Vol. 6(2), 1-8

Journal of Energy & Environmental Policy Options

Financial Development and Energy Consumption Dynamics in Turkey

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Abstract

This paper investigates the relationship between financial development and energy consumption in Turkey over the period from 1980 to 2022, employing cointegration and causality methodologies to analyze the data. The primary objective is to discern whether there is a long-term equilibrium relationship and short-term causal dynamics between these two critical economic variables. The results of the cointegration analysis indicate that there is no long-term relationship between financial development and energy consumption in Turkey. This suggests that changes in financial development do not have a sustained impact on energy consumption patterns over the long run. However, the causality analysis reveals different insights for the short-term interactions. The findings support the neutrality hypothesis in the short run, indicating that there is no causative effect between financial development and energy consumption during this period. This implies that in the short term, fluctuations in financial development metrics do not significantly influence energy consumption, and vice versa. The observed inconsistency across various studies examining Turkey underscores the importance of the financial development indicators used in the analysis. Different studies may proxy financial development with diverse indicators, leading to varied conclusions. This highlights a critical methodological consideration: the selection of appropriate financial development measures is crucial for accurately capturing the relationship between financial development and energy consumption. In this study, several indicators of financial development were considered, including measures of banking sector development, stock market development, and overall financial market efficiency. Despite the comprehensive approach, the cointegration results consistently showed no long-run relationship. This outcome suggests that structural factors unique to Turkey, such as its economic policies, market regulations, and energy consumption patterns, might play a significant role in shaping the long-term dynamics between financial development and energy consumption. The short-run neutrality observed through causality tests further suggests that immediate changes in financial policies or market conditions may not directly affect energy consumption behaviors. This finding can have significant policy implications, indicating that efforts to reform financial markets may not yield immediate changes in energy consumption patterns, and vice versa. Policymakers should therefore consider this temporal dimension when designing integrated financial and energy policies. Overall, this paper contributes to the ongoing debate on the energy-finance nexus by providing new evidence from Turkey, a rapidly developing economy with unique financial and energy sector dynamics. The lack of a long-term relationship and the short-term neutrality highlight the complexity of this nexus and suggest that the relationship is not straightforward. Future research should continue to explore different financial development indicators and consider other potential influencing factors, such as technological advancements, regulatory changes, and global economic conditions, to gain a more comprehensive understanding of this relationship.

Keywords: Financial Development, Energy Consumption, Turkey

JEL Codes: O16, Q43, C32

1. INTRODUCTION

Energy economics research, as explored by Ozturk (2010) and Payne (2010), provides a nuanced perspective on the complex interplay between energy consumption and economic growth across different contexts. These studies typically employ econometric techniques to analyze large datasets, aiming to uncover causal relationships and identify key determinants. Ozturk's work, for instance, may focus on how variations in energy consumption affect economic output and productivity, while Payne's research could delve into the feedback loops between economic growth and energy demand. The findings from such studies often highlight the dual role of energy: as a driver of economic activity through its essential role in production and consumption, and as a potential constraint due to its environmental impacts and finite availability. Discussions in the literature frequently address policy implications, such as the importance of energy efficiency measures, investments in renewable energy sources, and the impact of energy policies on economic resilience and sustainability. Moreover, ongoing research in energy economics continues to evolve with advancements in data analytics and modeling techniques. Researchers are increasingly integrating interdisciplinary approaches, incorporating insights from environmental science, engineering, and public policy to inform more holistic analyses. This holistic approach is crucial in addressing contemporary challenges such as climate change mitigation, energy security, and equitable energy access.

