

REGIONAL DOLLARIZATION DIFFERENCES AND DETERMINANTS: THE CASE OF TURKEY

BÖLGESEL DOLARİZASYON FARKLILIKLARI VE BELİRLEYİCİLERİ: TÜRKİYE ÖRNEĞİ

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Abstract

This study investigates the determinants of deposit dollarization within 81 cities of Turkey for the period of 2007:Q4 – 2019:Q1. Within this scope, exchange rate, CDS premiums, city inflation, city export and import are used to model deposit dollarization. As an econometric approach both fixed and random effect panel data methods are implemented using relevant libraries¹ in Python² programming language to measure the impact of independent variables. As a result, all independent variables have statistically significant and positive effect on deposit dollarization within cities. When evaluated according to the effect sizes, inflation, import, export, exchange rate and CDS premiums are considered to be determinant, respectively, on deposit dollarization in Turkish cities. On the other hand, when the two models are tested with the Hausman test, which has a null hypothesis “random effect estimator is true”, it is concluded that the random effect model is more suitable for our model. In addition, to see if citizens living abroad that have registered in the cities have an impact on the dollarization, Pearson correlation is conducted and it is found that there is relatively strong correlation between the number of expatriate citizens and deposit dollarization in the city.

Keywords: Dollarization, Panel Data, Regional Analysis, City-level Analysis

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1 Python version is 3.7.3.

2 Numpy, pandas, matplotlib, plotly express, seaborn, folium, json and statsmodel libraries are used.

Öz

Bu makale Türkiye'nin 81 ilindeki 2007:Q4 ve 2019:Q1 dönemi mevduat dolarizasyonunun belirleyicilerini konu edinmekte olup, bu kapsamda mevduat dolarizasyonunu döviz kuru, CDS primleri, enflasyonu, ihracatı ve ithalatının bir fonksiyonu olarak ele almaktadır. Ekonometrik model olarak panel veri analiz yöntemlerinden sabit etkili (fixed effect) model ile rassal (random) etkili modelin Python³ programlama dilinde ilgili kütüphaneleri⁴ kullanılarak yapılan çalışmada, öncelikle tüm bağımsız değişkenlerinin dolarizasyon üzerinde istatistiksel olarak anlamlı bir biçimde ve pozitif bir ilişkiye sahip olduğu sonucuna ulaşılmıştır. Etki büyüklüklerine göre değerlendirildiğinde ise, sırasıyla, enflasyon, ithalat, ihracat, döviz kuru ve CDS primlerinin illerdeki mevduat dolarizasyonu üzerinde belirleyici olduğu değerlendirilmektedir. Diğer taraftan, sıfır (null) hipotezi "rassal etkili model (random effect) tahmincisi doğrudur" olan Hausman testi ile iki model sınandığında, modelimiz için rassal (random) etkili modelin daha uygun olduğu sonucuna ulaşılmıştır. Ayrıca, yurtdışında yaşayan gurbetçi vatandaşların illerdeki dolarizasyon üzerinde bir etkisi olup olmadığına bakmak için sabit (fixed) etkili modelde her bir il için hesaplanan sabit terim ile il nüfusuna kayıtlı gurbetçi vatandaşlar (Türkiye Cumhuriyeti vatandaşı olup yurtdışında ikamet eden) arasında nispeten güçlü sayılabilecek bir korelasyon bulunmuştur.

Anahtar Kelimeler: Dolarizasyon, Panel Veri, Bölgesel Analiz, İl Analiz

1. Introduction

The issue of dollarization has become a questioned issue in the field of economics, with the globalization trend that started after the 1970s, especially with the collapse of the Bretton Woods fixed exchange rate system. As of this date, capital flows to the countries and the harmonization of international financial markets accelerated. With the use of the Euro as a common currency in the European Region (Eurozone) in 1999 and with the studies of the crises faced by developing countries (EMs), especially Latin American countries, dollarization⁵ topic has gained further interest in the literature.

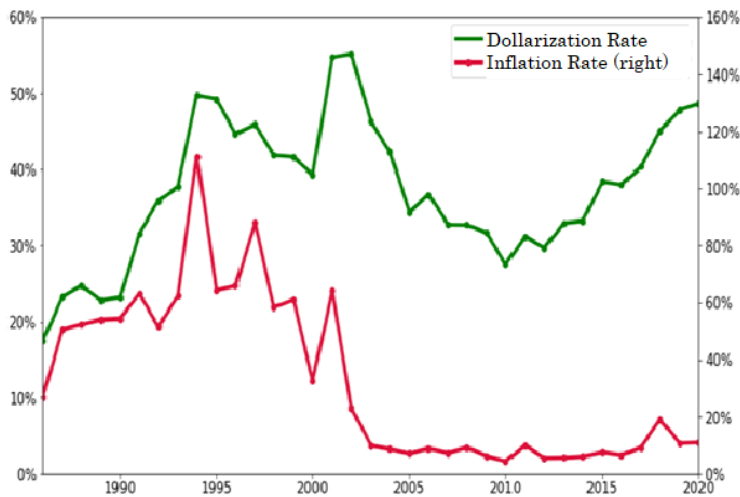
In Turkey, with the stabilization measures implemented in the 1980s, liberalization steps were taken in the economy, and financial markets were deregulated gradually by removing exchange rate controls. The Central Bank of the Republic of Turkey (CBRT) started to announce the exchange rates on a daily basis as of May 1, 1981, and subsequently, with the Decision No. 30 on the Protection of the Value of Turkish Currency (PVTC), which came into force on July 7, 1984, the exchange barriers were removed to a large extent. Thus, domestic residents were given the right to open foreign currency deposit accounts, hold foreign currency and make savings in foreign currency, by which the dollarization process

