolivia are not enough. Therefore, the model also includes network externalities to explain the hysteresis in Bolivia. They declare that network externalities create "bandwagon" effects, and agents become increasingly drawn to the "network" of dollar users. Therefore, if network effects are strong, there will be path-dependent multiple steady states in the country. In turn, this implies that hysteresis is not only dependent on variables such as inflation, expected depreciation, or interest rate but the history of the network.

In Turkey, the literature on currency substitution is studied extensively because of the prolonged high inflation levels. However, because of data limitations, the dollarization index is usually calculated with foreign currency deposits. For example, Us (2003), following the steps of Mongardini and Mueller (1999), created sub-periods and tried to find evidence for the ratchet effect in Turkey. Results indicate that there might be hysteresis in the narrow-defined dollarization; however, it is not captured in the broad sense. In addition, Ozcan and Us (2007) try to find evidence of for de-dollarization process in Turkey. The authors found that dollarization continues to persist, and it is still too early to conclude a de-dollarization occurrence in Turkey. Freitas (2003), on the other hand, chose three countries, Bolivia, Turkey, and Indonesia, which have different inflation and dollarization levels. Using different econometric methods, the author found a ratchet effect for all countries. Finally, Civcir (2005) analyzes the long-run dollarization process in Turkey with an extended portfolio model. The study concludes that having a positive linear trend and a small magnitude of error correction coefficient in the results could indicate the existence of a ratchet effect in Turkey. However, when a ratchet variable was added to the model, it was insignificant. Yet, the author concluded that the previous month’s foreign currency holdings have strong effects on current months, and low magnitudes of error correction term could indicate a dollarization “inertia” in Turkey.

Earlier studies of currency substitution give sufficient evidence of the route of Turkey. However, even though there are discussions on whether Turkey is in the irreversibility stage or not, we still think that there is still a gap to fill in these studies. This thesis follows a similar approach in the literature on currency substitution. We continue using the assumptions of Mongardini and Mueller (1999) to create the model. We think having a large time interval will give a better result overall for Turkey. Moreover, applying different proxies for checking the hysteresis nature of currency substitution, using different models of money demand and econometric methodologies reveals the importance and originality of the papers in the literature.

CHAPTER 4: TURKISH ECONOMY IN RETROSPECT

We divided Turkey's economic history into two stages: Before 1980 and after 1980[10]. This distinction is usually made because, before 1980, the economic status of The Republic of Turkey was considered a closed economy with statist policies. After 1980, the neoliberal transition of Turkey's economics easied the statist environment in Turkey. For example, financial liberalization, structural reforms, and an open economy were adopted for the whole country's well-being.

4.1. Before the 1980s

The fate of the early Turkish economy was determined in Izmir Economic Congress, which was held in 1923. In the nationwide congress, every electoral district would select a maximum of eight delegates, choosing one representative each for banking, business, industry, labour, and handicrafts, and three for agriculture (Finefrock, 1981). The reason was to include everyone in the economic progress and create a bridge between the government, merchants, the people, and owners of the means of production. However, Economic Congress gathered with the attendance of only 1135 delegates (Takim and Yilmaz, 2010)[11]. Even though decisions were taken in congress, until 1929, the Treaty of Lausanne was an obstacle to implementing independent economic policies (Dogruel and Dogruel, 2006). Therefore, it was difficult to conduct a protectionist policy. Nevertheless, it was essential to show the world that Turkey would give great importance to the country's economic progress.

The year 1929 was a major turning point for the world because of the Great Depression. The severe economic crisis started in the United States and spread to other countries. For example, the world trade volume decreased severely, unemployment in the U.S. and the rest of the world increased, stock market prices crashed, and most importantly, agricultural commodity prices fell sharply (Bernanke and Parkinson, 1991). For instance, the price of wheat decreased by sixty-eight percent between the years 1929 to 1932 in Turkey (Boratav, 2015). To fight the effects of the depression in Turkey; the main purpose was to create a strong environment with import substitution and a closed economy; empowering the weak state of the production industry, fighting the effects of the depression, and attaining the need for employment[12].

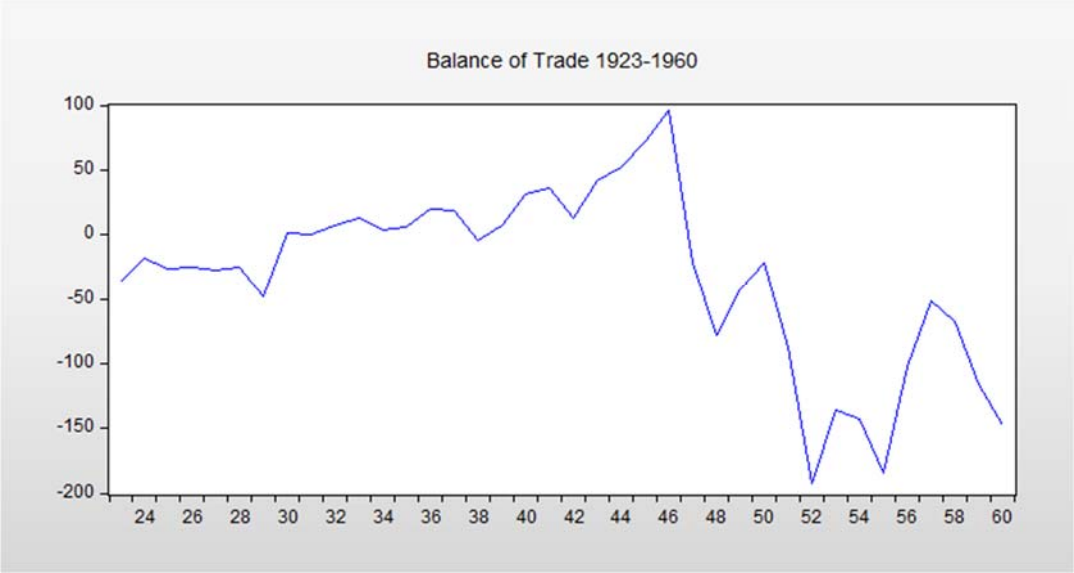
[10] We loosely follow the steps of Dogruel and Dogruel (2006), in which they started the second period in the middle of the 1970s.

[11] The fact that the worker and industrialist sectors are not formed enough yet and the delegates having difficulties in obtaining carfare have been effective in these numbers in Turkey (Alpay and Alkin, 2020).

[12] The years between 1930-1932 were the years of adaptation to protectionism. In the year of 1934 with the First Five-Year Industry Plan, protectionism was fully embraced and set into motion.

However, the rise of tension in the world, the start of the Second World War, increased Turkey's imports between 1945 and 1960 (Figure 1).

Figure 1: Balance of Trade between the years 1923-1960

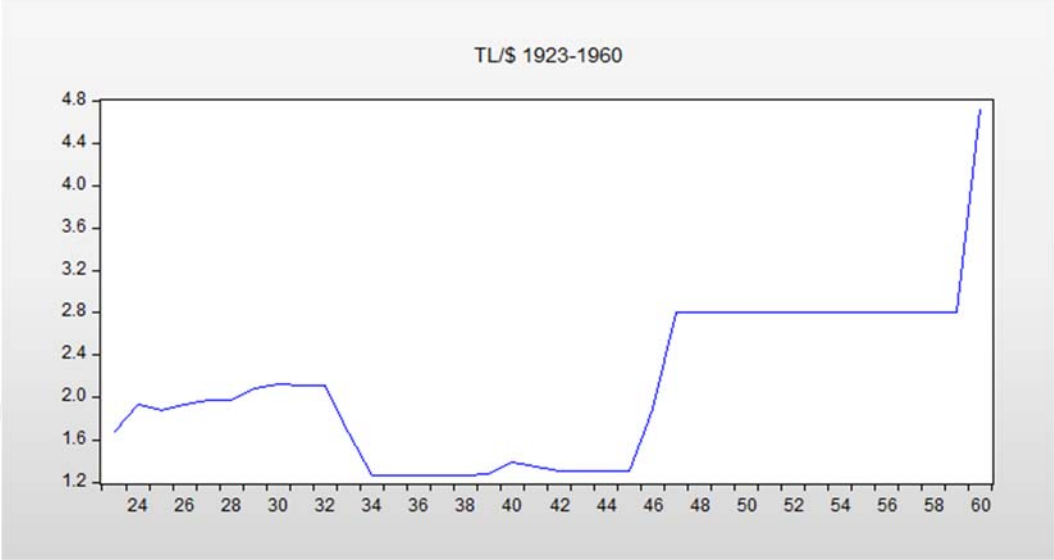


Source: TurkStat, Statistical Indicators 1923-2013

In the post-war world, Turkey joined the International Monetary Fund and World Bank and embarked on more liberal economic policies. In this period, closed, protectionist, and inward-looking economic policies were gradually eased; imports increased, the trade deficit became chronic, and the economic structure that survived with foreign aid with loans and foreign capital investments was settled (Boratav, 2015). Moreover, with the increase in the trade deficit, debt problems arose in the economy, foreign exchange reserves were depleted, and created shortages in food supply and investments. Especially the use of "import loans" increased imports and trade deficit even more, thus, creating further pressure. The import credit implementation eventually resulted in Turkey's inability to pay its foreign commercial debts made Turkey go on a moratorium (Kazgan, 2006). As a result, in 1958, Turkey experienced a currency crisis, and the Turkish lira lost more than twice its value to the U.S. dollar (Figure 2)[13]. In the end, this period ended with the military coup on 27 May 1960.

[13] In 1958 before devaluation 1$ = 2.80 TL. After devaluation, in 1961, 1$ = 9 TL.

Figure 2: TL/$ Rate between the years 1923-1965



Source: TurkStat, Statistical Indicators 1923-2013

After the military coup, State Planning Organization was established. This organization was responsible for the First, Second, and Third Five-Year Development Plans (1963-1967, 1968-1972, and 1973-1977, respectively). These plans set mandatory aims for the public, guided the private sector, and aimed to make the Turkish economy grow rapidly at a steady state. For example, the first development plan saw the Government as the regulator for public investments and import substitution. On the other hand, in the second and third development plans, the function of the government is limited to subsidies and assistance to the private sector (Boratav, 2015). However, decreasing rates of foreign exchange getting into the country because of the recession in Europe, increasing rates of the budget deficit and price of oil; deterioration of the balance of payments; the military operation to Cyprus, embargos, and international political turmoils made the economy even more fragile.

Moreover, Turkey created further economic fragility by introducing "Convertible Turkish Lira Deposits" to encourage Turkish workers abroad to keep some of their savings in Turkey and obtain much-needed foreign currency for imports (Ayarslan, 1979). This account could be opened by banks (only those who are authorized) and natural and legal persons who live abroad or in the country[14]. Notably, high levels of interest rates were appealing and had high returns. The state had given currency guarantees to these accounts; the risk arising from exchange rate changes until the debt was paid belonged to the state (Kazgan,

[14] There were 8 banks that were big enough: Ziraat Bank, İş Bank, Akbank, Vakıflar Bank, Garanti Bank, Yapı ve Kredi Bank, Turkish Trade Bank, Osmanlı Bank (Kazgan, 2005).

2005). Moreover, when it was time to pay off these short-term debts, the Turkish Government could not repay its liabilities. This period ended with the Turkish military army seizing power on September 12, 1980. Turkey has suffered the consequences of these economic crises through the breakdown of democratic regimes and their replacement by highly repressive military regimes (Öniş and Şenses, 2007).

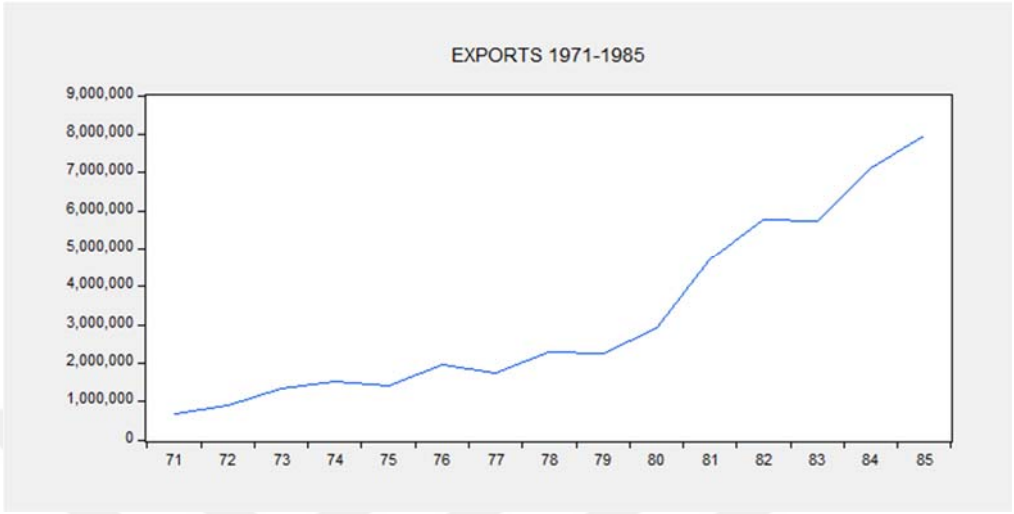
4.2. After the 1980s

Increasing inflation, government debts, political turmoils, economic crises, and other increasingly deteriorating economic indicators are the important events that describe the second half of the 1970s. To overcome the problems arising, on 24 January 1980, a new stabilization and liberalization program was announced. The program consisted of taking control of inflation, reducing the external deficit, improving and disciplining resource allocation and public finance; conducting strong structural reforms to make the country self-sufficient and sustainable; creating a liberal and open economy for the prices to be determined in the market, export-oriented industrialization rather than import substitution, flexible exchange rate policy and selling domestic debt securities to banks and individuals through auctions (Pamuk, 2020). In addition, foreign currency deposits were introduced to discharge the public's foreign exchange holdings (under-the-mattress savings) into the market.

On the international platform, the program was well-received. Especially the good relations with the IMF, World Bank, and NATO increased Turkey's credibility and, in turn, have provided new credits and debt restructuring. This way, Turkey could meet both its foreign exchange needs and investments. Especially good and strong relations between European Union and Turkey greatly impacted these numbers. In addition, after the program was announced in 1980, industrial exports skyrocketed from 1980 to 1990 (Figure 3 and Figure 4)[15].