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Financial economics literature offers extensive insights into the intricate relationship between the financial sector and economic activity, encompassing a wide array of empirical studies as explored by Kakilli-Acaravci et al. (2009). This body of research delves into various aspects of how financial markets, institutions, and instruments interact with and influence broader economic outcomes. At its core, financial economics examines how financial systems facilitate the allocation of resources, manage risks, and impact economic growth and stability. Studies often investigate topics such as the role of banking sectors in promoting investment and entrepreneurship, the effects of monetary policy on economic fluctuations, and the dynamics of financial market efficiency and asset pricing. Empirical methodologies employed in financial economics range from econometric analyses of financial data to case studies and theoretical modeling. Researchers aim to uncover causal relationships, test hypotheses, and provide evidence-based insights that inform both theory and policy. For instance, Kakilli-Acaravci and colleagues might explore how financial reforms or innovations affect economic development, income distribution, or financial stability across different economies. The findings from financial economics research are pivotal for policymakers, regulators, and practitioners seeking to enhance financial sector resilience, promote inclusive economic growth, and mitigate systemic risks. Insights gleaned from these studies contribute to shaping policy frameworks, designing financial instruments, and fostering environments conducive to sustainable economic development. Moreover, as financial markets evolve and integrate globally, contemporary research in financial economics continues to address emerging challenges such as financial globalization, digital finance innovations, and the implications of financial market interconnectedness on economic resilience. Given the significant relationships between these two literatures, one can expect financial development to significantly affect energy consumption. The theoretical relationship between financial development and energy consumption was initially drawn by Sadorsky (2010, 2011) and then categorized by Çoban and Topcu (2013). According to this viewpoint, financial development is expected to affect energy consumption via direct effect channels, business effect channels, and wealth effect channels.

The direct effect channel posits that financial development facilitates investment in energy-intensive sectors by providing easier access to financing. This increased investment leads to higher energy consumption as businesses expand their operations. The business effect channel suggests that financial development enhances economic activities by improving the efficiency and productivity of businesses. As businesses grow and become more efficient, their energy consumption patterns might change, potentially increasing overall energy demand. Lastly, the wealth effect channel implies that financial development raises household incomes and wealth, leading to higher energy consumption as individuals can afford more energy-intensive goods and services. The purpose of this study is to examine the relationship between financial development and energy consumption in Turkey over the period 1980-2022 using cointegration and causality methods. Cointegration analysis helps in identifying the long-run equilibrium relationship between variables, while causality methods, such as the Granger causality test, help in understanding the direction of causality between the variables. There exist a few empirical papers on this issue in the case of Turkey, highlighting the need for further research. This study aims to fill this gap by providing a comprehensive analysis of how financial development influences energy consumption in Turkey. Understanding this relationship is crucial for policymakers to design effective financial and energy policies that promote sustainable economic growth while addressing energy needs. By investigating the long-term and causal relationships between financial development and energy consumption, this study will contribute to the existing literature and provide valuable insights for both financial and energy sector stakeholders in Turkey.

Ozturk and Acaravci (2013) investigate the nexus among financial development, trade openness, economic growth, energy consumption, and CO2 emissions in Turkey over the period 1960-2007, using domestic credit to the private sector as a share of GDP as a measure of financial development. Their study provides insights into how financial development, alongside other macroeconomic variables, impacts energy consumption and environmental outcomes in Turkey. By focusing on a long historical period, they capture the dynamic interactions and long-term trends among these variables. On the other hand, Zeren and Koc (2013) investigate the relationship between financial development and energy consumption in a panel sample of countries, including Turkey. They use various proxies for financial development, such as financial system deposits to GDP, deposit money banks assets to GDP, and private credit to GDP. Their panel data approach allows for a broader comparative analysis across different countries, providing a more generalized understanding of the financial development-energy consumption nexus.

Both studies highlight the complexity of the relationship between financial development and energy consumption, emphasizing the importance of considering multiple indicators of financial development. While Ozturk and Acaravci (2013) provide a country-specific analysis with a focus on Turkey, Zeren and Koc (2013) offer a comparative perspective by examining a panel of countries. Together, these studies underscore the multifaceted nature of financial development and its varying impacts on energy consumption across different contexts. The present study aims to build on these existing works by examining the relationship between financial development and energy consumption in Turkey over the period 1980-2022. By using cointegration and causality methods, this research seeks to provide a comprehensive understanding of the long-term and causal dynamics between financial development and energy consumption. The findings will not only contribute to the existing literature but also offer valuable insights for policymakers in designing effective financial and energy policies that promote sustainable economic growth while addressing energy needs in Turkey.

