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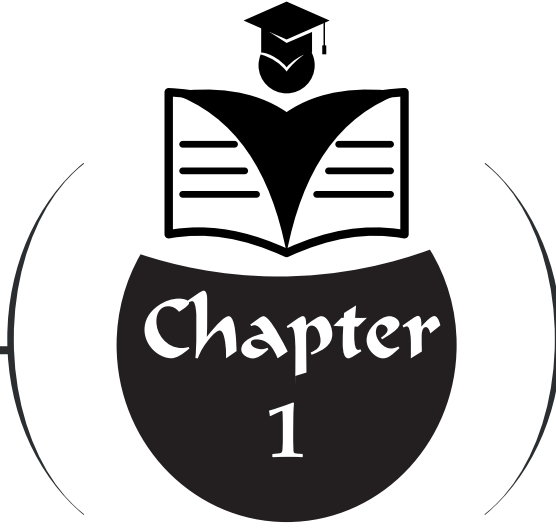
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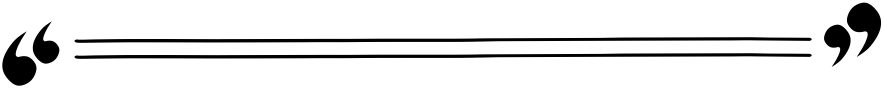
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INTERNATIONAL INFLATION SYNCHRONIZATION IN TURKEY



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This paper studies Turkish consumer price inflation and its determinants with a particular attention to possible synchronization with foreign inflation. Globalization of the last decades led to a significant increase in common variation in key macroeconomic and financial variables across countries. Hence, this paper contributes to the existing literature in assessing the degree of synchronization of Turkish inflation with foreign inflation. Results indicate that foreign inflation is one of the key drivers of inflation in Turkey, along with exchange rates and global commodity prices.

Keywords: Inflation, Spillovers, Regression Analysis, Emerging Markets.

JEL Classification: E31, F41, C32, F44, F62, O53

1. Introduction

Together with the recent episode of a surge in inflation across the globe, drivers and international synchronization of inflation across countries has become a key issue of consideration for policy makers. In particular, this issue is even more important for emerging market economies with a history of greater inflation variability. In the case of Turkey, inflation in recent years has surged to highest levels ever seen for the last two decades. There had been various views as to what were the key reasons for this surge in Turkish inflation during the last few years; ranging from Monetary and Fiscal Policy to global commodity prices. This paper aims to contribute to this debate by studying how much synchronization exists between foreign inflation and Turkish inflation.

Domestic drivers of consumer price inflation is widely studied in the literature, ranging from monetary policy, fiscal policy to domestic business cycles and more. On top of domestic drivers, countries that are integrated to the global economy and global supply chains are particularly vulnerable to volatility in international markets and business cycles. Turkey is a highly open economy with significant international trade volume and notable integration to global supply chains. Given this significant integration to the global economy, not only Turkish business cycle, but also changes in domestic consumer prices shall to a certain degree reflect developments in international prices. The transmission can take place directly from commodity prices, whether they may be raw materials or energy prices; through intermediate goods imports or directly imported goods; or even through global financial conditions and expectations channels. Given the numerous channels through which international price shocks may propagate

to Turkish consumer prices, quantifying the magnitude and persistence of these spillovers are of critical importance in designing optimal policy for domestic policy-makers.

From a historical perspective, past episodes of elevated inflation in Turkey often coincided with elevated global commodity prices and global economic volatility. For instance, Turkish inflation had been markedly elevated during late 1990's and early 2000's, mainly considered to be due to domestic issues such as fiscal imbalances and exchange rate policy and instability; but also coincided with rising oil prices and global financial uncertainty. Furthermore, after a relatively successful disinflationary period, Turkish inflation increased noticeably in 2008, which followed a surge in global commodity prices and elevated global inflation. Later, Covid pandemic brought about significant supply side disruptions globally, leading to a resurgence of inflation across the globe. Together with geopolitical tensions and conflicts, global inflation peaked to the highest levels seen in the last decades. During this episode, Turkish inflation also peaked to levels not seen for many years, partly considered to be due to domestic issues but perhaps also due to this international backdrop.

Existing academic literature has many important papers focusing on the drivers and dynamics of Turkish consumer prices. For instance, employ structural vector autoregression (SVAR) methods on monthly global oil prices, unemployment, policy rates and exchange rates to study the long term volatility of inflation in Turkey. The author argue that the Turkish inflation long term volatility can be mainly explained by global oil prices and currency dynamics. A recent paper by similarly utilizes an SVAR model to decompose and study supply and demand shocks on inflation. The author concludes that the monetary policy buffers demand driven inflation, and Turkish inflation has been driven to a greater extent by supply shocks compared to demand shocks during the post Covid period. provides an historical perspective on Turkish inflation and also study the decomposition of Turkish inflation episodes. Author argues that domestic structural issues and global price shocks are mainly behind the historical persistence in Turkish inflation.

Other studies on inflation from an international perspective lays further evidence on the global sources of inflationary shocks. For instance, employ a panel of data consisting of aggregate and core inflation across countries and

find that domestic inflation across countries has increasingly become driven by global inflation dynamics. study the changes in inflation expectations of analysts in emerging market countries with respect to global inflation. The authors find that the global inflation significantly affects mean expectation for inflation in these countries. employ a dynamic factor model to estimate and study the common global inflation component that exists as a common variation across different countries domestic inflation dynamics. Authors document strong evidence for the presence of a significant common global inflation factor that synchronizes inflation across emerging market economies.

Using the latest domestic and international data on inflation and underlying fundamentals, this paper focuses on the impact of international inflation on Turkish domestic inflation to study international synchronization of Turkish consumer prices. To do so, a trade weighted foreign inflation series is constructed along with other key fundamentals.

Empirical results suggest that one of the key drivers of Turkish consumer prices is indeed foreign inflation. A 1% increase in foreign inflation leads to a greater than 6% increase in Turkish headline inflation in 12 months horizon. Majority of this cumulative impact takes place within the first 3 months at close to 5%. Note that these results are obtained while controlling for all other factors that may affect inflation, including domestic business cycle, exchange rates, global commodity and energy prices and import prices.

The organization of the paper is as follows; Section 2 presents the dataset and descriptive statistics; Section 3 outlines the methodology employed in the empirical analysis; Section 4 illustrates the results and discussion; finally Section 5 concludes.

2. Dataset

The data used in this paper had been collected by the author from LSEG Workspace Datastream, Turkstat, St Louis FRED Database, and Central Bank of Turkey Database. The dataset is in monthly frequency and the sample period under investigation is 2005M2-2025M5.

In order to construct the foreign CPI index, Turkish import weights are utilized. As of 2024, top 9 trading partners constitute close to 75% of all imports of Turkey, namely European Union, China, Russia, United States, Switzerland, South Korea, India, United Kingdom and Japan. So import

weights and consumer prices for these respective countries are used to construct the foreign CPI index.

Table 1. Descriptive Statistics

	CPI	CPIC	CPIX	REER
Mean	1.372	1.268	0.243	-0.112
Std Dev	1.732	1.611	0.225	3.306

	IMPP	GAP	COMM	OIL
Mean	0.193	0.138	0.367	0.548
Std Dev	2.662	4.009	4.61	8.675

Notes: CPI = Domestic Consumer Price Inflation; CPIC = Domestic Core Consumer Price Inflation; CPIX = Foreign Consumer Price Inflation; REER = Real Effective Exchange Rate; IMPP = Import Prices; GAP = Output Gap; COMM = Commodity Price Index; OIL = Brent Crude Oil Prices.

Table 1 presents the descriptive statistics for the variables used in the analysis. Average Turkish consumer price inflation (CPI) stood at 1.37% per month month over month (mom) seasonally adjusted (sa) during the sample period, with the Core CPI excluding energy, food and non-alcoholic beverages, alcoholic beverages, tobacco and gold (CPIC) and foreign CPI (CPIX) averaging 1.27% and 0.24% respectively. The real effective exchange rate (REER) had a slight negative mean mom change at -0.11%, reflecting the fact that Turkish lira lost its value in real terms over the sample period under investigation. Among other determinants, import prices (IMPP) increased by an average of 0.19% mom, the domestic output gap, which is calculated with hpfilter applied to Turkish monthly industrial production index working day (wda) and sa, averaged 0.14%, global commodity prices (COMM), which is the Global Price Index of All Commodities provided by the St Louis FRED database, rose by 0.37% mom, and Brent crude oil prices (OIL) increased by 0.55% on average. Standard deviations indicate substantial volatility in oil and commodity prices, as well as in the output gap, highlighting some of the potential sources of significant external and cyclical variation for Turkish consumer prices inflation dynamics.

To further gauge into the variation across time for Turkish inflation and it's key determinants under consideration, Figures 1-3 presents the historical

evaluation of some of these time series. Starting with Figure 1, main series under investigation, CPI and core CPI are illustrated across the sample period as year over year percentage changes (YoY) in the respective indices sa. We can see that the dynamics of the headline CPI follows closely those of the core CPI series, with few notable periods of divergence, for instance in 2008 and 2022.

Figure 2 presents the Turkish headline CPI series yoy sa together with foreign import weighted CPI index constructed, the main driver under investigation here. The chart illustrates that the two series clearly share some commonality, with both inflation series rising noticeably in 2008, 2010, 2022, and falling together in few other periods.

Figure 3 presents the Output Gap constructed here as a proxy for the domestic business cycle conditions. There had been few marked episodes of significant negative output gaps in Turkey historically during the sample period considered here, for instance 2008, 2018-19 and 2024 periods. Apart from the downturns, 2006-08, 2017, 2021 periods have been accompanied with positive output gaps in Turkey.

Figure 1: Turkey: CPI and Cope CPI %YoY SA

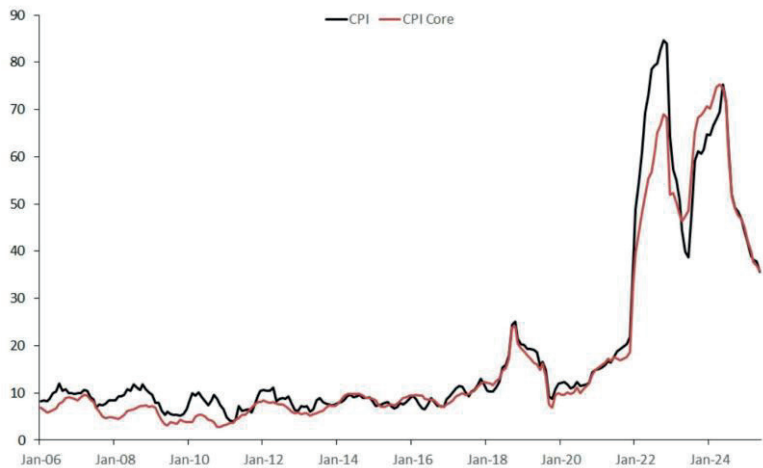
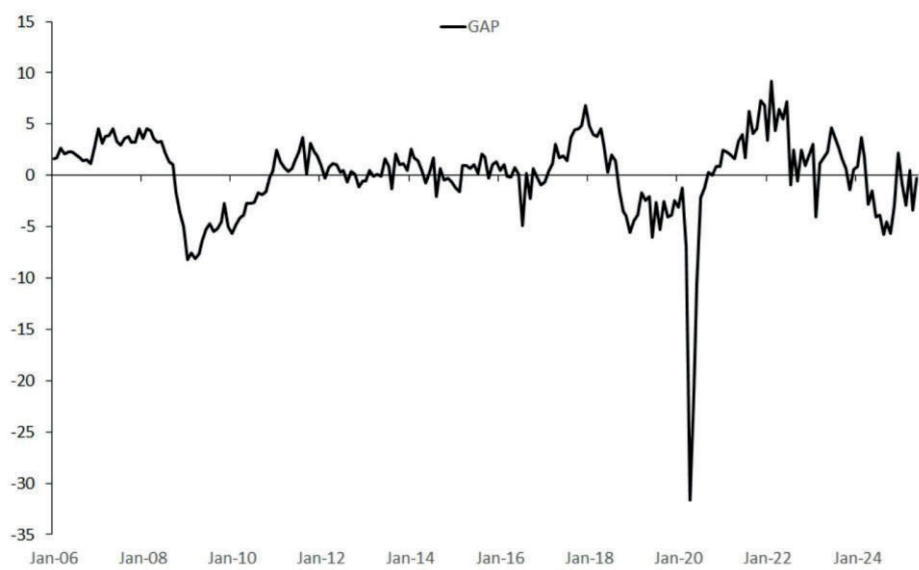


Figure 2: Turkey: CPI and Foreign: CPI %YoY SA



Figure 3: Output Gap SA



3. Econometric Model

As discussed previously, existing literature identifies some key drivers of consumer price inflation. These include domestic activity, international

commodity prices, oil prices, import prices and exchange rates.¹ Hence, in order to control for these other potential drivers of Turkish consumer price inflation besides foreign CPI, the empirical specification considered here includes measures for these fundamentals. So the following reduced form empirical models are specified for headline and Core CPI in Turkey,

$$\begin{aligned}
 \text{CPI}_t &= \alpha_0 + \sum_{i=0}^L \alpha_{1i} \text{CPIX}_{t-i} + \sum_{i=0}^L \alpha_{2i} \text{REER}_{t-i} + \sum_{i=0}^L \alpha_{3i} \text{GAP}_{t-i} \\
 &\quad + \sum_{i=0}^L \alpha_{4i} \text{COMM}_{t-i} + \sum_{i=0}^L \alpha_{5i} \text{OIL}_{t-i} + \varepsilon_t, \\
 \text{Core_CPI}_t &= \beta_0 + \sum_{i=0}^L \beta_{1i} \text{CPIX}_{t-i} + \sum_{i=0}^L \beta_{2i} \text{REER}_{t-i} + \sum_{i=0}^L \beta_{3i} \text{GAP}_{t-i} \\
 &\quad + \sum_{i=0}^L \beta_{4i} \text{COMM}_{t-i} + \sum_{i=0}^L \beta_{5i} \text{OIL}_{t-i} + u_t,
 \end{aligned}$$

where L denotes the lag length, which is set to 12 months for all explanatory variables. CPI_t is Turkish headline consumer price inflation, Core_CPI_t is Turkish Core CPI inflation, CPIX_t is foreign CPI inflation, REER_t is the real effective exchange rate, GAP_t is the domestic output gap, COMM_t is the global commodity price index, OIL_t is Brent crude oil price, and ε_t and u_t are regression error terms that are iid distributed.

To better understand the relative importance of each of the explanatory variables, alternative specifications in which some of the explanatory variables omitted are also considered and reported. Furthermore, the sample period includes the Covid pandemic period. As it can be seen from Figure 3, some of the variables illustrate drastic volatility during this period. So in order to control for the possible impact of Covid on estimation results, Covid dummies are also included in the regression equations during 2020.

The key assumption to make in order to estimate above illustrated regression models via the Ordinary Least Squares technique is the exogeneity of all explanatory variables. The literature on VARs mostly assume that the CPI shall be ordered the last in the system while making short term recursive exclusion restrictions since these explanatory variables are mostly pre-

¹ See for instance for exchange rates, for import prices, for oil prices, for commodity prices, Activity.

determined with respect to the CPI. For foreign and international variables such as foreign CPI, commodity and oil prices exogeneity assumption is valid since Turkey is a small open economy with respect to the rest of the world.

4. Results

In line with the empirical specification presented in the previous section, results for the headline CPI model is presented at Table 2.

