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Inflation and Exchange Rate Pass-Through

Enflasyon ve Döviz Kuru Geçişkenliği

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Ömer Kalav[1]

Abstract

This paper examines the relationship between exchange rate pass-through (ERPT) and inflation within dynamic structure, focusing on the impact of exchange rate changes on consumer prices (CPI) in Türkiye. The theoretical and empirical analysis builds on existing frameworks, considering how central banks' reactions to exchange rate movements play a crucial role in shaping inflationary dynamics. The study uses the ARDL model to analyse the long-term and short-term effects of exchange rate fluctuations on inflation, focusing on the interaction between the CPI and the nominal exchange rate (NEX). For these goals, we employed monthly data over the January of 2000 and August of 2024.

The analysis is based on two baseline models: the first examines how changes in the exchange rate directly impact the CPI, while the second assesses the rate of change in inflation due to exchange rate variations. Stationarity of the data is ensured through unit root testing, which confirms the appropriateness of using the ARDL model. The results reveal that exchange rate movements significantly affect CPI, with a 1% increase in the exchange rate leading to a 1.1625% increase in the CPI in the long run, as evidenced by a p-value of 0.00. Additionally, in the short term, a 1% increase in the exchange rate results in a 0.1164% rise in the CPI, indicating a persistent effect on prices. The error correction term further supports the existence of a significant relationship between the CPI and the exchange rate in both short and long-term dynamics. Based on model 2, exchange rate changes have a significant effect on inflation in the long-term relationship. In particular, it has been shown that exchange rate increases can lead to long-term increases in inflation.

Keywords: Exchange Rate Pass-Through (ERPT), Inflation, ARDL Model, Consumer Price Index (CPI), Monetary Policy, Emerging Economies, Exchange Rate Fluctuations
JEL Codes: E31, E52, F31, F41, O11, O43

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1. Introduction

The effect of exchange rate fluctuations on consumer prices and hence inflation is an important issue that monetary authorities carefully monitor and shape their policies. Exchange rate movements can directly affect the general price level, especially in import-dependent economies. In this context, monetary authorities react sensitively to changes in exchange rates in order to keep inflation under control.[2] While exchange rate fluctuations can cause inflationary pressures by increasing the cost of imported inputs, they can also have a deflating effect on inflation in the opposite case.[3] This article will discuss the effects of monetary authorities' reactions to exchange rate movements on price stability and economic balance.

Exchange rate fluctuations are a major determinant of inflation and can have significant effects on the shaping of monetary policies.[4] The anticipated impact of exchange rate movements on consumer prices plays a critical role in determining how the central bank will respond to these movements. In particular, monetary authorities may consider beyond the temporary effects of exchange rate movements on price levels but may need to intervene if the impact on inflation is persistent. If exchange rate pass-through is not analysed correctly, the risk of policy errors is particularly high in emerging market economies. In such economies, large exchange rate movements are more frequent and central banks are more likely to respond to such movements[5]. This situation highlights the need to properly assess the impact of exchange rate pass-

2 John B. Taylor, "The Role of the Exchange Rate in Monetary-Policy Rules," *American Economic Review* 91, no. 2 (2001): 263–267; Lars E. O. Svensson, "Open-Economy Inflation Targeting," *Journal of International Economics* 50, no. 1 (2000): 155–183.

3 Maurice Obstfeld and Kenneth Rogoff, "The Mirage of Fixed Exchange Rates," *Journal of Economic Perspectives* 9, no. 4 (1995): 73–96.

4 Stanley Fischer, "Speech by Vice Chairman Fischer on the Transmission of Exchange Rate Changes to Output and Inflation," *Board of Governors of the Federal Reserve System* (November 12, 2015), https://www.federalreserve.gov/newsevents/speech/fischer20151112a.htm.; Kristin Forbes, "Much Ado about Something Important: How Do Exchange Rate Movements Affect Inflation?" *The Manchester School* 84, no. S1 (2016): 15–41, https://doi.org/10.1111/manc.12159.; Frederic S. Mishkin, "Exchange Rate Pass-Through and Monetary Policy: A Speech at the Norges Bank Conference on Monetary Policy, Oslo, Norway, March 7, 2008," *Board of Governors of the Federal Reserve System*, https://econpapers.repec.org/paper/fipfedgsq/373.htm.

5 Guillermo A. Calvo and Carmen M. Reinhart, "Fear of Floating," *The Quarterly Journal of Economics* 117, no. 2 (2002): 379–408, https://doi.org/10.1162/003355302753650274.; Christopher P. Ball and Jorge A. Reyes, "Inflation Targeting or Fear of Floating in Disguise: A Broader Perspective," *SSRN Scholarly Paper 668981*, 2004, https://doi.org/10.2139/ssrn.668981.

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through on inflation—in this context, exchange rate pass-through is defined as the percentage increase in consumer prices caused by a 1% depreciation in the effective exchange rate over a one-year period.

The existing literature suggests that exchange rate movements are only partially reflected in domestic prices and that this effect is attenuated along the production chain. Pass-through to consumer prices occurs through a variety of channels, from direct effects on energy and other commodity prices to indirect effects on import prices, wage formation, and profit margins.[6]

A variety of structural factors reduce the sensitivity of domestic prices to exchange rate movements. These factors include the intensity of competition between importing and exporting firms[7], the frequency of price changes[8], the composition of trade, and the level of participation in global value chains. Other important factors that affect this sensitivity are the rate of trade in foreign currencies and the use of foreign exchange hedging instruments. In addition, a well-structured monetary policy framework is considered an effective tool in reducing the pass-through of exchange rate fluctuations on consumer prices by supporting the sound management of inflation expectations.

Beyond structural factors and country characteristics, the type of macroeconomic shock that causes exchange rate movements is an important factor in determining

6 Philippe Bacchetta and Eric van Wincoop, "A Theory of the Currency Denomination of International Trade," *Journal of International Economics* 67, no. 2 (2005): 295–319.; Ariel Burstein and Gita Gopinath, "International Prices and Exchange Rates," in *Handbook of International Economics*, vol. 4 (Elsevier, 2014), 391–451.; Takatoshi Ito and Kiyotaka Sato, "Exchange Rate Changes and Inflation in Post-Crisis Asian Economies: Vector Autoregression Analysis of the Exchange Rate Pass-Through," *Journal of Money, Credit and Banking* 40, no. 7 (2008): 1407–1438, https://doi.org/10.1111/j.1538-4616.2008.00165.x.; Jonathan McCarthy, "Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economies," *Staff Reports*, Article 111 (New York: Federal Reserve Bank of New York, 2000).

7 Mary Amiti, Oleg Itskhoki, and Jozef Konings, "Importers, Exporters, and Exchange Rate Disconnect," *American Economic Review* 104, no. 7 (2014): 1942–78, https://doi.org/10.1257/aer.104.7.1942.

8 Michael B. Devereux and Jay Yetman, "Price Setting and Exchange Rate Pass-Through: Theory and Evidence," *IO: Theory*, 2002, https://www.semanticscholar.org/paper/Price-Setting-and-Exchange-Rate-Pass-Through%3A-and-Devereux-Yetman/54b7c99133361f83564a4c8168a888bc98736d7c.; Giancarlo Corsetti and Luca Dedola, "A Macroeconomic Model of International Price Discrimination," *Journal of International Economics* 67, no. 1 (2005): 129–155.; Gita Gopinath and Oleg Itskhoki, "Frequency of Price Adjustment and Pass-Through," *Quarterly Journal of Economics* 125, no. 2 (2010): 675–727.

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the magnitude of the pass-through.[9] This reflects the fact that shocks affecting the exchange rate also affect economic activity, profit margins, productivity, price formation, and inflation expectations. Therefore, the estimated magnitude of the exchange rate pass-through may vary significantly depending on the nature of the shock that triggers exchange rate movements -a possibility that has not been adequately considered in most empirical studies.

In this section, the exchange rate pass-through is discussed both theoretically and empirically in terms of its effect on inflation, and it is emphasized why this relationship has a complex and dynamic structure. In developing economies, how monetary policies should be structured to reduce the effect of exchange rate fluctuations on inflation can be addressed in more detail in future studies on this subject.

