Academic Analysis in Macroeconomics

Editor: Assist. Prof. Dr. Gülferah ERTÜRKMEN

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Preface

This book provides an in-depth review of modern economic theories and their applications. It brings together studies in areas such as economic growth, unemployment, financial development, tourism, energy consumption and globalization, while addressing key economic issues affecting the Turkish and world economy. Each chapter analyzes a different economic problem or policy outcome, revealing the dynamics of both international and domestic economies.

The book consists of 13 different chapters. Each chapter deals with a different economic topic and compiles various studies on this topic. The first chapter examines the profile of the female labor force in Turkey and its impact on economic growth. It analyzes in detail how the economic participation of the female labor force is measured and the effects of this participation on the national economy. The second section deals with youth unemployment in the European Union countries and Turkey, analyzing the causes and solutions to youth unemployment, as well as comparing the similarities and differences between the European Union countries and Turkey.

The third chapter analyzes the impact of rule of law and control of corruption on economic growth. Using international evidence, this chapter analyzes in detail the effects of rule of law and corruption control on economic performance. The fourth chapter analyzes the impact of tourism revenues on economic growth through the case of MINT countries. It emphasizes the impact of the tourism sector on economic growth and the importance of this relationship for MINT countries.

The fifth section examines the relationship between indicators of financial development and renewable energy consumption and economic growth. It analyzes how this relationship evolved in Turkey over the period 1990-2021 and the dependence of financial development on renewable energy. The sixth section analyzes the impact of economic growth on population and cultural economy in Turkey, and the dynamics of population growth and cultural economy on economic growth.

The seventh chapter focuses on green economic growth and the performance of the Turkish economy. The eighth chapter examines the impact of economic growth on inflation, urbanization and interpersonal

social globalization index in Turkey and analyzes the effects of these factors on the number of airline passengers in detail.

The ninth chapter analyzes the relationship between tourism, trade openness and economic growth through the case of BRICS-T countries. The relationship between these three factors in BRICS-T countries is analyzed. In the tenth chapter, environmental economics is discussed in a macroeconomic framework and the effects of environmental economic policies on economic growth are analyzed.

Chapter Eleven presents a comparative analysis of macroeconomic performance in E7 countries. Chapter twelve analyzes the impact of global volatility indices on Turkey's default premiums. Chapter thirteen analyzes the impact of market linkages on the G7 economies. The book is designed to be a valuable resource for economists, academics, students and policymakers. By covering both theoretical foundations and applied analysis, it provides readers with the necessary tools to understand the complexity of economic problems.

Contents

Chapter 1

Female Labor Force Profile and Analysis in Türkiye

Gülferah Ertürkmen [1]

Zülküf Aydemir [2]

Abstract

This research addresses the main problems affecting women's labor force participation in Türkiye and the proposed solutions to these problems. Women's participation in economic activities is vital not only for economic development but also for the goal of achieving gender equality. The research analyzes multidimensional factors shaping women's employment, such as education level, gender roles, informal work, glass ceiling syndrome, marital status and childcare.

Data for 2021-2024 reveal that women's employment has increased, but this increase is largely concentrated in the service sector. In high value-added industrial and technology sectors, women's representation remains limited and they are mostly employed in low-status and unskilled jobs. Although higher levels of education support women's participation in the labor force, childcare responsibilities, insufficient flexible working arrangements and lack of social support mechanisms are among the main obstacles limiting women's employment.

In order to increase women's participation in the labor force and develop more sustainable solutions in this area, it is recommended to increase access to education, prevent informal work, expand flexible working opportunities and implement programs that encourage female leadership. Such policies will be an important step in ensuring social equality while supporting economic growth.

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INTRODUCTION

In Türkiye, as in the rest of the world, the goal of achieving full employment by raising the level of employment is adopted (Özen Atabey, 2020). The economic growth of a country depends on both qualitative and quantitative development of the factors of production. In addition, the efficient utilization of these resources at a level close to full employment is also of great importance. Underemployment conditions prevent the economy from reaching its potential growth rates. From this perspective, employment is not only an indicator of economic growth, but also one of its fundamental building blocks. Women's participation in the labor force is an integral part of employment and an important component that increases the efficiency of the labor market (Alpağut, 2023).

Women have played an important role in the economic, social and cultural development of societies throughout history. In addition to their position in the social structure, the fact that they are productive and fertile by nature has placed women in an indispensable position that ensures the continuity of the generation. However, the acceptance of women's labor as an economic value is quite recent compared to human history. Women's participation in economic life in return for a certain wage within the framework of a regular work shift started to gain importance in the modern period; however, it is a fact that this labor is still not sufficiently valued in social and economic terms (Konak Özçelik, 2023). This situation clearly shows that women's labor force is an issue that needs to be addressed from a historical and social perspective.

Women's participation in the labor market is critical for achieving sustainable growth. However, statistics reveal that women's labor force participation rates are well below the ideal level. Factors such as low levels of education, marital status, age, having children, unpaid family work, informal employment and harsh working conditions are the main reasons that make it difficult for women to enter the labor market (Erdoğan and Yaşar, 2018). These factors deepen gender inequality and hinder women's ability to participate more effectively in economic life.

Labor force participation is considered one of the main indicators of a country's economic development. Sustainability of economic growth is directly related to increasing employment rates and efficient use of labor force. Labor force participation does not only mean the participation of individuals in economic activities; it also contributes to increasing the productive capacity and welfare level of the society. In particular, women's labor force participation rate is an important indicator in achieving gender

equality. Increased participation of women in economic life not only supports economic growth, but also plays a critical role in the realization of social justice and gender equality goals (World Bank, 2023).

This study aims to analyze women's labor force participation rates and employment profiles in Türkiye, identify the obstacles faced by women in the labor market and propose solutions. By analyzing women's roles in economic activities, this study aims to contribute to policy development in line with the goals of gender equality and sustainable economic growth. It also aims to evaluate the distribution of women in different sectors and provide strategic recommendations for the solution of imbalances in the labor market.

2. CONCEPTS OF EMPLOYMENT, UNEMPLOYMENT AND LABOR FORCE

Employment refers to the participation of individuals who are willing to work, have the competence and physical strength to participate in business life in return for a certain wage. From a broader perspective, employment can be defined as the use of factors of production such as capital, labor and land in economic processes. Since these three factors of production are directly related to national income, it can be said that the concept of employment is closely linked to national income (Arda, 2002). While employment generally covers full-time and permanent employment relationships, it can also be divided into different categories such as underemployment, full employment and overemployment. In modern labor markets, flexible employment types have also emerged in line with the requirements arising from the relationship between labor supply and demand. Flexible employment types refer to working arrangements that fall outside traditional full-time jobs. In this context, various types of jobs such as part-time work, temporary jobs, telecommuting, telecommuting, telecommuting, job sharing, on-demand jobs, shift-based work, flexible hour practices, independent work and subcontractor job models can be counted (Ünlüönen et al., 2007; Ünlüönen and Şahin, 2011). While this diversity provides flexibility in working life, it also creates new dynamics in the labor market.

It is impossible not to mention unemployment when explaining the concept of employment. The relationship between employment and unemployment is one of the main factors that directly affect the economic capacity of a country and the ability of individuals to find paid work (Tutar, 2023). Unemployment, which is one of the main macroeconomic problems of economies, is defined as the situation where individuals of working

age cannot find a job despite their desire to work. The persistence of unemployment deeply affects not only the economic situation of individuals, but also the general welfare level and the effectiveness of economic policies (Atamer et al., 2023). Unemployment, as a macroeconomic variable, has a direct impact on social life. Therefore, by analyzing unemployment rates in an economy, important clues can be obtained about the general situation and functioning of that economy (Çelik, 2019).

Labor force is the cornerstone of economic processes and an indispensable element of production activities. Labor force is defined as "a concept that expresses the labor supply of individuals of working age and their potential to participate in the production process". While the labor force includes employed and unemployed individuals, those who are not included in the labor force consist of individuals who do not participate in economic activities such as those who are in education, those who are busy with household chores, retirees and individuals who have given up looking for a job (Alpağut, 2023). Although this group remains outside the labor market, it represents an important segment in terms of economic potential.

The labor force has two main components: employed individuals and unemployed individuals. It emphasizes that being in the labor force enables individuals to take a more active role not only in economic life but also in social life. The labor force participation rate is an important indicator that shows how many individuals of working age are involved in economic activities, and this rate is directly related to economic growth and welfare (Demir, 2018).

The level of education, occupational qualifications, gender equality and other socioeconomic factors are the main factors determining the efficiency of the labor force. It states that a skilled labor force is indispensable for economic development and international competitiveness. In this context, employment policies should aim not only to reduce unemployment but also to increase the quality of the labor force (Çetin, 2019).

3. FACTORS DETERMINING WOMEN'S LABOR FORCE PARTICIPATION

Gender is one of the key factors affecting labor force participation worldwide. Women are recognized as an important driver of global economic growth and competitiveness. As their labor force participation increases, their impact on economic development and poverty reduction becomes more pronounced. However, in many countries, women face

higher unemployment rates than men and are often forced to work in lower status and less skilled jobs (Çınar and Demirbilek, 2023).

There are many factors that limit women's participation in the labor force. These factors include legal regulations, social and cultural structure, glass ceiling syndrome, wage levels, marital status, age, education level and fertility rate (Küçükbay and Kocabaş, 2023). In particular, legal regulations can directly affect women's roles in business life. Although Labor Law No. 4857 contains regulations to protect the rights of women employees, some of its articles restrict women's employment in certain sectors and limit their participation in the workforce. Therefore, these regulations need to be revised taking into account today's technological and scientific developments (Yılmaz & Zoğal, 2015).

Social values and patriarchal family structure are among the important factors preventing women's participation in the labor force. The exclusion of women from working life cannot be explained solely by traditional values; global economic and social influences make this process even more complex (Çakır, 2008). Education has an important role in overcoming these obstacles. As the level of education increases, women's labor force participation rates rise, which supports economic growth and poverty reduction (Korkmaz & Korkut, 2012; Çatalbaş, 2015). However, barriers such as education costs, childcare responsibilities and the obligation to contribute to the family budget limit women's access to education opportunities (Karataş, 2006).

Another important factor that hinders women's labor force participation is informal employment. Women who cannot find jobs in formal sectors are forced to work in the informal economy. This deprives women of social security and public services, often leading to a higher risk of poverty (Lim, 2004).

Glass ceiling syndrome is another artificial barrier that prevents women from rising to senior positions in business life. In order to remove this barrier, seminars raising social awareness should be organized, mentoring systems should be expanded and policies supporting gender equality should be implemented. These steps are critical to support women's career development in the business world (Küçükbay and Kocabaş, 2023).

Marital status is also an important factor affecting women's labor force participation. While marriage generally decreases women's work rate, divorce may increase labor force participation due to the need for economic independence (Öztürk, 2018; Yılmaz, 2021). Women's labor force participation rates may vary as they get older; education at a young age,

family responsibilities in middle age and health problems in old age are the main factors affecting this process (Smith, 2023).

Finally, fertility directly affects women's labor force participation. Childcare responsibilities may cause women to withdraw from the labor force. However, flexible working arrangements and childcare services can facilitate this process and allow women to continue working (Johnson & Brown, 2021). Increasing women's labor force participation is an important goal that supports economic growth and strengthens social equality. For this purpose, comprehensive policies ranging from legal regulations to social awareness raising efforts should be implemented.

4. FEMALE LABOR FORCE PROFILE IN TÜRKİYE: AN OVERVIEW

The female labor force profile in Türkiye has undergone significant transformations over the years due to economic and social changes. While women's labor force participation rate has increased especially in the services sector, it is still limited in high value-added sectors such as industry and technology. Women are mostly concentrated in low-status and unskilled jobs, which hinders the strengthening of their economic independence and social status. While educational attainment is a critical factor that increases women's labor force participation, structural issues such as childcare, gender roles and informal employment limit women's presence in the labor market. The sectoral and occupational distribution of women's labor force participation in Türkiye clearly demonstrates the need to develop comprehensive policies in line with the goals of achieving gender equality and promoting economic development.

Table 1: Women's Employment by Economic Activity (Thousand person, 15+ age)

Areas of economic activity		2021	2022	2023	2024 (III.Q)
Agriculture	Agriculture, forestry and fishing	1951	1988	1864	2285
Industry	Mining and quarrying	9	8	9	8
	Manufacturing	1569	1702	1710	1714
	Electricity, gas, steam, water supply, sewerage etc	31	32	46	35
Construction	Construction	90	91	98	109
Services	Whole-sale and retail trade	1096	1243	1294	1326
	Transportation and storage	170	163	194	170
	Accommo-dation and food service activities	468	553	582	623
	Bilgi ve iletişim	67	72	110	107
	Financial and insurance activities	113	144	166	147
	Real estate activities	64	64	69	77
	Professional, scientific and technical activities	384	420	422	432
	Administra-tive and support service activities	414	461	452	442
	Public administra-tion and defence	375	420	419	471
	Educa-tion	1102	1175	1217	1029
	Human health and social work activities	1213	1348	1476	1441
	Arts, entertain-ment and recreation	41	54	60	81
	Other social, comminity and personal service activities	292	361	356	355
Total		**9460**	**10298**	**10546**	**10851**

Source: TSI, Note : Quarterly=Q

Table 1 shows the change in female employment by economic activity from 2021 to the third quarter of 2024. The data are important for examining how women's presence in various sectors has changed over time, and these changes point to the structural transformation of women's employment in the Turkish labor market.

In 2021, total female employment was 9,460, rising to 10,851 in the third quarter of 2024. This indicates an increase in women's labor force participation. The growth observed in the service sector and specific sub-sectors in particular reveals a significant increase in female employment.

In the agricultural sector, female employment fluctuates. From 1,951 women's employment in 2021, it increased to 2,285 in 2024. The agricultural

sector still has a significant share in women's employment, but seasonal and regional changes in this sector can be said to be effective in increases and decreases in women's employment.

In the industrial sector, female employment displays a relatively more stable outlook. Female employment in the manufacturing sector increases from 1,569 in 2021 to 1,714 in 2024. Employment in other industrial sub-sectors such as electricity, gas and water shows a limited increase. In the construction sector, female employment has also shown a steady increase, albeit at low levels.

In the services sector, female employment shows a significant upward trend. Sub-sectors such as wholesale and retail trade, accommodation and food services account for most of the increase in female employment. For example, the number of women working in accommodation and food services increased from 468 in 2021 to 623 in 2024. This increase shows that the services sector continues to be an attractive area for female employment.

Female employment in the education sector decreased from 1,102 in 2021 to 1,029 in 2024. This decrease may be due to changes in sectoral conditions or employment policies. In contrast, female employment in human health and social work activities increased from 1,213 in 2021 to 1,441 in 2024. This shows that the health sector continues to be an important area of employment for women.

Female employment in more technical and professional fields tends to increase. Female employment in the information and communication sector increased from 67 in 2021 to 107 in 2024. This increase shows that women are moving towards high value-added sectors such as technology and communications.

Overall, female employment is increasing overall. However, this increase is concentrated in the service sector and is more limited in some areas such as industry. The data reveal increasing sectoral diversity in women's labor force participation and a growing female presence in some non-traditional sectors (e.g. technology and information communication). These trends reflect the success of policies aimed at increasing women's employment and the transformation of the Turkish labor market.

Table 2. Employed According to Occupational Groups(Thousand person, 15+ age)

Years	2021				2022				2023				2024		
	Q I	Q II	Q III	Q IV	Q I	Q II	Q III	Q IV	Q I	Q II	Q III	Q IV	Q I	Q II	Q III
Total	8.422	8.881	9.327	9.460	9.392	9.936	10.035	10.298	10.013	10.319	10.429	10.546	10.629	10.856	10.851
Managers	305	290	316	326	302	286	316	330	339	328	350	358	352	363	366
Professionals	1.690	1.636	1.646	1.781	1.795	1.819	1.747	1.934	1.973	1.938	1.831	2.030	2.075	2.033	1.899
Technicians and associate professionals	518	534	524	507	568	629	612	620	632	636	672	676	671	698	749
Clerical support workers	815	870	846	897	931	897	922	948	986	931	948	1.000	1.051	1.043	965
Service and sales workers	1.636	1.674	1.813	2.020	2.077	2.133	2.126	2.283	2.298	2.458	2.329	2.424	2.541	2.509	2.430
Skilled agricultural, forestry and fishery workers	1.147	1.306	1.381	1.227	1.159	1.250	1.326	1.224	1.042	1.186	1.341	1.160	1.118	1.310	1.392
Craft and related trades workers	457	452	436	489	514	517	492	535	571	564	530	537	564	587	573
Plant and machine operators and assemblers	300	318	333	312	322	381	391	355	342	398	370	317	347	346	356
Elemantary occupations	1.554	1.800	2.034	1.901	1.725	2.024	2.104	2.069	1.831	1.880	2.059	2.044	1.909	1.968	2.122

Source: TSI, Note : Quarterly=Q

Table 2 shows the distribution of the employed by occupational groups from 2021 to the third quarter of 2024 and the changes in these groups over the years. The data provides an important source for understanding where employment is concentrated and trends over time.

In 2021, total employment starts at 8,422, reaching 10,851 in the third quarter of 2024. This shows a steady increase in the number of people employed. However, this increase has occurred at different speeds according to occupational groups and fluctuations have been observed in some areas.

Employment in the managers group has remained relatively stable. In 2021, the number of people employed in this group started with 305, while in 2024 this number reached 366. This increase is limited, indicating that there has not been a major expansion in managerial positions.

In the professional occupation group, employment growth is more pronounced. This number increased from 1,690 in 2021 to 1,899 in 2024. The increases in 2023 are particularly striking. This trend may indicate that the demand for highly skilled labor is increasing and the economic structure is shifting to areas requiring more knowledge and expertise. A steady increase was also observed in the technicians and technicians group. The number of employment increased from 518 in 2021 to 749 in 2024. This increase suggests that the demand for technical skills may have increased due to technological developments. There has also been a significant increase in the number of employees working in office and customer services. While the number of employees in this group was 815 in 2021, this number increased to 965 in 2024. This can be explained by the growth of the service sector and the increase in customer-oriented services. One of the most remarkable increases was realized in the service and sales personnel group. This number increased from 1,636 in 2021 to 2,430 in 2024. This clearly shows the expansion in the service sector and the increase in employment in areas such as retail trade and tourism.

Fluctuations were observed in the number of people working in skilled agriculture, forestry and aquaculture. This number increased from 1,147 in 2021 to 1,392 in 2024. However, periodic changes due to seasonal effects are evident in this group. Employment in the group of craftsmen and related trades showed a relatively constant increase. This number increased from 457 in 2021 to 573 in 2024. This shows that sectors such as small-scale production and craftsmanship still have an important place in the economic system. Employment in the plant and machinery operators and assemblers group increased from 300 in 2021 to 356 in 2024. This increase is limited and may reflect the impact of technological transformation in the industrial

sector on employment. The number of people working in unskilled jobs increased from 1,554 in 2021 to 2,122 in 2024. This increase indicates that the demand for low-skilled labor is still persistent, especially in certain sectors.

Overall, total employment growth indicates economic recovery and expansion. However, this growth is mostly concentrated in the service sector and low-skilled jobs. Demand for skilled labor has also increased, suggesting that education and professional qualifications are becoming increasingly important in the labor market. This data sheds light on how policymakers can shape their strategies for the education, technology, services and industry sectors.

Table 3: Reasons Why Women Cannot Participate In The Labor Force (Thousand person, 15+ age)

Years		Not in labor force	Discouraged workers [1]	Available to work but not seeking work	Seeking work but not available	Home responsibilities	Education/ Training	Retired	Disabled, old, ill etc.	Other
2021	Q I	21.987	875	1.234						2.732
	Q II	21.818	810	1.060	50	10.178	2.689	1.244	3.437	2.351
	Q III	21.222	781	931	40	10.133	2.493	1.276	3.376	2.191
	Q IV	21.375	864	922	41	9.770	2.654	1.285	3.523	2.317
2022	Q I	21.594	901	843	37	10.035	2.816	1.322	3.413	2.226
	Q II	21.225	875	835	52	10.085	2.688	1.283	3.322	2.085
	Q III	21.118	901	841	54	10.172	2.450	1.282	3.331	2.086
	Q IV	20.927	843	798	51	9.663	2.545	1.253	3.487	2.287
2023	Q I	21.340	879	890	62	9.426	2.596	1.317	3.643	2.529
	Q II	21.215	911	955	81	9.264	2.532	1.302	3.631	2.538
	Q III	21.080	1.018	1.024	82	9.062	2.299	1.324	3.661	2.610
	Q IV	21.213	1.060	1.123	44	8.606	2.480	1.334	3.922	2.644
2024	Q I	21.157	1.118	1.149	73	8.085	2.508	1.141	4.198	2.884
	Q II	21.096	1.100	1.308	84	7.714	2.434	1.124	4.217	3.115
	Q III	20.895	1.217	1.388	97	7.005	2.160	1.146	4.469	3.411

Source: TSI, Note : Quarterly=Q

The data in Table 3 shows the classification of individuals not in the labor force from 2021 to 2024 according to their reasons. This data is important for understanding the dynamics of the labor market, and a careful look at the trends over the years makes it possible to assess the economic and social impact of changes in different categories.

In the first quarter of 2021, the total number of those not in the labor force was 21,987, while this number decreased to 20,895 in the third quarter of 2024. This can be interpreted as an indication that labor market participation may increase or that demographic changes have been effective. Overall, the labor force participation rate increased and the total population not in the labor force decreased during this period.

There is a significant decrease in the number of individuals engaged in housework. The number decreased from 9,635 in 2021 to 7,005 in 2024. This may suggest that women, in particular, are participating more in the labor force or spending less time on housework and more on economic activities. This data can be considered as a positive development pointing to an increase in the labor force participation rate of women.

There is an increase in the number of individuals not in the labor force due to education or training. From 875 in 2021, this number increased to 1,217 in 2024. This trend may indicate that more individuals are choosing to stay in education and that the entry age of young people into the labor force is delayed. This may improve labor force quality in the long run, but has the potential to increase youth unemployment in the short run.

It is noteworthy that there has been a steady increase in the number of retired individuals. In 2021, the number of retirees was 1,234 and reached 1,388 in 2024. This increase can be considered as a reflection of Türkiye's aging population. This increase in pensioners may create additional pressures on social security systems and therefore strategic adjustments may be required in these areas.

There has also been a small increase in the number of people unable to work. In 2021, this number was 56, rising to 97 in 2024. The increase in the number of people unable to work due to health problems, old age or other reasons is an area that needs to be monitored carefully, especially in the context of an ageing population.

The share of individuals without job prospects decreased from 1,298 in 2021 to 1,146 in 2024. This may indicate that there has been some improvement in the labor market and individuals have partially regained hope of finding a job. However, there is an increase in the number of

individuals who are available for work but not looking for a job. This number increased from 3,522 in 2021 to 4,469 in 2024. This may indicate that factors preventing individuals from participating in the labor force are still effective and that some individuals have given up looking for a job.

Finally, there has also been an increase in the number of individuals looking for a job but unable to start work. In 2021, this number was 2,732, while in 2024 it increased to 3,411. This increase may indicate that factors in the labor market that prevent individuals from finding a job (e.g. health, logistics or other responsibilities) persist.

Overall, these data suggest that Türkiye's labor market is undergoing some structural changes, with an increase in female labor force participation, a strengthening educational attainment, rising retirement rates, and changes in job search behavior becoming evident. Such information plays a critical role in developing labor market policies and making strategic decisions for sustainable economic growth.

Table 4. Actual Working Hours of the Employed (Thousand person, 15+ age)

		Employment	Employed at work	Weekly total actual hours of work	Average actual weekly hours of work [1]
2020	Q I	8.318	7.716	302.720	39,2
	Q II	8.156	6.338	227.151	35,8
	Q III	8.493	7.606	305.862	40,2
	Q IV	8.207	7.611	299.483	39,3
2021	Q I	8.422	7.866	299.518	38,1
	Q II	8.881	8.243	318.818	38,7
	Q III	9.327	8.329	345.637	41,5
	Q IV	9.460	9.057	369.255	40,8
2022	Q I	9.392	8.878	359.010	40,4
	Q II	9.936	9.532	379.059	39,8
	Q III	10.035	8.921	367.842	41,2
	Q IV	10.298	9.912	404.663	40,8
2023	Q I	10.013	9.314	377.742	40,6
	Q II	10.319	9.666	384.897	39,8
	Q III	10.429	9.550	400.989	42,0
	Q IV	10.546	10.073	407.878	40,5
2024	Q I	10.629	10.008	395.274	39,5
	Q II	10.856	9.731	381.618	39,2
	Q III	10.851	9.716	395.857	40,7

Source: TSI, Note : Quarterly=Q

The data in Table 4 provide a detailed breakdown of the actual working hours of women employed between 2020 and 2024. The data is an important source for assessing women's labor market activity and changes in working hours.

In 2020, the number of women employed fluctuated throughout the year. For example, female employment fell from 8,318 in the first quarter of 2020 to 8,156 in the second quarter, but rose to 8,493 in the third quarter. During this period, women's employment rates also changed in parallel. In 2020, when the impact of the pandemic was intense, women's total weekly working hours decreased, falling to 227,151 hours in the second quarter of the year.

By 2021, there was a gradual increase in the number of women employed. Female employment increased from 8,422 in the first quarter of the year to 9,460 in the fourth quarter. The average actual weekly working hours of women also remained stable during this period. Especially in the third quarter of the year, average actual working hours reached 41.5 hours, the highest level of 2021. This increase indicates that women contributed more to the labor force during the economic recovery.

2022 was a year of continued growth in female employment. The number of employed women reached 10,298 in the fourth quarter of the year. Total weekly working hours peaked at 404,663 hours in this period. This shows that women are working longer hours in the labor market and employers' demand for female employees has increased. Average weekly working hours varied between 39-41 hours throughout the year.

2023 reveals that women's presence in the labor market continued to be strong. The number of employed women increased in each quarter of the year, reaching 10,546 in the fourth quarter. Average actual weekly working hours peaked at 42 hours in the third quarter. This was the year in which women participated most intensively in economic activities.

By 2024, female employment maintained its high level. In the third quarter of the year, the number of women employed was recorded as 10,851. Total weekly working hours remained high compared to previous years at 395,857 hours. Average actual weekly working hours varied between 39.2 and 40.7 hours.

Overall, there is a steady increase in women's employment and actual hours worked between 2020 and 2024. After declines during the pandemic, women's labor market activity has increased significantly, especially in 2021 and beyond. The increase in women's weekly working hours points to

economic growth and the success of policies aimed at women's employment. These data reveal in detail the structural transformations in women's labor force participation and their contribution to economic activity.

5. CONCLUSION

Women's labor force participation in Türkiye is of strategic importance for economic growth and gender equality. However, existing analysis reveals that women's labor force participation rates are low, which has a negative impact on economic development goals. The main factors hindering women's participation in the labor force include informal employment, limited access to educational opportunities, traditional gender roles, glass ceiling syndrome and inadequate social support mechanisms.

Education is one of the most important tools that enable women to participate more effectively in the labor force. As women's educational attainment increases, their labor force participation rates also increase, which not only supports economic growth but also contributes to poverty reduction. However, issues that limit women's access to education, such as childcare responsibilities, the cost of education and the imbalance in family income distribution, need to be addressed. To this end, state-funded scholarships, expanded vocational training programs and flexible working arrangements, especially for working mothers, are crucial.

Informal employment is a critical problem that threatens women's economic independence. Women in informal employment work for low wages without social security and legal rights, which reduces their quality of life. Reducing informal employment requires the implementation of supportive policies to encourage women's transition to the formal sector, along with effective monitoring mechanisms. In addition, the expansion of incentives to increase women's entrepreneurship can lead to a stronger participation of women in the economy.

The glass ceiling syndrome is an important structural problem that prevents women from rising to senior positions in business life. In order to eliminate this obstacle, it is necessary to develop policies that encourage women's leadership in the business world and to expand mentoring and leadership programs. Regulations that promote gender equality in the workplace will both support individual career goals and contribute to gender equality.

Demographic factors such as marital status and fertility also affect women's labor force participation. The process of having children can interrupt women's careers and negatively affect their long-term income

levels. At this point, the implementation of state-subsidized childcare services, flexible working hours and parental leave policies can increase women's persistence in the labor market. Such policies would not only facilitate women's integration into the labor force, but also reduce income imbalances within families.

An analysis of the sectoral distribution of women shows that there has been a significant increase in women's employment in the services sector. However, the representation of women in high value-added sectors such as industry and technology is quite limited. This situation reveals that women should be encouraged in STEM (Science, Technology, Engineering, Mathematics) fields and special programs should be developed for these sectors. Women's presence in these sectors will both strengthen their individual career goals and contribute to economic development.

As a result, increasing women's participation in the labor force will not only improve their individual well-being, but also promote social equality and economic sustainability. Achieving these goals requires a comprehensive approach to address the multifaceted problems faced by women. Holistic policies in areas such as education, informal employment, flexible working opportunities, leadership programs and childcare support will ensure women's strong inclusion in the labor market. By implementing such policies, Türkiye can move towards a brighter future in terms of both economic growth and gender equality.

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Chapter 2

Exploring Common Equilbrium in Youth Unemployment Through Club Convergence Analysis: The Case of European Union Countries And Türkiye

Aslı Özen Atabey[1]

Abstract

This study aims to analyze the dynamics and convergence processes of youth unemployment rates in 27 European Union member countries and Türkiye for the period 1991-2023. Using the Phillips and Sul (2007) club convergence method, the study examines whether countries converge to a common equilibrium level in terms of youth unemployment rates. This method allows for identifying heterogeneous dynamics and analyzing how countries behave within different groups (clubs).

The findings reveal that while countries generally do not converge to a common equilibrium level, they form three distinct clubs. In Club 1, youth unemployment rates have increased notably after 2010. In contrast, countries in Club 2 have demonstrated significant improvements in reducing youth unemployment rates, moving closer to the panel average. The countries in Club 3 have distinguished themselves from other groups with low youth unemployment rates and have consistently maintained this success. These results underscore the pivotal role of economic crises, structural reforms, and labor market policies in shaping youth unemployment rates.

1. Introduction

Youth unemployment, defined as the inability of individuals in the 15-24 age group to find employment despite their willingness to participate in the labor market, is a critical issue that directly impacts both economic growth and social welfare. This age group is in a transitional phase from

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education to the labor market, making youth unemployment rates significant indicators of the overall health of the economy and the efficiency of labor markets. In societies with high youth unemployment, social and economic costs tend to escalate, leading to productivity losses, income inequality, and societal unrest. The underlying causes of youth unemployment include the mismatch between education systems and labor market needs, economic recessions, structural issues in labor markets, and inadequate job-seeking skills. Additionally, regional disparities and economic integration processes are significant determinants of youth unemployment (ILO, 2020). The patterns and underlying causes of unemployment differ significantly between developed and developing countries (Taş & Bozkaya, 2012: 161). Globally, youth unemployment rates have shown an upward trend during economic crises, with the COVID-19 pandemic further exacerbating this issue. According to the ILO (2020) report, the global youth unemployment rate rose to 14.6% following the pandemic, with even higher rates observed in developing countries. In Europe, youth unemployment rates vary regionally, with Southern European countries generally exhibiting higher rates (Eurostat, 2021).

The long-term effects of youth unemployment include delayed career progression due to late entry into the labor market, social exclusion, low income levels, and psychological challenges. These consequences negatively affect not only individuals but also economic growth and social cohesion (Bell & Blanchflower, 2011). Integrating youth into the labor market is thus of paramount importance for achieving countries' long-term development goals. However, significant differences in youth unemployment rates across countries and regions highlight the existence of convergence or divergence processes within labor markets. This raises the critical question of whether unemployment rates are moving toward a common equilibrium level over time, a subject of considerable interest to economic policymakers and academics.

The primary priority of economic policies, regardless of the economic system implemented, is to reduce unemployment or maintain it at the lowest possible level (Apaydın, 2019: 1002). Various methodologies have been developed to examine the impacts of economic integration and structural reform processes on unemployment rates. The *club convergence* method proposed by Phillips and Sul (2007) offers a robust tool for analyzing heterogeneous dynamics among countries or regions. This method not only assesses the presence of general convergence trends but also identifies distinct subgroups with different equilibrium levels and examines the dynamics within these groups. Research on youth unemployment rates has

demonstrated that factors such as the effects of economic crises, structural reforms, and policy alignment processes significantly shape these dynamics (Phillips & Sul, 2007; Panopoulou & Pantelidis, 2012).

The aim of this study is to analyze the convergence trends in youth unemployment rates for 27 European Union member states and . Differences in youth unemployment rates reflect structural challenges and the effectiveness of labor market policies across countries, making such analyses valuable for policymakers. The study employs a long-term panel dataset spanning 1991-2023, sourced from the World Bank's official website. The analysis is based on the *club convergence* method developed by Phillips and Sul (2007), which allows for a detailed examination of heterogeneous dynamics across countries.

The study focuses on determining whether there is a general convergence trend toward a common equilibrium in youth unemployment rates. In the absence of panel-wide convergence, the study evaluates the presence of distinct convergence clubs among countries and the characteristics of these clubs. This approach aims to deepen understanding of the causes and consequences of heterogeneity in youth unemployment rates.

Analyzing youth unemployment convergence is a relatively underexplored area, and the unique contribution of this study lies in its focus on the specific dynamics of youth unemployment. By examining the heterogeneous dynamics of youth unemployment across countries, the study evaluates the impacts of economic crises, structural reforms, and policy differences. The use of advanced convergence methodologies facilitates the analysis of not only general convergence trends but also the similarities and differences among various groups (clubs). This approach provides policymakers with targeted solutions for reducing youth unemployment while offering a more comprehensive understanding of its economic and social implications. The study aims to make a unique contribution to the literature by evaluating the structural factors and global trends influencing youth unemployment in EU countries and Türkiye.

2. LİTERATURE REVİEW

Labor market dynamics are crucial determinants of economic performance and social welfare. In particular, regional and national unemployment convergence trends are significant indicators of reducing economic inequalities between countries and regions and achieving an integrated labor market. The literature on unemployment convergence aims to understand the dynamics of this process through various methodologies applied across

different geographical regions and time periods. Below are chronological examples of studies analyzing labor market convergence.

Martin (1997) examined the regional dynamics of unemployment rates in the United Kingdom, which doubled every decade starting from the 1960s. The study found that regional unemployment trends exhibited a high degree of synchronicity during this period, with persistent regional disparities in unemployment rates. These persistent disparities were interpreted as evidence of equilibrium within the regional labor market system. Rowthorn and Glyn (2006) analyzed how state-level employment rates in the United States responded to regional labor market dynamics, finding that regional unemployment rates in the U.S. also demonstrated significant persistence. Costantini and Lupi (2006) analyzed regional unemployment rates in Italy, evaluating long-term disparities and convergence dynamics among regions. Using data from 1977-2003, they employed panel unit root and cointegration methods to test the stochastic convergence hypothesis. The findings indicated that regional unemployment rates did not exhibit stochastic convergence, thus demonstrating persistent disparities over time. However, the possibility of long-term equilibrium relationships among some regions was also identified. Bayer and Juessen (2007) investigated the persistence of regional unemployment disparities in West Germany from 1960 to 2002 using time-series analysis methods. Univariate unit root tests suggested that regional unemployment differences were persistent, while more robust panel unit root tests indicated that these differences were temporary, suggesting convergence of unemployment rates across regions over time. However, the pace of this convergence was limited. Unit root tests accounting for structural breaks revealed that convergence accelerated following the second oil crisis, with regional unemployment rates adapting more rapidly to a new equilibrium. Mello and Guimarães-Filho (2007) analyzed the stochastic convergence dynamics of OECD countries using per capita income data. The study employed fractional time series techniques to test the convergence hypothesis for non-stationary stochastic processes exhibiting long-term dependence. The analysis revealed significant convergence trends among OECD countries in pairwise comparisons when income shocks were characterized by long-term dependence.

Carrera and Rodríguez (2009) examined the convergence trends of unemployment rates in 13 European countries from the first quarter of 1984 to the fourth quarter of 2005. Their study utilized various unit root tests to assess both stochastic and β-convergence. The results demonstrated that, particularly after 1993, most European countries entered a convergence process for unemployment rates. Gomes and da Silva (2009) investigated

the dynamics of unemployment rates in six major metropolitan regions of Brazil (São Paulo, Rio de Janeiro, Belo Horizonte, Porto Alegre, Salvador, and Recife) as well as nationwide. Their study employed unit root tests that account for structural breaks to test the hypotheses of hysteresis and the Non-Accelerating Inflation Rate of Unemployment (NAIRU). The findings indicated the presence of a hysteresis effect in all regions except Rio de Janeiro and at the national level, demonstrating a high degree of persistence in unemployment rates. Furthermore, a stochastic convergence analysis conducted for the five metropolitan regions exhibiting hysteresis revealed that only Porto Alegre did not converge to the national unemployment rate. Tyrowicz and Wójcik (2010) analyzed the dynamics of regional unemployment in Poland using NUTS4-level data from 1999–2006. They applied β and σ convergence tests, commonly used in income convergence studies. The findings revealed that unemployment rate distributions remained relatively stable over time, with weak "club convergence" observed in regions with high unemployment rates. However, the β and σ convergence hypotheses were not generally supported. Katrencik, Tyrowicz, and Wójcik (2010) extended this analysis to transitional economies, examining unemployment convergence in the Czech Republic, Poland, and Slovakia using NUTS4-level data from 1995–2005. Applying β and σ convergence tests and time series analyses, the results indicated no evidence of unemployment rate convergence, suggesting persistent disparities across regions. De Figueiredo (2010) examined the dynamics of regional unemployment in Brazil using fractional integration, structural break analysis, and Markov switching models. This study covered monthly data from 1982–2003, focusing on five major metropolitan regions. The findings indicated that unemployment rates exhibited long memory properties and structural breaks. Additionally, Markov switching models showed that unemployment rates transitioned between different regimes, with significant persistence in these regimes, highlighting their importance for understanding regional labor market dynamics. Nyong (2013) investigated the dynamics of unemployment rates across Nigeria's 36 states and their convergence toward the national average. Using unit root tests accounting for structural breaks and an Autoregressive Fractionally Integrated Moving Average (ARFIMA) model, the findings revealed convergence in some states while others exhibited persistent disparities. Estrada, Galí, and López-Salido (2013) analyzed macroeconomic convergence and divergence dynamics among Eurozone countries from 1999 to 2012, focusing on unemployment, inflation, relative prices, and current account balances. Using advanced economies outside the Eurozone and pre-EMU data as controls, the study revealed initial convergence trends

in unemployment rates, which reversed significantly after the 2008 financial crisis, leading to pronounced disparities among countries. Bratu (2014) examined the convergence trends of unemployment rates in the European Union between 2002 and 2012, using national data. The results suggested that unemployment rates exhibited convergence among EU countries, although the speed of this convergence varied significantly between nations. Notably, new member states demonstrated faster convergence compared to older members. Dikmen and Dursun (2015) analyzed unemployment rates in 12 Latin American countries from 1980–2015, assessing hysteresis and convergence tendencies using a nonlinear panel unit root test with threshold autoregressive (TAR) specifications. The findings indicated that unemployment hysteresis was valid under one regime, while convergence trends were observed under another. Colombia exhibited the fastest convergence rate under the second regime. Cuestas, Monfort, and Ordóñez (2015) examined unemployment rate convergence dynamics and their determinants in Central and Eastern European countries from 1995–2011. Using logistic smooth transition autoregressive (LSTAR) models and β-convergence tests, the study found no complete convergence across countries but identified two distinct convergence clusters: one comprising Hungary and Poland and another including the Czech Republic and Slovakia.

Beyer and Stemmer (2016) analyzed the spatial distribution of regional unemployment rates in Europe from 1986–2013. Their study highlighted polarization during 1986–1996, convergence during 1996–2007, and re-polarization during the 2007–2013 financial crisis, reflecting significant regional disparities. Çifçi (2016) examined convergence tendencies in youth, adult, and total unemployment rates across NUTS2 regions in Türkiye from 2004–2014 using spatial econometric methods. The study identified spatial dependencies, with high and low unemployment regions forming distinct clusters. Baktemur and Özmen (2017) investigated unemployment rate dynamics in advanced EU countries (e.g., Germany, France, the UK, the Netherlands, and Spain) from 1995–2013 using spatial econometric methods. While spatial dependencies were evident, no significant convergence dynamics were identified, highlighting limited harmonization in labor markets. Aral and Aytaç (2018) conducted spatial analyses of unemployment rates across Türkiye's 81 provinces, identifying spatial clusters of high and low unemployment regions. Using Moran's I statistics and spatial regression models, the study emphasized the importance of regional interdependencies in explaining unemployment patterns. Krištić, Dumančić, and Arčabić (2019) analyzed unemployment persistence and stochastic convergence among Eurozone countries from 1995–2016 using

LM and RALS-LM unit root tests. Their findings highlighted that Eurozone membership alone did not guarantee unemployment rate convergence, although economic integration contributed to reduced disparities in certain cases. Kónya (2020) explored unemployment convergence in EU countries from 1991–2014, applying σ, stochastic, and β-convergence methodologies. The results indicated general convergence trends across the EU, with variations based on country groups. Demir (2021) examined unemployment dynamics in Balkan countries from 1991–2020 using spatial econometric methods. The study revealed significant spatial dependencies and interrelations among neighboring countries' unemployment rates. Hadizadeh (2021) assessed stochastic convergence of unemployment rates across 50 U.S. states from 1976–2018 using quantile unit root tests. The findings supported stochastic convergence for 41 states, with varying behaviors across quantiles. Çorakcı, Omay, and Hasanov (2022) analyzed unemployment dynamics in Eurozone countries from 2000–2020 using advanced panel unit root tests incorporating structural breaks and nonlinear adjustments. The results confirmed the stationarity of unemployment rates and stochastic convergence across Eurozone members. Demirapl and Belliler (2023) examined unemployment rates in G-20 countries from 1991–2022 using Fourier panel unit root analysis. The findings highlighted significant convergence tendencies among most countries, excluding China, South Korea, and Argentina, with variations attributed to Fourier terms.

Analyses of labor markets reveal significant disparities in the convergence processes of unemployment rates across countries and regions. In economic unions such as the European Union and the Eurozone, pre-crisis periods exhibited noticeable convergence trends in unemployment rates, while these trends reversed in the aftermath of economic crises. In contrast, unemployment rates in developing economies have shown a tendency for persistence, with strong hysteresis effects observed in certain regions. Advanced methods such as spatial analyses and nonlinear unit root tests have enhanced the understanding of unemployment dynamics at both regional and national levels, emphasizing the need for policymakers to address these differences. Overall, the convergence process of unemployment rates is closely linked to the effectiveness of economic integration, structural reforms, and crisis management policies. Addressing labor market imbalances requires more comprehensive and targeted policy interventions.

3. DATA AND EMPIRICAL METHODOLOGY

This study analyzes whether the youth unemployment rates of 28 countries, including the 27 member states of the European Union and Türkiye, exhibit convergence. The primary objective is to identify similarities and differences in youth unemployment rates among these countries, establishing models of convergence or divergence. The study aims to evaluate whether trends in youth unemployment rates reach a common equilibrium and to explore the relationships between labor markets across the countries.

The dataset used in this study comprises youth unemployment rates derived from the official World Bank (2024) website, covering the 1991–2023 period. This extensive panel dataset enables a detailed examination of labor market dynamics across countries.

The analysis applies the club convergence approach (log t-test regression) developed by Phillips and Sul (2007), which tests the hypothesis of convergence in panel datasets. This method assesses whether countries converge toward a common equilibrium over time and identifies distinct subgroups (clubs) of countries that may converge independently. It is particularly effective for analyzing convergence or divergence patterns among countries with heterogeneous dynamics. The Phillips and Sul method employs the following fundamental equation within panel datasets:

$$X_{it} = g_{it} + a_{it} \tag{1}$$

In this equation, g_{it} represents systematic components, which may create cross-sectional dependence due to their inclusion of permanent common factors. On the other hand, aitait refers to transitory components. Since the model does not impose specific parameter assumptions on the systematic or transitory components, it can encompass linear or nonlinear, stationary or non-stationary processes. Moreover, the model, in its current form, incorporates both common factors and individual (idiosyncratic) elements.

To separate these two components within the panel, the authors reorganize Equation (1) as follows:

$$X_{it} = \left(\frac{g_{it} + a_{it}}{\mu_t} \right) \mu_t = \delta_{it} \mu_t \tag{2}$$

In Equation (2), μ_t represents a common factor, while δ_{it} denotes a time-varying individual component. If μ_t reflects one of the common trends within the panel, δ_{it} measures the relative contribution of individual i to this

trend at time t. Thus δ_{it}, serves as an indicator of the individual economic divergence between the observed variable (X_{it}) and the common trend factor μ_t. Moreover, Equation (2) implies that μ_t follows a time-varying factor model, with the assumption that as t→∞, this factor dominates the transitory component (aitait) in Equation (1) (Phillips and Sul, 2007).