Note that Table 1 and 2 presents the individual coefficients and their significance levels for the main explanatory variable of interest, CPIX. However, to conserve space, the coefficients of other control variables are not reported individually, but reported by cumulating individual coefficient for all lags from 0 to 12. Also, Specifications (2) to (6) drops one of the explanatory control variables in each specification. The purpose of carrying out estimation of these alternative specifications include checking for robustness of results, as well as understanding the relative importance of individual fundamentals via regression fit statistics R2 and Adj R2.

Examining the results for the baseline specification (1), the explanatory variables can explain around 60% of the total variation in Turkish headline CPI. Examining the results for the main explanatory variable of interest, foreign consumer price inflation, the first 2 lags and contemporaneous impact coefficient is significant. This result is robust across in other alternative specifications for contemporaneous impact and first lag coefficients. Higher order lags for CPIX seem to be not statistically significant.

Regarding the control variables, the 12 month cumulative impact of the REER is negative in all specifications where it is included, consistent with the prior expectation that currency appreciation shall reduce domestic price pressures, and vice versa. Cumulative effects of import prices (IMPP) are positive in most of the specifications, which suggests that imported inflation passes through to domestic CPI, again in line with the prior expectations. The cumulative impact of output gap (GAP) is small and mostly insignificant, which suggests limited short-run demand-effects. Commodity prices (COMM) show a negative cumulative sign in most specifications which is against the prior expectation of a positive relationship. However, one may argue that international commodity prices may proxy for global business cycle which may have a positive relationship with inflation

internationally. Oil prices (OIL) have mostly positive coefficients in line with expectations.

Table 2: Regression Results for CPI

	Specifications					
	(1)	(2)	(3)	(4)	(5)	(6)
CPIX(0)	1.59**	1.24*	1.83***	1.70***	1.58***	1.72***
CPIX(-1)	1.68**	1.65**	1.56**	1.57**	1.66***	1.60**
CPIX(-2)	1.27*	1.02*	1.23**	0.91	1.09*	0.87
CPIX(-3)	0.38	0.07	0.72	0.39	0.86	0.12
CPIX(-4)	-0.36	-0.28	-0.12	-0.33	-0.52	-0.52
CPIX(-5)	-0.27	-0.10	-0.09	-0.26	-0.27	0.24
CPIX(-6)	0.11	0.24	-0.15	-0.16	0.06	0.24
CPIX(-7)	0.07	0.26	-0.25	0.10	0.44	-0.03
CPIX(-8)	-0.73	-0.80	-0.31	-0.35	-0.47	-0.97
CPIX(-9)	0.22	0.16	0.71	0.36	0.29	0.65
CPIX(-10)	1.05	1.53**	1.15**	0.94*	1.09	1.44*
CPIX(-11)	0.68	0.21	0.12	0.75	0.53	0.76
CPIX(-12)	0.58	0.30	0.56	0.61	0.52	0.28
Cum_REER	-0.22	--	-0.28	-0.22	-0.26	-0.21
Cum_IMPP	1.10	1.23	--	0.96	-0.28	0.44
Cum_GAP	-0.02	-0.04	0.04	--	0.06	0.02
Cum_COMM	-1.24	-1.37	-0.46	-1.07	--	-0.43
Cum_OIL	0.36	0.43	0.19	0.29	-0.03	--
\$R^2\$	0.60	0.54	0.58	0.59	0.55	0.56
Adj. \$R^2\$	0.39	0.35	0.40	0.42	0.36	0.37
DW	0.58	0.71	0.60	0.60	0.64	0.65

Notes: "Cum_" denotes the sum of the estimated coefficients for that variable from lag 0 to lag 12. CPIX refers to foreign consumer price inflation, REER to the real effective exchange rate, GAP to the output gap, COMM to the commodity price index, and OIL to Brent crude oil prices. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

To study the relative importance of control variables, results across specifications (2) to (6) indicate that greatest reduction in Adjusted R2 happens when exchange rates, oil and commodity prices are omitted. However, excluding import prices and output gap does not lead to a fall in Adjusted R2 compared to the baseline specification (1). The exclusion of REER in (2) lowers the adjusted R2 from 0.39 to 0.35, while removing commodity prices and oil lead to Adjusted R2 falling to 0.36 and 0.37 respectively. Overall, the results indicate that foreign CPI, REER, oil and commodity prices are the main drivers of Turkish headline CPI dynamics, with other factors playing smaller or less consistent roles.

Turning to the results for core CPI at Table 3, baseline specification illustrates that none of the coefficients for the main explanatory variable of interest, CPIX, is significant at conventional statistical significance levels, apart from Lag 10 which is significant at only 10% level. This is in quite contrast to the findings for the headline CPI. Examining the results for the other explanatory variables, signs of the coefficients are in line with the prior expectations for exchange rates, import and oil prices. Similar to the results for headline CPI, coefficient of commodity prices is against the prior expectations of a positive sign. Adjusted R2s across specifications indicate that the most important explanatory variables besides CPIX is commodity prices and exchange rates.

Table 3: Regression Results for Core CPI

	Specifications					
	(1)	(2)	(3)	(4)	(5)	(6)
CPIX(0)	0.88	0.59	1.07*	1.14**	1.03*	0.88*
CPIX(-1)	0.98	0.95	0.88	0.78	0.85	0.61
CPIX(-2)	0.87	0.73	0.79	0.53	0.67	0.73
CPIX(-3)	0.05	-0.21	0.42	-0.05	0.30	0.12
CPIX(-4)	0.22	0.21	0.47	0.27	0.43	0.03
CPIX(-5)	-0.27	-0.11	-0.10	-0.17	0.01	0.04
CPIX(-6)	-0.07	0.15	-0.09	-0.35	-0.29	0.18
CPIX(-7)	0.18	0.42	-0.01	0.30	0.25	0.19
CPIX(-8)	-0.29	-0.38	-0.16	-0.01	-0.04	-0.58
CPIX(-9)	0.71	0.57	0.90**	0.73	0.89*	0.89
CPIX(-10)	1.00*	1.42**	1.15**	0.81	1.12*	1.43**

CPIX(-11)	0.56	0.22	0.32	0.56	0.20	0.66
CPIX(-12)	1.00	0.68	0.92*	0.99*	0.81*	0.59
Cum_REER	-0.14	--	-0.21	-0.13	-0.17	-0.13
Cum_IMPP	0.99	1.04	--	0.98	-0.36	0.41
Cum_GAP	-0.01	-0.02	0.05	--	0.07	0.04
Cum_COMM	-1.15	-1.22	-0.45	-1.10	--	-0.44
Cum_OIL	0.31	0.36	0.15	0.30	-0.03	--
\$R^2\$	0.58	0.53	0.56	0.56	0.52	0.54
Adj. \$R^2\$	0.35	0.34	0.38	0.38	0.32	0.35
DW	0.38	0.48	0.38	0.40	0.42	0.44

Notes: "Cum_" denotes the sum of the estimated coefficients for that variable from lag 0 to lag 12. CPIX refers to foreign consumer price inflation, REER to the real effective exchange rate, GAP to the output gap, COMM to the commodity price index, and OIL to Brent crude oil prices. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

Starting with the results for core exports, together with the Covid dummies, the full specification (1) is able to explain close to 70% of the total variation in Turkish core exports. Examining the results for individual explanatory variables, the biggest impact from external demand propagates in the same quarter, with a coefficient close to 0.4 and significant at 1% level. In other horizons, external demand still has sizeable and significant impact after 2 and 3 quarters. Coefficients for real effective exchange rate are also highly significant across all lags, apart from 4th lag. To decompose their relative contributions, specifications (2) and (3) includes only external demand and real effective exchange rates respectively. Interestingly, in specification (2), only the contemporaneous coefficient of external demand is significant at 10% level. Also the R2 falls to 50% in specification (2). However, one has to note that there may be correlation between different lags of explanatory variables since the external/global demand conditions occur in cycles and gradually across time. Turning to specification (3), coefficients of real effective exchange rates remain significant similar to specification (1), with all coefficients remaining significant apart from lag 4. R2 of 58% is also higher than the R2 in specification (2). These results signal that for core exports, real effective exchange rates is a more important driver as a whole. However, Comparing the Adjusted R2 of the three specifications, clearly the full model has the highest Adjusted R2 which means that both external

demand and real effective exchange rates are important drivers of the Turkish core goods exports.

Figure 4: Cumulate Foreign CPI Pass-Through to Turkey CPI and Core CPI

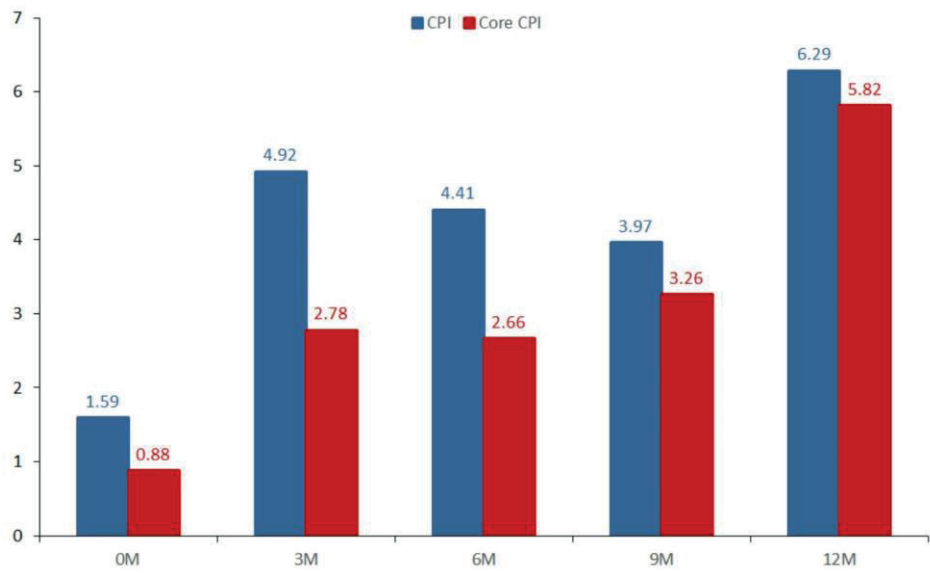
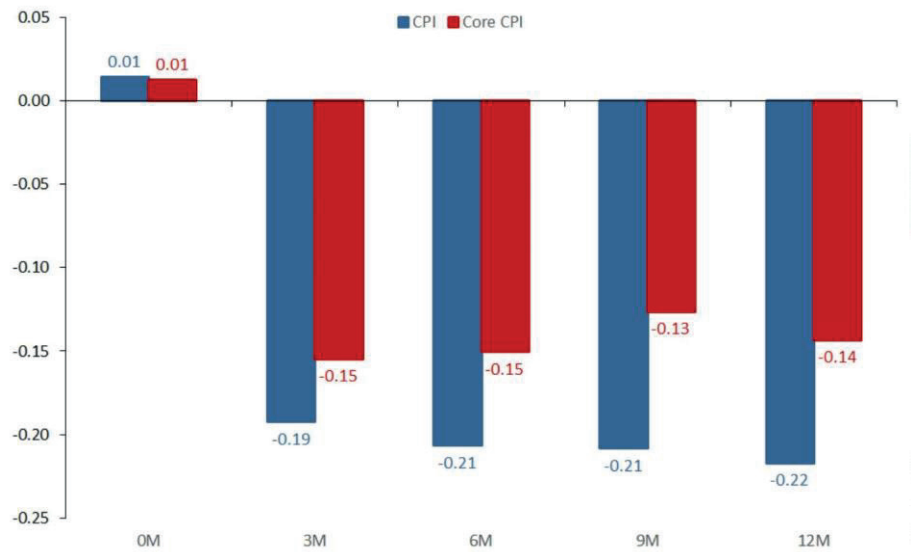


Figure 5: Cumulate REER Pass-Through to Turkey CPI and Core CPI



Turning to the results for core imports, the full specification (4) explains around 50% of the total variation. Looking at the coefficients for explanatory variables, the largest contemporaneous effect comes from domestic demand,

with a coefficient of around 0.07 and significant at the 1% level. At longer horizons, domestic demand seems to have a weaker impact on the dependant variable, with only the lags 3 and 4 being statistically significant at the 5%. In contrast, coefficients for the real effective exchange rate are more mixed in specification (4), with the contemporaneous impact and the 2nd lag coefficients being significant at 10% and 5% levels.

To examine the relative roles of each driver, specifications (5) and (6) include only domestic demand and real effective exchange rates respectively. In specification (5), the contemporaneous coefficient for domestic demand remains positive and significant at the 1% level, but none of the lagged terms are significant. The R2 falls slightly to 42%, which is similar to the the core exports case when exchange rates variable is removed. Turning to specification (6), the real effective exchange rate coefficients are only significant at the 1st and 2nd lags at the 5% and 10% significance levels respectively, while the coefficients for other lags being not statistically different from zero. The R2 of 35% is notably lower than in specifications (4) and (5). Comparing the adjusted R2 values across the three import specifications, the full model again produces the highest adjusted R2, confirming that for Turkish core imports, both domestic demand and real effective exchange rate movements contribute meaningfully to the observed variation. But removing domestic demand leads to a greater reduction in adjusted R2 compared to removing real effective exchange rates. This implies that domestic demand is a more important driver for Turkish core imports compared to real effective exchange rate overall.

Figures 4 and 5 Presents the cumulative impact of foreign CPI and real effective exchange rates on headline and core CPI in Turkey. Starting with Figure 4, each 1% rise in foreign CPI lead to around 6.3% rise in Turkish headline CPI cumulatively in 12 months. So the impact of foreign inflation on Turkish inflation highly substantial, standing at more than 1 to 6. Around 80% of this 6 fold impact/pass-through occurs in the first 3 months. The impact of foreign CPI on Turkish core CPI is also substantial, but smaller. 1% rise in foreign CPI leads to around 5.8% rise in Turkish core CPI. The around half of that impact happens in 3 months, and most of the rest in 12 months. So transmission of foreign prices to headline is greater and happens quicker compared to the core measure.

Real effective exchange rate impact on headline inflation is in line with the prior expectations, each 1% appreciation leads to around 0.2% fall in domestic headline inflation and around 0.15% in core inflation in Turkey. Most of the transmission for both measures happens in 3 months following the currency shock.

5. Conclusion

This paper constructed an import-weighted foreign CPI measure for Turkey, and examined empirically whether there exists evidence for international synchronization of consumer prices with the foreign consumer prices. Furthermore, the paper presents evidence for some other key fundamentals behind Turkish inflation.

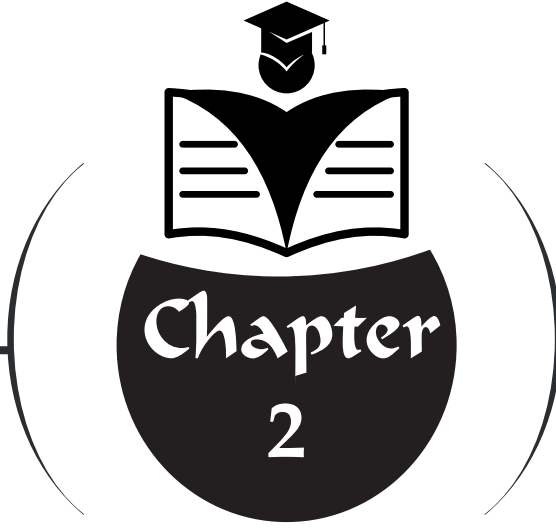
Results indicate that there is substantial synchronization of Turkish consumer prices internationally. Higher prices abroad leads to almost 6 fold higher prices in Turkish headline inflation and most of this increase happens within a quarter. Pass-through to core CPI is also close to 6 fold, but transmission is somewhat slower compared to the headline. This perhaps reflects the fact that volatile items in the CPI baskets adjust to international shocks more quickly than the core items.