3 Python 3.7.3 sürümü kullanılmıştır.

4 Numpy, pandas, matplotlib, plotly express, seaborn, folium, json ve statsmodel kütüphaneleri kullanılmıştır.

5 During the crisis that started in the 1990s, since the preferred foreign currency was the dollar, this phenomenon was called dollarization and also euroization has emerged for the countries that prefer the Euro (Brown and Stix, 2015).

in Turkey had the opportunity to start and accelerate. Furthermore, with the PVTC Decision No. 32 dated 11 August 1989, Turkish Lira was made by authorities fully convertible and foreign currency transaction restrictions applied to domestic and non-residents were completely removed. Since this date, short-term capital flows to Turkey have accelerated, and therefore, fluctuations in the exchange rate have increased. Trying to earn from high interest rates in Turkey, domestic banks made investments in domestic financial instruments and they financed these investments by borrowing from abroad in foreign currency. Depositors who want to protect their savings in the face of inflation or who are insecure about the economy, on the other hand, have preferred foreign currency and gold, which speeded up a strong dollarization trend in the economy. The economic crises (1994, 2000, 2001, 2008, 2011) that are experienced almost every ten year due to both global and geopolitical reasons have further reinforced the distrust of the savers in the Turkish Lira, and the country has faced high deposit dollarization even during periods of relative stability in macroeconomic terms.



Graph 1. Deposit dollarization and inflation in Turkey for the period 1986-2020

Source: CBRT, BRSA

Since there are many studies in the literature about the dollarization of different countries including Turkey and there is none study within Turkey, this article tries to investigate the determinants of deposit dollarization in the provinces of Turkey, and deals with deposit dollarization as a function of exchange rate, CDS premiums, provincial inflation, provincial exports and provincial imports. In the analysis, in which fixed effect model and random effect model from panel data analysis methods were used as econometric model, it was concluded that all these independent variables had statistically significant and positive impacts on dollarization. When evaluated according to effect sizes, it is found that inflation, import, export, exchange rate and CDS premiums play important roles on deposit dollarization in provinces, respectively. On the other hand, when two models are tested with the Hausman test, whose null hypothesis is that the “random effect estimator is correct”, it is concluded

that the random effect model is more accurate for our model. In addition, a relatively strong correlation was found between the fixed term calculated for each province in the fixed-effect method and the expatriate citizens in the provinces, that are registered in the province population.

2. Measurement of Dollarization

Although there is not a complete and precise formula for measuring dollarization, it is possible to reach a conclusion based on the former studies. It should be noted, however, that the dollarization measurement may vary depending on the study to be performed or how sensitive and comprehensive dollarization is targeted. In general, the monetary size of foreign currency deposits over total deposits or the broad money supply emerges as an usual measure of the level of domestic dollarization. Conceptually, it is accepted that one of the important criteria of the level of asset dollarization in the country is the ratio of foreign currency items in the total basket of households and the real sector (non-financial sector) (Akıncı, Barlas & Usta, 2005).

On the other hand, the ratio of liabilities of the private sector in foreign currency to total liabilities is expressed as credit dollarization. As another method, the ratio of the liabilities of the private sector in foreign currency to the total liabilities in the balance sheet of the banking sector is used as an indicator of the level of credit dollarization (Arteta, 2003). As a result of the working principle of the banking sector, since the size of the loan given is compatible (in the same amount) with the deposits collected as a rule, eliminating the risk of currency mismatch, Levy-Yeyati (2006) in his study brought forward that the dollarization level in a country was determined by the amount of foreign currency in both deposits and loans.

Although there is no generally accepted and precise indicator for the measurement of dollarization in a country, the “composite dollarization index”, which is put forward by Reinhart, Rogoff & Savastano (2003), is widely accepted and used in the literature since it gives a detailed representation of the dollarization level in a country and aggregates the traditional dollarization indicators in a meaningful way. “Composite dollarization index” has 3 components, which are;

- The share of foreign currency accounts in the broad money supply,
- The share of total external liabilities in national income,
- The share of the countries’ foreign currency denominated domestic liabilities within the total domestic liabilities.

Therefore, the composite index deals with dollarization indicators for both the household and private sector, as well as the public sector. Each of the 3 ratios mentioned is normalized to be equal to the number 10, and then the general index value is reached by summing. According to Reinhart, Rogoff & Savastano (2003), the dollarization level is interpreted as low in the 0-3 band, normal in the 4-8 band, high in the 9-13 band, and very high in the 14-30 band.

The biggest weakness of the indicators for measuring dollarization size mentioned so far is offshore accounts, which is why it is criticized since it does not fully reflect the dollarization level. Especially in countries experiencing economic and financial difficulties (depression), offshore accounts can reach surprising sizes due to the restrictive measures applied against foreign currency transactions. The best example of this situation was experienced in Brazil, Colombia and Venezuela. Domestic residents transferred a large part of their savings to their foreign accounts due to their concerns about the country's economy, and as a result of this, traditional dollarization measurements made on account sizes within the country are quite low (IADB, 2005). Turkey is also suspected to be on the same road with these countries, as net errors and omissions figures on the balance of payments statistics has risen drastically to 23 billion dollars in 2019 (almost 10 times of the average of last 15 years), which shows that residents financing their currency needs from off-shore accounts without transferring money to Turkey.