Since μ_t is considered a common factor in Equation (2), its effects are neutralized through a scaling method, which allows for the computation of relative factor loadings or transition parameters. This approach, which relies on cross-sectional averages instead of differences, makes it possible to eliminate the common factor from the system and facilitates the implementation of relative convergence tests (Phillips and Sul, 2007; Panopoulou and Pantelidis, 2012; Du, 2017).

$$h_{it} = \frac{X_{it}}{\frac{1}{N}\sum_{i=1}^{N} X_{it}} = \frac{\delta_{it}}{\frac{1}{N}\sum_{i=1}^{N} \delta_{it}} \tag{3}$$

h_{it} is a variable that measures the loading coefficient in relation to the panel average and is referred to as the relative transition parameter. This parameter represents the dynamics and position of country i in its transition process at time t. By definition, the cross-sectional mean of this parameter is always equal to one, as all panel units are evaluated relative to the same common trend. If the factor loadings converge to a constant value (δ), h_{it} also converges to one, indicating that a common equilibrium level has been reached. Furthermore, during this convergence process, the cross-sectional variance of h_{it}, which measures the differences between transition paths, approaches zero. This implies that the individual units within the panel begin to share a common trend over time, thereby reflecting a decrease in the level of heterogeneity (Phillips and Sul, 2007; Phillips and Sul, 2009; Panopoulou and Pantelidis, 2012).

$$H_{it} = \frac{1}{N}\sum_{i=1}^{N}\left(h_{it} - 1\right)^2 \to 0 \ \textit{if} \lim_{t\to\infty} \delta_{it} = \delta, \textit{for all } i \tag{4}$$

Within this convergence framework, Phillips and Sul (2007) developed the log t regression model to test whether countries or cross-sectional units converge to a common equilibrium. The model tests the null hypothesis ($\mathcal{H}_0 : \delta_i = \delta,\ \alpha \geq 0$), which assumes that all units converge to a common equilibrium, against the alternative hypothesis ($\mathcal{H}_A : \delta_i \neq \delta,\ \alpha < 0$

), suggesting that some units fail to reach this equilibrium. This method provides a robust tool for analyzing heterogeneity by examining both the speed of convergence and potential subgroups. The model proposed by Phillips and Sul (2007) is expressed as follows:

$$log\left(\frac{H_1}{H_t}\right) - 2logL(t) = \hat{\alpha} + \hat{b}log(t) + \hat{u}_t \tag{5}$$

$$for\, t = [rT], [rT]+1, \ldots, T \quad with \quad r > 0$$

Here:

$t = [rT], [rT]+1, \ldots, T$ represents the time dimension, where $r > 0$ denotes the truncation parameter.

$L(t) = \log(t+1)$, is the logarithmic transformation of time.

$\hat{b} = 2\hat{\alpha}$, is the estimated coefficient of $log(t)$, representing the speed of convergence.

In this method, $\hat{\alpha}$ is interpreted as an estimate of the speed of convergence under the null hypothesis $\mathcal{H}_0$ which assumes that all units converge to a common equilibrium level. If $t_{\hat{b}} < -1.65$ (at a 5% significance level), the convergence hypothesis is rejected, indicating that not all units in the panel reach a common equilibrium. For the truncation parameter (r), Phillips and Sul (2007) propose different values depending on the length of the dataset. For datasets spanning T ≥ 100 (long periods), r = 0.20 is used, while for shorter datasets T < 50, r = 0.30 is preferred. This parameter defines the starting point of the analysis, allowing the method to capture time-varying dynamics more accurately (Phillips and Sul, 2007; Sun et al., 2020).

The methodology developed by Phillips and Sul (2007) is a flexible and robust analytical tool widely applied in the literature, offering several advantages. The approach does not rely on assumptions of stationarity or stochasticity for either the variable (X_{it}) or the common factor (μ_t), making it suitable for addressing nonlinear dynamics and cross-sectional heterogeneity. Its focus on time-varying idiosyncratic components (δ_{it}) makes it particularly effective for analyzing differences in transition paths across units. Furthermore, its emphasis on relative cross-sectional means, rather than absolute values, overcomes the limitations of traditional unit root and cointegration tests (Apergis and Payne, 2017).

This method not only conducts a general convergence test but also has the capacity to identify groups (clubs) converging to multiple equilibrium levels

and divergent units (Panopoulou and Pantelidis, 2012). It is widely applied in analyzing heterogeneous social and economic indicators such as economic growth, youth unemployment rates, and environmental performance. Particularly effective for examining policy differences and integration processes among countries, this method is critical for evaluating both general convergence and the dynamics of subgroups. Its ability to identify subgroups offers significant advantages in situations where traditional unit root tests fall short (Phillips and Sul, 2009).

Phillips and Sul (2007, 2009) developed a five-step algorithm based on the club convergence approach to test the convergence hypothesis among countries or cross-sectional units. This algorithm evaluates whether units in panel data converge to a common equilibrium level over time and identifies subgroups (clubs) reaching multiple equilibria as well as divergent units. The steps of the algorithm are outlined below:

- Panel units are ranked based on their final observations. A core group is formed from the top-ranked units, which meet the threshold of a t-statistic greater than -1.65. This indicates convergence. The process continues until the t-statistic for all pairwise combinations of units falls below -1.65. If no convergence is observed across the entire panel at this stage, it is concluded that no common equilibrium level exists for all units (Phillips and Sul, 2007).
- Units are sequentially added to the core group, and the log t-regression is applied. If the newly added units meet the critical t-statistic value (-1.65), they are included in the group. Once the group is complete, the convergence hypothesis is tested for all units. If convergence is confirmed, the group is referred to as the initial convergence club (Panopoulou and Pantelidis, 2012).
- **T**he same process is repeated for units not included in the initial club**.** These units may form a new convergence club or be classified as divergent units. If a second convergence club is identified, the algorithm concludes here. However, if no convergence is observed among the remaining units, the process restarts (Apergis and Payne, 2017).
- Units that do not belong to either the first or second club and show no convergence are classified as divergent.This step is particularly important for identifying cross-sectional units with distinct long-term equilibrium levels (Du, 2017).

- In the final stage, tests are conducted to determine whether different convergence clubs approach a common equilibrium. If convergence is observed between two or more clubs, they are merged. However, if heterogeneity persists between clubs, they remain as distinct groups with separate equilibrium levels (Tomal, 2024).

4. EMPIRICAL RESULTS

Based on our analysis of youth unemployment rates, we find that the 27 European Union member countries and Türkiye did not converge toward a common equilibrium level during the 1991–2023 period. Table 1 summarizes the regression results obtained from the club convergence analysis for the youth unemployment variable. According to the log t-test results, the computed t-statistic is -7.8047, which is below the critical value of -1.65 at the 5% significance level. This indicates the rejection of the null hypothesis ($\mathcal{H}_0$) at the 5% level, which posits that all countries converge to a common equilibrium level. This finding suggests that these countries do not exhibit a common trend in reducing youth unemployment rates, implying the absence of panel-wide convergence in youth unemployment levels. However, the club convergence analysis can identify whether subgroups (clubs) of countries exhibit convergence even when no convergence is observed across the entire panel.

Table 1. Log (t) test results for Youth unemployment (1991-2023 Period)

Variable	Coefficient	Standard Error	T-statistic
Youth unemployment	**-0.8640**	**0.1107**	**-7.8047**

In the next step, the club convergence algorithm enables the examination of convergence tendencies among countries at the group level, providing a more detailed perspective. This method is particularly useful when panel-wide convergence is not observed, as it helps identify whether countries form distinct subgroups (clubs) that converge toward separate equilibrium levels. This approach allows for a more comprehensive analysis of the heterogeneous dynamics among countries and their impact on youth unemployment rates.Table 2 presents the different convergence clubs for the youth unemployment indicator and the corresponding log t-test results. The findings reveal the existence of five initial convergence clubs among the countries. According to the table:

- Club 1 countries exhibit strong convergence with high coefficients and t-statistics. Youth unemployment rates in Cyprus, Greece, Luxembourg, Portugal, and Spain converge rapidly toward a common equilibrium.
- Club 2 countries show convergence at a slower pace compared to Club 1. Youth unemployment rates in Croatia, Ireland, Italy, Sweden, and Türkiye are moving toward a common equilibrium.
- Club 3 countries (Austria, Belgium, Denmark, Estonia, Finland, France, the Netherlands, Romania, and Slovakia) demonstrate strong convergence.
- Club 4 countries (Bulgaria, Hungary, Latvia, Lithuania, Malta, Poland, and Slovenia) exhibit a moderate rate of convergence.
- Club 5 countries**,** consisting of the Czech Republic and Germany, have the lowest convergence coefficient. However, the t-statistics exceed the critical value, indicating that the convergence is statistically significant.
- Club 3, with 9 countries, represents the largest group of converging nations, followed by Club 4 with 7 countries. Clubs 1 and 2 have equal numbers of countries, while Club 5 contains the fewest countries.

Table 2. Initial Youth Unemployment Convergence Clubs

Clubs	Countries	Coefficient	T-Statistic
Club 1 [5]	| Cyprus | Greece | Luxembourg | Portugal | Spain |	0.7763	11.3937
Club 2 [5]	Croatia | Ireland | Italy | Sweden | Turkiye |	0.6365	4.5411
Club 3 [9]	| Austria | Belgium | Denmark | Estonia | Finland | France | | Netherlands | Romania | Slovak Republic |	0.5365	29.3773
Club 4 [7]	| Bulgaria | Hungary | Latvia | Lithuania | Malta | Poland | | Slovenia |	0.5692	16.0015
Club 5 [2]	Czechia | Germany |	0.0589	0.2158

The truncation parameter is set to $r = 0.3$***, with a t-statistic of -1.65 at the 5% significance level. The number of club members is indicated in square brackets.***

Table 3 presents the club merging test results from the club convergence analysis, which assess whether convergence exists between different clubs. These results provide valuable insights into the convergence tendencies among the clubs. Strong convergence was observed between Club 1 and Club 2 as well as between Club 2 and Club 3. Similarly, statistically significant convergence was identified between Club 3 and Club 4, although this convergence occurred at a slower rate compared to the other merges. On the other hand, the results between Club 4 and Club 5 indicate a clear lack of alignment and absence of convergence tendencies between these two groups. The negative coefficient and low t-statistic suggest that the economic dynamics and youth unemployment rates of these two clubs are moving in significantly different directions.

Table 3. Club merging test results for Youth Unemployment clubs

Clubs	Coefficient	T-statistic
Club 1+ 2	0.5301	8.6135
Club 2 +3	0.2221	9.9584
Club 3 + 4	0.3385	3.7922
Club 4 + 5	**-0.8226**	**-9.6578**

Note: The critical value for the t-statistic at the 5% significance level is -1.65.

Table 4 presents the final classification of clubs based on youth unemployment. This table demonstrates that countries are divided into three distinct clubs concerning youth unemployment. Club 1 comprises Austria, Belgium, Croatia, Cyprus, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Romania, Slovakia, Spain, Sweden, and Türkiye. This club includes the highest number of countries compared to other clubs. Club 2 consists of Bulgaria, Hungary, Latvia, Lithuania, Malta, Poland, and Slovenia. With a coefficient of 0.5692 and a high t-statistic of 16.0015, this group is shown to have converged to a common equilibrium in youth unemployment rates, with results being statistically significant. Club 3 includes Czechia and Germany, characterized by a notably low convergence coefficient (0.0589) and t-statistic (0.2158) regarding youth unemployment rates.

Table 4. Final club classifications for Youth Unemployment

Clubs	Countries	Coefficient	T-Statistic
Club 1 [19]	| Austria | Belgium | Croatia | Cyprus | Denmark | Estonia | | Finland | France | Greece | Ireland | Italy | Luxembourg | | Netherlands | Portugal | Romania | Slovak Republic | Spain | | Sweden | Turkiye |	**-0.0632**	**-1.2029**
Club 2 [7]	| Bulgaria | Hungary | Latvia | Lithuania | Malta | Poland | | Slovenia |	0.5692	16.0015
Club 3 [2]	| Czechia | Germany |	0.0589	0.2158

The truncation parameter is set to $r = 0.3$***, with a t-statistic of -1.65 at the 5% significance level. The number of club members is indicated in square brackets.***

Figure 1 illustrates the relative transition paths of three distinct clubs (Club 1, Club 2, Club 3) in terms of youth unemployment rates. Club 1 initially starts close to the panel average but moves above the panel average over time. This indicates an upward trend in youth unemployment rates for the countries in this group, with a particularly noticeable increase observed after 2010. Club 2, on the other hand, begins significantly above the panel average but shows a decline toward the panel average over time. The countries in Club 2 have made improvements in reducing youth unemployment rates, with a marked downward trend becoming evident after 2010. Club 3 starts well below the panel average, reflecting the low youth unemployment rates in the countries within this group. Over time, there is an increase in youth unemployment rates for countries in this club, but after 2005, the rates exhibit a trend toward lower levels. This suggests that the countries in Club 3 have consistently reduced youth unemployment rates, demonstrating a positive development trend.

Figure 1 also highlights the convergence processes among the clubs. Between Club 1 and Club 2, a strong convergence trend is observed until 2010; however, these two clubs diverge afterward and move away from the panel average. Club 3 distinctly separates itself from the other two clubs and gradually moves further from the panel average. This indicates that Club 3 does not fully converge with the other groups and maintains low youth unemployment rates. In conclusion, this figure reveals the differences in youth unemployment dynamics among countries and how these dynamics

evolve over time. The movement of the clubs reflects the influence of policy and economic disparities.

Figure 1. Relative Transition Path for Youth Unemployment, Convergence Clubs

5. CONCLUSİON

This study analyzes the dynamics of youth unemployment rates, convergence processes, and the varying impacts of these processes on 27 European Union member states and Türkiye during the period 1991–2023. It was found that youth unemployment rates exhibit significant variability among countries due to the effects of economic crises, structural reforms, and differing labor market policies. The analysis, conducted using the club convergence method developed by Phillips and Sul (2007), revealed that countries do not generally converge toward a common equilibrium level but form three distinct clubs with varying dynamics: Club 1, Club 2, and Club 3.

The results indicate that countries in Club 1 show an increasing trend in youth unemployment rates, while those in Club 2 demonstrate improvement, moving closer to the panel average. Meanwhile, Club 3 distinguishes itself with persistently low youth unemployment rates. Additionally, it was observed that Club 1 and Club 2 exhibited convergence until 2010 but diverged afterward, whereas Club 3 maintained its separation from the other groups with consistently low unemployment rates.

Countries in Club 1 (Austria, Belgium, Croatia, Cyprus, Denmark, Estonia, Finland, France, Greece, Ireland, Italy, Luxembourg, Netherlands,

Portugal, Romania, Slovakia, Spain, Sweden, and Türkiye) have experienced an increasing trend in youth unemployment rates over time, with this rise becoming more pronounced after 2010. The concentration of Southern European countries in this group highlights how economic crises and structural challenges have exacerbated youth unemployment. Recommendations for these countries include developing cross-sectoral transition policies to accelerate the integration of youth into the labor market, strengthening the link between the education system and labor market needs, and expanding technical education programs. Additionally, economic restructuring and increased employment incentives targeted at young people are essential.

Countries in Club 2 (Bulgaria, Hungary, Latvia, Lithuania, Malta, Poland and Slovenia) have successfully reduced youth unemployment rates closer to the panel average and have maintained this improvement sustainably since 2010. This positive trend indicates the effectiveness of the policies implemented. The decline in youth unemployment rates among Club 2 countries can be explained by the impact of economic and structural factors after 2010. While the 2008 Global Economic Crisis significantly increased youth unemployment in these countries, the economic recovery programs and targeted youth unemployment policies implemented after 2010 proved effective. Notably, initiatives such as the "Youth Guarantee" program in Europe and active labor market policies, including apprenticeships, internships, and entrepreneurship support, have facilitated youth participation in the workforce. Furthermore, education reforms and efforts to increase youth employment in technology-driven sectors have supported this trend. Thus, the decrease in unemployment rates in Club 2 reflects the impact of targeted policy implementation alongside economic recovery. Recommendations for these countries include expanding successful policies, ensuring sustainability, supporting youth entrepreneurship, increasing incentives to create jobs in innovative sectors, and promoting vocational education programs. Countries such as Poland and Slovenia, in particular, hold significant potential for further reducing youth unemployment through such projects.

Countries in Club 3 (Czechia and Germany) initially had low youth unemployment rates, which have steadily decreased over time. This reflects the strong labor market policies and stable economic structures of these countries. However, maintaining low levels of youth unemployment in the future will require increasing employment opportunities in digital and innovative sectors, continuing policies that encourage early youth labor

market participation, and advancing labor market reforms. This group can serve as a model for other clubs.

This study emphasizes the need to strengthen the connection between education and the labor market, increase employment incentives in innovative sectors, and expand the implementation of successful policies to reduce youth unemployment. Additionally, it highlights that Club 3 can serve as a model for other groups. These findings underscore the importance of more targeted and comprehensive policies for addressing youth unemployment effectively.

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Chapter 3

The Impact of the Rule of Law and Control of Corruption on Economic Growth: International Evidence With Panel Bias Corrected LSDV Analysis

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Abstract

This study examines the impact of corruption control and the rule of law on economic growth. Annual data for the period 1990-2023 were used in the study conducted on 134 countries. Panel data analysis was used in the study and bias-corrected LSDV analysis was used to perform econometric analysis. As a result of the study, the first finding is that increasing the control of corruption in countries positively affects economic growth. The strategies and policies implemented by countries in the fight against corruption have a positive impact on economic growth. The second finding is the relationship between rule of law and economic growth. It was observed that most of the countries have negative values in the rule of law index. This situation indicates that the countries have not made significant progress in the rule of law. As a result of the empirical analysis, the effect of this backwardness in the rule of law on economic growth was found to be negative. Developments in the rule of law are important for economic growth. For this reason, it is recommended that countries develop and implement rule of law policies.

1. INTRODUCTION

The concept of the rule of law (ROL) accepts all individuals and institutions as equal before the law. The concept of law, which expresses certain norms, makes individuals and institutions equal in a better norm. For this reason, the ROL emerges as an equalizing concept. Corruption, on the other hand, is the action that affects certain individuals or interest groups.

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Even if a benefit is obtained that is not legally and morally acceptable, this benefit is to the advantage of a small segment of society. In this respect, corruption is an expression of inequality. Seen from this perspective, corruption and the ROL are opposites.

Countries develop many policies to fight corruption. These policies include a series of incentives for bureaucrats and legal officials not to serve special interests. The implementation of these incentives also requires a series of legal procedures (Frye, 2010: 79). As can be seen; to combat corruption, it is necessary to resort to law and legislation. In this respect, corruption and ROL are concepts that work in harmony with each other.

Many studies in literature have concluded that the ROL and the fight against corruption support economic growth (EG). North et al. (2013: 777) state that the concepts of corruption and ROL should be addressed for a better understanding of modern EG. This study also examines the role and impact of the fight against corruption on EG for 134 countries. The countries are heterogeneous in terms of their level of development or income. The list of countries is presented in Appendix 1. Bias-corrected least squares dummy variable (LSDV) analysis was preferred as the econometric method. Dummy variable models were not preferred due to the econometric problem known as Nickell bias in panel data analysis. Judson and Owen (1999: 9) state that the bias is 20 percent even when the time dimension is 30. However, the development of estimators that correct for the Nickell bias over time has increased the use of LSDV analysis in panel data analyses. It has been observed that the econometric method mentioned in the literature is not widely used. For this reason, it is believed that analyzing the issue using the panel data bias-corrected LSDV method will contribute to the literature.

The second part of the study presents theoretical information on the subject. The third part summarizes the literature. In the fourth part, the econometric method is introduced, data and hypotheses are presented, and the results of the empirical analysis are shared. The last part is the results and evaluation section.

2. THEORETICAL BACKGROUND

Long-standing studies of corruption and the economy have led researchers to focus on two effects. The first of these effects is the "sand the wheels" effect. This effect is used to express that corruption harms EG. The second is the "grease the wheels" effect. This effect expresses that corruption helps EG (Uberti, 2022: 322).

The effect of corruption on EG is a very complex issue, and this effect can occur through many different channels. Researchers have examined the relationship between corruption and EG from different perspectives. Studies have shown that corruption generally has a negative effect on EG. The first of these negative effects is the relationship between corruption and resource allocation problems. Corruption leads to an inefficient allocation of resources. Investment tends to be directed to firms or individuals with political connections in places where corruption is widespread. This situation prevents economic efficiency by reducing competition (Del Monte and Papagni, 2001: 2; Ehrlich and Lui, 1999: 272). The second is the relationship between corruption and investor confidence. Corruption undermines the confidence of domestic and foreign investors. In an environment where corruption is not controlled, investors generally increase their perception of risk and may avoid investing. This situation has a negative impact on EG (Mauro, 1995; Wei, 2000: 3). The third is the relationship between corruption and innovation and entrepreneurship. In an environment where corruption is widespread, it becomes difficult for entrepreneurs to develop new ideas and business models. Corruption negatively affects long-term EG by inhibiting creative and innovative activities. In economies with high levels of corruption, weak property rights are a major obstacle to innovation (Tomaszewski, 2018: 251). The fourth is the relationship between corruption and income inequality. Corruption increases income inequality and can lead to social unrest. Such social problems can threaten EG and negatively affect the investment climate (Sulemana and Kpienbaareh, 2018: 27; Apergis et al., 2010: 125). The fifth is the relationship between corruption and public costs. Corruption increases the cost of public services. The state needs more resources to deal with corruption, which can negatively affect EG. On the other hand, the resources needed to fight corruption may require new tax policies. In this case, the administration trying to fight corruption may shrink the economy through taxation (Aghion et al., 2016: 24). Although the relationship between corruption and EG is divided into five parts in this section, the distinction is much broader in the literature.

Research has shown that reducing corruption is a factor that promotes EG. Strengthening the fight against corruption is crucial for more sustainable EG. However, there are some studies that claim that corruption can have a positive impact on EG. These studies generally emphasize that corruption is a factor that promotes EG under certain conditions. The first of these views is that bureaucratic obstacles can be overcome through corruption. Developing countries may have complex and poorly functioning bureaucratic systems. Corruption can be seen as a tool to overcome these bureaucratic

barriers. Especially in places where the ease of doing business is low, paying bribes can speed up transactions and allow resources to be used more quickly in the process (Leff, 1964: 9; Huntington, 1968). The second view is that corruption can foster innovation. Some studies suggest that corruption can lead firms to develop more creative and innovative strategies. It is argued that in environments where low taxes and regulatory burdens are combined with corruption, firms can gain competitive advantage and thus grow (Paul, 2010). At the same time, combating corruption increases trust in the economy. This increase in trust leads to the development of trade (Anokhin and Schulze, 2009: 465). Ensuring the liberalization of trade and reducing barriers to trade are expected to increase economic growth (Ertürkmen and Çelik; 2023: 1917). The third view is that corruption can attract investment. In cases where there are inadequate legal systems and poorly functioning state mechanisms, some investors may see corruption as a risk management tool. In this context, a certain level of bribery may develop in countries where corruption exists, and with it a habit of speeding up transactions. In particular, if the cost of bribery is lower than the bureaucratic transaction costs of the investment, corruption may be attractive for investment entry (Gossel, 2018: 648).

The concept of the ROL is still unclear (Haggard and Tiede, 2011: 674). However, if we are to make a general definition, the concept of the ROL indicates that the laws in a country are applied equally to all individuals and that judicial bodies make independent decisions. In countries where the ROL prevails, the fundamental rights and freedoms of individuals and institutions are protected by law. Acemoğlu et al. (2001), one of the seminal studies, finds that there is a strong positive relationship between the ROL and EG. As the ROL increases the institutional quality of countries, it is expected to accelerate investment processes. For foreign investors in particular, the ROL increases investor confidence in countries. At the same time, increased investor confidence leads to the development of foreign trade. Because foreign trade transactions depend on a series of procedural transactions based on law. The situation where the rules exist and are applied according to a certain standard is an indispensable environment of trust for foreign trade (Boettke and Subrick, 2003: 111).

Although the ROL may seem like an abstract concept, it is an important element that shapes the behavior and morality of individuals and institutions. The ROL, which means that everyone is equal before the law and the judiciary is independent, is an important concept. In countries where the ROL is high, the perception of trust is high (Zywicki, 2003: 26). It is also known that corruption increases in countries where the perception of trust

is low. This situation shows that there may be a relationship between the concepts of corruption and the ROL. In addition, the enforcement of legal rights and the effective implementation of international agreements are not very possible in an environment where corruption is high. Since corruption is a punishable crime in high ROL economies, corruption sanctions also have a deterrent effect. For this reason, the concepts of corruption and the ROL are closely related. Cooter (1996: 203) points out that corruption can increase in countries where the ROL is weak.

3. LITERATURE

The literature on corruption has used different variables. Some studies have used the Corruption Perceptions Index. Many studies using this index have found a negative relationship between corruption perception and EG. Spyromitros and Panagiotidis (2022) and Malanski and Póvoa (2021) have obtained results that differ from the literature, finding a positive relationship between the corruption perception index and EG. Some studies have used the corruption control variable. Theoretically, a positive relationship between corruption control and EG is expected. Nguyen and Bui (2022) found a negative relationship and obtained results different from the literature. Gründler and Potrafke (2019: 10) express this problem in literature. It is stated that some studies use the corruption perception variable, and some use the corruption control variable, which limits the formation of a single and complete structure. In the relationship between ROL and EG, some studies have found a positive relationship, and some studies have found a negative relationship.

David et al. (2024) investigated the links between oil rent, corruption, and economic growth (EG) in Nigeria. Their findings indicated that corruption not only has a positive impact on EG but that oil rent also contributes positively to it. Fengju and Wubishet (2024) analyzed the influence of institutional quality and financial development on EG in West African nations, utilizing corruption and legal aspects as measures of institutional quality. The study concluded that both corruption and law had a beneficial effect on EG.

Bayraktar et al. (2023) explored the correlation between institutional quality indicators and EG across 35 emerging and middle-income countries. They discovered that both corruption control and rule of law (ROL) had a positive effect on EG, while an interaction term with financial development indicators revealed a negative impact on EG. Hamdi and Hakimi (2023) analyzed data from 109 countries, finding that corruption negatively impacted EG, with the exception of countries in Africa.

Dokas et al. (2023) conducted an analysis involving 109 countries, focusing on the connections among corruption, innovation, and EG, using the corruption perception index. The study identified a negative relationship between corruption perception and EG. Simo-Kengne et al. (2023) studied the effects of corruption and ROL on EG in BRICS nations and determined that enhanced corruption control increased EG, whereas ROL had a detrimental impact on EG.

Mohd-Rashid et al. (2023) examined corruption in relation to ROL across 41 countries and found that an increase in ROL led to a decrease in corruption. Mohammed et al. (2022) investigated the effects of corruption and organized crime on EG in West African nations, identifying that rising organized crime alongside increasing corruption perception adversely affected EG. Amoh et al. (2022) assessed the interaction between corruption, an independent judiciary, and EG in developing countries. They found that corruption typically hinders EG, and notably, the strengthening of an independent judiciary negatively influenced EG.

Chapsa and Katrakilidis (2022) evaluated the dynamics between corruption, governance quality, and EG in 15 European countries, incorporating corruption perception and justice perception indices. Their study revealed that heightened corruption perception negatively impacted EG, while an increase in ROL positively influenced it. Nguyen and Bui (2022) explored 16 developing Asian countries, concluding that escalating corruption control negatively affects EG, although public spending can mitigate this effect.

Spyromitros and Panagiotidis (2022) researched 83 countries using corruption perception and control metrics, finding a negative correlation between corruption and EG. Interestingly, they noted that increased corruption perception in Latin American countries was associated with boosted EG—contrasting with the general negative correlation established in other research. Malanski and Póvoa (2021) investigated the impact of corruption on EG in Latin America and Asia, discovering that higher corruption perception correlated negatively with EG, while ROL had a positive relationship.

Trabelsi and Trabelsi (2021) analyzed the connection between corruption and EG in 88 countries from data spanning 1984-2011, utilizing a positively valued corruption index. They identified a complex asymmetric relationship, showing that corruption initially harms EG, eventually leading to a positive influence beyond a certain threshold. Ibrahim (2020) explored the relationships among corruption, public spending, and EG in 20 developing

nations, concluding that corruption negatively impacts EG and public debt via elevated public expenditures.

Mauro et al. (2018) researched the roles of institutions and ROL on EG in 23 OECD countries, concluding that ROL detrimentally affects EG and that decentralized public spending has a similar negative effect. Thach et al. (2017) studied 19 Asian countries, showing that corruption positively affects EG to a certain extent before having a negative impact thereafter. Yalçınkaya and Yazgan (2016) examined how institutional quality indicators relate to EG in developed nations and found a negative correlation between ROL and EG. Omoteso and Ishola Mobolaji (2014) focused on SAA countries and discovered with their study that corruption control had a positive effect on EG whereas ROL had a negative impact.

De la Croix and Delavallade (2011) conducted a dynamic panel data analysis on 62 countries, concluding that ROL has a negative effect on EG and increases in ROL lead to improvements in corruption control. Gani (2011) investigated governance and institutional quality indicators' relationships with EG across 84 low and middle-income developing countries, identifying a significant negative effect of corruption and ROL on EG. Yapraklı (2008) examined 36 upper-middle-income countries and found that ROL diminishes EG in those nations.

4. FINDINGS

4.1. Econometric Method

Panel data models are created by combining cross-sectional and time series of units. The advantage of panel data analysis over cross-sectional and time series analysis is that a group of countries can be analyzed instead of a single country.

$$Y_{it} = \alpha_{it} + X_{1,it} + X_{2,it} + u_{it} \quad , \; i:1....N \quad , t:1.....T \qquad (1)$$

Equation (1) shows the structure of a panel data analysis. Y, dependent variable; X, independent variable; i, units; t, time parameter; u, error term. In equation (1), all parameters have i and t symbols in their subscripts. This indicates that all parameters include unit and time effects. However, not all models include both unit and time effects. Some models include only unit effects, some models include time effects, and some models include both effects.

$$Y_{it} = \beta_0 + \overline{\beta}_{1,it} X_{1,it} + \zeta_i + u_{it} \qquad (2)$$

Equation (2) represents the fixed effects model with both unit and time effects under the assumption that the slope parameter is homogeneous. β_0 is the constant parameter. The constant parameter varies according to the unit and time information. β_1 is the slope parameter. The slope parameter does not change (Tatoğlu, 2020: 80).

In the LSDV method, unit effects are accepted as dummy variables. If there are fixed parameters in the model, N number of dummy variables are used, if there are no fixed parameters, N-1 number of dummy variables are used.

$$S = \sum_{i=1}^{N} u_i' u_i = \sum_{i=1}^{N} (Y_i - e\mu_i - X_i\beta)' (Y_i - e\mu_i - X_i\beta \qquad (3)$$

The Pooled Least Squares estimators of the prediction coefficients are obtained by minimizing the equation given in equation (3).

$$\hat{\mu}_i = \overline{Y}_i - \beta' \overline{X}_i \quad , \quad \overline{Y}_i = \frac{1}{T}\sum_{t=1}^{T} Y_{it} \quad , \quad \overline{X}_i = \frac{1}{T}\sum_{t=1}^{T} X_{it} \qquad (4)$$

If the derivative of "S" with respect to "u" given in equation (3) is taken and set to zero, equation (4) is obtained. $\overline{Y}_i$ and $\overline{X}_i$ are the mean values of the dependent and independent variables with respect to time.

$$\hat{\beta}_{LSDV} = \left[\sum_{i=1}^{N}\sum_{t=1}^{T} \left(X_{it} - \overline{X}_i\right)' \left(X_{it} - \overline{X}_i\right) \right]^{-1} \left[\sum_{i=1}^{N}\sum_{t=1}^{T} \left(X_{it} - \overline{X}_i\right)' \left(Y_{it} - Y_i\right) \right] \qquad (5)$$

i) Equality (4) is substituted into equation (3). ii) The derivative of "S" with respect to "β" is taken. iii) When the biases from the mean are used, equation (5) is obtained. Equality (5) is the LSDV estimator (Tatoğlu, 2020: 82).

There are two options for fixed effects analysis: least squares with dummy variables (LSDV) or within-group estimation (WE). "Nickell's Bias occurs in the WE and LSDV models. Nickell's Bias is particularly evident when N (number of units) is small, and T (number of times) is large. Under these conditions, the relationship between the lagged dependent variable and the fixed effects leads to a bias in the estimated parameters. It also causes the parameters extracted in the estimation of dynamic panel data models with small N to be inconsistent. This situation reduces the reliability of

the analyses carried out (Nickell, 1981: 1418). The autoregressive panel data model can be estimated using the least squares method with dummy variables, correcting for the Nickell bias that occurs due to the use of dummy variables when N is large, and T is small.

In practice, the first step estimates the fixed parameterless autoregressive model using LSDV. In the second stage, the parameters are corrected. Kiviet (1999), Bun and Kiviet (2003), Bruno (2005) can be used for the correction. In the second step, the variance-covariance matrix is used to calculate the standard errors in the model with the corrected parameters.

4.2. Data

The panel was constructed with annual data from 1990 to 2023 for 134 countries (see Appendix 1 for the list of countries) for which reliable data could be accessed. Although the data source contained data for 217 countries, 83 countries did not have data at a level that could be analyzed. So, the analysis was conducted with 134 countries. In addition, the fact that the study started in 1990 is also due to the lack of data. These two elements were presented as limitations of the study.

$$gdp_{i,t} = gdp_{i,t-1} + inv_{i,t} + emp_{i,t} + trd_{i,t} + inf_{i,t} + pop_{i,t} + law_{i,t} + cor_{i,t} + u_{i,t} \qquad (6)$$

In the research, the model was constructed using the Cobb-Douglas production function. Accordingly, the dependent variable is EG, the independent variables are capital and labor. Other variables were included as control variables. The functional form of the model is shown in equation (6).

Table 1: Variables, their descriptions and sources

Variables	Explanations	Sources	Expected effect
Economic Growth	GDP growth (annual %)	World Development Indicators	
Investment	Gross capital formation (% of GDP)		+
Employment	Employment to population ratio, 15+, total (%) (national estimate)		+
Trade	Trade is the sum of exports and imports of goods and services (% of GDP)		+/-
Inflation	Inflation, GDP deflator: linked series (annual %)		+/-
Population	Population, total		+/-
Rule of Law	Rule of Law: Estimate (index) The index measures perceptions of the degree of trust and adherence of individuals and institutions to community rules, enforcement of contracts, enforcement of property rights, quality of police and courts, and likelihood of crime and violence. The index ranges from approximately -2.5 to 2.5.	Worldwide Governance Indicators	+/-
Control of Corruption	Control of Corruption: Estimate (index), The index measures perceptions of the extent to which public power is used for private gain across all forms of corruption. The index ranges from approximately -2.5 to 2.5.		+

All data were obtained from the World Bank database. Table 1 shows the variables and their explanations. *Economic growth*, *Employment*, and *İnflation* variables represent percentage changes in the data. *Investment* and *Trade* are ratio variables. *Rule of Law* and *Corruption* are index variables. No adjustment was made for these variables prior to analysis. Since the *Population* variable is a level value, its logarithm was taken.

Table 2: Descriptive statistics of variables

Variables	Obs.	Median	Mean	Std. Dev.	Min.	Max.
Economic Growth	4513	3.666	3.391	6.679	-64.04	153.4
Investment	4287	22.72	23.62	8.287	-12.88	76.78
Employment	2690	56.88	56.19	10.03	7.350	98.38
Trade	4371	74.09	86.41	55.40	0.020	442.6
Inflation	4512	4.430	35.95	516.6	-30.19	2676
Population	4556	15.94	15.83	1.836	11.09	21.07
Rule of Law	3211	-0.158	0.005	0.981	-2.333	2.124
Control of Corruption	3211	-0.195	0.035	0.992	-1.712	2.459

Table 2 presents descriptive statistics for the variables. Since there are missing data for some years for variables belonging to countries, the number of observations differs from each other. This situation indicates that the panel is unbalanced. The *Inflation* variable is the variable with the highest standard deviation. Inflation, which expresses the percentage change in inflation, has quite small changes in some countries, while it has quite large changes in some countries. The variables with the lowest standard deviation are *Rule of Law* and *Corruption*, which are index variables. Volatility is lower for these variables compared to other variables. This is because they are index variables, and the data range is between -2.5 and 2.5.

An important point is that for the *Rule of Law* variable, 64 out of 134 countries have positive values in this index, while 70 countries have negative values. Among the countries with positive scores are developed countries. The fact that 64 countries have negative values for the *Rule of Law* is a sign of regression rather than development in this regard. On the *Corruption* variable, 62 out of 134 countries have positive values and 72 countries have negative values. This means that while 62 countries have made significant progress in the fight against corruption, 72 countries are lagging in the fight against corruption.

4.3. Empirical Results

This section begins with the stationarity test of the variables. Stationarity, which refers to the return of a series to its own means, is very important in econometric analysis. The fact that a series does not return to its own meaning indicates that the change in the independent variable has a permanent effect on the dependent variable.

Table 3: Cross-Section Dependency Test Results

	Economic Growth	*Investment*	*Employment*	*Trade*	*Inflation*	*Population*	*Rule of Law*	*Control of Corruption*
CD stat.	28.38	80.20	117.03	131.50	62.54	139.47	135.05	135.22
Prob.	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

In panel data analysis, the choice of the stationarity test to be applied to variables depends on whether the variables exhibit cross-section dependence. If a variable is found to be independent across sections, the first-generation unit root test is utilized. Conversely, if cross-section dependence is present, the second-generation unit root test is employed. This distinction arises because first-generation unit root tests are based on the assumption of independent cross-sections. Therefore, the Cross-Section Dependency (CD) test proposed by Pesaran (2004) was initially applied to determine the cross-sectional dependencies of each variable. The results are shown in Table 3. According to Table 3, all variables exhibit cross-section dependence. As a result, the second-generation unit root test is applied.

Table 4: Fisher-type-demean unit root analysis test results

	Inverse chi-squared	Inverse normal	Inverse logit t	Modified inv. chi-squared	Decision
	P stat. (Prob.)	Z stat. (Prob.)	L stat. (Prob.)	Pm stat. (Prob.)	
Economic Growth	906.13 (0.000)	-26.66 (0.000)	-51.16 (0.000)	87.58 (0.000)	I(0)
Investment	973.50 (0.000)	-27.70 (0.000)	-54.99 (0.000)	94.45 (0.000)	I(0)
Employment	1023.11 (0.000)	-29.16 (0.000)	-57.80 (0.000)	-99.52 (0.000)	I(0)
Trade	1252.94 (0.000)	-33.01 (0.000)	-70.79 (0.000)	122.97 (0.000)	I(0)
Inflation	919.01 (0.764)	-26.16 (0.828)	-51.87 (0.805)	88.89 (0.773)	I(0)
Population	838.13 (0.000)	-26.04 (0.000)	-47.35 (0.000)	80.64 (0.000)	I(0)
Rule of Law	1039.71 (0.000)	-29.30 (0.000)	-58.74 (0.000)	101.21 (0.000)	I(0)
Control of Corruption	1133.46 (0.000)	-31.02 (0.000)	-64.04 (0.000)	110.78 (0.000)	I(0)

Table 4 presents the results of the second generation of the Fisher type unit root test. The reason for choosing this test is that it can produce results in unbalanced panels. The H_0 hypothesis of the test is "all panels contain unit roots". The H_1 hypothesis is that at least one panel is stationary. Checking the probability values of the variables in Table 4, we see that all variables are I(0) and stationary at the level. These results indicate that no stationarity process is applied to the variables in the empirical analysis.

Table 6: Hausman Test Results

	Fe	Re	Difference	Hausman
Investment	0.2175	0.1959	0.0215	
Employment	0.0396	0.0225	0.0170	Stat. : 62.25
Trade	0.0363	0.0314	0.0048	Prob :
Inflation	-0.0008	0.0010	0.0018	(0.000)
Population	-6.0506	-0.5545	-5.5050	
Rule of Law	-2.1231	-2.3509	0.2277	
Control of Corruption	1.1286	1.0132	0.1153	

Table 6 presents the findings of the Hausman test. Hausman (1978) test is conducted to assess the correlation of these effects with the independent variables. If there is no correlation between the unit effect and the independent variables, the random effects model is deemed appropriate. This is based on the fact that the fixed effects estimator excludes unit effects from the model. Conversely, if a correlation exists, the random effects estimator may introduce an endogeneity issue, as the unit effect is incorporated into the error terms of the model. This correlation between the independent variables and the unit effect contradicts the assumption of exogeneity. Thus, if a correlation is found, the fixed effects estimator is considered consistent (Tatoğlu, 2020: 199-200). The results in Table 6 indicate that the fixed effects are consistent according to the Hausman test's outcome.

Assuming fixed effects, both the within-group estimator and the first-difference method can be employed. Under the fixed effects model, the within-group estimator and the shadow variable estimator yield identical results (Tatoğlu, 2020: 121). The autoregressive panel data model is estimated using the LSDV method, which corrects for Nickell bias that may arise when N is large, and T is small. This method estimates the model in two stages: the first stage estimates the fixed parameter-free autoregressive model using the dummy variable least squares (within-group) estimation method. In the second stage, the parameters are adjusted. The correction methods

proposed in the works of Kiviet (1999), Bun and Kiviet (2003), and Bruno (2005) are applied. In this second stage, the variance-covariance matrix is utilized to compute the standard errors for the model with the revised parameters. Initial values can be sourced from the estimators developed by Anderson and Hsiao (1982), Arellano and Bond (1991), and Blundell and Bond (1998) (Tatoğlu, 2020: 122).

Table 7: Results of the Anderson and Hsiao Estimator

	Kiviet (1999)		Bun and Kiviet (2003)		Bruno (2005)	
	Coeff.	z stat. (prob)	Coeff.	z stat. (prob)	Coeff.	z stat. (prob)
Economic Growth$_{-1}$	0.09	2.86 (0.004)	0.09	2.92 (0.004)	0.10	2.92 (0.003)
Investment	0.21	7.93 (0.000)	0.21	7.92 (0.000)	0.21	7.92 (0.000)
Employment	0.04	0.65 (0.513)	0.04	0.65 (0.514)	0.04	0.65 (0.514)
Trade	0.04	3.69 (0.000)	0.04	3.67 (0.000)	0.04	3.67 (0.000)
Inflation	0.02	0.79 (0.428)	0.02	0.79 (0.428)	0.02	0.79 (0.428)
Population	-8.69	-6.14 (0.000)	-8.66	-6.14 (0.000)	-8.66	-6.14 (0.000)
Rule of Law	-2.13	-3.12 (0.005)	-2.13	-3.15 (0.002)	-2.13	-3.15 (0.002)
Control of Corruption	0.45	2.16 (0.031)	0.45	2.15 (0.031)	0.45	2.15 (0.031)

Note: The variance-covariance matrix is computed with a bootstrap 50.

In Table 7, the Anderson and Hsiao estimator is used and the correction methods suggested by the studies of Kiviet (1999), Bun and Kiviet (2003), Bruno (2005) are applied.

Table 8: Results of the Arellano and Bond Estimator

	Kiviet (1999)		Bun and Kiviet (2003)		Bruno (2005)	
	Coeff.	z stat. (prob)	Coeff.	z stat. (prob)	Coeff.	z stat. (prob)
Economic Growth$_{-1}$	0.09	2.73 (0.006)	0.09	2.77 (0.006)	0.09	2.78 (0.005)
Investment	0.21	8.00 (0.000)	0.21	7.98 (0.000)	0.21	7.98 (0.000)
Employment	0.04	0.67 (0.505)	0.04	0.66 (0.506)	0.04	0.66 (0.506)
Trade	0.04	3.92 (0.000)	0.04	3.91 (0.000)	0.04	3.91 (0.000)
Inflation	0.02	0.79 (0.428)	0.02	0.79 (0.429)	0.02	0.79 (0.429)
Population	-8.62	-5.77 (0.000)	-8.59	-5.75 (0.000)	-8.58	-5.75 (0.000)
Rule of Law	-2.11	-2.86 (0.004)	-2.11	-2.87 (0.004)	-2.11	-2.87 (0.004)
Control of Corruption	0.50	2.31 (0.021)	0.50	2.31 (0.021)	0.50	2.31 (0.021)

Note: The variance-covariance matrix is computed with a bootstrap 50.

In Table 8, the Arellano and Bond estimator is used and the correction methods suggested by the studies of Kiviet (1999), Bun and Kiviet (2003), Bruno (2005) are applied.

Table 9: Results of the Blundell and Bond Estimator

	Kiviet (1999)		Bun and Kiviet (2003)		Bruno (2005)	
	Coeff.	z stat. (prob)	Coeff.	z stat. (prob)	Coeff.	z stat. (prob)
Economic Growth$_{-1}$	0.10	3.33 (0.001)	0.11	3.40 (0.001)	0.11	3.41 (0.001)
Investment	0.21	8.52 (0.000)	0.21	8.51 (0.000)	0.21	8.51 (0.000)
Employment	0.04	0.72 (0.470)	0.04	0.72 (0.471)	0.04	0.72 (0.471)
Trade	0.05	4.22 (0.000)	0.05	4.22 (0.000)	0.05	4.22 (0.000)
Inflation	0.02	0.83 (0.404)	0.02	0.83 (0.404)	0.02	0.83 (0.405)
Population	-9.38	-6.36 (0.000)	-9.38	-6.35 (0.000)	-9.38	-6.35 (0.000)
Rule of Law	-2.07	-2.78 (0.005)	-2.06	-2.78 (0.005)	-2.06	-2.78 (0.005)
Control of Corruption	0.48	2.51 (0.012)	0.48	2.52 (0.012)	0.48	2.52 (0.012)

Note: The variance-covariance matrix is computed with a bootstrap 50.