Besides foreign CPI, real currency movements significantly impact Turkish headline and core CPI. 1% real appreciation in the currency leads to around 0.2% and 0.15% reduction in headline and core inflation in Turkey respectively. Among other fundamentals, domestic business cycle seems not to play a major role in driving inflation in Turkey. But oil prices and commodity prices are other key drivers of Turkish inflation.

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OECD COUNTRIES AND TÜRKİYE IN TERMS OF SOCIAL INDICATORS

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Introduction

With globalization recent years, the welfare level of societies is no longer measured solely by economic data but is also analyzed by taking social improvement issues into account. The human development index, which is obtained by combining criteria such as access to health, access to education, and income level, which are important in human life, has become an important measurement tool for measuring the quality of life of individuals. The human development index is enable countries to be compared with each other in terms of development and to obtain more impartial information in terms of scientific criteria.

There are certain indicators for both developing countries' sustainable growth and enabling individuals to enjoy better living conditions. These indicators make it possible to bring development levels to a certain standard and to compare countries with one another. While helping to better understand the general welfare in countries, they also play a comprehensive role in reflecting the status of variables in different sectors. One of these indices is the human development index. The Human Development Index (HDI) consists of three components: life expectancy, education, and standard of living (income). The HDI represents the geometric mean of the normalized indices for each of these three variables. After the HDI is calculated, countries are divided into four categories: very high, high, medium, and low human development. The health factor included in the index is assessed based on life expectancy at birth. The education dimension is measured based on the average length of education of individuals aged 25 and over and the average expected length of education of children starting school. The living or income dimension is measured by the average gross domestic product per capita (UNDP, 2025).

One of the important social indicators for countries is the Better Life Index. The OECD Better Life Index (BLI) is an index created by the Organization for Economic Co-operation and Development in 2011. The Better Life Index is a comprehensive index consisting of a total of 11 factors, such as knowledge and skills, housing, environmental quality, and social connections. The topics included in the index are as follows: housing (housing conditions and spendings), income (household income and net financial wealth), jobs (earnings, job security and unemployment), community (quality of social support network), education (education and what one gets out of it), environment (quality of environment), governance (involvement in democracy), health, life satisfaction, safety (murder and assault rates), work (life balance).

Another type of index included in the article research is the happiness index. The happiness index is published annually by the United Nations as the World Happiness Report. The report calculates a happiness index for 147

countries and ranks them. Prepared by the Centre for Wellbeing Research at Oxford University, this index asks people to rate their own lives on a scale of 0 to 10. A score of 0 represents the lowest possible life, while a score of 10 represents the happiest (best) life. The three-year average of these calculated scores determines the country ranking.

The Legatum Prosperity Index (LPI) is an index published by the Legatum Institute, based in London. It measures prosperity levels both economically and in terms of individuals' freedoms and quality of life. The index utilizes a total of 12 key indicators for its measurement. These are: personal freedom, quality of government, safety, health, education, natural environment, investment environment, business environment, living conditions, social capital, infrastructure and market access, and economic quality. This index provides a comprehensive assessment by highlighting the strengths and weaknesses of countries, incorporating not only economic data but also many social indicators.

Table 1 contains data on selected social indicators for OECD countries in 2023. The countries with the highest human development index scores are Iceland, Norway, Switzerland, and Denmark, while the countries with the lowest scores are Colombia, Mexico, Costa Rica, and Türkiye. In the Better Life Index, the countries with the highest index scores are Norway, Sweden, Iceland, and Luxembourg, while the lowest are Türkiye, Mexico, Costa Rica, and Colombia. The countries with the highest scores in the happiness index are Finland, Denmark, Iceland, and Israel, while the countries with the lowest scores are Türkiye, Colombia, Greece, and South Korea. The countries with the highest scores in the Legatum Prosperity Index are Denmark, Sweden, Norway, and Finland, while the countries with the lowest scores are Türkiye, Colombia, Mexico, and Hungary.

The purpose of this study is to examine and analyze the comparative analysis of selected social indicators for OECD countries and Türkiye in 2024 using the TOPSIS method, one of the multi-criteria decision-making methods. In the study, the importance level of each criterion was considered equal, and the weight of each criterion was included in the analysis as 0.25. The social indicators used in the study are the human development index, the better life index, the happiness index, and the welfare index.

Table 1: OECD Countries Socioeconomic Indicators (2023)

COUNTRY	HDI	BLI	HI	LPI
Austria	0,930	7,52	7,09	79,38
Australia	0,958	7,98	7,10	79,36
Belgium	0,951	7,57	6,86	77,84
Canada	0,939	7,92	6,96	79,62
Chile	0,878	4,60	6,36	70,18
Colombia	0,788	4,31	5,63	58,01
Costa Rica	0,833	4,29	6,61	69,59
Czech Republic	0,915	6,99	6,84	75,08
Denmark	0,962	7,96	7,59	84,55
Estonia	0,905	6,95	6,46	77,31
Finland	0,948	8,05	7,80	83,47
France	0,920	7,00	6,66	76,73
Germany	0,959	7,55	6,89	80,81
Greece	0,908	5,63	5,93	68,48
Hungary	0,870	6,53	6,04	66,88
Iceland	0,97	8,12	7,53	81,02
Ireland	0,949	7,02	6,91	80,31
Israel	0,919	6,45	7,47	72,25
Italy	0,915	6,20	6,41	73,03
Japan	0,925	6,02	6,13	78,22
Korea	0,937	5,59	5,95	74,07
Latvia	0,889	6,21	6,21	72,99
Lithuania	0,895	6,31	6,76	72,54
Luxembourg	0,922	8,06	7,23	81,83
Mexico	0,789	3,73	6,33	59,3
Netherlands	0,955	7,93	7,40	82,32
New Zealand	0,938	7,48	7,12	80,47
Norway	0,970	8,37	7,32	83,59
Poland	0,906	6,37	6,26	70,15
Portugal	0,890	5,89	5,97	74,64
Slovak Republic	0,880	6,48	6,47	71,15
Slovenia	0,931	7,45	6,65	74,54
Spain	0,918	6,73	6,44	76,03
Sweden	0,959	8,19	7,39	83,67
Switzerland	0,970	7,76	7,24	83,42
Türkiye	0,853	3,23	4,61	55,5
United Kingdom	0,946	6,65	6,80	79,95
United States	0,938	7,73	6,89	77,44

1. Literature

There are numerous national and international studies in the literature on the social indicators possessed by countries. Kabakçı Günay (2025), in her study on 29 European countries, found that a one-unit increase in social support increased the happiness index by 0.84 units, while income and freedom variables were not statistically significant. On the other hand, she noted that increases in income reduced the happiness index value in Austria, Iceland, and the Netherlands, while social support and freedom to make life decisions had a positive effect on the happiness index in Estonia, France, Iceland, Ireland, Latvia, the Netherlands, Romania, Slovakia, and Türkiye. In their study, Yalçın and Gültekin (2024) examined the effects of the financial development index, stock market index, and inflation variables on the HDI through the Fragile Five countries (India, Brazil, Indonesia, Türkiye, and South Africa). According to the results obtained in the study conducted using the panel ARDL method, the long-term effect of the financial development index and stock market index value on the human development index is positive and significant. The effect of inflation on the human development index is negative and significant. Akgun, Türkoğlu, Erikli (2023), in their study on the happiness index in EU countries, found that the happiness index has a positive relationship with current tax rates, inflation, and output level, while it has a negative relationship with the employment rate. Alamoudi and Bafail (2023), in their study on 96 countries, found that skilled labor, R&D expenditures, tourism, imports, and exports have a positive and significant effect on the human development index. Sezgin and Budak (2022), in their study on developed countries (Germany, France, United Kingdom, Belgium, Canada, Japan, Denmark) and developing countries (Türkiye, India, Brazil, Russia, Mexico, Indonesia, and South Africa). They noted that for developed countries, a 1-unit increase in the human development index leads to a 38.7% increase in growth, while for developing countries, a 1-unit increase in the human development index leads to a 17.4% increase in growth. Şener (2022), in her study on 167 countries, found that Denmark is the country with the highest level of prosperity, while South Sudan is the lowest. In her study, Koşar Taş (2021) divided OECD countries into four groups according to HDI figures. She concluded that Türkiye's human development is most like that of Portugal, Greece, Mexico, and Chile among OECD countries, noting that education is the most important social indicator affecting HDI figures. And she stated that the least influential indicator is the GDP variable, emphasizing that development should not be considered solely in economic terms. Yeter, Eroğlu, and Kangal (2021), in their study on EAGLE countries (Emerging and Growth-Leading Economies), found that there is a two-way relationship between economic growth and human development, and that the effects of economic growth on human development are more limited. Yiğiteli and Şanlı (2020) examined Türkiye's human development index by province in

their study. Their research findings revealed that the most developed provinces in terms of HDI were Ankara, Istanbul, and Kocaeli, while the provinces with the lowest scores were Van, Şanlıurfa, and Ağrı. On the other hand, they stated that the province with the least inequality loss was Muğla, while the province with the most inequality loss was Hakkâri. Iqbal, Rahman, and Hasan (2019) compared India with Bangladesh, Bhutan, China, Nepal, Pakistan, Sri Lanka, and Afghanistan in terms of various social indicators. The study findings show that although India has poor indicators in terms of absolute poverty, gender index, and aging population, it is in a good position in terms of the Gini index and health indicators, China is sometimes in a better position than India, but Brazil does not have developing indicators. In her 2019 study, Zor assessed inequalities in education, health, and income in Türkiye using current data. While describing Türkiye, she also expanded her research by making country-based comparisons. The study concluded that despite all the progress made in human development, existing inequalities remain prominent. It concluded that for Türkiye's human development to reach better levels, opportunities in the social, cultural, and economic fields must be more accessible to everyone, and argued that development should be determined qualitatively. Kpolovie, Ewansiha, and Esara (2017), in their study of 182 countries, found that Africa had the lowest average HDI, with Asian, European, North American, South American, and Oceanian countries significantly below the global HDI average (0.697). They showed that Africa's average HDI is 0.536, which is significantly lower than each of the other continents (Asia 0.714, Europe 0.845, North America 0.733, South America 0.738, and Oceania 0.693) and the global average of 0.697. Europe has a significant advantage over the global average and has a higher HDI than all other continents in the world. Öztürk (2016) examined the relationship between the human development index, economic development, and nutrition in Türkiye, Norway, Korea, Italy, Greece, Bulgaria, Iran, and the United States. The research findings revealed that Türkiye showed similar characteristics to Iran in terms of human development index and malnutrition, but differed from European countries, Korea, and the United States. Tunç and Ertuna (2015) compared the human development index between Balkan countries (14 countries) and Türkiye. According to the results, Türkiye ranks 8th in the HDI index. On the other hand, it states that while the annual average HDI growth rate in the Balkans was 0.45% between 1980 and 2013, Türkiye's annual average growth rate was 1.56%. Alberto, Tella, and MacCulloch (2004), in their study on EU countries and the US, stated that individuals tend to report lower levels of happiness when inequality is high, and that the poor in Europe are more concerned about inequality than the poor in America. Dowrick, Dunlop, and Quiggin (2003), in their study on 58 countries, emphasized that ignoring social indicators such as average life expectancy in estimates related to GDP and human capital investments could lead to losses in measuring the welfare level of society.

2. Data and Methodology

The study conducted a comparative analysis of selected social indicators for 38 OECD countries in 2023 using the TOPSIS method, one of the multi-criteria decision-making methods. Since the sum of the criterion weights must equal 1, the importance level of each criterion was considered equal and included in the analysis as 0.25. The social indicators used in the study are the human development index, the better life index, the happiness index, and the Legatum prosperity index.

The following steps were taken when using the TOPSIS method.

- Creating a standardized decision matrix,
- Creating a weighted decision matrix,
- Identifying idealized and non-ideal solutions,
- Using the “n”-dimensional Euclidean distance and calculating distance measures,
- Calculating relative proximity to the ideal solution,
- Ranking.

In the numerical calculation of indicators, some indicators having the minimum value creates a positive assumption, while some values reaching the maximum value can create a negative assumption. In the analysis, all the preferred values reaching the maximum value creates a positive assumption.

Table 2: Definition of the Variables

Variables	Symbol	Source	Orientation for Each Criterion
Human Development Index	HDI	UNDP	Maximum
Better Life Index	BLI	OECD	Maximum
Happiness Index	HI	World Population Review	Maximum
Legatum Prosperity Index	LPI	Prosperity Institute	Maximum

4. Analysis Results

In the first stage of the analysis, standardized decision matrices were calculated with weights. Table 3 shows the decision matrix for socioeconomic data in OECD countries. The criterion weight for each indicator was set at 0.25.

Table 3: Decision Matrix for Socioeconomic Data in OECD Countries

Importance Weight	0,25	0,25	0,25	0,25
COUNTRY	HDI	BLI	HI	LPI
Austria	0,164403349	0,178606669	0,171114605	0,170023265
Australia	0,169353127	0,189532077	0,171355951	0,169980427
Belgium	0,168115683	0,179794213	0,165563637	0,166724753
Canada	0,165994349	0,188107023	0,167977101	0,170537318
Chile	0,155210904	0,109254079	0,153496317	0,150317873
Colombia	0,139300902	0,102366322	0,135878029	0,124251066
Costa Rica	0,147255903	0,101891304	0,159529977	0,149054157
Czech Republic	0,161751682	0,166018699	0,165080945	0,160813136
Denmark	0,170060238	0,189057059	0,183181925	0,181096838
Estonia	0,159983904	0,165068663	0,155909781	0,165589551
Finland	0,167585349	0,191194639	0,1882502	0,178783597
France	0,162635571	0,166256208	0,160736709	0,164347255
Germany	0,169529905	0,179319195	0,166287677	0,173086168
Greece	0,160514238	0,133717493	0,143118421	0,146676659
Hungary	0,153796681	0,155093291	0,145773232	0,143249634
Iceland	0,171828016	0,192857201	0,181733847	0,173535965
Ireland	0,167762127	0,166731225	0,166770369	0,172015223
Israel	0,162458793	0,15319322	0,180285768	0,154751586
Italy	0,161751682	0,147255498	0,154703049	0,15642226
Japan	0,16351946	0,142980339	0,147945349	0,167538672
Korea	0,165640794	0,132767457	0,143601114	0,158649826
Latvia	0,157155459	0,147493007	0,149876121	0,156336585
Lithuania	0,158216126	0,149868096	0,163150173	0,155372734
Luxembourg	0,162989127	0,191432148	0,174493455	0,175270896
Mexico	0,13947768	0,088590808	0,152772278	0,127014104
Netherlands	0,168822794	0,188344532	0,178596343	0,176320423
New Zealand	0,165817571	0,177656633	0,171838644	0,172357925
Norway	0,171474461	0,198794923	0,176665572	0,179040624
Poland	0,160160682	0,151293149	0,151082853	0,150253616
Portugal	0,157332237	0,139892723	0,144083807	0,159870704
Slovak Republic	0,155564459	0,153905746	0,156151127	0,152395506
Slovenia	0,164580127	0,176944107	0,160495363	0,159656515
Spain	0,162282015	0,159843468	0,155427088	0,162847932
Sweden	0,169529905	0,194519763	0,178354997	0,179211975
Switzerland	0,171474461	0,184306882	0,174734801	0,178676502
Türkiye	0,150791459	0,076715364	0,111260695	0,118874921
United Kingdom	0,167231794	0,157943397	0,164115559	0,171244142
United States	0,165817571	0,183594355	0,166287677	0,165867997

Table 4 shows the negative and positive values of each indicator based on their proximity coefficient. Each indicator reaching its maximum value is interpreted as positive, while approaching its minimum is interpreted as negative (undesirable).