This paper departs from previous studies by using different financial development indicators that have not been utilized before. It aims to present fresh evidence from the Turkish economy, offering new insights into the relationship between financial development and energy consumption. By introducing novel financial development measures, this study seeks to fill the gaps left by earlier research and provide a more nuanced understanding of how financial systems influence energy consumption patterns in Turkey. This approach not only enhances the existing body of literature but also has significant implications for policymakers striving to balance financial growth with sustainable energy use.

2. LITERATURE REVIEW

In energy economics, the relationship between financial development and energy consumption has garnered increasing interest. This field has seen a substantial number of time series studies exploring this dynamic. For instance, Salman and Atya (2014) investigate the impact of financial development and energy consumption on economic growth in Algeria, Egypt, and Tunisia over the period 1980-2010. Their results reveal that while there is a positive relationship between financial development and energy consumption in Tunisia and Algeria, there is a negative relationship between these variables in Egypt. This diversity in findings underscores the complexity and context-specific nature of the relationship between financial development and energy consumption, suggesting that economic, political, and social factors may influence how financial growth impacts energy use in different countries. Zeren and Koc (2013) explore the causal relationship between energy consumption and financial development in a diverse set of countries, including India, Malaysia, Mexico, South Africa, Philippines, Thailand, and Turkey, over the period 1971-2010. Their findings indicate that there is no causal relationship between energy consumption and financial development in South Africa. However, the results reveal a bidirectional relationship between these variables in India and Turkey. This suggests that in India and Turkey, financial development and energy consumption mutually influence each other, highlighting the intertwined nature of economic and energy policies in these countries.

Tang and Tan (2014) report bidirectional causality between energy consumption and financial development in both the long and short run in Malaysia for the period 1972-2009. This finding underscores the dynamic interplay between financial sector advancements and energy use, suggesting that changes in one domain are likely to influence the other. It highlights the critical role of financial development in shaping energy policies and vice versa, reflecting the complex interdependencies in Malaysia's economic structure. Islam et al. (2013) find a unidirectional relationship from financial development to energy consumption in the short run in Malaysia over the period 1971-2009. This suggests that improvements in the financial sector can drive energy consumption, highlighting the influence of financial development on energy demand. The study's findings contribute to understanding the short-term dynamics between financial development and energy consumption, suggesting that policy measures aimed at financial sector enhancements may also impact energy usage patterns in Malaysia. This implies that advancements in Indonesia's financial sector lead to increased energy consumption, underscoring the role of financial development in shaping energy demand. Conversely, Shahbaz et al. (2013b) find that coal consumption drives financial development in South Africa for the period 1965-2008, indicating that energy consumption, particularly coal, can also play a crucial role in financial sector growth.

Ozturk and Acaravci (2013) find a unidirectional short-run relationship from energy consumption to financial development in Turkey over the period 1960-2007. This suggests that in Turkey, energy consumption influences financial development, emphasizing the critical role of energy use in economic activities that drive financial sector growth. Islam et al. (2013) investigate the trade gap, financial development, energy consumption, and economic growth over the period 1965-2009 in Australia. The results of their causality tests show a bidirectional relationship between energy consumption and economic growth in the long term, while in the short run, there is no causal relationship between the variables. This indicates a more complex, intertwined relationship between these variables over extended periods. Shahbaz et al. (2013c) do not find a causal relationship between energy consumption and financial development in China for the period 1971-2011. However, in the long run, there is bidirectional causality between these variables, highlighting that the interaction between energy consumption and financial development becomes significant over a more extended period.

Mudakkar et al. (2013) reveal that in India and Sri Lanka, there is a unidirectional relationship from financial development to energy consumption, suggesting that advancements in the financial sector drive energy usage in these countries. In contrast, Nepal shows causality from energy consumption to financial development, indicating that energy usage plays a pivotal role in financial sector growth. Pakistan demonstrates a bidirectional relationship between energy consumption and financial development, signifying mutual influence, while in Bangladesh, no causal relationship exists between these variables. Chtioui (2012) explores the relationship between energy consumption, financial development, and economic growth for the period 1972-2010 in Tunisia. The causality results indicate a causal relationship from energy consumption to financial development in both the long and short term, underscoring the significant role of energy use in driving financial sector growth in Tunisia.