2. Exchange Rate Pass-Through and Inflation: Theoretical Framework

Exchange rate pass-through refers to the impact of exchange rate changes on domestic price levels and has an important place in economic theory. Exchange rate pass-through is considered one of the main factors determining inflation dynamics, especially in developing economies. In the theoretical literature, exchange rate pass-through is examined depending on various factors such as pricing behavior, market structure, trade relations and macroeconomic policies.

Exchange rate pass-through (ERPT) is used for the analysis of how prices of imported and locally produced products change as the currency exchange rates change. Ceteris paribus, if the exchange rate goes down, the imported products become costlier, and this can stimulate an increase in the prices of local products. The degree of pass-through is not homogenous; in some countries most of the changes in the exchange rate are fully transmitted to the prices of goods and services in the economy while in

9 Mariarosaria Comunale and Davor Kunovac, "Exchange Rate Pass-Through in the Euro Area," *Working Paper Series 2003,* European Central Bank, 2017, https://econpapers.repec.org/paper/ecbecbwps/20172003.htm.; Kristin Forbes, Ida Hjortsoe, and Tsvetelina Nenova, "Shocks versus Structure: Explaining Differences in Exchange Rate Pass-Through across Countries and Time," *Discussion Papers, Article 50,* London: Bank of England, 2017, https://ideas.repec.org/p/mpc/wpaper/0050.html.; Jay Shambaugh, "A New Look at Pass-Through," *Journal of International Money and Finance* 27, no. 4 (2008): 560–591.

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other countries this is not fully transmitted.[10]

There are some determinants of exchange rate pass-through including but not limited to inflation targeting by the central banks, the nature of markets and competition, specific currencies used in trade contracts, trade openness among other factors[11]. There is a tendency for countries which maintain a fixed exchange rate regime to exhibit a higher degree of pass-through compared to those which maintain a flexible regime because under fixed exchange rate some disturbances may require a very large change in prices while in a flexible regime many adjustment movements occur gradually.[12]

The relationship between exchange rate pass-through and inflation is affected by many factors in the economy, such as pricing behaviour, market structure, and trade relations. While exchange rate pass-through refers to the impact of exchange rate changes on local prices, the degree of this pass-through varies depending on firms' pricing strategies, market structure, and implemented macroeconomic policies. Concepts such as local currency pricing (LCP) and foreign currency pricing (PCP) have significant effects on exchange rate pass-through, determining which currency firms prefer and the consequences of this preference on inflation. In this context, let's consider the interaction between exchange rate pass-through and inflation under the following headings:

2.1. Pricing Behaviour and Exchange Rate Pass-Through

Exchange rate pass-through is often discussed in the context of pricing strategies of importing and exporting firms. Importing firms can cause increases in domestic price levels by directly reflecting exchange rate changes in their prices. This situation is called "Full Pass-Through" and indicates that exchange rate changes are fully reflected in consumer prices. However, the situation where exchange rate changes are not fully reflected in domestic prices is called "Partial Pass-Through". In this case, firms partially reflect exchange rate fluctuations in their prices, which has a more limited

10 Gita Gopinath and Roberto Rigobon, "Sticky Borders," *Quarterly Journal of Economics* 123, no. 2 (2008): 531–575, https://doi.org/10.1162/qjec.2008.123.2.531.

11 Michael Mussa, "Factors Driving Global Economic Integration," in *Global Economic Integration: Opportunities and Challenges*, ed. Federal Reserve Bank of Kansas City (Kansas City, MO: Federal Reserve Bank of Kansas City, 2000), 9–56.

12 Corsetti and Dedola, "A Macroeconomic Model of International Price Discrimination."

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effect on inflation.[13]

Firms' pricing behaviour is an important factor determining the degree of exchange rate pass-through. For example, firms that price in domestic currency are less affected by exchange rate fluctuations and have low pass-through. In contrast, firms that price in foreign currency can reflect exchange rate fluctuations directly into their prices, causing high pass-through.[14]

2.2. Market Structure and Exchange Rate Pass-Through

Exchange rate pass-through can also vary depending on market structure. In competitive markets, firms can reflect exchange rate changes more quickly to their prices, while monopolies determine their pricing strategies according to exchange rate changes, and the extent to which they reflect cost increases to domestic prices determines the degree of exchange rate pass-through. In the literature, two basic pricing strategies stand out: "Local Currency Pricing" (LCP) and "Producer Currency Pricing" (PCP).[15]

The study of firms' pricing decisions is one of the important research topics in international macroeconomics. It is directly related to the movement of international relative prices, expenditure shifting and adjustment of global imbalances, and imported inflation. Moreover, such studies can also provide important information about the nature of price-setting mechanisms; these mechanisms feature prominently in most macroeconomic models.

In recent years, the empirical literature estimating exchange rate pass-through at the commodity level has provided important insights into firms' pricing behaviour following exchange rate shocks. While the findings have revealed a large heterogeneity along various dimensions such as firm or commodity characteristics, a common conclusion is that the pass-through is quite incomplete even in the long run: import prices

13 Pinelopi Koujianou Goldberg and Michael M. Knetter, "Goods Prices and Exchange Rates: What Have We Learned?" *Journal of Economic Literature* 35, no. 3 (1997): 1243–1272.

14 Michael B. Devereux and Charles Engel, "Monetary Policy in the Open Economy Revisited: Price Setting and Exchange-Rate Flexibility," *The Review of Economic Studies* 70, no. 4 (2003): 765–783.

15 Raphael A. Auer and Raphael S. Schoenle, "Market Structure and Exchange Rate Pass-Through," *Journal of International Economics* 98 (2016): 60–77, https://doi.org/10.1016/j.jinteco.2015.10.003.

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do not move one-to-one with the exchange rate.[16]

Incomplete exchange rate pass-through in the long run can be explained by the adjustment of margins (profit margins) to adapt to local market conditions. This channel was first introduced by Krugman[17] and Dornbush[18] and later elaborated by Melitz and Ottaviano[19],Atkeson and Burstein[20],Chen et.al[21], and Gopinath and Itskhoki.[22] These studies show that firms adjust their margins in response to exchange rate changes and, as a result, import prices are not fully reflected in exchange rate changes.

2.3. Local Currency Pricing (LCP)

Local currency pricing strategy refers to importers implementing a fixed price policy in the domestic market. According to this strategy, importers try to keep domestic prices constant despite exchange rate changes. In this case, exchange rate pass-through is low because importing firms do not fully reflect exchange rate changes in domestic prices. LCP is especially common in highly competitive markets and in products with low price elasticity. This approach can limit the impact of exchange rate shocks on domestic inflation, but it can put pressure on margins in the long run.[23]

16 Auer and Schoenle, "Market Structure and Exchange Rate Pass-Through,".

17 Paul Krugman, *Pricing to Market When the Exchange Rate Changes* (Cambridge, MA: National Bureau of Economic Research, 1986), https://econpapers.repec.org/paper/nbrnberwo/1926.htm.

18 Rudiger Dornbusch, "Exchange Rates and Prices," *The American Economic Review* 77, no. 1 (1987): 93–106.

19 Marc J. Melitz and Gianmarco I. P. Ottaviano, "Market Size, Trade, and Productivity," *The Review of Economic Studies* 75, no. 1 (2008): 295–316.

20 Andrew Atkeson and Ariel Burstein, "Pricing-to-Market, Trade Costs, and International Relative Prices," American Economic Review 98, no. 5 (2008): 1998–2031.

21 Natalie Chen, Jean Imbs, and Andrew Scott, "The Dynamics of Trade and Competition," *Journal of International Economics* 77, no. 1 (2009): 50–62.

22 Gita Gopinath and Oleg Itskhoki, "Frequency of Price Adjustment and Pass-Through," *Quarterly Journal of Economics* 125, no. 2 (2010): 675–727.