Table 4: Performance Values Based on Proximity Coefficients

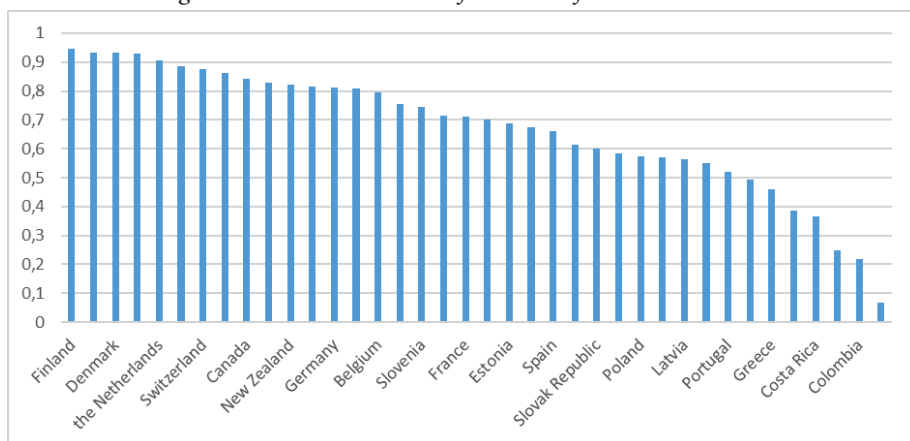
COUNTRY	Positive $S\bar{I}^+$	Negative $S\bar{I}^-$	Ci
Austria	0,007411747	0,03279731	0,8156697
Australia	0,005595286	0,03522602	0,862932211
Belgium	0,008276644	0,03230127	0,796030839
Canada	0,006474782	0,03446592	0,841849761
Chile	0,025554926	0,01597733	0,384696949
Colombia	0,03194798	0,00898919	0,219584981
Costa Rica	0,027209471	0,01568801	0,365709397
Czech Republic	0,011521871	0,02865152	0,713196466
Denmark	0,002779821	0,03759241	0,931145226
Estonia	0,012659291	0,02784992	0,687496002
Finland	0,002251605	0,03826058	0,944421524
France	0,011674785	0,02858942	0,710045554
Germany	0,007628518	0,03298500	0,812168026
Greece	0,021772545	0,01851874	0,459621473
Hungary	0,018492677	0,02255337	0,54946505
Iceland	0,002903513	0,03750103	0,928138945
Ireland	0,009963907	0,03043242	0,753346202
Israel	0,01352036	0,02788004	0,673424413
Italy	0,016755766	0,02342140	0,58295298
Japan	0,017664592	0,02330707	0,568858273
Korea	0,020759512	0,02009909	0,49191817
Latvia	0,017558493	0,02266990	0,563529811
Lithuania	0,015554057	0,02466490	0,61326553
Luxembourg	0,00471385	0,03614205	0,884622535
Mexico	0,032953676	0,01098441	0,249997413
Netherlands	0,003826332	0,03637194	0,904813513
New Zealand	0,007196616	0,03299848	0,820957855
Norway	4,614630418	0,03859750	0,829477947
Poland	0,017185134	0,02314007	0,57383637
Portugal	0,019494896	0,02102754	0,518911043
Slovak Republic	0,016073383	0,02418889	0,600783026
Slovenia	0,010488114	0,03038506	0,743398601

Spain	0,013735723	0,02660205	0,659482415
Sweden	0,002795376	0,03785984	0,931241872
Switzerland	0,004990944	0,03554598	0,876879053
Türkiye	0,039642864	0,00287264	0,067566863
United Kingdom	0,012169452	0,02841028	0,700110065
United States	0,007832037	0,03294178	0,807915034

The Ci coefficient calculated in the final stage of the analysis was ranked for OECD countries, and the relevant results are presented in Table 5. The analysis findings show that Finland, Sweden, Denmark, and Iceland are the best performing countries in terms of the selected social indicators among OECD countries, while Türkiye, Colombia, Mexico, and Costa Rica are the lowest performing countries.

Table 5: Performance Values Ranking Based on Proximity Coefficients

Rank	Country	Ci Coefficient	Rank	Country	Ci Coefficient
1	Finland	0,944421524	20	United Kingdom	0,700110065
2	Sweden	0,931241872	21	Estonia	0,687496002
3	Denmark	0,931145226	22	Israel	0,673424413
4	Iceland	0,928138945	23	Spain	0,659482415
5	Netherlands	0,904813513	24	Lithuania	0,61326553
6	Luxembourg	0,884622535	25	Slovak Republic	0,600783026
7	Switzerland	0,876879053	26	Italy	0,58295298
8	Australia	0,862932211	27	Poland	0,57383637
9	Canada	0,841849761	28	Japan	0,568858273
10	Norway	0,829477858	29	Latvia	0,563529811
11	New Zealand	0,820957855	30	Hungary	0,54946505
12	Austria	0,8156697	31	Portugal	0,518911043
13	Germany	0,812168026	32	Korea	0,49191817
14	United States	0,807915034	33	Greece	0,459621473
15	Belgium	0,796030839	34	Chile	0,384696949
16	Ireland	0,753346202	35	Costa Rica	0,365709397
17	Slovenia	0,743398601	36	Mexico	0,249997413
18	Czech Republic	0,713196466	37	Colombia	0,219584981
19	France	0,710045554	38	Türkiye	0,067566863

Figure 1: Social Indicator Performance of OECD Countries

5. Conclusions

The study conducted a comparative analysis of social indicators for 38 OECD countries in 2023 using the TOPSIS method, one of the multi-criteria decision-making methods. Since the sum of the criterion weights must equal 1, the importance level of each criterion was considered equal and set at 0.25. The social indicators used in the study are the human development index, the better life index, the happiness index, and the Legatum prosperity index.

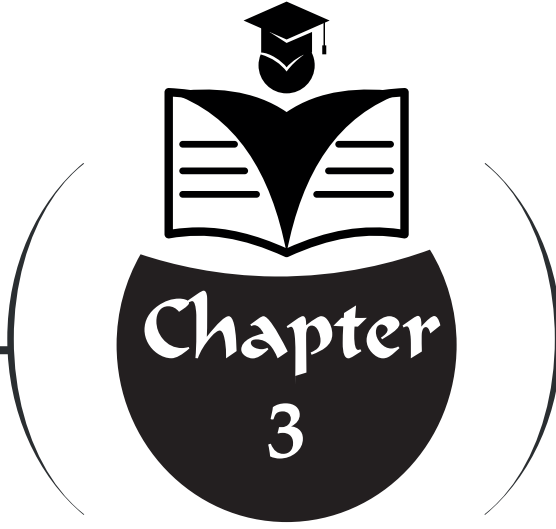
When each variable is evaluated, it is observed that some countries perform better while others show poor performance. The Human Development Index consists of three components: life expectancy, education, and average income per capita. The best countries in the Human Development Index are Iceland, Norway, Switzerland, and Denmark, while the lowest are Colombia, Mexico, Costa Rica, and Türkiye. The Human Development Index is a comprehensive index consisting of a total of 11 factors, such as knowledge and skills, housing, environmental quality, and social connections. The countries with the best scores in the Better Life Index are Norway, Sweden, Iceland, and Luxembourg, while the lowest are Türkiye, Mexico, Costa Rica, and Colombia. The Happiness Index is an index obtained according to a specific scoring system based on questions asked to individuals. The countries with the best scores in the happiness index are Finland, Denmark, Iceland, and Israel, while the countries with the lowest scores are Türkiye, Colombia, Greece, and South Korea. The Legatum Prosperity Index is a type of index that measures both economic prosperity and the level of prosperity in terms of individuals' freedoms and quality of life. The countries with the highest scores in the Legatum Prosperity Index are Denmark, Sweden, Norway, and Finland, while the countries with the lowest scores are Türkiye, Colombia, Mexico, and Hungary. Türkiye ranks only 35th in the Human Development Index and ranks last among OECD countries in the other three variables.

According to the analysis findings obtained using the TOPSIS method, Finland, Sweden, Denmark, and Iceland are the countries with the best performance among the OECD countries in terms of selected social indicators, while Türkiye, Colombia, Mexico, and Costa Rica are the countries with the lowest performance. Türkiye ranks as the country with the lowest performance among OECD countries in terms of social indicators. The values of the indicators for 2023 have remained at the same level on average in recent years. It is thought that Türkiye's economic difficulties are reflected in its social indicators. Although there have been increases in per capita income in Türkiye, the fact that it is among the countries with the highest Gini coefficient and that income inequality is on an upward trend has a negative impact on people's living conditions. The rising inflation rates in recent years have caused significant difficulties, both psychologically and financially, for low-income groups, leading to deteriorating living conditions. In this context, it is necessary to develop solution-oriented proposals, especially in terms of social dimensions, in parallel with the economy, and to pursue policies aimed at raising people's welfare levels.

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CLIMATE POLICY UNCERTAINTY, GREEN FINANCE, AND THE MONETARY POLICY TRANSMISSION: EVIDENCE FROM THE TURKISH ECONOMY

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1. Introduction

The risks posed by climate change are a significant factor in the increasing emphasis placed on environmental protection and the adoption of sustainable policies. As countries combat climate change, they are actively participating in global climate management by identifying and implementing various green policies. While policy implementations to combat climate change are increasingly gaining traction as countries pursue sustainable future goals, these green policies also involve numerous uncertainties (Ayhan, 2010; Engle et al., 2020). These various uncertainties can have negative effects on firms' investment decisions (Bloom, 2009; Gavriilidis, 2021). Furthermore, such uncertainties not only deter investment but also increase costs (Han et al., 2025). Uncertainties arising in climate policies are a fundamental risk factor that can impact both the macroeconomic and financial systems. Therefore, they represent a systematic source of risk for the decisions of economic agents (Bouri, 2023). Climate policy uncertainty (CPU) is considered a new element within macroeconomic risks. The indices developed on this subject express changes in response to policymakers' decisions (Gavriilidis, 2021). CPU, arising from unexpected climate policy changes, creates price volatility in financial markets (Ji et al., 2024). CPU is a very important issue due to its impact on the economy and financial markets (Bouri et al., 2022; Cepni et al., 2022; Khalfaoui et al., 2022). Therefore, assessments regarding this element are as important as the implemented policies themselves (Ma et al., 2023). Examining CPU has become a necessity to ensure the sustainability of economic targets (Han et al., 2025). For all these reasons, understanding and analyzing the dynamics of CPU is important in the context of green policies.

With increasing concerns about global climate change, green economy and finance issues have come to the fore, and interest in these areas has increased significantly (Wang et al., 2019; Wang et al., 2022). Green finance (GF) is an effective tool in combating climate change. Economic agents can be encouraged to adopt sustainable investment practices by becoming knowledgeable about environmental problems. In recent years, investments

in areas such as clean energy, green index, and environmental initiatives have increased (Raza et al., 2024). Although it is generally accepted that green financing provides positive impacts in the fields of renewable energy and environmentally friendly technologies, studies addressing the impact of this financing on factors such as carbon efficiency (CPU) are quite limited in the literature (Han et al., 2025).

Risks associated with climate change are considered a significant negative externality that can affect socioeconomic life. From the perspective of central banks, with the core mandate of maintaining price and financial stability negative externalities cause deviations from these two objectives. Therefore, central banks must guide the economic system through monetary policies to protect themselves from the possible negative impacts of climate change risks. The monetary transmission mechanism is a process that expresses the effects of changes in monetary policy decisions on price and output levels (Yıldırım & Mirasedoğlu, 2015). When central banks use interest rates as policy instruments, their decisions influence the economy through multiple transmission channels (CBRT, 2013: 11). Expansionary monetary policy decisions implemented by policymaker's influence interest rates. Decreasing interest rates also lead to a decline in real interest rates. This reduction stimulates both consumption and investment demand, ultimately boosting real economic activity. The financing costs required for areas such as sustainable infrastructure and clean energy investments can increase the effectiveness of green finance due to the decrease in loan interest rates. Despite this positive impact, the monetary transmission mechanism has not been adequately addressed within the framework of GF in the academic literature, and monetary policy has been neglected in global GF discussions (Monnin, 2015: 155). Understanding this interaction is critical, and this article aims to contribute in this direction.

This research aims to determine the short and long run dynamics of the CPU-GF-interest rate transmission channel triangle in the Turkish economy, using basic research hypotheses. We investigate whether adjustments in the policy rate and the BIST Sustainability Index indicators have an impact on

commercial loan rates. We also analyze the consequences of the Central Bank (CBRT) on GF. The BIST Sustainability Index represents the Central Bank index, and the policy rate and commercial loan rates serve as monetary transmission mechanism variables. We also examine the impact of macroeconomic control variables (inflation and industrial production index) on GF. The analysis utilizes monthly data for the period 2014:01-2024:12 using an autoregressive distributed lag (ARDL) bounds testing approach. Two models are constructed to determine the long-short run dynamics. The first model examines the transmission between the policy rate and the commercial loan rate to examine the effects of the interest rate channel. Analyzing the effects of the interest rate channel on the Central Bank within the context of the monetary transmission mechanism helps understand the sensitivity of monetary policy mechanisms to environmental shocks. The second model was developed to examine the impact of loan interest rates and the GF market on GF. Examining the effectiveness of GF instruments against the GF market can guide the development of models for integrating GF into interest rate policies.

To combat climate change, policymakers have begun to integrate environmental sustainability into economic policies. The economic implications of CPU in developing countries like Turkey are still unclear (Karagöl, 2022). GF instruments and climate change issues are gaining increasing importance. Discussions continue regarding their impact on monetary policy decisions, particularly through the transmission mechanism (Tutar et al., 2023). Examining the dynamics involving CPU and GF through the interest rate transmission channel in countries with structural fragility, such as the Turkish economy, will fill a significant gap at the academic and policy levels. It is hoped that the research findings will provide practical contributions to monetary policy and sustainable finance policy.

2. An overview of climate policy uncertainty (CPU)

Policy uncertainty—characterized by frequent policy changes that generate market volatility and hinder performance—represents a significant barrier to the development of financial markets. Furthermore, the possible risks associated with climate change are increasingly being recognized. This

has led to changes in climate policies. There is no clear consensus on effective approaches to combating climate change. Consequently, these changes carry uncertainties. Furthermore, countries are far from uniform regarding global climate policies. Consequently, the issue of climate policy uncertainty is a long-run concern for all countries (Raza et al., 2024: 2).

CPU refers to the government's unclear stance on combating climate change (Su et al., 2024). This multidimensional concept encompasses economic and environmental factors, as well as various energy sources. CPU refers to the uncertainty in policymakers' and investors' expectations about the future of environmental policies due to the implementation timeframes and uncertain content of climate policies (Han et al., 2025: 3). Frequent adjustments to climate policies lead to a rise in CPU (Li et al., 2023). The risks posed by increasing environmental degradation to the real economy, price stability, and financial stability are extremely significant. Climate change policies are decreasing the value of fossil fuel companies, creating shocks in financial markets. It should be noted that central banks that fail to consider these critical issues may also overlook significant risks (Monnin, 2015: 158).

3. Literature review

The literature review is structured in three parts. First, some research on the CPU and its economic impacts is reviewed. Then, research on the link between the CPU and GF is examined. Finally, studies addressing the CPU's relationship with the monetary transmission mechanism are included. Focusing specifically on the interest rate channel, the impact of the CPU on policymakers is highlighted.

Studying the effects of the Central Bank (CB) in the context of the carbon trading price (CTP), SU et al. (2024) demonstrated that the CB has a complex impact on the CTP in the short run. Examining the interaction between the CTP and financial markets, Ji et al. (2024) constructed a new index for the CB. They found that the CTP has heterogeneous effects across financial markets.