In Table 9, the Blundell and Bond estimator was employed, along with the correction methods proposed by Kiviet (1999), Bun and Kiviet (2003), and Bruno (2005). It is evident that the outcomes from the three estimators are closely aligned. The first lagged value of the dependent variable, *Economic Growth*, positively influences the current value of EG, suggesting that EG is affected by its own previous values. Consistent with economic theory, the

capital and employment variables, fundamental components of the growth model, also exert a positive influence on EG. However, the results from all three estimators indicate that the impact of *Employment* on EG is not statistically significant. The effect of *Trade* on EG can vary between positive and negative according to economic literature, as trade openness reflects the overall volume of trade. This variable, representing the ratio of imports and exports to national income, may negatively affect EG if imports exceed exports. Conversely, if exports are greater, trade is expected to positively influence EG. The estimation results reveal that *Trade* contributes positively to EG across countries. Although Inflation has a positive effect on EG, the results across all three estimators are not statistically significant.

A notable finding of the study is the formidable negative influence of the *Population* variable on EG, suggesting that an increasing population diminishes EG in countries.

Additionally, the index used to measure the *Rule of Law* also negatively affects the EG of nations. The *Rule of Law* variable is an indexed measure ranging from -2.5 to +2.5. In many countries within the study group, the *Rule of Law* variable reflects a negative index value, indicating a lack of success in enforcing the *Rule of Law*. Consequently, the insufficient achievement in the *Rule of Law* correlates negatively with EG. These results align with the research conducted by Simo-Kengne et al. (2023); Amoh et al. (2022); Mauro et al. (2018); Yalçınkaya and Yazgan (2016); Omoteso and Ishola Mobolaji (2014); De la Croix and Delavallade (2011); Gani (2011); and Yapraklı (2008).

Furthermore, the study highlights the impact of *Control of Corruption* on EG. Statistically significant findings demonstrate that enhanced measures to combat corruption positively affect EG. These results are consistent with the studies of David et al. (2024); Fengju and Wubishet (2024); Bayraktar et al. (2023); Simo-Kengne et al. (2023); Spyromitros and Panagiotidis (2022); and Omoteso and Ishola Mobolaji (2014).

5. CONCLUSION

This study examines the impact of control of corruption and ROL on EG. The study used annual data for the period 1990-2023. The study used panel data, bias-corrected LSDV analysis for econometric analysis. The study included 134 developed, developing, underdeveloped or low-income and high-income countries. The countries have a heterogeneous structure in terms of development or income. They were taken from the data source without selection.

The first result of the empirical analysis is that the increase in the control of corruption in countries has a positive effect on EG. The international results obtained show that the policies or measures adopted by countries in relation to corruption are appropriate. It shows that the strategies implemented in the fight against corruption have positive effects on factors such as the development of the investment environment of the countries, the increase in foreign trade, the increase in the confidence of foreign investors and the transparency and accountability of public institutions. Most studies in the literature also conclude that the control of corruption increases EG. The findings are similar to David et al. (2024); Fengju and Wubishet (2024); Bayraktar et al. (2023); Simo-Kengne et al. (2023); Spyromitros and Panagiotidis (2022); Omoteso and Ishola Mobolaji (2014).

Another finding is that there is a negative relationship between the ROL and EG. Although at first glance it may seem an unexpected result that an increase in the ROL is detrimental to EG, the situation is different. The ROL index used in the study consists of negative and positive values. The index takes a negative value when countries fail to make progress in the ROL. A significant number of countries in the study received a negative score on the ROL index. Thus, in the empirical analysis, the effect on EG was negative. It would be more useful to interpret this situation as meaning that the backwardness of countries in the ROL is detrimental to EG. Indeed, many studies in literature have found negative relationships found in this study. The findings are similar to Simo-Kengne et al. (2023); Amoh et al. (2022); Mauro et al. (2018); Yalçınkaya and Yazgan (2016); Omoteso and Ishola Mobolaji (2014); De la Croix and Delavallade (2011); Gani (2011); Yapraklı (2008).

These results show that taking decisive steps to fight corruption is crucial for EG. In this context, it is recommended that anti-corruption laws are strictly implemented, and that transparency and accountability mechanisms are strengthened. With regard to the ROL, it is clear that the focus should be on legal reforms and strengthening practices. Increasing the independence

of the courts and speeding up judicial processes will help restore investor confidence. In addition, it is recommended as a policy suggestion that ROL efforts be aligned with international standards.

As a result, developments in the fight against corruption and the ROL play a crucial role in achieving EG objectives. It is recommended that future studies focus on a more in-depth examination of the interaction between these two concepts, cross-country comparisons and the evaluation of the effectiveness of policies in this regard.

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Appendix 1: countries in the study

Albania	Botswana	Cote d'Ivoire	Greece	Kazakhstan	Mongolia	Senegal
Algeria	Brazil	Croatia	Guatemala	Kenya	Morocco	Serbia
Argentina	Brunei Darussalam	Cuba	Guinea	Korea, Rep.	Mozambique	Seychelles
Armenia	Bulgaria	Cyprus	Guyana	Kuwait	Namibia	Sierra Leone
Aruba	Burkina Faso	Czechia	Haiti	Kyrgyz Rep.	Netherlands	Singapore
Australia	Burundi	Denmark	Honduras	Lao PDR	New Zealand	Slovak Rep.
Austria	Cabo Verde	Dominica	Hong Kong SAR, China	Latvia	Norway	Slovenia
Azerbaijan	Cambodia	Dominican Rep.	Hungary	Lebanon	Oman	Solomon Islands
Bahamas	Cameroon	Ecuador	Iceland	Lesotho	Pakistan	Spain
Bahrain	Canada	Egypt, Arab Rep.	India	Libya	Panama	Sri Lanka
Bangladesh	Central African Rep.	El Salvador	Indonesia	Luxembourg	Peru	Thailand
Barbados	Chad	Estonia	Iran, Islamic Rep.	Macao SAR, China	Philippines	Uruguay
Belarus	Chile	Eswatini	Iraq	Madagascar	Poland	Uzbekistan
Belgium	China	Fiji	Ireland	Malaysia	Portugal	Vanuatu
Belize	Colombia	Finland	Israel	Mali	Romania	Venezuela
Benin	Comoros	France	Italy	Malta	Russian Federation	Vietnam
Bhutan	Congo, Dem. Rep.	Georgia	Jamaica	Mauritania	Rwanda	West Bank and Gaza
Bolivia	Congo, Rep.	Germany	Japan	Mauritius	Samoa	Yemen, Rep.
Bosnia and Herzegovina	Costa Rica	Ghana	Jordan	Mexico	Saudi Arabia	Zambia
						Zimbabwe

Chapter 4

The Impact Of Tourism Revenues On Economic Growth: Panel Data Analysis For Mint Countries

Tuğba Konuk[1]

Abstract

The tourism sector, which holds a significant place in achieving sustainable economic growth and development globally, is crucial for countries to realize objectives such as job creation, generating tax revenues, and reducing trade deficits. Tourism revenues can positively influence a country's economic growth through various channels. Therefore, the tourism sector is receiving increasing attention worldwide, with diverse policies and strategies implemented in this regard. In the literature, the relationship between tourism and growth is referred to as tourism-led growth.

This study aims to analyze the impact of tourism revenues on economic growth in MINT (Mexico, Indonesia, Nigeria, Turkey) countries using panel regression analysis for the period 2005–2020. The findings indicate that the impact of tourism revenues on economic growth is statistically significant. In other words, a 1% increase in tourism revenues leads to a 0.2211% increase in economic growth.

1. Introduction

Countries around the world have macroeconomic goals that they set for themselves. Realizing as high an economic growth as possible, achieving full employment and maintaining price stability are at the top of these goals. Countries set policies to achieve these goals and to ensure stability after achieving these goals. If the policies implemented are successful, the targets set are also achieved (Ertürkmen, 2023).

Tourism revenues are of great importance to national economies worldwide, serving as a crucial instrument for growth and development.

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They contribute positively to increasing employment and tax revenues and reducing trade balance deficits. Hence, countries aim to enhance tourism revenues to ensure sustainable economic growth and development. Just as increasing production and reducing unemployment are necessary for the sustainability of economic growth, the development of the tourism sector should also be included among these goals. Tourism offers opportunities for nations to increase their income (Ağır & Özbek, 2021).

Tourism activities can be defined as individuals traveling from where they live to other places and performing various activities such as rest, entertainment, learning, cultural education, health and sports (Önder, 2022). Today, with the development of transportation facilities, tourism activities have increased (Kara, 2012).

The positive effect of tourism revenues on economic growth is often explained in the literature by the relationship between exports and economic growth, defined as the tourism-led growth hypothesis (Kızılkaya et al., 2016). Tourism is categorized under international services in the current account of the balance of payments, providing foreign exchange earnings for host countries through consumption and investment spending by foreign tourists. Thus, it can be argued that the tourism sector has a structure similar to merchandise exports (Ağır & Özbek, 2021).

In the light of economic, social and cultural developments, tourism revenues in MINT countries (Malaysia, Indonesia, Nigeria and Turkey) are fluctuating. Figure 1 below shows the international tourism and travel revenues of MINT countries between 2005 and 2020.

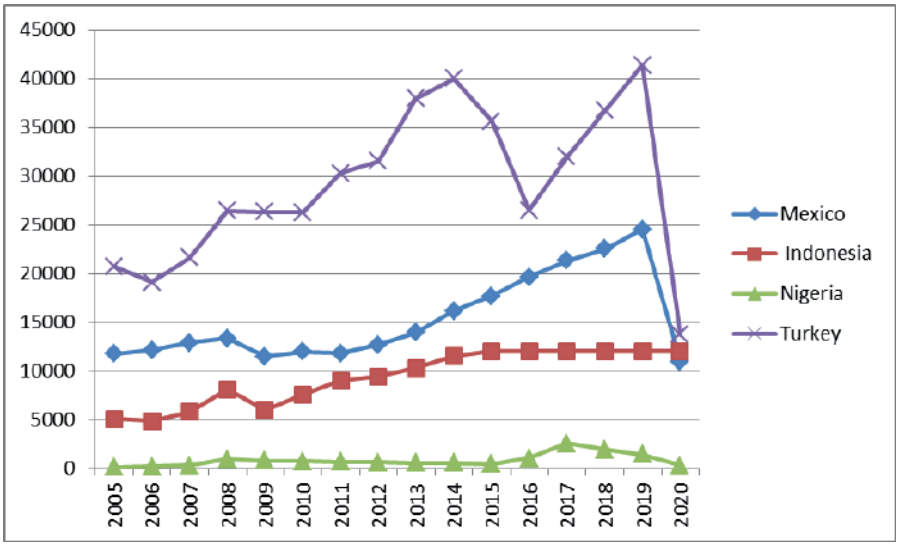

Figure 1: International Tourism and Travel Revenues in MINT Countries (2005-2020), (Million Dollars)

Source: Created by the author with data obtained from World Development (World Bank).

As seen in Figure 1, Turkey has the highest tourism revenues in MINT countries, while Nigeria has the lowest. As can be seen in the figure, the impact of Covid 19, known as the 2019 health crisis, was seen with the bottoming out of the indicators in 2020. The symptoms of Covid 19 were especially felt on Turkey's tourism revenues.

As an economic indicator of the MINT countries formed by Mexico, Indonesia, Nigeria and Turkey, Figure 2: shows the values of gross domestic product per capita between 2005-2020.

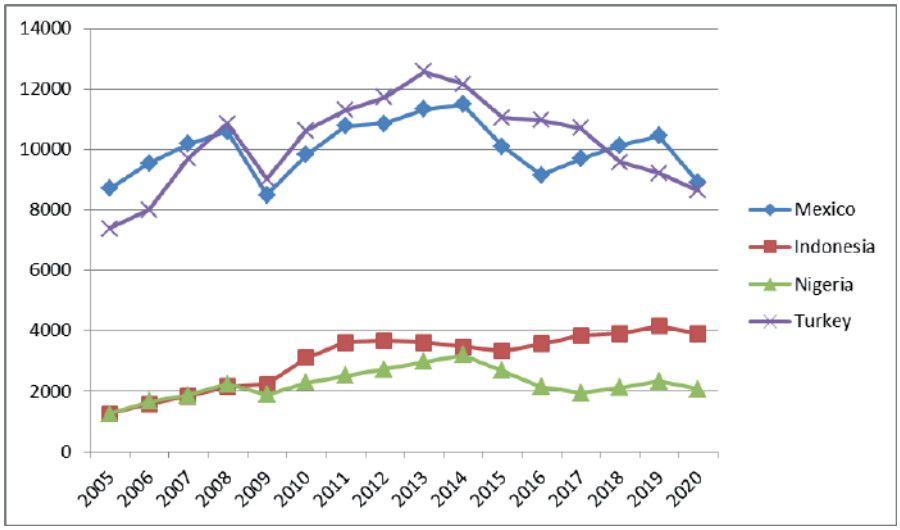

Figure 2: Gross Domestic Product per Capita in MINT Countries (2005-2020), (Current USD)

Source: Created by the author with data obtained from World Devolopment (World Bank)

As can be seen in Figure 2, it can be stated that the Gross Domestic Product per Capita values for the MINT country group followed a fluctuating course between 2005-2020. When the country group is analyzed, it is seen that Turkey and Mexico have a higher GDP per capita compared to Indonesia and Nigeria.

In this context, when the two graphs are evaluated together, it can be said that there are graphical similarities between Tourism Revenues and Gross Domestic Product per Capita. In other words, when tourism revenues are evaluated for the MINT country group between 2005 and 2020, it is seen that the two countries with the highest tourism revenues are Turkey and Mexico, while the two countries with the lowest tourism revenues are Indonesia and Nigeria. Only for 2020, although Turkey experienced a sharp decline due to the COVID-19 process, the decline in Malaysia, together with the decline in Malaysia, almost reached the level of Indonesia's tourism revenues.

The aim of this study is to investigate the impact of tourism revenues on economic growth for MINT countries. In this direction, Panel Regression Analysis has been conducted by considering the data between 2005-2020. In the study, after the introduction and theoretical framework, the studies

in the literature will be examined. Then, the impact of tourism revenues on economic growth for MINT countries will be analyzed by Panel Regression method and conclusions and evaluations will be made in line with the findings obtained.

2. Literature Review

Many studies in the literature examine the effect of tourism revenues on economic growth. Empirical studies generally agree that tourism revenues positively impact economic growth. However, differences in periods, countries, groups of countries, methods, and variables lead to varying results. Table 1 below presents some of the studies on this topic.

Table 1. Literature Review on the Impact of Tourism Revenues on Economic Growth

Authors	**Countries**	**Period** **Method**	**Findings**
Balaguer & Cantavella-Jorda (2002)	Spain 1975–1997	Cointegration Analysis & Causality Test	Long-term improvements in tourism significantly influence growth.
Eugenio-Martin et al. (2004)	Latin America 1985–1998	Panel Data Analysis	Strong tourism-growth relationship in developing countries; weaker in developed nations.
Dritsakis (2004)	Greece 1960–2000	Johansen Cointegration & Granger Causality Test	Strong causality between tourism and economic growth.
Oh (2005)	South Korea 1990–2005	Engle-Granger Causality Analysis	No long-term relationship between tourism and economic growth.
Yavuz Çil (2006)	Turkey 1992–2004	Granger Causality & Toda-Yamamoto Causality Analysis	No causality between tourism revenues and economic growth.
Brida et al. (2008)	Mexico 1980–2007	Granger Causality Analysis	Unidirectional causality from tourism spending to real GDP.
Kızılgöl & Erbaykal (2008)	Turkey 1992–2006	Toda-Yamamoto Causality Analysis	Causality from economic growth to tourism revenues.

Mishra et al. (2011)	India 1978-2009	Granger Causality Analysis	According to the findings of the study, it is concluded that there is a positive relationship between tourism and economic growth. In addition, it is concluded that there is a causality relationship from tourism to economic growth in the long run, while there is no causality relationship in the short run.
Kamacı & Oğan (2014)	Turkish Republics 1995-2011	Panel Cointegration Analysis Panel Causality Tests	According to the findings of the study, there is a positive relationship between tourism and economic growth in the long run. In addition, there is a bidirectional causality relationship between tourism and growth.
Balıkçıoğlu & Oktay (2015)	Turkey 2003-2014	Granger Causality Analysis	According to the findings of the study, it is concluded that there is unidirectional causality from tourism to economic growth.
Kızılkaya et al. (2017)	Turkey 1980–2014	ARDL Bound Test	Positive impact of tourism revenues on economic growth in both long and short terms.
Gövdeli & Direkçi (2017)	34 OECD Countries 1997–2012	Panel Cointegration	Analysis Long-term increase in tourism revenues positively affects economic growth.
Sahin (2017)	20 Mediterranean Countries 2000-2015	Panel Data Analysis	According to the findings of the study, there is a positive relationship between tourism revenues and economic growth.
Turgut et al. (2021)	Turkey 1998–2009	ARDL Bound Test & Granger Causality Test	Tourism revenues are found to be a Granger cause of economic growth.
Rossaol et al. (2021)	BRICS Countries 1995-2015	Panel ARDL Test	According to the results obtained from the study, there is a long-run relationship between the variables.
Ordu & Duran (2023)	Northern Cyprus 1990–2019	Johansen Cointegration & Granger Causality Test	Short-term bidirectional causality; no long-term relationship.
Baghirov (2023)	7 Western OECD Countries 1988–2015	Panel Cointegration Analysis	Tourism and economic growth are found to be related.

The reviewed literature generally shows that the effect of tourism revenues on economic growth is positive and significant. Particularly for developing countries, the importance of tourism revenues is highlighted.

3. Econometric Methodology and Findings

This study uses data from the World Bank's World Development Indicators for 2005–2020, focusing on MINT (Mexico, Indonesia, Nigeria, Turkey) countries. Panel regression analysis was conducted with logarithmic transformations of the dependent and independent variables. The data were obtained from the World Bank's World Development Indicators database.

The variables used in the analysis are shown in Table 2, and the countries included in the analysis are listed in Table 3:

Table 2: Variable Definitions

Variable	Description	Source and Period
LT	Logarithmic International Tourism Revenue	World Bank (WDI) 2005–2020
LGDP	Logarithmic Per Capita GDP	World Bank (WDI) 2005–2020

Table 3: MINT Countries in the Analysis

1	Mexico
2	Indonesia
3	Nigeria
4	Turkey

The logarithmically transformed equation is shown in equation 1 below:

$$LGDP_{it} = \beta_0 + \beta_1 LT_{it} + \upsilon_i \quad (1)$$

In the model used in the study, MINT countries are considered. In this model, "i" indicates the unit dimension and "t" indicates the time dimension.

$$i=(1...4) \text{ and } (t= 2005...2020)$$

LT: Logarithm of International Tourism and Travel revenues.

LGDP: Logarithm of GDP per capita.

In panel data models, whether the classical model is valid or not, in other words, whether there is a unit and/or time effect in the model can be revealed by analyzing through some tests. F Test, LR Likelihood Test, Breush Pagan LM Test are some of these tests. In this study, LM and F tests were used to analyze the results. These tests determine whether the series differ by units. If the series do not differ by units, the classical model is accepted to be valid. The main and alternative hypothesis of the F test is as follows (Yerdelen Tatoğlu, 2020).

H0: Unit and/or time effects are equal to zero.

H1: Unit and/or time effects are different from zero.

In panel data regression analyses, the Bresuch-Pagan LM test can be used to determine whether the classical model or the random effects model is valid.

H0: The variance of the unit and/or time effect is equal to zero.

H1: The variance of the unit and/or time effect is different from zero.

It is constructed as follows. In other words, the null hypothesis H0 can also be stated as "there is no unit and/or time effect". As a result of the rejection of the null hypothesis H0, it is decided that there are unit and/or time effects in the model. After determining that there are unit and/or time effects in the model as a result of LM and F tests, it should be determined whether these effects are fixed effects or random effects.

After the detection of unit and/or time effects, Hausman (1978) test is applied to determine the correlation of these effects with independent variables (Alpağut, 2024). In other words, if fixed effects and random effects are consistent in the model, the analysis showing which is more efficient in terms of efficiency is the Hausman Test and the hypothesis is established as follows:

H0: There is no correlation between explanatory variables and the error term.

H1: Explanatory variables and the error term are correlated (Yerdelen Tatoğlu, 2020).

Table 4 summarizes the results showing which of the classical model, fixed effects and random effects model is most appropriate for the model of the effect of tourism revenues on economic growth.

Table 4: Panel Data Regression Analysis Estimator Tests

	Statistic Values	Probability (Prob) Values
F Test	29.47*	0.000
LM Test	157.45*	0.000
Hausman Test	0.01*	0.9247

Note: Denotes 5% significance level.

Table 4 presents the results of F, LM. and Hausman tests. According to the results of the F test, since the probability (prob) value is less than 0.05, i.e. $p=0.000<0.005$, the null hypothesis H0 is rejected and the existence of unit and/or time effect is accepted. In other words, it is concluded that the existence of unit and/or time effect is significant in the model of the effect of tourism revenues on economic growth at 5% significance level. In short, as a result of this analysis, it can be stated that the classical model, the Pooled ECT model, is not valid for this model.

When the results of the Bresuch-Pagan LM (1980) test are analyzed in the model in which the effect of tourism revenues on economic growth is examined, it is seen that the x2 test statistic is 157.45. In addition, since the Prob(probability) value is less than 0.05, i.e. $p=0.000<0.05$, the null hypothesis H0 is rejected. In this case, the presence of unit and/or time effect is significant at 5% significance level. Thus, according to the result of the LM test analysis, it can be stated that the classical model is not valid.

According to the results of the F test and Breusch-Pagan LM test analysis, it is seen that the pooled ECM method is not valid in the model. As a result of the detection of unit and/or time effect as a result of F, LM test, Hausman Test was used to analyze whether the effect is fixed effect or random effect. As explained in Table 4, the probability value is greater than 5% significance level ($p=0.92>0.05$). According to this result, the null hypothesis is not rejected. It is seen that the appropriate analysis method for the Impact of Tourism Revenues on Economic Growth model is the random effects model.

Random effects regression analysis was found to be appropriate for the model of the impact of tourism revenues on economic growth and assumption tests were conducted to test whether there are heteroskedasticity, autocorrelation and inter-unit correlation problems. In the study, the random effects model was determined as the estimation method. Levene (1960), Brown and Forstyhe (1974) analyses were conducted to test the presence of heteroskedasticity in the random effects model. The results of these analyses are given in Table 5.

Table 5: Heteroskedasticity Test Results

	X^2	Prob. Value
W0	6.8906*	0.000
W50	6.1238*	0.001
W10	6.5301*	0,000

** Note: Indicates 5% significance level.*

Table 5. shows the heteroskedasticity test results in the random effects model. According to the heteroskedasticity result, since the probability values are less than 0.05 (p=0.000< 0.05), the main hypothesis H0 "there is no heteroskedasticity" is rejected and it is determined that there is a heteroskedasticity problem according to the units.

The Durbin Watson Test and Baltagi-Wu (1999) Best Invariant LBI Test were used to determine whether there is an autocorrelation problem in the efficiency of the random effects model. Table 6 presents the results.

Table 6. Autocorrelation Test Results

ModifiedBhargavavd.Durbin Watson	0.3131
Baltagi –Wu LBI	0.7674

Table 6 presents the Autocorrelation test results in the random effects model. It is seen that the critical values obtained for both tests shown in Table 6 are below 2 and the null hypothesis H0 "There is no autocorrelation" is rejected. Therefore, it is seen that there is an autocorrelation problem in the random effects model.

Pesaran and Friedman tests are used to test for the presence of correlation between units. Table 7 shows the findings of inter-unit correlation in the random effects model.

Table 7: Inter-unit Correlation Test Results

	x^2	Prob. Value
PesaranTest	7.726*	0.0000
Friedman Test	48.066*	0.0000

Note: Indicates 5% significance level

Table 7 presents the inter-unit correlation test results of the model. According to the table, since p=0.000< 0.05 at 0.05 significance level, the main hypothesis H0 "there is no correlation between units" is rejected. Therefore, Pesaran and Friedman Tests show that there is correlation between units in the random effects model.

In our model, in which we investigate the effect of tourism revenues on growth, there are heteroskedasticity, inter-unit correlation and autocorrelation problems. Therefore, the estimators lose their consistency and efficiency. The impact of tourism revenues on economic growth should be estimated with the Driscoll-Kraay robust estimator. The results of the Diriscoll-Kraay estimator are presented in Table 8.

Table 8: .Driscoll- Kraay Robust Estimator Results

	Coefficient	DriscollKraaySt	t	P>|t|
LT	0.2211	0.6806	3.25	0,005
Fixed	9.6758	0.7800	12.40	0,000
Prob(Probability)	0,001			

Note: Indicates 5% significance level

According to the Driscoll- Kraay robust estimator results in Table 8, the LT variable is statistically significant for the model of the Impact of Tourism Revenues on Economic Growth for MINT (Mexico, Indonesia, Nigeria, Turkey) countries using data from 2005 to 2020 (P>|t| value 0.001).

The results of the Driscoll-Kraay robust estimator show that a 1% increase in tourism revenues increases economic growth by 0.2211%.

As a result of the robust estimator, the effect of tourism revenues on economic growth was found to be positive at 5% significance level. In other words, a 1% increase in tourism revenues increases economic growth by 0.2211%.

It is seen that the findings obtained from the study are consistent with Kızılkaya et al. (2017), Gövdeli and Direkçi (2017) and Turgut et al. (2021).

4. Conclusion

Tourism is one of the fastest growing sectors in the world. The development of the tourism sector is of great importance for developed and developing countries in terms of economic growth and capital development. Tourism revenues, which are seen as a tool for regional and national development, are

seen as an issue that attracts the attention of policy makers in order to ensure sustainable growth and development. The tourism sector is considered to be an important source for countries to increase their revenues. Tourism is seen to be important for economic growth and development due to its contribution to closing the current account deficit, reducing unemployment and many other contributions (Ağır and Özbek, 2021).

The theoretical basis of the view that tourism causes economic growth is based on export-led growth theory. Tourism, which is included in the national services item in the sub-item of the balance of payments, is one of the important service items. In other words, tourism activity can be defined as the consumption and investment expenditures made by foreign tourists in the host country and the foreign exchange earnings of the related country. Therefore, it can be stated that tourism activity is similar to exports of goods. In other words, it can be stated that tourism is an invisible item of exports (Kara et al. 2012).

In this study, the impact of tourism revenues on economic growth for MINT countries (Mexico, Indonesia, Nigeria, Turkey) for the years 2005-2020 has been investigated using Panel Regression Analysis. According to the results obtained from the analysis, the effect of tourism revenues on economic growth is positive and significant. In other words, a 1% increase in Tourism Revenues increases Economic Growth by 0.2211%.

In line with the results obtained, it is seen that Tourism Revenues have an important place for the economy of MINT countries as in all countries around the world. In this direction, in future studies, the effect of tourism revenues on economic growth can be analyzed with up-to-date empirical methods. Thus, it can be revealed how important the tourism sector is for sustainable growth and development.

In addition, the globalization and liberalization process, which affects the world, increases the importance of airline transportation day by day. Especially the fast transportation has made the aviation sector indispensable. It is observed that in countries with high tourism revenues, infrastructure investments are gradually increasing in order to develop airline transportation and this situation has positive effects on economic growth by significantly increasing the number of passengers carried (Uçar et al. 2024). Based on these findings, investments can be made in areas such as air transportation in order to increase economic growth through tourism revenues.

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Chapter 5

Estimation of the Relationship Between Financial Development Indicators - Renewable Energy Consumption - Economic Growth: 1990-2021 Period Türkiye

Ayşe Eryer[1]

Abstract

Energy, which is important in achieving sustainable growth and development goals, is present in every aspect of our lives in different forms. Likewise, financial development also plays an important role in achieving the sustainable economic growth targets of countries. In this context, this study investigates the relationship between renewable energy, financial development and economic growth in Türkiye in the period 1990-2021. As a result of the cointegration analysis test, the existence of a long-term relationship between the variables was obtained. According to the causality analysis findings, a bidirectional causality relationship was obtained between economic growth and money supply representing financial development. While a one-way causality relationship from economic growth and money supply to renewable energy consumption is obtained, a bidirectional relationship is obtained between private sector loans provided by banks representing financial development and renewable energy consumption.

1.Introduction

Economic growth is generally defined as the increase in the goods and services produced by a country compared to the previous year (Dinler, 1997). Therefore, economic growth is seen as one of the main macroeconomic variables affecting the welfare level of a country and one of the main driving forces of sustainable development. In this context, one of the main policies of all countries in the world is to achieve economic growth targets and to make it sustainable.

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Recently, the interaction between financial development, renewable energy consumption and economic growth has become an important focal point in realising global sustainable development goals. The increase in global energy demand and the increased attention to environmental factors have led to a growing interest in renewable energy consumption. While the widespread consumption of renewable energy contributes to environmental sustainability, it also provides significant advantages for economic growth. In this context, it is stated that financial development can support economic growth by contributing to the financing of renewable energy consumption projects (Apergis & Payne, 2010).

Renewable energy consumption is critical to ensure low carbon emissions and sustainable energy sources. By reducing dependence on fossil fuels, renewable energy sources strengthen energy security and support healthy economic growth in the long term. It is stated that this transformation is felt more clearly especially in developing countries. Various studies indicate that renewable energy investments can accelerate economic growth by transforming energy consumption (Sadorsky, 2009).

Financial development is expressed as a multidimensional concept. This concept is used to indicate the changes occurring in the financial system. Financial development indicators are important in determining the direction of the relationship between financial development and economic growth. It is stated that they vary from country to country. (Ertürkmen, 2023; Furstenberg and Fratianni, 1886). Financial development is particularly important in the increase in renewable energy consumption, which is supported by technological developments in energy production. Investments in renewable energy both increase energy efficiency and create long-term benefits for economic growth (Esen et al., 2024). In this context, this paper will examine the relationship between financial development, renewable energy consumption and economic growth, and also evaluate the contribution of this interaction to achieving sustainable development goals.

While the effects of financial development and energy consumption on economic growth are usually analysed separately in the literature, these variables will be analysed together as in Aslan and Yılmaz (2023). In this context, the aim of this study is to examine the relationship between financial development, renewable energy consumption and economic growth in Türkiye for the period 1990-2021 within the scope of Johansen Co-integration analysis and Toda Yamamoto causality analysis. Following the introductory section, studies on the relationship between financial development, renewable energy consumption and economic growth

are evaluated separately. Considering the literature, both the financial development-economic growth relationship and the energy consumption-economic growth relationship have been intensively addressed. There is a limited number of studies on the relationship between financial development-renewable energy consumption and economic growth in Türkiye. In addition, energy consumption is generally discussed in the studies and renewable energy variable is rarely used in the relationship between financial development-renewable energy consumption-economic growth. The study is expected to contribute to the literature in this respect. In the third part of the study, the data set, methodology and findings are evaluated. In the conclusion section, conclusions, policies and suggestions for future studies are made.

2.Energy Consumption-Financial Development and Economic Growth Relationship: Literature Review

When the literature is analysed, it is seen that the studies on financial development-economic growth relationship and energy consumption-economic growth relationship are intensive. In this section, some studies on financial development-economic growth, energy consumption-economic growth and financial development-energy consumption and economic growth relationship are summarised in Table 1, Table 2 and Table 3 respectively.

Table 1. Some Studies on the Relationship between Financial Development and Economic Growth

Author-Year	**Country-Country Group/Period**	**Method**	**Result**
Gökdeniz et al. (2003)	Türkiye/1989-2002	EKK	Bank asset growth rate and Capital markets do not support economic growth and private bonds cannot explain economic growth. However, it is determined that money supply explains economic growth and inflation has a negative effect on economic growth.
Acaravcı et al. (2007)	Türkiye/1986-2006	Johansen Co-integration and Causality Analysis	In the study, no co-integration relationship was found between financial development and economic growth. However, a unidirectional causality relationship was obtained from financial development to economic growth.
Khan and Quayyum (2007)	Pakistan/1961-2005	ARDL bounds test analysis	A long-run relationship was found between economic growth and financial development.
Özcan and Arı (2011)	Türkiye/1998-2009	Time series analysis	A unidirectional causality is found between financial development and economic growth
Aydın et al.(2014)	Türkiye/1988-2012	Toda Yamamoto Causality Analysis	A unidirectional causality relationship was found from financial development to economic growth.
Bozuklu and Yılancı (2013)	14 Developing Countries/1988-2011	Panel Data Analysis	Empirical findings show that financial development increases economic growth.
Hayaloğlu (2015)	Fragile Five/1990-2012	Panel Data Analysis	The findings indicate that there is a positive relationship between financial development and economic growth.

Kılıç, et al. (2019)	Türkiye/1968-2017	Cointegration and Causality Analysis	A long-term cointegration relationship was found between economic growth and financial development indicators, and a causality relationship was found between financial development variables.
Eren, et al. (2021)	Selected Emerging Market Economies/2000-2018	Panel Data Analysis	At the end of the analysis, the effect of financial development on economic growth in emerging market economies was found to be statistically significant and positive.
Önder (2022)	Fragile Five/1990-2019	Panel Data Analysis	As a result of the analysis, the effect of financial development on economic growth is found to be significant. Increases in financial development reduce economic growth. It is emphasised that there are different findings in country-based coefficient results.
Çınar et al. (2023)	39 Africa, 34 Asia-Pacific, 41 Africa, 25 Middle East-Central Asia, 34 Western Hemisphere countries/1995-2020	Panel Data Analysis	A bidirectional causality relationship was found between economic growth and financial development.
Demirkale and Ebghaei (2023)	Türkiye/2008-2020	NARDL Analysis	Shocks to financial development are found to have a positive impact on economic growth
Gök and Biçer (2024)	MINT/1980-2021	Panel Data Analysis	Financial development is found to have a significant effect on economic growth.
Tekin et al.(2024)	Türkiye-G7 countries/1980-2019	Panel Data Analysis	Co-integration analysis revealed a cointegration relationship between variables in Türkiye, France and Italy. In addition, causality analysis revealed a bidirectional relationship between financial development and economic growth in the USA, while no finding was found among other countries

There are many studies in the literature on the relationship between energy, which constitutes one of the indispensable elements of production, and economic growth. Here, some studies on the relationship between energy consumption and economic growth are presented. Information on the studies is shown in Table 2.

Table 2. Some Studies on the Relationship between Energy Consumption and Economic Growth

Author-Year	**Country-Country Group/Period**	**Method**	**Result**
Sarı et al.(2001)	Türkiye/1960-1995	Johansen Co-integration Test	A long-run cointegration relationship was found between the variables considered.
Paul and Bhattachar (2004)	India/1950-1996	Engle Granger Co-integration Analysis	It is determined that there is a mutual relationship between the variables
Erdal et al. (2008)	Türkiye/1970-2006	Johansen Co-integration Analysis	It was found that there is a bidirectional cointegration relationship between the variables in question.
Güvenek and Alptekin (2010)	25 OECD Countries/1980-2005.	Panel Co-Integration Analysis.	Empirical results indicate the existence of a bidirectional causality relationship between energy consumption and economic growth.
Apergis and Payne (2010)	9 South American Countries/1980-2005	Panel Data Analysis	The results show a unidirectional causality relationship from economic growth to energy consumption.
Polat (2017)	Türkiye/1960-2015	Gregory Hansen Co-integration Analysis	Relationship The existence of a long-run relationship between these variables was obtained.
Kızılkaya (2018)	Türkiye/1960-2015	Co-integration and causality analysis	There is no cointegration and causality relationship between the variables.
Alper (2018)	Türkiye/1990-2017	Bayer Hank Co-integration and Toda Yamamoto Causality Analysis	A long-run relationship was found between renewable energy and economic growth. In addition, according to the causality analysis results, a unidirectional relationship was found from economic growth to renewable energy consumption.

Uslu (2018)	21 Developing Countries/1990-2014	Panel Data Analysis	The findings indicate that there is a long-run relationship between energy consumption and economic growth. The study also emphasises that there is a bidirectional causality between energy consumption and economic growth.
Yanıktepe et al.(2021)	Yanıktepe et al.(2021)	Granger Causality Analysis	The findings indicate that there is a positive relationship between the variables.
Özen and Levent (2022)	Selected OECD countries/2000-2019	Panel Data Analysis	In the study, the existence of a long-run relationship between energy consumption and economic growth was found. In addition, the existence of a unidirectional causality between economic growth and energy consumption was determined.
Bozkaya and Aytekin (2023)	Bozkaya and Aytekin (2023)	Panel Data Analysis	It was found that there was no significant relationship between energy consumption and economic growth.
Şimşek (2024)	Türkiye/1990-2020	Toda Yamamoto Causality Analysis	It was found that there was no causality relationship between the variables.

It is observed that energy consumption, GDP and financial development indicators are used in many studies analysing the relationship between financial development and economic growth or energy consumption and economic growth. There is a large literature on both issues. However, there is no common consensus. It can be said that the differences in the methods, country-country groups, periods and variables used are effective in this.

Table 3 summarises the studies on the relationship between Financial Development-Energy Consumption and Economic Growth. As can be understood from the literature review, it is seen that the number of studies dealing with the three issues together and the studies using renewable energy consumption as a variable are limited. It is seen that energy consumption is used intensively in these studies. It is foreseen that the study will contribute to the literature in this respect

Table 3. Some Studies on the Relationship between Financial Development, Energy Consumption and Economic Growth

Author-Year	**Country-Country Group/Period**	**Method**	**Result**
Shahbaz et al. (2013)	China/1971-2011	ARDL Test and Co-integration Analysis	It is found that there is a positive relationship between the variables analysed and economic growth.
Salman and Atya (2014)	Algeria, Tunisia, Egypt/1980-2010	Granger Causality and ECM Analysis	It is emphasised that financial development and energy consumption contribute positively to growth in Algeria and Tunisia, but have a negative impact in Egypt.
Sidique and Majeed (2015)	Five South Asian Countries/1980-2010	Panel Data Analysis	They found that financial development, energy consumption and trade positively affect economic growth
Doğan and Değer (2016)	India /1970-2013	Causality and Co-integration Analysis	As a result of causality analysis, they found that there is a causality relationship from economic growth to energy consumption, while there is no causality relationship from energy consumption to economic growth. They also found a causal relationship from economic growth to financial development.
Boz et al. (2017)	ASEAN Countries/1985-2013	Panel Data Analysis	The findings showed that there is a unidirectional causality from economic growth to energy consumption and financial development.
Burakov and Freidin (2017)	Russia/1990-2014	VECM Analysis and Granger Causality Test	There was no causality relationship between financial development and renewable energy consumption.
Yılmaz and Şen (2018)	Türkiye/1980-2014	ARDL analysis	It was found that there is a long-run relationship between the variables.
Şahin (2018)	Emerging Market Economies/1990-2014	Panel Data Analysis	Co-integration relationship was found between the variables. In addition, a causality from financial development to economic growth was found in India, Argentina, Malaysia and Mexico.

Demirci (2019)	Türkiye/1980-2016	Johansen Co-Integration and VECM Causality Analysis	It was found that there is a long-run relationship between the variables.
Tutgun (2019)	Türkiye/1961-2014	ARDL Analysis	Financial development and energy consumption have been found to increase economic growth.
Gürsucu (2021)	Türkiye/1960-2015	Toda Yamamoto Causality Analysis	It was not found any causality between financial development and energy consumption. However, it is among the findings that there is a unidirectional causality from financial development to economic growth.
Yılmaz (2021)	G-7 Countries/1980-2018	Panel Causality Analysis	A causality relationship was found from financial development to renewable energy consumption and from renewable energy consumption to financial development. In addition, the findings emphasise that there is a causality from renewable energy consumption to economic growth.
Uslu (2022)	Türkiye/1960-2019	VECM Causality Analysis	According to the causality analysis, a unidirectional causality relationship was found from economic growth to energy consumption and financial development. In addition, it is also found that there is a bidirectional causality between energy consumption and financial development.
Aslan and Yavuz (2023)	BRICS-MINT/2001-2019	Panel Data Analysis	It was found that there is a cointegration relationship between the variables. It is also concluded that there is a unidirectional causality relationship from financial development to economic growth and a unidirectional causality relationship from financial development to renewable energy.
Şahin (2023)	Türkiye/1990-2020	ARDL Analysis	A significant relationship was found between financial development and renewable energy consumption.

As a general assessment, with the globalisation process, it is important to identify the issues of financial development-economic growth and energy consumption and the relations between these issues. In both time series and panel data analyses, it has been found that there is an interaction between financial development and growth, energy consumption and growth or between financial development and energy consumption and growth.

3.Empirical Findings

3.1.Data Set

In this study, the relationship between financial development indicators, renewable energy consumption and economic growth in Türkiye is analysed using the data set for the period 1990-2021. When the variables are evaluated, GDP per capita (LGDP-2015 US$) is used as the dependent variable, domestic loans provided by banks to the private sector (% GDP) (LK) and broad money supply (LPA), renewable energy consumption (% total energy consumption) (LYEN) variables are used as independent variables. Aslan and Yavuz (2023) study was utilised in determining the model. In this study, a model was constructed as follows and the logarithmic forms of the variables were used.

$$LGDP_t = \beta_0 + \beta_1 LYEN_t + \beta_2 LK_t + \beta_3 LPA_t + \varepsilon_t \quad (1)$$

In Equation 1, 'β' represents both the coefficient and the elasticity coefficients of the variable and 'ε_t' represents the error term of the model. Descriptive statistics of the variables are presented in Table 4

Table 4. Descriptive Statistics

	LGDP	LK	LYEN	LPA
Mean	8.9690	3.3792	2.7815	3.7237
Median	8.9560	3.236	2.6905	3.7149
Maximum	9.5067	4.2612	3.1945	4.2711
Minimum	8.5673	2.6398	2.4336	3.1671
St. deviation	0.2965	0.5874	0.2578	0.2890
Jargue -Bera	2.6369	3.6620	3.0743	1.1092
Jargue –Bera probability	0.2675	0.1602	0.2149	0.5742

In Table 4, economic growth, financial development and renewable energy variables are analysed. According to the Jargue-Bera probability values, the variables are normally distributed.

3.2 Methodology and Evaluation of Findings

3.2.1 Unit Root Test and Results

Time series analysis, which is one of the econometric analyses, is a method based on the values of variables over a time interval and the comparison of these values for different variables. Before statistical analysis of a time series, it should be investigated whether it is stationary or not. On the contrary, t and F tests and R2 value may give biased results in studies with non-stationary results (Zabun, 2015). In this case, the problem of spurious regression occurs (Granger and Newbold, 1974). Therefore, it is important to investigate the stationarity of a series in the model to be analysed. A Yt series,

Average : $E(Y_t) = \mu$

Constant Variance : $var(Y_t) = E(Y_t - \mu)^2 = \sigma^2$ (2)

Constant Covariance : $\gamma_k = E[(Y_t - \mu)(Y_{t+k} - \mu)]$

A time series is said to be stationary if it has the above characteristics (Gujarati, 1999). In this study, Augmented Dickey-Fuller (ADF) (1979-1981) and Phillips- Perron (PP) (1988) unit root tests were used to determine the stationarity levels of the variables. While ADF unit root test is considered as a parametric test, PP unit root test is considered as a nonparametric test (Alpagut, 2023). The unit root test results of the variables in the study are shown in Tables 5 and 6.

Table 5. ADF Unit Root Test Results

	Level				**First Difference**			
	Fixed	Prob.	Fixed and Trend	Prob	Fixed	Prob.	Fixed and Trend	Prob
LGDP	-0.5548	0.9860	-2.4673	0.3407	-5.4406	0.0001	-5.4658	0.0006
LYEN	-1.6197	0.4600	-2.4341	0.3561	-6.4368	0.0000	-6.7859	0.0000
LK	-0.2123	0.9267	2.4489	0.3482	-4.2736	0.0002	-4.2167	0.0001
LPA	-0.5677	0.8634	-2.4707	0.3545	-8.3324	0.0000	-8.1843	0.0000

Note: Critical values for the model with constant are calculated as -3.66 at 1%, -2.96 at 5% and -2.61 at 10%. For the model with constant and trend, critical values are calculated as -4.29 at 1%, -3.56 at 5% and -3.21 at 10%.

Table 6. PP Unit Root Test Result

	Level				First Diffrence			
	Fixed	Prob.	Fixed and Trend	Prob	Fixed	Prob.	Fixed and Trend	Prob
LGDP	-1.7952	0.9996	-2.3734	0.3852	-5.9755	0.0000	-7.2043	0.0000
LYEN	-1.1702	0.6744	-2.2901	0.4266	-7.1200	0.0000	-8.0794	0.0000
LK	-0.3109	0.9122	-1.7311	0.7129	-4.2303	0.0002	-4.1664	0.0013
LPA	-0.8865	0.7790	-2.3890	0.8788	-9.9750	0.0001	-9.9983	0.0000

When the stationarity analyses of the series used in the study are evaluated, it is seen that all variables are not stationary at level according to both ADF and PP unit root tests. With the ADF and PP unit root test applied to the first differences, it is seen that all series become stationary in the first difference. In more technical terms, it is understood that the series are I(1). In order to perform Johansen cointegration test based on VAR analysis, the condition that the series are stationary (I(1)) of the same order is met.

3.2.2. Johansen Co-integration Test and Results

Johansen cointegration test was used to determine the long-run relationship between the series used in the study. In the studies of Johansen (1988) and Johansen- Juselius (1990), Johansen (1988) and Johansen-Juselius (1990) introduced the trace statistic and the max eigenvalue statistic to determine the number of cointegration vectors and their significance levels (Sipahi, 2021).

In the Johansen cointegration test, it is stated that it is important to determine the appropriate lag length (Eryer and Eryer, 2023). The appropriate lag length of the VAR model is shown in Table 7.