3. Literature Review

The issue of dollarization has become a questioned issue in the field of economics, with the globalization trend that started after the 1970s, especially with the collapse of the Bretton Woods fixed exchange rate system. As of this date, capital flows to the countries and the harmonization of international financial markets have been accelerated. Especially with the introduction of the Euro as a common currency in the European Region (Eurozone) in 1999 and with the studies of the crises faced by developing countries (EMs), mainly Latin American countries, dollarization topic has been studied heavily in the literature. For this reason, the literature review on dollarization, will be discussed in two parts; studies conducted around the world and studies specific to Turkey.

3.1. Studies Conducted Around the World

The first studies on dollarization came to the fore in the 1980s, when inflation pressure was felt in general and residents especially in emerging economies turned to strong currencies (hard currency) to protect their purchasing power. Ramirez-Rojas (1985) dealt with currency substitution in three countries for the period 1970-1982 in his study titled "Asset Substitution in Argentina, Mexico and Uruguay". As a result of the study, a positive relationship was found between the depreciation of national currency and currency substitution in these countries.

In the study conducted by Honohan and Shi (2001), deposit dollarizations of 58 emerging market economies in the 1990-2000 period were examined, and the share of dollar deposits in bank deposits showed a constantly increasing trend in the related period. Deposit dollarization has continued to increase since 2001, and has accelerated afterwards. While the average dollarization level of the countries discussed in the study was 10% in 1980, it doubled to 33% in 2004 and the median was 5% in 1980, it increased to 28% in 2004 (Honohan, 2007).

Edwards and Magendzo (2003) tried to explain the effects of dollarization on economic performance by using inflation and growth variables. According to the results of the study, in which the

indicators of high dollarized countries were compared with low dollarized countries, the inflation rate in high dollarized countries is clearly higher than low dollarized countries. On the other hand, growth rates in high dollarized countries are lower than in other countries.

Analyzing the interaction between regional currencies and dollarization, Larrain and Tavares (2003) examined the countries in East Asia, South America and Central America through variables such as exchange rate volatility, output asymmetry, export differences and trade intensity. Although there is no economic integration, it has been revealed that East Asia gradually approaches towards the level of integration, while Central and South America are gradually moving away from integration.

Another study dealing with the relationship between dollarization and the banking sector was done by Nicolo, Honohan & Ize (2005). The authors, who analyzed the effect of foreign currency deposits on the banking sector, performed the cause-effect relationship of these variables. In the study conducted with the data of a total of 100 countries, including Turkey, it has been determined that dollarization is a method that investors use to protect their purchasing power. Furthermore, it was emphasized in the study that although countries may reach low inflation figures in the short term, the widespread dollarization process may trigger the banking crisis as a final result.

Neanidis and Savva (2006) examined the interaction of currency substitution and inflation volatility with average inflation and currency substitution for 12 developing countries, including Turkey. In almost all of the developing countries covered in the study, inflation volatility has a positive effect on both the average of inflation and currency substitution. In another study, Neanidis and Savva (2009) examined the short-term determinants of financial dollarization in similar countries and found out that while short-term credit dollarization was generally affected by banks' avoidance of currency mismatch, international financial integration and institutionalization. Deposit dollarization moves in direct proportion to the development in the exchange rate in the short run. In another study, the authors examined the institutionalization and financial dollarization dimensions of the countries that joined the European Union and revealed empirical findings (Neanidis and Savva, 2013). Accordingly, a development that will reinforce confidence, in which case joining the EU, will act as a catalyst in establishing confidence, both reducing economic fluctuations and increasing confidence in the domestic currency. Therefore, it has been concluded that this interaction, which seems to be indirect, has a direct effect on financial dollarization.

Yinusa (2008) examined the interaction between exchange rate fluctuations (nominal exchange rate) and dollarization with the Granger causality test, using the data set on a quarterly basis for the years 1986-2003, through the data of Nigeria. In the study, a stronger and more dominant causality was found from dollarization to exchange rate fluctuation. In Yinusa (2009)'s study, which deals with the factors determining dollarization in 18 Sub-Saharan African economies, the data were analyzed using the ordinary least squares (OLC) and panel least squares methods. Expectations that the local currency will depreciate in Sub-Saharan African countries have been identified as an important factor explaining the

dollarization rate. According to both OLC and panel data results, improvements in political uncertainties reduce deposit dollarization and contribute positively to country risk. Therefore, inflation, political uncertainties, monetary policy implemented by the FED, exchange rate volatility, national interest rates and changes in the exchange rate play a decisive role on the dollarization rate.

Honig (2009), who analyzed the relationship between the banking crisis and dollarization in developing countries in the 1988-2000 period, did not find a strong relationship between dollarization and banking crises in 85 economies, including Turkey. However, as a result of dollarization, it has been determined that developing countries are more fragile in terms of macroeconomic factors compared to the economies of developed countries.

Lay, Kakinaka and Kotani (2010) analyzed the interaction between dollarization and exchange rate fluctuations in Cambodia over the monthly data for the 1998-2008 period. In the study, it was found that exchange rate instability and depreciation of the national currency cause dollarization. In summary, erosion in institutional capacity, political uncertainty and instability, and the thought of inflationary pressure accelerate the dollarization mechanism.

Neanidis (2010) tried to find an answer by examining the relationship between institutionalization and dollarization by examining the countries that have entered the EU membership. In the study, which is based on the monthly data set of a period of approximately 20 years, it has been revealed that the entry to the EU has a direct effect on both deposit and loan dollarization, and the EU accession increases the credit dollarization while decreasing the deposit dollarization in these countries. As a result, the direct effect of institutionalization under the EU framework on dollarization has been empirically proven.

Arellano and Heathcote (2010) examined the relationship between dollarization and financial integration. According to the research on the foreign exchange position of the countries and their credibility in the financial markets, a positive relationship was found between the two variables. In the study, which states that with high dollarization, countries will have the opportunity to borrow large amounts from global markets, waivers about printing money (seigniorage) together with the dollarization process have been identified as negative for countries.