Numerous studies have examined GF markets from a CPU perspective. Bouri et al. (2022), in their study using the CPU index, indicate that it is a critical factor in determining the performance of green stocks against brown stocks. In another study, Raza et al. (2024) concluded that CPU increases volatility in various indexes they use.

Agliardi & Agliardi (2021) developed a model derived from the CPU in their study. They examined the effects of bond pricing on climate policies. Bouri et al. (2023), in their study focusing on global green bond returns in Europe, determined that transition risk is more pronounced in brown stocks. Dong et al. (2024) examined the causal relationships between the CPU and GF markets. Their research findings indicate that the CPU, GF market has positive and negative effects that do not fully support the theoretical foundations. The results of this research reveal that the function of GF in mitigating climate change is complex. Gao (2025) examined the role of GF reform under the CPU in promoting energy transition and ensuring energy security. The main conclusion of the research is that GF reform significantly impacts the low-carbon energy transition. However, this positive effect is inhibited by the CPU.

In a study conducted by Gavriilidis (2021), which proposed a news-based CPU index, a new uncertainty measure was created from leading newspaper news in the US. As a result of the author's basic research, it was determined that the effect of the CPU index on CO₂ emissions is negative and strong. A review of the literature shows that although there is a wide area of research on economic policy uncertainty, studies based on the CPU index are limited. He & Zhang (2022), using the CPU index, determined that it is a critical predictor for stock returns in the oil industry. Liang et al. (2022), who examined the predictive power of this index through the volatility of the renewable energy index, also worked with a continuous separate uncertainty index. According to the results of this study, CPU has a negative effect on the volatility in renewable energy markets in terms of geopolitical risk. Examining the causal relationships between conventional and green markets with a focus on CPU, Ren et al. (2023) determined that causality occurs in different ways

between series pairs. In another study, Ren et al. (2022) examined the relationship between the CPU index and total factor productivity in firms. The results of this study showed that CPU reduces productivity. Han et al. (2025), in their study on factor productivity, also identified the negative effects of CPU on green total factor productivity.

There is also much research addressing the economic impacts arising from climate risks (Stern, 2007; Pankratz et al., 2023). There are also studies focusing on the impacts of various risks posed by climate change on investment decisions (Bolton & Kacperczyk, 2021; Bua et al., 2024). Fuss et al. (2008) investigated the impact of obtaining information on the government's commitment to the climate policy regime by focusing on this issue. The findings suggest that producers invest in carbon-saving technologies earlier in an environment where they face uncertainty regarding CO₂ prices. The research by Li et al. (2023) on policy uncertainty and patterns of energy consumption showed that CPU causality operates in two ways, producing both negative and positive outcomes. In another study determining the effects of CPU on renewable and non-renewable energy sources (Shang et al., 2022), economic growth and oil prices were used as control variables. The evidence suggests that CPU contributes positively to renewable energy demand over the long run.

Karagöl (2022), who addresses monetary policy and climate change issues from the perspective of the Turkish economy, examines international experiences in combating climate change and draws conclusions for monetary policy in Turkey. Tutar et al. (2023) also emphasized the fight against climate change in their research examining green monetary policy implementation in Turkey. Another study examining the function of central banks in climate change from the perspective of the Turkish economy (Yılmaz & Çakaloğlu, 2022) explains climate-related financial risks and their impact across the real economy and financial markets.

Research results from the literature review also demonstrate that GF indicators and the use of the CPU index are still a nascent area of research in

this field. Given the limited empirical studies in the Turkish economy, this study seeks to offer a novel perspective to the academic literature.

4. Data, Methodology and empirical analysis

4.1. Variable Selection

Climate policy uncertainty and GF indicators are two key variables frequently examined together in the literature towards sustainable economic development and ensuring stability in financial markets. For example, Raza et al. (2024) stated that CPI affects investment decisions and emphasized that uncertainty weakens the effects of GF instruments. The index developed by Gavriilidis (2021) was selected as a variable for CPI, but since there is no index calculation for this index in Turkey, which is the subject of the analysis, it was used as a proxy variable. A new economic country-specific uncertainty (ECSU) index for the Turkish economy, developed by Kilic and Balli (2024), was used as a proxy variable. In the literature, the economic uncertainty index is frequently preferred for situations where uncertainty types cannot be measured directly for some countries. The ECSU, chosen as a proxy variable, was chosen as an accurate indicator because it can also reflect risks to green sustainability and climate policies (Hunjra et al., 2024; Kilic & Balli, 2024). Using the ECSU proxy variable instead of the CPU index is consistent with the academic literature in that it considers uncertainty indices consistent with different policies (Apergis et al., 2021; Kilic & Balli, 2024). Due to data constraints in the Turkish economy, the inclusion of ECSU as a proxy variable in the analysis is also consistent with the literature. The ECSU variable, included in the analysis with the symbol CPU_Z, was also z-score transformed. This transformation was performed to ensure scale independence and comparability of variables.

GF indicators reflect the environmental impacts of financial markets. They can also be examined using different tools such as green bond issuances and sustainability indices. Sustainability-focused indices are widely used in the academic literature, particularly to determine the direction of capital flows (Broadstock et al., 2012; Reboredo, 2018). In this study, the opening values of

the BIST Sustainability Index (XUSRD) were used as the GF indicator. The symbol LN_GF was used to represent the natural logarithm of the variable used in the analysis. The use of opening values in XUSRD was chosen because it reduces the impact of short-run volatility in a monthly analysis and allows for the examination of long-run dynamics. XUSRD includes companies that meet certain standards according to environmental, social, and governance (ESG) criteria. It is a tool that reflects investors' demands for companies that comply with sustainability principles. It is an important research tool that also measures the impact of these demands on the financial system (Borsa Istanbul, 2023). This and similar indices are important because they not only measure investor reactions to climate policies in financial systems but also reflect interest in financing environmental projects. Therefore, they are considered a suitable variable for research examining the impact of the CPU on financial markets (He et al., 2006).

The monetary transmission mechanism is a process that expresses the effects of changes in monetary policy decisions on price and output levels (Yıldırım & Mirasedoğlu, 2015: 106). The monetary transmission mechanism involves various channels, including the exchange rate, credit channel, expectations channel, and interest rate channel. Policy makers' short-run interest rate changes affect investment and consumption behavior through the user costs of capital. This effect is called the interest rate channel (Erdoğan & Yıldırım, 2009: 57). Economic repercussions can also arise from green investments and renewable energy (Guo et al., 2025). The policy rate is a fundamental tool that directly impacts market interest rates by reflecting the monetary policy stance (Mishkin, 2001). Loan rates are also an important indicator for measuring the transmission of changes in policy rates implemented by central banks to the real sector through the banking sector (Bernanke & Gertler, 1995). For the interest rate channel of the monetary transmission mechanism, the Central Bank of the Republic of Turkey (CBRT) policy rate and commercial loan interest rate variables were chosen. The effectiveness of the interest rate channel depends on the strength and timing of the transmission from policy makers' interest rate changes to loan rates. When policy rates change, banks' funding costs are primarily affected. This

impact has an impact on the real economy by influencing investment and consumption decisions through loan rates (Boivin et al., 2010). In the analysis, the combination of these two interest rates was chosen to assess the impact of monetary policy decisions on real economic activity as well as financial market conditions. The policy rate is used with the symbol PR. The CBRT one-week repo auction interest rate is used for PR. The symbol LR is used for commercial loans, and the average interest rate on Turkish Lira-denominated loans is used.

The Consumer Price Index (LN_CPI) and the seasonally and calendar-adjusted Industrial Production Index (LN_IPI) were used to represent inflation and real economic activity in the transmission mechanism. The natural logarithm of both variables was taken and included in the analysis. The table reports information on the variables.

Tablo 1. Variables

Variables	Symbol	Source
Türkiye Economic Uncertainty Index	CPU_Z	PolicyUncertainty.com
Borsa Istanbul Sustainability Index	LN_GF	Borsa Istanbul
Policy Rate	PR	tradingeconomics.com
Commercial Loan Rate	LR	TCMB EVDS
Consumer Price Index	LN_CPI	TÜİK
Industrial Production Index	LN_IPI	TÜİK

The analysis period was determined as 2014:12–2024:12 due to data constraints (data availability for the Borsa Istanbul Sustainability Index (XUSRD)). CPU_Z was used as the key independent variable, while the BIST Sustainability Index (LN_GF), considered as a green finance indicator, was incorporated in the analysis as the dependent variable. The consumer price index (LN_CPI) and the industrial production index (LN_IPI) were used as control variables to control macroeconomic dynamics in the models. The main hypotheses developed for the research are presented below.

H₁: Changes in policy rates have a positive effect on commercial loan rates in the long run.

H₂: The structural break identified after February 2022 increased the transmission power from the policy rate to the commercial loan rate.

H₃: Commercial loan interest rates have a significant effect on the BIST Sustainability Index, which is examined as a green finance indicator.

H₄: CPU has a strong effect on the green finance market.

H₅: The macroeconomic control variables used as inflation (CPI) and industrial production index (IPI) have a strong effect on the green finance market in the short run.

With these established research hypotheses, it is aimed to examine the impacts of monetary policy transmission channels and macroeconomic factors on green finance in the Turkish economy with a holistic approach within the framework of CPU.

4.2. Methodology

This analysis, aims to determine the long-run relationships between the variables under study, is defined as the 'statistical representation of long-run relationships between economic variables' (Sevüktekin & Nargeleçekenler, 2010: 481). While traditional methods require variables to be integrated at the same order, this requirement is not required in the ARDL (Auto Regressive Distributed Lag Models) cointegration approach. The main limitation of this method is that no variable is integrated at two or more orders (Pesaran et al., 2001: 290). The ARDL model offers significant advantages such as estimating long-run parameters together, being applicable to small samples, and producing stable and robust findings even with a limited number of observations (Esen & Özata, 2017: 48). Due to these advantages, the ARDL approach was preferred as the cointegration method.

4.3. Empirical analysis

4.3.1. Stationarity test

In econometric time series analyses, the stationarity of the series is primarily examined. If the series contains a unit root, regression does not accurately reflect the interrelationship of variables (Gujarati, 1999). In the ARDL model, there is no requirement for series to be integrated at the same order; it is sufficient for them not to be integrated at levels I(2) or above. The Augmented Dickey-Fuller (ADF) (1979) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) tests, which are widely used unit root tests in the literature, were used to determine the degree of integration of the series. The ADF test tests the null hypothesis that the series has a unit root (is non-stationary), while the KPSS test, conversely, tests the hypothesis that the series is stationary. Therefore, evaluating the two tests together allows for a robust determination of the degree of integration of the series. The table 1 displays the results.

Table 1. ADF ve KPSS Unit root test results (Level)

Series	ADF				KPSS	
	Constant		Constant, Linear Trend		Constant	Constant, Linear Trend
	t-statistic	Prob.*	t-statistic	Prob.*	LM-Stat.	LM-Stat.
CPU_Z	-6548721	0.0000**	-6772776	0.0000* *	0,284741	0,052914
1% level	-3.485.586		-4.036.310		0,739	0,216
5% level	-2.885.654		-3.447.699		0,463	0,146
10% level	-2.579.708		-3.148.946		0,347	0,119
LN_GF	1570780	0.9994	-1039124	0.9338	1.036.155	0,298114
1% level	-3.485.586		-4.036.310		0,739	0,216
5% level	-2.885.654		-3.447.699		0,463	0,146
10% level	-2.579.708		-3.148.946		0,347	0,119
PR	-2574149	0.1013	-3618713	0.0325* **	0,658009	0,129389
1% level	-3.487.046		-4.038.365		0,739	0,216
5% level	-2.886.290		-3.448.681		0,463	0,146
10% level	-2.580.046		-3.149.521		0,347	0,119
LR	-0,965491	0.7638	-1940844	0.6269	0,630897	0,169698
1% level	-3.486.064		-4.036.983		0,739	0,216
5% level	-2.885.863		-3.448.021		0,463	0,146
10% level	-2.579.818		-3.149.135		0,347	0,119
LN_CPI	2461178	1.0000	-0,693955	0.9708	1.201.411	0,311093

1% level	-3.486.064		-4.036.983		0,739	0,216
5% level	-2.885.863		-3.448.021		0,463	0,146
10% level	-2.579.818		3.149.135		0,347	0,119
LN_IPI	-1790017	0.3839	-4345874	0.0038*	1.198.490	0,093911
1% level	-3.485.586		-4.036.310		0,739	0,216
5% level	-2.885.654		-3.447.699		0,463	0,146
10% level	-2.579.708		-3.148.946		0,347	0,119

CPU_Z, ADF test statistics are below the critical values and significant at the 1% level ($p=0.0000$). The series is stationary at the level ($I(0)$). The KPSS test does not reject the stationarity assumption. Stationarity cannot be rejected in the LN_GF, ADF test ($p\approx 0.99$), and the stationary hypothesis is rejected in the KPSS test. LN_GF is not stationary at the level. For the PR series, based on the ADF test results ($p=0.0325$), the unit root hypothesis is rejected, and the KPSS test also gives a result in favor of stationarity. The PR series is stationary at the level ($I(0)$). Stationarity cannot be rejected in the LR, ADF test, and the stationary hypothesis is rejected in the KPSS test. The LR series is not stationary at the level. LN_CPI, ADF and KPSS results show that the series is not stationary at the level. LN_IPI, stationarity cannot be rejected in the ADF test, but the stationary hypothesis is rejected in the KPSS test. The series is not stationary at the level.

Because the differences of series with non-stationary level values may be stationary, unit root tests were performed by taking the first differences of the variables. The ADF and KPSS test results, which used the first differences of the series determined to be non-stationary. The table 2 displays the results.

Table 2. ADF ve KPSS Unit root test results (first difference)

Series	ADF				KPSS	
	Constant		Constant, Linear Trend		Constant	Constant , Linear Trend
	t-statistic	Prob.*	t-statistic	Prob.*	LM-Stat.	LM-Stat.
LN_GF	-9.828.412	0.0000**	-1.024.782	0.0000**	0,650719	0,08034
1% level	-3.486.064		-4.036.983		0,739	0,216
5% level	-2.885.863		-3.448.021		0,463	0,146
10% level	-2.579.818		-3.149.135		0,347	0,119
LR	-5.441.970	0.0000**	-5.510.592	0.0001**	0,190197	0,068309
1% level	-3.486.064		-4.036.983		0,739	0,216
5% level	-2.885.863		-3.448.021		0,463	0,146
10% level	-2.579.818		-3.149.135		0,347	0,119
LN_CPI	-4.983.984	0.0001**	-5.951.725	0.0000**	0,84244	0,096864
1% level	-3.486.064		-4.036.983		0,739	0,216
5% level	-2.885.863		-3.448.021		0,463	0,146
10% level	-2.579.818		-3.149.135		0,347	0,119
LN_IPI	-1.206.661	0.0000**	-1.201.477	0.0000**	0,128922	0,132452
1% level	-3.486.064		-4.036.983		0,739	0,216
5% level	-2.885.863		-3.448.021		0,463	0,146
10% level	-2.579.818		-3.149.135		0,347	0,119

According to the test results, first-difference stationarity was achieved for the LN_GF series. The series is significant at the 1% level according to the ADF test result ($p=0.0000$). The KPSS test also yields the same result. The LN_GF series is $I(1)$. For the LR, LN_CPI, and LN_IPI series, the ADF ($p=0.0000$) and KPSS test results also reveal difference stationarity. All series in the table are $I(1)$.