23 Devereux and Engel, "Monetary Policy in the Open Economy Revisited,".

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2.4. Foreign Currency Pricing (PCP)

The foreign currency pricing strategy refers to importers directly reflecting cost increases to domestic prices. In this strategy, exchange rate changes cause full pass-through on domestic prices, which creates a more pronounced effect on inflation. The PCP strategy is generally preferred in cases where the importer has high market power and high price flexibility. This strategy can be more common in countries with high exchange rate pass-through and can lead to increased inflationary pressures.[24]

2.5. Market Structure and Trade Relations

The degree of exchange rate pass-through is also closely related to the market structure and the nature of trade relations. In oligopolistic markets, firms reflect exchange rate changes to prices more limitedly, while pass-through may be higher in competitive markets. In addition, the structure of trade also plays a determining role in pass-through. For example, in economies where intermediate goods are heavily imported, the impact of exchange rate changes on costs may be higher and this situation may be reflected in prices more quickly.[25]

2.6. Macroeconomic Policies and Exchange Rate Pass-through

Macroeconomic policies also have an important effect on exchange rate pass-through. The monetary policy framework plays a critical role in determining the impact of exchange rate pass-through on inflation. Especially in inflation targeting regimes, the credibility of central banks and their ability to manage inflation expectations may limit exchange rate pass-through. This situation may weaken the impact of exchange rate changes on inflation and enable central banks to be more effective in ensuring price stability (Taylor, 2000)a decline that is frequently characterized as a reduction in the 'pricing power' of firms. The decline appears to be associated with the decline in inflation in many countries. The decline has important implications for monetary policy because it affects both forecasts of inflation and the effects of changes in monetary policy on inflation. Some have argued that the decline in pricing power

24 Obstfeld and Rogoff, "The Mirage of Fixed Exchange Rates,".

25 Pinelopi Koujianou Goldberg and Rebecca Hellerstein, "A Structural Approach to Explaining Incomplete Exchange-Rate Pass-Through and Pricing-to-Market," *American Economic Review* 98, no. 2 (2008): 423–429, https://doi.org/10.1257/aer.98.2.423.

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helped to keep inflation low in the face of apparently strong demand pressures in the United States in the late 1990s. This paper puts forth the view that the decline in pass-through or pricing power is due to the low inflation environment that has recently been achieved in many countries. First, a microeconomic model of price setting is used to show that lower pass-through is caused by lower perceived persistence of cost changes. Evidence is then presented showing that inflation is positively correlated with persistence of inflation, suggesting that the low inflation itself has caused the low pass-through. An economy-wide model consistent with the micromodel is then presented to illustrate how such changes in pricing power affect output and inflation dynamics in favorable ways, but can disappear quickly if monetary policy and expectations change.[26]

3. Literature Reviews

Research shows that the effect of exchange rate pass-through on domestic prices is affected by the inflationary environment and monetary policy regimes. Lower inflation rates have been found to be associated with lower exchange rate pass-through.[27] Countries with flexible exchange rate regimes and credible inflation targets generally experience lower pass-through rates.[28] The frequency of price changes by importing firms is determined by monetary policy, and this frequency affects pass-through rates. A looser monetary policy leads to increased inflation and exchange rate volatility, causing price changes to occur more frequently and thus increasing the pass-through rate[29]. Central bank independence can play an important role in stabilizing inflation following large currency movements.[30] The nature of the shocks that trigger exchange

26 John B. Taylor, "Low Inflation, Pass-Through, and the Pricing Power of Firms," *European Economic Review* 44, no. 7 (2000): 1389-1408, https://doi.org/10.1016/S0014-2921(00)00037-4.

27 Ehsan U. Choudhri and Dalia S. Hakura, "Exchange Rate Pass-Through to Domestic Prices: Does the Inflationary Environment Matter?" *Journal of International Money and Finance* 25, no. 4 (2006): 614–639, https://doi.org/10.1016/j.jimonfin.2005.11.009.; Jeannine Bailliu and Eiji Fujii, "Exchange Rate Pass-Through and the Inflation Environment in Industrialized Countries: An Empirical Investigation," *SSRN Electronic Journal* (2004), https://doi.org/10.2139/ssrn.560762.

28 Jongrim Ha, Marc Stocker, and Hakan Yilmazkuday, *Inflation and Exchange Rate Pass-Through*, Policy Research Working Paper 8780 (Washington, DC: World Bank Group, 2019), https://doi.org/10.1596/1813-9450-8780.

29 Devereux and Yetman, "Price Setting and Exchange Rate Pass-Through."

30 Ha, Stocker, and Yilmazkuday, *Inflation and Exchange Rate Pass-Through*.

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rate movements and country-specific characteristics are also critical in determining pass-through rates[31]. These findings highlight the complex relationship between inflation, monetary policy, and exchange rate pass-through. The table below shows the summery of selected studies about exchange rate pass-through to inflation.

Table 1: Summery of Selected Studies about Exchange Rate Pass-Through to Inflation

Study	Summery	Main findings	Methodology
(Bailliu & Fujii, 2004)	Exchange rate pass-through loses its effect on consumer prices when a low inflation environment is provided by monetary policy changes.	- Exchange rate pass-through decreases when moving to a low inflation environment. - Pass-through decreased after inflation stabilization in the early 1990s, but the same effect was not observed after a similar event in the 1980s. - The difference between the 1980s and 1990s can be explained by more reliable monetary policy changes in the 1990s.	- Panel data approach is used to estimate exchange rate pass-through for 11 industrialized countries between 1977-2001. - Dynamic GMM panel data estimator is used to account for the lagged dependent variable. - Bai and Perron (1998) test is applied to detect changes in inflation in each country. - Interactions between exchange rate and inflation environment changes are examined.
(Ha et al., 2019)	Exchange rate pass-through varies across countries due to the nature of shocks and country-specific characteristics.	- Different local and global shocks can greatly alter the impact of exchange rate pass-through on inflation. - Countries with flexible exchange rate regimes and credible inflation targets generally have lower pass-through rates. - Central bank independence can help moderate inflation.	- Structural factor augmented vector autoregressive (FAVAR) models are estimated for 47 countries. - Two main factors explaining the variations in exchange rate pass-through are examined: 1. Nature of shocks (local vs. global) 2. Country-specific characteristics (monetary policy frameworks and structural characteristics). - The effects of country-specific factors on exchange rate pass-through are analyzed.

31 Ha, Stocker, and Yilmazkuday, *Inflation and Exchange Rate Pass-Through*.

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Study	Summery	Main findings	Methodology
(Choudhri & Hakura, 2006)	Inflationary environment is positively related to exchange rate pass-through.	- There is a positive and significant relationship between inflation rate and exchange rate pass-through. - Inflation rate is more dominant than other macroeconomic variables in explaining exchange rate pass-through. - The findings contradict the hypothesis that low inflation environment reduces exchange rate pass-through.	- The exchange rate pass-through relationship is derived from new open economy macroeconomic models. - This relationship is estimated using a large dataset consisting of 71 countries between 1979-2000. - The relationship between pass-through and average inflation rate across different countries and time periods is examined. - The importance of inflation rate compared to other macroeconomic variables in explaining pass-through rates is evaluated.
(M. Devereux & Yetman,2002)	Exchange rate pass-through is determined by the frequency of price changes by importing firms, and this frequency is affected by monetary policy and exchange rate volatility.	- Exchange rate pass-through is determined by the frequency of price changes by importing firms, which is shaped by the central bank's monetary policy rules. - A looser monetary policy leads to higher inflation and exchange rate volatility, leading to more frequent price changes and higher exchange rate pass-through.	- A theoretical model was developed to examine how monetary policy and exchange rate volatility affect the frequency of price changes by importing firms. - The model's predictions were tested using a data set from 122 countries. - The positive but nonlinear relationship between exchange rate pass-through and average inflation and exchange rate volatility was tested with the model's predictions.

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Study	Summery	Main findings	Methodology
(M. B. Devereux & Yetman, 2005)	Sticky prices and the frequency of endogenous price adjustments determine the degree of exchange rate pass-through.	- Sticky prices are an important determinant of low exchange rate pass-through in low-inflation countries. - Exchange rate pass-through increases with average inflation, but at a decreasing rate. - Empirical results closely match model predictions, providing strong support for the role of price stickiness in determining exchange rate pass-through.	- A theoretical model on exchange rate pass-through with sticky prices and endogenous price adjustment frequency is developed. - Model parameters and shock processes are calibrated for a large sample of countries. - Model simulations are performed to calculate theoretical pass-through coefficients for each country. - Empirical pass-through coefficients are estimated for the same set of countries. - Theoretical and empirical relationships between pass-through and inflation are compared.
(Oladipo, 2017)	Inflation targeting has reduced exchange rate pass-through in South Africa.	- Inflation targeting has had significant effects on inflation, production and exchange rate movements. - After inflation targeting, the transmission of exchange rate changes to consumer prices has decreased. - After inflation targeting, the impact of foreign producer costs on import prices has decreased.	- Vector Autoregressive (VAR) model was used. - The effects of inflation targeting on inflation, production, exchange rate movements and the transmission of exchange rate changes to consumer prices were examined. - The effect of foreign producer costs on import prices was analyzed.