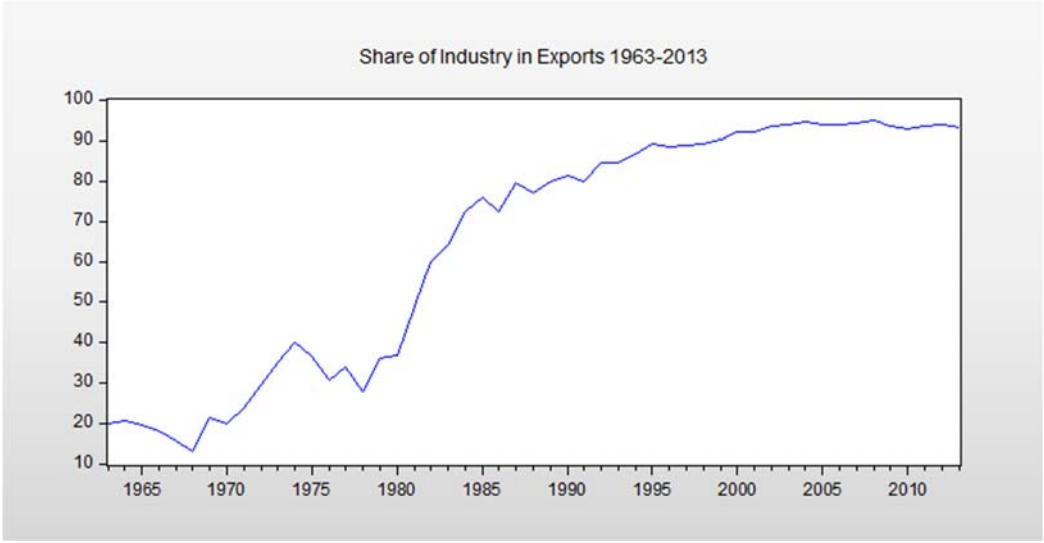
[15] Exports in the late 1970s mainly consisted of agriculture and industry production, but the leading export was agriculture. However, after 1980 leading export is industrial production.

Figure 3: Exports of Turkey between the years 1971-1985



Source: TurkStat

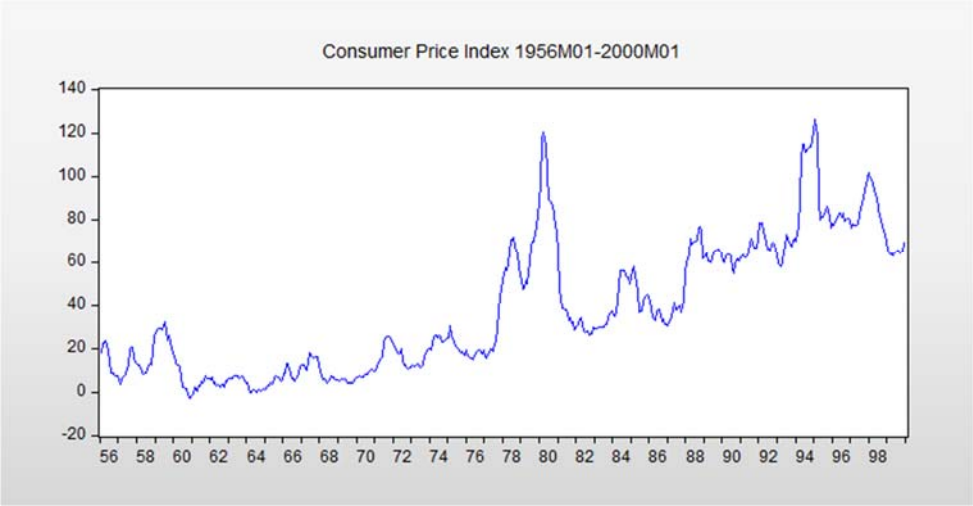
Figure 4: Industry percentage in exports between the years 1963-2013



Source: TurkStat, Statistical Indicators 1923-2013

The program was also, to some degree, successful in decreasing the inflation rate. For example, in 1980, with fast-paced devaluations, inflation reached triple-digit heights, but it was reduced from 30% to 40% in the first half of the 1980s, yet it was only temporary. In the second half of the 1980s, inflation began to climb (Figure 5). The contrast between the variables of the real economy, which all show definite signs of improvement, and the behaviour of prices, which only seem to increase, justifies the contention that high persistent inflation is the puzzle of the Turkish economy (Akat, 2000).

Figure 5: Consumer Price Index of Turkey between the years 1956M01-2000M01



Source: OECD

In the meantime, Turkey was experiencing a new phenomenon called "stagflation"; high inflation and unemployment rates (Figure 6). This phenomenon created a dilemma for economic policy; the decisions to lower inflation most likely aggravate the unemployment rate. This phenomenon was followed by a series of economic crises; 1991, 1994, 1998-1999, and 2001. It is evident that dollarization reached new heights in these times; for example, between 1991 and 2004, dollarization in the country reached its highest level, almost reaching 70% (Figure 9). This meant that the country's demand for foreign currency was high to avoid the risk of holding domestic currency.

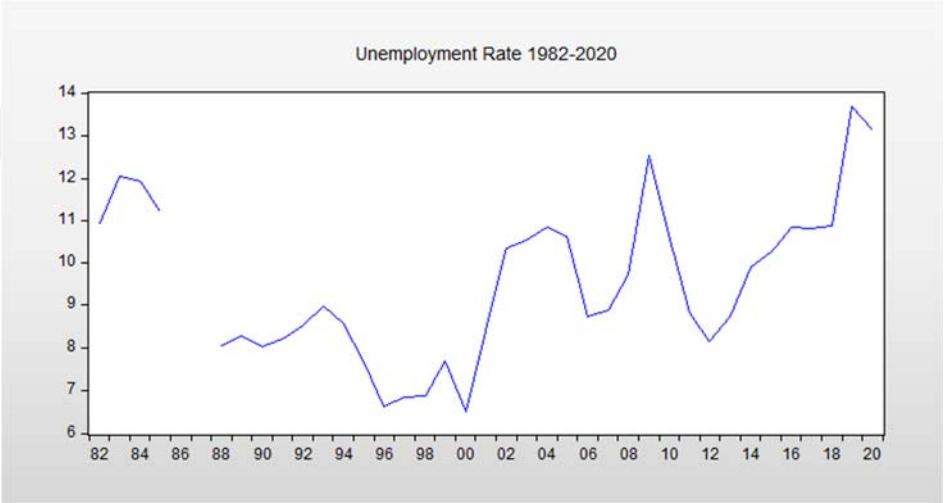
After the general election in 1999, the Turkish government and IMF came to a stand-by agreement. This agreement was to decrease the high inflation levels in addition to new structural reforms. However, this program lasted relatively short because of the crisis in 2001. The program applied for an "exchange rate stabilization program" in which the exchange rate is treated as a nominal anchor[16]. According to the program, the Central Bank moved from a "managed float" to a pre-announced exchange rate path against a currency basket composed of a weighted average of the euro and the US dollar (Aytac, 2007)[17]. The program succeeded at decreasing inflation, nominal interest rates and appreciating the currency. For instance, Figure 9 shows the rapid appreciation of the Turkish Lira from 1998 to 2000; Figure 10 clearly shows the

[16] According to Sobolev (2000), in incomplete markets these programs could result in rapid expansion of bank credits financed by short-term capital inflows, currency overvaluation, and current account deficits that would generate in financial fragilities and make the economy vulnerable to a small shock that would trigger banking crises (Sobolev, 2000).

[17] More information on exchange rate stabilization can be found in Sobolev (2000), Eichengreen (2002), Aytac (2008), and Gokkent et al. (2003).

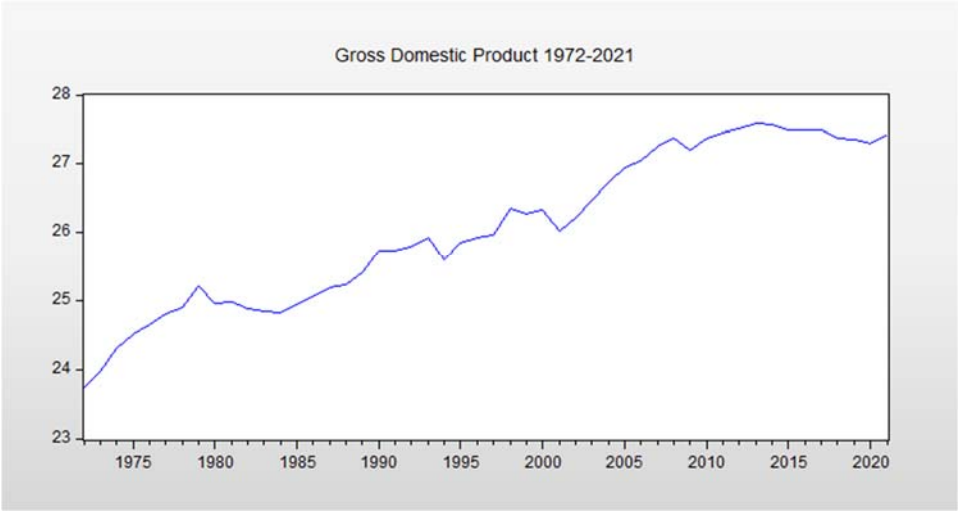
decreasing path of the CPI between 1998 and 2000. On the other hand, Figure 9 shows a slow transition to the Turkish Lira initially; however, dollarization is still high. In the end, the Turkish economy was severely damaged by capital outflows. In 2001, Turkey entered a full-fledged crisis in which a deeply weakened economy was hit drastically. For example, the banking system collapsed and led many banks to bankruptcy; the economy shrank, there were sharp decreases in production and labour sectors, and the Turkish Lira lost its value against other currencies.

Figure 6: Unemployment Rate between the years 1982-2020



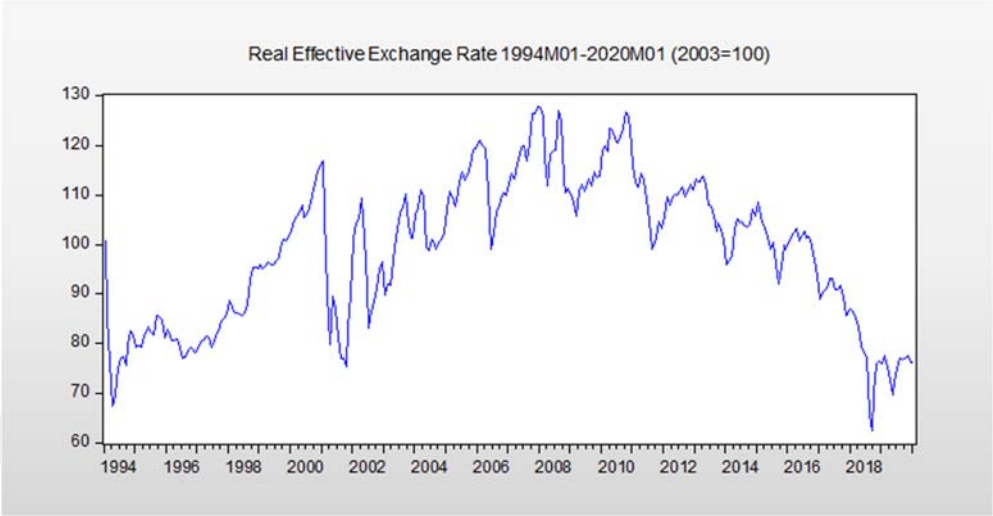
Source: World Bank

Figure 7: Gross Domestic Product between the years 1972-2021



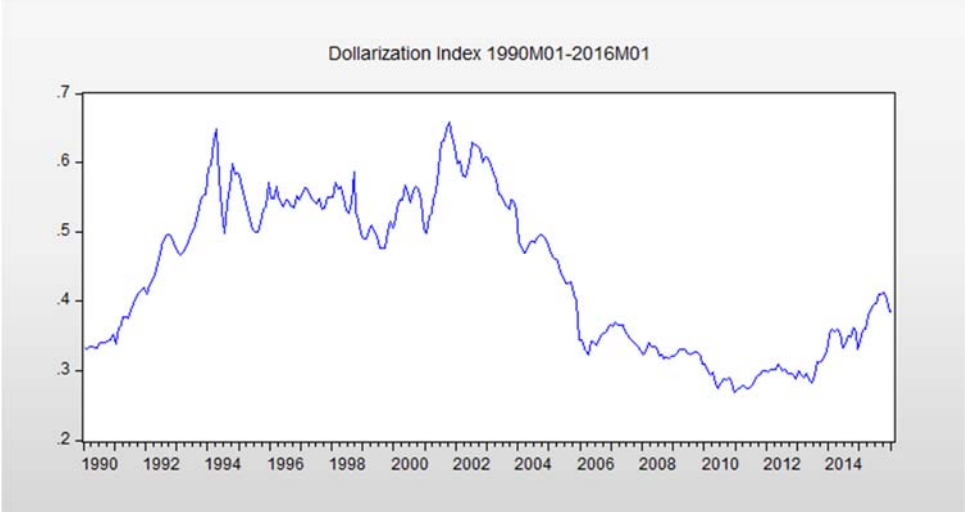
Source: TurkStat

Figure 8: Real Effective Exchange Rate between the years 1994M01-2020M01



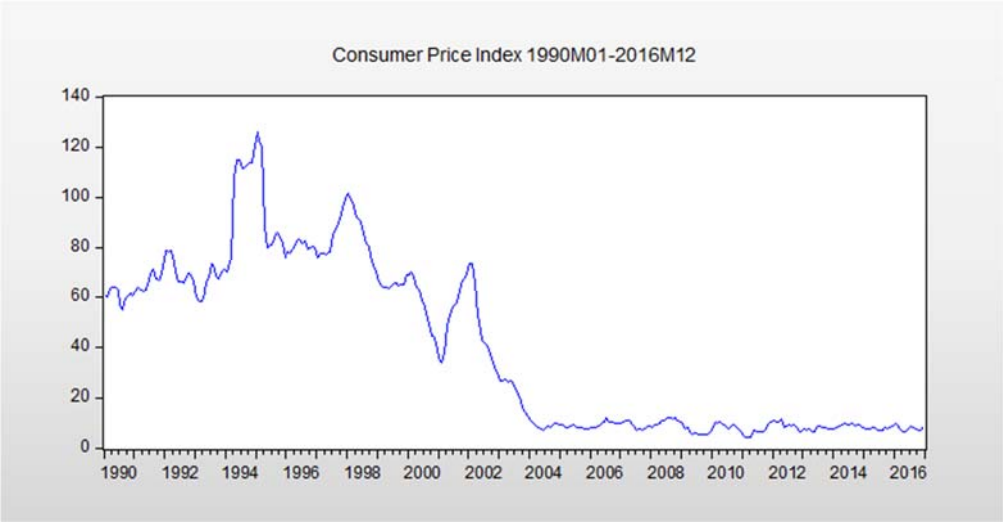
Source: The Central Bank of the Republic of Turkiye

Figure 9: Dollarization Index between the years 1990M01 to 2016M12



Source: Author's calculation

Figure 10: Consumer Price Index of Turkey between the years 1980M01-2016M12



Source: OECD

After the crisis in 2001, Turkey made another agreement with the IMF, which covered the issues of structural reforms, long-run stability of inflation and budget deficit, independence of the Central Bank, and restructuring of the banking system, which had played a crucial part before/in the crisis. For example, "bad" banks were taken over by Savings Deposit Insurance Fund. They were excluded from the system, overnight borrowing of these excluded banks was reduced, and some were merged, recapitalized, or sold. Moreover, accumulated debts of the Treasury to the state-owned banks were paid and recapitalized (Ozatay and Sak, 2002). The success of the ongoing program made the economic outlook optimistic. Inflation was under control and had a decreasing trend after almost four decades. On the other hand, dollarization successfully declined thanks to the decreasing inflation and depreciation rates; however, despite its decreasing trend, dollarization was still present in the country. For example, the base value for the dollarization rates was somewhere between 20% to %30 (Figure 9)[18].