The test results in both tables indicate that the series have different degrees of integration. CPU_Z and PR are stationary at the level ($I(0)$), while LN_GF, LR, LN_CPI, and LN_IPI are stationary at the first difference ($I(1)$). Therefore, the ARDL approach, which allows for combinations of variables $I(0)$ and $I(1)$, is an appropriate econometric method for the study's data structure.

4.3.2. Cointegration test

To holistically assess the relationships between the monetary policy transmission mechanism, green finance (GF/XUSRD), and climate policy

uncertainty (CPU) triangle, two-stage models, designated ARDL-A and ARDL-B, were employed. The first model examined the transmission from the policy rate to the commercial loan rate through the interest rate channel. The second model examined the effects of commercial loan rates and CPU on the GF market.

4.3.2.1. ARDL-A Model Results

ARDL-A (the loan rate equation) examines the transmission among the PR and the commercial loan rate (LR). The model equation (1), which conforms to the ARDL form of Pesaran et al. (2001), with LR_t as the dependent variable, is given below.

$LR_t = \alpha_0 + \sum_{i=1}^p \varphi_i LR_{t-i} + \sum_{j=0}^{q1} \beta_j PR_{t-j} + \sum_{k=0}^{q2} \gamma_k LN_CPI_{t-k} + \sum_{m=0}^{q3} \delta_m LN_IPI_{t-m} + \sum_{n=0}^{q4} \theta_n CPU_Z_{t-n} + \varepsilon_t$	(1)
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The interest rate channel is critical within the monetary policy transmission mechanism. Adjustments in the policy rate are anticipated to be reflected in the real sector and investments through commercial loan rates (Örnek, 2009: 107; Erdoğan & Yıldırım, 2009: 58). The ARDL-A model aims to measure the transmission of the policy rate, the primary instrument of monetary policy, to the commercial loan rate, which determines the cost of accessing financing for the real sector. Macroeconomic variables such as inflation and production, as well as climate policy uncertainty, can weaken the monetary transmission mechanism or, conversely, strengthen its operation. To this end, control variables (LN_CPI, LN_IPI, and CPU_Z) were added to the model.

The long-run relationship among the PR and LR was examined using the ARDL bounds testing approach. Appropriate lag lengths for the model were automatically determined using the Akaike info criterion (AIC). A Bounds F-test was applied to the model equation (1) to demonstrate a long-run link between the variables under study. According to the findings of the diagnostic test applied to the model results (Breusch-Godfrey Serial Correlation LM Test, $p = 0.7219$; Heteroskedasticity Test: ARCH, $p = 0.0011$;

Jarque-Bera normality test, $p = 0.0054$; Ramsey Reset Test, $p = 0.0451$; CUSUM within the confidence limits; CUSUMQ outside the limits), it was determined that there was a specification error in the model. Therefore, Bai-Perron multiple breakpoint tests were applied. Accordingly, 1 structural break was detected (2022M02). This structural break indicates a regime change in the coefficients of the PR and LR transmissions. Accordingly, the break (D2022) and slope break (PR_D22) dummies were added to the model. Diagnostic tests conducted on the residuals of the model in which the structural break was included revealed no autocorrelation up to degree 12 (BG-LM $p > 0.50$). Heteroskedasticity was detected according to the ARCH-LM test results ($F=12.249$, $p < 0.001$). Therefore, coefficient estimates are reported with HAC (Newey-West; Bartlett, automatic bandwidth) robust standard errors. Furthermore, cross-checks were performed using White HC. Accordingly, it was determined that the results did not change in terms of direction and significance. In the model in which the structural break was included, the CUSUM and CUSUMSQ plots were observed to be within the band. The Ramsey Reset Test ($p=0.2476$) result was also improved compared to the previous model. To examine the presence of multicollinearity among the explanatory variables, the Variance Inflation Factor (VIF) test was conducted.¹ The results indicate that all VIF values are below the critical threshold of 10, suggesting that multicollinearity is not a serious issue in the ARDL_A model. Although LN_CPI shows a slightly higher value (around 7), it remains within acceptable limits widely recognized in econometric literature (O'Brien, 2007; Hair et al., 2010). In light of these findings, the Bounds F-test results for the long-run ARDL-A model with structural breaks are presented in Table 3.

¹ PR (2.1), CPU_Z (1.07), LN_CPI (7.2), LN_IPI (4.3).

Table 3. Bounds F-test for cointegration ARDL-A

Dependent variable	F-test statistic	Asymptotic critical values		
PR (Policy Rate)	11.64214	Signif.	I(0)	I(1)
		10%	2.08	3.00
		5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

According to the cointegration (Bounds) test findings, the F-statistic (11.64) is above both the asymptotic (4.587) and finite-sample upper bound (3.00) at the 1% level. This finding indicates the presence of a very strong long-run cointegration association among the policy rate (PR) and the independent variables incorporated in the model. Therefore, it is possible to examine long and short-run dynamics together within the ARDL framework. The table shows the long-run dynamics for the ARDL-A model.

Table 4. Long-run coefficients of the ARDL(2, 4, 3, 3, 1, 1)

Variable	Coefficient	t-statistic	Prob.
PR	0.724551	10.43246	0.0000*
PR_D22	0.527614	8.235317	0.0000*
LN_CPI	-8.529530	-5.198866	0.0000*
LN_IPI	9.855026	2.391680	0.0187**
CPU_Z	0.110427	0.249877	0.8032
C	4.913169	0.341250	0.7337
$R^2=0.994519$ and $\bar{R}^2=0.993307$ $Prob(F-statistic)=0.000000$ $DW\ stat=1.928671$			
EC = LR - (0.7246*PR + 0.5276*PR_D22 -8.5295*LN_CPI + 9.8550*LN_IPI + 0.1104*CPU_Z + 4.9132)			

As presented in Table 4, which determine the long-run effects of the examined variables on LR, PR (0.72) was found to be significant at the 1% level. This shows that the rise in the policy rate positively and strongly affects commercial loan rates in the long run. When the policy rate (pre-break slope of 2022, 0.72 ($p<0.01$)) increases by 1 point, the commercial loan rate increases

by around 0.72 points in the long run. After the break (2022), this increase was determined as 0.52 points (PR_D22).

The short-run (ECM) results of the ARDL-A model with breaks are given in the table.

Table 5. ARDL-A Error Correction Regression (2, 4, 3, 3, 1, 1)

Variable	Coefficient	t-Statistic	Prob.
D(LR(-1))	0.419285	5.452224	0.0000*
D(PR)	0.516284	6.359295	0.0000*
D(PR(-1))	0.161843	1.792813	0.0762***
D(PR(-2))	0.149704	1.834330	0.0697***
D(PR(-3))	0.173917	2.272475	0.0253**
D(PR_D22)	-0.216123	-2.723450	0.0077*
D(PR_D22(-1))	-0.093983	-1.088657	0.2791
D(PR_D22(-2))	-0.353690	-4.405895	0.0000*
D(LN_CPI)	31.34312	4.572621	0.0000*
D(LN_CPI(-1))	1.646621	0.195754	0.8452
D(LN_CPI(-2))	22.45283	2.634782	0.0098*
D(LN_IPI)	-1.104525	-0.445296	0.6571
D(CPU_Z)	0.263424	2.199984	0.0302**
@SEAS(12)	0.173431	0.430680	0.6677
D2022	0.751240	2.079548	0.0403**
CointEq(-1)*	-0.495768	-9.308168	0.0000*
$R^2=0.796725$ and $\bar{R}^2=0.766536$ $DW\ stat=1.928671$			

The R^2 value in the model indicates a high degree of explanatory power, while the DW result indicating that the model is free from autocorrelation. CointEq denotes the error correction term. The coefficient is a lagged value of the model residuals that examines the long-run relationships among the variables. This coefficient suggests how much of the effect of a short-run shock will vanish in the long run (Paseran et al., 2001). The CointEq(-1) coefficient is significant at the 1% level and negative (-0.495768), suggesting that nearly 50% of the deviations from the long run equilibrium are corrected in each period. This result confirms that the model converges to the long-run equilibrium.

The coefficient for the $D(PR)$ variable was found to be significant at the 1% level. This result suggests that a rise in the policy rate increases statistically commercial loan interest rates in the short run. The coefficients for $D(PR(-1))$ and $D(PR(-2))$ are borderline significant ($p \approx 0.07$). This result suggests that policy rate shocks persist in the short run, even if the lagged effects weaken. The coefficient for $D(PR(-3))$ was found to be significant at the 5% level. This suggests that the impact of the increase in the policy rate persists even after three periods.

In the model in which structural break and regime effects are included, the $D(PR_D22)$ coefficient is also found to be significant. It is concluded that the pass-through effect from the policy rate to the loan rate decreases after the 2022 break. The $D(PR_D22(-2))$ coefficient is also found to be significant at the 1% level. This result emphasizes that this weakening is more pronounced with a two-period lag. The $D2022$ coefficient, which represents the structural break dummy, is also found to be significant at the 5% level. This indicates that the structural break has a level effect on loan rates (regime jump).

$D(LN_CPI)$, which was included in the model as a macroeconomic control variable, was found to be significant at the 1% level. It was determined that inflation affects loan interest rates in the short run. The $D(LN_CPI(-2))$ coefficient is found to be significant at the 1% level. This indicates that the two-period lagged impact of inflation is positive and strong. The $D(CPU_Z)$ coefficient was also found to be significant at the 5% level. This result indicates that the rise in climate policy uncertainty increases loan interest rates in the short run. $D(LN_IPI)$ was found to be statistically insignificant.

4.3.2.2. ARDL-B Model Results

The ARDL-B model was developed to determine the impact of commercial loan interest rates and CPU on green finance. This model is designed to analyze the effect of banking sector credit costs and climate policy uncertainty on the BIST Sustainability Index, used as an indicator of the green finance market. Model equation (2), where LN_GF_t is considered the dependent variable, is presented below.

$\text{LN_GF}_t = \mu_0 + \sum_{i=1}^p \lambda_i \text{LN_GF}_{t-i} + \sum_{j=0}^{q1} \rho_j \text{LR}_{t-j} + \sum_{k=0}^{q2} \sigma_k \text{CPU_Z}_{t-k} + \sum_{m=0}^{q3} \psi_m \text{LN_CPI}_{t-m} + \sum_{n=0}^{q4} \varphi_n \text{LN_IPI}_{t-n} + u_t$	(2)
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Sustainable investments in financial markets are sensitive to macroeconomic stability, policy uncertainty, and credit conditions. Commercial loan interest rates are a metric that determines firms' costs of accessing finance. Climate policy uncertainty also affects investors' risk perceptions (Bloom, 2009; Gavrilidis, 2021; Han et al., 2025). The ARDL-B model is important for measuring the impact of uncertainty shocks through the credit channel on sustainable finance instruments in capital markets, such as the green finance index. The impact of macroeconomic control variables (CPI and IPI) and the general economic conjuncture is also excluded.

According to the Bounds test results, the F-statistic is less than the critical lower bound in both the break-even and break-even models. These results indicate that there is no long-run cointegration association between the BIST Sustainability Index and the variables examined in the green finance equation. Therefore, it is not meaningful to consider long-run dynamics within the ARDL framework. Therefore, the long-run coefficients are not reported. A pure short-run model (ECM-OLS) based on the ECM was used for short-run dynamics. The DLR_D22 (D(LR)xD2022) variable was added to the model for the short-run loan interest interaction. This variable aimed to determine the short-run effects of loan interest shocks after 2022 on green finance.

In the applied model, no autocorrelation and conditional heteroscedasticity problems were found up to lag 12 (B-G LM Test (F=0.985, p=0.468; χ^2 p=0.418), ARCH-LM (lag 1: F=0.104, p=0.747; lag 12: F=0.885, p=0.564)). J-B normality test (Jarque–Bera=1.294, p=0.524) results show that the residuals are normally distributed. Ramsey RESET Test (t=0.116, p=0.908; F=0.013, p=0.908) results show that the linear functional form of the model is sufficient. The results obtained from the VIF test for the ARDL-B model show

that the VIF values of all variables are below 10.² This reveals that there is no serious multicollinearity problem in the model (O'Brien, 2007).

The ECM short-run model was computed via the classical least squares (OLS) method and then re-estimated with HAC (Newey–West) robust standard errors to eliminate the risk of heteroskedasticity. Although there were no differences in the coefficients, the results obtained with robust standard errors are shown in the table.

Table 6. ARDL-B – ECM-OLS Results

Variable	Coefficient	t-Statistic	Prob.
D(LN_CPI)	0.843581	3.459790	0.0008*
D(LN_IPI)	0.583534	7.249370	0.0000*
DLR_D22	0.002346	0.412484	0.6808
@SEAS(12)	0.036313	1.161439	0.2479
D2022	0.012668	0.553682	0.5809
R ² = 0.248049 and $\bar{R}^2$ = 0.221894			
DW stat = 2.044161			

According to the results, D(LN_CPI) and D(LN_IPI) are found to be statistically significant ($p < 0.05$) and positive. When the monthly inflation rate increases by approximately 1%, the sustainability index increases by approximately 0.084%. The monthly rise in IPI has a similar effect. The CPI and the IPI have a positive effect on the BIST Sustainability Index based on short-run dynamics. These two variables affect the green finance indicator in the short run.

For the period after 2022 (DLR_D22), LR shocks are found to be insignificant ($p > 0.05$). This result indicates that the monetary policy channel and structural breaks do not have a short-run effect on green finance. This effect is found to be strong in the ARDL-A model (PR→LR), while it is weak in the short-run in the second model (LR→GF). The structural break dummy

² LR (2.8), CPU_Z (1.06), LN_CPI (7.3), LN_IPI (4.3).

(D2022) and the seasonal dummies (@SEAS(12)) incorporated in the model to exclude seasonal effects are found to be statistically insignificant ($p>0.05$).

The Durbin-Watson statistic suggests the absence of autocorrelation in the model. Because financial market indicators such as the BIST Sustainability Index are highly volatile and affected by various factors, low R^2 and $\bar{R}^2$ values can be considered reasonable in the short run.

These key findings suggest that green finance is largely determined by macroeconomic indicators in the short run. However, monetary policy shocks and CPU has a limited role in the short run.

Because CPU was found to be insignificant according to the ARDL Bounds test results, a CPU shock (D_CPU) was added to the model to determine whether it was significant as a news/shock. The table displays the results.

Table 7. ARDL-B – ECM-OLS Results (with CPU Shock)

Variable	Coefficient	t-Statistic	Prob.
D(LN_CPI)	0.848343	2.699996	0.0080*
D(LN_IPI)	0.586516	3.921692	0.0002*
DLR_D22	0.002339	0.658618	0.5115
D_CPU	-0.000427	-0.062517	0.9503
@SEAS(12)	0.036285	1.564022	0.1206
D2022	0.012456	0.756416	0.4510
$R^2 = 0.248075$ and $\bar{R}^2 = 0.215096$			
Durbin-Watson stat=2.043655			

The CPU shock (D_CPU), added to the model, had a statistically insignificant effect on LN_GF. Accordingly, it can be said that the monthly news flow (z-score change) regarding climate policy uncertainty does not explain the BIST Sustainability Index (XUSRD) in the short run. D(LN_CPI) and D(LN_IPI), which were also significant according to the main result of the ARDL-B model, were again shown to be positive and significant. This

result indicates that inflation and real activity shocks have short-run dynamics in green finance. The effect of the credit interest shock (DLR_D22) on the regime after 2022:02 was not found to be statistically significant ($p>0.05$). Accordingly, it can be said that the LR→GF channel is weak in the short run. Although the R^2 and $\bar{R}^2$ values are low, they are reasonable for the short run. The Durbin-Watson statistic suggests the absence of autocorrelation in the model.