Soto (2009), who discussed the effect of dollarization on economic growth and unemployment, concluded that dollarization will support economic growth because it allows low capital costs, supporting the findings of Arellano and Heathcote (2010). On the other hand, it is another finding of the study that the balance between imports and labor should be observed.

In the study of Lin and Ye (2010), which deals with the effect of dollarization on foreign trade, a linear relationship was determined between dollarization and foreign trade volume. In the study examining the foreign trade transactions between the sample of 6 different countries and the USA, a linear relationship was found between the dollarization rates of the countries and the high foreign trade volumes.

Dealing with the dollarization process and exchange rate uncertainty, Sever (2012) tried to explain the relationship between the two variables with the help of Granger causality analysis (E-GARCH). According to the results obtained from the study, there is a bidirectional causality, although stronger, from dollarization to exchange rate uncertainty between the 1989-2010 period. According to the author, a decrease in exchange rate uncertainty can be mentioned with the decrease in dollarization.

Examining the relationship between dollarization and systematic risk, Vieira, Holand & Resende (2012), on the other hand, worked on a data set consisting of 79 different countries, including Turkey. According to the results obtained from the study, in which variables such as inflation, non-payment risk, total debt/GDP are used and the dynamic panel data (GMM) model is applied, dollarization increases as inflation increases, but a decrease in inflation does not affect the decrease in dollarization. According to the results of the study, the increase in inflation not only increases the risk of non-payment, but also causes an increase in the systematic risk, and the systematic risk ultimately accelerates the dollarization.

Luca and Olivero (2012) questioned the relationship between dollarization and currency risk. As a result, it has been determined that dollarization may cause a banking crisis and hinder competition in the banking sector, especially in developing countries. In the imperfect competitive environment, it has been revealed that foreign currency deposits negatively affect the sector through exchange rate risk, and it is suggested that developing countries should pay attention to this situation and implement policies to increase competition.

Stix (2013), on the other hand, looked at dollarization from a different perspective and investigated why people keep their savings under the pillow rather than in the bank, and the effect of dollarization on this behavior. According to the results of the survey applied to 1000 randomly selected participants from 10 different countries, 5 European Union countries and 5 European Union candidate countries, there are many different reasons why people deposit their money in foreign currency instead of banks and keep it at home. The most important of these are; bank crises in the past, distrust in the economic policies of countries and the motivation to protect the purchasing power of their money. According to the study, all these reasons push people to dollarization and cause them to prefer to keep their savings under the pillow instead of banks due to distrust of financial institutions.

Aiming to measure the effects of dollarization on the Russian economy, Ponomarenko, Solovyeva & Vasilieva (2013) focused especially on the relationship between dollarization and liquidity. In the study, the data of the 2000-2010 period of Russia were examined by Panel OLS and Generalized Method of Moments (GMM) methods. In the study, which determined that countries became more open to risks with the increase in dollarization, exchange rate risk, financial instability and deterioration in macroeconomic balance are the final results of dollarization.

Canofari and Marini (2014), who focus on exchange rate pressure in countries in monetary union or full dollarization, make empirical inferences from countries in the European Region (Eurozone). The financial resilience index created by the output gap and the shadow exchange rate has been

associated with the currency crisis. As a result, the authors, who determined that Greece and Portugal are the countries with the highest probability of being removed from the union or the most sensitive to crises, emphasize that the model created is an early warning mechanism.

Neanidis and Savva (2015) questioned whether there is an interaction between the credit dollarizations of 23 developing countries, including Turkey. Countries that are divided into two groups as low and high dollarized countries have been examined through these groups, and it has been revealed that there is a pure contagion in credit dollarization in high dollarized countries. Geographical proximity between countries, institutional capacity, trade volume and banking integration and the economic size of the country are effective in this contagion.

In the study conducted by Marcelin and Mathur (2016), which examines the effect of dollarization on the financial sector development of developing countries, the effect of foreign currency debt on companies' balance sheets is stressed out. Stating that the exchange rate volatility that will occur due to dollarization will have negative effects on the balance sheets of the companies, the authors stated that as a final result of this situation, both micro and macro indicators in the country will deteriorate. According to the authors, who claim that dollarization will slow down the development of the financial sector, it has been suggested that central banks should control the exchange rate by keeping inflation low for the development of the sector.

Cristo and Puig (2014), which deals with the effect of dollarization on country risk, focused on Latin American countries (Argentina, Brazil, Colombia, Chile, Mexico, Ecuador and Panama) in their study. They analyzed the interaction of macroeconomic variables such as the emerging market bond index (EMBI), inflation, growth and external debt in the 2001-2009 period, and they concluded that countries with high dollarization were less affected by external shocks than countries with low dollarization. It is emphasized that the main reason for this is that investors in countries with high dollarization already minimize the economic losses that external shocks will create within the country through natural hedging.

Capasso and Neanidis (2019), which separates deposits held in the banking system, credits given and electronic funds transfer (EFT) and money transfer transactions in local and foreign currencies, suggested optimal dollarization for the banking sector in 14 Central and Eastern European countries, including Turkey. They tried to estimate the rate. According to the results of the study, it was concluded that while money transfers increase credit dollarization, it decreases deposit dollarization.

Corrales and Imam (2019), who examined the change of households and companies against dollarization in low and high income countries, also discussed the determinants of dollarization in these countries. As a result, it has been found that the currency substitution model is not valid in countries without inflation problems, while currency substitution is present at a high rate in countries where inflation is an important factor. Market enhancing factors such as financial depth, ease of access to foreign debt instruments and foreign exchange financing play an important role in deposit and loan dollarization.