Getting close to the global crisis in 2008, which shook the world deeply, the growth rates of the Turkish economy indicated a decreasing path. When the crisis spread to other countries from the U.S., it affected the world deeply, especially the countries of Southern Europe. With the biggest export partners in crisis, it was inevitable for the Turkish economy to have reductions in growth rates, industrial production and employment[19] (Figures 6 and 7).

[18] Although it is debatable at what value an economy is decided to be highly dollarized, Balino et al (1999) declares that highly dollarized economies should have a dollarization rate of more than 30%.

[19] Germany, the United Kingdom, Italy, France, the United States, and Spain were in the top ten countries Turkey exported to.

In this section, we tried to give a broad understanding of the economic history of Turkey, and it can be seen that Turkey is a developing country with high inflation rates. Therefore, we think that as a natural behaviour against high inflation, residents of the country tried to protect themselves and avoid the risk of holding domestic currency. As in the words of Dogruel and Dogruel (2006), inflation received a negative reaction from society in general when price increases became a permanent part of daily life. Especially with the liberalization of both the foreign exchange regime and financial assets over the 1980s and 1990s, new financial instruments like mutual fund shares, corporate finance bills, treasury bills, and asset-backed securities were introduced as alternative domestic assets and led to enlarging opportunities for obtaining foreign balances (Başkurt, 2005). This, in turn, canalized a significant increase in the demand for foreign currencies since residents tried to protect their wealth against high inflation. In inflationary periods domestic currencies start to lose their properties of money, unit of account, store of value and in the end, medium of exchange. For example, strong currencies, the Deutsche mark and the U.S. dollar were partially "substituting" the place of the Turkish lira. The people assumed they were fully protected from the effects of inflation even though the government put precautions to hold against the rising of dollarization.

CHAPTER 5: DATA AND METHODOLOGY

After a brief explanation of the history of the Turkish economy, we continue with a detailed analysis of the data and the methodology used in this research. With the variables and model used in this analysis, we will investigate the existence of hysteresis in Turkey.

5.1. Data

All of the series are monthly, and data covers the years from 1990:01 to 2016:09. Data consists of Broad Dollarization Index, Narrow Dollarization Index, Expected Depreciation of Exchange Rate, Difference Between Policy Rates for Turkey and the U.S., and a Ratchet Variable generated from the Consumer Price Index. In addition, for the purpose of comparison, we use Deposit Rate Difference between the Turkish Lira and U.S. Dollar; and Interbank Difference between Turkey and the U.S. Also, we create other ratchet variables, past peak values of the expected depreciation and dollarization ratio itself, to test the existence of ratchet effects in Turkey.

5.1.1. Dollarization Indices

Currency substitution is measured by the foreign currency in circulation in the country. However, since it is not possible to know the state of foreign currency circulating in the country, we will be using a proxy that consists of foreign currency deposits in the banking system. This proxy will give a general idea of the level of *de facto* dollarization. Two types of dollarization measures are used; foreign currency deposits over total deposits in the narrow sense and foreign currency deposits over the M2 money supply in the broad sense[20]. They can be shown as:

$$\text{NDI} = \frac{\text{Foreign Currency Deposits}}{\text{Foreign Currency Deposits} + \text{Turkish Lira Deposits}} \tag{1}$$

$$\text{BDI} = \frac{\text{Foreign Currency Deposits}}{\text{M2}} \tag{2}$$

where NDI is the Narrow Dollarization Index, and BDI is the Broad Dollarization Index.

[20] These data are taken from The Central Bank of the Republic of Turkiye.

5.1.2. Expected Depreciation of Exchange Rate

The number of proxies used for the expected exchange rate is extensive in the literature. For example, Ortiz (1983) indicated that when the real return on foreign currency is equal to the real return on foreign currency holdings plus the expected rise in the peso price of a dollar, a clear proxy could be the difference between spot and real exchange rates. Cuddington (1983) used the difference between forward and spot exchange rates to spot exchange rates. Akçay et al. (1997) used a two-currency model of exchange rate determination under currency substitution and created an exchange rate volatility series based on a multi-currency version of Purchasing Power Parity. In addition, to measure expected depreciation, Ozcan and Us (2007) impose the restriction that forward transactions of the agents reflect their expectations of the future, thus, assumed that the uncovered interest rate parity is equal to the covered interest rate parity. In this study, we will calculate the expected depreciation rate as the difference between the official (spot) and real exchange rates. Finally, we calculate the real exchange rate as follows:

$$Real\ exchange\ rate\ (R): \frac{e * P^*}{P} \tag{3}$$

where e is the exchange rate between Turkey and U.S.; P^* is the inflation rate in the country, and finally, P is the inflation rate in the U.S.[21]. This variable will reflect the depreciation expectations of the residents of Turkey.

5.1.3. Interest Rate Difference between Turkey and U.S.

Interest rate difference measures the difference between two similar assets, implying the opportunity cost between domestic and foreign currencies. For example, Clements and Schwartz (1993) suggest using the difference between domestic and foreign currency deposit rates in the banking system; Ozcan and Us (2005) use 1-month time deposits and foreign exchange. On the other hand, Mongardini and Mueller (2000) use interest rate difference between equivalent treasury bills, and Ju (2020) uses the difference between the domestic interbank offered rate and Libor. To follow a different path from other analyses, we will mainly use the difference between the policy rates between Turkey and the U.S. to measure the interest rate's effect on dollarization[22]. Then, we will also use the other proxies mentioned above in our analysis.

[21] Then, we take the log of the difference between real and official exchange rates.

[22] The policy rate of Turkey is the 1-week repo rate and the policy rate of the U.S. is the federal funds rate.

5.1.4. Inflation - Ratchet Variable

In addition, we add a ratchet variable to the model. When this variable is present in an economic model, it is presumed that the explained variable behaves asymmetrically to changes in one of the dependent variables (Us, 2003). This means that the past peak values are remembered by the residents and have long-term effects on dollarization. The ratchet effect in these models is usually accounted by including the past peak value of the independent or, in some cases, dependent variable (Mongardini and Mueller, 2000). In the literature, there are a few ways of creating such a variable: past maximum inflation rate, peak depreciation rate of the domestic currency, or past peak values of the dollarization ratio itself. For example, Civcir (2005), Tasdemir (2003), and Ponomarenko (2015) use the maximum rate of depreciation; Doguwa (2016), Kamin and Ericsson (1993) use the maximum inflation rate; and, Mongardini and Mueller (2000), Us (2003) and Ozcan and Us (2005) use the dollarization ratio itself for creating ratchet variable. In addition, rather unconventionally, Corsen (2011) uses two ratchet variables in the model; maximum inflation and interest rate. If this variable is significant in the analysis, it is said that there is a ratchet effect or irreversibility of dollarization in the country. Therefore, for the reason of inflation rate dynamics in Turkey, we will use a ratchet variable generated from the consumer price index series[23]:

$$\text{RatchetCPI}_t = \max \text{CPI}_i \qquad (i = 0,1, \dots, t) \tag{4}$$

The basic summary statistics are in Table 1, and the graphs of the variables are in Figure 11 and Figure 12 below. These results are essential for the initial analysis of the data set.

Table 1: Descriptive Statistics

	BDI	NDI	ED	PD	RatchetCPI
Mean	0.35	0.44	-1.51	0.39	1.17
Median	0.35	0.43	1.66	0.31	1.26
Maximum	0.59	0.66	6.79	3.95	1.26
Observations	321	321	321	321	321

The graphics for the variables can be seen below:

[23] We will also create above-mentioned ratchet variables and test them in the model as well.

Figure 11: Broad and Narrow Dollarization Index

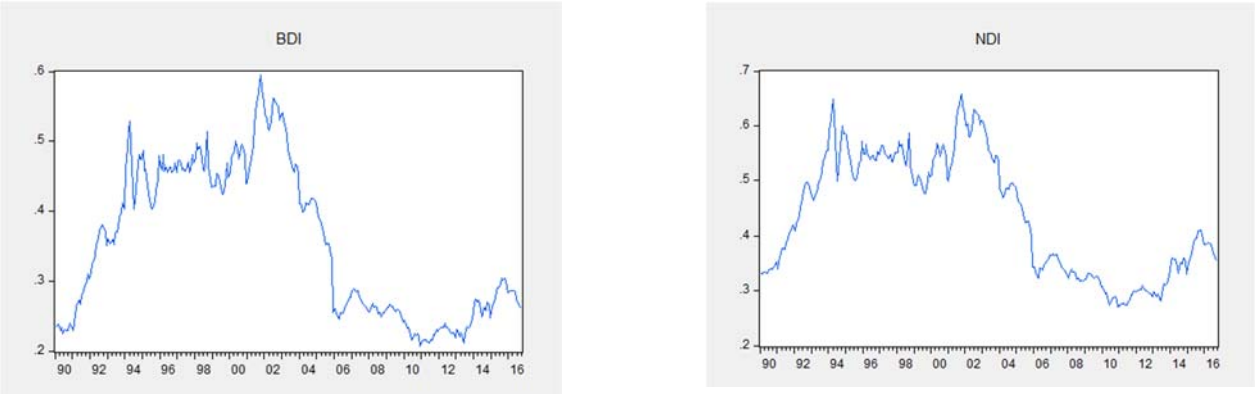
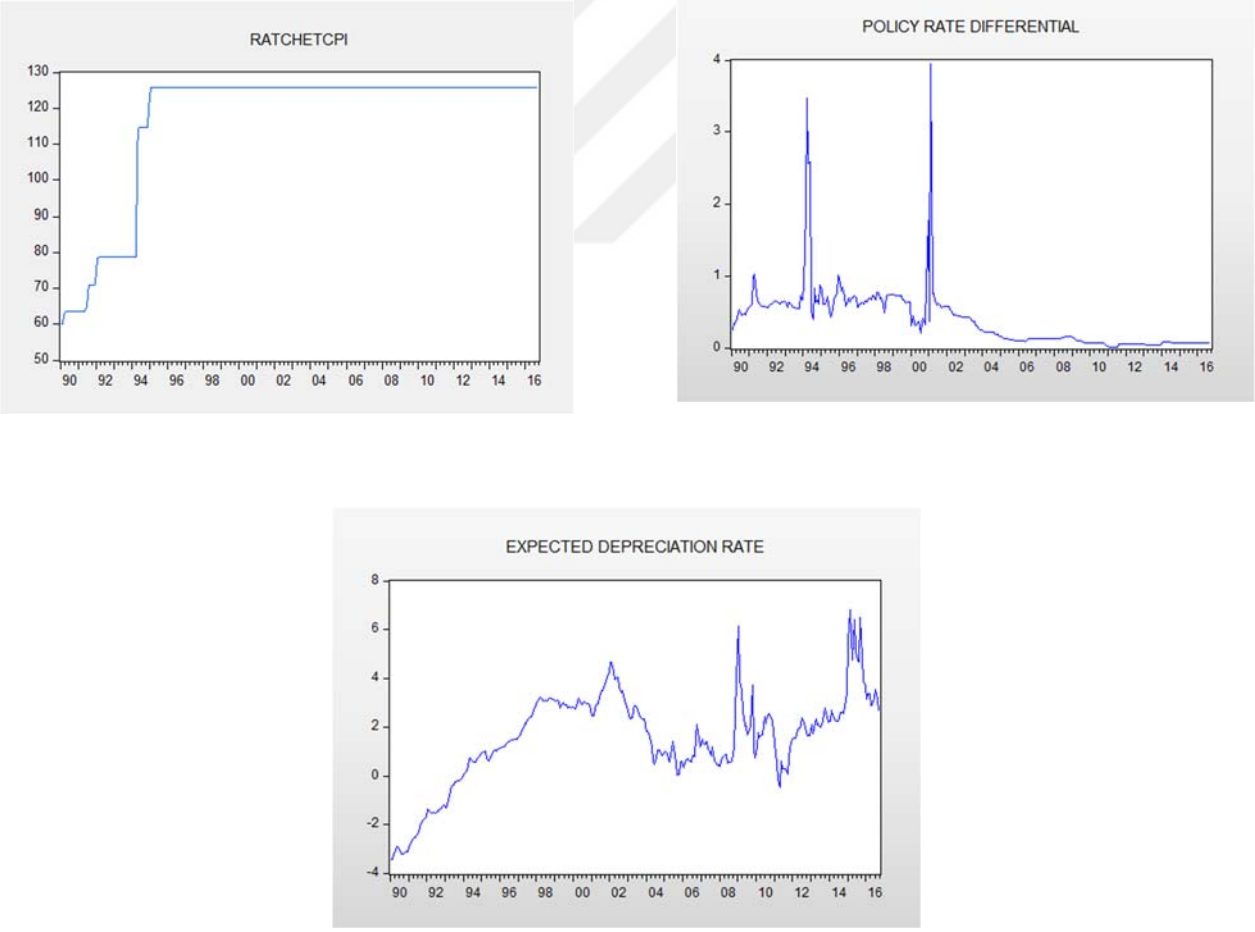


Figure 12: Ratchet Variable, Policy Rate Difference, and Expected Depreciation



In the figures above, we plotted the level values of the variables; BDI, NDI, PD, ED, and a Ratchet Variable generated from CPI. It can be seen that there is a significant trend that the variables follow. For example, NDI and BDI have decreased significantly but later on; they entered an upward trend. We suspect that this could be an indication of the hysteresis nature of dollarization.