These findings suggest that the BIST Sustainability Index in Turkey responds more to macroeconomic factors at a monthly frequency. The climate policy uncertainty shock did not provide explanatory power. This may indicate that the monthly volatility of the ECSU, used as an uncertainty indicator, is reflected in the index components with a lag or at a lower frequency.

To further test the short-run effect of LR on the short-run dynamics of the ARDL_B model (robustness), the ECM short-run model was estimated using the classical least squares (OLS) method. The table displays the results.

Table 8. Robustness Analysis: Short-Run Impact of LR on Green Finance (ECM-OLS Results)

Variable	Coefficient	t-Statistic	Prob.
D(LR)	-0.002897	-0.792614	0.4297
D(LR(-1))	0.001969	0.559679	0.5768
D(LN_CPI)	0.957011	2.983500	0.0035*
D(LN_IPI)	0.570864	4.008028	0.0001*
@SEAS(12)	0.036223	1.545129	0.1251
D2022	0.011882	0.730838	0.4664
$R^2=0.248927$ and $\bar{R}^2=0.215693$			
DW stat=2.012487			

As shown in the table, where the short-run effects of LR are additionally tested with robustness, the current and one-period lagged values of loan interest rates are found to be statistically insignificant. The CPI and IPI are

positive and significant. This result suggests that short-run fluctuations in the green finance context are primarily driven by macroeconomic conditions. The interest rate channel does not have a significant impact in the short run.

5. Conclusion

The growing interest in the monetary policy framework has led to the emergence of the monetary policy framework as an important research area for sustainable economic growth. Investigating such a critical research focus within the framework of the monetary transmission mechanism contributes to filling a significant gap in the existing academic literature. This study presents empirical results based on the Turkish economy for the period 2024:12-2024:12, focusing on the interest rate channel of monetary transmission. Two models (ARDL-A and B) are used to examine the long-short run dynamics of the variables under study using the ARDL bounds testing approach.

According to the short-run findings of the analysis conducted on the ARDL-A model, rise in the policy rate significantly increase commercial loan interest rates. However, the structural break that emerged at 2022:02 led to a regime deterioration of the interest rate transmission mechanism. While inflation dynamics continued to play a determining role on interest rates, the impact of industrial production was found to be limited. Furthermore, the CPU emerged as a prominent factor increasing loan rates in the short run. The negative and significant error correction coefficient (CointEq) confirmed that the model converged to a long-run equilibrium.

The Bounds test performed for the ARDL-B model did not support cointegration. Short-run dynamics for the green finance equation were analyzed with LS-ECM. Accordingly, a positive and significant relationship was identified between $D(LN_CPI)$ and $D(LN_IPI)$ and green finance. After the structural break at 2022:02, the change in loan interest rates was found to have no significant short-run impact. These key findings indicate that the monthly dynamism of the green index in Turkey moves in line with price levels and real activity. The interest rate channel effect was determined to be

weak in the short run. GF instruments operate dependent on the macroeconomic conjuncture, and credit conditions and policy uncertainty can have an indirect impact in the long run. In the ARDL-B analysis, which examines short-run dynamics, the R^2 and $\bar{R}^2$ values are relatively low. In a short-run model using several macroeconomic variables, the R^2 value is likely to be low. Indeed, the ARDL approach aims to identify short-run dynamics through long-run cointegration relationships rather than achieving a high R^2 . Therefore, rather than weakening the validity of the model, these low values indicate that GF movements can be partially explained. In the model where the BIST Sustainability Index (LN_GF) is used as a GF indicator, macroeconomic variables (IPI, CPU, PR) explain short-run dynamics to a limited extent. These results indicate that external shocks and market expectations are largely influential in explaining the short-run dynamics of GF. This finding aligns with previous studies in the literature. For instance, Keswani et al. (2024) argue that macroeconomic variables cannot fully reflect index movements in the short run. Adrian (2017) similarly suggests that financial indices establish stronger relationships with financial conditions than macroeconomic indicators.

In summary, the research results support hypotheses H1, H2, and H5. However, hypotheses H3 and H4 are rejected. Accordingly, changes in policy rates in the Turkish economy positively affect loan rates in the long run. After the 2022:02 periods, when the structural break was identified, the transmission power of changes in policy rates to loan rates increases. Inflation and industrial production index variables have a significant short-run effect on the GF market. Despite these results, GF was not found to have a significant impact on loan rates, and neither was the CPU found to have a significant impact on the GF market. These findings indicate that the impact of the CPU on financial markets in the Turkish economy has significant implications in run of both the environmental and monetary transmission mechanisms. With the green transformation of monetary policy, the economic repercussions of climate-related risks can be predicted and managed.

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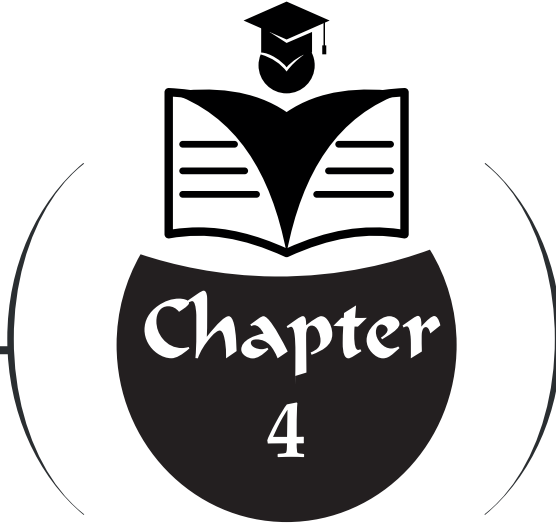
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EXTERNAL TRADE DYNAMICS AND DETERMINANTS OF TURKEY

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1. Introduction

External sector has been one of the soft pillars of the Turkish economy for decades. One of the major source of macro-financial vulnerabilities for Turkey had been the chronic current account deficit. Despite the significant surplus in the services balance, which reflects the fact that Turkey is one of the top tourism destinations, significant deficit in the goods trade balance has been pushing the overall current account balance into the deficit category mostly. Among the major components of the trade balance deficit, core goods trade balance, which excludes gold and energy, is known to be quite dependent on macroeconomic and financial developments. In order to design and implement accurate macroeconomic policies to mitigate risks emanating from the chronic core trade balance, It is critical to study and understand the drivers and dynamics of the core trade balance. For these reasons, this paper focuses on the drivers and determinants of core external trade dynamics of Turkey.

Studying the major past macroeconomic and financial crisis in Turkey, one can note that the majority of these events involved external balance crisis. To name a few among the many crisis Turkey experienced in the past, 1994 Currency Crisis, 2001 Financial Crisis, 2011-13 Overheating Episode, 2018 Currency Crisis. 1994 episode involved a large current account deficit coupled with short term capital inflows and a sudden stop, which then led to a sharp lira depreciation and import collapse. 2001 Episode started with a very fragile banking system and fiscal imbalances under a fixed exchange rate, then combined with a worsening in loss of investor confidence and capital flight. These led to the abandonment of currency peg and a sharp currency depreciation, followed by a marked reduction in imports, and external adjustment. Then comes 2011-13 overheating episode, which in contrast to most of the previous episodes involved a marked rise in capital inflows that led to a significant appreciation of the domestic currency and accompanied by a credit fuelled domestic demand boom, widening the current account deficit to more than 8% of GDP. This episode relied on volatile portfolio capital inflows and hence increased the vulnerability of the Turkish economy to shifts in global financial conditions and capital flows. Lastly, the 2018 Currency Crisis followed a period of a large domestic credit impulse, high domestic demand and high import dependence. These factors combined together brought about a marked depreciation in domestic currency, sharp import contraction and again an external adjustment.

The past crisis Turkey faced clearly involves external sector as either the initial starting point or the mechanism through which the shocks propagate in the economy during these events. Hence, it is of a critical importance for policy makers to accurately understand the relevant drivers of external trade balance of Turkey. Two of the most important components in Turkish trade balance is known to be energy and gold. Since Turkey is a net energy importer country, it is straightforward to understand the evident energy trade deficit which is mostly driven by the international energy prices. Also, Turkey is a net importer of Gold and the respective Turkish gold trade dynamics reflects the price of gold as well as other idiosyncratic factors that are solely relevant to gold as being a valuable asset that can be used as a hedge against macro-financial shocks. So gold and energy aside, the rest of the trade balance can be assumed to be the "Core" trade balance that reflects local and international demand conditions, as well as the value of the domestic currency with respect to other international currencies.

There has been many noteworthy studies that aim to lay down the key drivers of external dynamics for both Turkey and other countries in the literature. Starting with Turkey, employs a cointegration methods to estimate export supply and import demand functions for Turkey. Authors find that exports are positively affected by foreign income and negatively by the currency appreciation; whereas imports are driven by domestic demand and currency appreciation leads to higher imports. focuses on the import side by decomposing import demand into intermediate, capital, and consumption goods to study the underlying structural factors by employing cointegration methods. The authors find that domestic demand is the key driver of import dynamics. study the exchange rate pass through to trade in Turkey via cointegration techniques. They find that real currency depreciation significantly increases exports and decreases imports, and that the pass-through is asymmetric. aims to model import demand with various domestic demand measures using cointegration methods. The authors find that absorption measure is better than pure gdp and that the real currency movements are important drivers but less than demand. focus on the cyclically adjusted current account via HP filter techniques and find that domestic business cycle significantly affect current account fluctuations. utilize ARDL and error correction methods to test the J-curve effect in post-floating exchange rate period in Turkey. Authors find no evidence for the J-curve effect and conclude on Turkey's structural reliance on imported

intermediate goods. employ ARDL Bounds tests to identify long term drivers of Turkish trade balance. Authots find that domestic and foreign GDP and REER are significant long-run drivers.

Besides studies on Turkey, existing literature has numerous key papers to mention for external trade dynamics and determinants. For instance, estimates the trade elasticities for the G7 economies by employing OLS and ECM techniques. The authors find that the exports can be explained mostly by external demand and relative prices; whereas imports are mainly explained by domestic activity and relative prices. employs multivariate panel data models to estimate trade elasticities for 46 economies. They find that the elasticities change with the level of respective country' s level of income; and real currency movements lead to more significant impact on imports compared to exports in emerging economies. employs cross-country trade models that involve income and price measures to estimate trade dynamics. The authors find that domestic demand and external demand are key drivers for imports and exports respectively.

Unlike the existing literature, this paper focuses on the "core" trade dynamics, which excludes energy and gold components. As discussed previously, these components mostly reflects energy and commodity prices in the international markets and hence introduces noise while estimating the elasticity of exports and import to fundamental macro and financial drivers; namely to real currency movements, domestic and external demand.

Results indicate that the domestic demand and real currency movements are significant drivers of core goods imports for Turkey. In particular, domestic demand explains a significantly larger share of movement in import dynamics compared to real exchange rate. Similarly, Turkish core exports are also driven by both real exchange rate and external demand; but in contrast to core imports, real effective exchange rate is more important than external demand for core exports.

The rest of the paper is organized as follows; the next section outlines the dataset; Section 3 describes the methodology and statistical models; Section 4 presents the empirical results and the accompanied discussion, and Section 5 concludes.

2. Dataset

Table 1: Descriptive Statistics

	CA	SB	PIB	SIB
Mean	-3.3%	3.7%	-1.2%	0.4%
Std Dev	2.4%	1.1%	0.4%	0.5%

	TB	TB Core	TB Energy	TB Gold
Mean	-6.1%	-1.8%	-3.6%	-0.7%
Std Dev	2.2%	2.2%	1.9%	0.8%

	EX	EX Core	EX Energy	EX Gold
Mean	19.1%	17.8%	0.9%	0.4%
Std Dev	4.2%	4.0%	0.4%	0.3%

	IM	IM Core	IM Energy	IM Gold
Mean	25.2%	19.6%	4.5%	1.1%
Std Dev	4.8%	4.1%	2.2%	0.8%

Notes: CA = Current Account Balance; SB = Services Balance; PIB = Primary Income Balance; SIB = Secondary Income Balance; TB = Trade Balance; EX = Exports; IM = Imports. “Core” excludes gold and energy components. All values are expressed as percentages of GDP, 12-month moving sum.

The data used in this paper had been collected by the author from LSEG Workspace Datastream, Turkstat and Central Bank of Turkey Database. The sample period under investigation is 2000Q1-2025Q1.

Table 1 presents the descriptive statistics for Turkish Current Account and its components as percentage of GDP, 12 month moving average seasonally adjusted. Turkish Current Account has been around 3.3% of GDP during the sample period of 2000Q1-2025Q1. Out of the 3.3%, Trade Balance constitutes a marked drag at -6.1% of GDP. Services Balance at +3.7% partially offset the significant deficit from goods trade. Finally Primary and Secondary Income Balances stand around -1.2% and +0.4% respectively.

The most important contributor to the -6.1% of GDP Turkish Trade Balance Deficit is the Energy Trade Balance. Given the fact that Turkey is not a energy

resource rich economy, this deficit reflects mainly the ongoing energy imports. Following energy, Core Goods Trade Balance also a significant contributor to the overall Goods Trade Balance and hence the Current Account, averaging -1.8% of GDP. Lastly, Gold Trade Balance averaged -0.7% during the sample period.