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Study	Summery	Main findings	Methodology
(López-Villavicencio & Mignon, 2016)	The inflation environment, monetary policy regime and institutional quality affect exchange rate pass-through in developing countries.	- Lower and more stable inflation environments are associated with lower exchange rate pass-through to consumer prices. - Adoption of monetary policy regimes such as inflation targeting leads to a significant reduction in exchange rate pass-through. - Greater transparency of monetary policy decisions reduce exchange rate pass-through.	- Exchange rate pass-through is estimated for 15 developing countries between 1994-2015. - A multivariate approach that transcends the binary relationship between exchange rates and inflation is used. - The effects of inflation environment (level and volatility), monetary policy regime (inflation targeting, exchange rate targeting) and institutional factors (transparency, central bank independence) on exchange rate pass-through are examined.
(Alexius & Holmberg, 2024)	Exchange rate volatility increases with the level, variance and persistence of inflation, as well as exchange rate pass-through, but inflation targeting can reduce this effect.	- Exchange rate volatility, inflation level, variance and persistence, and exchange rate pass-through increase. - Inflation targeting can reduce the transmission of exchange rate changes to consumer prices. - Inflation targeting can make prices more stable by increasing the reliability of monetary policy.	- Various econometric models have been used to examine the effects of inflation targeting on exchange rate pass-through in emerging markets. - An analysis based on the structural vector autoregressive (SVAR) model has been conducted to determine the factors affecting exchange rate pass-through. - A data set for various developing countries between 1995-2010 has been used.

This table comprehensively summarizes various studies on exchange rate pass-through and the inflation environment. The reviewed articles provide important findings to understand how exchange rate pass-through is affected by factors such as the

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inflation environment, monetary policy regimes, and institutional quality.

3.1. Relationship of Exchange Rate Pass-Through to Inflation Environment

Bailliu[32]and Choudhri's[33] studies show that low inflation environments reduce exchange rate pass-through. This finding supports the view that low inflation provides price stability and limits the impact of exchange rate changes on prices. Studies such as Ha[34]and López-Villavicencio[35] emphasize that exchange rate pass-through is shaped by country-specific characteristics and monetary policy frameworks such as inflation targeting. These studies reveal that flexible exchange rate regimes and credible inflation targets reduce pass-through.

3.2. Monetary Policy and Pass-Through

Devereux (2002)[36] and Devereux's (2005)[37] studies have examined the impact of monetary policies on exchange rate pass-through. In particular, they show that loose monetary policies create higher pass-through associated with high inflation and exchange rate volatility. Oladipo's[38] study shows that inflation targeting in South Africa reduces exchange rate pass-through, that is, inflation targeting limits the impact of exchange rate changes on consumer prices.

32 Bailliu and Fujii, "Exchange Rate Pass-Through and the Inflation Environment."

33 Choudhri and Hakura, "Exchange Rate Pass-Through to Domestic Prices."

34 Ha, Stocker, and Yilmazkuday, *Inflation and Exchange Rate Pass-Through*.

35 Ana López-Villavicencio and Valérie Mignon, "Exchange Rate Pass-Through in Emerging Countries: Do the Inflation Environment, Monetary Policy Regime and Institutional Quality Matter?" (July 5, 2016), https://www.semanticscholar.org/paper/Exchange-rate-pass-through-in-emerging-countries%3A-L%C3%B3pez%E2%80%90Villavicencio-Mignon/258aa0c6789323f401736bc4059ae02bfce1dd71.

36 Devereux and Yetman, "Price Setting and Exchange Rate Pass-Through."

37 Devereux and Yetman, "Price Adjustment and Exchange Rate Pass-Through."

38 Oladipo, O., "Inflation Targeting and Exchange Rate Pass-Through to Domestic Prices: Evidence from South Africa," *Journal of Economic & Financial Studies* 5, no. 5 (2017): Article 05, https://doi.org/10.18533/jefs.v5i05.294.

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3.3. The Impact of Exchange Rate Shocks

Alexius's[39] study examines how exchange rate volatility and inflation shocks increase pass-through. This study emphasizes the effects of the persistence of exchange rate shocks on pass-through, especially in low inflation environments.

3.4. Comprehensive Approaches

The methodological diversity of the studies is striking. Different dimensions of exchange rate pass-through have been addressed using various methods such as panel data analyses, vector autoregressive models extended with structural factors, and Bayesian VAR. This methodological diversity increases the robustness and validity of the findings on exchange rate pass-through. In summary, the table shows that exchange rate pass-through is affected by many factors and how these factors interact. The effects of the inflation environment, monetary policy and country-specific characteristics on pass-through play an important role in shaping economic policies. These findings provide valuable information for understanding the economic effects of exchange rate changes and determining the strategies of policy makers.

4. Data and Methodology

In this study, the theoretical frameworks of Goldberg and Knetter[40], Campa and Goldberg[41], Gopinath and Rigobon[42], Berman et. al[43], and Karamelikli[44] were used to an-

39 Annika Alexius and Mats Holmberg, "Pass-Through with Volatile Exchange Rates and Inflation Targeting," *Review of World Economics* 160, no. 2 (2024): 377–387, https://doi.org/10.1007/s10290-023-00502-8.

40 Goldberg and Knetter, "Goods Prices and Exchange Rates."

41 José Manuel Campa and Linda S. Goldberg, "Exchange Rate Pass-Through into Import Prices," *Review of Economics and Statistics* 87, no. 4 (2005): 679–690.

42 Gita Gopinath and Roberto Rigobon, "Sticky Borders," *Quarterly Journal of Economics* 123, no. 2 (2008): 531–575, https://doi.org/10.1162/qjec.2008.123.2.531.

43 Nicolas Berman, Philippe Martin, and Thierry Mayer, "How Do Different Exporters React to Exchange Rate Changes?" *The Quarterly Journal of Economics* 127, no. 1 (2012): 437–492, https://doi.org/10.1093/qje/qjr057.

44 Hasan Karamelikli, "The Dynamics of Exchange Rate Pass-Through to Domestic Prices in Turkey," *Pressacademia* 5, no. 1 (2016): 39–39, https://doi.org/10.17261/Pressacademia.2016116552.

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alyse the relationship between inflation and exchange rate pass-through. In addition, a long-term model was created by following the methods of Çiçek and Boz[45] and Karamelikli and Korkmaz[46]. The model used in the study is based on the Consumer Price Index (CPI) and nominal exchange rate data as an indicator of inflation. In the analysis, how inflation responds to exchange rate changes and the long-term structure of this effect will be discussed based on these data. The main purpose of the model is to quantitatively reveal the effects of exchange rate fluctuations on inflation. Based on that research we set two baseline model as follows:

Baseline Model 1: $CPI_t = f(NEX_t)$

Baseline Model 1: $\frac{CPI_t - CPI_{t-1}}{CPI_{t-1}} = f(NEX_t)$

In the models used in this study, CPI (Consumer Price Index) is represented by CPI and nominal exchange rate is represented by NEX.

Baseline Model 1 examines how CPI in a certain period (t) is affected by the nominal exchange rate (NEX) in the same period. The model aims to measure the effect of changes in exchange rate directly on CPI. This approach provides a simple but effective way to determine the effect of exchange rate pass-through on price levels. The second model examines the relationship between the rate of change in $\frac{CPI_t - CPI_{t-1}}{CPI_{t-1}}$ and nominal exchange rate (NEX). This model aims to analyze the sensitivity of inflation to exchange rate fluctuations, that is, how prices change periodically. In particular, it attempts to understand the dynamics of price level increases by examining the impact of exchange rate changes on the inflation rate.

These two models examine the effects of exchange rate changes on the CPI both at the level and at the rate, allowing a more comprehensive assessment of the impact of exchange rate pass-through on inflation.

45 Sema Çiçek and Çağdaş Boz, "A New Test of Exchange Rate Pass-Through in a Small Open Economy: Evidence from Asymmetric ARDL Bounds Approach," *İktisat İşletme ve Finans* 28, no. 333 (2013): 43–64, https://doi.org/10.3848/iif.2013.333.3840.