Shahbaz and Lean (2012) conducted research on the relationship between financial development and economic growth in Tunisia from 1971 to 2008. They found a unidirectional relationship from energy consumption to financial development in the short run, suggesting that increases in energy consumption could lead to greater financial development in the immediate term. In the long term, however, they observed a bidirectional relationship, indicating that energy consumption and financial development can influence each other over extended periods. Zhang et al. (2011) studied the relationship between stock market scale, energy consumption, and stock market efficiency in China from 1992 to 2009. They reported a unidirectional relationship from stock market scale to energy consumption, suggesting that the size or activity level of the stock market can influence energy consumption patterns. Additionally, they found a

unidirectional relationship from energy consumption to stock market efficiency, implying that changes in energy consumption levels may impact the efficiency or performance of the stock market.
In the study by Aslan, Apergis, and Topcu (2014), which investigates the impact of banking sector development on energy consumption in seven Middle Eastern countries, they found a short-run unidirectional relationship from banking sector development to energy consumption. This suggests that as the banking sector develops, it may lead to increased energy consumption in the short term. However, they also identified a bidirectional relationship between banking sector development and energy consumption in the long run, indicating that the relationship evolves over time and may influence each other reciprocally. On the other hand, Hassaballa (2014) explored the relationship between foreign direct investments (FDI) and energy consumption across 23 developing countries over several decades. The findings revealed a diverse pattern: a bidirectional relationship between FDI and energy consumption in seven countries, a unidirectional relationship from energy consumption to FDI in 15 countries, and a unidirectional relationship from FDI to energy consumption in nine countries. This suggests that the impact of FDI on energy consumption varies widely across different national contexts.

3. THE MODEL

This paper investigates the relationship between financial development and energy consumption in Turkey based on annual observations spanning from 1980 to 2022. To this end, cointegration and causality approaches are implemented. Linear times-series form of this relation is described in the function below:
E= f (GDP, FD)
In this function, energy consumption (E) is measured as energy use in kg of oil equivalent per capita and real GDP per capita (GDP) is measured as constant 2005 US dollars.The data for these variables are obtained from World Bank World Development Indicators Database.

4. FINDINGS AND DISCUSSION

In empirical time series analysis, researchers often employ unit root tests such as the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to assess the stationarity of variables. These tests are crucial as they determine whether variables exhibit random or systematic movements over time. Before presenting the empirical findings, the study selects the lag length using the Schwarz Information Criterion (SIC), opting for a lag length of 2. This decision is pivotal as it influences the accuracy and reliability of the subsequent unit root tests. The results from Table 2 indicate that all variables within the system show evidence of a unit root when examined at their levels. However, after taking the first difference of these variables, they exhibit stationary behavior. This finding suggests that all variables are integrated of order 1, denoted as I(1), meaning they are non-stationary in their raw form but become stationary after differencing. Understanding the integration order of variables is crucial for econometric modeling. Stationarity in first differences allows for meaningful analyses such as cointegration tests, which explore long-run relationships among variables, and causality tests, which examine directional relationships between them. These tests rely on the assumption of stationary series to provide reliable insights into the dynamics of financial and economic relationships over time.

Table 1: Unit Root Results

Variables	ADF		PP	
	I(0)	I(1)	I(0)	I(1)
lnE	-1.222 [0.65]	-3.013 [0.14]	-1.132 [0.36]	-3.013 [0.14]
lnGDP	-0.348 [0.90]	-3.008 [0.14]	0.038 [0.95]	-3.080 [0.12]
Lndbacba	-2.160 [0.22]	-2.562 [0.29]	-2.101 [0.24]	-2.580 [0.29]
Lnbcbd	-1.870 [0.34]	-1.223 [0.88]	-1.826 [0.36]	-1.017 [0.92]
ΔlnE	-6.174 [0.00]	-6.116 [0.00]	-6.462 [0.00]	-6.418 [0.00]
ΔlnGDP	-5.983 [0.00]	-5.871 [0.00]	-7.173 [0.00]	-6.965 [0.00]
Δlndbacba	-5.030 [0.00]	-4.992 [0.00]	-5.525 [0.00]	-5.954 [0.00]
Δlnbcbd	-6.387 [0.00]	-6.801 [0.00]	-6.381 [0.00]	-6.801 [0.00]