Figure 1: CA and Components % as of GDP 3mma sa

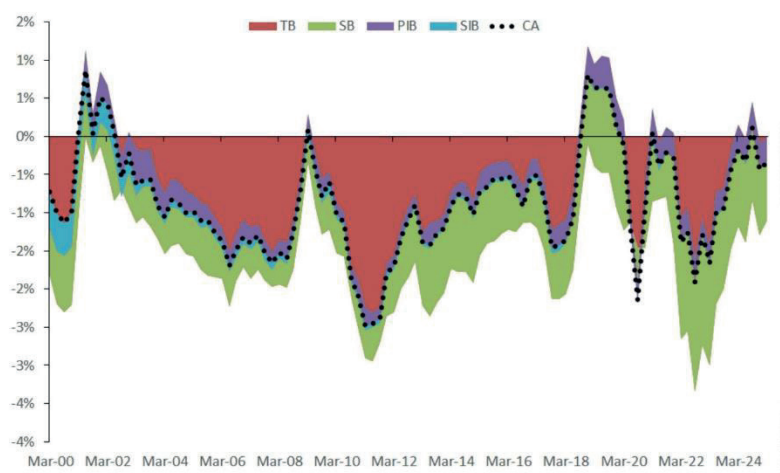


Figure 2: CA and Components % as of GDP 12mma sa

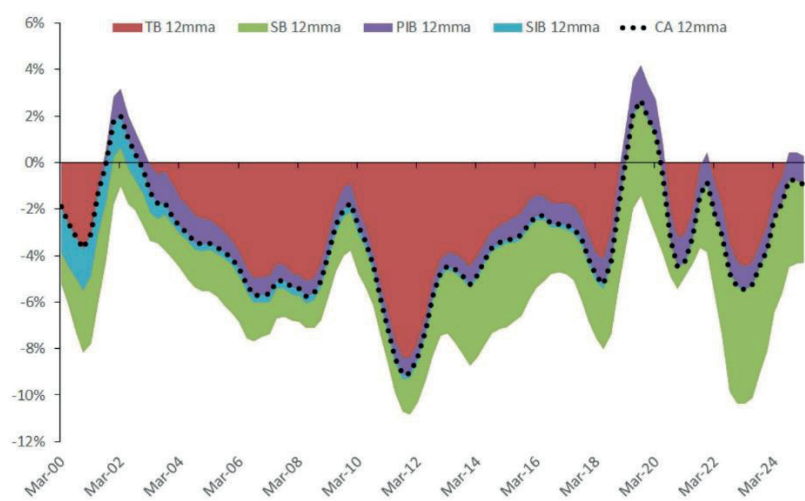


Figure 3: Trade Balance and Components % as of GDP 12mma sa

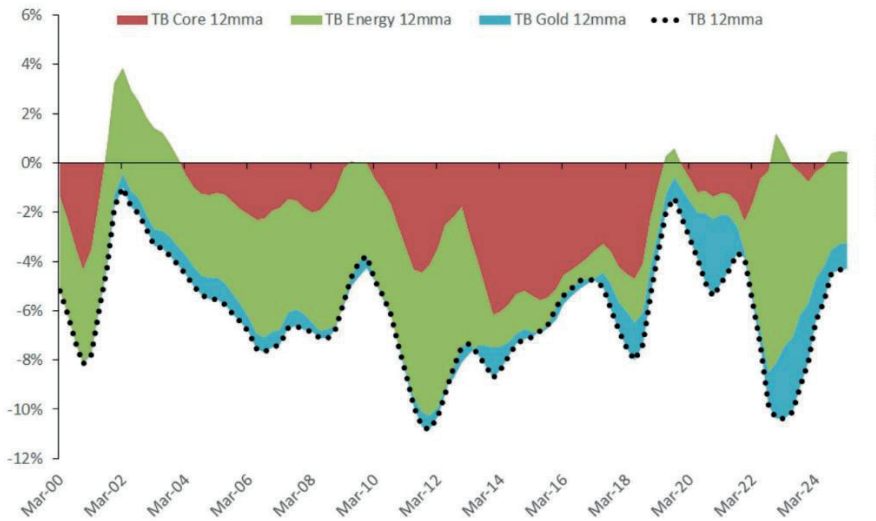


Figure 4: Export and Components % as of GDP 12mma sa

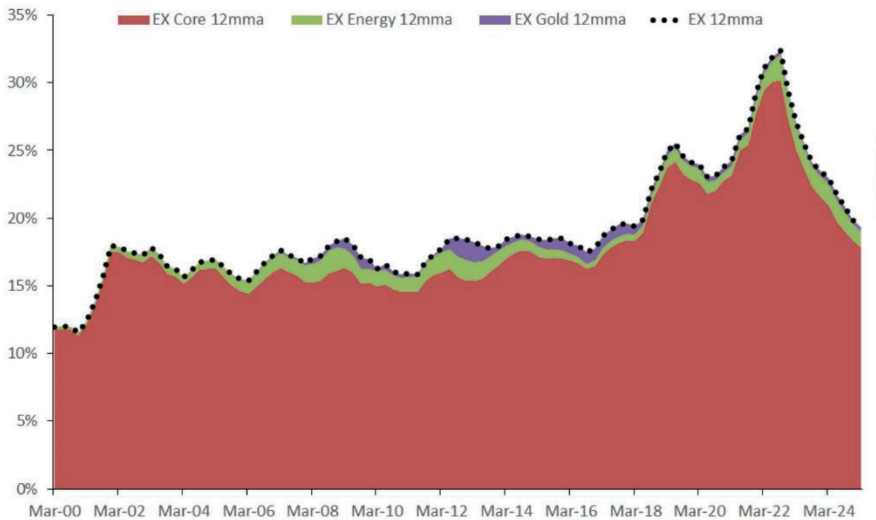
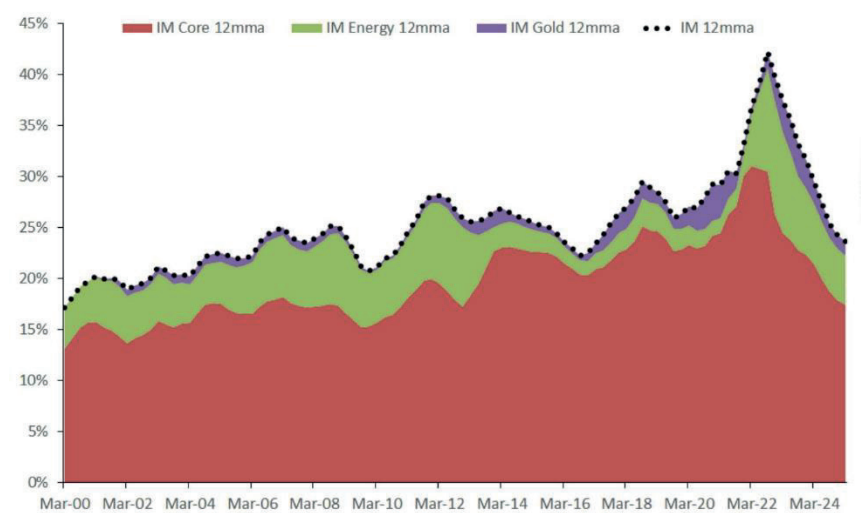


Figure 5: Imports and Components % as of GDP 12mma sa



Examining the Goods Exports and Imports breakdown, one can see that the Core Exports represents most of the Total Goods Exports at 17.8% of GDP out of a total of 19.1%. On the Imports side, In addition to Core Imports, Energy Imports represent a notable portion of total Imports, standing at 19.6% and 4.5% of Turkish GDP respectively.

Apart from the descriptive statistics which summarizes the average magnitude of the Current Account and it’s components during the sample period under investigation, Turkish external sector has gone through marked volatility across time. In order to better analyse this time variation, Figure 1 presents the overall Current Account and it’s key components as % of GDP 3mma sa across the sample period. One can see that the Turkish Current account very rarely touched the surplus threshold, only briefly during the periods of macro-financial turmoil at 2001, 2009 and 2018. Similarly, Figure 2 presents the same data but as % of GDP 12mma sa to eliminate short term volatility from the dynamics. Nevertheless, similar dynamics are observed in both charts.

Figures 3 to 5 present the 12mma time series for Turkish Trade Balance, Goods Exports, Goods Imports and each is decomposed into Core, Energy and Gold components respectively.

Starting with the Trade Balance decomposition, Figure 3 highlights the structural and persistent drag from Energy Trade Balance, which mostly stood at around -4% to -6% of Turkish GDP and worsened during periods of high global energy prices, for instance during 2011–14 and 2021–22. The Core Goods Trade Balance has remained persistently negative, standing mostly

around -2% of GDP but worsened to a peak of around 6% of GDP in 2013. There has been temporary improvements only during sharp domestic demand contractions of 2001 and 2023-25. Finally, Gold Trade Balance is volatile, driven by portfolio gold flows and international gold prices rather than macroeconomic structural factors.

Examining Exports at Figure 4, the majority of Turkish Goods Exports is Core Goods, which has gradually risen from around 12% of GDP in the early 2000s to a peak of around 30% in recent years, before moderating to below 20% after 2024. Energy exports have remained low, typically around 1% of GDP, reflecting limited domestic energy production and export capacity. Gold exports, while generally below 1% of GDP, have seen period of surges, often coinciding with changes in gold trade patterns.

Apart from the current account data, Turkish domestic demand is calculated as the sum of consumption, investment and government expenditures. The data for these components can be easily obtained from quarterly national account statistics. Particular domestic demand variable we use here is the quarterly percentage change in real domestic demand seasonally adjusted.

On the exports side, calculation of the external demand variable is more complex compared to domestic demand. The reason is, external demand shall account for a importance weighted activity/demand of major trading partners. So, in order to construct the external demand variable, top trading partners of Turkey has been listed and their quarterly percentage real GDP growth rates are aggregated by the export weights of Turkey to the corresponding trading partner. These top export destinations for Turkey are namely EU27, United Kingdom, Switzerland, United States of America, Russia, China, India, South Korea and Poland. Exports to these regions/countries represent around 60% of total Turkish goods exports. This ensures that more attention is rightly given to the trading partner with a greater Turkish export share.

Figure 5 presents the Imports Side, in which Core Imports constitutes the biggest part, averaging around 20% of GDP, reflecting the Turkey's strong integration to global supply chains. Energy imports constitutes the second-largest component, fluctuating mostly with international energy prices, peaking above 10% of GDP during the 2022 energy crisis. Gold imports, while generally modest at around 1% of GDP, exhibit sharp surges linked to changes in international gold prices, as well as investor sentiment toward gold as a hedging asset.

Overall, the decomposition of exports, imports, and trade balances underscores the structural nature of Turkey's external imbalances, with energy dependency acting as a structural drag, core goods trade remaining in deficit, and gold trade constituting an additional source of volatility.

3. Econometric Model

Theoretical macroeconomic models, as well as the empirical findings in the literature identifies the key drivers of goods exports and imports as mainly domestic and external demand conditions, as well as real currency movements.¹ For this reason, in our empirical setup, we model core imports as a function of domestic demand and real effective exchange rates. Whereas core exports are modelled similarly with external demand and real effective exchange rates. In line with the theoretical and empirical findings, the following estimation equations are specified for Core Imports and Core Exports,

$$\begin{aligned} \text{IM_Core}_t &= \alpha_0 + \sum_{i=0}^p \alpha_{1i} \text{DD}_{t-i} + \sum_{j=0}^q \alpha_{2j} \text{REER}_{t-j} + \varepsilon_t, \\ \text{EX_Core}_t &= \beta_0 + \sum_{i=0}^p \beta_{1i} \text{ED}_{t-i} + \sum_{j=0}^q \beta_{2j} \text{REER}_{t-j} + u_t, \end{aligned}$$

where IM_Core_t and EX_Core_t represent quarterly change in seasonally adjusted Core Imports and Exports as a percentage of Turkish GDP respectively; DD_t and ED_t represent quarterly percentage change in Domestic and External Demand respectively; REER_t denotes quarterly percentage change in real effective exchange rate for Turkey; and finally ε_t and u_t are the idiosyncratic errors.

Given that both exchange rates and demand variables shall be exogenous to core imports and exports, estimation for the empirical models can be conducted using Ordinary Least Squares (OLS) estimation. In line with the literature, to allow for delayed impact from the exogenous variables in the regression models, a lag length of 4 has been set which allows for a 1 year of delayed impact on the dependant variables.

¹ See for instance Hooper et al. (2000a) and Eren & Tüzün (2018).

Given that the sample period under investigation includes the Covid episode, in which there had been marked disturbances to global trade, dummy variables are included for the year 2020 in order to account for the breaks during that period. Furthermore, to better gauge into the relative importance of demand vs exchange rate impact on the trade variables, alternative specifications are considered and estimated. Namely, a full specification that includes both explanatory variables, and two other specifications that included one of the two.

4. Results

Table 2 presents the results for the empirical models presented in the previous section for both core exports and imports.

Table 2: Regression Results for Core Exports and Core Imports

	Core Exports			Core Imports		
	(1)	(2)	(3)	(4)	(5)	(6)
ED/DD(0)	0.399***	0.285*	-	0.072***	0.067***	-
ED/DD(-1)	-0.040	-0.074	-	0.000	-0.016	-
ED/DD(-2)	-0.083***	-0.007	-	-0.010	-0.008	-
ED/DD(-3)	-0.073***	-0.028	-	-0.018**	-0.008	-
ED/DD(-4)	-0.010	0.006	-	-0.026**	- 0.025***	-
Reer(0)	-0.010***	-	-0.007*	-0.012*	-	-0.008
Reer(-1)	-0.019***	-	-0.015***	-0.004	-	0.011**
Reer(-2)	-0.017***	-	-0.014***	- 0.014***	-	-0.008*
Reer(-3)	-0.010***	-	-0.008**	-0.005	-	-0.003
Reer(-4)	0.000	-	0.000	0.003	-	0.002
R2	0.687	0.500	0.581	0.501	0.423	0.353
Adj. R2	0.633	0.448	0.537	0.415	0.363	0.285
DW	2.154	1.575	1.819	2.277	2.242	1.998

Notes: IM_Core_t and EX_Core_t : Core Imports & Exports qoq change %GDP sa; DD_t and ED_t : Domestic & External Demand qoq percentage change sa; $REER_t$: qoq percentage change in the real effective exchange rate.

Starting with the results for core exports, together with the Covid dummies, the full specification (1) is able to explain close to 70% of the total variation in

Turkish core exports. Examining the results for individual explanatory variables, the biggest impact from external demand propagates in the same quarter, with a coefficient close to 0.4 and significant at 1% level. In other horizons, external demand still has sizeable and significant impact after 2 and 3 quarters. Coefficients for real effective exchange rate are also highly significant across all lags, apart from 4th lag. To decompose their relative contributions, specifications (2) and (3) includes only external demand and real effective exchange rates respectively. Interestingly, in specification (2), only the contemporaneous coefficient of external demand is significant at 10% level. Also the R² falls to 50% in specification (2). However, one has to note that there may be correlation between different lags of explanatory variables since the external/global demand conditions occur in cycles and gradually across time. Turning to specification (3), coefficients of real effective exchange rates remain significant similar to specification (1), with all coefficients remaining significant apart from lag 4. R² of 58% is also higher than the R² in specification (2). These results signal that for core exports, real effective exchange rates is a more important driver as a whole. However, Comparing the Adjusted R² of the three specifications, clearly the full model has the highest Adjusted R² which means that both external demand and real effective exchange rates are important drivers of the Turkish core goods exports.

Turning to the results for core imports, the full specification (4) explains around 50% of the total variation. Looking at the coefficients for explanatory variables, the largest contemporaneous effect comes from domestic demand, with a coefficient of around 0.07 and significant at the 1% level. At longer horizons, domestic demand seems to have a weaker impact on the dependant variable, with only the lags 3 and 4 being statistically significant at the 5%. In contrast, coefficients for the real effective exchange rate are more mixed in specification (4), with the contemporaneous impact and the 2nd lag coefficients being significant at 10% and 5% levels.

To examine the relative roles of each driver, specifications (5) and (6) include only domestic demand and real effective exchange rates respectively. In specification (5), the contemporaneous coefficient for domestic demand remains positive and significant at the 1% level, but none of the lagged terms are significant. The R² falls slightly to 42%, which is similar to the the core exports case when exchange rates variable is removed. Turning to specification (6), the real effective exchange rate coefficients are only significant at the 1st and 2nd lags at the 5% and 10% significance levels

respectively, while the coefficients for other lags being not statistically different from zero. The R2 of 35% is notably lower than in specifications (4) and (5). Comparing the adjusted R2 values across the three import specifications, the full model again produces the highest adjusted R2, confirming that for Turkish core imports, both domestic demand and real effective exchange rate movements contribute meaningfully to the observed variation. But removing domestic demand leads to a greater reduction in adjusted R2 compared to removing real effective exchange rates. This implies that domestic demand is a more important driver for Turkish core imports compared to real effective exchange rate overall.

5. Conclusion

This paper examined the dynamics and determinants of Turkish imports and exports. Unlike the existing literature, this paper solely focuses on the "Core" external trade, which strips energy and gold trade out of the more macro-fundamental driven trade dynamics.

Results indicate that the Turkish core exports are driven both by external demand condition in the key trading partners of Turkey, as well as real effective exchange rates. Comparing the two fundamental drivers, real effective exchange rates seems to be more important than external demand overall. About the horizon of impact from the fundamentals, external demand impact Turkish core exports mostly contemporaneously; whereas changes in real effective exchange rates peak impact materializes with a lag of 3 to 6 months.

Results suggest that Turkish core imports are also influenced significantly by both domestic demand conditions and real effective exchange rate movements. Between the two fundamentals, domestic demand emerges as the relatively more important driver in explaining core imports, particularly with a marked contemporaneous impact. This is quite in contrast to the case of core exports, for which real effective exchange rates are more important relatively to external demand conditions. Also, in contrast to core exports, the impact of real effective exchange rates on core imports is also more specific to few quarters, with peak impact appearing around 3 to 6 months.

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