46 Hasan Karamelikli and Sibel Korkmaz, "The Dynamics of Exchange Rate Pass-Through to Domestic Prices in Turkey," *Pressacademia* 5, no. 1 (2016): 39–39, https://doi.org/10.17261/Pressacademia.2016116552.

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The variables used in this study are carefully selected to analyze the relationship between inflation and exchange rate pass-through, relying on data from the Central Bank of the Republic of Türkiye (TCMB). The Consumer Price Index (CPI) is employed as a measure of inflation, while the nominal exchange rate (NEX) serves as the primary independent variable representing exchange rate fluctuations. The following table summarizes the variables, their symbols, descriptions, and data sources, providing a clear foundation for the subsequent analysis.

Table 2: Variables and Description

Variable	Symbol	Description	Source
Consumer Price Index	CPI	Represents inflation, measured as the general price level in the economy.	TCMB (Central Bank of the Republic of Türkiye)
Nominal Exchange Rate	NEX	Represents the nominal exchange rate, indicating the value of the domestic currency relative to foreign currencies.	TCMB (Central Bank of the Republic of Türkiye)

Before starting the analysis, a unit root test will be applied to determine whether the data is stationary. The unit root test helps determine whether the series is stationary by testing whether the series fluctuates around a constant mean and variance over time. This is an important step in analysing the long-term relationships of the variables used in the model (CPI and NEX). A non-stationary series can lead to incorrect results; therefore, a unit root test is necessary to check whether the series has the property of stationarity. Depending on the result of this test, the series may need to be made stationary by taking their differences.

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Table 3: Unit Root Test Results

UNIT ROOT TEST RESULTS TABLE (PP)				
Null Hypothesis: the variable has a unit root				
	At Level			
		LCPI	LDOLLAR	INF
With Constant	t-Statistic	6.5451	3.6605	-7.3043
	Prob.	***1.0000***	***1.0000***	***0.0000***
		n0	n0	***
With Constant & Trend	t-Statistic	4.7676	-0.5806	-8.3571
	Prob.	***1.0000***	***0.9790***	***0.0000***
		n0	n0	***
	At First Difference			
		d(LCPI)	d(LDOLLAR)	d(INF)
With Constant	t-Statistic	-7.2941	-10.1429	-52.5080
	Prob.	***0.0000***	***0.0000***	***0.0001***
		***	***	***
With Constant & Trend	t-Statistic	-8.3672	-10.4481	-58.4794
	Prob.	***0.0000***	***0.0000***	***0.0001***
		***	***	***

Notes:

a: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1% and (no) Not Significant

b: Lag Length based on SIC

c: Probability based on MacKinnon (1996) one-sided p-values.

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UNIT ROOT TEST RESULTS TABLE (ADF)					
Null Hypothesis: the variable has a unit root					
	At Level				
		LCPI	LDOLLAR	INF	
With Constant	t-Statistic	4.9489	3.4593	-2.7816	
	Prob.	***1.0000***	***1.0000***	***0.0623***	
		n0	n0	*	
With Constant & Trend	t-Statistic	3.8162	-0.6552	-5.8728	
	Prob.	***1.0000***	***0.9745***	***0.0000***	
		n0	n0	***	
Without Constant & Trend	t-Statistic	2.5078	5.0156	-1.7862	
	Prob.	0.9972	1.0000	0.0705	
		n0	n0	*	
	At First Difference				
		d(LCPI)	d(LDOLLAR)	d(INF)	
With Constant	t-Statistic	-2.7388	-11.1358	-12.4445	
	Prob.	***0.0689***	***0.0000***	***0.0000***	
		*	***	***	
With Constant & Trend	t-Statistic	-4.4661	-12.2557	-12.4234	
	Prob.	***0.0021***	***0.0000***	***0.0000***	
		***	***	***	
Without Constant & Trend	t-Statistic	-1.7290	-7.2226	-12.4630	
	Prob.	***0.0795***	***0.0000***	***0.0000***	
		*	***	***	

Notes:
a: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1% and (no) Not Significant
b: Lag Length based on SIC
c: Probability based on MacKinnon (1996) one-sided p-values.

According to the ADF test results, it was determined that the LCPI and EXCHANGE RATE variables were not stationary at the level values and had a unit root. This shows that these variables were not stationary at the level and that their first differences should be taken in the modelling. For the INF variable, it was stated that it could be stationary at the level value of 10% significance level, but it could have a unit root at the 5% and 1% significance levels. When the first differences were taken, d (LCPI) could be stationary at the 10% level, but stationarity was not certain at the 5% and 1% levels. On the other hand, and were stationary at their first differences and did not have a unit root.

The Augmented Dickey-Fuller test was performed to check the stationarity of the

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series of the variables. The test checks the null hypothesis of a unit root in the time series against the alternative of stationarity. In the present paper, all the series of the variable have been checked at levels and the first-difference form with or without the trend component to represent deterministic trends that may exist in the series.

The Phillips-Perron test gives largely parallel results to the ADF test. LCPI and EXCHANGE RATE were not stationary at the level value and had a unit root. However, the Phillips-Perron test results for the INF variable show that this series was stationary even at the level value and did not have a unit root. When the first differences were taken, it was determined that all the variables d(LCPI), d (EXCHANGE RATE) and d(INF) were stationary in their first differences and did not have a unit root.

The PP test was also conducted as a complementary method to confirm stationarity. The main difference from the ADF test is that the PP test automatically removes effects of autocorrelation and heteroskedasticity of error terms without going explicitly for adding lagged difference terms. That characteristic, in fact, extends its flexibility under some conditions for data.

The results showed that although all the variables, such as the Consumer Price Index and the Exchange Rate, at their level form were non-stationary, through first differencing they become stationary, implying that they were integrated of order one, I (1). The inflation variable, INF, was found to be stationary even at the level by the ADF test and hence integrated of order zero, I (0). The lag length for the ADF test is chosen based on AIC and robustness in results. Finally, one would need to implement PP Test and present the results.

Also, in tandem with the ADF results, under the PP test, stationarity for CPI and the Exchange Rate was again confirmed to be at the first difference, I (1), while that of INF was confirmed at the level, I (0). These consistent results of stationarity from the two tests consolidate the reliability of the tests' outcome and hence lay a clear foundation for the application of the ARDL bounds test. The combination of I (0) and I (1) confirmed the suitability of the ARDL approach since the model can accommodate series with mixed orders of integration. More importantly, no series was found to be integrated of order two, i.e., I (2), which would invalidate the ARDL model along with the bounds test results.

The analysis, therefore, ascertains that the stationarity assumptions are thoroughly proven using both ADF and PP tests, hence reducing the chances of spurious regres-

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sion results and improving the robustness of the subsequent ARDL model estimation.

As a result, both the ADF and Phillips-Perron tests generally show that the series are stationary in their first differences. However, the INF variable was found to be stationary even at the level with the Phillips-Perron test. This situation emphasizes that you need to develop appropriate modelling strategies by considering the stationarity levels of these series in the modelling process.

According to these results, the ARDL (Autoregressive Distributed Lag) bounds test developed by (Pesaran et al., 2001) can be applied. The ARDL bounds test allows the series to be at different stationarity levels (I (0) or I (1)). In other words, some series may be stationary at the level value (I (0)), while others may be stationary at the first difference (I(1)). The ADF and Phillips-Perron tests show that some of the series (LCPI and EXCHANGE RATE) are not stationary at the level value and are stationary at the first difference (I (1)), and the INF variable is stationary even at the level according to the PP test (I(0)). This situation is suitable for the use of the ARDL model because the ARDL model works effectively in cases where the stationarity degrees of the independent variables are mixed. However, our series should not be stationary at the second difference (I (2)). If any of your series, is I (2), the ARDL model and bounds test results will be invalid. According to the information given, since our series are I (0) and I (1), a suitable ground has been created to apply the ARDL bounds test. By applying this test, we can test whether there are long-term relationships between the variables. According to the ARDL model, the long-term relationship between the dependent variable Consumer Price Index (CPI) and the independent variable Net Exports (NEX) can be expressed as follows:

Model 1:

$$\Delta CPI_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta CPI_{t-i} + \sum_{j=0}^{q} \gamma_i \Delta NEX_{t-j} + \lambda_1 CPI_{t-1} + \lambda_2 NEX_{t-1} + \varepsilon_t$$

Similarly, the relationship between Inflation (INF) and Net Exports (NEX) can be expressed as:

Model 2:

$$\Delta INF_t = \alpha_0 + \sum_{i=1}^{p} \beta_i \Delta INF_{t-i} + \sum_{j=0}^{q} \gamma_i \Delta NEX_{t-j} + \lambda_1 INF_{t-1} + \lambda_2 NEX_{t-1} + \varepsilon_t$$

Hypotheses for Long-Term Relationship.