5.2. Methodology

Most econometric studies aimed at identifying the determinants of the dollarization process rely on a basic money demand function and incorporate inflationary or exchange rate expectations or interest rate differences as the main explanatory variables (Mongardini and Mueller, 2000). In this study, we follow this reasoning and try to find evidence of hysteresis in Turkey using two widely used specifications for dollarization in the literature; broad and narrow dollarization indices. Our model follows Mongardini and Mueller (2000), the basic money demand function where expected depreciation and interest rate difference are the explanatory variables for the demand for foreign currencies. In addition to these variables, we add a ratchet variable to the model to capture the hysteresis effect. We assume that the ratchet variable will capture the fixed costs arising from developing, learning, and applying new monetary management techniques that would cause irreversibility in the demand for foreign currencies. Therefore, the ratchet variable in the model indicates that the dependent variable will behave asymmetrically to the changes in one of the independent variables. The models are as follows:

$$\mathrm{BDI}_t = \beta_0 + \beta_1 \mathrm{ED}_t + \beta_2 \mathrm{PD}_t + \beta_3 \mathrm{RatchetCPI}_t + \varepsilon_t \quad (5)$$

where BDI is the natural logarithm of the Broad Dollarization Index, which is the U.S. Dollar deposits over M2 money supply; ED is the difference between official and real exchange rates; PD is the difference between policy rates of Turkey and the U.S., and ratchet is the hysteresis or ratchet variable that measures the irreversibility of dollarization.

$$\mathrm{NDI}_t = \alpha_0 + \alpha_1 \mathrm{ED}_t + \alpha_2 \mathrm{PD}_t + \alpha_3 \mathrm{RatchetCPI}_t + \epsilon_t \quad (6)$$

where NDI is the natural logarithm Narrow Dollarization Index, which is the U.S. Dollar deposits over U.S. Dollar deposits plus Turkish lira deposits; ED is the difference between official and real exchange rates; PD is the difference between policy rates of Turkey and U.S and Ratchet is the hysteresis variable that measures the irreversibility of dollarization.

5.2.1. ARDL Bound Test

This research uses the ARDL Bound Test by Pesaran et al. (2001). The authors suggest an alternative approach that uses the method of Autoregressive Distributed Lag to test the cointegration between variables regardless of whether they are integrated of order zero (I(0)) or one (I(1)). ARDL Bound Test produces two critical value bonds; the first assumes all variables are purely I(0), and the second assumes all variables are purely I(1)[24]. The statistic underlying this procedure is F-statistic in a generalized Dickey-Fuller type of regression used to test the significance of the lagged levels of the variables (Pesaran et al., 2001). One of the most significant advantages of this method is that it can simply be applied without using the unit-root tests.

Moreover, we have the following representations of the models:

$$\Delta BDI = \omega_0 + \sum_{i=1}^{p} \delta_i \Delta BDI_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta ED_{t-i} + \sum_{i=0}^{r} \theta_i \Delta PD_{t-i} + \sum_{i=0}^{u} \varphi_i \Delta RatchetCPI_{t-i} + \sigma_1 BDI_{t-1} + \sigma_2 ED_{t-1} + \sigma_3 PD_{t-1} + \sigma_4 RatchetCPI_{t-1} + \varepsilon_t \quad (7)$$

$$\Delta NDI = \omega_0 + \sum_{i=1}^{p} \delta_i \Delta NDI_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta ED_{t-i} + \sum_{i=0}^{r} \theta_i \Delta PD_{t-i} + \sum_{i=0}^{u} \varphi_i \Delta RatchetCPI_{t-i} + \sigma_1 BDI_{t-1} + \sigma_2 ED_{t-1} + \sigma_3 PD_{t-1} + \sigma_4 Ratchet_{t-1} + \epsilon_t \quad (8)$$

where "Δ" represents the first difference of the variables; $\delta, \gamma, \theta, and\ \varphi$ are the short-run coefficients of the models; $\sigma_1, \sigma_2, \sigma_3, \sigma_4$ are the long-run coefficients; p, q, r, u are the different optimal lags for the variables, and ε and ϵ are the error terms. In addition, for bound testing, we use F-statistics for the equations as follows:

$$H_0: \sigma_i = 0 \qquad i: 1, \dots, 4 \quad (9)$$
$$H_1 = \text{otherwise}$$

If the null hypothesis of no cointegration is rejected, there is evidence of the cointegration between variables. Then, we continue with the estimation of Conditional Error Correction and the Long-run models.

[24] These critical values are shown in Pesaran et al. (2001).

CHAPTER 6: EMPIRICAL RESULTS

Before conducting the ARDL bounds test, we test for structural breaks in our variables because we have a long time period and several economic crises in our data. The model will likely be unstable if the ARDL analysis is done without considering structural breaks.

6.1. Bai-Perron Structural Break Test

A structural break in time series is a sudden or immediate change at a point in time. These breaks are mostly interpreted as changes in economic policies or structure of the economy, global crises, natural causes, political tension, etc. Studies show that the analyses could be biased if they are not taken into account. For example, there are several methods that take into account structural breaks; Chow (1960), Perron (1989 and 1997), Zivot and Andrews (1992), Brown et al. (1975), Bai (1997), and Bai and Perron (1998, 2003a, 2003b, 2006)[25]. These studies suggest different models and analyses for the outcome of structural breaks. For example, in their original paper, Bai and Perron considers the issue of multiple structural changes in the linear regression model estimated by minimizing the sum of squared residuals and allowing for serial correlation and heteroskedasticity in the errors, lagged dependent variables, trending regressors (Bai and Perron, 1998). Their model follows a linear regression model with *m* breaks (m+1 regimes):

$$y_t = x_t'\beta + z_t'\delta_j + u_t, \qquad t = T_{j-1} + 1, \dots, T_j \tag{14}$$

where $j = 1, \dots, m+1$; y_t is the dependent variable, $x_t(p * 1)$ and $z_t(q * 1)$ are vectors of coefficients and u_t is the disturbance. The indices (T_1, …, T_m) are the breakpoints, treated as unknowns, which are global minimizers of the objective function (Bai and Perron, 1998). The model we use for investigating structural breaks allows for serial correlation using the Heteroskedasticity-autocorrelation consistent estimator of variance and standard errors. It was found that correcting for heterogeneity in the data and/or errors across segments yields improvements over a more straightforward uncorrected interval. Correcting serial correlation also leads to substantial improvements (Bai and Perron, 2003a). We allow up to five breaks and use 15% of the trimming percentage in our analyses[26]. Since we have 321 observations in the sample, regimes are restricted to using at least 48 observations. Bai-Perron test results are as follows:

[25] Perron (2006) gives extensive information on structural breaks.

[26] Trimming numbers are of great importance according to Bai and Perron. They suggest different numbers for different data types; more information can be found in Bai and Perron (2003a).

Table 2: Bai-Perron Structural Break Test: Expected Depreciation of Exchange Rate

Tests[a]						
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$	UDMax	WDMax
0.00	1.39	2.15	2.32	3.55	3.55	7.80
Number of Breaks Selected[b]						
Sequential	0					
LWZ	5					
BIC	5					
Break Dates Selected						
--						

Notes: [a] $SupF_T(k)$ tests and reported statistics allow for the possibility of serial correlation in the results.

[b] 5% significance level is used for the sequential test $SupF_T(l+1|l)$.

**indicates significance level of 0.05.

Table 3: Bai-Perron Structural Break Test: Narrow Dollarization Index

Tests[a]						
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$	UDMax	WDMax
16.15**	19.71**	15.76**	21.28**	24.13**	24.13**	52.94**
$SupF(2\|1)$						
0.72						
Number of Breaks Selected[b]						
Sequential	1					
LWZ	2					
BIC	2					
Break Dates Selected						
2005M10						

Notes: [a] $SupF_T(k)$ tests and reported statistics allow for the possibility of serial correlation in the results.

[b] 5% significance level is used for the sequential test $SupF_T(l+1|l)$.

**indicates significance level of 0.05.

Table 4: Bai-Perron Structural Break Test: Broad Dollarization Index

Tests[a]						
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$	UDMax	WDMax
12.97**	21.68**	15.24**	55.18**	50.0**	55.18**	50.0**
$SupF(2\|1)$						
0.69						
Number of Breaks Selected[b]						
Sequential	1					
LWZ	4					
BIC	2					
Break Dates Selected						
2005M10						

Notes: [a] $SupF_T(k)$ tests and reported statistics allow for the possibility of serial correlation in the results.

[b] 5% significance level is used for the sequential test $SupF_T(l+1|l)$.

**indicates significance level of 0.05.

Table 5: Bai-Perron Structural Break Test: Policy Rate Difference between U.S. and Turkey

Tests[a]						
$SupF_T(1)$	$SupF_T(2)$	$SupF_T(3)$	$SupF_T(4)$	$SupF_T(5)$	UDMax	WDMax
108.81**	103.16**	82.29**	101.23**	88.61**	108.81**	108.81**
$SupF(2\|1)$	$SupF(3\|2)$					
36.44**	2.54					
Number of Breaks Selected[b]						
Sequential	2					
LWZ	1					
BIC	1					
Break Dates Selected						
2003M05 - 2009M04						

Notes: [a] $SupF_T(k)$ tests and reported statistics allow for the possibility of serial correlation in the results.

[b] 5% significance level is used for the sequential test $SupF_T(l+1|l)$.

**indicates significance level of 0.05.

The first notable thing is that all $SupF_T(k)$, UDmax and WDmax tests are valid for NDI, BDI, and PD. In addition, only the WDmax test is valid for ED. However, these tests do not give exact information on the date of breaks. Instead, they indicate the existence of at least one break in the variable. In addition, the Sequential procedure, Bayesian Information Criteria, and the modified Schwarz criterion of Liu-Wu-Zidek (LWZ) also choose the number of breaks. However, as suggested by Bai and Perron, we will use the sequential method results instead because it gives overall optimum results[27]. Again, all Sequential $SupF_T(l+1|l)$ tests are valid for all variables except ED. We conclude that; both NDI and BDI have one, and PD between U.S. and Turkey has two structural breaks. However, in the case of ED, we conclude that there is little evidence for structural breaks. After analyzing the places of structural breaks, we create dummy variables and add them to the analyses to prevent structural breaks in the models.

6.2. ARDL Bounds Test

The ARDL bounds test, suggested by Pesaran et al. (2001), investigate the long-run relationship between the variables. Two critical bound values assume two polar cases; the lower bound assumes that all variables are integrated of order zero, and the upper bound assumes that all variables are integrated of order one[28]. If the F-statistics are outside the critical value bounds, we can reject the null hypothesis of no cointegration without needing to know the cointegration rank of the analysis (Pesaran et al., 2001). However, if it is between these critical bounds, the cointegration process is inconclusive to decide. The results of the bounds test are as follows:

Table 6: Bounds Test for Cointegration using NDI

Variables	F-statistics	Lower Bound	Upper Bound
NDI, Policy Rate Difference, Expected Depreciation, RatchetCPI	8.61*	3.91[1]	5.04[1]

[1] Upper and lower bound values are in 0.01 significance level.

[27] More information can be found in Bai and Perron (2003a, 2003b and 2006).

[28] These critical values are generated by Pesaran et al. (2001). There is more information on Narayan (2004) for analyzing cointegration for small sample sizes with the ARDL bounds test.

Table 7: Bounds Test for Cointegration using BDI

Variables	F-statistics	Lower Bound	Upper Bound
BDI, Policy Rate Difference, Expected Depreciation, RatchetCPI	11.26*	3.91[1]	5.04[1]

[1] Upper and lower bound values are in 0.01 significance level.