3.2. Studies Specific to Turkey

Hakioğlu (1988), in his study on currency substitution in Turkey, analyzed the foreign exchange deposit accounts in the 1984-1987 period, including both the time deposits and demand deposits, using the least squares method (LSM) and came to the conclusion that the Turkish lira was substituted for foreign currencies.

Ertürk (1991), on the other hand, analyzed the foreign exchange deposit accounts and money supply with the national and foreign currency interest rates and exchange rates variables for the period 1986-1988, using the least squares method. As a result, in line with the study of Ulusoy and Küçükkale (1996), a linear relationship was determined between increases in inflation, devaluation expectations, and increases in foreign currency interest rates and foreign currency demand.

Özkaramete (1996) discussed the rate of change in exchange rates, interest rates, broad money supply, inflation and dollarization rate with the vector autoregression (VAR) method. According to the results of the study covering the period 1990-1995, there is a positive relationship between dollarization and all variables except the interest rate variable.

Following the liberalization of capital movements in Turkey, Akçay, Alper & Karasulu (1997) examined the interaction between exchange rate instability and the magnitude of currency substitution in 1987-1996 period. In this study, exchange rate instability was modeled using the EGARCH method and it was revealed that currency substitution had a positive (positive) effect on exchange rate instability.

Researching the determinants of currency substitution in Turkey, Domaç and Oskooee (2003) tried to make inferences based on the 1990-2001 period data. According to the findings of the study, economic instability, high inflation and erosion in institutional capacity are the main determining factors on currency substitution. The purchasing power, which was lost with the rise of inflation, prompted people to save and make transactions in foreign currency. In addition, there are findings that the expected volatility in the exchange rate also increases the currency substitution.

Civcir (2005) investigated dollarization with the expected exchange rate changes, the difference in national and foreign currency interest rates, the exchange rate risk and the credibility of economic policy using the Johansen Co-Integration method. In the study, in which monthly data for the period 1986-1999 were used, it was found that the determinants of the dollarization process in the long run was the difference in real interest rates and the expected exchange rate changes.

Akıncı, Barlas & Usta (2005), based on the study of Reinhart, Rogoff & Savastano (2003), created asset, liability and compound dollarization indices as indicators of the dollarization process in Turkey. All indices confirm that the stabilization program implemented since 2002 reversed the dollarization trend and that the program was successful.

In the study conducted by Yılmaz (2005), inspired by the composite dollarization index which is created in the studies of Reinhart, Rogoff & Savastano (2003), the combined dollarization index was calculated for Turkey, and the index value was found to be 10 (high) for the period 1989-2004.

Özcan and Us (2007), on the other hand, examined whether inflation, which entered into continuous falling trend owing to the economic policies implemented in Turkey during the 2002-2005 period, affected dollarization or not. The study revealed that reverse dollarization was experienced in this period. According to the authors, who stated that macroeconomic indicators should improve in order for dollarization, which has been on the rise since the first half of 2006, to enter a downward trend again, a clear policy is required to combat dollarization. Terzi and Kurt (2007), on the other hand, examined the causes of dollarization and discussed the ratio of the foreign currency deposits to the M2Y money supply between 1990-2006. In this period, it was concluded that inflation, exchange rate and money supply changes were the main causes of dollarization.

Uluç and Acar (2008) discussed the effect of banks' debt dollarization on financial fragility for 24 developing countries in the 1990-2004 period using the Panel Probit method, and concluded that the debt dollarization of banks had an increasing effect on financial fragility.

Dumrul (2010) investigated the relationship between dollarization and inflation in Turkey, and analyzed the 1988-2009 period data with the Vector Autoregressive Model (VAR) method. As a result of variance decomposition results, 1% change in the inflation rate in the 10th period is affected the dollarization rate by 0.63%. According to Granger Causality findings, it was determined that the dollarization rate was the cause of the inflation rate at 10% significance level.

In another study dealing with dollarization in Turkey, Zeybek (2014) examined the effect of the dollarization process on the financial performance of banks in the 1990-2013 period. In this study, which examines the relationship between the real sector confidence index, inflation, required reserve provisions and dollarization, which affect the performance of the banking sector, multiple regression analysis was applied with the other two variables after determining that the required reserve provisions had no effect on dollarization. As a result of this analysis, it was seen that both variables (inflation and real sector confidence index) had a statistically significant effect on dollarization.

Alp and Yalçın (2015) analyzed the CBRT Company Balance Sheets data for the period 1996-2010 using the dynamic panel method (GMM), and they concluded that debt dollarization had a positive effect on the operating income and employment areas of the companies in general. The authors emphasize that the real sector firms in Turkey are generally below the Turkish lira borrowing limit, and this limit can be overcome by borrowing in foreign currency. On the other hand, it is among the results obtained that credit dollarization negatively affects the growth of firms with low exports and high credit dollarization. Finally, it has been revealed in the study that firms can increase their growth performance by increasing their export revenues, however especially in times of economic depression, significant decreases are observed in the net profit margins of the firms with high credit dollarization, and as a result, the activities of firms are negatively affected through the "balance sheet channel".

On the other hand, Çağlayan and Talavera (2016) examined the effect of credit dollarization on the efficiency (liquidity and bank profitability) of banks in Turkey in the period of 2003 – 2014 by using panel data method. It was concluded that the foreign currency funds received by the banks are

mostly used as foreign currency loans and the banks that provided foreign currency loans held less liquid assets in order to increase profitability. On the other hand, it was determined that banks carry out their liquidity management more aggressively in order to obtain more return (profitability), especially in periods when the Turkish Lira is stable, and therefore, credit dollarization increases the performance of the banks.