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(Null Hypothesis): There is no long-term relationship. That is, there is no cointegration between the dependent and independent variables.

$H_0 : \gamma_1 = \gamma_2 = 0$

(Alternative Hypothesis): There is a long-run relationship. That is, there is cointegration between the dependent and independent variables.

$H_1 : \gamma_1 \neq 0$ and/or $\gamma_2 \neq 0$

These hypotheses can be tested with the ARDL bounds test to evaluate whether there is a long-term relationship between CPI and INF and NEX. As a result of the test, if the F-statistic is greater than the critical bounds, the existence of a long-term relationship (co-integration) is accepted. If the F-statistic is smaller than the critical values, the long-term relationship is rejected.

The ARDL model estimation and bounds testing, developed by Pesaran et al. (2001), were implemented using EViews. This software was chosen for its robust capabilities in time series analysis, including the computation of short- and long-term coefficients, the error correction term (ECT), and the statistical bounds test for co-integration. The ARDL approach in EViews ensures reliable results even when the stationarity levels of the variables are mixed. To confirm the presence of a long-term relationship, the F-statistic for the ARDL bounds test was computed in EViews. Furthermore, diagnostic tests such as autocorrelation (using the Durbin-Watson statistic) and model stability (with CUSUM and CUSUMSQ tests) were performed. These diagnostic evaluations validated the model's assumptions and reinforced the credibility of the estimated relationships.

The results obtained from the ARDL model, including coefficients, probabilities, and test statistics, were exported to Microsoft Excel. This step facilitated the organization and formatting of the data into clear and comprehensive tables, enhancing the readability and interpretability of the findings. The entire analysis process, from data preparation to result interpretation, was systematically documented using Microsoft Word. Visual aids, such as charts and tables, were incorporated into the documentation to support the narrative and provide clarity. This approach ensured that the analysis could be reproduced and easily understood by other researchers or practitioners. The results of short and rung run relationship between CPI and exchange rate (Model 1) are summarised in Table 4 and Table 5.

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Table 4: Conditional Error Correction Regression

Variable	Coefficient	Standard Error	t-Statistic	Probability (p)
C	0.0447	0.0206	21.686	0.0311
CPI_{-1}[47]	-0.0094	0.0044	-21.480	0.0327
NEX_{-1}	0.0109	0.0037	29.406	0.0036
ΔCPI_{-1}	0.4745	0.0629	75.473	0.0000
ΔCPI_{-2}	-0.1363	0.0648	-21.036	0.0364
ΔCPI_{-3}	0.1589	0.0551	28.850	0.0043
ΔNEX	0.1164	0.0183	63.669	0.0000
ΔNEX_{-1}	0.0620	0.0205	30.298	0.0027

The error correction model demonstrates that there is a significant relationship between CPI and exchange rate in both short and long term. Exchange rate has a positive and significant impact on CPI in the short term, both in its contemporaneous and lagged values. This ARDL model is a model where CPI is the dependent variable and exchange rate is used as the independent variable. The error correction term is which is within the accepted range of (-1 < *ECT* < O).

Tablo 5: Long-Run coefficients of model 1

Variable	Coefficient	Standard Error	t-Statistic	Probability (p)
LDOLLAR	11.625	0.1986	58.523	0.0000
C	47.526	0.1136	418.226	0.0000

The coefficient for exchange rate is , p-value is . This coefficient shows that a increase in exchange rate in the long run leads to a increase in CPI. A p-value less than 0.05 indicates that this relationship is statistically significant. Constant term of model 1 is , again the p-value is . This indicates that when exchange rate is zero, CPI is at .

The unlagged and 1-period lagged differences of the exchange rate variable are significant. The coefficient for exchange rate without a lag is and the p-value is . This indicates that a 1% increase in exchange rate in the short run leads to a % increase in CPI. The coefficient for the 1-period lagged difference of exchange rate is and the p-value is . This again shows that the effect of exchange rate on CPI continues in the

47 $EC = CPI - (1.1625 \times NEX + 4.7526)$

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short term.

The lags of CPI are also significant in the model. For example, the coefficient of the 1-period lagged difference of CPI is and the p-value is . This shows that CPI is affected by its own lagged values in the short term. The coefficient of the second period lagged difference of CPI is and the coefficient of the third period lagged difference is . These coefficients indicate that CPI fluctuates in the short term and these fluctuations are in different directions. F-Bounds Test results of Model 1 is summarised in Table 6.

Table 6: F-Bounds Test Results

Test Statistic	Value	Significance Level	I(0)	I(1)
F-statistic	66.371	10%	3.02	3.51
		5%	3.62	4.16
		2.5%	4.18	4.79
		1%	4.94	5.58

The F-statistic of the model is calculated as 6.6371, which exceeds the critical value range of 3.62 to 4.16 at the 5% significance level. This result indicates the presence of a significant long-term relationship. Specifically, the bounds test confirms a robust long-term association between the Consumer Price Index (CPI) and the exchange rate. The results of the autocorrelation test are presented in Table 7.

Table 7: Autocorrelation and Heteroskedasticity Test Results

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 1 lag			
F-statistic	2.2716	Prob. F (1,246)	0.133
Obs*R^2	2.333182	Prob.	0.126
Heteroskedasticity Test: ARCH			
F-statistic	0.6880	Prob. F (1,250)	0.503
Obs*R^2	1.3848	Prob.	0.500
CUSUM test Results			

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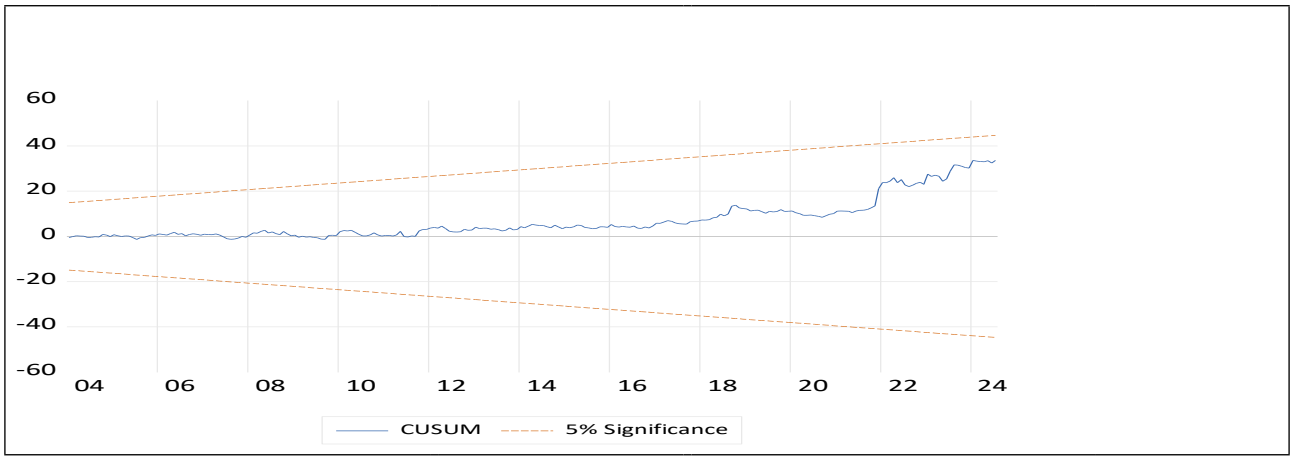

Since both p-values (and) are greater than the common significance levels (such as), we fail to reject the null hypothesis. This means that there is no evidence of serial correlation in the residuals up to 1 lag, suggesting that the residuals are independent over time for this model and since both p-values (and) are greater than the common significance levels (such as), we fail to reject the null hypothesis. This indicates that there is no evidence of heteroskedasticity in the residuals. The variance of the residuals appears to be constant, suggesting that the model does not suffer from heteroskedasticity issue. There is no problem regarding to CUSUM test of model 1.