The results clearly show that F-statistics are greater than the value of the upper bound level. This indicates that the null hypothesis of no cointegration is rejected for both narrow and broad dollarization indices and implies a long-run connection among the variables. Now we have the conditional error correction model:

$$\Delta BDI = \omega_0 + \sum_{i=1}^{p} \delta_i \Delta BDI_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta ED_{t-i} + \sum_{i=0}^{r} \theta_i \Delta PD_{t-i} + \sum_{i=0}^{u} \varphi_i \Delta RatchetCPI_{t-i} + \lambda ECM_{t-1} + u_t \quad (15)$$

$$\Delta NDI = \omega_0 + \sum_{i=1}^{p} \delta_i \Delta NDI_{t-i} + \sum_{i=0}^{q} \gamma_i \Delta ED_{t-i} + \sum_{i=0}^{r} \theta_i \Delta PD_{t-i} + \sum_{i=0}^{u} \varphi_i \Delta RatchetCPI_{t-i} + \lambda ECM_{t-1} + e_t \quad (16)$$

where λ is the speed of adjustment; which measures how rapid the adjustment period is to the equilibrium in the long run; ECM is the long-run equilibrium errors and u_t and e_t are the cointegration model error term, respectively. The vital part of the models above is the interpretation of the λ, error correction coefficient. λ shows how much adjustment to equilibrium takes place in each period, and it is expected to have a negative sign between the values of 0 and 1. For example, if $\lambda = 1$, 100% of the adjustment occurs within the given period. On the contrary, if $\lambda = 0$, there is no adjustment and long-run equilibrium. The results for the error correction model and long-run model are as follows:

Table 8: ARDL Error Correction Model Regression for PD using RatchetCPI

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Chosen Model: ARDL (9, 0, 6, 4) [1]			**Chosen Model: ARDL (9, 0, 5, 4)** [1]		
Variables	**Coefficient**	**P-value**	**Variables**	**Coefficient**	**P-value**
D(NDI(-1))	0.1219	0.0254	**D(BDI(-1))**	0.0166	0.7555
D(NDI(-2))	0.1169	0.0325	**D(BDI(-2))**	0.1293	0.0149
D(NDI(-3))	0.0377	0.4948	**D(BDI(-3))**	0.0995	0.0700
D(NDI(-4))	-0.0913	0.0956	**D(BDI(-4))**	-0.0974	0.0725
D(NDI(-5))	-0.0544	0.3147	**D(BDI(-5))**	-0.0346	0.5151
D(NDI(-6))	0.0947	0.0762	**D(BDI(-6))**	0.1142	0.0331
D(NDI(-7))	0.0740	0.1581	**D(BDI(-7))**	0.0749	0.1441
D(NDI(-8))	-0.1496	0.0035	**D(BDI(-8))**	-0.1538	0.0028
D(PD)	0.0156	0.0036	**D(PD)**	0.0187	0.0052
D(PD(-1))	-0.0218	0.0027	**D(PD(-1))**	-0.0226	0.0111
D(PD(-2))	-0.0317	0.0000	**D(PD(-2))**	-0.0332	0.0001
D(PD(-3))	-0.0315	0.0000	**D(PD(-3))**	-0.0358	0.0000
D(PD(-4))	-0.0114	0.0746	**D(PD(-4))**	-0.0181	0.0064
D(PD(-5))	0.0076	0.1611	**D(RatchetCPI)**	0.0793	0.5001
D(RatchetCPI)	0.0990	0.2886	**D(RatchetCPI(-1))**	-0.3481	0.0031
D(RatchetCPI(-1))	-0.2788	0.0026	**D(RatchetCPI(-2))**	-0.0937	0.4502
D(RatchetCPI(-2))	-0.1151	0.2402	**D(RatchetCPI(-3))**	-0.2949	0.0177
D(RatchetCPI(-3))	-0.2496	0.0127			
ECM	-0.0901	0.0000	ECM	-0.1267	0.0000
R^2	0.33		R^2	0.30	
Durbin-Watson stat	1.96		Durbin-Watson stat	1.97	

[1] *The optimal lags of the variables are chosen by the Akaike information criteria.*

Table 9: ARDL Long-run Model for PD using RatchetCPI

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Variables	**Coefficient**	**P-value**	**Variables**	**Coefficient**	**P-value**
Expected Depreciation	0.0542	0.0015	**Expected Depreciation**	0.0578	0.0001
Policy Rate Difference	0.2953	0.0063	**Policy Rate Difference**	0.2992	0.0014
RatchetCPI	-0.2555	0.2065	**RatchetCPI**	0.0548	0.7413

6.2.1. Analysis Using Narrowly Defined Dollarization Index (NDI)

In Table 9, we gave results of the short-run error correction model. Using Narrow Dollarization Index as a currency substitution measure produces significant short-run results. Expected Depreciation has the expected positive sign. This indicates that when there is a change in the expected exchange rate depreciation level, citizens increase their holdings of foreign currency assets, thus increasing the level of dollarization in the country. In addition, the policy rate in the short run has the anticipated negative sign; further increase in the level of difference decreases the demand for dollars. This means that the residents shift their foreign-denominated deposits to TL-denominated deposits. At the same time, we observe a significant ratchet effect in the short run; however, it has the wrong sign. Additionally, the error correction term has the expected sign and magnitude. A small magnitude of the speed of adjustment indicates a relatively slow convergence to the long-run equilibrium.

In Table 10, we show the results of the long-run ARDL model. The empirical evidence from the long-run results indicates that policy rate difference and expected exchange rate are all significant explanatory variables explaining the narrow dollarization index. We found that the policy rate, in the long run, behaves differently from the short run; a positive relationship could indicate that people are giving more importance to the risk premium rather than gaining the benefits of switching back to domestic currency. In the end, agents prefer foreign-denominated assets in the case of an increase in interest rate in the long run.

6.2.2. Analysis Using Broadly Defined Dollarization Index

The results suggest that the policy rate is significant and has a negative sign overall. A positive sign between the policy rate and the dollarization index could mean that an increase in the interbank difference shifted domestic portfolio allocations toward foreign-denominated assets rather than TL-denominated assets due to a rise in risk premium (Us, 2003). This represents that economic agents in the country are adaptive to the changes to the policy rate. Also, there is a significant short-run ratchet effect in the broad dollarization index; however, it still has the wrong sign. In addition, the error correction term has the anticipated negative sign and magnitude. Even though it is relatively greater than the error correction term in the narrowly defined model, it is still within the requirements of the ECM. Having a greater measure of error correction term indicates faster convergence to the long-run equilibrium. Finally, the magnitude of the coefficients is similar to the narrow definition; however, some variables seem to have a greater impact on the broad definition of dollarization.

Moreover, there is still no evidence for the existence of the ratchet effects. However, the ratchet variable has the expected positive sign in the long run. In addition, expected depreciation and policy rate difference are strongly significant in BDI. Furthermore, this result suggests that dollarization in the country is not persistent enough to be irreversible.

It is common practice to make further analyses of the model. For instance, two common ways are removing the ratchet variable to look for any disturbance in the results and looking for other sources of hysteresis in the country.

6.2.3. Analysis with alternative models

6.2.3.1. Removal of the Ratchet Variable

When we remove the ratchet variable from the model, the policy rate and expected depreciation are still strongly effective against NDI and BDI both in the long and short run. There are changes in the coefficients of all variables, yet, they are similar to the previous model that includes a ratchet variable. Therefore, we can conclude that policy rate difference and expected depreciation are strong indicators of dollarization in the country (see Section 2 in the Appendix).

6.2.3.2. Using RatchetDepr[29]

In the short run, for NDI and BDI, the policy rate has the expected negative sign; however, there are slight differences in the magnitude of the coefficients. In the long run, the policy rate is only significant at the 10% significance level for NDI. Yet it is significant for BDI and has a positive sign, indicating that the residents in the country increase their demand for dollars in the case of a change in the difference. Expected depreciation still strongly affects currency substitution and has the expected positive sign. Depreciation ratchet, on the hand, has the expected positive sign for NDI, representing that the past peak values of expected depreciation increase the level of currency substitution in the country. However, this variable is not significant in both models; therefore, there is no sufficient evidence to confirm the existence of the ratchet effect in Turkey (see Section 3 in the Appendix).

[29] This ratchet variable is created as: $\text{RatchetDepr}_t = \max \text{Depr}_i \ (i = 0,1, \dots, t)$ the past maximum values of expected depreciation rate.

6.2.3.3. Using RatchetDol[30]

Using RatchetDol created an autocorrelation problem for the analyses; therefore, we used HAC (Heteroskedasticity and autocorrelation consistent) standard errors. The results are similar in the short-run with few differences. The main difference, however, is the existence of a ratchet effect in the short-run. However, the most significant differences are in the long-run; the dollarization ratchet becomes significant in both models, indicating the existence of ratchet effects in the country. The existence of a ratchet effect in the broad dollarization model suggests that hysteresis can be found in the whole economy. Moreover, it seems that the interest rate loses its effect on foreign currency demand in the country in the presence of ratchet effect. This suggests that the existence of hysteresis can render monetary policy instruments ineffective in the long run. However, expected depreciation still significantly affects the demand for foreign currency (see Section 4 in the Appendix).

6.2.3.4. Using the Difference between TL and Dollar-Denominated Deposit Rates

In this analysis, we used deposit rates instead of policy rates. The results from using inflation ratchet for deposit rates suggest that, in the short run, the deposit rate in both the NDI and BDI has significant expected negative rates. In the long run, however, its sign changes to positive, yet it is not significant. In addition, expected depreciation is significant and positive in the short run and long run for BDI and NDI. In the short run, the inflation ratchet variable does have positive coefficients; however, it becomes negative as time passes for NDI and BDI. In addition, the ratchet variable is insignificant and has a negative sign in the long run. Moreover, error correction terms are significant, negative, and lower than one (see Section 5 in the Appendix). Yet, when we remove the ratchet variable from the model, the model with NDI exhibits severe autocorrelation problems, indicating that the ratchet variable is a major component of the model. Nevertheless, the results for the model with BDI excluding the inflation ratchet variable suggest that the difference is minor. For instance, expected depreciation is still positive and significant; however, the deposit rate is still insignificant in the model (see Section 6 in the Appendix).

We also test with the ratchet variable generated from dollarization indices. We found that the expected depreciation is strongly significant and positive, and the deposit rate is insignificant in the long run. In addition, the results indicate that there is indeed a positive ratchet effect in the short run and long run

[30] This ratchet variable is created as: $\text{RatchetDol}_t = \text{maxDollarization}_i$ $(i = 0,1,\dots,t)$ the past maximum values of dollarization rates (RatchetNDI and RatchetBDI).

for both the NDI and BDI[31]. The significance of the ratchet variable for BDI shows that hysteresis is seen in the economy as a whole (see Section 7 in the Appendix).

6.2.3.5. Using the difference between Turkey and U.S. interbank rates[32]

The results suggest that the interbank rate in the short run has the expected negative rates. However, in the long run, there is a significant change in the sign of the interbank rate indicating the preference change of the economic agents. In addition, the expected depreciation rate strongly affects the dollarization in the country. On the other hand, the inflation ratchet has a negative sign, opposite to what has been expected and is not significant overall in the short run. Also, there is no indication of a significant inflation hysteresis in the long run. (see Section 8 in the Appendix). Removing the inflation ratchet from the model does not change much in the short run; all the variables have their expected signs and significantly affect dollarization. However, in the long run, the interbank rate loses its influence on the demand for foreign currency. Its sign has also become positive (see Section 9 in the Appendix).

We also tested the model with other ratchet variables; for instance, the use of the depreciation ratchet generates positive yet insignificant results in the model. In addition, the interbank rate becomes insignificant and loses a significant impact on dollarization in the long run (see Section 10 in the Appendix). Finally, we tested for the existence of a dollarization ratchet for NDI and BDI. However, the analysis indicates a severe autocorrelation problem; therefore, we used HAC (Heteroskedasticity and autocorrelation consistent) standard errors. Continuing with the analysis with NDI, the interbank variable is significant and has the expected sign in the short run; however, in the long run, it is insignificant and has the wrong sign. In addition, expected depreciation is positive and significant in the long and short run. Finally, NDI ratchet in the long run is only significant at the 10% significance level. BDI ratchet on the other hand, is strongly significant and shows that there is a ratchet effect in the country (see Section 11 in the Appendix).

Finally, we have done the necessary tests to ensure there is no heteroskedasticity and autocorrelation in the models. Most of the results indicate no heteroskedasticity and autocorrelation problem. Also, we tested for CUSUM Squares for stability. The stability test shows that the trend line in all models does not pass over critical lines, indicating the stability of the models.

[31] p-value for the RatchetNDI is 0.0567 as shown in the Appendix, Section 6. However, we conclude that it can be significant at the 0.05 significance level.

[32] Interbank difference is the difference between 24-hour interbank rates of Turkey and the U.S.

CHAPTER 7: CONCLUSION

Currency substitution is one the important topics in emerging economies. Studies show that under high inflation, domestic currency depreciation rates (exchange rate instability), and low credibility, domestic currencies lose their basic monetary functions; store of value, unit of account, and medium of exchange. Currency substitution is acknowledged as losing the "medium of exchange" function, which is the domestic currency losing the role of legal tender and using foreign currency for transaction purposes instead (Kheng, 2020; Sturzenegger, 1997). However, it is not possible to know the extent of currency substitution within the country because there is no such data. There are alternative ways of calculating currency substitution; for example, the dollarization index is used as a measure of currency substitution in the economy. In this thesis, we compute dollarization in two ways; narrowly and broadly defined dollarization indices. The narrow way of calculating the dollarization consists of dividing foreign currency deposits by total currency deposits in the country, and the broad way consists of dividing foreign currency deposits by M2 money supply. Moreover, we analyze the persistence of dollarization in Turkey between 1990 and 2016. We used two definitions for dollarization indices and then created a ratchet variable that includes the past peak values of inflation to test whether there is a ratchet effect in the country.

In our results, the overall significance of the expected depreciation variable indicates that economic agents increase their foreign currency holdings to benefit from the loss of the store of value. As we get closer to broader definitions of dollarization, expected depreciation becomes more significant in some cases. Furthermore, expectations of a disturbance in the foreign exchange market make agents hold more foreign currencies. The results for the differences of interest rates (policy rate, deposit rate, and interbank rate) suggest that in the short run, agents prefer higher returns from the domestic currency; however, in the long run, agents prefer lower returns from foreign currencies because holding domestic currency is risky. Therefore, agents give more importance to risk premiums rather than enjoying higher returns in the long run. In addition, according to Boyer (1996), the central bank of the country is the main factor that affects the decisions of the agents in the short run; however, in the long run, this influence changes from the central bank to the portfolio managers. For this reason, this significant change in the signs of interest rates could be attributed to the influence change between the central bank to portfolio managers. Moreover, it could be said that overall expected depreciation and policy rate are significant determinants of the currency substitution process in the country. However, we cannot attribute the currency substitution and its

persistence only to the high levels of expected depreciation and policy rate because the results of R-squared suggest that other effects are at work.

In this study, we also include a ratchet variable in the analysis to measure the persistence of currency substitution in the country. We apply the accustomed ratchet variables in the literature; past peak values of the expected depreciation, inflation, and the dollarization ratio itself. The results suggest that the dollarization ratchet created to test the existence of hysteresis produces significant coefficients in all models. Founding hysteresis in the results validates the other studies in the literature. For example, Us (2003) and Ozcan and Us (2005) found that there is hysteresis in Turkey[33]. The significance of the broad dollarization ratchet suggests that the hysteresis can be found in the whole economy. A ratchet effect on the entire economy makes it difficult for the Central Bank to conduct monetary policy. For instance, our results suggest that when there is a significant ratchet effect in the country, the interest rate becomes insignificant, unable to affect the demand for foreign currencies. Therefore, effective policies might be needed for the dollarization to be reduced. We also found that almost all models suggest that current dollarization ratios heavily depend on their past values. This result can be seen as proof of the dollarization inertia, which negatively affects the reversal process.

We use different variables in this study to validate the results and confirm the existence of the ratchet variable in Turkey. Yet, our finding that there is a ratchet effect may not be "hard" evidence since dollarization index should include the foreign currency in circulation; however, such data does not yet exist. Therefore, our results are only a fraction of the real results.