Marcelin and Mathur (2016), examined the share of foreign currency loans used by companies in total loans and national income in the 2005-2013 period. The study revealed that companies in Turkey have foreign currency loans at the rate of 40.63 percent, and the ratio of these loans to national income is 27 percent.

In the study by Özen (2018), which deals with Turkey's current dollarization process comparatively, it is claimed that Turkey is one of the unofficially dollarized countries. In order to prove this claim, the weight of foreign currency in the size of deposits in banks was calculated and this ratio was compared with other countries. In addition, it has been determined that from 2000 to 2017, foreign currency deposits in banks have never fallen below 30 percent of total deposits and this figure has risen above 40 percent in recent years.

Kaya and Açıdoğuran (2018) on the other hand, examined the relationship between financial dollarization elements and stock returns for the Turkish economy. The relationship between dollarization and BIST 100 index return indicators was first examined with the VAR model, and then Granger causality analysis was conducted. The Granger test results point out that there is a causal relationship from BIST 100 index return variable to credit dollarization and deposit dollarization variables.

The relationship between the amount of foreign currency accounts held by individuals and companies residing in Turkey and the US dollar rate, market interest rate and the VIX (Chicago Board Options Exchange Volatility Index) index, also known as the fear index in international financial markets was analyzed by Baykut and Erdoğan (2019) using weekly data for the period 2012-2018. They found that there is a long-run relationship between the amount of foreign currency accounts held by individuals and companies residing in Turkey and the amount of TL deposits, exchange rate, market interest rate and international VIX index variables. In addition, another statistically significant finding is that when the market interest rate increases by 1 percent, the foreign currency accounts of individuals and companies residing in the country increase by approximately 0.40 percent in the long run. In the study, in which the ARDL-Boundary Test approach was applied, variance decomposition and impulse-response techniques were also used to measure the relative importance of random shocks.

Finally, in the study of Yılmaz and Uysal (2019), which investigates the relationship between dollarization and inflation in Turkey, CPI (Consumer Price Index) and deposit dollarization rate (Currency Deposit Account / M2) over a 7-year period (2012: 1 – 2018: 9) are analyzed using Vector Autoregressive Model (VAR). According to the results of the study, 1% change in the inflation rate is affected the dollarization rate by %0,63. The relationship between the variables was tested with the

Johansen Cointegration Test and no long-term relationship was found between the two variables. According to the Granger causality findings, it was determined that the dollarization rate was the cause of the inflation rate at the 10% significance level.

As can be seen, the differences in dollarization between countries and its determinants have often been studied in the literature. Similarly, there are lots of studies regarding deposit and loan dollarization in Turkey. However, as far as we know, there is no study that deals with the dollarization differences in the regions and provinces of Turkey and the drivers for this. Therefore, with this study, it is aimed to fill a gap that the researches in the literature have not addressed so far. The closest study to the subject that inspired this paper is Brown, Haas & Sokolov (2013) study titled “Regional Inflation and Financial Dollarization” for 71 cities in the Russian Federation. In this study, the authors examine the relationship between exchange rate and financial dollarization through regional inflation data. The study found that regions experiencing high inflation had higher deposit dollarization and lower credit dollarization. In addition, it has been found that there is a relationship between the number of bank branches in the region and inflation and credit dollarization.

4. Data and Methodology

In this study, dollarization data at quarterly frequency for the period 2007:Q4 and 2019:Q1 on the basis of Turkey Statistical Regional Units Classification (NUTS) Level-3 were obtained from Banking Regulation and Supervision Agency (BRSA) via FINTÜRK (Selective Banking Sector Data By Provinces). Percentage change in exchange rate and CDS of Turkey, annual inflation, import and export data of 81 provinces of Turkey covering the period of 2007:Q4-2019:Q1 (47 observations since BRSA banking data starts from December 2007) are included in the dataset.

In the study, panel data models were used in order to analyze the time and cross-sectional effects of dollarization in the provinces. In the panel data model, i represents the provinces and t represents the time dimension. Both fixed and random effect panel data models are useful for cross sectional data with high number of observation since these models leads more effective estimations by allowing more accurate results to be obtained, reducing the problem of multiple dependency and obtaining.

In the econometric model, $Dollarization_i$ represents the dependent variable whereas $Exchange_Rate_{i,t}$, $CDS_{i,t}$, $Inflation_{i,t}$, $\log(Export)_{i,t}$ ve $\log(Import)_{i,t}$ are the independent variables⁶. The individual effect of the fixed and random effect model, which is not included in the regression and has

6 These independent variables are used widely in the previous studies like Ramirez-Rojas (1985), Edwards and Magendzo (2003), Larrain and Tavares (2003), Neanidis and Savva (2006), Özcan and Us (2007), Yinusa (2008), Lay, Kakinaka and Kotani (2010), Dumrul (2010), Luca and Olivero (2012), Ponomarenko, Solovyeva & Vasilieva (2013), Cristo and Puig (2017), Corrales and Imam (2019).

an effect on the dollarization in the province, is denoted by u_i , the error term is shown as $v_{i,t}$ and a is the constant term.

$$Dollarization_i = (a+u_i) + \beta_1 * \Delta(Exchange_Rate)_{i,t} + \beta_2 * \Delta(CDS_{i,t}) + \beta_3 * \Delta(Inflation_{i,t}) + \beta_4 * \log(Export)_{i,t} + \beta_5 * \log(Import)_{i,t} + v_{i,t} \text{ (Equation 1)}$$

$$Dollarization_i = a + \beta_1 * \Delta(Exchange_Rate) + \beta_2 * \Delta(CDS_{i,t}) + \beta_3 * \Delta(Inflation_{i,t}) + \beta_4 * \log(Export)_{i,t} + \beta_5 * \log(Import)_{i,t} + (u_i + v_{i,t}) \text{ (Equation 2)}$$

Equation 1 shows the fixed effect formula of the econometric model, while Equation 2 shows the random effect formula. Although the two linear models have their own differences, the fixed effect panel data model excludes unobservable effects over time, while the random effect model allows these effects to be examined. In other words, with the fixed effects method, individual differences between provinces are included in the constant term and it is assumed to be time invariant, while in the random effects method, this effect is included in the error term. For this reason, the random effects model is also known as the Error Component Model in the literature.