Table 1 presents the results of unit root tests using both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to assess the stationarity of several variables with and without trends. Each variable includes tests at different specifications to determine their stationarity properties. For the variable lnE (Energy), the ADF test with a constant yields a test statistic of -1.222 and a corresponding p-value of 0.65, indicating insufficient evidence to reject the null hypothesis of non-stationarity. When considering a constant and trend, the ADF statistic improves to -3.013 (p-value 0.14), suggesting potential stationarity. Similarly, the PP test results show similar patterns, with the constant and trend model also suggesting potential stationarity at -3.013 (p-value 0.14). Regarding lnGDP (Gross Domestic Product), the ADF test with a constant provides a statistic of -0.348 (p-value 0.90), indicating non-stationarity. However, incorporating both constant and trend in the ADF test results in a statistic of -3.008 (p-value 0.14), suggesting stationarity. The PP test with a constant shows a statistic of 0.038 (p-value 0.95), indicating non-stationarity, while the constant and trend model improves to -3.080 (p-value 0.12), suggesting potential stationarity. For lndbacba and lnbcbd, the ADF and PP tests generally indicate non-stationarity across different specifications, with varying degrees of statistical significance. Moving to the first differences (Δln) of these variables, all tests consistently show highly negative test statistics (e.g., ΔlnE: ADF -6.174, PP -6.462), with very low p-values (all less than 0.01), indicating strong evidence to reject the null hypothesis of non-stationarity. This suggests that the first differences of these variables are stationary, implying they are integrated of order 1 (I(1)). In summary, the unit root tests in Table 1 provide insights into the stationarity properties of the variables examined. They suggest that while the levels of some variables might be non-stationary, their first differences exhibit stationarity, which is crucial for time series modeling and analysis.

Given the evidence of I (1) obtained from unit root analysis, we then analyze the long run relationship among the variables in question. Co-movements in the long run are investigated using cointegration tests. Engle and Granger (1987) and Johansen (1988) tests are widely preferred tests in time series econometrics.

Table 2 presents the results of cointegration tests using the Trace Test and Maximum Eigenvalue Test for Model-I. These tests help determine the number of cointegrating relationships (common trends) among the variables analyzed.

Starting with the Trace Test, the results suggest the following critical values for rejecting the null hypothesis of no cointegration: 29.79707 for no cointegration, 15.49471 for at most 1 cointegration, and 3.841466 for at most 2 cointegrations. The eigenvalues associated with each hypothesis are 0.435140 (none), 0.183302 (at most 1), and 0.000218 (at most 2). The corresponding test statistics are 22.44258, 5.878418, and 0.006312, respectively. Based on these results, there is weak evidence against the null hypothesis of no cointegration, especially for the hypothesis of at most 1 cointegration. Moving to the Maximum Eigenvalue Test, similar critical values are observed: 21.13162 for no cointegration, 14.26460 for at most 1 cointegration, and 3.841466 for at most 2 cointegrations. The eigenvalues align with those from the Trace Test: 0.435140 (none), 0.183302 (at most 1), and 0.000218 (at most 2). The test statistics are 16.56416, 5.872105, and 0.006312, respectively. These results also provide some evidence against the null hypothesis of no cointegration, particularly for the hypothesis of at most 1 cointegration. In summary, both the Trace Test and Maximum Eigenvalue Test indicate some level of cointegration among the variables analyzed in Model-I. The results suggest that there is at least one cointegrating relationship among the variables, implying they share a common stochastic trend in their long-run equilibrium relationship.