[33] However, Us (2003) only found hysteresis in NDI which is calculated as the foreign currency deposits divided by M1 money supply which is even narrower than our calculated narrow dollarization; Ozcan and Us (2005) follow Us (2003), therefore, the authors' results are only effective in narrow dollarization compared to our study.

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APPENDIX

Section 1

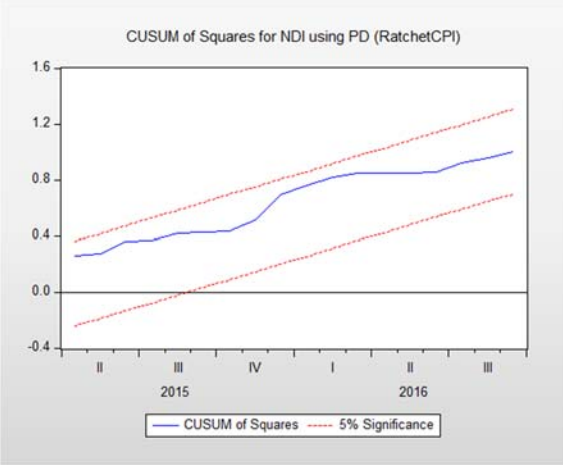
Table 10: Breusch-Pagan-Godfrey Heteroskedasticity Test for PD using RatchetCPI

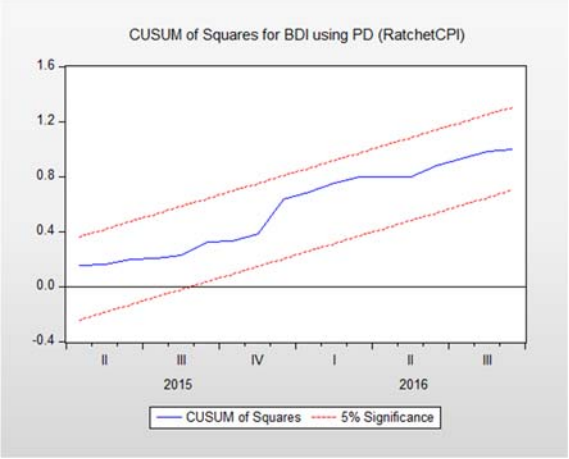
Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
12.36	0.9889	22.11	0.6292

Table 11: Serial Correlation LM Test for PD using RatchetCPI

Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
14.12	0.2934	16.88	0.1543

Graph 13: CUSUM of Squares Test for PD using RatchetCPI





Section 2

Table 12: ARDL Error Correction Model Regression only for PD

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Chosen Model: ARDL (9, 0, 5)			**Chosen Model: ARDL (9, 0, 5)**		
Variables[1]	**Coefficient**	**P-value**	**Variables**[1]	**Coefficient**	**P-value**
D(NDI(-1))	0.1382	0.0110	**D(BDI(-1))**	0.0210	0.6956
D(NDI(-2))	0.1260	0.0216	**D(BDI(-2))**	0.1316	0.0136
D(NDI(-3))	0.0725	0.1906	**D(BDI(-3))**	0.1099	0.0415
D(NDI(-4))	-0.0907	0.0957	**D(BDI(-4))**	-0.1377	0.0097
D(NDI(-5))	-0.0455	0.3927	**D(BDI(-5))**	-0.0478	0.3587
D(NDI(-6))	0.0704	0.1860	**D(BDI(-6))**	0.0795	0.1274
D(NDI(-7))	0.0718	0.1764	**D(BDI(-7))**	0.0708	0.1717
D(NDI(-8))	-0.1240	0.0176	**D(BDI(-8))**	-0.1518	0.0035
D(PD)	0.0201	0.0001	**D(PD)**	0.0217	0.0005
D(PD(-1))	-0.0060	0.2858	**D(PD(-1))**	-0.0013	0.8551
D(PD(-2))	-0.0251	0.0000	**D(PD(-2))**	-0.0241	0.0006
D(PD(-3))	-0.03401	0.0000	**D(PD(-3))**	-0.0351	0.0000
D(PD(-4))	-0.0196	0.0002	**D(PD(-4))**	-0.0200	0.0018
ECM	-0.1100	0.0000	ECM	-0.1259	0.0000
R^2	0.29		R^2	0.28	
Durbin-Watson stat	1.94		Durbin-Watson stat	1.97	

[1] *The optimal lags of the variables are chosen by the Akaike information criteria.*

Table 13: ARDL Long-run Model only for PD

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Variables	**Coefficient**	**P-value**	**Variables**	**Coefficient**	**P-value**
Expected Depreciation	0.0419	0.0000	**Expected Depreciation**	0.0669	0.0000
Policy Rate Difference	0.1833	0.0045	**Policy Rate Difference**	0.1785	0.0112

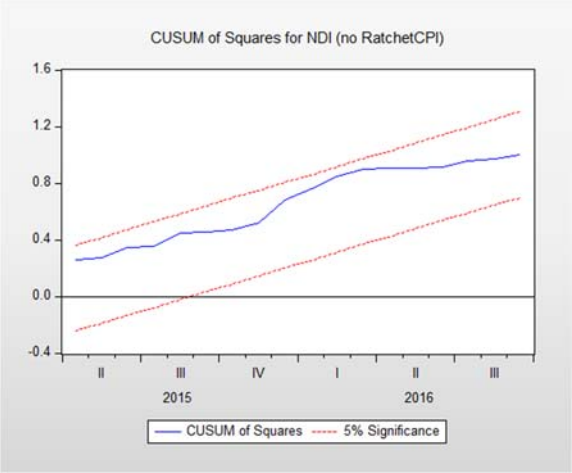
Table 14: Breusch-Pagan-Godfrey Heteroskedasticity Test only for PD

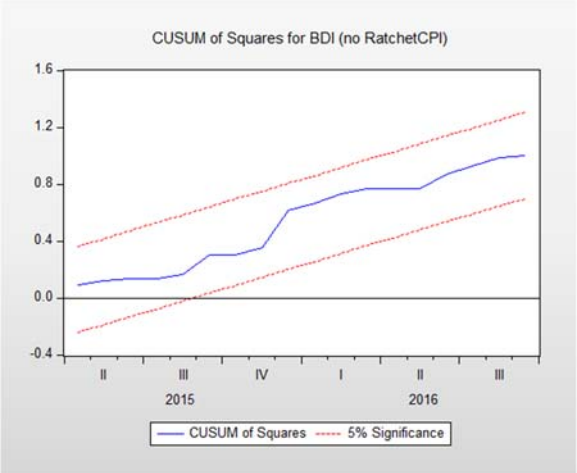
Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
18.10	0.5809	15.15	0.7680

Table 15: Serial Correlation LM Test only for PD

Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
18.62	0.0981	18.28	0.1075

Graph 14: CUSUM of Squares Test only for PD





Section 3

Table 16: ARDL Error Correction Model Regression for PD using RatchetDepr

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Chosen Model: ARDL (9, 0, 6, 0)			**Chosen Model: ARDL (9, 0, 5, 0)**		
Variables[1]	**Coefficient**	**P-value**	**Variables**[1]	**Coefficient**	**P-value**
D(NDI(-1))	0.1445	0.0084	**D(BDI(-1))**	0.0187	0.7245
D(NDI(-2))	0.1296	0.0187	**D(BDI(-2))**	0.1378	0.0093
D(NDI(-3))	0.0644	0.2427	**D(BDI(-3))**	0.1124	0.0343
D(NDI(-4))	-0.1096	0.0457	**D(BDI(-4))**	-0.1272	0.0165
D(NDI(-5))	-0.0632	0.2430	**D(BDI(-5))**	-0.0446	0.3873
D(NDI(-6))	0.0728	0.1708	**D(BDI(-6))**	0.0668	0.2015
D(NDI(-7))	0.0747	0.1598	**D(BDI(-7))**	0.0683	0.1847
D(NDI(-8))	-0.1322	0.0114	**D(BDI(-8))**	-0.1474	0.0044
D(PD)	0.0198	0.0001	**D(PD)**	0.0222	0.0004
D(PD(-1))	-0.0002	0.9686	**D(PD(-1))**	-0.0023	0.7451
D(PD(-2))	-0.0211	0.0001	**D(PD(-2))**	-0.0250	0.0003
D(PD(-3))	-0.3003	0.0000	**D(PD(-3))**	-0.0363	0.0000
D(PD(-4))	-0.0129	0.0339	**D(PD(-4))**	-0.0209	0.0010
D(PD(-5))	0.0081	0.1286			
ECM	-0.1018	0.0000	ECM	-0.1285	0.0000
R^2	0.29		R^2	0.29	
Durbin-Watson stat	1.97		Durbin-Watson stat	1.96	

[1] *The optimal lags of the variables are chosen by the Akaike information criteria.*

Table 17: ARDL Long-run Model for PD using RatchetDepr

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Variables	**Coefficient**	**P-value**	**Variables**	**Coefficient**	**P-value**
Expected Depreciation	0.0550	0.0006	**Expected Depreciation**	0.0620	0.0000
Policy Rate Difference	0.1311	0.0864	**Policy Rate Difference**	0.1892	0.0079
RatchetDepr	0.0165	0.3416	**RatchetDepr**	-0.0066	0.6879

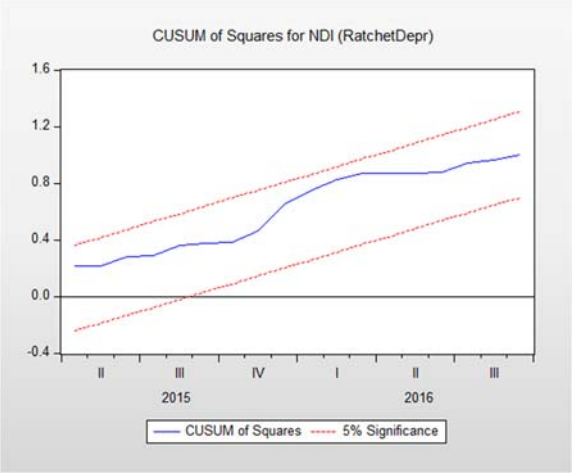
Table 18: Breusch-Pagan-Godfrey Heteroskedasticity Test for PD using RatchetDepr

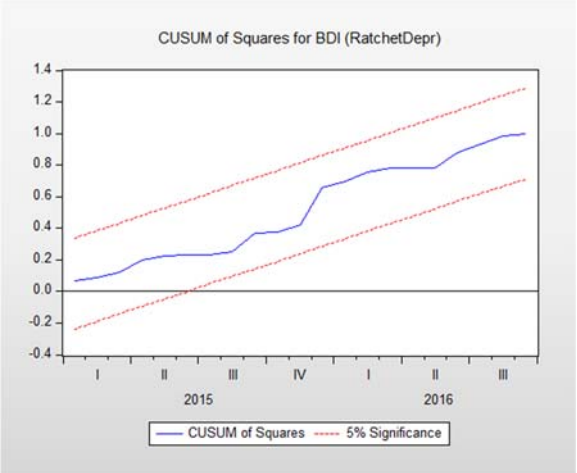
Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
17.54	0.7329	17.44	0.7388

Table 19: Serial Correlation LM Test for PD using RatchetDepr

Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
11.80	0.4618	14.07	0.2960

Graph 15: CUSUM of Squares Test for PD using RatchetDepr





Section 4

Table 20: ARDL Error Correction Model Regression for PD using RatchetDol

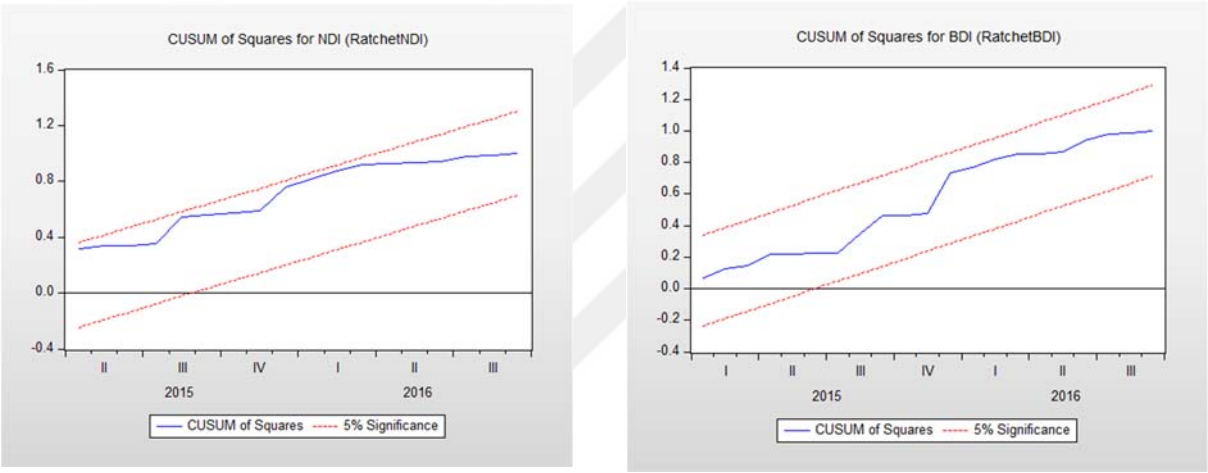
Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Chosen Model: ARDL (3, 0, 5, 3)			**Chosen Model: ARDL (7, 0, 4, 8)**		
Variables[1]	**Coefficient**	**P-value**	**Variables**[1]	**Coefficient**	**P-value**
D(NDI(-1))	0.1527	0.0029	**D(BDI(-1))**	0.0381	0.4729
D(NDI(-2))	0.0824	0.1116	**D(BDI(-2))**	0.0921	0.0870
D(PD)	0.0099	0.0402	**D(BDI(-3))**	0.0919	0.0849
D(PD(-1))	-0.0117	0.0330	**D(BDI(-4))**	-0.0909	0.0877
D(PD(-2))	-0.0241	0.0000	**D(BDI(-5))**	-0.0313	0.5560
D(PD(-3))	-0.0305	0.0000	**D(BDI(-6))**	0.1273	0.0144
D(PD(-4))	-0.0214	0.0000	**D(PD)**	0.0117	0.0739
D(RatchetNDI)	2.5150	0.0000	**D(PD(-1))**	-0.0146	0.0613
			D(PD(-2))	-0.0242	0.0021
			D(PD(-3))	-0.0215	0.0012
			D(RatchetBDI)	3.2712	0.0000
			D(RatchetBDI(-1))	0.3040	0.5405
			D(RatchetBDI(-2))	-0.7901	0.1840
			D(RatchetBDI(-3))	-0.3603	0.5569
			D(RatchetBDI(-4))	-0.8799	0.1519
			D(RatchetBDI(-5))	-0.3337	0.5845
			D(RatchetBDI(-6))	-0.6654	0.1890
			D(RatchetBDI(-7))	1.1122	0.0130
ECM	-0.1306	0.0000	ECM	-0.1642	0.0000
R^2	0.33		R^2	0.38	
Durbin-Watson stat	1.96		Durbin-Watson stat	1.99	