Equations, formulas, graphics and other images in the study were performed using Python programming language with related libraries such as numpy, pandas, matplotlib, plotly express, seaborn, folium, json and statsmodel. The Python coding language, which has been improved constantly since the 1990s, is an open source language that has been widely used in fields such as data analysis, data science, machine learning, artificial intelligence, system automation, web and software development.

5. Empirical Results

The results obtained by using Python coding language with fixed and random effect models are shown in Table 1. According to the findings, all of the independent variables are determinants of the deposit dollarization in the provinces, and all independent variables have a positive effect on the dollarization. When evaluated according to effect sizes, it is evaluated that inflation, import, export, exchange rate and CDS premiums are determinative on dollarization, respectively.

Table 1: Fixed and random effect models results

	Model Comparison	
	Fixed Effect Model	Random Effect Model
Dep. Variable	Dollarization	Dollarization
Estimator	PanelOLS	RandomEffects
No. Observations	3807	3807
Cov. Est.	Unadjusted	Unadjusted
R-squared	0,4247	0,4199
R-Squared (Within)	0,4247	0,4247
R-Squared (Between)	0,0369	0,0395
R-Squared (Overall)	0,1348	0,1368

F-statistic	549,35	550,17
P-value (F-stat)	0	0
Const	-	16,077
	-	-11,458
$\Delta(\text{Exchange_Rate})$	0,0131*	0,0131*
	(-24,912)	(-24,904)
$\Delta(\text{CDS})$	0,0088***	0,0088***
	(-33,561)	(-33,609)
$\Delta(\text{Inflation})$	0,7725***	0,772***
	(-43,949)	(-43,935)
$\log(\text{Export})$	0,1113*	0,1202*
	(-22,115)	(-24,04)
$\log(\text{Import})$	0,1597***	0,1706***
	(-33,314)	(-35,907)
Effects	Entity	
Note: Significance levels: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 '' 1 T-statistics are in parentheses		

Within the scope of the results, It is in line with previous studies in the literature that there is a significant and positive relationship between inflation, CDS, exchange rate and the deposit dollarization . In addition, the positive and significant effect of provincial exports and imports on deposit dollarization in the provinces is an expected development since exports are usually foreign currency denominated transactions. Detailed statistics on fixed and random effects are presented in Annex 1 and Annex 2. Since, as explained before, the constant term is different for each province in the fixed effect panel data analysis, the relevant section appears blank in the table. However, the constant term calculated for 81 provinces with the fixed effect method is shown in Figure 1, which suggests that when the effect of the independent variables used in the fixed effect model is neglected, there is a dollarization rate of 33% to 41% in the provinces of Ankara, Yozgat, Nevşehir and Aksaray. According to the constant term, the lowest dollarization rate can be observed in Çanakkale and the provinces of the East and Southeast. It is thought that this difference between provinces is due to the different saving cultures (habits) of the citizens in the related provinces.

Moreover, it was found that there is a 60% correlation (Pearson) with the expatriate citizens of the Republic of Turkey living in the provinces but residing abroad and the constant term calculated for each provinces in the fixed effect method.

On the other hand, as to the selection of most suitable panel data methods for this economic model, the Hausman test is applied, whose null hypothesis is that the “random effect estimator is correct”. In this test, it is examined whether the difference between the parameter estimators of the fixed effect model and the parameter estimators of the random effect model is statistically significant. As a result of the Hausman test, it is found that the random effect model is more accurate for our model with the p-value of 0.6703.

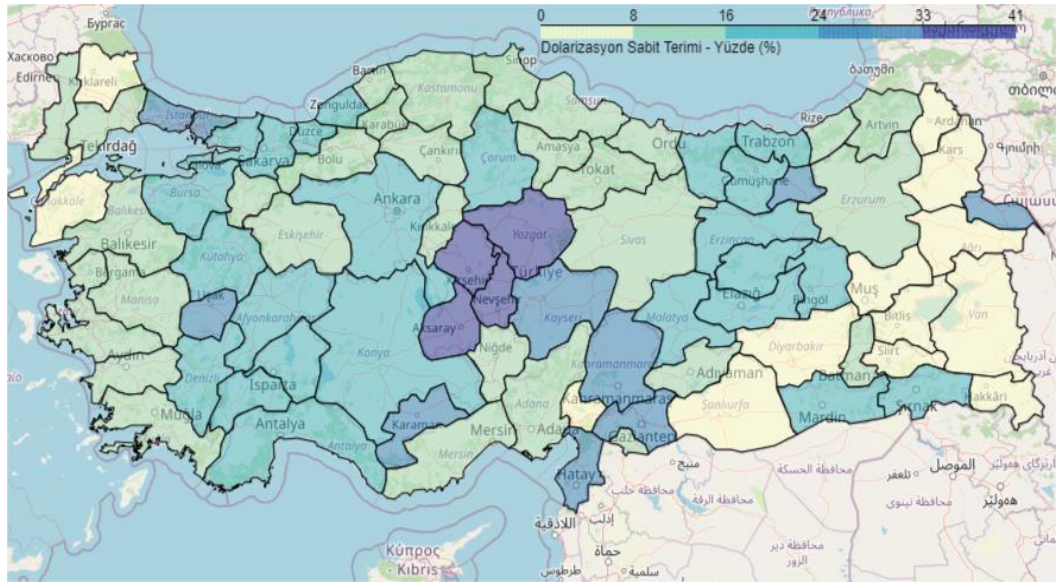


Figure 1. Heat map of constant term calculated for provinces in the fixed effect method