Table 7. Determination of Lag Length

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	49.43057	NA	5.69e-07	-3.028704	-2.841878	-2.968937
1	156.9178	179.1455*	1.29e-09*	-9.127857*	-8.193728*	-8.829020*
2	171.7528	20.76890	1.49e-09	-9.050185	-7.368748	-8.512279

Note: LR: Likelihood Ratio FPE: Final Prediction Error AIC: Akaike Information Criteria SC: Schwarz İnformation Criteria HQ: Hannan Quinn

According to FPE, AIC, SIC and HQ information criteria in Table 7, where the VAR model of the variables is installed and the appropriate lag length is shown, the lag length is determined as 1 for the model in question.

After determining the appropriate lag length, the results of the Johansen co-integration test, which is used to determine the long-term relationship between the variables, are shown in Table 8.

Table 8. Johansen Co-integration Results

Hypothesis	**Trace İst.**	**0.05 Critical Value**	**Prob. Value**	**Max. Eigen Value İst.**	**0.05 Critical Value**	**Prob. Value**
r=0*	62.0865	54.0790	0.0082	30.7432	28.5880	0.0261
r≤1	31.3433	35.1927	0.1228	18.569	22.299	0.1532
r≤2	12.774	20.2618	0.3821	7.7572	15.892	0.5769

According to the trace statistic and maximum eigenvalue statistic in Table 8, there is one cointegration vector in the model. According to the estimation results, it was found that there is a long-run cointegration relationship between the variables used in the model. Because the null hypothesis stating that there is no long-run relationship between the variables used in the model (r = 0) is rejected at 5% significance level according to both trace and maximum eigenvalue statistics.

3.2.3. Toda Yamamoto Causality Test and Results

In Toda Yamamoto causality analysis, it is stated that the series are analysed with level values. It is stated that this test has two important advantages over other causality tests. The first one is that it can be applied even if the series have different stationarity conditions. Secondly, it is known as not looking for a cointegration relationship between variables (Meçik & Koyuncu, 2020).

In order to perform Toda Yamamoto causality analysis, the extended VAR model with (k+dmax) lags should be determined as a priority. Here, k indicates the lag length of the model, while dmax indicates the highest degree of integration of the series. It is emphasised that the lag length of the WALD test is determined by summing these two values. Determination of these two values allows the model to be estimated accurately, preventing data loss and enabling more successful results to be obtained at the level level (Toda and Yamamoto, 1995; Okur and Çiçek, 2023). The model of the Toda and Yamamoto test is established as follows:

$$Y_t = \beta_0 + \sum_{i=t}^{k} \beta_{1i} Y_{t-1} + \sum_{j=k+1}^{k+d_{\max}} \beta_{2j} Y_{t-j} + \sum_{i=1}^{k} a_{1i} X_{t-1} + \sum_{j=k+1}^{k+d_{\max}} a_{2j} X_{t-j} + \varepsilon_{1t} \quad (3)$$

$$X_t = c_0 + \sum_{i=t}^{k} c_{1i} X_{t-1} + \sum_{j=k+1}^{k+d_{\max}} c_{2j} X_{t-j} + \sum_{i=1}^{k} d_{1i} Y_{t-1} + \sum_{j=k+1}^{k+d_{\max}} d_{2j} Y_{t-j} + \varepsilon_{2t} \quad (4)$$

In Equation 4, the null hypothesis is that X is not the Granger cause of Y, while the alternative hypothesis is that X is the cause of Y. In Equation 5, while the null hypothesis is that Y is not the Granger cause of X, the alternative hypothesis is that Y is the Granger cause of X.

It was found that there is a long-run relationship between the variables. Toda Yamamoto causality analysis was used to determine the direction of this relationship. In the empirical findings, dmax was determined as 1 for the maximum degree of integration when LGDP, LYEN, LK and LPA variables are considered. The appropriate lag length of the VAR model was determined as 1. By adding the maximum degree of cointegration of the variables to the appropriate lag length of the VAR model (k+dmax= 1+1=2), the second order VAR model analysis was performed. As a result of the findings obtained, the study continued with Toda Yamamoto causality analysis.

Table 9. Toda Yamamoto Causality Results

Dependent Variable LGDP	**Wald st.**	**Prob. Value**
LPA	7.4973	0.0235**
LK	0.8679	0.6479
LYEN	1.6108	0.4469
Dependent Variable LPA	**Wald st.**	**Prob. Value**
LGSYH	8.0159	0.0182
LK	2.4674	0.2912
LYEN	0.1607	0.9228
Dependent Variable LK	**Wald st.**	**Prob. Value**
LGSYH	0.1097	0.9466
LPA	2.4924	0.2876
LYEN	4.6614	0.0972***
Dependent Variable LYEN	**Wald st.**	**Prob. Value**
LGSYH	12.085	0.0024**
LPA	10.4773	0.0053**
LK	0.9570	0.0069**

Note: Test results are obtained from VAR(1+1) at level. **, %5 and ***, %10 indicate critical values.

Causality findings are presented in Table 9. When the test results are analysed, bidirectional causality was found between economic growth and money supply, which represents financial development, at 5% significance level. The results also show that there is a unidirectional causality relationship from economic growth to renewable energy consumption. In this period, the protectionism hypothesis was found to be valid for Türkiye. According to this hypothesis, economic growth is considered as a factor supporting energy consumption (Alper, 2018). In addition, while a unidirectional causality relationship was obtained from money supply to renewable energy consumption at 5% significance level, a bidirectional causality relationship was obtained between the other variable representing financial development, private sector loans provided by banks, and renewable energy consumption at 5% and 10% significance levels. The causality findings obtained are in line with the studies of Apergis and Payne (2010), Alper (2018), Yılmaz and Şen (2018), Yılmaz (2021), Uslu (2022), Aslan and Yavuz (2023) in the literature.

Conclusion

Sustainable economic growth and development are among the main macro objectives of countries. Recently, one of the factors whose impact on economic growth has attracted the most attention is the energy factor. Because energy is seen as one of the basic inputs for the realisation of economic growth. The need for energy continues to increase for both developed and developing countries. In this context, energy and especially renewable energy is one of the issues that need to be addressed today.

Progress in financial markets, diversification of financial instruments in the country and increasing accessibility of these financial instruments are considered as financial development. Thanks to financial development, economic units can utilise their existing savings with the help of different financial instruments. These financial instruments are actively traded in financial markets and offer many choices to investors. In fact, developments in the financial system contribute to the utilisation of savings as investment and the use of resources in more productive areas (Erim and Türk, 2005). With the globalisation process, studies on financial development have also started to gain importance and be discussed. It is an expected phenomenon that the level of financial development increases in parallel with economic development. In particular, its relationship with economic growth, which is one of the macroeconomic factors, has been evaluated in many research topics. Energy is one of these subjects. The integration of clean energy resources into economic activities has become more and more widespread day

by day. Financial development factors such as financial markets, investment methods, and the amount of funds in financial markets are important in the financing of renewable energy investments such as wind, solar and geothermal (Sadorosky, 2010).

In this context, in this study, the relationship between renewable energy consumption, financial development indicators and economic growth is tested using the data set for the period 1990-2021 for Türkiye. In the empirical part of the study, ADF and PP unit root tests were applied to the variables. As a result of the ADF and PP unit root test, it was observed that all variables used in the model became stationary in the first difference. Johansen cointegration test was used to determine the long-run relationship between the variables. In addition, Toda Yamamaoto Causality analysis was used to determine the direction of the relationship between the variables. According to the causality analysis findings, bidirectional causality was found between economic growth and money supply, which represents financial development. While a unidirectional causality relationship was found from economic growth and money supply to renewable energy consumption, a bidirectional causality relationship was found between private sector loans provided by banks, another variable representing financial development, and renewable energy consumption. The findings obtained are consistent with the literature.

The interaction between financial development -renewable energy consumption-economic growth both ensures environmental sustainability and increases economic welfare. In this respect, effective policies should be developed for the efficient functioning of this relationship and innovative and environmentally friendly investments should be supported.

Geographically, Türkiye is a country rich in renewable energy resources. Türkiye can transform its energy resources into renewable energy resources for a sustainable growth and environment. In addition, more investments should be made in renewable energy resources and it can be suggested to support projects for this purpose. In conclusion, country-country group comparisons can be made and policy recommendations can be developed through analyses to be made with different structural break techniques.

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Chapter 6

Economic Growth Population and Cultural Economy in Türkiye

İbrahim Aytekin[1]

Abstract

This research examines the relationship between economic growth, population and cinema culture in Türkiye. To determine the relationship between these variables, the time series analysis method was preferred. Based on the results of the unit root tests, the autoregressive distributed lag (ARDL) bounds test and the Toda-Yamamoto causality test were used in the analysis. The period between 1978 and 2023 was used as the analysis period. In this direction, according to the ARDL bounds test analysis results, no cointegration relationship was found between the variables. According to the results of the Toda-Yamamoto causality tests, a bidirectional causality relationship was found between the number of cinema audiences and the population growth rate in Türkiye. Likewise, a bidirectional causality relationship was found between growth and the number of cinema audiences. Finally, a unidirectional causality relationship was found from population growth rate to economic growth.

1. INTRODUCTION

Weber's "Protestant Ethics and the Spirit of Capitalism" is generally recognised as a work dealing with the relationship between religion and economic development. However, in a real sense, this work is implied as a work that contains the first research on the relationship between culture and economic growth. In fact, this work emphasises the beginning of a period when economic research began to ignore culture (Jong, 2015: 528). Therefore, when we look at the historical process, it is possible to say that population, economy and culture are affected by each other. The increase in population increases the labour supply as well as the number of consumers.

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While the increase in the number of consumers increases the demand for goods and services, it supports production and this can be a driving force for economic growth. Increasing income and welfare along with growth increases the demand for cultural goods and services as well as the demand for other goods and services.

In this framework, this study aims to empirically examine the relationship between economic growth, population and the number of cinema audiences in Türkiye between 1978 and 2023. Due to data limitations and the aim of creating common data, the limitations of the study are drawn within the boundary between 1978 and 2023.

Some studies on economic growth, population and cultural economy in the literature: Güneş (2005), Khan et al. (2010), Telatar & Terzi (2010), Shi et al. (2012), Erataş, Alptekin & Uysal (2013), Karakaş (2016), Uçan & Kaçar (2017), Polat (2018), Coşkun-Yılmaz (2023), Tiryaki & Ekinci (2023), Ajayi (2023), Leitao et al. (2023), Alarussi & Yen (2023), Chukwunonso (2024), Hasnawati et al. (2024), Alemu & Zegema (2024). These studies differ from each other in terms of the countries or country groups, variables and results obtained. The characteristics that distinguish this study from the studies in the literature: It is possible to list the characteristics that distinguish this study from the studies in the literature as follows: it is a Türkiye-specific study, the analysis period is unique and it differs from other studies in terms of the results obtained.

This research is designed as follows. The general framework of the study is outlined in the introduction in Section 1, and the theoretical foundations of economic growth, population and cultural economy are discussed in Section 2. Section 3 presents the existing literature. Section 4 presents the data and the empirical methods used. Section 5 presents the findings of the analyses and the interpretations of these findings, and finally, Section 6 presents conclusions and recommendations.

2. THEORETICAL BACKGROUND

2.1. Economic Growth

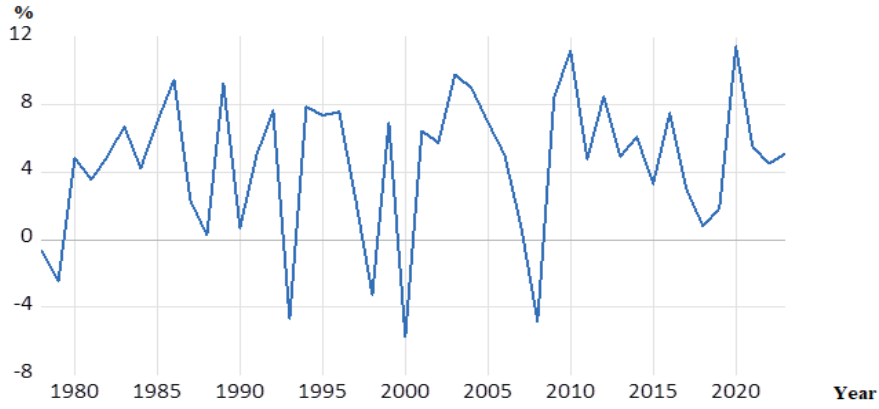
Economic growth is defined as the outward shift of the production possibilities curve and the increase in the potential gross domestic product (GDP) in the economy due to the increase in labour supply due to capital, technological progress and population growth. In other words, it is the achievement of sustainable increases in production volume and income in the long run within the limits of natural resources, population structure and institutional structures (Dikmen, 2022: 43-44).

One of the main economic policies of countries is to achieve the targeted growth in the economy. Of course, achieving this target is not enough. Because this target must also be sustainable. Therefore, with the achievement of sustainability in economic growth, there will be an increase in production and employment, as well as an increase in the income level of the society. Until the Industrial Revolution, the dominant sector in the global economy was agriculture. The industrial revolution was a turning point for production and mass production was rapidly introduced. In this process, countries that quickly adapted to the industrial revolution and industrialised have made significant progress in economic growth, while the economic growth and development rates of countries lagging behind in this process have progressed slowly (Sayar-Özkan & Çelik, 2018: 2).

It is possible to categorise the sectors that contribute to the growth of the economy into two categories: public and private sectors. However, it should be said that the shares and contributions of these sectors in economic growth vary from country to country (Çelik & Paksoy, 2021: 740). Today, although developed countries have reached their desired targets in economic growth, the desire to make this target sustainable, as well as the desire to improve the periodic growth level, continues. In most of the developing countries, including Türkiye, economic growth figures are not at the targeted levels and stability. Therefore, these countries are implementing various economic policies in order to reach their desired targets and achieve sustainability in economic growth (Dikmen, 2022: 43-44).

In this study, Türkiye's annual gross domestic product is used as an economic growth variable. In this framework, the time series graph showing the annual growth rate of Türkiye between 1978 and 2023 is given below.

Figure 1. Economic growth in Türkiye (1978-2023)



Source: The World Bank and Türkiye Statistical Institute

When we look at the time series graph of the economic growth rate of Türkiye, which is in the category of developing countries, between 1978 and 2023, it is possible to see that there is a serious fluctuation in the graph. These fluctuations show that Türkiye has not yet achieved stability in economic growth and this situation is unfavourable for sustainable growth. It is understood from the graph breaks in the years 1994, 1999, and 2001 national economic crises and 2008 global economic crisis that Türkiye's growth figures were adversely affected by national and international economic crises. In addition, it is possible to read from the graph that the foreign exchange shocks experienced in Türkiye in 2018 negatively affected economic growth.

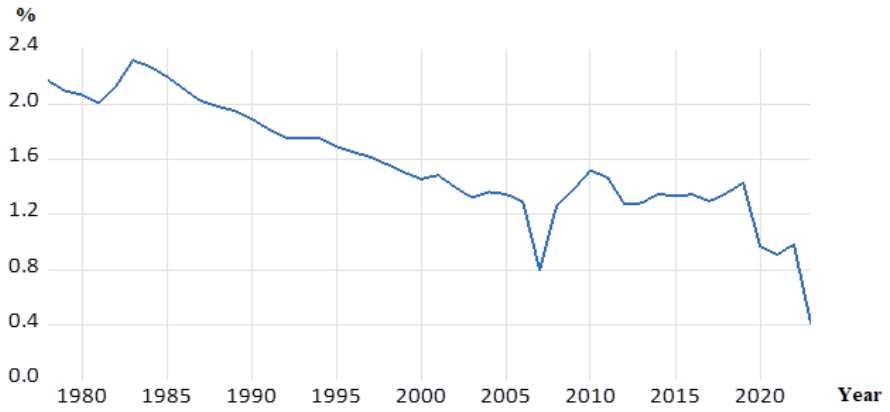
2.2. Population

Population growth rate is the increase in the number of people living in a country, region, city or town over time (Hasnawati, et al., 2024: 486). For nearly two centuries, population, economy and welfare have been a subject of debate for researchers. The starting point of these discussions is Thomas Malthus's 'An Essay on the Principles of Population' in 1798. In this work, Malthus stated that "population increases geometrically, but the products such as food etc. that people need to sustain their lives increase arithmetically". According to Malthus, the increase in population will cause the needs to reach unmet dimensions, and this situation will lead to various disasters. However, Malthus stated that this process has a self-control mechanism. As a matter of fact, if states do not activate this mechanism and take the population under control, after a certain level, population growth will lead to an increase in situations such as war, epidemics, disease, crime, poverty, and thus the population will control itself due to such reasons. The neo-classical economic approach, one of the leading representatives of contemporary economic thought, on the other hand, is of the view that capital variation and technological developments will make population growth no longer a problem and that population is even a positive driving force for the economy (Güneş, 2005: 124).

Population growth is important as a source of supply of labour, which is crucial for production. For example, in developed countries, where the population growth rate is extremely low, the problem of an "ageing society" arises and they are faced with labour force problems that strain their pension systems. On the other hand, most developing countries are experiencing rapid population growth that affects the economy. Development economists emphasise the relationship between economic development and population growth. The positive interaction between economic development and

population growth is important for developing countries as it promotes not only development but also welfare and living standards. This is because population growth is a driving force for competition in commercial activities and as the population increases, the active market expands. The expansion of the market means that entrepreneurs can expand their businesses as well as the opening of new investment areas (Konat & Fendoğlu, 2021: 281). In this study, Türkiye's annual population change rate is used as the population variable. In this framework, the time series graph showing the rate of population change in Türkiye between 1978 and 2023 is given below.

Figure 2. Türkiye's population growth rate (1978-2023)



Source: The World Bank

When the graph in Figure 2, which shows Türkiye's population growth rate between 1978 and 2023, is analysed, it is seen that Türkiye's population growth rate trend is generally decreasing. Here, it is understood from the graph that although Türkiye's population is constantly increasing, the rate of increase is decreasing.

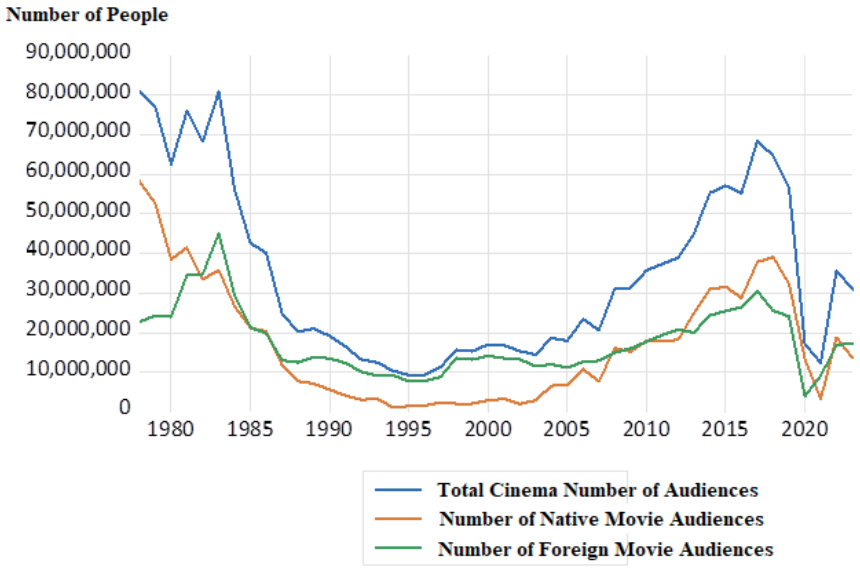
2.3. Cultural Economy

The cultural economy consists of the totality of cultural industries whose basic inputs are creativity and cultural labour and whose outputs are artistic and architectural works, events and cultural industries that bring together cultural buyers and sellers, protected by intellectual property rights. The categorisation of cultural activities as economic activities does not devalue culture; on the contrary, it expands the economic impact of culture from local to national and from national to international dimensions. In this direction,

it is possible to list the main fields of the cultural economy as follows: Publishing industry, film industry, visual publishing, music, performing arts, visual and plastic arts, museums, retail trade of cultural materials, architecture, design industry and modern creativity (Erataş, Alptekin and Uysal, 2013: 27-28).

The potential of cultural factors to influence economic growth and development has been the subject of considerable debate among academics and policy experts. However, economic theory, especially the neo-classical approach, does not take cultural factors into account in terms of development and economic growth. Instead, variables such as human and physical capital and technological development are considered as the main factors affecting growth and development regardless of the cultural environment. For this reason, the traditional economic understanding gives little attention to cultural factors when trying to find solutions to economic problems (Altman, 2001: 379-380). Recently, however, there have been significant changes in economic, social and technological fields. In particular, the emphasis on the concept of creativity has led to a better recognition of the pervasive role of cultural production in terms of creative industries and talent. In this process, revolutionary developments in digitalisation have changed the role of culture in production and consumption. In addition, the increase in prosperity and positive economic developments in regions outside the western regions have contributed to putting culture and heritage on the agenda of many developing countries (Bertacchini & Segre, 2016: 69). Defined as a cultural activity, cinema is one of the most important sectors in terms of cultural economy. Therefore, in this study, the total number of domestic and foreign cinema audiences in Türkiye is used to represent the cultural economy. The time series graph showing the number of domestic, foreign and total cinema audiences in Türkiye between 1978 and 2023 is given below.

Figure 3. Number of cinema audiences in Türkiye (1978-2023)



Source: Türkiye Statistical Institute 100th year basic indicators

When we look at Figure 3, it is seen that the direction of movement of the total number of cinema audiences and the number of domestic and foreign film audiences in Türkiye between 1978 and 2023 are generally similar. It is understood from the graph that the total number of film viewers in Türkiye was around 80 million people in the years before 1980, and this figure decreased to 10 million people in 1995 and 2000. One of the main reasons for this situation is the introduction of televisions in Türkiye at that time, the widespread use of film viewing devices in homes, other technological developments and the slow spread of the internet. These developments also paved the way for the emergence of the pirated film industry. The development of the film piracy sector has, of course, caused a decrease in the number of cinema audiences. The number of cinema viewers, which started to increase again after the 2000s, approached the figures in the 1980s until 2020 when Covid-19 broke out. It is also understood from the figure that the cinema sector, which experienced a sharp decline with Covid-19, has entered a recovery process again.

3. LITERATURE REVIEW

It is possible to list some of the studies on economic growth, population and cultural economy in the literature as follows. Güneş (2005), Khan et al.(2010), Telatar & Terzi (2010), Shi et al. (2012), Erataş, Alptekin &

Uysal (2013), Karakaş (2016), Uçan & Kaçar (2017), Polat (2018), Coşkun-Yılmaz (2023), Tiryaki & Ekinci (2023), Ajayi (2023), Leitao et al. (2023), Alarussi & Yen (2023), Chukwunonso (2024), Hasnawati et al. (2024), Alemu & Zegema (2024). Detailed summarized information about these studies is given below in a chronology from past to present.

Güneş (2005), who analyzed the population and growth variables of Türkiye between 1943-2003 using the time series method, observed that population has a short-term effect on economic growth, but the effect of economic growth on population is long-run. Khan et al. (2010), in their study of selected Asian countries for the period 1995-2007, found that respect and self-determination, which constitute a culture of trust, have a positive effect on economic growth. However, cultural attitudes related to obedience were found to have a negative relationship with economic growth. Telatar & Terzi (2010) analysed Türkiye's growth, population and education variables using the time series method for the period 1968-2006 and found a negative causality relationship from economic growth to population and a positive causality relationship towards higher education graduates. Shi et al. (2012), in a study of China between 1978-2008, show that Christian commercial culture has a positive impact on economic performance. In addition, it is observed that culture has a heterogeneous effect on economic development in different regions of China.

Erataş, Alptekin & Uysal (2013), in their study of the 1995-2011 period in Türkiye, observed that within the framework of the cultural economy, promising developments have been observed in the sub-sectors of performing arts, visual arts, plastic arts and film industry in Türkiye as a whole, in the Aegean region and in the Central Anatolia region. Karakaş (2016) analysed the population, carbon dioxide, and per capita welfare variables of 61 selected countries with different income structures between 1990-2013 using the panel data method. In the study, the population was found to be the cause of both per-capita welfare and carbon dioxide increase. It is also found that per capita welfare increases carbon emissions. Uçan & Kaçar (2017) analysed the variables of energy consumption, economic growth and population for Türkiye for the period 1980-2010 using the time series method. They found a unidirectional causality relationship between population and energy consumption and gross national product.

Polat (2018) analysed the economic growth and population variables in Türkiye and used the time series analysis method for the period 1998-2015. In this framework, it was observed that a causality relationship was found from population to growth. Coşkun-Yılmaz (2023) investigated the

relationship between GDP per capita and population growth in Türkiye for the period 1980-2021 using the time series method. In the study, a long-run causality relationship was found between population growth and GDP per capita. In this framework, it is concluded that population growth in Türkiye has a positive effect on GDP per capita. Tiryaki & Ekinci (2023) analysed Türkiye's population, economic growth, life expectancy, capital formation and inflation variables for the period 1968-2019 using time series method. In the study, it is observed that population affects economic growth negatively in the short run but positively in the long run. In addition, life expectancy and capital formation affect growth positively in the short and long run, while the effect of inflation is negative in the long run.

Ajayi (2023) analysed the effects of mineral rents, conflict and population growth on the economic growth of 13 selected countries in Sub-Saharan Africa from 1980-2022 using the panel data method. The study revealed the long-term negative effects of population growth rates and the prevalence of civil war on economic growth. Leitao et al. (2023) analysed the effects of the environmental Kuznets curve and the determinants of economic growth for the Visegrad countries between 1990-2018 using the panel data method. In the study, the relationship between urban population and foreign direct investment and economic growth is positive. Alarussi & Yen (2023) examined the impact of population ageing (demographic changes) on economic growth (measured by labour supply, household savings and labour productivity) in China, Japan and Malaysia using the panel data method for the period from 1990 to 2018. The findings show that as the population ages, the negative impact on the economy increases. In fact, it is observed that population ageing has a negative impact on the labour supply. In addition, the effect of population ageing on housing savings is negative in Japan and Malaysia and positive in China.

Chukwunonso (2024) analysed the impact of population growth and climate change on Nigeria's economic growth for the period 1981-2021 using the time series method. Cointegration relationship was found between all variables used in the analysis. In addition, it was found that population growth positively and significantly affects economic growth in the short and long run. On the other hand, climate change has a negative and insignificant effect on economic growth in the short and long run. Hasnawati et al. (2024) analysed the relationship between life expectancy at birth, carbon dioxide emissions, population growth and gross domestic product growth variables for the period 1950-2020 using the time series method in Indonesia. While a bidirectional causality relationship was found between life expectancy at birth and population growth, no causality relationship was found between gross

domestic product and population. Alemu & Zegema (2024) investigated the dynamic effect of population and economic growth in Ethiopia for the period 1991-2022 using the time series method. It is found that population growth has a more short-term positive impact on economic growth.

4. DATA SET AND METHOD

In this Türkiye-specific study, economic growth, total population and total number of cinema audience variables are considered. Due to the common data constraint, the analysis period started in 1978 and ended in 2023. Detailed information on these variables is given in Table 1.

Table 1. Data set and source

Variables	Explanation	Source
Growth	Annual % change rate of GDP	The World Bank Turkish Statistical Institute
Population	Annual % change	The World Bank
Cinema Audience	Logarithmic transformation of the sum of the number of domestic and foreign cinema film viewers	Turkish Statistical Institute 100th year basic indicators

Based on the results of the unit root tests, the autoregressive distributed lag (ARDL) bounds testing and the Toda-Yamamoto causality test were used as time series analysis methods.

ARDL bounds test is a time series estimation model developed to determine whether there is a cointegration relationship between variables. This model, developed by Pesaran, Shin, & Smith (2001), is an estimation model that can be used when the variables are stationary at different orders (Pesaran, Shin, & Smith, 2001). The ARDL bounds test estimation model for economic growth, population and cinema audince variables considered in this study is as in equation 1 below (Nazir, et al., 2018: 951):

$$\Delta \text{Cinema Audienc} = \beta_0 + \sum_{i=1}^{p} \beta_{1ik} \Delta Cinema\ Audience_{2t-i} + \sum_{i=0}^{p} \beta_2 \Delta \text{Growth}_{t-i} + \sum_{i=0}^{p} \beta_3 \Delta \text{Population}_{t-i} + \lambda_1 Cinema\ Audience_{2t-i} + \lambda_2 \text{Growth}_{t-i} + \lambda_3 \text{Population}_{t-i} + \varepsilon_t \quad (1)$$

Toda-Yamamoto (1995) causality test is a time series estimation model that analyses the causality relationship between variables. In this model, as in the ARDL bounds test, it can be applied to variables that are stationary at different orders (Toda & Yamamoto, 1995). The Toda-Yamamoto causality test estimation equations for economic growth, population and cinema attendance variables considered in this study are as follows (Sotiropoulou, 2023: 175):

$$\text{Growth}_{i,t} = \alpha_{1i} + \sum_{p=1}^{k+m} \beta_{1i,p} Growth_{i,t-p} + \sum_{p=1}^{k+m} \lambda_{1i,p} \text{Population}_{i,t-p} + \sum_{p=1}^{k+m} \&_{1i,p} \text{Cinema Audience}_{i,t-p} + \varepsilon_t \quad (2)$$

$$\text{Population}_{i,t} = \alpha_{2i} + \sum_{p=1}^{k+m} \beta_{2i,p} Growth_{i,t-p} + \sum_{p=1}^{k+m} \lambda_{2i,p} \text{Population}_{i,t-p} + \sum_{p=1}^{k+m} \&_{2i,p} \text{Cinema Audience}_{i,t-p} + \varepsilon_t \quad (3)$$

$$\text{Cinema Audience}_{i,t} = \alpha_{3i} + \sum_{p=1}^{k+m} \beta_{3i,p} Growth_{i,t-p} + \sum_{p=1}^{k+m} \lambda_{3i,p} \text{Population}_{i,t-p} + \sum_{p=1}^{k+m} \&_{3i,p} \text{Cinema Audience}_{i,t-p} + \varepsilon_t \quad (4)$$

5. FINDINGS AND EVALUATION

Before the findings of the study, summary statistics of the variables are given in Table 2.

Table 2. Summary statistics

	Growth	Population	Cinema Audience
Mean	4.512	1.572	17.156
Median	5.039	1.494	17.138
Maximum	11.439	2.315	18.210
Minimum	-5.750	0.406	16.046
Std. Dev.	4.196	0.418	0.664
Skewness	-0.743	-0.256	0.071
Kurtosis	3.016	2.939	1.697
Jarque-Bera	4.237	0.510	3.290
Probability	0.120	0.774	0.192
Observations	46	46	46

Each variable used in the research consists of 46 observations. Looking at the growth rate, it is seen that the highest growth rate figure was 11.439% and this growth rate was realised in 2020, while the lowest growth rate was -5.750% and this figure was realised in 2000. Türkiye's average growth rate between 1978 and 2023 was 5.039%. The fact that the skewness value of growth is negative indicates that growth is skewed to the left, and the kurtosis coefficient is greater than zero indicates a pointed distribution.

When the population growth rate is analysed, it is seen that the highest population growth rate was 2.315% and this growth rate was realised in 1983, while the lowest population growth rate was 0.406% and this figure was realised in 2023. Türkiye's average population growth rate between 1978 and 2023 was 1.572%. The fact that the skewness value of population

growth is negative, as in growth, indicates that the population growth rate is skewed to the left, while the kurtosis coefficient is greater than zero indicates a pointed distribution.

Finally, when we look at the number of cinema attendance, the highest attendance figure is 18,210 and this figure belongs to 1978 with 81,040,712 people. The lowest attendance figure is 16,046, which belongs to 1995 with 9,305,694.00 people. The average number of people going to the cinema in Türkiye between 1978 and 2023 is 17,156 and this figure is 34,848,031.98 people. The fact that the skewness coefficient of the number of cinema attendance takes a positive value in contrast to the growth and population shows that the demand for cinema is skewed to the right, and the kurtosis coefficient being greater than zero shows a pointed distribution.

Table 3. Unit root test findings

	ADF		**PP**	
Model	**Constant**	**Constant and Trend**	**Constant**	**Constant and Trend**
Level	t-Statistic [Prob]	t-Statistic [Prob]	t-Statistic [Prob]	t-Statistic [Prob]
Growth	-3.584 [0.000]*	-4.175 [0.000]*	-3.584 [0.000]*	-4.175 [0.000]*
Population	-3.584 [0.081]	4.175 [0.291]	-3.584 [0.086]	-4.175 [0.314]
Cinema Audience	-3.584 [0.298]	-4.175 [0.638]	-3.584 [0.281]	-4.175 [0.639]
First difference	**Constant**	**Constant and Trend**	**Constant**	**Constant and Trend**
ΔPopulation	-3.588 [0.000]*	-4.180 [0.000]*	-3.588 [0.000]*	-4.180 [0.000]*
ΔCinema Audience	-3.588 [0.000]*	-4.180 [0.000]*	-3.588 [0.000]*	-4.180 [0.000]*

Note: * is significant at 1% significance level.

According to the unit root test results given in Table 3, the growth variable is stationary at 1% significance level according to the two models of ADF and PP unit root tests. Population and cinema attendance variables are stationary at 1% significance level according to the two models of ADF and PP unit root tests. After applying the unit root test, it is observed that the trends of growth and cinema attendance are not significant. However, the trend of population growth rate is significant and therefore, population growth rate is included in the analysis by removing the trend. As a result, the

variables were found to be stationary at different orders and it was decided to apply ARDL bounds test and Toda-Yamamoto causality test to the variables.

Table 4. ARDL bounds test findings

Test Statistic	**Value**	**k**
F-statistic	2.503	2
Critical Value Bounds		
Significance	**I(0) Bound**	**I(1) Bound**
10%	3.17	4.14
5%	3.79	4.85
1%	5.15	6.36

It is observed that the F statistic value of the ARDL bounds test in Table 4 is below the lower bound values of all significance levels. According to these results, it shows that there is no cointegration relationship between the variables.

Following the ARDL bounds test, Toda-Yamamoto causality test was applied to the variables. While applying this test, the lag length was chosen as 2 by taking into account the AIC information criterion, and dmax was taken as 1, where the variables are stationary at the highest order.

Table 5: Causality test findings

Dependent variable: Cinema Audience			
Excluded	**Chi-sq**	**df**	**Prob.**
Population	11.203	2	0.003*
Growth	5.039	2	0.080***
All	13.914	4	0.007*
Dependent variable: Population			
Excluded	**Chi-sq**	**df**	**Prob.**
Cinema Audience	8.364	2	0.015**
Growth	0.885	2	0.642
All	8.765	4	0.067***
Dependent variable: Growth			
Excluded	**Chi-sq**	**df**	**Prob.**
Cinema Audience	6.118	2	0.046**
Population	7.514	2	0.023**
All	10.197	4	0.037**

Note: * is significant at 1%, ** at 5%, *** at 10% significance level.

When Table 5 is examined, it is confirmed at a 1% significance level that the rate of population growth is the cause of the number of cinema viewers. On the other hand, it is found significant at 10% significance level that the rate of growth is the cause of the number of cinema viewers.

It is found significant at a 5% significance level that the increase in the number of cinema viewers is the cause of the population growth rate. According to another result, it is found significant at a 5% significance level that the increase in population growth rate and the increase in the number of cinema audiences are the causes of growth.

Based on these results, it is determined that there is a bidirectional causality relationship between the number of cinema audiences and the population growth rate. Likewise, it has been determined that there is a bidirectional causality relationship between growth and the number of cinema audiences.

6. CONCLUSION AND DISCUSSION

In the analyses conducted in this study, no cointegration relationship was found between the variables. After the cointegration test, the causality relationship between the variables was examined.

The first step of the causality test is the part where the number of cinema viewers is taken as the dependent variable and economic growth and population are taken as independent variables. Here, the results show that economic growth and population growth rate are the causes of the number of cinema audiences. According to this result, it has been shown that people increase their spending on cultural activities with economic growth in Türkiye and that economic growth in Türkiye is a macroeconomic variable that supports cultural economy. Like economic growth, population growth in Türkiye also increases the number of cinema audiences and this shows that the population naturally increases the demand for cultural economy. Therefore, it has been determined that as Türkiye grows economically and in terms of population, the consumption of cultural economy increases.

The second step of the causality test in the study consists of the part where the population is taken as the dependent variable and economic growth and a number of cinema audiences are taken as independent variables. Here, the results show that the number of cinema viewers is the cause of the population growth rate. In other words, as the number of cinema viewers in Türkiye increases, the population increases. This result shows us that the cinema industry in Türkiye is not only a place where people come together, have fun and have a good time, but also a cultural economic activity where some people meet and establish a home in addition to cultural exchange.

The third step of the causality test in the study consists of the part where economic growth is taken as the dependent variable and population and number of cinema audiences are taken as independent variables. In this section, it is determined that the population growth rate and the increase in the number of cinema audiences are the causes of economic growth in Türkiye. According to this result, it shows that the labour supply increasing with the population growth in Türkiye supports production. According to another result, it is possible to say that the development of cinema culture and industry in Türkiye supports production by providing employment and investment opportunities in the cultural economy and services sector as well as indirectly affecting other sectors.

The findings obtained in this study support the results of studies conducted both in Türkiye and other countries and country groups in the literature; Güneş (2005), Khan et al. (2010), Shi et al. (2012), Erataş, Alptekin & Uysal (2013), Uçan & Kaçar (2017), Polat (2018), Coşkun-Yılmaz (2023), Leitao et al. (2023), Chukwunonso (2024), Alemu & Zegema (2024).

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Chapter 7

Green Economic Growth and the Performance of the Turkiye Economy

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Abstract

This study examines the concept of green economic growth within the framework of Türkiye's transition to a sustainable green economy. By outlining the historical and theoretical foundations of green economy principles, it explores Türkiye's economic, environmental, and policy transformations in the context of global green transitions. Key indicators from the 2017-2023 period are analyzed to evaluate Türkiye's efforts in promoting renewable energy, enhancing energy efficiency, and encouraging environmentally friendly practices.

The findings highlight significant progress in renewable energy investments, particularly in wind and solar power, which have enabled substantial advancements in this sector. By 2023, the share of renewable energy in total electricity generation reached 41.73%. However, challenges persist in achieving substantial reductions in CO2 emissions and improving energy efficiency. Türkiye's development plans and national policies emphasize alignment with international standards, the promotion of green financing, and the adoption of innovative technologies. For Türkiye to achieve its green economic growth objectives, more integrated strategies and robust policy support are essential. This analysis aims to contribute to the academic literature and policymaking processes by presenting Türkiye's experiences and potential pathways in green transformation.

This study aims to provide insights into Türkiye's green transformation journey, offering valuable contributions to both academic discourse and policymaking processes by identifying key experiences and outlining potential pathways for further progress in sustainable economic development.

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1. INTRODUCTION

The Industrial Revolution marked the beginning of a period during which economic systems prioritized competitive growth and industrialization, often disregarding the finite nature of natural resources. This trend intensified in the post-World War II era, resulting in production and consumption patterns that have led to significant global challenges. In recent decades, growing international competition, technological advancements, rapid urbanization, and environmental degradation have contributed to a reduction in green spaces, overuse of natural resources, and escalating climate change issues.

The concept of "sustainable development," which gained prominence in the late 20th century and became widely recognized through international agreements in the 1990s, proposes a model aimed at meeting the needs of the present generation without compromising the ability of future generations to meet their own needs. However, the relentless pursuit of economic growth has heightened pressure on limited natural resources, raising critical concerns about sustainability. To address these concerns, it has become crucial for nations to align their economic policies with sustainability principles (Tsonkoy, 2021: 1-2).

In light of the increasing inability of existing economic systems to tackle the intensifying global crises linked to inefficient resource use, a paradigm shift has become essential. Economies must incorporate the limitations of natural resources into their development strategies, emphasizing environmental sustainability and the well-being of future generations. Within this context, the concepts of green economy and green economic growth have emerged as key tools for fostering environmentally conscious and sustainable economic progress. Through policies focused on green growth, it will be possible to achieve broader economic integration, enhance technological cooperation, and develop regulatory frameworks and standards aimed at reducing dependency on and pressure on limited natural resources (Özen Atabey, 2022: 55).

This study aims to explore the concept of green economic growth, assess its scope, and evaluate Türkiye's efforts in transitioning to a green economy while examining its performance in this area. The study delves into the historical development and evolution of green economic growth as a concept, situating it within a broader theoretical framework. Additionally, it investigates the structural transformations occurring within Türkiye's economy, particularly as it navigates the global shift toward sustainable development and resource-efficient practices. Through an analysis of Türkiye's policy approaches and economic adjustments in this transition,

the research provides insights into the country's position within the broader green economic movement. Furthermore, it offers policy recommendations to support Türkiye's ongoing adaptation to this global green transformation, contributing both to the academic discourse and to the development of actionable strategies.

2. THE SCOPE AND CONCEPTUAL FRAMEWORK OF GREEN ECONOMIC GROWTH

2.1. The Concept of Green Economy

At the core of economics lies the principle of meeting unlimited human needs with limited resources. Throughout history, individuals have focused on increasing their personal incomes to satisfy their boundless needs, leading nations to develop policies aimed at enhancing economic growth and development, often disregarding the constraints of limited resources. This competitive approach to economic growth, which placed resource scarcity as a secondary consideration, has caused irreversible damage to ecosystems. Over time, these growing problems have necessitated the more efficient use of limited resources to ensure the sustainability of economic growth and leave a more livable planet for future generations.

As a result, the concept of a "green economy," which prioritizes ecosystems, equitable resource distribution, and sustainable economic growth, has emerged as a focal point for researchers. Within the literature, the concept of the green economy has undergone significant transformations over time, resulting in various definitions. Therefore, it is challenging to identify a single, universally accepted definition of what the green economy entails (Newton & Cantarello, 2014: 2–3).

The United Nations Environment Programme (UNEP) defines the concept of a green economy as a policy proposition aimed at enhancing societal well-being and social equity while simultaneously reducing environmental risks and damages (UNEP, 2011). The optimal utilization of natural resources and all forms of capital is achievable through sustainable development, which, in turn, is made possible through green economy policies. Furthermore, the goals of green economic growth have been identified as the revitalization of the global economy, achieving inclusive and sustainable growth, creating new green jobs and employment opportunities to address unemployment, and protecting disadvantaged groups within society by providing them with necessary support (UNEP, 2011).

Although the emergence of the green economy concept is often attributed to the ecological and environmental degradations observed in developed economies, it was first explicitly articulated in the work "*Blueprint for a Green Economy*" (Ehresman & Okereke, 2015: 5). Researchers generally approach the green economy by focusing on its environmental and economic dimensions. The environmental dimension encompasses issues such as renewable energy, climate change, and natural capital, while the economic dimension includes economic growth, sustainable development, cost management, and competitive efficiency (Loiseau et al., 2016: 362–363). Since the global financial crisis of 2008, interest in the green economy has exhibited an upward trend. Before the crisis, subsidy policies aimed at promoting green economic activities were implemented, and the valuation of green technology firms increased. However, on a global scale, it appears that the steps taken toward a green economy have yet to reach a transformative level (Georgeson et al., 2017: 3).

The *Guidebook to the Green Economy* is a comprehensive guide that consolidates the principles of the green economy from various organizations. When these principles are evaluated as a whole, the concept of the green economy can be analyzed through three fundamental dimensions: environmental, social, and economic (UNDESA, 2012: 20-21).

- Economic Dimension:

The economic dimension of the green economy focuses on goals such as achieving sustainable development, enhancing energy and resource efficiency, supporting green economic growth, and creating green jobs. These principles emphasize the transition to an economic model that responsibly manages limited resources while fostering sustainability.

- Social Dimension:

The social dimension prioritizes reducing poverty, improving societal well-being, and ensuring intergenerational and international equity. This dimension supports an inclusive approach that ensures all segments of society benefit equally from economic growth.

- Environmental Dimension:

The environmental dimension revolves around principles such as preventing biodiversity loss and pollution, investing in natural resources, and achieving international environmental sustainability targets. It promotes the protection of ecosystems and encourages global collaboration to mitigate the adverse impacts of climate change.

By integrating economic, social, and environmental dimensions, the green economy offers a framework that promotes sustainable growth while aiming for ecological preservation and social equity. The simultaneous consideration of these three dimensions provides a viable alternative to the unsustainable practices associated with the brown economy.

The United Nations Environment Programme (UNEP) defines the green economy as a concept that enhances societal well-being and equitable distribution while reducing environmental risks and promoting the efficient use of limited natural resources (UNEP, 2011: 1).

The Green Economy Coalition has identified five fundamental principles to ensure a fair, effective, and swift global economic transition (Green Economy Coalition, 2020: 13-18):

- The Wellbeing Principle:

The green economy places human well-being and equitable distribution of resources at its core. Well-being refers not only to financial prosperity but also to improvements in social, human, natural, and physical dimensions of welfare. This principle aims to create a sustainable investment environment that fosters global opportunities for all individuals, driving national prosperity through the transition to green jobs.

- The Justice Principle:

As an inclusive concept, the green economy emphasizes intergenerational equity and the fair distribution of costs. It supports the empowerment of disadvantaged groups, including women, workers, and minorities, while promoting fairness and equality across all sectors of society.

- The Planetary Boundaries Principle:

The green economy acknowledges the importance of addressing economic issues while safeguarding cultural and ecological values. It advocates for investments in natural resources and aims to create societal awareness of potential risks associated with limited natural resources, with the goal of minimizing these risks.

- The Efficiency and Sufficiency Principle:

The green economy promotes the adoption of sustainable development models that prioritize resource efficiency, low-carbon usage, and innovative technologies. It seeks to establish an economy where sustainable and innovative technologies are central to growth.