[1] *The optimal lags of the variables are chosen by the Akaike information criteria.*

Table 21: ARDL Long-run Model for PD using RatchetDol

Narrow Dollarization Index - NDI			Broad Dollarization Index - BDI		
Variables	**Coefficient**	**P-value**	**Variables**	**Coefficient**	**P-value**
Expected Depreciation	0.0426	0.0002	**Expected Depreciation**	0.0474	0.0001
Policy Rate Difference	0.0945	0.1479	**Policy Rate Difference**	0.1384	0.0505
RatchetNDI	0.5211	0.0410	**RatchetBDI**	0.9231	0.0047

Graph 16: CUSUM of Squares Test for PD using RatchetDol



Section 5

Table 22: ARDL Error Correction Model Regression for DRD using RatchetCPI

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Chosen Model: ARDL (9, 0, 6, 3)			**Chosen Model: ARDL (9, 0, 4, 2)**		
Variables[1]	**Coefficient**	**P-value**	**Variables**[1]	**Coefficient**	**P-value**
D(NDI(-1))	0.1639	0.0040	**D(BDI(-1))**	0.0419	0.4382
D(NDI(-2))	0.1203	0.0321	**D(BDI(-2))**	0.1514	0.0052
D(NDI(-3))	0.0191	0.7370	**D(BDI(-3))**	0.0678	0.2149
D(NDI(-4))	-0.1133	0.0429	**D(BDI(-4))**	-0.0853	0.1214
D(NDI(-5))	-0.0443	0.4167	**D(BDI(-5))**	-0.0293	0.5687
D(NDI(-6))	0.1029	0.0574	**D(BDI(-6))**	0.0922	0.0763
D(NDI(-7))	0.0446	0.3930	**D(BDI(-7))**	0.0508	0.3237
D(NDI(-8))	-0.1554	0.0028	**D(BDI(-8))**	-0.1604	0.0021
D(DRD)	-0.0209	0.3843	**D(DRD)**	0.0090	0.7597
D(DRD(-1))	-0.1116	0.0000	**D(DRD(-1))**	-0.0868	0.0032
D(DRD(-2))	-0.0293	0.2298	**D(DRD(-2))**	-0.0751	0.0081
D(DRD(-3))	-0.0426	0.0684	**D(DRD(-3))**	-0.0696	0.0143
D(DRD(-4))	0.0537	0.0222	**D(RatchetCPI)**	0.1590	0.1609
D(DRD(-5))	-0.0343	0.1452	**D(RatchetCPI(-1))**	-0.2687	0.0179
D(RatchetCPI)	0.1031	0.2503			
D(RatchetCPI(-1))	-0.1662	0.0691			
D(RatchetCPI(-2))	-0.1966	0.0299			
ECM	-0.0832	0.0000	ECM	-0.1260	0.0000
R^2	0.32		R^2	0.28	
Durbin-Watson stat	1.99		Durbin-Watson stat	1.96	

[1] *The optimal lags of the variables are chosen by the Akaike information criteria.*

Table 23: ARDL Long-run Model for DRD using RatchetCPI

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Variables	**Coefficient**	**P-value**	**Variables**	**Coefficient**	**P-value**
Expected Depreciation	0.0590	0.0012	**Expected Depreciation**	0.0620	0.0000
Deposit Rate Difference	0.1774	0.2943	**Deposit Rate Difference**	0.2076	0.1186
RatchetCPI	-0.3669	0.1202	**RatchetCPI**	-0.0116	0.9470

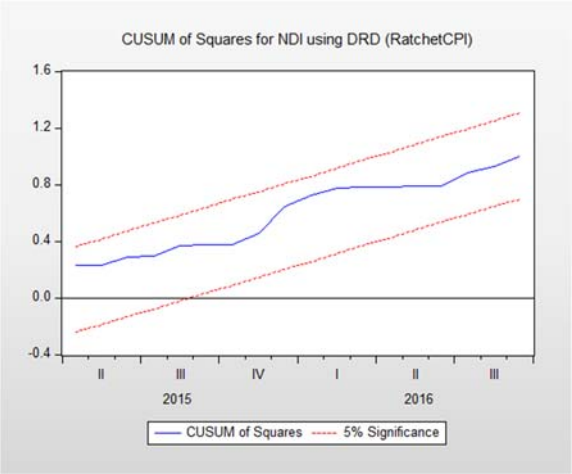
Table 24: Breusch-Pagan-Godfrey Heteroskedasticity Test for DRD using RatchetCPI

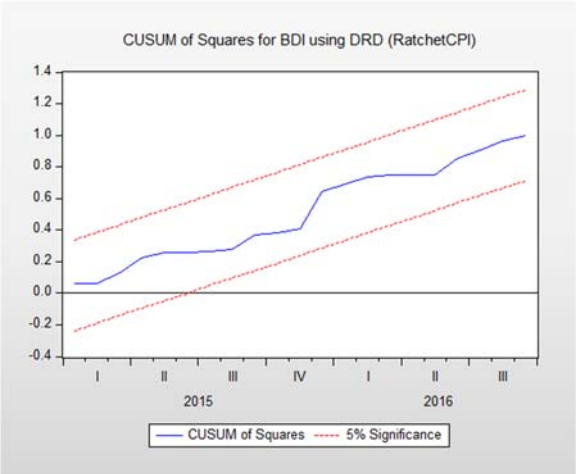
Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
15.19	0.9368	24.12	0.3410

Table 25: Serial Correlation LM Test for DRD using RatchetCPI

Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
14.33	0.2796	15.26	0.2273

Graph 17: CUSUM of Squares Test for DRD using RatchetCPI





Section 6

Table 26: ARDL Error Correction Model Regression only for DRD

Broad Dollarization Index - BDI

Chosen Model: ARDL (9, 0, 4)

Variables[1]	**Coefficient**	**P-value**
D(BDI(-1))	0.0441	0.4169
D(BDI(-2))	0.1484	0.0065
D(BDI(-3))	0.0850	0.1150
D(BDI(-4))	-0.1059	0.0518
D(BDI(-5))	-0.0299	0.5627
D(BDI(-6))	0.0893	0.0873
D(BDI(-7))	0.0468	0.3663
D(BDI(-8))	-0.1534	0.0034
D(DRD)	0.0218	0.4315
D(DRD(-1))	-0.1052	0.0001
D(DRD(-2))	-0.0763	0.0064
D(DRD(-3))	-0.0778	0.0060
ECM	-0.1286	0.0000
R^2	0.27	
Durbin-Watson stat	1.94	

[1] *The optimal lags of the variables are chosen by the Akaike information criteria.*

Table 27: ARDL Long-run Model only for DRD

Broad Dollarization Index - BDI

Variables	**Coefficient**	**P-value**
Expected Depreciation	0.0620	0.0000
Deposit Rate Difference	0.1781	0.1513

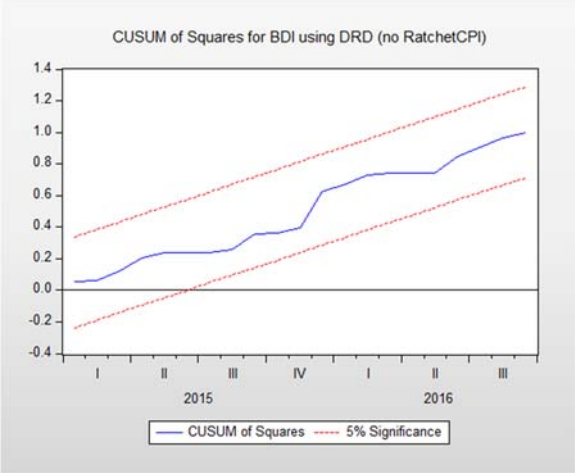
Table 28: Breusch-Pagan-Godfrey Heteroskedasticity Test only for DRD

Broad Dollarization Index - BDI	
F-statistic	p-value
17.54	0.5535

Table 29: Serial Correlation LM Test only for DRD

Broad Dollarization Index - BDI	
F-statistic	p-value
16.94	0.1517

Graph 18: CUSUM of Squares Test only for DRD



Section 7

Table 30: ARDL Error Correction Model Regression for DRD using RatchetDol

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Chosen Model: ARDL (9, 0, 6, 1)			**Chosen Model: ARDL (9, 0, 4, 1)**		
Variables[1]	**Coefficient**	**P-value**	**Variables**[1]	**Coefficient**	**P-value**
D(NDI(-1))	0.1822	0.0008	**D(BDI(-1))**	0.0619	0.2189
D(NDI(-2))	0.0972	0.0716	**D(BDI(-2))**	0.1128	0.0275
D(NDI(-3))	0.0437	0.4187	**D(BDI(-3))**	0.0765	0.1315
D(NDI(-4))	-0.1029	0.0540	**D(BDI(-4))**	-0.1091	0.0317
D(NDI(-5))	-0.0603	0.2468	**D(BDI(-5))**	-0.0396	0.4074
D(NDI(-6))	0.0965	0.0624	**D(BDI(-6))**	0.0843	0.0781
D(NDI(-7))	0.0423	0.3956	**D(BDI(-7))**	0.0463	0.3323
D(NDI(-8))	-0.1314	0.0083	**D(BDI(-8))**	-0.1239	0.0100
D(DRD)	-0.0207	0.3304	**D(DRD)**	0.0130	0.6092
D(DRD(-1))	-0.1243	0.0000	**D(DRD(-1))**	-0.1074	0.0000
D(DRD(-2))	-0.0518	0.0164	**D(DRD(-2))**	-0.0638	0.0129
D(DRD(-3))	-0.0564	0.0088	**D(DRD(-3))**	-0.0651	0.0119
D(DRD(-4))	0.0476	0.0286	**D(RatchetBDI)**	2.8537	0.0000
D(DRD(-5))	-0.0330	0.1358			
D(RatchetNDI)	2.7589	0.0000			
ECM	-0.1274	0.0000	ECM	-0.2004	0.0000
R^2	0.38		R^2	0.39	
Durbin-Watson stat	1.95		Durbin-Watson stat	1.94	

[1] *The optimal lags of the variables are chosen by the Akaike information criteria.*

Table 31: ARDL Long-run Model for DRD using RatchetDol

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Variables	**Coefficient**	**P-value**	**Variables**	**Coefficient**	**P-value**
Expected Depreciation	0.0403	0.0002	**Expected Depreciation**	0.0422	0.0000
Deposit Rate Difference	0.0375	0.7137	**Deposit Rate Difference**	0.1344	0.0663
RatchetNDI	0.5294	0.0567	**RatchetBDI**	1.0160	0.0000

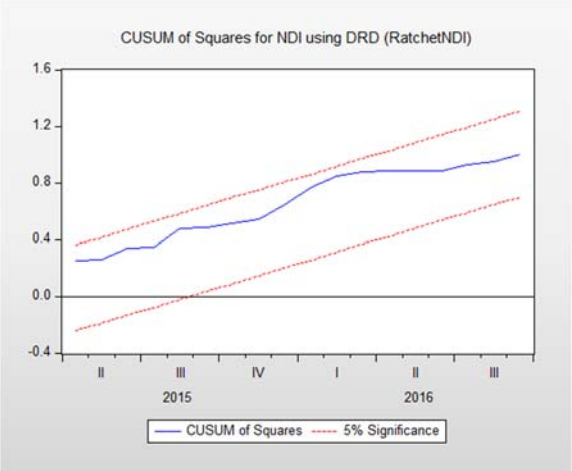
Table 32: Breusch-Pagan-Godfrey Heteroskedasticity Test for DRD using RatchetDol

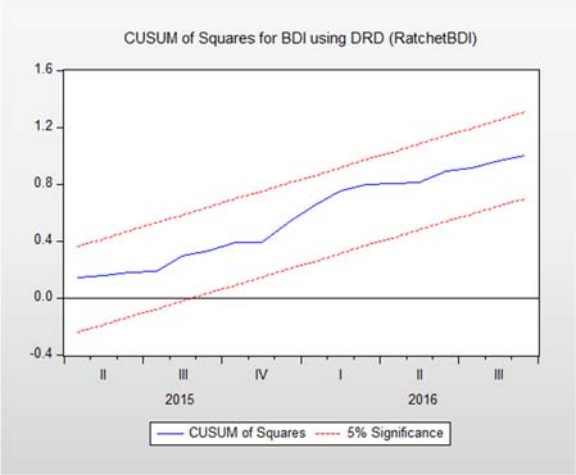
Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
20.18	0.6312	25.98	0.2081

Table 33: Serial Correlation LM Test for DRD using RatchetDol

Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
15.85	0.1982	13.70	0.3200

Graph 19: CUSUM of Squares Test for DRD using RatchetDol





Section 8

Table 34: ARDL Error Correction Model Regression for INT using RatchetCPI

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Chosen Model: ARDL (3, 0, 4, 3)			**Chosen Model: ARDL (9, 0, 4, 4)**		
Variables[1]	**Coefficient**	**P-value**	**Variables**[1]	**Coefficient**	**P-value**
D(NDI(-1))	0.1430	0.0074	**D(BDI(-1))**	0.0410	0.4456
D(NDI(-2))	0.1091	0.0391	**D(BDI(-2))**	0.1422	0.0084
D(INT)	0.0058	0.6399	**D(BDI(-3))**	0.0681	0.2182
D(INT(-1))	-0.0665	0.0000	**D(BDI(-4))**	-0.0932	0.0881
D(INT(-2))	-0.0297	0.0079	**D(BDI(-5))**	-0.0280	0.6009
D(INT(-3))	-0.0415	0.0000	**D(BDI(-6))**	0.1015	0.0591
D(RatchetCPI)	0.0306	0.7611	**D(BDI(-7))**	0.0538	0.3079
D(RatchetCPI(-1))	-0.1145	0.2875	**D(BDI(-8))**	-0.1466	0.0052
D(RatchetCPI(-2))	-0.3213	0.0015	**D(INT)**	0.0021	0.8983
			D(INT(-1))	-0.0641	0.0002
			D(INT(-2))	-0.0351	0.0398
			D(INT(-3))	-0.0325	0.0166
			D(RatchetCPI)	0.0837	0.5286
			D(RatchetCPI(-1))	-0.2401	0.0864
			D(RatchetCPI(-2))	-0.2745	0.0468
			D(RatchetCPI(-3))	-0.2011	0.1459
ECM	-0.0804	0.0000	ECM	-0.1133	
R^2	0.29		R^2	0.28	
Durbin-Watson stat	1.96		Durbin-Watson stat	1.95	