In model 1, there is a significant relationship between exchange rate (logarithm of exchange rate) and CPI (logarithm of the CPI) in both the short and long term. In the long term, it is seen that an increase in the dollar exchange rate has a positive effect on inflation. In the short term, the effect of sudden changes in the dollar exchange rate on inflation is again positive and significant. Since the error correction term is negative and significant, we can conclude that the imbalances that occur in the short term will return to balance in the long term. This shows that inflation adapts to the changes in the dollar exchange rate.

Based on the results from the long-term model demonstrate that a 1% increase in the exchange rate leads to a 1.1625% increase in CPI (p-value = 0.0000). This shows that exchange rate movements have a strong pass-through effect to inflation, highlighting the sensitivity of consumer prices to currency fluctuations. In the short term, a 1% increase in exchange rate leads to a 0.1164% increase in CPI, while the 1-period lagged effect shows an additional increase of 0.0620%. This indicates that both immediate and delayed changes in the exchange rate drive inflation, making exchange rate stability crucial for price stability. Policymakers should focus on stabilizing the exchange rate to avoid triggering sharp inflationary spikes, as even short-term ex-

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change rate movements have significant effects on CPI. The substantial long-term pass-through (1.1625%) underscores the importance of minimizing prolonged currency depreciation, which could have lasting inflationary effects.

The error correction term (ECT) of -0.0094, which is within the accepted range of -1 to 0, suggests that short-term deviations from the long-term equilibrium between exchange rates and CPI are corrected gradually. This means that although inflationary shocks from the exchange rate can persist in the short term, the economy will eventually return to equilibrium. However, the slow rate of correction, indicated by the small magnitude of the ECT, implies that it may take significant time for inflation to fully stabilize after an exchange rate shock. The long-term relationship also suggests that inflation targeting needs to account for exchange rate fluctuations. The sensitivity of CPI to exchange rate changes, particularly in the long term (with a coefficient of 1.1625), means that central banks must consider these movements when setting inflation targets and adjusting interest rates.

The constant term of 47.526 (p-value = 0.0000) in the long-term regression suggests that even when the exchange rate is held constant, CPI remains at a baseline level driven by other structural factors. The baseline level of inflation, independent of exchange rate fluctuations, could reflect underlying domestic factors such as import dependency, supply chain inefficiencies, or inflation expectations. Structural reforms that address these issues are critical to lowering the economy's baseline inflation rate. For example, reducing reliance on imported goods and enhancing domestic production capabilities could mitigate the impact of exchange rate shocks. A reduction in structural inflation could also lower the sensitivity of CPI to exchange rate movements, thereby improving the effectiveness of monetary policy.

The significant short-term effects of exchange rate changes on CPI, with a coefficient of 0.1164 for the contemporaneous effect and 0.0620 for the 1-period lagged effect, suggest that inflation responds quickly to currency depreciation. The presence of these significant short-term effects (with p-values of 0.0000 and 0.0027, respectively) indicates that inflation expectations are highly sensitive to exchange rate fluctuations. During periods of exchange rate volatility, policymakers should consider employing short-term monetary interventions to stabilize expectations. Central banks may need to act decisively to prevent a feedback loop where high inflation expectations exacerbate inflationary pressures. In particular, the significant lagged effects of CPI suggest that inflation dynamics have a delayed but persistent response to exchange rate movements.

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To summarised, the model's results show a clear relationship between exchange rate movements and inflation. The strong pass-through in both the short and long term underscores the importance of managing exchange rate fluctuations to maintain price stability. Furthermore, the gradual adjustment process in the error correction model suggests that while short-term inflationary shocks may be persistent, the economy will eventually return to equilibrium. Thus, a combination of exchange rate stabilization, structural reforms, and flexible monetary policy is necessary to manage inflation effectively. The results of model 2 are tested in below.

Table 8: Conditional Error Correction Regression of model 2

Variable	Coefficient	Std. Error	t-Statista Prob (p)
C	0.000299	0.001090	0.273951
			0.7844
inf_{-1}[48]	-0.542382	0.073139	-7.415.745
			0.0000
NEX_{-1}	0.003978	0.001162	3.424.185
			0.0007
Δinf_{-1}	0.054657	0.075314	0.725725
			0.4687
Δinf_{-2}	-0.117405	0.060388	-1.944.174
			0.0530
Δinf_{-3}	0.098282	0.056109	1.751.633
			0.0811
ΔNEX	0.122702	0.019144	6.409.418
			0.0000
ΔNEX_{-1}	0.061259	0.021553	2.842.278
			0.0049

In terms of validity of the model, ARDL analysis clearly reveals the relationship between inflation and exchange rate. The coefficient of the previous period of inflation being -0.542382 shows that past inflation has a negative effect on current inflation. This situation shows that decreases in inflation have a positive effect on future inflation.

The past value of the exchange rate variable and current value also provide statistically significant results. The coefficients of for and for show that increases in

48 $EC = INF - (0.0073 * LDOLLAR + 0.0006)$

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exchange rate have the potential to increase inflation. This finding emphasizes the effect of exchange rate fluctuations on inflation in Türkiye and shows that changes in exchange rate should be taken into consideration.

In addition, in the analysis conducted to measure the effect of previous periods of inflation, the coefficients Δinf_{-2} and Δinf_{-3} also show significance. This reveals that the effect of past periods on inflation is significant and indicates that policy makers should also pay attention to historical data when determining inflation. The long run coefficient of model 2 are summarised in blow table.

Table 9: Long-Run Coefficients of Model 2

Variables	coefficients	Std. Error	t-Statista	Prob (p)
NEX	0.007334	0.001581	4.638.658	0.0000
C	0.000551	0.002012	0.273698	0.7845

Based on Table S, the coefficient of the NEX (nominal exchange rate) variable in Table 8 was found to be 0.007334 and this coefficient was statistically significant at the 0.0000 significance level. This shows that increases in the exchange rate have a positive effect on inflation in the long term. In other words, increases in the exchange rate have the potential to increase inflation. This result emphasizes the effect of exchange rate fluctuations on inflation in the Turkish economy and shows that exchange rate changes should be considered on inflation. The constant term was calculated as 0.000551 but was not found to be statistically significant at the 0.7845 significance level. This indicates that the constant term of the model does not have a significant effect on long-term inflation dynamics. the results in Table S show that exchange rate changes have a significant effect on inflation in the long-term relationship of model 2. In particular, it has been shown that exchange rate increases can lead to long-term increases in inflation.

The F-bounds test results reveal that there is a long-term relationship between inflation and the exchange rate. The value of F-statistics, 23.22034, is well above the critical values at the 1% significance level. This indicates that there is a long-term equilibrium relationship between the exchange rate and inflation and that economic policies should take this relationship into account.

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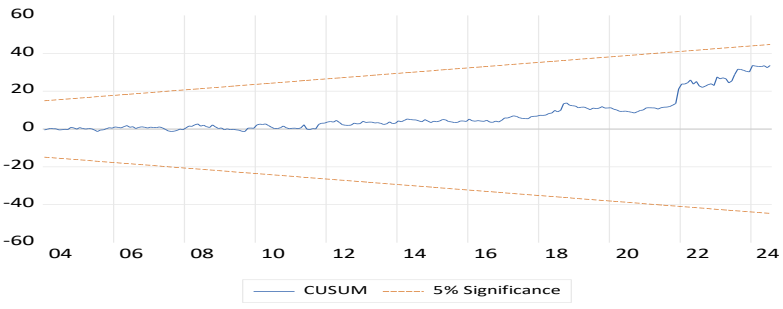
Table 10: Bound Test Results

Test Statista	Critical value	%10 Statistic	%5 Statistic	%1 Statistic
F-Statista	23.22034	3.02 - 3.51	3.62 - 4.16	4.94 - 5.58

As a result, this model shows that there is a strong interaction between inflation and the exchange rate in Türkiye. In particular, the effect of exchange rate fluctuations on inflation should be considered and policy makers should consider the potential effects of exchange rate changes on inflation. This situation is of critical importance in ensuring economic stability. Serial correlation and heteroskedasticity and CUSUM tests were performed to test the validity of the model.