- The Good Governance Principle:

Grounded in scientific evidence, the green economy emphasizes the integration of institutions into the economy with a focus on transparency, accountability, inclusivity, and reliability. This principle also underlines the importance of sustainable and dependable employment opportunities that serve the broader interests of society.

These principles collectively provide a robust framework for achieving sustainable and inclusive economic development, offering solutions to ecological and societal challenges through the lens of a green economy.

2.2. The Concept of Green Economic Growth

In the literature, there are various definitions of the concept of green economic growth. The World Bank defines green economic growth as an economic growth model that ensures the efficient use of limited natural resources, incorporates resilient and effective environmental management, and includes policies that enable rapid recovery from natural disasters (World Bank, 2021: 24).

The concept of green economic growth was first introduced at the Fifth Ministerial Conference on Environment and Development in 2005, where the necessity of green economic growth policies for achieving sustainable development was emphasized (Kanianska, 2017: 19). Following the global financial crisis of 2008, green economic growth was adopted as a strategy. The inability of existing economic policies to address the global crisis led to the emergence of green economic growth strategies. Notably, the Organisation for Economic Co-operation and Development (OECD) and the United Nations Environment Programme (UNEP) have conducted various policy studies at the global level to facilitate economic growth and sustainable development in countries. Consequently, the concept of sustainable development has gained a new dimension.

Green economic growth has been recognized in the literature as both a complement to the dimensions of sustainable development and a concept that promotes green economy initiatives. Among the various definitions, the OECD's definition of green economic growth is one of the most widely accepted in the literature. According to the OECD, green economic growth is an economic system that promotes economic growth and innovation while ensuring the efficient use of natural resources and maintaining the ecological system for societal well-being (OECD, 2011: 4).

The concepts of green economic growth and green economy offer solutions to address the challenges of limited natural and energy resources. They propose more effective and innovative policies while taking into

account climate issues and resource scarcity. These concepts also aim to ensure sustainability by providing actionable policy solutions (Kasztelan, 2017: 491).

Economic growth is typically defined as the annual increase in Gross Domestic Product (GDP). However, GDP is not widely regarded as a macroeconomic indicator that accurately reflects improvements in societal well-being (Stiglitz et al., 2009: 21). The concepts of economic growth and green economic growth differ significantly in this regard.

Green economic growth emphasizes the efficient use of limited natural resources, minimizing environmental damage, and adopting more equitable distribution mechanisms alongside sustainable policy strategies (Hallegatte et al., 2012: 3).

3. TÜRKİYE'S GREEN ECONOMIC TRANSITION PROCESS AND GROWTH PERFORMANCE

3.1. Steps Toward Green Economic Growth and Green Transformation Policies in Türkiye

Türkiye's development plans serve as crucial guidelines for the advancement of environmental policies, green economic transformation, and the determination of sustainable development goals. In these plans, environmental policies are adopted as fundamental components of sustainable development and the green economy. Türkiye has set concrete goals in several areas, including aligning its environmental management practices with European Union standards, reducing greenhouse gas emissions, and promoting the widespread use of environmentally friendly technologies.

These development plans present a long-term vision for Türkiye's environmental and green economic transformation, as well as for achieving sustainable economic growth. They have become foundational documents reflecting the state's perspective on the environment by addressing economic, social, and environmental development in an integrated manner. A comprehensive understanding of sustainable development and the green economy necessitates a detailed examination of these plans.

In Türkiye's First and Second Five-Year Development Plans (1963–1972), concepts such as the environment, nature, or sustainability were absent. Environmental issues were addressed for the first time in the Third Five-Year Development Plan (1973–1977). This plan emphasized the need to resolve environmental problems without hindering economic development and aimed to enable individuals to maintain a sustainable balance in their

interactions with the environment. Additionally, policies to raise public awareness for the protection and development of nature were proposed (Presidency of Strategy and Budget, 1972: 866–867).

The Fourth Five-Year Development Plan (1979–1983) expanded the scope of environmental considerations, drawing attention to issues such as air, water, and soil pollution, as well as erosion and land degradation. It underlined the necessity of addressing environmental problems alongside societal transformation processes and set goals to incorporate environmental considerations into agriculture, industry, and urbanization practices. Furthermore, increasing green spaces in major cities was identified as a fundamental policy objective (Presidency of Strategy and Budget, 1978: 83–297).

With the Fifth Five-Year Development Plan (1985–1989), the concept of sustainability was introduced into environmental policy for the first time. The plan aimed not only to prevent environmental pollution but also to ensure the transfer of natural resources to future generations. It prioritized research and development (R&D) activities related to environmental issues, advocated for the support of universities and non-governmental organizations, and implemented policies to control air pollution (Presidency of Strategy and Budget, 1984: 171).

The Sixth Five-Year Development Plan (1990–1994) adopted the protection of human health and the environment as a fundamental objective alongside economic and social development. Concrete measures were proposed, including the development of renewable energy sources, the establishment of solid waste management facilities by municipalities, and the creation of environmental risk assessment centers in urban areas. Additionally, regulations were planned for facilities utilizing nuclear energy and radiation-based technologies (Presidency of Strategy and Budget, 1989: 312–313).

The Seventh Five-Year Development Plan (1996–2000) included a significant self-critique regarding environmental policies. It highlighted the inadequacies in implementing the environmental goals outlined in previous plans, pointing to legislative and institutional gaps, insufficient personnel and resources, and a lack of coordination among environmental organizations. The plan emphasized adopting environmentally friendly technologies, addressing environmental challenges in alignment with European Union standards, and applying the "polluter pays" principle as a fundamental policy (Presidency of Strategy and Budget, 1995: 189–194).

The Long-Term Strategy and Eighth Five-Year Development Plan (2001–2005) focused on resolving environmental issues through strengthened legislative and institutional frameworks. During this period, emphasis was placed on enhancing energy efficiency in the transportation, energy, industrial, and construction sectors to reduce greenhouse gas emissions. Furthermore, the development of sustainable development indicators and the integration of environmental policies with economic and social strategies were proposed as essential measures for achieving long-term sustainability (Presidency of Strategy and Budget, 2000: 187–189).

The Ninth Development Plan (2007–2013) emphasized the harmonization of environmental policies in line with Türkiye's European Union accession process. Policies focused on conserving natural resources, increasing investments in environmentally friendly technologies, and implementing the "polluter pays" principle. Moreover, financing strategies were developed to support environmental infrastructure investments (Presidency of Strategy and Budget, 2006: 2–74).

The Tenth Development Plan (2014–2018) stands out as one of the most comprehensive in addressing environmental policies. This plan highlighted the need for economic growth to be based on a green economy framework. It aimed to accelerate environmentally friendly practices such as renewable energy, clean production technologies, and ecological efficiency. Additionally, concrete steps such as constructing disaster-resilient and sustainable cities and preparing integrated risk maps to address climate change were proposed (Presidency of Strategy and Budget, 2013: 117–137).

The Eleventh Development Plan (2019–2023) aimed to enhance efficiency and sustainability in environmental management. Key goals included expanding zero-waste practices, improving air quality management, preserving biodiversity, and strengthening regional clean air centers. The plan also emphasized controlling greenhouse gas emissions and preparing climate change action plans for seven regions (Presidency of Strategy and Budget, 2019: 157–170).

The Twelfth Development Plan (2024–2028), currently in effect, holds strategic importance for achieving Türkiye's sustainable development goals. The plan prioritizes disaster-resilient living spaces and a sustainable environment alongside economic and social development. It focuses on five main pillars: green and digital transformation with competitive production, skilled workforce, strong family structure, healthy society, and justice-based democratic governance (Presidency of Strategy and Budget, 2023: 42–251).

Türkiye's development plans have played a critical role in shaping environmental policies and defining sustainable development goals. These plans present strategic approaches aimed at balancing green economic growth with environmental sustainability.

As the impacts of climate change become increasingly evident worldwide, the significance of transitioning to a green economy has grown. With the European Union and other developed countries emphasizing climate change in their economic policies, green transformation has also become imperative for Türkiye. In this context, Türkiye has taken and continues to take significant steps toward achieving environmental and economic sustainability goals.

Türkiye's first major initiative toward sustainable environmental policies was the enactment of the Environmental Law No. 2872 in 1983. To implement this law, the Environmental Directorate General was established under the Prime Ministry in 1984. As environmental issues and nature conservation became increasingly critical, the Environmental Directorate General was upgraded to the Environmental Undersecretariat in 1989, and by 1991, it was decided to establish an independent Ministry of Environment with an expanded scope of responsibilities (Şengün, 2015: 114).

The National Climate Change Strategy adopted in 2010 and the Climate Change Action Plan (CCAP) covering the 2011–2023 period marked a turning point in Türkiye's fight against climate change. Under the CCAP, a total of 541 actions were identified across various sectors, including energy, industry, transportation, agriculture, construction, and forestry. These actions focus on reducing greenhouse gas emissions and preparing for risks associated with climate change (Presidency of Communications, 2021: 77).

To address the regional impacts of climate change, the Ministry of Environment, Urbanization, and Climate Change prepared Regional Climate Change Action Plans (RCCAPs). These plans, specifically tailored for Türkiye's seven regions, encompass comprehensive strategies. One notable goal outlined in these plans is to ensure that by 2053, all buildings in Türkiye can meet their energy needs through renewable energy sources (Ministry of Environment, Urbanization, and Climate Change, 2022).

The European Green Deal has also been a pivotal point for Türkiye, influencing policy shifts toward sustainability. In line with this, the Green Deal Action Plan was published by the Ministry of Trade. This plan is structured around nine key policy areas, including border carbon regulations,

green and circular economy, sustainable agriculture, clean energy, and green finance (Ministry of Trade, 2021: 9).

Furthermore, the New Economy Program (2021–2023) emphasized sustainable growth, high-value-added production, and digital transformation. As part of this program, action plans were developed to enhance R&D efforts, promote green production processes, and improve energy efficiency (Presidency of Strategy and Budget, 2020: 17–19).

3.2. Türkiye's Green Economic Growth Performance

Türkiye's performance in green economic growth has been shaped by its efforts to integrate sustainability into economic development. Over the years, the country has adopted various strategies to promote renewable energy, enhance energy efficiency, and encourage environmentally friendly technologies, demonstrating its commitment to achieving sustainability.

Table 1: Türkiye's Green Economic Growth Performance with Selected Indicators

Years	2017	2018	2019	2020	2021	2022
Environmental and Resource Productivity (Kilogramme)						
· GHG Productivity (Kilogramme)						
Production-based CO2 emissions (Tonnes, Millions)	378,63	374,70	366,42	366,19	400,79	374,82
CO2 emissions from air transport per unit of GDP (Kilogramme)	8,73	9,05	9,22	4,06	5,70	7,91
· Energy productivity (Tonnes of oil equivalent, Millions)						
· · Total energy supply (Tonnes of oil equivalent, Millions)	146,81	144,20	146,51	146,92	159,43	156,50
Renewable energy supply (Tonnes of oil equivalent, Thousands)	17.738.486	19.110.546	23.339.118	24.076.253	24.224.615	26.539.692
Renewable electricity generation (Percentage of electricity generation)	29,34	32,08	43,52	41,85	35,42	41,97
Socio-Economic Context (Years)						
· Social context (Years)						
Life expectancy at birth (Years)	77,04	77,45	77,74	76,53	75,72	77,59
Net migration (Persons)	7,94	2,22	-0,18	0,44	0,23	-3,46
Real GDP (US dollars, PPP converted, Millions)	2.246.367	2.314.054	2.332.995	2.376.385	2.648.229	2.794.767

· Economic context (US dollars per person, PPP converted)						
Real GDP per capita (US dollars per person, PPP converted)	27.970,25	28.425,66	28.251,52	28.499,06	31.471,34	32.887,38
Nominal exchange rate (National currency per US dollar)	3,65	4,83	5,67	7,01	8,85	16,55
Purchasing power parity (National currency per US dollar)	1,38	1,63	1,84	2,11	2,73	4,61
Economic Opportunities and Policy Responses (US dollars per litre, PPP converted)						
· Environmental taxes and transfers (US dollars per litre, PPP converted)						
Diesel tax rate (US dollars per litre, PPP converted)	1,29	0,97	0,93	0,96	0,36	0,48
Petrol tax rate (US dollars per litre, PPP converted)	1,71	1,36	1,25	1,19	0,42	0,57
· Technology and innovation: Patents (Inventions per 1 000 000 inhabitants)						
Development of environment-related technologies (Inventions per 1 000 000 inhabitants)	1,87	1,42	1,28	1,54	1,41	
· Technology and innovation: R&D (Percentage of government allocations for R&D)						
Renewable energy public RD&D budget (Percentage of public energy RD&D budget)	29,51	40,99	17,30	29,01	36,13	24,27
Environment related government R&D budget (Percentage of government allocations for R&D)	0,78	0,68	0,60	0,56	0,27	0,14

Source: (OECD Data, 2024). This table was created by the author using data from OECD Data.

Analyzing Türkiye's Green Economic Growth Performance (2017–2023)

The table provides various environmental, socio-economic, and policy-focused indicators based on OECD data from 2017 to 2023 to evaluate Türkiye's green economic growth performance. The analysis of Türkiye's green economic transformation and growth performance is supported by selected data published by the OECD.

Environmental and Resource Productivity

In the context of Production-Based CO2 Emissions, the trend between 2017 and 2019 shows a decline from 378.63 million tons to 366.42 million tons, indicating a downward trend in emissions. However, in 2021, CO2 emissions increased to 400.79 million tons, demonstrating heightened environmental pressure. Regarding Renewable Energy Supply, the data indicates a consistent rise from 17.7 million tonnes of oil equivalent in 2017 to 27.4 million tonnes in 2023, with particularly significant increases observed during the period of 2019–2023. This growth reflects Türkiye's strong investments in solar and wind energy.

Despite the notable increase in renewable energy capacity, the reduction in CO2 emissions remains limited. A more aggressive shift from fossil fuels to renewable energy is essential to achieve sustainable reductions in CO2 emissions. Furthermore, the share of renewable energy within the total energy supply needs to be significantly increased to align with environmental sustainability goals.

In terms of Renewable Electricity Generation, the share of renewable energy in electricity production increased significantly, rising from 29.34% in 2017 to 41.73% in 2023. This growth highlights the expansion of renewable energy investments and the promotion of energy efficiency targets. However, the fluctuations over the years underline the importance of ensuring a more stable integration of renewable resources into the energy system. Additionally, while Türkiye has made progress in transitioning to renewable energy and environmentally friendly technologies, economic and environmental challenges persist. Notably, the increase in CO2 emissions underscores the need for stronger policy support to achieve environmental sustainability in the economy.

Socio-Economic Context

In the socio-economic context, Real GDP Per Capita demonstrated a steady increase between 2017 and 2023, reflecting sustained economic growth. However, this economic growth also emphasizes the necessity of addressing its environmental costs. Regarding the Nominal Exchange Rate, the USD/TL exchange rate rose sharply from 3.65 in 2017 to 23.79 in 2023, indicating economic instability and high inflation in Türkiye. While economic growth is evident, such significant fluctuations in exchange rates highlight macroeconomic challenges that need to be addressed.

Economic Opportunities and Policy Responses

In the context of the Renewable Energy Public RD&D Budget, its share rose from 29.51% in 2017 to 30.33% in 2023, indicating progress in government funding for renewable energy research and development. However, the budget share dropped to 17.30% in 2020, revealing inconsistencies in resource allocation. Regarding Petrol and Diesel Tax Rates, a decline was observed compared to 2017 levels, suggesting insufficient incentives to promote environmentally friendly fuel alternatives.

Energy Trends in Türkiye

The data on Total Energy Supply reveals an increase from 146.81 million tonnes of oil equivalent in 2017 to 158.09 million tonnes in 2023, despite some fluctuations over the years. This increase reflects the growing energy demand driven by economic expansion in Türkiye. From a green economic growth perspective, it is crucial to develop policies that address the carbon impact of rising energy consumption while supporting sustainable growth.

In terms of Energy Productivity, levels remained relatively stable between 2017 and 2023, with no significant decline in total energy supply. The limited progress in energy productivity highlights the dominance of energy-intensive sectors in the economy. Enhancing energy productivity will require greater technological advancements and policy support. Transforming energy-intensive industries will be critical to achieving meaningful energy efficiency improvements.

Despite GDP growth, the relatively limited increase in energy supply and CO2 emissions, coupled with the rising share of renewable energy in total energy supply and electricity generation, indicates promising progress in Türkiye's green transition. These trends suggest that Türkiye is making strides toward sustainable green economic growth, but significant challenges remain.

4. CONCLUSION AND RECOMMENDATIONS

Türkiye has made notable progress in formulating and implementing policies to address climate change, drive green economic transformation, and achieve sustainable development goals at both national and international levels. Through robust collaborations, Türkiye is steadily advancing toward a low-carbon economy, increasing its reliance on renewable energy, and promoting environmentally friendly development strategies. The country's green economic growth policies reflect a comprehensive approach that

not only prioritizes environmental sustainability but also aims to enhance economic and social well-being.

In its transition toward green transformation, Türkiye emphasizes sustainable development, energy efficiency, green financing, and circular economy principles. Region-specific and sectoral strategies play an instrumental role in the nation's shift to a low-carbon economy. However, the success of this transformation depends heavily on the adoption of actionable policies and alignment with international standards and best practices.

Türkiye's strengths position it as a key player in global green economic growth. Its swift adoption of renewable energy policies, coupled with its advantageous geographical location for expanding wind and solar energy capacities, underscores its potential. Continued investment in green economic transformation and energy efficiency will enable Türkiye to further solidify its role in the global green economy. While the country has exhibited robust economic growth, it remains essential to implement corrective and supportive policies to strengthen its green economic growth performance.

Improving energy efficiency remains a pressing priority, particularly in energy-intensive sectors. Türkiye's dependency on fossil fuels continues to pose challenges, and current reductions in CO2 emissions are insufficient to signify a complete transition toward renewable energy sources. Accelerating the deployment of renewable energy and ensuring sustained investments in this area are critical to achieving significant environmental and economic outcomes.

This analysis underscores the progress Türkiye has made in its energy policies while highlighting the need for more comprehensive, integrated strategies to reach sustainability objectives. Future policies should focus on fostering energy efficiency, increasing renewable energy adoption, and reducing dependence on fossil fuels. These measures will not only strengthen Türkiye's transition to a sustainable economy but also contribute to its resilience and competitiveness on the global stage.

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Chapter 8

The Effects of Ecoairnomic Growth, Inflation, Urbanization and Interpersonal Social Globalization Index on the Number of Airline Passengers in Türkiye

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Abstract

The aim of the study is to analyze some economic indicators that are thought to have an impact on airline passenger transfer (the number of passengers carried) in Türkiye in the period 1988-2022. As airline transportation has become more widely used than other types of transportation today, and as a result of the opening of new airports and large investments made in airline transportation, the economic contributions of these investments have recently found a place in academic studies. In light of these developments, this study aims to analyze the effects of economic growth, inflation, urbanization and interpersonal social globalization index on the number of passengers carried by airline in Türkiye. The ARDL method was used in the model and it was determined that urbanization had a positive effect on the number of passengers carried by airline. In addition, when the results of the model were examined, it was determined that inflation had a negative effect on the number of passengers carried by airline. Again, according to the ARDL results, it was determined that there was no significant relationship between the number of passengers carried by airline and economic growth and interpersonal social globalization index.

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1. INTRODUCTION

Airline transportation in Türkiye has entered a rapid development and transformation process, especially since 1983. In order to provide a more competitive and liberal structure to the airline transportation sector, the Civil Aviation Law No. 2920 was adopted, which will encourage the private sector in this process. With the entry into force of this law, the liberalization process in the field of airline transportation in Türkiye has been initiated. As part of the process, standards and regulations such as SHY-6A and SHY-6B have been introduced so that the Turkish civil aviation sector can compete internationally and continue its activities in a safe, reliable, high-quality and transparent manner. Thus, competition and security-oriented policies have been adopted in airline transportation services, competitiveness has been increased and the country's economic and social development has accelerated (Kiracı and Battal, 2018: 1537). This process is an important breaking point in terms of comprehensive reforms and structural transformations in the field of airline transportation. In addition, airlines are one of the most important transportation modes among various transportation modes (Uçar et al., 2024). Therefore, airline transportation is closely related to various macroeconomic factors such as economic growth, inflation, urbanization and interpersonal social globalization index.

First of all, one of the most important factors affecting airline transportation is the existence of a relationship between GDP and the number of passengers carried by airline. GDP is a basic measure of the overall economic performance of a country. As expected, when a country's GDP increases, economic activities and travel demand will also increase. As expected, higher incomes make it easier for people to travel internationally for various purposes. In this context, GDP increases positively affect passenger flows (Chang and Lin, 2010). At the same time, a country's economic growth can have significant effects on airline transportation expansion. This includes the development of hard infrastructures such as airports. A growing country has to integrate into the global economy; firms need to be connected to potential sales markets. Reciprocally, airport infrastructures offer the opportunity to promote export activities, especially tourism, and to increase business operations and productivity (Halpern and Bråthen, 2011). According to Hakim and Merkert (2016), the relationship between economic growth and airline transportation primarily emphasizes the need for the timely establishment of aviation support infrastructure. This process emphasizes the need for a meticulous examination of spatial dimensions, considering the growth rates projected for the aviation sector, and the need

to make significant early investments, taking into account the risks and uncertainties associated with this growth.

The CPI for air travel measures the change in prices paid by consumers for air travel. This index includes taxes and distribution costs not collected by airline carriers (Bureau of Transportation Statistics, 2006: 6). Chang and Lin (2010) concluded in their study that the CPI variable has a negative effect on air passenger flows. A high CPI represents relatively high prices of most goods in the destination country, which makes it difficult to attract more tourists to the country. As a result, if the CPI is high in the destination countries, the demand for travel between the two countries will decrease.

The population of cities with limited resources increases due to the urbanization process (Ülger et al., 2024). Therefore, another factor affecting airline transportation is urbanization. Therefore, airline transportation can have different economic effects on the host urban area or region. An expanding airport can directly or indirectly increase the number of employees. In addition, air traffic can facilitate face-to-face contact, thus improving the provision of tradable services, increasing tourism and information flows, and the attractiveness for business investment. These last effects can be most appropriately captured by referring to bilateral air traffic data (Bernardoa and Fageda, 2019: 2).

The globalization index is another indicator that affects airline transportation. With the widespread use of the concept of globalization, countries have also started to participate in this process (Ertürkmen and Çelik, 2023). The literature on economic globalization discusses the networks of firms, workers, and consumers; the flow of both people and goods across international borders, and the resulting imbalances in economic development. Globalization contributes to the world economy (Ertürkmen, 2023). All globalization processes depend on transportation to some extent to move goods and people from one place to another. However, there has been little discussion of the connections between transportation and globalization. Even less attention has been paid to airline transportation, especially despite the fact that this mode is of vital importance in the continuous growth of global transfers of people and materials. As Smith points out, the fluidity of globalization processes ironically depends on infrastructure located in fixed locations. As the demand for this infrastructure increases, existing airports, highways, ports, etc. As cities come under pressure to provide more capacity, there is also pressure on other locations that can host facilities in the future (Cidell, 2006).

The course of domestic, international and overflight aircraft traffic in Türkiye, with the investments in the aviation sector in recent years, is shown in Table-1.

Table-1: Landings/Takeoffs and Overflight Aircraft Traffic Served in Türkiye*

Years	2016	2017	2018	2019	2020	2021	2022
Domestic	886.228	909.332	892.405	839.894	572.994	738.352	786.150
International	566.767	591.125	651.764	716.523	280.756	466.266	702.476
Overflight	376.913	413.560	473.051	478.013	201.418	262.242	394.845
Total	1.829.908	1.914.017	2.017.220	2.034.430	1.055.168	1.466.860	1.883.471

****It was prepared by us using the data in the SAA 2022 Sector report.***

The data in Table-1 show that total aircraft traffic has increased over the years. There is a high level of decrease in domestic passenger traffic in 2020, while there is an increase in international traffic over the years, and there was also a high level of decrease in 2020. Due to the COVID-19 pandemic, there has been a decrease in both domestic, international and overflight figures, as in the whole world. As can be understood from this table, Türkiye has an increasingly dense air traffic every day in terms of both Overflight and Landing/Takeoff due to its geographical location.

Türkiye has important opportunities for the use of all kinds of transportation systems in terms of both its geographical location and its characteristics. Especially being at the connection point of the Asian and European continents and being in a central position in terms of regional power with some country groups, it provides important opportunities for the development of the country's transportation activities (Bakırcı, 2012).

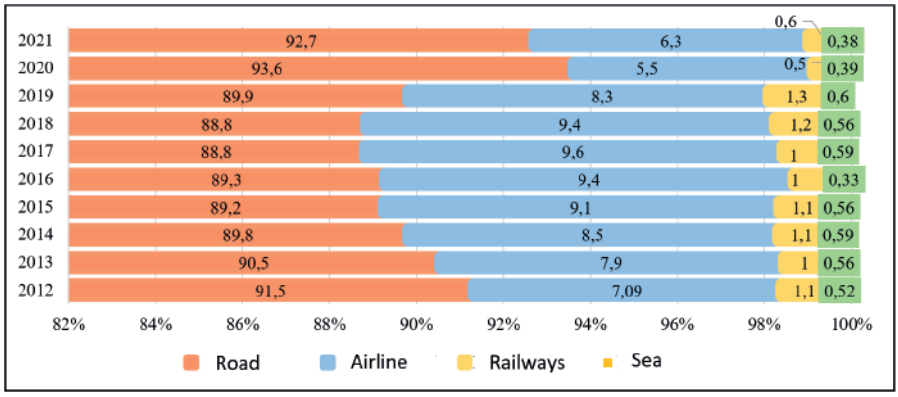
The passenger traffic, which was 34.4 million (domestic and international) in 2003, reached 161 million in November 2022. Aviation continues to develop rapidly in the world and plays a major role in both international and intercontinental integration and integration. In today's world, the most important sectors that direct and add volume to the world economy, such as foreign trade and tourism, come to life thanks to the aviation sector and build their future under the wings of the aviation sector.

Airline transportation, which has an important place among the basic transportation systems, is preferred more and more every day due to its advantages compared to other types of transportation. The increase in the

effectiveness of airline transportation in both international transportation and domestic transportation continues to increase every year.

The change in the proportional shares of the highway, airline, railway and maritime sectors in the ongoing domestic passenger transportation in Türkiye is presented in graph-1.

Graph-1: Domestic Passenger Transportation Rates (% Rate per Passenger-Km)*



****Prepared by us using the data in the MEU 2022 Environmental Indicators report.***

Note: Passenger-Km: It is the traffic measurement unit obtained by transporting a passenger one kilometer.

According to the data in the graph; in domestic passenger transportation; the share of airlines, which was 1.8% in 2000, increased to 6.3% in 2021, while the share of roads, which was 95.9% in the same period, decreased to 92.7% and the share of railways, which was 2.2%, decreased to 0.6%. When we look at domestic freight transportation rates, it is seen that the share of airline passenger transportation increased over the years until the COVID-19 pandemic, while there was a proportional decrease during and after the pandemic.

The decline in airline transportation due to the COVID-19 pandemic that started at the end of 2019 in the world and in Türkiye continued until the discovery of the COVID-19 vaccine in 2020. During this process, various restriction decisions implemented by countries were reduced with the discovery of the vaccine and the upward trend in airline transportation began.

The numerical information on the separation of domestic and international passengers in airline passenger transfers in Türkiye from 1988 to 2022 is as in Table-2.

Table-2: The Number of Airline Passengers in the Period 1988-2022*

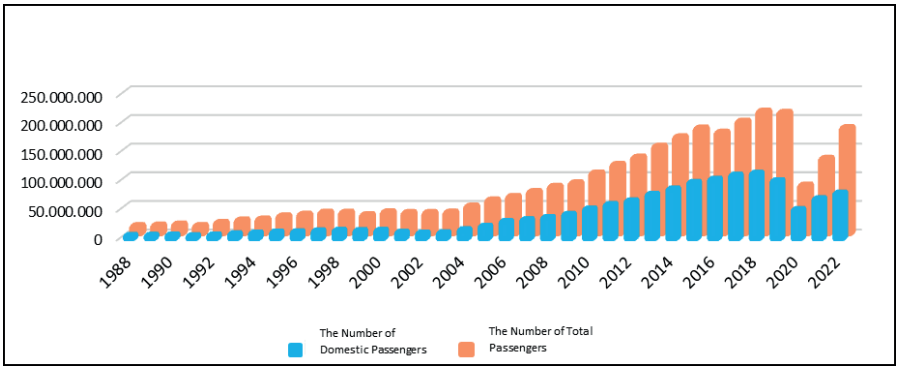
Years	Total Number of Passengers	Proportional Share of International Passenger Number (%)	Proportional Share of Domestic Passenger Number (%)	Years	Total Number of Passengers	Proportional Share of Domestic Passenger Number (%)	Proportional Share of International Passenger Number (%)
1988	10.840.179	0,40	0,60	**2006**	61.684.203	0,47	0,53
1989	11.843.563	0,40	0,60	**2007**	70.352.867	0,45	0,55
1990	13.629.965	0,39	0,61	**2008**	79.438.289	0,45	0,55
1991	11.019.464	0,36	0,64	**2009**	85.508.508	0,48	0,52
1992	16.495.118	0,33	0,67	**2010**	102.800.392	0,49	0,51
1993	20.674.531	0,36	0,64	**2011**	117.620.469	0,50	0,50
1994	22.334.286	0,39	0,61	**2012**	130.351.620	0,50	0,50
1995	27.767.379	0,37	0,63	**2013**	149.430.421	0,51	0,49
1996	30.780.662	0,35	0,65	**2014**	165.720.234	0,52	0,48
1997	34.396.334	0,36	0,64	**2015**	181.074.531	0,54	0,46
1998	34.199.679	0,39	0,61	**2016**	173.743.537	0,59	0,41
1999	30.011.658	0,43	0,57	**2017**	193.045.343	0,57	0,43
2000	34.972.534	0,38	0,62	**2018**	210.498.164	0,54	0,46
2001	33.620.448	0,30	0,70	**2019**	208.373.696	0,48	0,52
2002	33.755.452	0,26	0,74	**2020**	81.616.140	0,61	0,39
2003	34.424.340	0,27	0,73	**2021**	128.155.762	0,53	0,47
2004	45.034.589	0,32	0,68	**2022**	181.789.339	0,43	0,57
2005	55.545.473	0,37	0,63				

****The table was prepared by us using the data in the SAA 2022 report.***

In Table-2, it can be seen that passenger transfers (numbers) in Türkiye increased between 1988-2018. In addition, the proportional shares of domestic and international lines in total passenger transfers can also be seen. According to the data in the table, as of 2010, the proportional share of domestic lines in total passenger transfers in Türkiye is over 50%. This proportional share increased from 49% to 59% in the 2010-2016 period. Due to the restriction decisions and measures implemented due to the COVID-19 pandemic, it caused a decrease in both the total number of passengers and the number of domestic passengers in 2020.

The Graph-2 shows the course of Türkiye's airline domestic and total passenger numbers in the 1988-2022 period.

Graph-2: Airline Passenger Traffic in Türkiye in the Period 1988-2022*



Years	1988	1989	1990	1991	1992	1993	1994	1995	1996
The Number of Domestic Passengers	4.329.890	4.696.520	5.347.723	4.009.724	5.445.081	7.403.941	8.784.310	10.347.528	10.862.539
Years	1997	1998	1999	2000	2001	2002	2003	2004	2005
The Number of Domestic Passengers	12.413.720	13.238.832	12.931.771	13.339.039	10.057.808	8.700.839	9.128.124	14.438.292	20.502.516
Years	2006	2007	2008	2009	2010	2011	2012	2013	2014
The Number of Domestic Passengers	28.799.878	31.970.874	35.832.776	41.226.959	50.575.426	58.258.324	64.721.316	76.148.526	85.416.166
Years	2015	2016	2017	2018	2019	2020	2021	2022	
The Number of Domestic Passengers	97.041.210	102.499.358	109.511.390	112.911.108	99.946.572	49.740.303	68.466.177	78.323.824	

****The graph was prepared by us using the data in the SAA 2022 report.***

As can be seen in Chart-2, the total number of passengers in Türkiye decreased in 1991, 1999, 2001, 2016, 2019 and 2020 and increased again in the following years. These periods are the periods when Türkiye was under the influence of negative political and economic events, natural disasters and global epidemics. It can also be seen in the table that the number of domestic passengers within the total number of passengers continued to increase in the period 1988-2022, except for 2019-2020, compared to the previous year. Türkiye is in a position to make significant contributions to the development of the civil aviation sector in both the world and the region with its growth level in the civil aviation sector. In many reports published

by international aviation organizations, it is seen that Türkiye has been ranked at the top of the world aviation sector in recent years. According to the 2018 Administrative Activity Report of the General Directorate of Turkish Civil Aviation; While the world average for passenger accessibility to aircraft is 74.41%, this rate is 91.34% for Türkiye. (SHGM, 2018 Activity Report, pp. 27-27). It can be said that this situation positively affects both the income of airports and the personnel employment numbers of airline companies and DHMI.

In this study, the effects of these factors on the number of passengers carried by airline in Türkiye were empirically examined. While economic growth can directly affect the purchasing power of the consumer and therefore the demand for airline transportation, cost indices such as CPI and inflation play a key role in determining airline ticket prices. While the urbanization process increases the demand for airport infrastructure and access, the interpersonal social globalization index can strengthen the need for travel together with international mobility and cultural interactions.

This study is structured to consist of four parts. Following the introduction, the second part includes a review of the relevant literature. In this section, some studies examining the effects of these factors on the number of passengers carried by airline and some studies evaluating the effects of Türkiye's economic growth, CPI, inflation, urbanization and interpersonal social globalization index on the number of passengers carried by airline using ARDL and ECM methods are included. The third section provides information about the methodology of this study and the data used. Finally, the findings are brought together and a comprehensive evaluation is made.

2. LITERATURE REVIEW

The air transport sector in Türkiye is directly affected by various macroeconomic factors such as economic growth, urbanization, inflation, CPI and social globalization. The relationship between the number of passengers carried by airline and these variables has gained importance as an indicator of economic and social development. There are many studies in the literature examining the effects of these factors on air transport demand. In this context, the literature on the relationship between economic growth, CPI, inflation, urbanization and interpersonal social globalization index and the number of passengers carried by airline is summarized in Table 3.

Table 3: The Relationship between Macroeconomic Indicators and Number of Passengers Carried by airline

Researchers	**Sample Group**	**Time Period**	**Method(s)**	**Results**
Button and Taylor (2000)	41 Metropolitan Standard Areas (MSA) within the United States	1977-1978	Regression analysis	It highlights that wider and more comprehensive international airline services can play a critical role in stimulating economic growth.
Honcu et al. (2013)	European countries	2010-2012	Data analysis based on trends	Fuel costs and economic recessions are important factors affecting airline transportation demand.
Hakim and Merkert (2016)	South Asian country	1973-2014	Panel data, Granger causality tests, Pedroni/ Johansen cointegration test	In low-income, large-population regions, the relationship between air transport and economic growth is complex and diverse.
Kiboi et al. (2017)	10 airline companies	2005-2014	Panel data regression model	Local and global GDP growth rates as well as GDP per capita have a positive and significant impact on airline passenger demand.
Olaniyi et al. (2017)	Nigeria	2010-2015	Pearson correlation coefficient and regression analyses	It has been shown that Consumer Price Index (CPI) and exchange rate changes do not have a statistically significant impact on air passenger demand.
Kiracı and Battal (2018)	Türkiye	1983-2015	VAR (Vector Autoregressive) model	It has been determined that per capita income, GDP and CPI have significant effects on domestic and international passenger demand.
Wei et al. (2022)	China	2006-2019	Time Series Data	The growth of primary industry and per capita income has led to a long-term decline in passenger flow at Tianjin Airport.

Yones (2023)	Egypt	1982-2019	VECM (Vector Error Correction Model)	It has been observed that decreases in exchange rates increase passenger demand by making local prices more attractive compared to other countries, while CPI affects demand positively. No significant effect of GDP per capita on passenger demand has been found.

In this study, the factors affecting airline transportation in the literature on the relationship between economic growth, CPI, inflation, urbanization and interpersonal social globalization index with the number of passengers carried by airline are classified as positive or negative by the authors;

Positive effects on the relationship between economic growth, CPI, inflation, urbanization and interpersonal social globalization index and the number of passengers carried by airline; Kiboi et al. (2017), in their study on 10 airline companies, determined that local and global GDP growth rates and GDP per capita had a positive and significant effect on air passenger demand. This result shows that airline transportation is also positively affected as economic growth increases. Wei et al. (2022), in a study in China, found that changes in exchange rates positively affected air passenger demand. When the exchange rate decreases, local prices become more attractive, which increases passenger demand. Kiracı and Battal (2018), in their analysis on Türkiye, revealed that domestic and international passenger demand is positively related to per capita income and GDP. This finding supports the conclusion that increasing income levels increase airline transportation demand.

The positive effects of economic growth, CPI, inflation, urbanization and interpersonal social globalization index on the relationship between the number of passengers carried by airline; Honcu et al. (2013), in this study conducted in European countries, determined that economic recession and fuel costs negatively affected airline transportation demand. It was observed that demand decreased especially during economic recession periods. Olaniyi et al. (2017), in the Nigerian example, determined that Consumer Price Index (CPI) and exchange rate changes did not have a significant effect on air passenger demand and could not affect demand negatively. This situation shows that airline transportation acts relatively independently of economic changes. Yones (2023), in his study in Egypt, reached the conclusion that

CPI negatively affected demand. The increase in inflation has a decreasing effect on passenger demand.

This literature review shows that the demand for airline transportation has a positive relationship with macroeconomic factors such as economic growth and income growth, but factors such as inflation, economic recession and high fuel costs can negatively affect the demand. Therefore, the increase or decrease in the demand for airline transportation is directly linked to the economic dynamics and market conditions of the countries.

3. DATASET AND EMPIRICAL MODEL

The aim of the study is to empirically analyze the effects of gross domestic product, urbanization, social globalization and consumer price index (CPI) on air passenger transfer (number of passengers carried) for Türkiye using annual data for the period 1988-2022. In this direction, the Autoregressive Distributed Lag Model (ARDL) method was used in the application phase. For this purpose, explanatory information about the variables of the model established in the study is as follows in Table 4:

Table-4: Variables and Data Resource Information

Variables Descriptions Data source	**Descriptions**	**Data Resource**
HYY	Number of domestic passengers carried by airline (Türkiye)	The Statistics of General Directorate of State Airports Authority
GDP	Gross domestic product	World bank data
PU	Urbanization	World bank data
KOFS	Interpersonal Social Globalization Index	KOF Swiss Economic Institute
INF	Inflation Rate	TURKSTAT

The purpose of this study is to investigate how the number of passengers carried by airline for Türkiye, which is determined as the dependent variable, is affected by the gross domestic product, interpersonal social globalization index, inflation and urbanization variables. In the study, as the independent variables; Türkiye's gross domestic product, representing economic growth; interpersonal social globalization index (KOF-social-interpersonal index) representing social globalization; consumer price index, representing

changes in the prices of goods and services; and urbanization indicator, as the demographic factor, were included in the analysis.

The empirical model was established to investigate the relationship between the number of passengers carried by airline (HYY) for Türkiye and gross domestic product (GSYH), urbanization (PU), interpersonal social globalization index (KOFS) and consumer price index (CPI).

All variables used in the model were log transformed. The empirical model established is as follows:

$$HYY_t = \alpha_1 + \beta_1 GSYH_t + \beta_2 PU_t + \beta_3 KOFS_t + \beta_4 TÜFE_t + \mu_t \qquad (1)$$

In the established model, α_1 represents the constant term, β symbol represents the estimated coefficients for the variables used in the analysis, and μ_τ represents the error term.

In the application phase of the study, it is important to first test the stationarity of the time series. If the series are not stationary (there is a unit root), spurious regression may occur. Therefore, in order to obtain healthy results, a unit root test must be applied to the series (Gujarati, 2016, 320). In this study, the Augmented Dickey Fuller (ADF) unit root test was used. The null hypothesis of the ADF test is "there is a unit root" (Sevüktekin and Çınar, 2017, 374-378). The results of the unit root test for the variables are as in Table 6.

Table-5: ADF Unit Root Test Results

Variables	Level		First Difference	
	Constant	**Trend & Constant**	**Constant**	**Trend & Constant**
HYY	0.277490 (0.9730)	-1.882041 (0.6387)	-5.882964 (0.0000)	-5.863317 (0.0002)
GDP	0.491165 (0.9835)	-2.305522 (0.4184)	-5.954476 (0.0000)	-5.913759 (0.0002)
PU	-1.443482 (0.5381)	-11.55040 (0.0000)	-6.461099 (0.0001)	-4.268217 (0.0187)
KOFS	-0.391728 (0.8984)	-3.015502 (0.1459)	-4.552232 (0.0011)	-4.480205 (0.0067)
CPI	-3.083382 (0.0395)	-3.762328 (0.0441)	-3.089161 (0.0467)	-4.579990 (0.0155)
Note: Values in parentheses are probability values.				

According to the results obtained from the unit root tests of the series with differences in Table 6, it is seen that the dependent and independent variables are stationary in I(0) and I(1) structures. According to this result, the applicability conditions of the ARDL Method are provided in this study.

The ARDL method used in the study was developed by Pesaran and Shin (1999) and Pesaran et al. (2001). This method can provide reliable results without causing loss of information in the sample when the series used are stationary at the level or first difference level. It also provides reliable results in small sample situations. In this direction, the ARDL estimate was made as follows in this study, which investigated the relationship between the number of passengers carried by airline (HYY) and gross domestic product (GSYH), urbanization (UP), social globalization index (COFS) and consumer price index (CPI) for Türkiye.

$$\Delta HYY_t = \alpha_0 + \sum_{i=1}^{k_1} \theta_{it}\, \Delta HYY_{t-i} + \sum_{i=0}^{k_2} \delta_{it}\, \Delta GSYH_{i,t-i} + \sum_{i=0}^{k_3} \vartheta_{it}\, \Delta UP_{i,t-i} + \sum_{i=0}^{k_4} \sigma_{it}\, \Delta KOFS_{i,t-i} + \sum_{i=0}^{k_5} Q_{it}\, \Delta T\ddot{U}FE_{i,t-i} + \beta_{1i} HYY_{t-1} + \beta_{2i} GSYH_{t-1} + \beta_{3i} UP_{t-1} + \beta_{4i} KOFS_{t-1} + \beta_{5i} T\ddot{U}FE_{t-1} + \varepsilon_{it} \quad (2)$$

The significance of the β_i . coefficients in the model is investigated with the F statistic (Wald Test). The procedure applied here is called the bounds test. The hypothesis of the test is as in equation (3);

Modelde yer alan β_i katsayılarının bir arada anlamlılık durumları F istatistiği (Wald Test) ile araştırılmaktadır. Burada uygulanan işlem, sınır testi olarak adlandırılmaktadır. Testin hipotezi (3) nolu denklemdeki gibidir;

$$H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$$

$$(There\ is\ no\ cointegration)$$

$$H_1 : \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$$

$$At\ least\ one\ of\ the\ \beta_i\ 's\ is\ not\ zero. There\ is\ cointegration)$$

If the bounds test is rejected, it is concluded that there is a cointegration relationship. As a result of the test, if the F statistic value is less than the lower critical value, it is understood that there is no long-term relationship (cointegration) between the series, and if it is between the lower critical value and the upper critical value, it is understood that there is no sufficient evidence for a cointegration relationship. If the F statistic value obtained is greater than the upper critical value, the H_0 hypothesis is rejected. Accordingly, it is understood that there is a cointegration relationship.

The ARDL bounds test results, which were conducted to decide whether there is a cointegration relationship between the variables of the model, are presented in Table 7:

Table-6: ARDL Bound Test Results

F-Statistics	8.333808	
K	4	
Level of Significance	**Critical Value**	
	Lower Limit	**Upper Limit**
%1	3.29	4.37
%5	2.56	3.49
%10	2.2	3.09
Diagnostic Tests	**Statistics**	
R^2	0.999432	
Adjusted R2	0.998359	
Breusch-Pagan-Godfrey VaryansTest	0.689442 (0.7568)	
Breusch-Pagan-Godfrey LM Testi	4.566123 (0.0634)	
Jarque- Bera Normality Testi	0.554464(0.757879)	
Note: Critical values are taken from table CI(iv) in Peseran et al. (2001). Numbers in parentheses show probability values.		

According to the results in the table, the term k indicates that the number of explanatory (independent) variables is 4. According to the ARDL bounds test result, since the F statistic value calculated at 1%, 5% and 10% significance levels is greater than the upper bound values, the H0 hypothesis is rejected. Therefore, it is concluded that there is a cointegration relationship. The existence of a cointegration relationship indicates that there is a long-term relationship between the variables. However, according to the diagnostic test results in the table, it is understood that there is no autocorrelation (Breusch-Pagan-Godfrey LM Test), heteroscedasticity (Breusch-Pagan-Godfrey Test) problem, and the error term has a normal distribution (Jarque-Bera Normality Test).

After the existence of a cointegration relationship is determined with the ARDL bounds test, the long-term relationships between the variables will be examined. The estimated long-term ARDL results are given in Table 7.