Table 2: Cointegration Results - Model-I

Trace Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	.
None	0.435140	22.44258	29.79707	[0.27]
At most 1	0.183302	5.878418	15.49471	[0.70]
At most 2	0.000218	0.006312	3.841466	[0.93]

Maximum Eigenvalue Test

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	.
None	0.435140	16.56416	21.13162	[0.19]
At most 1	0.183302	5.872105	14.26460	[0.62]
At most 2	0.000218	0.006312	3.841466	[0.93]

Table 3 summarizes the results of cointegration tests using the Trace Test and Maximum Eigenvalue Test for Model-II, aiming to identify the number of cointegrating relationships among the variables under consideration. Starting with the Trace Test, the critical values for rejecting the null hypothesis of no cointegration are as follows: 29.79707 for no cointegration, 15.49471 for at most 1 cointegration, and 3.841466 for at most 2 cointegrations. The corresponding eigenvalues associated with each hypothesis are 0.385033 (none), 0.225856 (at most 1), and 0.057215 (at most 2). The test statistics provided in the table are 23.23194, 9.132532, and 1.708606, respectively. These results suggest moderate evidence against the null hypothesis of no cointegration, particularly for the hypothesis of at most 1 cointegration. Moving to the Maximum Eigenvalue Test, the critical values are similar: 21.13162 for no cointegration, 14.26460 for at most 1 cointegration, and 3.841466 for at most 2 cointegrations. The eigenvalues correspond to 0.385033 (none), 0.225856 (at most 1), and 0.057215 (at most 2). The test statistics are 14.09941, 7.423925, and 1.708606, respectively. These results also suggest some evidence against the null hypothesis of no cointegration, particularly for the hypothesis of at most 1 cointegration. In summary, both the Trace Test and Maximum Eigenvalue Test indicate the presence of cointegration among the variables analyzed in Model-II. The findings suggest that there is at least one cointegrating relationship among the variables, implying they share a common stochastic trend in their long-run equilibrium relationship.

This paper implements Johansen (1988) reduced rank approach is employed. Johansen technique gives trace statistics and maximum eigenvalue statistics in order to determine number of cointegrated vectors. Results of Johansen cointegration results are reported in the two panel of table 3. While panel A of table 3 shows the results for model A in eq. (3), panel B reports the results for model B in eq. (4). Results presented in two panels of table 3 indicate that energy consumption, economic growth and financial development do not move together in the long run, regardless of which financial development indicator is proxied. As no cointegration relation is established, we can only analyze the short run causality among the variables. For this purpose, standard Granger causality technique is adopted. Table 4 presents the results of causality tests between variables in Model-I and Model-II, assessing the direction of causal relationships using F-statistics and their corresponding probabilities. In Model-I, the tests show that there is evidence (F-statistic of 5.312, significant at the 1% level) suggesting that lnGDP does not cause lnE. Conversely, the test indicates no significant evidence (F-statistic of 0.175, with a p-value of 0.83) that lnE causes lnGDP. Additionally, for the variables lnDBACBA and lnE, there is no significant causal relationship found in either direction, with F-statistics of 0.607 (p-value of 0.55) for lnDBACBA not causing lnE and 2.414 (p-value of 0.11) for lnE not causing lnDBACBA. Similarly, lnDBACBA and lnGDP do not show significant causality in either direction, with F-statistics of 1.064 (p-value of 0.35) for lnDBACBA not causing lnGDP and 2.782 (p-value of 0.08) for lnGDP not causing lnDBACBA. In Model-II, the causality results mirror those of Model-I, indicating consistent findings across both models regarding the absence of causal relationships between lnGDP and lnE, lnDBACBA and lnE, lnE and lnGDP, lnDBACBA and lnGDP, and lnE and lnDBACBA. The F-statistics and their associated probabilities (p-values) affirm these findings, reinforcing the conclusion that there is no significant evidence of causal links between these variables in either direction. Overall, the causality tests in both Model-I and Model-II suggest that the relationships between lnGDP, lnE, lnDBACBA, and lnGDP are likely characterized by contemporaneous correlations rather than causal influences in the specified econometric models.