[1] *The optimal lags of the variables are chosen by the Akaike information criteria.*

Table 35: ARDL Long-run Model for INT using RatchetCPI

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Variables	**Coefficient**	**P-value**	**Variables**	**Coefficient**	**P-value**
Expected Depreciation	0.0641	0.0006	**Expected Depreciation**	0.0642	0.0001
Interbank Rate Difference	0.3137	0.0293	**Interbank Rate Difference**	0.3099	0.0235
RatchetCPI	-0.3219	0.1361	**RatchetCPI**	-0.0479	0.8096

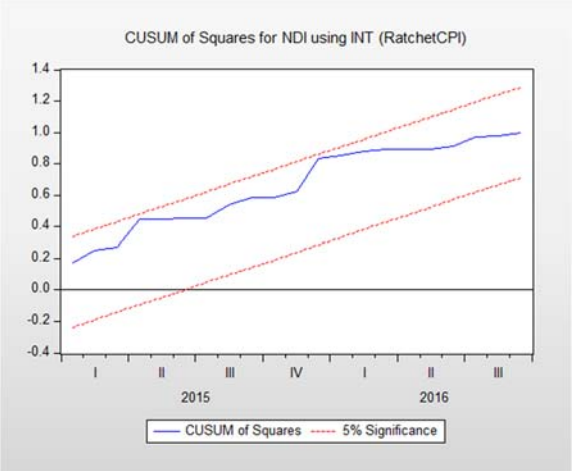
Table 36: Breusch-Pagan-Godfrey Heteroskedasticity Test for INT using RatchetCPI

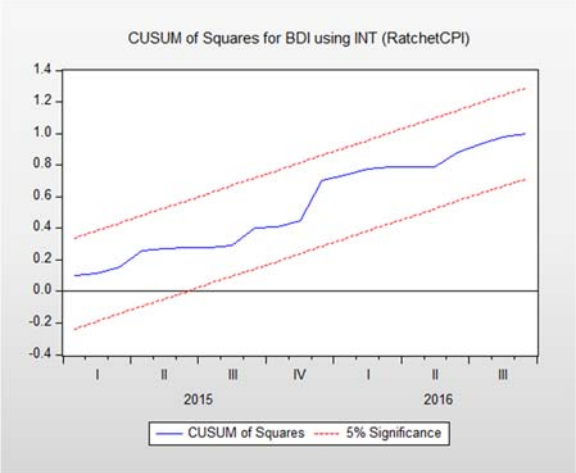
Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
11.77	0.8139	25.10	0.4004

Table 37: Serial Correlation LM Test for INT using RatchetCPI

Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
12.53	0.4044	14.86	0.2490

Graph 20: CUSUM of Squares Test for INT using RatchetCPI





Section 9

Table 38: ARDL Error Correction Model Regression only for INT

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Chosen Model: ARDL (3, 0, 4)			**Chosen Model: ARDL (9, 0, 4)**		
Variables[1]	**Coefficient**	**P-value**	**Variables**[1]	**Coefficient**	**P-value**
D(NDI(-1))	0.1901	0.0005	**D(BDI(-1))**	0.0625	0.2456
D(NDI(-2))	0.1124	0.0401	**D(BDI(-2))**	0.1501	0.0058
D(INT)	0.0145	0.1464	**D(BDI(-3))**	0.0705	0.1995
D(INT(-1))	-0.0529	0.0000	**D(BDI(-4))**	-0.1056	0.0527
D(INT(-2))	-0.0361	0.0007	**D(BDI(-5))**	-0.0464	0.3777
D(INT(-3))	-0.0446	0.0000	**D(BDI(-6))**	0.0813	0.1257
			D(BDI(-7))	0.0341	0.5165
			D(BDI(-8))	-0.1449	0.0059
			D(INT)	0.0175	0.1689
			D(INT(-1))	-0.0480	0.0005
			D(INT(-2))	-0.0320	0.0198
			D(INT(-3))	-0.0427	0.0009
ECM	-0.0944	0.0000	ECM	-0.1178	0.0000
R^2	0.23		R^2	0.25	
Durbin-Watson stat	1.97		Durbin-Watson stat	1.96	

[1] *The optimal lags of the variables are chosen by the Akaike information criteria.*

Table 39: ARDL Long-run Model only for INT

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Variables	**Coefficient**	**P-value**	**Variables**	**Coefficient**	**P-value**
Expected Depreciation	0.0445	0.0000	**Expected Depreciation**	0.0654	0.0000
Interbank Rate Difference	0.1376	0.1765	**Interbank Rate Difference**	0.1185	0.2548

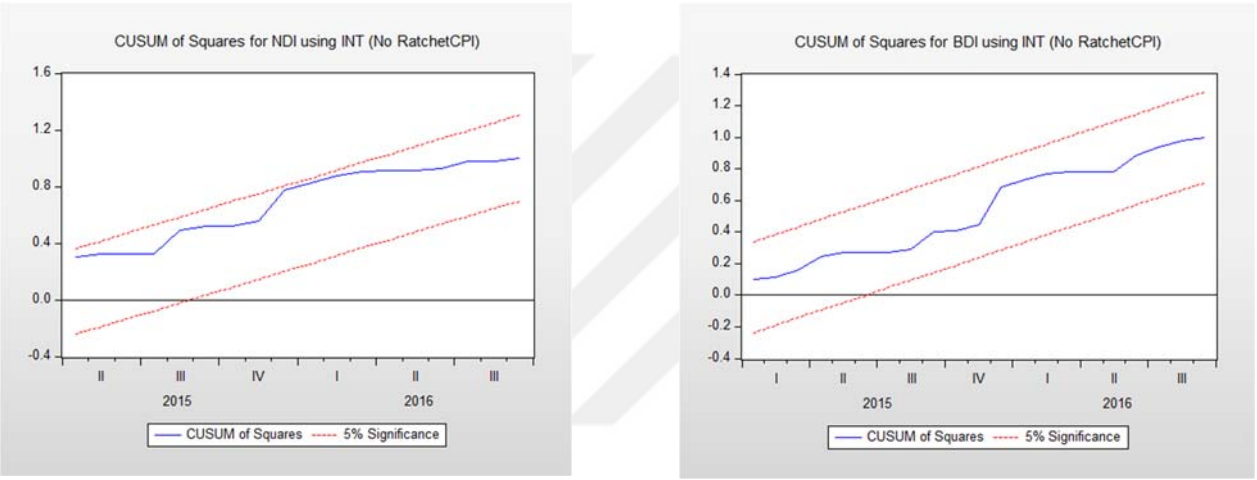
Table 40: Breusch-Pagan-Godfrey Heteroskedasticity Test only for INT

Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
14.70	0.3261	17.13	0.5811

Table 41: Serial Correlation LM Test only for INT

Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
14.07	0.2963	12.82	0.3819

Graph 21: CUSUM of Squares Test only for INT



Section 10

Table 42: ARDL Error Correction Model Regression for INT using RatchetDepr

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Chosen Model: ARDL (3, 0, 4, 0)			**Chosen Model: ARDL (9, 0, 4, 0)**		
Variables[1]	**Coefficient**	**P-value**	**Variables**[1]	**Coefficient**	**P-value**
D(NDI(-1))	0.1795	0.0010	**D(BDI(-1))**	0.0601	0.2647
D(NDI(-2))	0.1011	0.0630	**D(BDI(-2))**	0.1478	0.0066
D(INT)	0.0124	0.2118	**D(BDI(-3))**	0.0688	0.2108
D(INT(-1))	-0.0488	0.0000	**D(BDI(-4))**	-0.1070	0.0497
D(INT(-2))	-0.0338	0.0014	**D(BDI(-5))**	-0.0473	0.3687
D(INT(-3))	-0.0434	0.0000	**D(BDI(-6))**	0.0801	0.1312
			D(BDI(-7))	0.0333	0.5272
			D(BDI(-8))	-0.1459	0.0055
			D(INT)	0.0169	0.1833
			D(INT(-1))	-0.0468	0.0006
			D(INT(-2))	-0.0313	0.0227
			D(INT(-3))	-0.0422	0.0011
ECM	-0.0880	0.0000	ECM	-0.1152	0.0000
R^2	0.23		R^2	0.25	
Durbin-Watson stat	1.98		Durbin-Watson stat	1.96	

[1] *The optimal lags of the variables are chosen by the Akaike information criteria.*

Table 43: ARDL Long-run Model for INT using RatchetDepr

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Variables	**Coefficient**	**P-value**	**Variables**	**Coefficient**	**P-value**
Expected Depreciation	0.0643	0.0012	**Expected Depreciation**	0.0691	0.0002
Interbank Rate Difference	0.0678	0.5901	**Interbank Rate Difference**	0.1040	0.3958
RatchetDepr	0.0248	0.2541	**RatchetDepr**	0.0051	0.8100

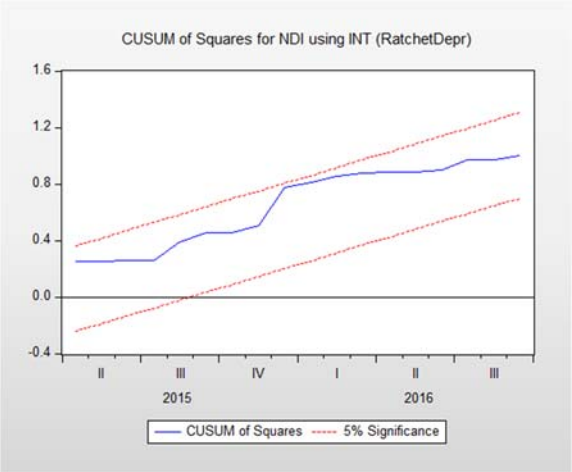
Table 44: Breusch-Pagan-Godfrey Heteroskedasticity Test for INT using RatchetDepr

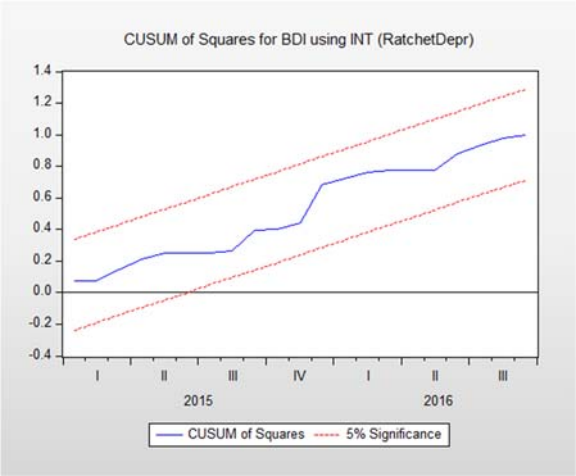
Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
13.67	0.4745	19.86	0.4666

Table 45: Serial Correlation LM Test for INT using RatchetDepr

Narrow Dollarization Index - NDI		Broad Dollarization Index - BDI	
F-statistic	p-value	F-statistic	p-value
12.45	0.4103	12.43	0.4121

Graph 22: CUSUM of Squares Test for INT using RatchetDepr





Section 11

Table 46: ARDL Error Correction Model Regression for INT using RatchetDol (HAC)

Narrow Dollarization Index - NDI			**Broad Dollarization Index - BDI**		
Chosen Model: ARDL (2, 0, 6, 1)			**Chosen Model: ARDL (9, 0, 4, 5)**		
Variables[1]	**Coefficient**	**P-value**	**Variables**[1]	**Coefficient**	**P-value**
D(NDI(-1))	0.1878	0.0004	**D(BDI(-1))**	0.0313	0.5598
D(INT)	1.71E-05	0.9986	**D(BDI(-2))**	0.1077	0.0452
D(INT(-1))	-0.0561	0.0000	**D(BDI(-3))**	0.0787	0.1423
D(INT(-2))	-0.0438	0.0000	**D(BDI(-4))**	-0.0988	0.0614
D(INT(-3))	-0.0559	0.0000	**D(BDI(-5))**	-0.0573	0.2564
D(INT(-4))	-0.0137	0.1750	**D(BDI(-6))**	0.0872	0.0826
D(INT(-4))	-0.0205	0.0267	**D(BDI(-7))**	0.0619	0.2173
D(RatchetNDI)	2.6794	0.0000	**D(BDI(-8))**	-0.1017	0.0408
			D(INT)	-0.0017	0.9000
			D(INT(-1))	-0.0511	0.0002
			D(INT(-2))	-0.0398	0.0055
			D(INT(-3))	-0.0288	0.0222
			D(RatchetBDI)	3.0936	0.0000
			D(RatchetBDI(-1))	0.6955	0.1461
			D(RatchetBDI(-2))	-0.4443	0.4327
			D(RatchetBDI(-3))	-0.6153	0.2240
			D(RatchetBDI(-4))	-0.9100	0.0811
ECM	-0.1235	0.0000	ECM	-0.1650	0.0000
R^2	0.32		R^2	0.38	
Durbin-Watson stat	1.98		Durbin-Watson stat	1.93	

[1] *The optimal lags of the variables are chosen by the Akaike information criteria.*

Table 47: ARDL Long-run Model for INT using RatchetDol

Narrow Dollarization Index - NDI			Broad Dollarization Index - BDI		
Variables	**Coefficient**	**P-value**	**Variables**	**Coefficient**	**P-value**
Expected Depreciation	0.0440	0.0000	**Expected Depreciation**	0.0471	0.0000
Interbank Difference	0.1158	0.1753	**Interbank Difference**	0.1796	0.0864
RatchetNDI	0.4541	0.0753	**RatchetBDI**	0.8931	0.0000

Graph 23: CUSUM of Squares Test for INT using RatchetDol