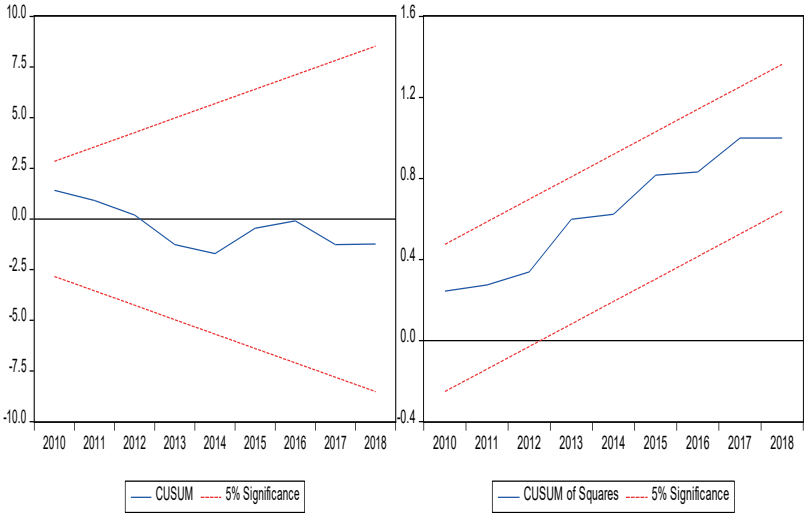
Table-7: ARDL Long-Term Forecast Results

Variables	**Coefficient**	**t-statistics**	**Probability**
GDP	0.320104	0.428657	0.4743
KOFS	0.574376	0.670738	0.4140
PU	5.498514	1.194762	0.0013
CPI	-0.150813	0.040780	0.0049
C	-37.57897	4.001045	0.0000

According to the long-term results in Table 8, a statistically insignificant relationship was found between GDP and interpersonal social globalization index (COFS) on the number of passengers carried by airline in Türkiye (HYY). In addition, a statistically significant and positive relationship was found between the number of passengers carried by airline in Türkiye (HYY) and urbanization (PU) variable. In addition, another result obtained is that the consumer price index (CPI) has a statistically significant and negative effect on the number of passengers carried by airline in Türkiye (HYY). According to these results, when the urbanization (PU) variable increases by 1 percent, the number of passengers carried (HYY) will increase by 5.49 percent. In addition, when the consumer price index (CPI) increases by 1 percent, the number of passengers carried (HYY) will decrease by 0.15 percent.

The results of the CUSUM and CUSUMQ tests applied to examine whether the model estimated with the ARDL method contains a structural break within the scope of the considered period and the stability status of the model are as follows:

Table-8: The Results of CUSUM and CUSUMQ Tests



CUSUM and CUSUMQ tests were developed by Brown et al. (1975). The results of these tests show that the test values remain within critical limits. According to this result, it can be said that the model established for the analysis is stable and does not contain any structural breaks.

4. CONCLUSION

In the study, Autoregressive Distributed Lag Model (ARDL) and Error Correction Model (ECM) were used to analyze the relationship between the number of passengers carried by airline and GDP, urbanization, interpersonal social globalization index and consumer price index indicators in Türkiye during the period 1988-2022. According to the results of the ARDL analysis, while the urbanization (PU) indicator has a statistically significant and positive effect on the number of passengers carried by airline (HYY) in Türkiye, it was determined that the consumer price index (CPI) has a statistically significant and negative effect. In addition, it was determined that GDP and interpersonal social globalization index have no statistical effect on the number of passengers carried by airline (HYY). Considering the growth of civil aviation in Türkiye to date, it can be predicted that the aviation sector will exceed the world average in terms of size in the coming periods and achieve significant gains in bo macroeconomic and social terms.

4.1. Policy Implications

Policy recommendations regarding the relationship between GDP, urbanization, interpersonal social globalization index and consumer price index indicators and the number of passengers carried by airline can be listed as follows;

- Considering the positive impact of urbanization on airline transportation, it is important to irease airport capacities in large cities and rapidly developing regions. The construction of new airports or the expansion of existing airports will support economic mobility by meeting passenger demand in these regions.
- The negative impact of CPI on passenger demand reveals the importance of price stability in the airline sector. Airlines should take efficiency-enhancing measures to reduce their costs, and public authorities should develop policies that will reduce price fluctuations in the sector.
- The equal spread of transportation infrastructure throughout the country can reduce economic imbalances between regions. Investments in airline transportation, especially in developing cities, can revitalize local economies and accelerate regional development.
- Considering the potential impact of the interpersonal social globalization index, increasing international connections can support passenger demand. Opening new international flights by taking advantage of the advantages offered by Türkiye's geographical location will contribute to the country both economically and socially.

These suggestions can help Türkiye develop strategies to increase airline transportation demand and maximize the sector's contribution to economic growth.

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Chapter 9

The Relationship Between Tourism, Trade Openness and Economic Growth: The Case of BRICS-T Countries

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Abstract

With the acceleration of globalization, the relationships between trade openness, tourism and economic growth have become an important area of interest in academic literature. Trade openness has the potential to support economic growth by increasing the integration of countries into international markets and stimulating the tourism sector. Especially in emerging economies such as BRICS-T countries, the contribution of trade and tourism to growth is of strategic importance in terms of sustainable development goals. This study examines the causal relationships between economic growth, tourism and trade openness variables in BRICS-T countries. The Dumitrescu-Hurlin panel causality test was applied in the analysis conducted using annual data for the period 1995-2020. The findings of the study reveal that there is no statistically significant causal relationship between economic growth and tourism in BRICS-T countries. However, a unidirectional causality from trade openness to economic growth was determined. Similarly, a unidirectional causality relationship from trade openness to tourism was determined. The study emphasizes the importance of trade openness policies that support economic growth and contribute to the development of the tourism sector in BRICS-T countries. In this context, it is thought that the findings may guide policy makers in BRICS-T countries in developing strategic steps to promote economic growth and the tourism sector.

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INTRODUCTION

Tourism is an important source of income and employment for many countries' economies. Therefore, it is considered as the driver of economic growth for local and global economies (Danish & Wang, 2018). Tourism development has been established as a popular strategy for economic growth worldwide (Matarrita-Cascante, 2010). Therefore, increasing the number of tourist arrivals is at the focal point of economic planning for local and central governments. Especially in developing countries, tourism has a great potential in terms of foreign exchange inflows and local development. The increase in the number of tourist arrivals can positively affect the economic growth of the country with its direct and indirect effects. The expenditures of tourists on accommodation, food and beverage, transportation and other services trigger the multiplier effect of economic growth spreading to different sectors. In this context, examining the relationship between tourism and economic growth is of great importance in understanding the contribution of tourism to the economy. In addition, investment in the tourism sector to promote economic growth will not only increase the income of the existing workforce, but also create new job opportunities for those who want to work in tourism and related industries (Singh & Alam, 2024). Therefore, examining the impact of the tourism sector on economic growth in BRICS-T countries (Brazil, Russia, India, China, South Africa and Türkiye) reveals the potential role that tourism can play in achieving the sustainable development goals of these countries. BRICS-T countries have attracted attention with their high growth rates and rapidly developing economic structures in recent years. This group of countries attracts attention with their rapid economic growth and becoming an attractive center for international investments (Ertürkmen, 2023).

Figure 1 shows the annual changes in the number of tourists in BRICS-T countries between 2005 and 2020. It is noteworthy that China was the country with the highest number of tourists in the entire country group during the period examined. In recent years, Türkiye has stood out as the second country following China. This situation can be evaluated as a reflection of the efforts of both countries to develop their tourism infrastructure and gain competitive advantage in the sector. In particular, improvements in Türkiye's tourism policies and promotional activities have brought the country to a position close to China. The country with the lowest number of tourists is Brazil. Brazil's lower level of tourist numbers compared to other countries indicates that the country may have been affected by factors such as geographical distance, inadequate infrastructure or lack of promotion. A steady increase trend was observed in all countries until 2019, and this

increase was interrupted after 2019 due to travel restrictions brought about by the COVID-19 pandemic. It is seen that there was a significant decrease in the number of tourists in all countries as a direct effect of the restrictions implemented during the pandemic period. This situation shows that global crises such as pandemics can lead to fluctuations in the tourism sector and therefore pose a risk to the sustainability of tourism-based economic growth.

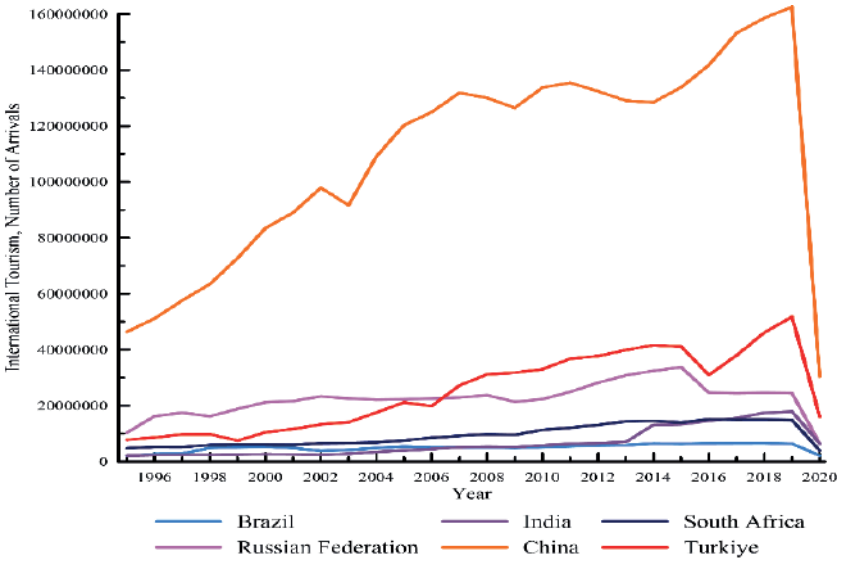

Figure 1: Number of Tourist Arrivals (BRICS-T Countries)

Trade openness, one of the important factors affecting economic growth, is a critical indicator of a country's degree of integration into the global economy. In addition, measuring countries' trade openness levels is an important concept for determining the level of trade liberalization (Ertürkmen & Çelik, 2023). Trade openness is the sum of exports and imports of goods and services measured as a share of gross domestic product. This rate is considered a reflection of the level of economic liberalization in the country. The trade openness rate, which increases with the increase in exports and imports, expresses the openness of country economies to international markets, while also emphasizing the contributions that foreign trade can provide for economic growth. Trade openness is of vital importance for economic growth not only in developing but also in developed economies (Udeagha & Ngepah, 2020). In international economic theory, it is widely accepted that trade openness can help improve the quality of economic growth (Kong, Peng, Ni, Jiang & Wang, 2021).

Figure 2 presents annual changes in trade openness rates in BRICS-T countries between 2005 and 2020. It is noteworthy that trade openness rates have followed a rather volatile course in all countries during the period under review. Türkiye was the country with the highest trade openness rate as of the end of the reference period, while the lowest rate was observed in Brazil; Brazil has continued to have a relatively closed trade structure since the beginning.

There has been a general increase in the trade openness rates of BRICS-T countries, especially since 1998; this situation reflects the countries' economic liberalization policies and their efforts to increase their integration with global trade. However, in 2009, during the global economic crisis, there was a significant decrease in trade openness rates in all countries. This decrease shows the negative effects of the crisis on global trade volume and the sensitivity of trade openness to global economic fluctuations. While such fluctuations emphasize the sensitivity of trade openness to global and regional economic conditions, it is observed that economies such as Türkiye tend to adopt more open policies to trade, while Brazil maintains a more inward-looking economic structure.

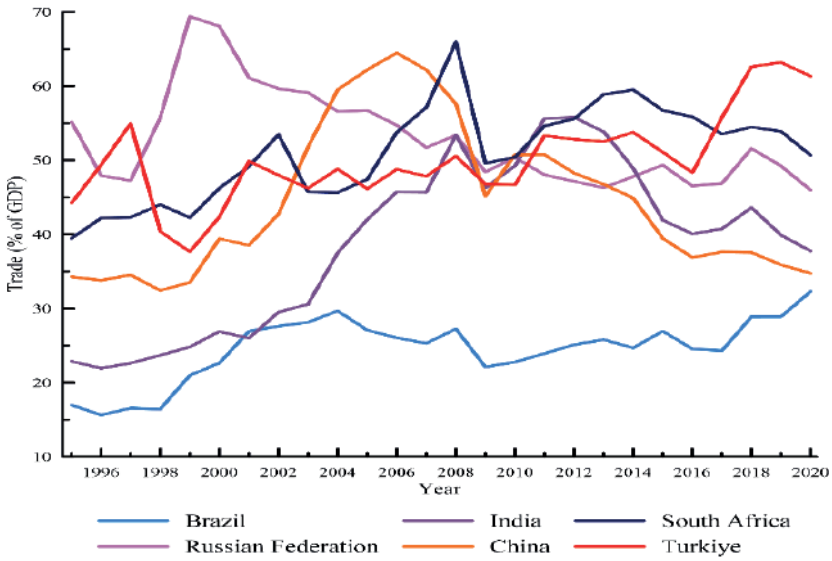

Figure 2: Trade Openness Rate (%) (BRICS-T Countries)

The tourism sector and trade openness indicators are not only related to economic growth, but also support each other in a mutual interaction. The increase in tourism is seen as a factor that encourages international

trade, and this situation is gaining importance in sustainable growth strategies, especially in developing economies such as BRICS-T countries. Understanding this strong connection between tourism and trade openness makes it possible to consider the effects of tourism, which is a part of international economic activities, on economic growth in a broader context. The interaction between trade openness and the growth dynamics of the economy, as well as the contribution of tourism to economic growth, has an important place in the growth strategies of countries.

BRICS-T countries are a group of rapidly growing developing countries (Uçar, Ülger & Atamer, 2024). These countries offer remarkable examples in terms of economic growth with their different economic structures, natural resource wealth, large population structures and rapidly developing industrialization processes. The impact of indicators such as tourism and trade openness on the growth dynamics in these economies plays an important role in achieving sustainable development goals. The study aims to better understand the effects of these sectors on growth by evaluating the growth recorded in the tourism and trade sectors of BRICS-T countries in line with their economic development goals.

The aim of the study with this motivation is to reveal the causal relationship between economic growth, tourism and trade openness in BRICS-T countries. Using annual data between 1995-2020, this study aims to understand the role played by tourism and trade openness in the economic structures and development processes of these countries.

In the literature, the effects of tourism and trade openness on economic growth have usually been examined separately. This study comparatively analyzes the causal relationships of tourism and trade openness on economic growth in BRICS-T countries by considering both sectors together, thus aiming to fill the gap in the literature. Studies on developing economies such as BRICS-T countries address the effects of tourism and trade openness on growth from a different perspective than developed countries. The study aims to offer a new perspective to the literature on this subject by examining the effects of tourism and trade openness on economic growth in developing countries. This analysis, conducted with up-to-date data for the period 1995-2020, will provide meaningful implications for policy makers by examining the effects of tourism and trade openness on growth in BRICS-T countries. The study will contribute to the empirical studies on this subject in the literature by examining the causal relationship between economic growth, tourism and trade openness.

LITERATURE

The literature is examined under two main headings: the causal relationship between tourism and economic growth and the causal relationship between trade openness and economic growth. Under these headings, the causal relationships between the relevant variables are discussed in more detail by considering them at different levels. In order to examine the literature in a more systematic manner, the causal relationships between the variables under both headings are divided into three main categories: (i) studies that found a one-way causal relationship, (ii) studies that found a two-way causal relationship, and (iii) studies that did not find a causal relationship. This structure allows for a clearer comparison and interpretation of different research findings in the literature. Thus, the complexity of the relationships between tourism, trade openness and economic growth and the place of these relationships in different contexts can be evaluated more comprehensively.

2.1. Causal Relationship Between Tourism and Economic Growth

Studies examining the one-way causal relationship between tourism and economic growth in the literature show that there is a relationship between these two variables in different directions in different countries and periods. For example, Kibara, Odhiambo, and Njuguna (2012) found a unidirectional causality from tourism to economic growth in Kenya during the period 1999-2010. In the case of Tanzania, Kyara, Rahman, and Khanam (2021) confirmed that tourism development affected economic growth unidirectionally for the period 1989-2018. In another study conducted in Romania, Surugiu and Surugiu (2013) found that tourism had a unidirectional effect on economic growth during the period 1988-2009. Similarly, Bento (2016) found a causality relationship from tourism to economic growth in Portugal during the period 1995:Q1-2015:Q1. In a study conducted in small island developing states, Akadiri and Akadiri (2021) found a unidirectional causality relationship from tourism to economic growth during the period 1995-2016.

Similar to these findings, L. Zhang and Gao (2016) found that tourism development in China affected economic growth in a unidirectional manner for the period 1995-2011. In addition, Tang and Tan (2015) showed that tourism development was linked to economic growth with a unidirectional causality for Malaysia in the period 1975-2011. Aratuo and Etienne (2019) found that there was a unidirectional causality from economic growth to each subsector in the United States between 1998-2017. In another study conducted in 29 regions of China, Lin, Yang and Li (2019) found that

there was a unidirectional causality from tourism to economic growth in ten regions and from economic growth to tourism in nine regions. In the case of Indonesia, Suryandaru (2020) showed that there was a unidirectional causality from economic growth to tourism between 1974-2017. Naseem (2021) found a one-way causality between economic growth and tourism in Saudi Arabia during the period 2003-2019.

Studies examining the bidirectional causality relationship between tourism and economic growth in the literature show that these two variables can mutually support each other. Especially in developing and tourism-based economies, the tourism sector contributes to economic growth, while economic growth encourages the development of tourism infrastructure and the sector. For example, Roudi, Arasli and Akadiri (2019) found a two-way causality between tourism and economic growth in small island developing states (SIDS) for the period 1995-2014. Similarly, Bilen, Yilanci and Eryüzlü (2017) revealed a long-term bidirectional causality between tourism and economic growth in 12 Mediterranean countries during the period 1995-2012. In another study conducted on Caribbean countries, Apergis and Payne (2012) found that the short-term causality relationship between economic growth and tourism was bidirectional in the period 1995-2007. In the case of Nigeria, Lawal, Asaleye, Iseolorunkanmi, and Popoola (2018) stated that there was a bidirectional causality relationship between economic growth and tourism between 2000-2016.

Examining a larger sample group, Wijesekara et al. (2022) showed that the relationship between economic growth and tourism in 105 countries during the period 2003-2020 was reciprocal. In another study conducted in micro-states, Fahimi, Saint Akadiri, Seraj and Akadiri (2018) found a bidirectional causality between tourism and GDP for the period 1995-2015. Seghir, Mostéfa, Abbes, and Zakarya (2015) revealed a reciprocal causality relationship between tourism and economic growth in 49 countries during the period 1988-2012. Finally, J. Zhang and Zhang (2021) confirmed the bidirectional causality between GDP and tourism in 30 provinces of China during the period 2000-2017, both in the short and long term.

These studies show that in addition to the contribution of the tourism sector to economic growth, economic growth can also play a supporting role in the tourism sector. In particular, infrastructure investments and increased welfare provided by economic growth accelerate the development of tourism and support a mutual growth cycle.

There are also studies in the literature that do not find a causal relationship between tourism and economic growth. For example, Ekanayake and Long

(2012), in their study on developing countries in the period 1995-2009, revealed that there is no causal relationship between tourism and economic growth. Similarly, Eyuboglu and Eyuboglu (2020), in their study examining 9 developing countries for the period 1995-2016, found that there is no causal relationship between tourism and economic growth. These findings show that the tourism sector may not always be effective as a factor supporting economic growth in developing countries and indicate that the contribution of tourism to economic growth may vary depending on the sectoral development level of the countries.

2.2. Causality Relationship Between Trade Openness and Economic Growth

Studies in the literature that find a unidirectional causality relationship between trade openness and economic growth show that the direction of the relationship between these two variables may differ by country and region. Raghutla (2020) found a unidirectional causality from economic growth to trade openness in five emerging market economies during the period 1993-2016. In a similar study conducted in India, Kaushal and Pathak (2015) showed a unidirectional causality from economic growth to trade openness during the period 1991-2013. Dutta, Haider, and Das (2017) found a unidirectional causality from economic growth to trade openness in Bangladesh during the period 1976-2014.

However, some studies found a causal relationship from trade openness to economic growth. For example, Keho (2017) found a causal relationship from trade openness to economic growth in Ivory Coast during the period 1965-2014. Dritsakis and Stamatiou (2016) found a unidirectional causal relationship from trade openness to economic growth in the thirteen new European Union members during the period 1995-2013, both in the short and long term. In another study conducted in Pakistan, Chandio, Rehman, Jiang and Joyo (2017) found a unidirectional causality between trade openness and economic growth during the period 1970-2014. These findings indicate that the contribution of trade openness to economic growth may vary according to the country's economic structure and level of liberalization.

Studies examining the bidirectional causal relationship between trade openness and economic growth reveal that these two variables mutually affect each other. For example, Idris, Yusop, and Habibullah (2016) found a reciprocal causality between trade openness and economic growth in a sample of OECD and developing countries between 1977 and 2011.

Another study covering G7 countries, Zeren and Ari (2013), confirms a similar bidirectional relationship with data from 1970 to 2011.

Regional studies also support this interaction. Alam and Sumon (2020) found a reciprocal interaction between trade openness and economic growth in 15 Asian countries between 1990 and 2017. Similarly, Jamel and Maktouf (2017) found a bidirectional causality between 40 European economies between 1985 and 2014.

Among the studies conducted in OECD countries, Belazreg and Mtar (2020) found that trade openness and economic growth interact with each other with data from the period 2001-2016; Fan and Hossain (2018) observed the effect of trade openness on growth and growth on trade openness in the period 1974-2016 in the case of China and India. In addition, Wijesekara et al. (2022) suggested that trade openness and economic growth can mutually affect each other with their study on 105 countries in the period 2003-2020. All these findings show that the interaction between trade openness and economic growth has an important role in the economic development processes of countries.

Studies that could not find a causal relationship between trade openness and economic growth suggest that there is no direct connection between these two variables. For example, Ayad and Belmokaddem (2017) examined 16 MENA (Middle East and North Africa) countries for the period 1980-2014 and found that trade openness did not have a significant effect on economic growth. Similarly, Kumari et al. (2023) determined that there was no bidirectional causality between trade openness and economic growth in the case of India between 1985-2018. Such studies show that the effect of trade openness on economic growth cannot always be confirmed and that this relationship may be complex or weak in some regions.

3. MODEL, DATA, METHODS AND FINDINGS

3.1. Model and Data Definition

This study investigates the direction of the causal relationship between per capita income, tourism and trade variables in BRICS-T countries. Annual data for the period 1995-2020 are taken as basis. Information on the variables is given in Table 1.

Table 1: Variables and Details

Variables and Their Symbols	Definition and Measurement	Database
Economic Growth (lnGDPpc)	GDP per capita (Constant 2015 US$)	WDI/1995-2020
Tourism (lnTourism)	International tourism, number of arrivals	WDI/1995-2020
Trade Openness (lnTrade)	Trade (% of GDP)	WDI/1995-2020

Note: WDI: World Development Indicators

The models estimated in the study are as follows;

$$lnGDPpc_{i,t} = \beta_0 + \beta_1 lnTourism_{i,t} + u_{i,t} \quad (1)$$

$$lnTourism_{i,t} = \beta_0 + \beta_1 lnGDPpc_{i,t} + u_{i,t} \quad (2)$$

$$lnGDPpc_{i,t} = \beta_0 + \beta_1 lnTrade_{i,t} + u_{i,t} \quad (3)$$

$$lnTrade_{i,t} = \beta_0 + \beta_1 lnGDPpc_{i,t} + u_{i,t} \quad (4)$$

$$lnTourism_{i,t} = \beta_0 + \beta_1 lnTrade_{i,t} + u_{i,t} \quad (5)$$

$$lnTrade_{i,t} = \beta_0 + \beta_1 lnTourism_{i,t} + u_{i,t} \quad (6)$$

3.2. Method

CD and Homogeneity Test

Firstly, it was investigated whether the model included cross-sectional dependence. Cross-sectional dependence in the estimated model prevents effective and consistent results. Therefore, in order to reach unbiased and consistent results, robust estimators should be used in the presence of cross-sectional dependence. In this context, determining cross-sectional dependence is very important. Since N<T in this study, Breusch and Pagan (1980) "CD_{LM}" test was used. The test statistic is as follows;

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T\hat{p}_{ij}^2 - 1) \quad (7)$$

The null hypothesis of this test is "H_0: There is no cross-sectional dependence". When the null hypothesis cannot be rejected according to the test statistics, it is concluded that there is no cross-sectional dependence

between the cross-sections in the panel. Otherwise, it is concluded that there is cross-sectional dependence between the countries. Therefore, in such a case, it is decided to use second-generation estimators (Baltagi & Baltagi, 2008).

In order to determine whether the slope coefficients of the variables are heterogeneous or not, the test developed by Swamy, later expanded by Pesaran, Ullah, and Yamagata (2008) in 2008 and named as Delta (Δ) test was used (Pesaran et al., 2008). In this test; A cointegration equation of the form $Yit = \alpha + \beta itXit + \varepsilon it$ is taken into account. βi is used to represent the slope coefficient. The hypotheses of the Delta test are as follows;

$H_0: \beta i = \beta$, the slope coefficients are homogeneous.

$H_1: \beta \neq \beta j$, the slope coefficients are not homogeneous.

Pesaran et al. (2008) developed the following equations to test the null and alternative hypotheses.

To be able to use it in more observations; $\hat{\Delta} = \sqrt{N}(\frac{N^{-1}\hat{S} - k}{\sqrt{2k}}$ (8)

To be used in smaller samples; $\tilde{\Delta}\, adj = \sqrt{N}(\frac{N^{-1}\hat{S} - k}{\sqrt{2k}}$ (9)

Second Generation Unit Root Test (CIPS)

The unit root test investigates whether the variables in the estimated model have become stationary and their degree of stationarity. Since the estimated model in this study includes cross-sectional dependence, the CADF (Crosssectional Augmented Dickey Fuller) test, which is a second generation unit root test and is considered useful for heterogeneous-homogeneous series, was used. This test was developed by Pesaran (2007). The test first calculates the CADF test statistic for all series forming the panel. Then, the arithmetic mean of these calculated statistics is taken. Thus, the CIPS statistic is calculated for the entire panel. The model used in the calculation of the CADF test is as follows (Pesaran, 2007);

$$t_i \text{ (N,T)} = \frac{\Delta y_i^{'} \bar{M}_w y_{i-t}}{\sigma_i \left(y_{i-1}^{'} \bar{M}_w y_i \right)^{1/2}} \quad (10)$$

The model used to calculate the CIPS statistics for the entire panel (Pesaran, 2007) is as follows:

$$\text{CIPS (N,T)} = N^{-1}\sum_{i=1}^{N} t_i \text{ (N,T)} \tag{11}$$

Dumitrescu-Hurlin Causality Test

In this study, Dumitrescu and Hurlin (2012) panel causality test was used to investigate the causality relationship between the variables. This causality test has certain advantages. These advantages are as follows; it produces effective results in the presence of cross-sectional dependence between the countries forming the panel, it can be used both when the time dimension (T) is larger than the cross-sectional dimension (N) and when it is smaller, and it can be used in the presence of both heterogeneous and homogeneous slope coefficients (Dumitrescu & Hurlin, 2012). The model investigating the causality relationship between the Y and X variables in the test is as follows;

$$y_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i^k Y_{i,t-k} + \sum_{k=1}^{K} \beta_i^k X_{i,t-k}^k + \varepsilon_{i,t} \tag{12}$$

K in the equation represents the optimum lag length. The null hypothesis of the test is as follows;

For $H_0 : \beta_i^{(k)} = 0 \ \forall_i$, there is no causality relationship from X to Y in all cross-sections. Dumitrescu and Hurlin (2012) calculate individual Wald statistics ($W_{i,T}$) for each cross-section to test the null and alternative hypotheses in question. Then, they take the arithmetic mean of the calculated Wald statistics and obtain the Wald statistic of the panel ($W_{N,T}^{HNC}$). Dumitrescu and Hurlin (2012) recommend using the test statistic with an asymptotic distribution in the case of T>N. On the other hand, they recommend using the test statistic with a semi-asymptotic distribution $Z_{N,T}^{HNC}$ in the case of T<N.

$$Z_{N,T}^{HNC} = \sqrt{\frac{N}{2K}}\left(W_{N,T}^{HNC} - K\right) \tag{13}$$

$$Z_{N}^{HNC} = \frac{\sqrt{N}[W_{N,T}^{HNC} - N^{-1}\sum_{i=1}^{N} E\left(W_{i,T}\right)}{\sqrt{N^{-1}\sum_{i=1}^{N} Var\left(W_{i,T}\right)}} \tag{14}$$

Dumitrescu and Hurlin (2012) calculate test statistics and probability values of these statistics using the panel causality test Monte-Carlo simulation.

In addition, in order to apply this test, all variables must be stationary at the level. In the study, the variables that were not stationary at the level were made stationary at the level by taking the difference and then the causality test was applied.

3.3. Findings

Table 2 shows the summary statistics of the variables as well as the correlation matrix.

Table 2: Summary Statistics and Correlation Matrix

Variables	Obs	Mean	St.Dev.	Min	Max
lnGDPpc	156	3.679	0.338	2.791	4.086
lnTourism	156	7.163	0.506	6.290	8.210
lnTrade	156	1.618	0.144	1.194	1.841
Correlation Matrix					
	Variables	***lnGDP***	***lnTourism***	***lnTrade***	
	lnGDPpc	1			
	lnTourism	0.310	1		
	lnTrade	0.165	0.505	1	

According to the table, the number of observations is 156. This number is sufficient for panel data. The minimum value is 1.194 in the lnTrade variable, while the maximum value is 8.210 in the lnGDPpc variable. According to the correlation matrix, it was observed that there was no problem of multiple linear connection between the variables. If multiple linear connection was detected, it would have been concluded that the variables in question were not suitable for econometric analysis. Table 3 shows the results obtained from the cross-sectional dependency and homogeneity test.

Table 3: Cross-Section Dependency and Homogeneity Test Results

Panel Cross Section Results		
Tes	**Statistics**	**p-value**
LM	91.52	0.000***
LMadj	37.13	0.000***
LM_{CD}	8.816	0.005**
Homogeneity Test		
	Delta	**p-value**
	6.295	0.000***
adj.	6.844	0.000***

The statistics in the table show that the panel results of the model estimated in the first part of the table contain cross-sectional dependence. In addition, the statistics in the second part of the table lead to the conclusion that the slope coefficients of the variables in the estimated model are heterogeneous. Table 4 shows the unit root test results investigating the stationarity levels of the variables.

Table 4: Unit Root Test Results

Variables	**CIPS Value**		**CIPS Value**	
	At the level		***First Difference***	
	Constant	Constant+Trend	Constant	Constant+Trend
lnGDPpc	-1.608	-1.332	-2.604*	-2.801**
lnTourism	-2.285***	-2.318	-	-
lnTrade	-1.557	-1.836	-3.660***	-3.755***

Note: 10%: -2.21; 5%: -2.33 and 1%: -2.57. *, **, and *** represent significance at 10%, 5%, and 1% significance levels, respectively.

According to the results obtained from the unit root test, it was observed that the variables lnGDPpc and lnTrade became stationary at the first difference, while the variable lnTrade was stationary at the level. As a result of the method followed for the estimation of the model, it was decided to apply the D-H panel causality test. Table 5 shows the causality test results.

Table 5: Dumitrescu-Hurlin Causality Test Results

	W-bar	**Z-bar**	**P-value**	**Lag Length**
lnGDPpc →lnTourism	1.509	0.882	0.377	1
lnTourism→lnGDPpc	1.384	0.665	0.506	1
lnGDPpc→lnTrade	2.419	2.457	0.014**	1
lnTrade→lnGDPpc	10.779	4.477	0.0000***	5
lnTourism→lnTrade	7.776	1.255	0.209	6
lnTrade→lnTourism	2.012	1.323	0.076*	1

Note: *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively.

According to the results in Table 5, both hypotheses established between lnGDPpc and lnTourism were accepted. Accordingly, no causality relationship was found between these variables. While one of the hypotheses established between lnGDPpc and lnTrade variables was rejected, the other was accepted. In this context, a one-way causality from lnTrade to lnGDPpc variable was

observed. In addition, while the first of the hypotheses established between lnTourism and lnTrade variables was accepted, the second was rejected. Therefore, a one-way causality relationship from lnTrade to lnTourism was determined.

CONCLUSION AND EVALUATION

This study investigated the causal relationship between economic growth, tourism and trade openness variables in BRICS-T countries. The analysis period is 1995-2020 and annual data is used. Dumitrescu-Hurlin panel causality test was used. According to the findings obtained from the causality test, no causal relationship was detected between economic growth and tourism. One-way causality from trade openness to economic growth was observed. Finally, one-way causality from trade openness to tourism was found.

The absence of a causal relationship between tourism and economic growth is an unexpected result from the findings obtained. This result may be due to the fact that the infrastructure, service quality or sustainable tourism policies that will affect the tourism sector in terms of growth in BRICS-T countries have limited this relationship. In addition, while most of the sample group countries show growth in the industry, agriculture or service sectors, the fact that tourism is not strong enough to directly contribute to economic growth in these countries may also explain this causality. Tourism is a sector affected by global economic fluctuations and political instabilities. The fact that tourism does not have a direct effect on economic growth in developing countries such as the countries in question may be due to such external factors. There may be steps to be taken and policies to be implemented in order to increase the impact of tourism on economic growth and to ensure income from tourism. In this context, BRICS-T countries should develop tourism infrastructure such as transportation, accommodation, security and environmental protection in order to increase the contribution of tourism to economic growth. Improvements can be made especially in airports, hotel capacities and access to tourist areas. Sustainable tourism policies should be adopted in order to protect natural and cultural assets. These policies can increase the long-term economic contribution of tourism and sustain the interest of tourists in the country. In addition, by providing diversity in tourism, investments should be made not only in coastal tourism but also in areas such as ecotourism, cultural tourism and business tourism. BRICS-T countries should strengthen their marketing strategies and expand the promotion of the country in the international arena and highlight

opportunities in tourism. In this way, both tourism will develop, tourism revenues will increase and growth will be contributed.

The determination of one-way causality from trade openness to growth; the increase in trade volume may have enabled BRICS-T countries to earn more income through foreign trade and increase their production capacity. This may explain a one-way causality from trade volume to economic growth. The sample countries, especially countries such as China, India and Brazil, follow export-oriented growth strategies. The fact that trade has a direct effect on economic growth for these countries shows the importance of exports and foreign markets on growth. Most of these countries have a significant share in the export of industrial and agricultural products. Such trade may have a positive effect on economic growth, but it has been observed that growth does not affect trade in the same way. In order to increase the supportive effect of trade on economic growth, BRICS-T countries can offer incentives to increase the export of especially high value-added products. This both accelerates economic growth and increases the competitiveness of countries in global trade. At the same time, in order to increase the contribution of trade to economic growth, regulations can be made by reducing bureaucracy, accelerating customs procedures and facilitating trade. For example, regional cooperation can be developed by making trade agreements between BRICS-T countries. In order to increase the effect of trade on economic growth, a trade strategy compatible with industrial policies should be followed. Investments in manufacturing and technology-based sectors can be supported to increase revenues obtained from trade. The finding of one-way causality from trade openness to tourism indicates that the increase in trade volume may have indirectly supported tourism by increasing the number of international business people, entrepreneurs or foreign investors coming to BRICS-T countries. Business and trade travel may support the tourism sector. The increase in trade volume may have stimulated tourism demand by increasing the international awareness of the countries. For example, countries such as China or India may have the potential to attract more tourists as they grow in trade. Tourism may have a smaller economic impact compared to the size of the trade volume in some BRICS-T countries. Therefore, tourism may not provide sufficient contribution to increase trade. In order to strengthen the causality effect from trade openness to tourism, BRICS-T countries can develop policies that encourage business tourism. They can increase trade by organizing international fairs, congresses and trade events while also increasing tourism revenues. Incentives can be provided to increase the interest of foreign investors in the tourism sector in the country. Growth in tourism can be supported by directing the revenues from trade to more

touristic infrastructure and activities. In order to increase the impact of trade relations on tourism, BRICS-T countries can invest more in international promotional activities. The country's tourism potential can be promoted through touristic and cultural activities, especially in countries that are trade partners.

The Dumitrescu-Hurlin panel causality test was used in our study; however, the results obtained with alternative causality and interaction tests may reveal different findings. Therefore, future studies may allow the comparison of the results by applying different methods. In addition, this study focused only on BRICS-T countries. Similar analyses to be conducted among groups of countries with different economic structures would be useful in assessing the general validity.

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Chapter 10

Environmental Economics: A Macroeconomic Framework

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Abstract

The literature on environmental macroeconomics is still in its early stages and does not yet have a fully defined framework. Therefore, this section examines the theoretical and conceptual foundations of environmental economics and current research on environmental economics from a macroeconomic perspective.

Current macroeconomic theory has so far addressed environmental issues as the relationship between CO2 emissions and growth. However, other macroeconomic variables and environmental issues have recently begun to be associated. The concept of climate change is part of a broader network of environmental issues, such as population growth, problems in agricultural production, water resources, and species loss. To achieve a low-carbon future, it is necessary to control population growth, reduce consumption, and take care to protect the environment. Therefore, macroeconomic theory needs to evolve to respond to these new challenges.

This study briefly summarizes the main concepts and discussions in the literature on environmental macroeconomics. Theoretical and empirical studies on this topic have been reviewed, and the framework of environmental issues has been outlined, showing the global dimension of the problem. In the continuation of the study, the macroeconomic effects of environmental factors are discussed in light of the debates in the literature, with a particular focus on their impact on inflation. Additionally, the study examines how the traditional IS-LM model has been extended to include environmental effects. Finally, this study presents a sustainable economic growth model and demonstrates the relationship between economic growth and the environment using the Environmental Kuznets Curve.

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1. INTRODUCTION

Climate change is known to cause significant physical risks, including hurricanes, monsoons, floods, avalanches, and increasing desertification and drought. These extensive effects impact all actors and sectors of economies worldwide, albeit to varying degrees. Global temperature changes will naturally impact economic activities. Additionally, environmental events on a global scale will influence consumer preferences and, consequently, well-being.

The greatest economic challenge of the twenty-first century is the disconnect between scientists' warnings about potential disasters caused by uncontrolled carbon emissions and the political and economic implications of rising emissions. This raises the question of whether economic growth can continue when carbon emissions are significantly reduced. Therefore, it is necessary to reassess what economic growth truly means.

Although environmental economics has roots that go back further, it began to develop around fifty or sixty years ago. However, for a long time, there has been almost a complete disconnect between environmental economics and macroeconomic policy. Only recently have policies related to the subject started to be expressed in economic policy reports published by international organizations such as the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD), and the European Commission, as well as by national central banks. According to Pisani-Ferry (2021), there are intellectual and political reasons for this long neglect. The intellectual reason is that environmental economics initially developed within the framework of public economics rather than a macro framework. Politically, the reason is that decarbonization has been seen as a longer-term issue.

Climate change is one of the most discussed global issues of the 21st century, with its significance extending beyond physical impacts such as extreme weather patterns, rising sea levels, hurricanes, wildfires, and heatwaves. It also has significant macroeconomic implications. These can be examined through its effects on economic activity, such as the impact of high temperatures on labor productivity, efficiency, mortality, and disease rates. Moreover, severe climate events can disrupt supply chains, potentially affecting prices, particularly for food. The uncertainty surrounding climate change and its policies may also lead to higher carbon prices, increasing production costs, reducing profitability, and lowering the value of company equity (Adediran et al., 2023).

Nearly everyone now acknowledges that global warming threatens both humanity and nature. The economic consequences of climate change are substantial, influencing businesses, households, and government policies. Climate change also disrupts ecosystems, thereby harming economic development by affecting primary resources, human capital, and productivity. At present, nations are enacting measures to lower greenhouse gas emissions and lessen adverse economic effects. Climate risk is a worldwide issue with long-term impacts that become evident over time.

The literature on environmental macroeconomics that we have examined is just beginning to mature and its framework has not yet been fully defined. In this study, we will try to summarize the prominent concepts and discussions in the environmental macroeconomics literature. In the second part of our study, the literature including both theoretical and empirical studies on the subject is reviewed. In the third part, the framework of environmental problems and the issue of global cooperation are discussed. In the fourth part, the macroeconomic effects of environmental factors are discussed within the framework of the literature. In the fifth part, the transmission mechanisms of environmental factors to macroeconomics are examined. In the sixth part, the effects of environmental factors on inflation are discussed. In the seventh part, the traditional IS-LM macroeconomic analysis is expanded to include environmental effects. In the eighth part, the sustainable economic growth model and in the ninth part, the Environmental Kuznets Curve are discussed, concluding the study.

2. LITERATURE

In classical economics, economic activities are associated with natural resources. Malthus highlights the economic growth implications of limited agricultural production areas by drawing attention to the production limits in agriculture and the impoverishment caused by uncontrolled population growth. Ricardo stated that diminishing returns from land would limit both wealth and population growth. Hotelling, on the other hand, advanced the theory of exhaustible resources. In more recent times, Koopmans (1973) highlighted the crucial role of the macroeconomic interest rate by integrating exhaustible natural capital from Hotelling's 'cake-eating' problem with produced capital accumulation in a Ramsey-type growth model (Munasinghe, 2004). Withagen's 1990 study explored various aspects of this approach and paved the way for more advanced studies by Hartwick and colleagues in 1990. Stiglitz (1974) demonstrated through a model that capital, labor, and natural resources can be substituted for each other in production. His study shows that if technological advancements

continue to offset the depletion of natural resources, it is possible to achieve sustainable higher levels of consumption.

Daly (1991) argues that appropriate macroeconomic policies can lead to optimal resource allocation, but they fail to address the scale issue when economies exceed environmental limits. Solow (1993) introduces the concept of net national product (NNP) adjusted for the depletion of natural resources and changes in environmental quality as an indicator of the highest sustainable level of consumption.

These points blend neoclassical economic theory with previous studies on environmental economics and national income measurement. England (2000) identifies three factors that will constrain growth and result in a stable economy: the scarcity of natural capital, the inability to substitute produced capital for natural capital in production, and the limitations of technological advancements in enhancing the efficiency of natural capital use.

Another historical approach uses input-output (I-O) analysis developed in the 1930s. Leontieff (1970) provides a basic framework for analyzing pollution outputs from productive sectors and the effects of policies aimed at reducing these externalities in pollution control sectors.

Subsequent research has expanded on the foundational input-output approach by integrating older models that account for labor demand and capital stock, as well as incorporating consumer demand through linear expenditure systems. Advanced models have further developed by making technical input-output coefficients dependent on prices. For environmental macroeconomic analyses, cutting-edge computable general equilibrium models and advanced models for environmental national income accounting utilize the input-output approach (Munasinghe, 2004).

In addition to these developments, environmental factors have been integrated into traditional macroeconomic models used in policy-making. These range from extended Keynesian IS-LM models for comparative static analysis to advanced computable general equilibrium models that include environmental variables. Macroeconomic models are increasingly examining environmental issues, particularly in relation to short-term Keynesian topics such as capacity utilization, unemployment, and economic cycles.

In his study, Girma (1992) included the environmental sector in a traditional macroeconomic model to assess the effects of fundamental macroeconomic policies on the environment. Long-term environmental macroeconomic models for both closed and open economies emphasize

supply-side elements like capital accumulation, natural resource depletion, long-term labor supply, discount rates (used to calculate the present value of future cash flows), and technological advancements.

Empirical studies like those by Grossman and Krueger (1995) on the connections between macroeconomics and the environment examine the relationship between per capita income and various air and water pollution indicators. This study investigates whether the 'environmental Kuznets curve,' which suggests an inverted U-shaped relationship between economic growth and environmental pollution, truly exists. According to the results of this study, while it is generally accepted that environmental quality deteriorates with increasing per capita income in the early stages of growth, it remains uncertain whether this trend will reverse with further growth, as the shape of the curve varies significantly between countries and types of environmental degradation.

In another study, Opschoor and Jongma (1996) comprehensively examine the environmental consequences of structural adjustment and stabilization programs implemented by the World Bank and the International Monetary Fund in developing countries. They advocate for the implementation of complementary environmental policies to mitigate the adverse effects of growth-oriented macroeconomic strategies in the short term, while emphasizing the need for a more holistic approach in the long term.

Jorgensen and Wilcoxon (1990) investigate how environmental regulations impact the U.S. economy using a computable general equilibrium (CGE) model. This model focuses on the fundamental energy-economy-environment linkages and uses intertemporal analysis to estimate the proportion of abatement costs within the total costs of industry and transportation, investigating the long-term growth effects. Similarly, Bergman (1990) uses a CGE model to simulate the impact of environmental regulations and energy policies on the Swedish economy. In Bergman's study, environmental market failures are addressed by creating a market for emission permits and integrating these costs into cost functions.

In another study, Kessler and Van Dorp (1998) emphasize the unforeseen impacts of structural adjustment programs, particularly on land, water resources, and forests. They advocate for the proactive assessment of environmental impacts before implementing regulatory policies, highlighting the importance of mitigation efforts.

Holden et al. (1998) conducted simulations on the economies of six Zambian villages, revealing that structural adjustment policies can negatively

impact the environment. They noted that eliminating policy distortions doesn't necessarily result in efficient markets due to high transaction costs and imperfect information, particularly in remote regions. Contrary to the previous belief that climate change would mainly impact developing countries, it also affects developed nations. Colacito et al. (2018) found that rising temperatures could reduce U.S. economic growth by one-third by 2100. A rise of 1°F in the average summer temperature leads to a 0.154% decrease in the annual GDP growth rate. Elevated summer temperatures adversely impact not just agriculture but multiple sectors of the U.S. economy. According to Kiley (2021), who analyzed data from 124 countries between 1961 and 2010, climate change heightens the probability and intensity of economic downturns, thereby affecting economic and financial stability and overall well-being.