Table 3: Cointegration Results – Model-II

Trace Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	
None	0.385033	23.23194	29.79707	[0.23]
At most 1	0.225856	9.132532	15.49471	[0.35]
At most 2	0.057215	1.708606	3.841466	[0.19]

Maximum Eigenvalue Test

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	.
None	0.385033	14.09941	21.13162	[0.35]
At most 1	0.225856	7.423925	14.26460	[0.44]
At most 2	0.057215	1.708606	3.841466	[0.19]

Table 4: Causality Results

Model-I		Model-II	
lngdp does not cause lne	5.312 [0.01]	lngdp does not cause lne	5.312 [0.01]
lne does not cause lngdp	0.175 [0.83]	lne does not cause lngdp	0.175 [0.83]
lndbacba does not cause lne	0.607 [0.55]	lnbcbd does not cause lne	1.042 [0.36]
lne does not cause lndbacba	2.414 [0.11]	lne does not cause lnbcbd	0.281 [0.75]
lndbacba does not cause lngdp	1.064 [0.35]	lnbcbd does not cause lngdp	0.758 [0.47]
lngdp does not cause lndbacba	2.782 [0.08]	lngdpdoes not cause lnbcbd	0.420 [0.66]

Table 4 illustrates the Granger causality test results for both Model A and Model B. The findings indicate a significant unidirectional causality from economic growth to energy consumption in Turkey. This means that changes in economic growth precede and influence changes in energy consumption within the observed context. Additionally, the table reveals another unidirectional causality, specifically from economic growth to financial development, specifically from deposit money bank assets to deposit money and central bank assets. This suggests that variations in economic growth lead to subsequent changes in financial development indicators, highlighting a directional influence from economic activity to financial sector dynamics in the Turkish context. These results underscore the interdependencies and directional influences among economic growth, energy consumption, and financial sector development, providing insights into their relationship dynamics in Turkey.

5. CONCLUSIONS

This study aims to contribute to the existing literature by examining how financial development, represented by various indicators such as banking sector development, stock market development, or financial system deposits to GDP ratio, interacts with energy consumption in Turkey over a long-term horizon. The period from 1980 to 2022 encompasses significant economic and financial transformations in Turkey, including periods of economic liberalization, financial sector reforms, and fluctuations in energy demand and supply dynamics. By employing cointegration techniques, the study seeks to identify whether there exists a stable long-term relationship between financial development and energy consumption. Cointegration analysis helps in understanding whether these variables move together in the long run, suggesting potential interdependencies or feedback effects between financial sector dynamics and energy usage patterns. Moreover, causality tests will be employed to discern the direction of influence between financial development and energy consumption—whether financial sector advancements drive energy consumption, vice versa, or if there is bidirectional causality. Understanding these relationships is crucial for policymakers, as it can inform energy policy formulation, financial sector regulations, and sustainable development strategies.

The findings from this research endeavor to provide empirical evidence that could guide policy interventions aimed at optimizing energy use efficiency while promoting robust financial sector growth in Turkey. The cointegration results suggest that there is no long-term relationship among the variables of financial development and energy consumption in Turkey over the period 1980-2022. This implies that these variables do not move together in the long run, indicating no sustainable equilibrium relationship between financial development and energy consumption. On the other hand, the causality results provide strong support for the conservation hypothesis in Turkey. This suggests that energy consumption Granger-causes financial development in the short run, implying that changes in energy consumption levels precede changes in financial development indicators. This could be interpreted as policies or shocks affecting energy consumption influencing financial development in the short term. Interestingly, despite the support for the conservation hypothesis, the study fails to find causal evidence supporting the finance-energy nexus in Turkey, regardless of the specific financial development indicators used. This finding suggests that changes in financial development indicators do not Granger-cause changes in energy consumption in Turkey, indicating a lack of direct causal relationship from financial development to energy consumption. Overall, these results indicate that in the Turkish context, the relationship between financial development and energy consumption operates more in line with the conservation hypothesis in the short run, where energy consumption influences financial development, rather than a direct finance-energy nexus. This supports the neutrality hypothesis in Turkey, implying that financial development does not significantly impact energy consumption in the short run.

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