Table 11: Breusch-Godfrey Serial Correlation LM and Heteroskedasticity Test Results:

Breusch-Godfrey Serial Correlation LM Test:			
Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.483771	Prob. F(2,244)	0.6170
Obs*R^2	1.003217	Prob.	0.6056
Heteroskedasticity Test: ARCH			
F-statistic	0.658329	Prob. F(1,251)	0.4179
Obs*R^2	0.661839	Prob.	0.4159
CUSUM Test result			



Breusch-Godfrey Serial Correlation LM Test was applied to test whether there is autocorrelation in the model. Since both probability values are above the 5% significance level, the null hypothesis cannot be rejected. This situation shows that there is no autocorrelation in the model up to 2 lags. Therefore, there is no serial correlation problem in the model error terms.

ARCH test was applied to test whether the error terms have constant variance. Since

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both probability values are above the 5% significance level, the null hypothesis cannot be rejected. These results show that there is no heteroskedasticity problem in the model. CUSUM test shows that there is not any problem regarding stability of model.

The model 2 results show that changes in the dollar exchange rate significantly affect inflation in both the short and long term. While sudden increases in the dollar exchange rate rapidly increase inflation in the short term, there is a positive and significant relationship between the dollar exchange rate and inflation in the long term. In addition, the error correction term reveals that the system returns to equilibrium in the long term. The findings emphasize that the dollar exchange rate should be considered in monetary policy decisions.

Based on results of Model 2, the ARDL analysis provides a clear depiction of the relationship between exchange rates and inflation in Türkiye. The coefficient of -0.542382 for past inflation suggests a negative feedback mechanism, where decreases in inflation have a positive impact on future inflation. This finding suggests that inflationary reductions tend to lead to inflationary pressures in subsequent periods. From an economic standpoint, this highlights the persistence of inflationary expectations in the Turkish economy. Policymakers should consider the momentum of inflationary trends when crafting monetary policy, as even after periods of inflation reduction, there may be an underlying propensity for future inflation increases.

The coefficients for the lagged exchange rate variable (NEX (-1)) and the current exchange rate change (ΔNEX) provide statistically significant results, reinforcing the relationship between exchange rate fluctuations and inflation. Specifically, the coefficients of 0.003978 for NEX (-1) and 0.122702 for ΔNEX suggest that increases in exchange rates lead to higher inflation. This indicates that exchange rate movements, especially in the short term, have an immediate impact on inflationary pressures. In the case of Türkiye, where the economy is heavily dependent on imports and external factors, fluctuations in the exchange rate significantly influence domestic price levels. Therefore, exchange rate policies should be integrated into inflation control measures, as these fluctuations directly affect inflation outcomes.

The inclusion of lagged inflation variables (Δinf (-2) and Δinf (-3)) also demonstrates significant effects on current inflation. This finding emphasizes the importance of considering historical inflation data when forecasting future inflation trends. Economically, this suggests that past inflationary shocks persist in the economy, influencing inflation expectations and price-setting behavior. Policymakers need to consider

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the lagged effects of past inflation in their decision-making process, as historical inflation data plays a crucial role in determining future inflationary pressures. This highlights the necessity of managing inflation expectations through consistent and predictable policies.

The long-run coefficient for the nominal exchange rate (NEX) of 0.007334, statistically significant at the 0.0000 level, indicates that exchange rate increases positively affect inflation in the long term. The relationship suggests that currency depreciation, through increased import prices, contributes to persistent inflationary pressure in Türkiye. From an economic perspective, this underlines the importance of managing the exchange rate to prevent long-term inflationary spirals. Policymakers need to account for this dynamic when formulating long-term monetary policies, as sustained currency depreciation could have lasting impacts on inflation, thus undermining price stability.

The results of the Breusch-Godfrey Serial Correlation LM Test and the ARCH test show no evidence of autocorrelation or heteroskedasticity in the model. These results confirm the robustness of the model, suggesting that the relationships observed between exchange rates and inflation are not driven by statistical anomalies or model misspecification. The CUSUM test also indicates stability in the model, further validating the consistency and reliability of the results. The absence of serial correlation and heteroskedasticity strengthens the credibility of the findings, making them valuable for economic policy formulation.

The F-bounds test confirms the long-term equilibrium relationship between exchange rates and inflation. The significant F-statistic value (23.22034) suggests that exchange rate fluctuations and inflation are tightly linked, necessitating careful consideration of exchange rate policy in Türkiye's broader economic strategy. In particular, the model highlights the need for monetary policymakers to monitor and address exchange rate fluctuations, as these can have both short-term and long-term effects on inflation. The positive relationship between the exchange rate and inflation underlines the critical importance of exchange rate stability for maintaining price stability and ensuring economic stability in Türkiye.

The ARDL analysis of model 2 shows a significant and dynamic relationship between exchange rate movements and inflation in Türkiye. The findings suggest that both short-term fluctuations and long-term trends in the exchange rate play a critical role in determining inflationary pressures. Policymakers must integrate exchange rate

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considerations into inflation-targeting frameworks and adopt policies that mitigate the adverse effects of exchange rate volatility on inflation. The model's robustness and the statistical tests further validate the conclusions, emphasizing the importance of exchange rate management in achieving sustained economic stability.

This study has some limitations. First, the dataset is mainly focused on the Turkish economy, which may limit the generalization of the findings to different economic structures and policies in other countries. In addition, the study is based on historical data and may not reflect recent economic developments, which may limit the applicability of the findings to current conditions. Second, although the ARDL model used provides valuable information about the inflation and exchange rate relationship in Türkiye, its validity may be limited under different economic conditions in other countries. In addition, the model may not include some important variables; for example, international commodity prices, global economic shocks, or political factors are not included in the model. These deficiencies may affect the accuracy of the model. Since the study is based on a specific historical period, structural breaks or changes in the economy during this period may not be fully modeled. For example, political events, policy changes, or external shocks may affect the relationship between exchange rate and inflation. The effects of exchange rate fluctuations may also differ depending on the magnitude and duration of these fluctuations, but the study could not fully capture this complexity.

Finally, the ARDL model assumes linear relationships, but in reality, these relationships may be nonlinear or subject to threshold effects. Such complexities may not be adequately captured by the current model. These limitations highlight the need for caution in interpreting the results and the importance of further research in this area.

Conclusion

Exchange rate pass-through is an important policy issue in both developed and developing economies in terms of its effects on inflation. The impact of exchange rate fluctuations on domestic prices varies depending on several factors such as economic structure, trade composition, price elasticity and global economic conditions. Therefore, policy strategies to be developed to reduce exchange rate pass-through should take these factors into account and be designed in accordance with country-specific conditions.

To reduce the impact of exchange rate pass-through on inflation, especially in de-

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veloping countries, it is necessary to strengthen the monetary policy framework, carefully manage foreign exchange market interventions and diversify the economic structure. In addition, monitoring global economic conditions and developing risk management strategies can play a key role in limiting the negative effects of exchange rate fluctuations on inflation.

In conclusion, managing exchange rate pass-through requires a holistic policy approach that combines inflation targeting, foreign exchange market interventions, structural reforms and risk management strategies. Such an approach will contribute to maintaining economic stability and ensuring a sustainable growth environment by reducing the impact of exchange rate fluctuations on domestic prices. Future studies can make significant contributions to the literature on exchange rate pass-through by evaluating the effectiveness of these policies and conducting comparative analyses across countries.

The findings of the study show that the effect of exchange rate fluctuations on the consumer price index (CPI) is significant in both the short and long term and that this effect should be considered in terms of economic policies. As a result of the analysis conducted with the ARDL model, it was revealed that the pass-through effect of exchange rate changes on inflation is significant and that this effect continues to decrease over time. In particular, the effect of exchange rate movements on import costs and the process of reflecting these costs on prices stand out as important determinants of inflation dynamics.

In this context, being able to correctly analyse the effects of exchange rate pass-through is of critical importance for central banks to achieve their inflation targets. In future studies, comparatively addressing the effects of exchange rate pass-through in different countries and under different economic shocks can provide a more in-depth understanding in this area. The results of the study emphasize the importance of a strong monetary policy framework to control the effects of exchange rate fluctuations on inflation, especially in developing economies. In this direction, it is suggested that policy makers should develop flexible policies that are sensitive to exchange rate movements.

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