In their study, Feyen et al. (2020) examined the interaction between climate risks and macro-financial risks. They highlight that both the physical effects of climate change and the shift to a low-carbon economy present major challenges for macro-financial stability. These challenges can disrupt investment, economic growth, fiscal revenues and expenditures, debt sustainability, and the valuation of financial assets, adversely affecting the financial health of governments, households, businesses, and financial institutions. As a result, macro-financial risks can weaken resilience to physical climate risks and hinder the ability to adapt to and mitigate climate change. The study concludes that many countries are simultaneously dealing with high levels of climate-related and macro-financial risks, a situation termed as 'double jeopardy'.

Byrne and Vitenu-Sackey (2024) investigated the impact of climate on macroeconomic activities in their study. They differentiated climate change into global and country-specific climate risks and examined their distinct effects on macroeconomic activities. The study also separates the impact of climate on developed and developing economies to account for country differences. They found that global climate risk has significant and adverse effects on macroeconomic activities in both developed and developing countries.

3 ENVIRONMENTAL ISSUES AND GLOBAL COOPERATION ACTIVITIES

Climate change typically describes the ongoing rise in average temperatures on Earth's surface, a trend that has been tracked since the late 1800s when global temperature data started being consistently recorded. This warming has significantly accelerated globally since the early 2000s.

While per capita greenhouse gas emissions in developing countries like India, China, Brazil, and Indonesia remain lower than those in developed nations, they have surged in recent years due to GDP growth with industrialization. This situation has sparked the argument that developed nations should bear greater responsibility in combating climate change. Meanwhile, developing countries like Mexico, South Korea, and Turkey have experienced notable rises in emissions as they continue to industrialize and urbanize. Although their emissions have not yet reached the levels of developed countries, they are rising faster than those of other developing nations. Small developing island states, despite having the lowest greenhouse gas emissions, are the most vulnerable to climate change impacts like rising sea levels, ocean acidification, and more frequent and severe natural disasters. Many of the least developed countries, especially in Africa and Asia, have minimal greenhouse gas emissions but are highly susceptible to the impacts of climate change. They contend that developed nations, due to their historical contributions to the issue, should take the lead in combating climate change.

Despite the urgent need to reduce carbon emissions and mitigate global warming, the long-term nature of climate change, its high costs, and the difficulty of measuring its impact have prevented the increase in global warming from being halted. However, many economic actors, especially governments, have recently taken action to prevent global warming.

The United Nations reports that the decade from 2011 to 2020 was the hottest on record, with each decade since the 1980s being warmer than the previous one. Arctic temperatures have risen at least twice as fast as the global average. This phenomenon, known as global warming, is primarily due to high levels of carbon dioxide (CO2) and other greenhouse gases in the atmosphere, which trap heat from the sun and increase the Earth's average surface temperature. The elevated levels of CO2 and other greenhouse gases are largely the result of burning coal, oil, gas, and other fossil fuels for energy production and various economic activities. Fossil fuel use alone is estimated to be the largest contributor to climate change, responsible for about 75% of global greenhouse gas emissions and 90% of all carbon dioxide emissions (Bakoup, 2023).

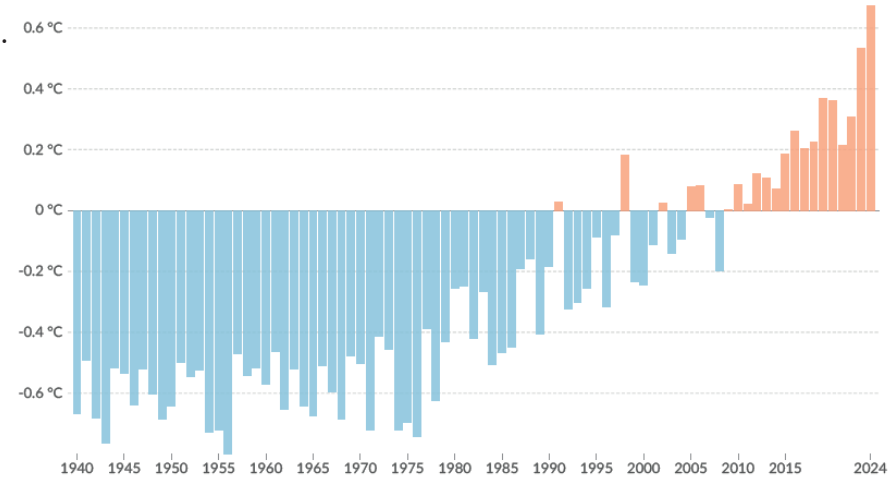

Figure 1. Global Average Temperature (The deviation of the average surface temperature of a specific month from the average temperature of the same month during the 1991-2020 period, measured indegrees Celsius).

Source: Our World In Data, https://ourworldindata.org/grapher/temperature-anomaly (accessed 16.11.2024).

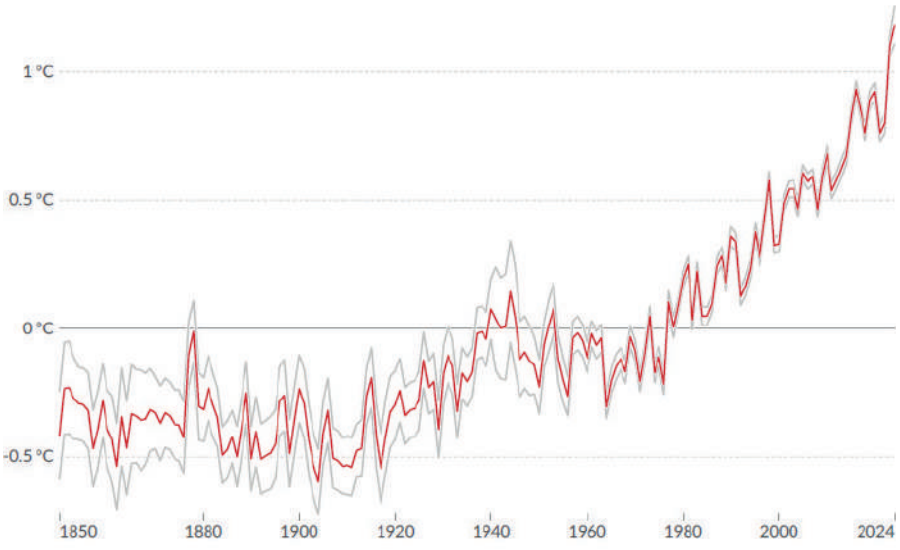

Figure 2. Global average land-sea temperature anomaly relative to the 1961-1990 average temperature reference line.

Source: Our World In Data, https://ourworldindata.org/grapher/temperature-anomaly (accessed 16.11.2024).

In February 2008, climate model studies, including those on deep-sea warming, concluded that carbon dioxide emissions must reach zero by mid-century to prevent a temperature rise of about 7°F by 2100. These conclusions align with the Fourth Assessment Report of the United Nations Intergovernmental Panel on Climate Change (IPCC), which advises a 50-85% reduction in carbon emissions by 2050 to keep temperature increases below 2°C (3.6°F) (Harris, 2009).

In the 2015 Paris Agreement, 220 countries committed to creating national climate action plans, known as nationally determined contributions (NDCs), which include long-term emission targets to be revised every five years. The IPCC concluded that to keep temperature increases well below 2°C, with a target of 1.5°C, global annual emissions must be reduced to 50% of 2010 levels by 2030.

Climate change is a global challenge that requires collective action from all countries. The international community, led by the United Nations, is spearheading efforts to mitigate climate change and enhance resilience. Under the Paris Agreement, nations have committed to achieving net zero greenhouse gas emissions by 2050, aiming to limit global warming to no more than 1.5°C above pre-industrial levels. This goal involves reducing new emissions to near zero and ensuring any remaining emissions can be absorbed by natural sinks like forests and oceans.

The Paris Agreement mandates urgent actions to limit temperature rise to 2 degrees Celsius, ideally 1.5 degrees Celsius above pre-industrial levels. The IPCC (2018) has set estimated reference limits for global emissions, termed the 'carbon budget,' to align with these goals. The challenge lies in cutting per capita CO2 equivalent emissions from around seven tons today to about three tons in a decade and nearly zero by mid-century, while sustaining or boosting economic growth. (Bernal-Ramirez & Ocampo, 2020).

The IPCC, in its Sixth Assessment Report, emphasized that climate change is making our climate more variable and that extreme temperature changes are affecting more regions over time. A study covering more than a century and thirty countries shows an increase in both the average annual temperature rise and variability. From 1901 to 1950, the average annual temperature increase was 0.012°C with a standard deviation of 0.279°C. Between 1950 and 2020, this increase rose to 0.015°C, with the standard deviation rising to 0.292°C (Byrne & Vitenu-Sackey, 2024).

4 MACROECONOMIC EFFECTS OF ENVIRONMENTAL FACTORS

Among the factors determining the macroeconomic performance and outlook of countries, climate change has been gaining increasing importance in national and global public policy discussions and thus in macroeconomic policy analyses since the 1990s.

Climate change has both direct physical effects on countries' macroeconomic variables and will affect nations' macroeconomic performance through the transition to low-carbon production processes. Almost all major macroeconomic policy variables and tools are linked to climate change. The variables that will be primarily affected include production and growth rates. In addition, monetary policies and financial stability in the inflationary process will be impacted by these developments. Furthermore, labor markets will be affected in terms of unemployment, income distribution, and labor productivity. Moreover, capital stock, technological progress, and investments will be influenced by climate change and the accompanying preventive policies. Finally, consumption and aggregate demand will be affected by this process. Naturally, all these interactions will impact both exchange rates and the fiscal structure.

Table 1 The process by which climate change affects macroeconomic variables

Shock/impact Type		Physical effects		Transition Risks
		caused by weather events	caused by global warming	
Demand	Investment	Uncertainty arising from climate change		The crowding-out of climate policies
	Consumption	risk of flooding		The crowding-out of climate policies
	Trade	Disruption of international trade due to natural disasters		Distortions resulting from asymmetric climate policies

Supply	Labour Supply	Loss of working hours due to natural disasters	Loss of working hours due to extreme heat	
	Energy, food and other inputs	Possible shortages of food and other inputs		Risks to energy supply
	Capital Stock	Damage caused by extreme weather conditions	Shift of resources from productive investments to depreciation investments	Shift of resources from productive investments to activities aimed at reducing environmental impacts
	technology	Redirecting resources from innovation to reconstruction and renewal	Directing resources from innovation to adaptation capital	Uncertainty about the speed of innovation and the adoption of clean energy technologies

Source: Batten et al., (2020).

Examining the impact of environmental factors on macroeconomic variables, that is, understanding the mutual interaction, requires addressing the following issues. These issues are essentially related to the macroeconomic impacts of climate change. In other words, it concerns how climate change affects economic performance and policy. Additionally, it is an important dimension to consider how macroeconomic policies affect climate change. Another issue is the evaluation of the macroeconomic effectiveness of climate change policies.

When these relationships are considered in terms of developing economies, three main facts need to be discussed. First, although developing economies contribute very little to climate change, they are highly vulnerable to its effects and face significant and disproportionate impacts. Second, while these economies cope with the macroeconomic effects of climate change, they are also dealing with other major global economic, financial, and geopolitical shocks they are constantly exposed to. Third, most developing economies show weak macroeconomic management while dealing with the macroeconomic effects of climate change. As a result, the effects of environmental changes on the macroeconomic variables of these countries will be quite significant. This increases the importance of prioritizing climate change and environmental degradation issues in macroeconomic analysis and policies, especially in the context of developing countries (Bakoup, 2023).

Current macroeconomic theory largely assumes continuous, exponential GDP growth. Historically, GDP growth has been closely linked to increased fossil fuel use and CO2 emissions. Reducing carbon emissions will require significant changes in economic growth models. Climate change is part of a broader set of environmental issues related to growth limits, including population growth, agricultural production, water resources, and species loss. Achieving a low-carbon future will require stabilizing the population, limiting consumption, and making significant investments in environmental protection and social priorities such as public health, nutrition, and education. Macroeconomic theory needs to be adjusted to adapt to these new realities (Harris, 2009).

A distinction will need to be made between goods and services that can continue to grow and those that must be limited to reduce carbon emissions. This new approach offers numerous opportunities for environmentally friendly economic growth. New Keynesian policies that focus on ecological sustainability, meet basic social needs like education and health, and ensure equitable distribution can help rapidly reduce carbon emissions while promoting investment in human and natural capital

Climate change will hinder economic growth through multiple pathways. Extreme weather events like floods, severe storms, and hurricanes will damage physical assets, including productive capital, causing negative supply shocks that reduce production and slow economic growth. Furthermore, as temperatures rise, more of the existing capital stock will need to be used as adaptation capital to protect against heat-related damages (Batten, 2018). This adaptation capital will not contribute to productivity. Consequently, global warming will result in slower economic growth.

Climate change will also impede growth by affecting aggregate demand. Environmental impacts will reduce capital stock and cause significant supply-side shocks, decreasing the productivity of both capital and labor, which in turn will lower output and incomes. Additionally, physical impacts will destroy consumer wealth. According to Keynesian theory, life cycle approach and permanent income hypothesis, which try to explain private consumption, these factors may lead to a decline in real and expected incomes, thus reducing private consumption. Uncertainties about future transition policies, regulations, and market preferences may also negatively affect investment, resulting in a lower growth trend in the short, medium, and long term.

The macroeconomic effects of environmental disaster shocks are similar to cost shocks. A disaster shock reduces the capital stock, leading to a decline

in consumption and production. This reduction in capital stock increases the cost of capital and thus raises the real interest rate, leading to higher inflation. Inflation can also be affected by the impacts of environmental change on the agriculture and energy sectors. Changes in the environment affect agricultural yields, which can have long-term impacts on the prices of agricultural commodities. While yields might initially increase in some regions, they could decrease in others, with the overall impact depending on a country's location and sources of agricultural imports. Additionally, rising sea levels and desertification, which lead to land loss, could affect commodity prices. Inflation can also be influenced by extreme weather events. The effects of environmental changes on inflation are further explored in the following sections.

5 TRANSMISSION MECHANISMS OF ENVIRONMENTAL FACTORS TO MACROECONOMICS

According to partial equilibrium analyses, macroeconomic stability is a minimum and necessary condition for environmental protection. Secondly, environmental degradation often results from market, policy, and institutional failures related to the use of environmental resources. Thirdly, macroeconomic policies can have negative effects on the environment, but these adverse outcomes only occur when market, policy, and institutional failures are present, although it is difficult to predict how severe these effects will be in advance (Gandhi, 1996).

The shift to an economy with reduced carbon emissions, driven by changes in climate policies, technological advancements, and evolving consumer preferences, is known as transition risks in the literature. Consequently, there are various ways climate change impacts both the supply and demand sides of the macro economy and the financial sector. At this point, the effects of environmental changes on the overall economy are mainly examined from the perspectives of supply, demand, and productivity.

Andersson et al. (2020) examined how climate change and related policies can affect the macro economy in ways relevant to central banks' monetary policy assessments regarding inflation outlooks. For this purpose, the potential transmission channels and economic impacts of climate change, as well as evidence on mitigation policies that may be of potential importance to macroeconomic policymakers, are reviewed. According to them, early policy efforts to address climate change may entail significant upfront costs but will likely reduce long-term costs.

In their study, Diebold and Yılmaz (2012) developed generalized temperature spillover indices and demonstrated the interconnectedness of climate changes between countries. Therefore, the spread of temperature changes from one country to another and the interconnectedness of countries is an inevitable reality. This interconnectedness suggests that temperature changes share common factors. Given this global interconnection, it is essential to consider these shared climate factors when assessing their impacts on macroeconomic activities.

Climate risk can affect the economy through various channels. Due to uncertainty, firms may delay irreversible investments with option value waiting (Bloom, 2009), leading to a decrease in new working capital and R&D expenditures. Berestycki et al. (2022) discovered that uncertainty surrounding climate policies leads to notable reductions in investments in capital-intensive industries, especially in sectors with high pollution levels that are impacted by changes in climate policies. Comprehensive research emphasizes the need to incorporate the physical aspects of climate threats into economic impact studies. These studies show that climate risks reduce economic growth by negatively affecting labor productivity, capital quality, and R&D expenditures. In summary, climate risks can have a direct impact on both economic production and consumption. (Byrne & Vitenu-Sackey, 2024).

Climate-related risks are divided into two types: physical risks arising from climate changes and transition risks arising from the shift to a low-carbon economy. Physical risks include the effects of more frequent and intense weather events such as tropical hurricanes, droughts, heatwaves, and floods, as well as the gradual impacts of global warming. For example, rising sea levels can significantly reduce the productivity of coastal areas and even cause entire atoll countries in the Pacific, such as Kiribati and Tuvalu, to be submerged. Additionally, increases in temperature and changes in precipitation patterns can negatively affect the productivity of agricultural lands (Feyen et al. 2020).

Agriculture, livestock, and fisheries are highly vulnerable to climate change. Extreme weather conditions can cause crop spoilage; gradual warming and unpredictable rainfall can further degrade soil and exacerbate desertification, reducing crop yields. In livestock, changes in temperature and precipitation affect pasture quality and feed, impacting meat and milk production. In fisheries, rising sea temperatures, acidification, and overfishing significantly reduce biodiversity, threatening many species.

Climate change-related events can temporarily or permanently disrupt agricultural supply. This is particularly concerning for developing economies where agriculture is a significant economic sector and food constitutes a major portion of consumer expenditures. Such disruptions can affect overall income and employment and lead to more volatile inflation rates due to fluctuations in food prices.

Natural events, like physical risks, can negatively impact various productive sectors such as transportation, coastal real estate, and public utilities. Additionally, policy decisions and technological developments (transition risks) can affect industries like oil and coal, as well as those heavily dependent on fossil fuels such as steel, aluminum, cement, glass, chemicals, plastics, and paper. Conversely, some sectors may benefit from new opportunities, such as renewable energy, electric vehicle production, and the information technology industry.

Extreme weather events can also destroy physical infrastructure and production capacity, cause resource and product shortages, and lead to more frequent disruptions in domestic and international production processes, trade, and supply chains. This situation necessitates directing investments towards adapting to climate change and potentially rebuilding damaged infrastructure, buildings, and machinery.

Firms may encounter a more complex environment with increased operating costs, potential legal liabilities, regulatory and reputational risks, and shifts in customer behavior and demand for eco-friendly products. Additionally, market signal disruptions, uncertainties about growth and future demand, expected depreciations of existing assets due to policy changes, and more uncertain investment conditions due to low profitability of current assets can arise. Higher expenditures on adaptation, mitigation, and developing alternative technologies (Batten, 2018) also contribute to these challenges. Necessary climate policy decisions, such as carbon taxes, can further increase transition risks.

It is possible to anticipate structural effects and fluctuations in the relative prices and trade volumes of key commodities, such as hydrocarbons, minerals, and food, which are crucial in international trade. This can unpredictably alter the terms of trade and real exchange rates for many emerging and developing countries. Transition policies, including taxes, regulations, and import/export restrictions, can also influence trade patterns. Additionally, low labor productivity can impact the real exchange rates of numerous countries. Supply chains may face more frequent disruptions due to geophysical changes and weather events.

Although the effects vary by region and sector, climate change is expected to significantly impact global economic growth. Estimating the scale of these risks and financial losses is difficult due to the inherent uncertainty of the evolving environmental, social, and economic problem. Traditional risk assessments and existing climate-economic models fall short in fully predicting the nature of climate-related risks. Physical risks and transition risks arising from climate change involve complex, unpredictable dynamics fundamentally altered by increasing greenhouse gas concentrations. Crossing climate tipping points could lead to catastrophic and irreversible consequences.

Many sectors are expected to suffer from climate change, though agriculture in high latitudes might initially see some benefits. Climate change is anticipated to affect both the European production system and physical infrastructure. Extreme events and rising sea levels may lead to increased global population movements. Agriculture, fisheries, forestry, and bioenergy production are likely to be directly impacted. The agricultural sector will probably experience changes in crop yields, with pests and plant diseases becoming more prevalent. Grain yields in northern Europe may increase, while those in southern Europe are likely to decline.

Climate change will affect the productivity of specific land and water areas. Altered rainfall patterns are likely to increase the need for irrigation. However, in some regions, irrigation might not be enough to prevent crop damage from heatwaves. The amount of water extracted from rivers and groundwater sources may significantly decrease in the context of increasing demand from agriculture, energy, industry, and housing. A warming climate might boost forest productivity in northern Europe, but it could also lead to increased damage from pests and diseases across all regions. Additionally, the risk of uncontrolled fires and storm damage may rise.

As cooling and heating demands change, it is likely that the energy, energy-intensive sectors, and construction sectors will be affected. Heating demand may decrease while cooling needs increase. Implementing more energy-efficient buildings and cooling systems, along with demand-side management, will help reduce future energy demand. However, water scarcity could lead to a decline in hydroelectric supply in some parts of Europe. Additionally, thermal energy production might drop during the summer, and overheating in buildings could become more common.

In the transportation sector, climate change might reduce winter traffic accidents in high latitudes, but it could also negatively affect inland water transport on some rivers. For instance, low water levels in the Rhine River are

already impacting river transportation in the region. Railway infrastructure may experience more damage due to high temperatures. Extreme weather conditions in transportation could cause economic damage equivalent to 0.5% to 1% of global GDP by mid-century, although there may be some benefits, such as reduced winter maintenance costs.

The health sector could face negative impacts, and social welfare costs might rise due to increased health and mortality risks from extreme events. Specifically, exposure to heat and cold, along with infectious, cardiovascular, and respiratory diseases, may become more prevalent in Southern Europe. According to the World Health Organization (WHO) assessment in 2018, climate change is expected to cause approximately 250,000 additional deaths per year globally between 2030 and 2050 due to malnutrition, malaria, diarrhea, and heat stress. Health care costs may also rise due to high levels of local air pollution (e.g., in the form of particulates and nitrogen dioxide) resulting from the burning of fossil fuels. Lung diseases and premature deaths related to air pollution are already a problem in many major cities worldwide. It is estimated that air pollution from burning fossil fuels results in 3.7 million premature deaths annually worldwide.

6 THE EFFECTS OF ENVIRONMENTAL CHANGES ON INFLATION

This section discusses three interrelated concepts put forward by Schnabel[2]. These are fossilflation, climateflation, and greenflation. The first two refer to the persistent cost of dependency on fossil fuels, which has not been adequately addressed over the years, known as fossil inflation, and the increasing impact of natural disasters and severe weather conditions on economic activity and prices, known as climate inflation. Traditionally, inflation is seen as a contextual or descriptive aspect of environmental issues, but the economic impacts of climate change contradict this traditional understanding (Jackson 2024).

Schnabel (2022) introduces the concept of energy inflation with terms like climateflation, fossilflation, and greenflation. He also explains 'green inflation,' which refers to inflationary pressures arising from the scarcity of essential metals and minerals for renewable energy infrastructure. Carbon taxes and other climate policies can also lead to price stability effects known as 'green inflation' (Mckibbin et al., 2021). It is recognized that transition scenarios will bring their own inflationary pressures. This article does not

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address the price instability that may result from delayed or unsuccessful transitions.

The relationship between energy prices and price stability is well-known, with fossil fuel price-driven inflation (fossilflation) being a long-standing issue, recently exacerbated by Russia's invasion of Ukraine. The inflationary effects of climate change (climateflation) and environmental degradation are relatively new but increasingly discussed. Climateflation, which is global but disproportionately affects low-income households and countries, mainly results from reduced agricultural activities and crop yield damage. As environmental degradation worsens, it will increasingly contribute to price instability.

The inflation caused by fossil fuel prices (fossilflation) has been a long-standing issue. However, it has become more pronounced with the Ukraine war. The importance of energy for price stability is well known. The effects of climate change (climate inflation) and environmental degradation on inflation are relatively new but increasingly significant. Climate inflation, which affects the whole world but disproportionately impacts low-income households and countries, primarily stems from the reduction in agricultural activities and damage to crop yields. As environmental degradations intensify, they will increasingly contribute to price instability.

The situation where fossil fuels drive inflation, known as fossilflation, is not actually a new phenomenon and has continued from the oil price shocks of the 1970s to the present day. Given the dependence of economies on energy for production and transportation, energy prices affect inflation both directly and indirectly. On the other hand, the strengthening of the US dollar is also leading to increases in global energy prices, which exacerbates the fossil fuel shock for net energy-importing countries.

The burning of fossil fuels is the main cause of climate change, leading to higher temperatures and more frequent and persistent extreme weather events. This trend causes adverse supply shocks and creates inflationary pressures known as climate inflation. These pressures primarily affect the agricultural sector. Current research increasingly shows evidence that extreme weather conditions and rising temperatures have a general inflationary effect. As climate change and environmental degradation intensify in the future, this effect is expected to worsen (Barmes & Bosch, 2024).

Low-income households and countries in the Southern Hemisphere are most adversely affected by rising food prices due to their vulnerability to climate. Therefore, climate inflation further increases inequality both within

and between countries. Inflation targeting and the primary policy response of central banks aimed at price levels (interest rate increases) deepen this inequality while failing to address the root cause of inflation. Consequently, financial stability is jeopardized, and green investments necessary for a green and secure transition are hindered in the long term for the sake of price stability.

A recent study indicates that storms and floods can lead to short-term inflation spikes (within one to two quarters) in developing countries, while droughts may have a more lasting upward impact on inflation, persisting for several years. The study also suggests that severe natural disasters in developed countries can influence inflation (Andersson et al., 2020).

In this context, traditional monetary policy negatively impacts price stability and the economic, social, and environmental goals of governments. Raising interest rates does not address the underlying causes of rising energy and food prices and can restrict the government's fiscal capacity while hindering investment in capital-intensive green projects. Instead, central banks should incorporate environmental considerations into monetary policy and enhance coordination with fiscal and industrial authorities. Additionally, new international monetary regulations will be needed to maintain price stability and ensure a fair transition.

Climate change, environmental degradation, and global energy markets together play a role in price instability, significantly affecting inflation forecasts and macroeconomic policy. Central banks need to develop their understanding of these factors influencing inflation and adjust their policies accordingly. It must be acknowledged that achieving environmental goals is vital to prevent the continuation of macroeconomic instability related to the environment. Although fiscal, industrial, and environmental authorities primarily drive the transition to a sustainable economy, innovative monetary policy approaches and improved inflation forecasting should support these efforts (Barmes & Bosch, 2024).

Climate change can also affect the design and implementation of monetary policy. Central banks need to consider the supply and demand shocks caused by climate change, as these factors significantly impact prices and inflation. Using data from 'more developed regions,' a classification by the UN that includes 27 EU countries, four EU candidate countries, the United Kingdom, Canada, the USA, New Zealand, and Australia, Engin and Thakoor (2022) found in their study that climate change shocks increase real interest rates and inflation in these countries. This can also negatively affect

developing countries due to the global economic impact of the sampled economies.

Due to energy shocks and the climate crisis, inflation in the disrupted global economy is becoming inherently more ecological and disproportionately affects low-income households and countries. Economic authorities, especially central banks and finance ministries, need to adapt to this new era by incorporating environmental considerations into policy tools and increasing coordination to ensure price stability and a fair transition.

7 INCORPORATING ENVIRONMENTAL FACTORS INTO THE TRADITIONAL IS-LM MODEL

In open economy macroeconomic analyses, similar to the IS-LM-BOP approach, the traditional IS-LM model can be extended to include environmental changes. In Figure 3 below, the traditional IS-LM model is expanded by adding the EE curve, which represents environmental changes.

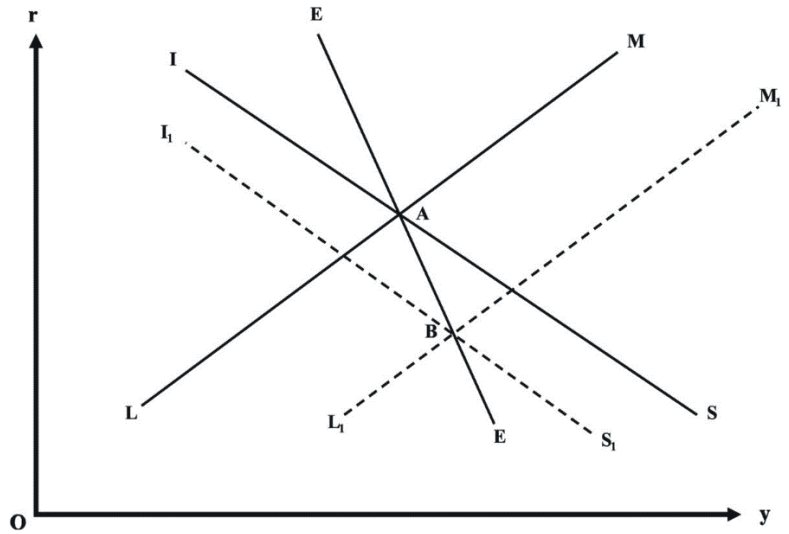

Figure 3 Extending the traditional IS-LM analysis to include the environment

Source: Munasinghe (2004)

In the comparative static analysis of macroeconomic policies, we can also include environmental issues in the IS-LM framework. As is known, IS-LM curves are drawn in the (R, Y) space; where R is the interest rate and Y is the aggregate demand.

$$\frac{dY}{dt} = \varnothing\left[A\left(R, Y, F\right) - Y \right] \equiv \varnothing\left(R, Y, F\right) \tag{1}$$

Here,

Y = real output

A = aggregate demand for goods

R = long-term real interest rate

r = short-term real interest rate

i = short-term nominal interest rate

F= index of fiscal stance

π = rate of inflation

First, let's assume that consumption and investment are affected by R. Here, the demand for goods can be written as $A\left(R, Y, F\right)$, where $A_R < 0$ and $A_Y, A_F > 0$. Here, $\emptyset$ has a decreasing relationship with R and Y, and an increasing relationship with F. Equilibrium in the goods market requires $\emptyset = 0$. In this case, the equality A = Y will implicitly give the IS curve. In the {Y, R} space, the slope of the IS curve is $(\frac{-\varnothing_Y}{\varnothing_R})$ and is negative. Increases in F (expansionary fiscal policy) cause rightward shifts.

Monetary market equilibrium is also characterized by traditional portfolio evaluations. Assuming rational expectations (and risk neutrality), arbitrage equates the yield rates of short-run nominal bonds and real consols as follows:

$$R - \frac{\frac{dR}{dt}}{R} = i - \pi^* \tag{2}$$

The balance of the money market requires the equality of money supply and demand.

(M/P)= L(i, Y).

Substituting i into Equation (2) will give the LM curve:

$$\frac{M}{P} = L\left(R - \frac{\frac{dR}{dt}}{R} + \pi^{*}, Y \right) \tag{3}$$

The LM curve is upward sloping, and monetary expansion will shift it to the right.

To understand the logic behind the EE curve, let's consider a situation where technological progress remains constant. In this scenario, if the amount of materials and energy required to maintain the equilibrium output level exceeds the environment's ability to renew and absorb waste, the output level will become unsustainable. This means that natural capital stocks will deplete, making it impossible to sustain the necessary production in the long term.

Producing output requires a certain amount of natural capital. It is clear that natural capital and physical capital complement each other rather than substitute for one another. Therefore, sustainability requires the preservation of both types of capital.

The necessity of preserving natural capital indicates that a macro-environmental constraint should be added to the standard IS-LM framework. This constraint is represented by the EE curve in the (R, Y) space. To form the EE curve, consider (E) as the technical efficiency of resource use in production.

$$E = \frac{\text{the current energy used for the produced real output}\left(\text{Y}\right)}{\text{available energy in the resource flow}\left(\text{T}\right)}$$

Due to the complementarity between natural and artificial capital, E is always less than one. In equilibrium, E is affected by the production techniques used. More resource-intensive or polluting techniques result in a lower E. It is assumed that E is a function of $R, \beta \, and \, \gamma$, i.e., E = E(R, β, γ).

Cleaner production techniques are more likely to be adopted when R values are low and β values are high. Additionally, an increase in γ provides producers with more advanced techniques that save resources and reduce pollution. By doing so, production at a certain level of technical efficiency will be less costly. Therefore, $E_R < 0$, $E_\beta > 0$ and $E_\gamma > 0$.

Rearranging equation (6) allows us to express the total throughput of matter-energy in the economic process as $T = \Upsilon/E$ where $T\Upsilon > 0$ and $TE < 0$. Therefore, the total matter-energy throughput can be represented as follows:

$$T = \frac{Y}{E\left(R.\beta,\gamma\right)} \tag{4}$$

Let *Nt* represent the physical stock of natural capital at time t. Assuming natural capital regenerates at a rate of $s \cdot Nt$ the net rate of natural capital enhancement or depletion can be expressed as follows:

$$-\left(\frac{dN}{dt}\right) = T - s * N \tag{5}$$

$$-\left(\frac{dN}{dt}\right) = \frac{Y}{E\left(R.\beta,\gamma\right)} - s * N \tag{6}$$

For environmental equilibrium, natural capital must remain intact. Equation (7) defines the EE curve in the (R, Υ) space when $dN/dt = 0$. Differentiating equation (7) indicates that the EE curve has the following slope.

$$\left.\frac{dR}{dY}\right|_{\mathrm{dN/dt}=0} = \frac{E}{Y} \tag{7}$$

Because $ER < 0$, the slope of the EE curve is negative. However, the slope will change over the length of its locus. Indeed, it will be steep whenever the technical efficiency of production is insensitive to changes in R.

As shown in Figure 3, this trend will become more pronounced as the maximum allowable output level (Ymax) is approached. When Ymax is achieved and the cleanest available technique is utilized, additional resource savings and pollution reductions cannot be achieved solely by changing production techniques.

In an initially balanced economy, the IS, LM, and EE curves intersect at point A. Expansionary monetary policies will cause the LM curve to shift to L_1M_1. To re-establish the triple equilibrium at point B, assuming the EE

curve remains constant, contractionary fiscal policies will be needed to shift the IS curve to I_1S_1.

One of the first studies addressing environmental issues within the IS-LM-EE framework is Lawn (2003). This study suggests the use of tradable resource use permits when production exceeds sustainable levels. Auctioning these permits will raise their prices, increasing production costs and output prices. As prices rise, the real money supply will decrease, creating a contractionary monetary effect that reduces output.

8 SUSTAINABLE ECONOMIC GROWTH

Nowadays, sustainable economic growth and environmental quality have become topics that are evaluated together. As is known, emissions increase as the economy grows. On the other hand, technologies developed to reduce emissions that pollute the atmosphere, especially CO2, can mitigate this environmental impact. For example, a new smokestack filter can reduce emissions while maintaining the same level of production. In the model below, (g_A) represents technological progress that reduces emissions. The emission growth rate (g_E) accompanying balanced growth can be written as follows (Milani, 2023):

$$g_E = g_B + n - g_A \tag{1}$$

Here,

g_E, growth rate of emissions.

$g_B + n$, scale effect (g_Y).

g_A is the technical effect.

$g_B + n$, the scale effect (g_Y), this suggests that higher output levels lead to increased emissions. In other words, larger GDP values are linked to higher emissions. The term g_A represents the technique effect, indicating that the advancement of clean production techniques will help lower pollution emissions. As can be seen from the equation above, it is subtracted from the first term in the equation because it will reduce the increase in emissions.

Sustainable growth is defined as a balanced growth trajectory that enhances per capita income while improving the environment. To achieve sustainable growth, the following conditions must be satisfied.

$$g_B > 0 \tag{2}$$

$$G_A > g_B + n \tag{3}$$

$$g_E < 0 \tag{4}$$

Equation 2 shows that technological progress is necessary for sustainable per capita income growth. Meanwhile, Equation 3 indicates that for emissions to decrease and production to increase, technological progress in reduction must exceed the growth in total production g_Y. Together, these two conditions express the negative emission growth rate given by Equation (4).

9 ECONOMIC GROWTH AND ENVIRONMENTAL POLLUTION: ENVIRONMENTAL KUZNETS CURVE (EKC)

The relationship between the environment and economic growth is complex and often contradictory. Economic growth is vital for social stability and development, making it a top priority for governments. However, as economies grow, environmental constraints related to climate, energy, and land use increasingly limit growth. Uncontrolled growth can lead to irreversible environmental damage. Today, traditional economic models that assume continuous growth are no longer valid.

Currently, there is no comprehensive theory to resolve the conflict between economic growth and environmental sustainability. Although the concept of 'green growth' is appealing, achieving it in practice is difficult. Despite the limited evidence of a significant decoupling between GDP growth and carbon-intensive energy use, it is clear that economic growth and environmental health are opposing concepts (Niu et al., 2022). One approach that attempts to explain the relationship between growth and environmental pollution is the Environmental Kuznets Curve (EKC) model.

The Environmental Kuznets Curve (EKC) shows a relationship between indicators of environmental degradation and per capita income. As economies become wealthier, environmental impacts initially increase but eventually decrease. On the other hand, while some environmental issues decrease in developed countries, other problems persist. However, the statistical evidence for the EKC is not very strong, and the mechanisms behind this approach are still debated (Stern, 2014).

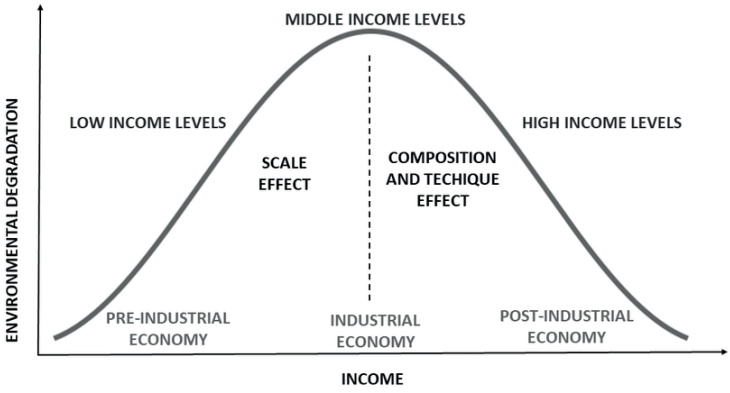

Figure 4 Environmental Kuznets Curve (EKC)

Source: Mitić et al. (2019)

As can be seen from Figure 4, the Environmental Kuznets Curve (EKC) is a hypothesized relationship between environmental degradation indicators and per capita income. According to this, in the early stages of economic growth, pollution and environmental degradation increase. However, after reaching a certain income level (which varies according to different indicators), this trend reverses, leading to environmental improvements at higher income levels. This indicates that the environmental impacts or emissions per capita follow an inverted U-shaped pattern relative to per capita income (Stern, 2014). The EKC is named after Simon Kuznets, who proposed that income inequality initially increases and then decreases as economic development progresses.

10 CONCLUSION

Significant investments aimed at mitigating climate change are already being made by all countries to decarbonize the energy needed for economic growth and to increase energy efficiency. However, much more effort is required to completely decarbonize the economy. Additionally, new climate mitigation measures will be necessary to address rising sea levels and increasingly extreme weather conditions.

Climate change can be seen as a negative shock to the supply potential of the economy. By its nature, climate change appears to be a trend shift accompanied by larger fluctuations rather than being entirely temporary like weather conditions. As a negative supply shock, it will exert downward pressure on production, upward pressure on prices, and reduce future

potential growth. Additionally, the uncertainty about the speed and scope of climate change and humanity's ability to adapt is expected to increase uncertainty about future potential growth. This could lead to fluctuations as economic actors adjust their expectations of potential growth based on changing weather conditions and new scientific evidence. As economic units revise their expectations of potential growth in light of changing weather conditions and related emerging scientific evidence, this will likely mean some degree of fluctuation. Changes in the preferences of economic agents can affect product demand and alter behaviors, impacting production and supply.

Climate change can also alter demand conditions. In the short term, infrastructure damage might boost investment, but weaker economic growth and income expectations, along with increased uncertainty, could lead firms to reduce investment and households to save more and spend less in the medium term. Trade may be disrupted by transportation and infrastructure issues due to rising global temperatures. Additionally, the broad impacts of climate change on supply and demand are likely to have indirect effects on inflation. In particular, upward price pressures can arise due to the reduced supply potential of the economy.

A large part of the potential negative macroeconomic impacts comes from climate change's effects on productivity. Some output losses are also due to low productivity. Climate change can negatively affect productivity through various channels. Higher heat and humidity levels can reduce working capacity and cause output losses. Both higher average temperatures and more frequent extreme weather events can adversely impact productivity.

Lower investment can negatively impact capital stock and capital formation. Damage to physical capital, such as infrastructure, buildings, and equipment, may reduce the capital stock, affecting governments, businesses, and households. Although this damage might prompt renewal investments in the short term, it is likely to decrease net wealth at the overall economic level. If firms become more pessimistic about the future impact of climate change on growth, they may reduce investment, leading to a lower capital stock and potential production growth.

Global warming can negatively impact the labor market and household sector. Rising temperatures can affect people's health and working capacity, reducing labor input. With lower labor input and productivity, households might expect decreased future income, leading to reduced spending. Damage to capital stock can also pressure consumer spending by reducing net wealth.

Additionally, climate change can alter migration patterns, causing labor supply to decrease in some regions and increase in others.

In response to the impact of climate change on transportation, trade and production patterns may be affected. While transportation links in colder regions might improve, severe storms, altered precipitation patterns, and extremely high temperatures could cause adverse effects elsewhere. If companies relocate from areas heavily impacted by climate change, it could lead to a reallocation of capital stock, employment, and production across different countries.

Climate change is anticipated to have wider welfare impacts that GDP losses alone do not fully capture. GDP, by design, does not include significant welfare determinants like health risks from changing climates and disruptions from displaced communities. Standard national accounting does not directly account for environmental externalities and the depletion of natural resources (or damage to natural capital). However, activities aimed at addressing these issues, such as healthcare and pollution reduction expenditures, generally have a positive impact on GDP. This measurement issue has led to efforts to supplement GDP with satellite accounts that measure environmental and social variables affecting welfare.

Environmental economics studies are expanding to include macroeconomic analyses due to the undeniable effects of environmental factors on macroeconomic variables. In these studies, the relationships between the environment and economic growth are examined through both growth theory and Kuznets-type approaches. Additionally, the relationships between greenhouse gas emissions and economic development are also being intensively studied. On the other hand, efforts to extend the IS-LM model to include environmental effects are being observed. Therefore, the development of macroeconomic analysis with an environmental dimension inevitably lies ahead of us.

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Chapter 11

Comparative Analysis of Macroeconomic Performance in the Case of E7 Countries

Seher Suluk[1]

Abstract

Macroeconomic indicators are generally used to analyze and evaluate the general economic performance of a country. The macroeconomic indicators in question include GDP, GDP per capita, unemployment rates, inflation rates, interest rates, etc. In this context, the main objective of this study is to examine the macroeconomic performance of seven emerging countries (E7), that is, Brazil, China, India, Indonesia, Mexico, Russia, and Turkey, and to reveal the macroeconomic situation of these countries, thereby contribute to the relevant literature. For this purpose, selected macroeconomic indicators were used in the study, and the macroeconomic performance was analyzed comparatively with the help of table and graphs. As a result of the study, in the light of the data, it can be said that China is the country that shows the best performance among the other E7 countries, while Turkey is the country with the lowest macroeconomic performance compared to other E7 countries.

1. INTRODUCTION

Macroeconomic indicators provide information about the general economic situation of a country. The indicators in question include economic growth, GDP per capita, employment rates, unemployment rates, inflation rates, interest rates, foreign trade balance, current account balance, etc. These indicators provide an overall analysis of a country's economic performance.

Macroeconomic instability negatively affects society. For example, if the macroeconomy is unstable, economic growth will be affected negatively and the environment of trust will be shaken. Investments, which are an important driver of economic growth will decrease, thus creating a negative impact on

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new employment opportunities that investments can create. To give another example, if inflation rates are high, the purchasing power of individuals will decrease, thereby negatively affecting the country's economy. Therefore, macroeconomic stability is important for the sustainable development, economic development and social welfare of a country.

The main goal of policy makers is to establish a strong economic structure with economic stability. These basic objectives are to increase output by expanding production volume, reduce unemployment by creating new employment areas, and ensure price stability, current balance and public income-expenditure balance by preventing price fluctuations. The success of these goals is reflected in the economic performance level of the countries (Koşaroğlu, 2021: 204). For this reason, countries need to see the gaps in their development policy making and determine the reasons behind the periods in which they exhibit low economic performance. Interpretation of macroeconomic variables is significant in determining the economic structure and determining the strengths or weaknesses of the macroeconomic policies followed (Ekinci Hamamcı and Şahinoğlu, 2020: 729). As a matter of fact, the macroeconomic performance of countries reflects how successful the policies they implement and the targets they set have been met (Orhan and Göçeri, 2019: 169).

The aim of this study is to evaluate the macroeconomic performance of seven emerging countries (E7) with selected macroeconomic indicators and to reveal the macroeconomic situation of these countries in general. Although there are studies examining the macroeconomic performance of different countries or country groups in the literature, not many studies have been found evaluating the macroeconomic performance for the E7 countries. Therefore, this study aims to fill this gap in the literature. Besides, this study is considered to be important in terms of identifying and presenting the macroeconomic performances of the E7 countries in order to provide ideas for policies that can be implemented. However, the fact that each country has different historical, structural and economic characteristics should be taken into account. In this context, the literature review will be included in the section following the introduction. Then, the macroeconomic performance of the E7 countries will be evaluated with the help of table and graphs. The study will be concluded with a conclusion and general evaluation.