6. Conclusion

In this article, the determinants of deposit dollarization in the 81 provinces of Turkey were examined, and in this context, deposit dollarization was tried to be explained with exchange rate, CDS premiums, provincial inflation, provincial exports and provincial imports. In the analysis both fixed effect model and random effect panel data methods were used. It was concluded that all independent variables are statistically significant and have positive effect on dollarization. As for effect sizes, it is concluded that inflation, import, export, exchange rate and CDS premiums are more deterministic on deposit dollarization in provinces, respectively. On the other hand, when two models are tested with the Hausman test, whose null hypothesis is “the random effect estimator is correct”, it was suggested that the random effect model is more accurate for our model. On the other hand, if the independent variables are set aside, the fixed term calculated for each province in the fixed effect model is quite high (at least 31%) in the provinces of Ankara, Yozgat, Nevşehir and Aksaray, while it is quite low in Çanakkale, the Eastern and Southeastern provinces, which shows the diverse saving culture (habits) of the citizens in the mentioned provinces. In addition, the Pearson correlation between the fixed term calculated for each province in the fixed effect method and the expatriate citizens registered in the provinces is 60%, which reflects that the expatriate citizens living abroad have an effect on the deposit dollarization in the provinces.

As for the policy makers, it is thought that the establishment of the necessary economic confidence to motivate the savers for the Turkish lira and similar instruments, mostly, depends on decreasing inflation rate, exchange rate and CDS premiums. Nevertheless, it is expected that the de-dollarization processes of the 81 provinces of Turkey would also be different from each other as their dollarization.

In the future studies on dollarization, it may be useful that a broader definition of dollarization study can be carried out by including under-the-pillow savings and offshore savings of the citizens in the provinces or the determinants of credit dollarization may be analyzed in a similar way. In addition, it is seen that studies generally focuses on the dollarization of the households, the real sector and the financial sector, so dollarization in the public sector is somehow neglected, so it is thought that there is a great lack of literature in this area.

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Annex 1.**Fixed Effect Model Regression Results**

Dep. Variable:	Dollarization	R-squared:	0.4247
Estimator:	PanelOLS	R-squared (Between):	0.0369
No. Observations:	3807	R-squared (Within):	0.4247
Date:	Mon Jun 01 2020	R-squared (Overall):	0.1348
Time:	12:05:35	Log-likelihood	-1,05E+07
Cov. Estimator:	Unadjusted		
		F-statistic:	549.35
Entities:	81	P-value	0.0000
Avg Obs:	47.000	Distribution:	F(5,3721)
Min Obs:	47.000		
Max Obs:	47.000	F-statistic (robust):	549.35
		P-value :	0.0000
Time periods:	47	Distribution:	F(5,3721)
Avg Obs:	81.000		
Min Obs:	81.000		
Max Obs:	81.000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
Const	-	-	-	-	-	-
$\Delta(\text{Exchange_Rate})$	0.0131	0.0053	24.912	0.0128	0.0028	0.0235
$\Delta(\text{CDS})$	0.0088	0.0026	33.561	0.0008	0.0037	0.0140
$\Delta(\text{Inflation})$	0.7725	0.0176	43.949	0.0000	0.7380	0.8070
log(Export)	0.1113	0.0503	22.115	0.0271	0.0126	0.2101
log(Import)	0.1597	0.0479	33.314	0.0009	0.0657	0.2537

F-test for Poolability: 221.99

P-value: 0.0000

Annex 2.

Random Effect Model Regression Results

Dep. Variable:	Dollarization	R-squared:	0.4199
Estimator:	RandomEffects	R-squared (Between):	0.0395
No. Observations:	3807	R-squared (Within):	0.4247
Date:	Mon Jun 01 2020	R-squared (Overall):	0.1368
Time:	11:35:04	Log-likelihood	-1,05E+07
Cov. Estimator:	Unadjusted		
		F-statistic:	550.17
Entities:	81	P-value	0.0000
Avg Obs:	47.000	Distribution:	F(5,3801)
Min Obs:	47.000		
Max Obs:	47.000	F-statistic (robust):	550.17
		P-value	0.0000
Time periods:	47	Distribution:	F(5,3801)
Avg Obs:	81.000		
Min Obs:	81.000		
Max Obs:	81.000		

Parameter Estimates

	Parameter	Std. Err.	T-stat	P-value	Lower CI	Upper CI
Const	16.077	14.031	11.458	0.0000	13.326	18.828
$\Delta(\text{Exchange_Rate})$	0.0131	0.0053	24.904	0.0128	0.0028	0.0235
$\Delta(\text{CDS})$	0.0088	0.0026	33.609	0.0008	0.0037	0.0140
$\Delta(\text{Inflation})$	0.7720	0.0176	43.935	0.0000	0.7375	0.8064
log (Export)	0.1202	0.0500	24.040	0.0163	0.0222	0.2183
log (Import)	0.1706	0.0475	35.907	0.0003	0.0775	0.2638