2. LITERATURE REVIEW

In the economic literature, the macroeconomic performance of different countries or country groups has been evaluated and compared. However,

there are not many studies conducted for E7 countries. This section includes some studies evaluating the macroeconomic performance of countries.

Güran and Tosun (2005) investigated the macroeconomic performance of Turkey for the period 1951-2003 using data envelopment analysis. According to the results obtained, it was concluded that Turkey's macroeconomic performance generally decreased and that macroeconomic performance had an unstable structure, especially after 1980. It has also been stated that the years with the worst macroeconomic performance were the crisis years. In their study investigating the macroeconomic performance of BRICS countries and Turkey, Ağır and Yıldırım (2015) concluded that Turkey performed worse than other countries. Benlialper et al. (2015) examined Turkey's economic performance by comparing Turkey with similar country groups and countries taking into account the period between 2002 and 2014. According to the results obtained, the relative performance of the Turkish economy is either close to the average or below the average in all periods and sub-periods except for one or two variables. It was also concluded that Turkey is one of the most fragile country among the countries considered. It was stated that during the period under consideration, Turkey was among the countries with the lowest relative performance and that Turkey did not have particular success in basic macroeconomic indicators. Koşaroğlu (2021) compared the macroeconomic performances of E7 countries using ENTROPY and ARAS methods. The study covers the period 2010-2019. According to the weight coefficients obtained from the ENTROPY method, the current account deficit was found to be the most effective criterion on macroeconomic performance. The findings obtained from the ARAS method showed that the country with the best economic performance is China, while the country with the lowest economic performance is Brazil. Nalçakan (2022) examined the macroeconomic situation of Turkey during the COVID-19 pandemic. According to the results, it was concluded that macroeconomic data deteriorated. Yöyen (2023) revealed the macroeconomic performance of the Turkish economy for the period 2003-2022. For this purpose, Turkey's macroeconomic performance index was calculated using economic growth, inflation, unemployment, current account balance and budget balance data. According to the findings, while Turkey is not in a bad position in unemployment and current account deficit variables compared to the past two decades, the country has shown a poor performance in economic growth, inflation and budget deficit variables. As a result of the calculated macroeconomic performance index, it was concluded that the last five years of the Turkish economy have been the worst five-year period in the last two decades. At the same time, Turkey's macroeconomic performance,

which was compared with other countries from around the world was found to have not performed successfully compared to these countries; and it was concluded that Turkey has a negative economic outlook in its 100th year.

3. MACROECONOMIC PERFORMANCE OF E7 COUNTRIES

Emerging Seven (E7) countries, consisting of Brazil, China, India, Indonesia, Mexico, Russia, and Turkey are countries with a high rate of development (Yavuz Tiftikçigil et al., 2018). Hence, it is considered important to evaluate the macroeconomic performance of these countries. In this context, in this section, the macroeconomic performance of E7 countries with selected macroeconomic indicators is evaluated with the help of table and graphs.

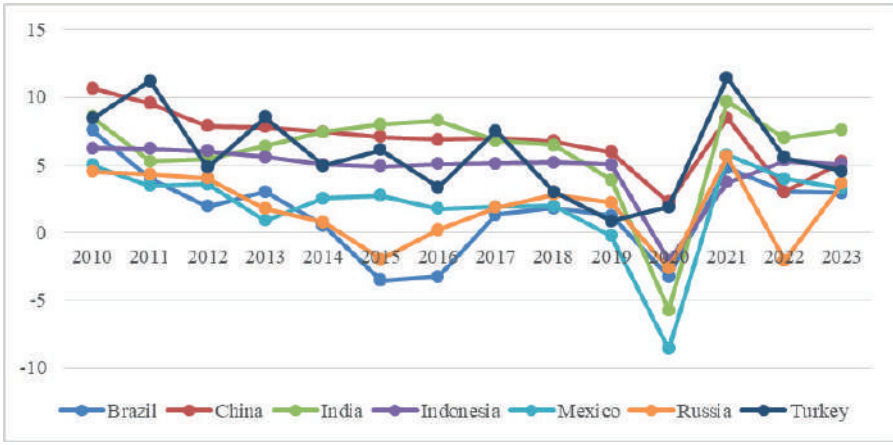
Table 1: Total Population of E7 Countries, 2023

Country	Total Population	Population Growth Rate (%)	Urban Population (% of Total Population)	Rural Population (% of Total Population)
Brazil	216.422.446	0,51	87,79	12,21
China	1.410.710.000	-0,10	64,57	35,43
India	1.428.627.663	0,81	36,36	63,64
Indonesia	277.534.122	0,74	58,57	41,43
Mexico	128.455.567	0,74	81,58	18,42
Russia	143.826.130	-0,29	75,33	24,67
Turkey	85.326.000	0,41	77,46	22,54

Source: World Bank, https://data.worldbank.org (Accessed: 07.09.2024).

Population is the number of people living in a particular region or country at a particular time. The size and structure of a population are significant in many issues such as the development of countries, economic growth, the distribution of national income and the increase of welfare (Tıraş et al., 2023: 3312). Table 1 shows the total population of E7 countries for 2023. When the table is examined, the most populous country among the E7 countries in 2023 is India, while the country with the least population is Turkey. The population growth rate was highest in India. India was followed by Indonesia and Mexico. Russia and China are the countries with the lowest population growth rates in 2023. Most of the E7 countries, except India, and more than 50% of them live in urban areas.

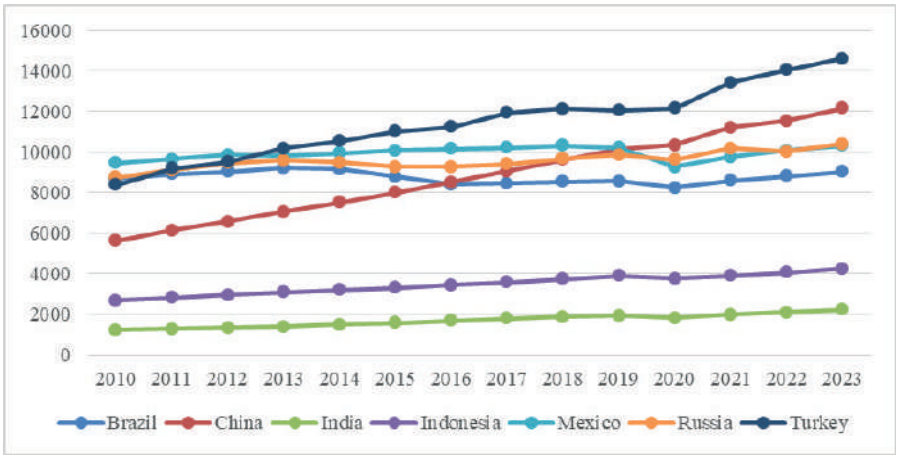
Graph 1: Economic Growth Rates (GDP) of E7 Countries



Source: World Bank, https://data.worldbank.org (Accessed: 06.09.2024).

When evaluating a country's economic performance and making comparisons with other countries, economic growth rates are usually taken as a basis. The main goal of countries is to achieve economic growth. Economic growth, which is a quantitative change, can be expressed as the real increase in production and per capita income (Taban and Kar, 2014: 4). Graph 1 shows the growth rates of E7 countries between 2010 and 2023. When the growth rates of the E7 countries are examined, it is seen that there is generally a fluctuating trend. In 2020, all E7 countries except China and Turkey experienced negative growth. This situation can be attributed to the COVID-19 pandemic. There has been a decline in the growth rates of all E7 countries from 2010 to 2023. While India and China showed the best performance in terms of growth rates in 2023, Brazil and Mexico were the countries with the lowest growth rates. Turkey has been observed to be the country with the fourth highest growth rate among the E7 countries.

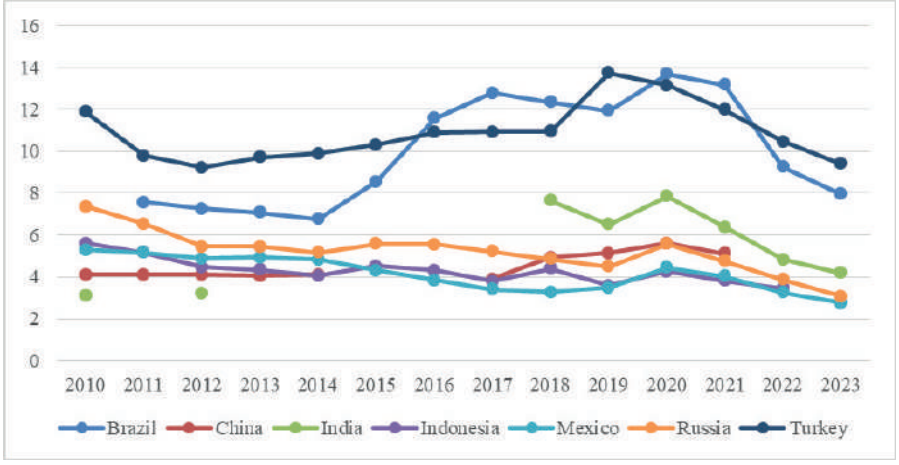
Graph 2: GDP Per Capita of E7 Countries (Constant 2015 US$)



Source: World Bank, https://data.worldbank.org (Accessed: 06.09.2024).

Although not sufficient on its own, GDP per capita is often used as an indicator of a country's standard of living. Graph 2 shows the GDP per capita values of E7 countries for the years from 2010 to 2023. According to the information in the graph, there is an increase in the GDP per capita of all E7 countries during the period considered. As of 2023, the country with the highest GDP per capita is Turkey. Turkey is followed by China. On the other hand, India and Indonesia are seen to be the countries with the lowest GDP per capita, respectively.

Graph 3: Unemployment Rates of E7 Countries

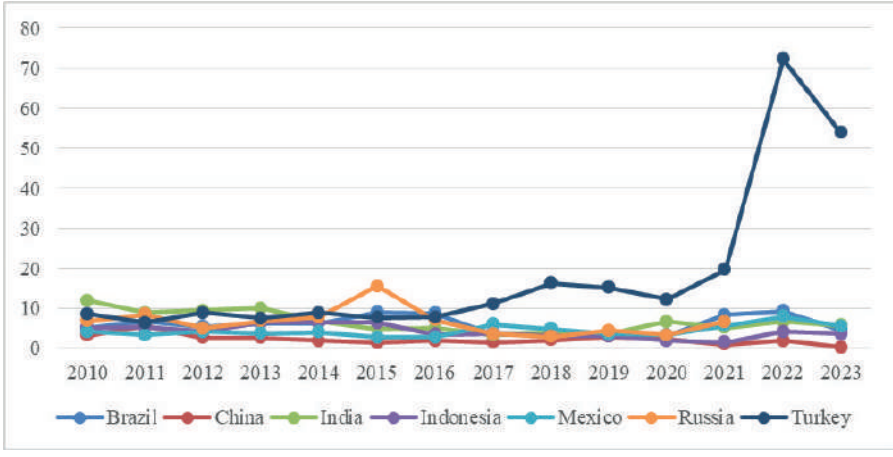


Source: World Bank, https://data.worldbank.org (Accessed: 06.09.2024).

According to ILO, a person is considered unemployed if the person is not working, currently available for work and seeking work (Byrne and Strobl, 2001). Unemployment is the situation where people who want to work but cannot find a job. The phenomenon of unemployment, which is a serious macroeconomic problem that directly affects individuals, brings with it many problems, including economic, social and psychological. Because job loss not only reduces the standard of living of individuals, but also creates uncertainty and insecurity about the future, which negatively affects the individuals.

Although the data for Brazil, China, India and Indonesia are not complete, graph 3 shows the unemployment rates of the E7 countries for the period 2010-2023. When the graph is examined, Turkey is the country with the highest unemployment rates among E7 countries, except for the periods 2016-2018 and 2020-2021. It is seen that Brazil is the country with the highest unemployment rates in 2016-2018 and 2020-2021 periods. In contrast, the country with the lowest unemployment rates in 2023 was Mexico.

Graph 4: Inflation Rates of E7 Countries

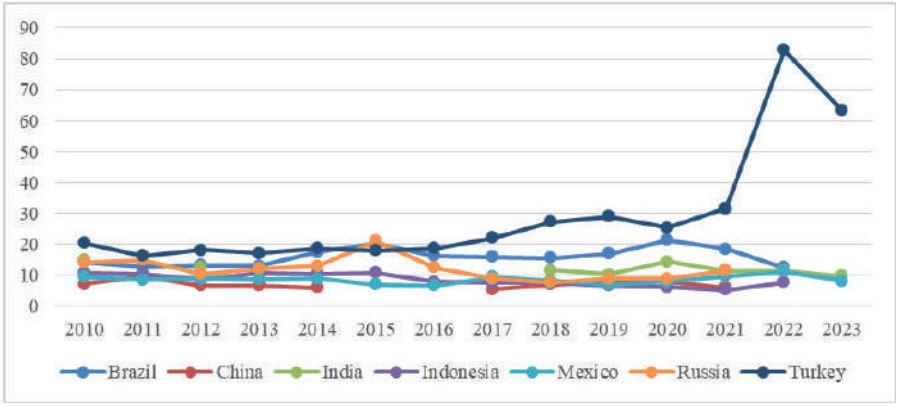


Source: World Bank, https://data.worldbank.org (Accessed: 06.09.2024).

Inflation can be defined as the continuous increase in the general level of prices of goods and services in an economy. A country's high inflation rate affects society both economically and socially. As a matter of fact, high inflation rates reduces the purchasing power of individuals and lead to deterioration of income distribution. In this connection, the inflation rates of E7 countries for the period 2010-2023 are given in graph 4. While China

was the country with the lowest inflation rates in the aforementioned period, Turkey has been the country with the highest inflation rates, especially since 2017.

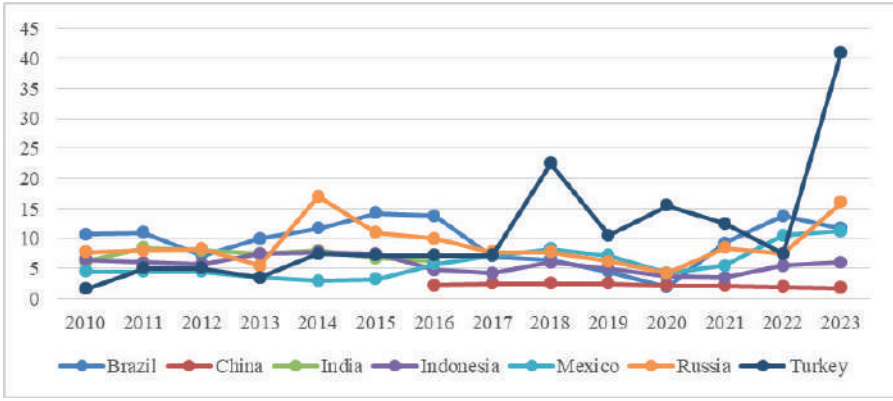
Graph 5: Misery Index of E7 Countries



Source: Calculated by the author.

The misery index is widely used to measure the macroeconomic performance of a country. The misery index was created by Arthur Okun and later developed by Barro and Hanke. In this study, the Okun Misery Index, which was developed by Okun in the 1970s and obtained by adding the unemployment and inflation rates is calculated. Within this framework, the misery index values of E7 countries between 2010 and 2023 are shown in graph 5. When the graph is evaluated in general, it is seen that while the other E7 countries except Turkey follow a more horizontal course, Turkey's misery index value is higher than the other E7 countries and it exhibits the worst performance in this regards. The reason why Turkey has high values in the index is due to both high unemployment and inflation rates.

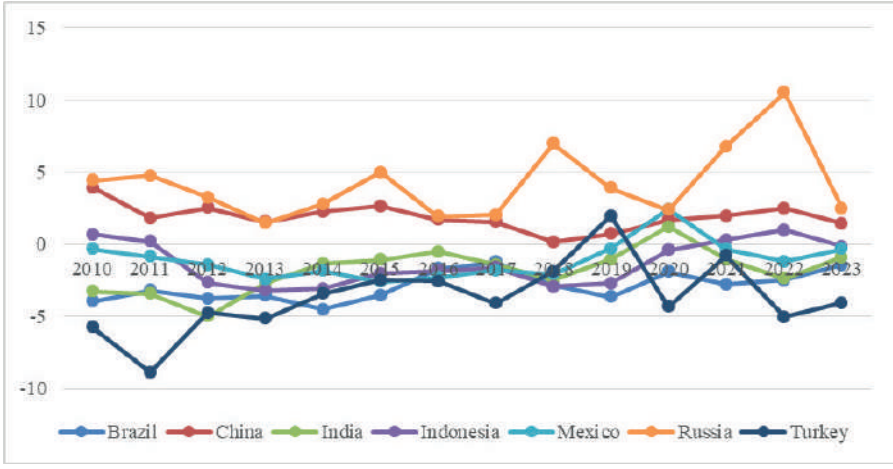
Graph 6: Interest Rates of E7 Countries



Source: IMF, https://data.imf.org (Accessed: 11.09.2024).

Graph 6 shows the interest rates of E7 countries between 2010-2023. While the country with the highest interest rate in 2010 was Brazil, the country with the lowest interest rate was Turkey. In 2023, it was observed that China was the country with the lowest interest rate, while Turkey had the highest interest rate, and there was a big difference compared to other E7 countries.

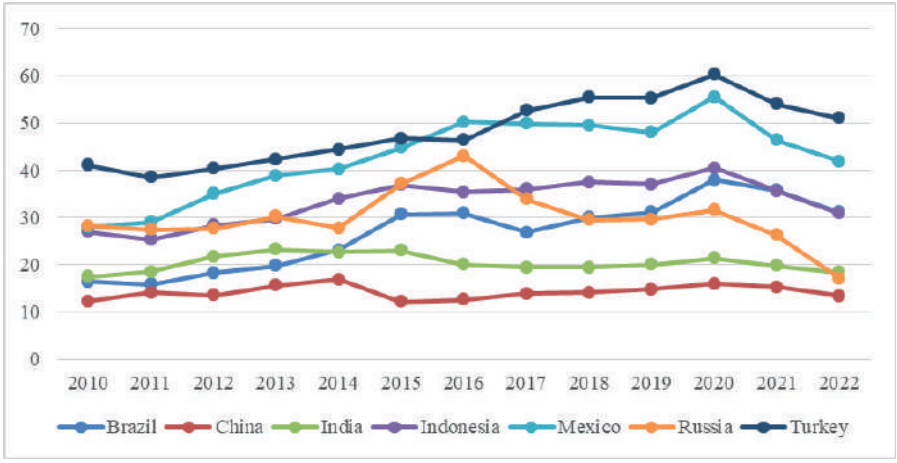
Graph 7: Current Account Balance of E7 Countries (% of GDP)



Source: World Bank, https://data.worldbank.org (Accessed: 06.09.2024).

The current account balance, one of the important indicators of macroeconomic performance, is a record of a country's international transactions with the rest of the world (OECD, 2024). Graph 7 shows the current account balance values of E7 countries for the years 2010-2023. The current account balance in E7 countries follows a fluctuating course. When the graph is evaluated in general, Russia and China were the two countries with a current account surplus in the period in question. It has been observed that Turkey is the country with the largest current account deficit among the E7 countries with its current account deficit between the periods considered in general.

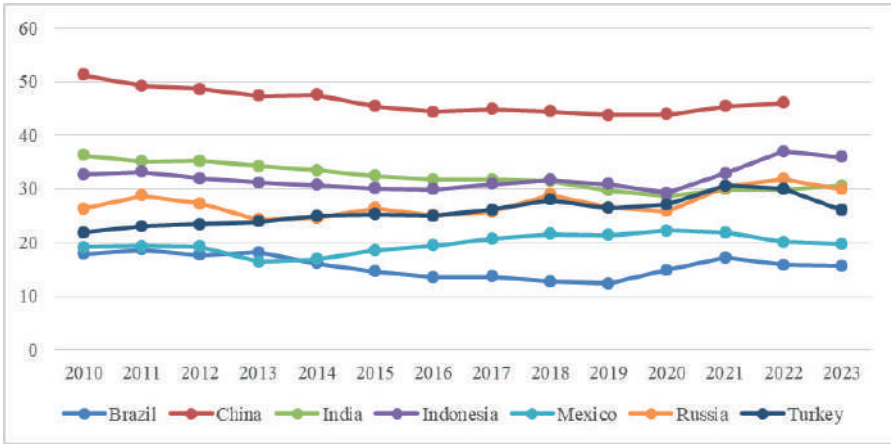
Graph 8: External Debt Stocks of E7 Countries (% of GNI)



Source: World Bank, https://data.worldbank.org (Accessed: 07.09.2024).

Graph 8 shows the external debt stocks of E7 countries for the years 2010-2022. The graph shows that the external debt stock of other E7 countries, except Russia, increased from 2010 to 2022. When the graph is evaluated, while China is the country with the lowest external debt stock both at the beginning and at the end of the period under consideration, Turkey has the highest external debt stock by years except for 2016.

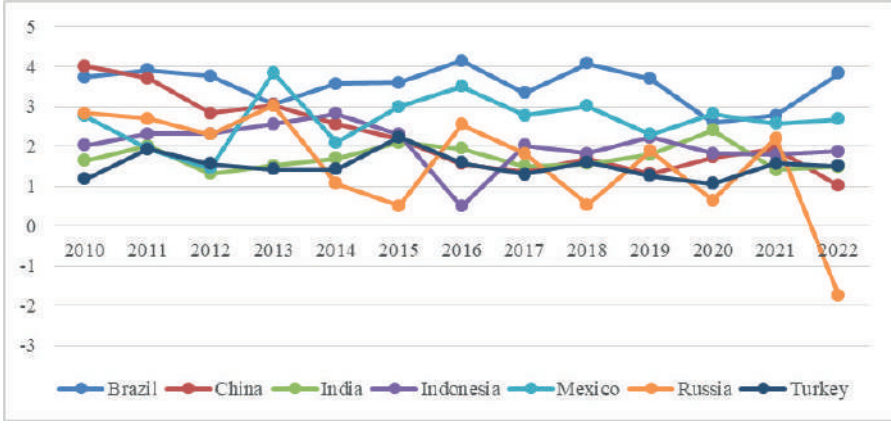
Graph 9: Savings of E7 Countries (% of GDP)



Source: World Bank, https://data.worldbank.org (Accessed: 11.09.2024).

Savings are important to be able to transform them into investment in an economy. Graph 9 shows the savings of E7 countries from 2010 to 2023. Due to data availability, China's data is up to 2022. As can be seen in the graph, China has the highest savings rates. Conversely, savings rates in Brazil and Mexico are observed to be lower than those of other E7 countries.

Graph 10: Foreign Direct Investment Inflows of E7 Countries (% of GDP)

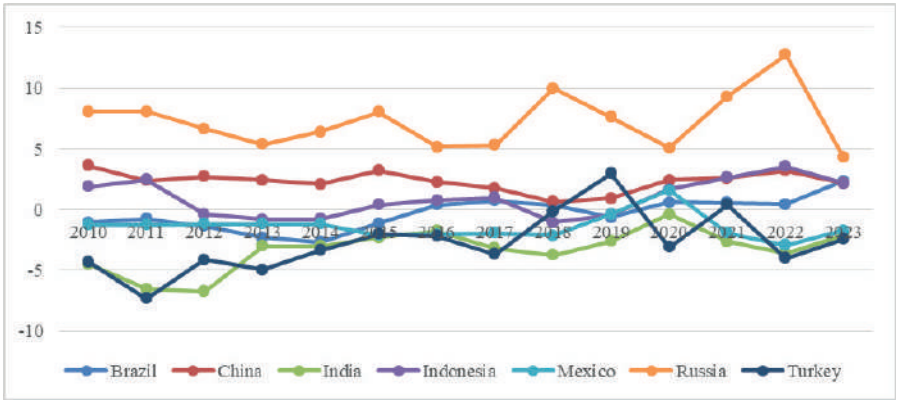


Source: World Bank, https://data.worldbank.org (Accessed: 06.09.2024).

Foreign direct investment, which has a positive influence on production, employment and economic growth can be expressed as the establishment

of a new company in foreign countries, either alone or with partners, by expanding the production of a company outside the borders of the country where the main center is located (Kurtaran, 2007: 367). Foreign direct investments of E7 countries between 2010 and 2023 are shown in graph 10. In the light of the information in the graph, it is seen that there is a fluctuating trend in foreign direct investment inflows of E7 countries. However, the country with the highest ratio of foreign direct investment to GDP in 2010 was China with 4%, while the country with the lowest ratio of foreign direct investment to GDP was Turkey with 1.17%. Looking at 2023, Brazil is the country that attracted the highest rate of foreign direct investment with 3.82%, while Russia had a negative value (-1.76%).

Graph 11: Foreign Trade Balance of E7 Countries (% of GDP)



Source: World Bank, https://data.worldbank.org (Accessed: 06.09.2024). Calculated by the author using export and import data.

Imports are goods and services purchased from other countries, while exports are the sale of goods and services produced within the country to other countries. The difference between exports and imports is the foreign trade balance. If exports exceed imports, the country has a trade surplus, and if imports exceed exports, the country has a trade deficit. A country's trade surplus contributes positively to the country's economic growth. The foreign trade of E7 countries is given in graph 11. Accordingly, only Russia and China have always had a foreign trade surplus among the E7 countries throughout the period under consideration. Although the foreign trade of other countries varies, it has been observed that the countries with the largest foreign trade deficit are Turkey and India.

CONCLUSION

In this study, the macroeconomic performance of Brazil, China, India, Indonesia, Mexico, Russia and Turkey, which are called emerging seven (E7) was evaluated. When China's macroeconomic performance is examined in the light of the information obtained from the data, the country can be evaluated as the country that generally shows the best performance in terms of macroeconomic performance among the E7 countries. China, which has the highest growth rates among E7 countries after India, has also shown good performance in terms of GDP per capita. China has the lowest interest rates among the E7 countries. However, China, which has the lowest inflation rate, also has low values in terms of the misery index. China has a current account surplus and is also the country with the lowest external debt stock compared to other E7 countries. Moreover, it is the country with the highest savings rate among the E7 countries and has consistently had a trade surplus as of the period covered. It can be said that China showed the lowest performance in foreign direct investments. Because China was the country that attracted the least foreign direct investment after Russia in 2022.

When India's macroeconomic performance is examined, despite having the highest growth rates, India has not been able to show the same successful performance in GDP per capita. As a matter of fact, India's GDP per capita is the lowest among the E7 countries. India's unemployment rates have been seen to increase from 2010 to 2023, and in 2023, India became the third country with the highest unemployment rates after Turkey and Brazil. India, which managed to reduce inflation rates from double digits in 2010 to single digits in 2023, is still the country with the highest inflation rates among the E7 countries after Turkey. Although the country has improved in terms of misery index by years, it became the country with the highest misery index after Turkey and Brazil in 2023. The interest rate figures for India which is up until 2016 show that the interest rates were the same as at the beginning of the period. India has always had a deficit in its current account balance except for 2020. Although its external debt stock has increased from 2010 to 2023, it is a country with less external debt stock than other E7 countries. There was a decrease in savings from the beginning of the period to the end of the period under consideration. When foreign direct investments are examined, there has been a decrease from 2010 to 2023, and in 2023 it became the fifth country that attracted the most foreign direct investments among the E7 countries.

Considering Indonesia's macroeconomic performance, Indonesia, which had the third highest growth rates among E7 countries in 2023, has not

been able to show the same performance in GDP per capita, although its growth rates have increased by years. In fact, Indonesia has the lowest GDP per capita after India. In terms of current account balance, Indonesia had a deficit in 2023 and its external debt stock increased from 2010 to 2023; at the end of the period, it became the country with the third highest external debt stock. Although data is not complete, Indonesia has seen a decrease in unemployment rates and also a decrease in inflation rates. Thus, Indonesia has the lowest misery index among the E7 countries. Indonesia's interest rates have fallen from 2010 to 2023, making it the country with the lowest interest rates after China. It has become the country with the highest savings after China among the E7 countries. Despite there was a decrease in Indonesia's foreign direct investments between 2010 and 2023, it became the country that attracted the third highest foreign direct investment in 2023. At the same time, in 2023, it has become the country with the highest trade surplus after Russia and Brazil.

When Russia's macroeconomic performance is evaluated, it can be said that there has been a decline in growth rates and that it ranks fifth in growth rates among the E7 countries, but it has shown a more successful performance in GDP per capita. When unemployment rates are examined, it is seen that Russia's unemployment rates have decreased from 2010 to 2023 and that it became the country with the lowest unemployment rates after Mexico in 2023, while inflation rates have not changed much over the years. There was an increase in interest rates from 2010 to 2023 and at the end of the period it became the country with the second highest interest rates after Turkey. Russia is the country with the highest current account balance compared to other E7 countries and has consistently had a surplus. In terms of external debt stock, it is seen that there was a decrease from 2010 to 2022. When savings rates are examined, they decrased from 2010 to 2023. Russia, which shows the most successful performance in foreign trade, has attracted the least foreign direct investment among E7 countries.

When Mexico's macroeconomic performance is examined, there has been a decline in growth rates from 2010 to 2023, and it has shown the lowest performance after Brazil in 2023. Mexico, which ranks higher in GDP per capita, stands out with its successful performance, especially in unemployment rates. Because Mexico's unemployment rate is the lowest among E7 countries in 2023. However, it is the country with the third highest inflation rates. There has also been a rise in interest rates by years. When the current account balance and external debt stock are examined, it is seen that the country has a current account deficit and is the country with the highest external debt stock after Turkey. Although there has not been

much change by years, Mexico's savings are at the lowest level after Brazil. Mexico, which attracted the most foreign direct investment after Brazil in 2023, could not show a successful performance in foreign trade in the same year and had a trade deficit.

When Brazil's macroeconomic performance is examined, it is seen that the country has underperformed in many indicators. Brazil, which has the lowest growth rates among the E7 countries in 2023, does not rank high in GDP per capita either. Besides, it is the country with the highest unemployment rates after Turkey. There was a decrease in inflation rates from 2010 to 2023. However, Brazil has the highest misery index value after Turkey, in particular due to high unemployment rates. Interest rates also increased from 2010 to 2023. When the current account balance is examined, Brazil has always had a current account deficit by years; and in 2023, it is the country with the highest current account deficit after Turkey. Brazil's external debt stock increased from 2010 to 2023, and in 2023 it became the fourth country with the highest external debt stock. However, Brazil is the country with the lowest savings. On the other hand, Brazil has become the country that has attracted the most foreign direct investment. At the same time, there has been an improvement in the foreign trade balance by years and a trade surplus was achieved in 2023.

It can be said that Turkey's overall macroeconomic performance is the lowest when compared to other E7 countries. Despite Turkey's high growth rates and GDP per capita, unemployment rates remained high. In addition, Turkey has displayed a low performance compared to other E7 countries in terms of inflation, misery index, current account balance, external debt stock and foreign trade. It is very important for Turkey to improve these macroeconomic indicators.

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Chapter 12

The Impact of Global Volatility Indices on Sovereign Credit Risk: A Case Study of Türkiye's Cds Premiums

Ayşe Nur Şahinler[1]

Abstract

This study examines the influence of global market volatility, measured by the CBOE Volatility Indices (VIX and VXO), on Türkiye's five-year Credit Default Swap (CDS) premiums. The analysis, covering VIX data from February 28, 2008, to November 27, 2024, and VXO data from February 28, 2008, to August 30, 2021, utilizes advanced econometric techniques, including multivariate GARCH models and the causality in variance test. The results reveal a significant and time-varying correlation between Türkiye's CDS premiums and global volatility indices, particularly during times of heightened market uncertainty, such as the 2008 Global Financial Crisis and the 2020 COVID-19 pandemic. The study highlights the critical role of global financial conditions in shaping fluctuations in Türkiye's CDS premiums, emphasizing the interconnectedness between sovereign credit risk and global volatility during crises. The use of second-moment causality analysis provides deeper insights into how volatility shocks transmit, revealing asymmetric effects on CDS premiums. Overall, the research underscores the growing importance of global financial volatility as a determinant of sovereign credit risk for emerging markets like Türkiye, with implications for both policymakers and investors in managing risk during periods of instability.

1. INTRODUCTION

The global financial crisis, which began with the bankruptcy of Lehman Brothers on September 15, 2008, marked the start of the most severe economic downturn since the Great Depression of the 1930s. This crisis led to the collapse of key financial institutions and a significant contraction in

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global markets (Wang and Yao, 2014). In the aftermath, another wave of financial instability emerged, largely driven by sovereign debt crises in several European countries, including Portugal, Ireland, Greece, and Spain (Wang and Yao, 2014). Unlike domestic debts, sovereign debts are typically denominated in US dollars and traded on international financial markets, which exposes them to greater global economic and political risks. The risks associated with sovereign debt, particularly in emerging economies, are influenced by both economic and political factors. Economic risk reflects the financial health of the issuing country, including its fiscal conditions and external debt levels, while political risk pertains to the stability of its political regime (Wang et al., 2013). As sovereign default probabilities increase, these risks are often mirrored in widening sovereign debt spreads and rising Credit default swap (CDS) prices, key indicators of investor perceptions of sovereign risk.

The financial turmoil resulting from this crisis highlighted the growing importance of instruments like CDS in managing credit risk within global markets (Ho, 2016:580). As the crisis unfolded, the role of CDSs expanded significantly, offering a means for investors to hedge against credit events. A CDS contract provides the buyer with protection against losses due to predefined credit events related to a reference entity (Ertugrul and Ozturk, 2013). These events include defaults, failures to pay, or debt restructurings, triggering compensation for the protection buyer. The widespread financial upheaval emphasized the necessity for these instruments, as investors sought solutions to manage default risks more effectively. In response, CDSs became indispensable in the financial environment, serving as vital tools to mitigate credit risk and protect investors from potential losses.

Sovereign Credit Default Swaps (SCDS) are a specific subtype of CDSs that offer protection against losses tied to sovereign debt credit events. These contracts generally consist of two key components: the premium leg, where the buyer pays for protection, and the contingent leg, which obligates the protection seller to make a payment if a predefined credit event occurs. Settlement is usually done through the physical delivery of eligible bonds in exchange for the original face value (Fender et al., 2012). Sovereign CDS contracts include five main features: (1) the reference entity (the issuer of the debt), (2) reference obligations, (3) the contract term (with 5-year contracts being the most liquid), (4) a notional principal, and (5) specific credit events that trigger payments, such as bankruptcy, failure to pay, debt restructuring, or rare events like obligation default, obligation acceleration, and repudiation or moratorium (Markit Credit Indices Primer, 2014[2]).

2 https://content.markitcdn.com/www.markit.com/Company/Files/DownloadFiles?CMSID=577e364482314b31b158ae2c2cecc89d

SCDS pricing is primarily determined by macroeconomic fundamentals such as inflation, fiscal stability, and debt levels, which directly influence the perceived risk of a country's ability to meet its debt obligations. Theoretical frameworks suggest that greater economic volatility increases this risk, leading to wider CDS spreads as investors demand higher premiums for the added uncertainty. This heightened risk, driven by factors such as inflation, fiscal stability, and terms of trade volatility, is reflected in wider CDS spreads, as investors demand higher premiums for the additional uncertainty and potential for default (Hilscher and Nosbusch, 2010). Empirical studies consistently highlight the importance of these domestic economic factors in shaping sovereign risk premiums (Mellios and Paget-Blanc, 2006; Georgievska et al., 2008; Aizenman et al., 2010; Hilscher and Nosbusch, 2010; Ho, 2016). However, in addition to macroeconomic conditions, global financial factors, particularly since the 2008 financial crisis, have become increasingly significant (Bellas et al., 2010; Csonto and Ivaschenko, 2013; Eyssell et al., 2013; Doshi et al., 2017; Jang, 2017; Erer, 2022; Çevik and Şahin Çevik, 2023). Theories of global financial contagion and financial stress point to the role of global risk indicators, such as the VIX, in driving CDS spreads. These global factors are shown to affect sovereign CDS pricing both in the short and long term, emphasizing the interplay between domestic economic conditions and global financial market dynamics.

Some studies, particularly following the 2008 financial crisis, have found that global markets have become even more influential in shaping sovereign CDS spreads (Pan and Singleton, 2008; Wang et al., 2010; Longstaff et al., 2011; Fender et al., 2012; Wang and Yao, 2014. The global interconnectedness of financial markets and the rise of systemic risks have made international factors increasingly decisive in determining sovereign risk, sometimes even overshadowing domestic economic conditions. In the wake of the crisis, global financial conditions (shaped by risk appetite, financial stress, and investor sentiment) have played a crucial role in driving risk premiums, highlighting the growing significance of the global financial environment in the post-crisis era. This shift underscores the importance of considering both domestic and global factors in understanding the pricing dynamics of sovereign credit risk.

In this broader context, specific global financial indicators such as global market volatility and shifts in risk appetite have become key determinants of sovereign CDS spreads in emerging markets. These factors not only affect borrowing costs but also influence investor perceptions of risk, thereby shaping international lending conditions and sovereign credit risk. The underlying assumption in many studies is that international lenders are

risk-neutral, and that changes in the U.S. real interest rate affect sovereign interest rates in international markets through arbitrage mechanisms, along with a higher risk premium for default risk. However, international lenders are risk-averse and require additional premiums to compensate for shifts in their risk appetite, which are influenced by both interest rate movements and market volatility (Akıncı, 2013). Consequently, fluctuations in global financial conditions, such as changes in stock market volatility or interest rate movements, can have significant impacts on CDS spreads, reflecting the evolving financial environment.

The purpose of this study, within the framework of the latest literature, is to examine the effects of the CBOE S&P 500 Volatility Index (VIX) and CBOE S&P 100 Volatility Index (VXO) indices, which are commonly used to measure market volatility, on Türkiye's 5-year sovereign CDS premium. The VIX and the VXO are key measures of market expectations regarding future volatility. The VIX is based on the implied volatility of S&P 500 index options and is often referred to as the "fear gauge" of the financial markets, as it reflects investor sentiment and uncertainty. On the other hand, the VXO measures implied volatility from options on the S&P 100 index, focusing specifically on the largest, most liquid companies. Both indices provide insights into investor expectations of market risk, but the VIX is more widely used and is considered a broader gauge of market volatility.

The contribution of this study to existing literature is twofold: both in a broad sense and a more specific context. First, while there is a limited amount of research focusing on Türkiye, this study provides insights into the impact of global volatility indices (VIX and VXO) on Türkiye's CDS premium. Second, unlike most studies that focus on the relationships between first moments (mean values), our study investigates the second moments (volatility) of the series, offering a more nuanced understanding of the relationships between these variables. In this context, we not only employ multivariate GARCH models to explore volatility spillovers but also investigate whether there is an asymmetric effect in the correlations between the series. Finally, we conduct causality in variance tests to explore whether the relationship between the series is unidirectional or bidirectional in terms of volatility transmission.

2. LITERATURE REVIEW

Over the past two decades, an increasing body of literature has delved into the determinants of CDS spreads, with some studies concentrating on country-specific conditions, while others emphasize the interplay between

global and domestic factors influencing CDS spreads. In the aftermath of the global financial crisis, a subset of research has predominantly directed its attention toward the influence of global markets on CDS spreads, underscoring the interconnectedness of financial systems across borders. Among the studies focusing on country-specific conditions, Mellios and Paget-Blanc (2006), Georgievska et al. (2008), Aizenman et al. (2010), and Ho (2016) emphasize the importance of economic fundamentals in explaining sovereign risk premiums. Specifically, Aizenman et al. (2013) investigate emerging markets from 2004 to 2012, including the global financial crisis period, and find that inflation, state fragility, and debt ratios are crucial determinants of CDS spreads, with higher inflation and external debt leading to wider spreads. Similarly, Augustin and Tédongap (2016) show that expected U.S. growth and consumption volatility are key factors driving CDS spreads, while financial variables such as the VIX and volatility risk premium fall short in explaining both the level and slope components of spreads. Building on this, Chernov et al. (2020) extend this perspective by demonstrating that U.S. sovereign CDS premiums have remained elevated since the crisis, primarily due to concerns over the probability of fiscal default. Their macrofinance model, which incorporates fiscal and monetary policies, underscores the crucial role of macroeconomic factors including such as inflation, growth, and debt in determining the risk of fiscal default and shaping CDS premiums. These findings emphasize the central role of macroeconomic variables in the pricing of sovereign risk, particularly regarding fiscal default risk. In a similar vein, Güngör and Erer (2020) explore the volatility spillover between CDS premiums and the BIST 100 index in Türkiye from January 4, 2010, to December 31, 2019, using the variance causality test of Hafner and Herwartz (2006) and the DCC-FIAPARCH model, revealing bidirectional causality.

While some studies primarily emphasize country-specific factors, others examine the combined influence of domestic and global determinants on sovereign CDS spreads. Bellas et al. (2010) argue that the impact of macroeconomic conditions and global financial market factors on sovereign bond spreads varies across time horizons. Specifically, they find that macroeconomic conditions have a more significant effect in the long run, while in the short term, financial stress indicators—such as the VIX, which reflects market volatility and liquidity—play a more prominent role. Similarly, Eyysell et al. (2013), in their study on China, highlight that both domestic economic conditions and global factors, such as the VIX, term structure slope, and financial shocks, significantly influence CDS spreads. Doshi et al. (2017) further emphasize the importance of both economic

factors and financial indicators, including the VIX, on CDS contracts in three regions: Europe, Asia, and Latin America, using a no-arbitrage model. Their findings show significant variability in predicted risk premiums, with a marked peak during the 2008 financial crisis for most countries.

In the literature, several studies examine the impact of global factors on CDS spreads. One such study is by Pan and Singleton (2008), who investigate the influence of global market dynamics on sovereign credit default swaps. They explore sovereign CDS spreads for three geographically dispersed countries (Mexico, Türkiye, and Korea) over the period from March 19, 2001, to August 10, 2006. Their analysis highlights the critical role of the VIX index in explaining the co-movements in CDS spreads across these countries, emphasizing that global factors, particularly shifts in investor sentiment and credit exposure, outweigh country-specific economic fundamentals. While the authors observe the presence of country-specific risks, especially in Türkiye and Mexico, they argue that the term structures of CDS spreads in these countries are predominantly influenced by broader global financial conditions. This aligns with the findings of Wang et al. (2010), who investigate the intertemporal causality between daily sovereign CDS returns and financial spread determinants in Latin America, including Mexico. Their study identifies those global factors such as the VIX, U.S. Treasury yields, and TED spreads are key predictors of CDS prices, and also highlights that exchange rates play a particularly crucial role in Mexico's CDS pricing. Both studies reinforce the notion that global financial factors, such as investor sentiment and market volatility, are crucial in explaining movements in sovereign CDS spreads, often surpassing the impact of domestic economic variables.

Extending this global focus, Wang and Yao (2014) examine the influence of global financial factors and the Greek sovereign debt crisis on sovereign CDS spreads in six Latin American countries during the period from August 10, 2006, to September 30, 2010. By utilizing pooled regression and GARCH models, their results indicate that increases in U.S. default yield spreads, TED spreads, and the VIX are consistently associated with higher CDS spreads and increased volatility in these countries. This study complements the findings of Fender et al. (2012), which investigates the determinants of sovereign CDS spreads for 12 emerging market countries, including Brazil, Russia, Türkiye, and others, during the period from April 2002 to December 2011. Fender et al. (2012) confirm that global and regional risk premiums dominate the movements in CDS spreads, particularly during the financial crisis, with U.S. bond, equity, and high yield returns, alongside emerging market credit returns, emerging as the most

significant drivers. The substantial role of global financial conditions, as noted by both Wang and Yao (2014) and Fender et al. (2012), underscores the pervasive influence of global risk factors on sovereign CDS pricing in emerging markets, where domestic conditions often play a secondary role, especially in times of crisis.

Similarly, Longstaff et al. (2011) analyze sovereign credit risk using CDS data from 26 countries, including Türkiye, from October 2000 to January 2010. They find that sovereign credit spreads are more highly correlated across countries than equity returns, driven largely by global factors such as U.S. equity markets and high-yield bonds. Their study decomposes CDS spreads into risk-premium and default-risk components, showing that both components are heavily influenced by global macroeconomic factors, with the risk premium making up about one-third of the spread. This finding aligns with Ertuğrul and Öztürk (2013), who examine CDS markets in Brazil, Bulgaria, Mexico, Russia, South Africa, and Türkiye from January 2003 to March 2012, employing ARDL and SGARCH models. They show that CDS spreads reflect sovereign credit risk accurately, especially in countries with high external debt, and that long-term relationships exist between CDS spreads and bond markets. They also observe that rising bond yields tend to drive CDS spreads.

Furthermore, Stolbov (2017) investigates the relationship between Russian sovereign credit risk, measured by five-year CDS spreads, and its determinants from January 2001 to May 2015. His study identifies external factors, especially the VIX, Brent oil prices, global credit conditions (such as the TED spread), and changes in sovereign credit ratings (e.g., Fitch Ratings), have a greater influence on Russian CDS spreads than domestic macroeconomic variables. This complements the findings of Srivastava et al. (2016), who examine the relationship between VIX, sovereign bond yields, currency exchange rates, and CDS spreads in 56 countries from 2001 to 2010. The study identifies VIX as the most significant factor influencing sovereign CDS spreads, with a strong unidirectional effect from global financial sentiment to sovereign CDS prices, which also reinforces the importance of external risk factors in shaping sovereign credit risk, as seen in both Stolbov (2017) and Srivastava et al. (2016).

Bouri et al. (2017) examines the volatility transmission from global commodity markets to sovereign CDS spreads for 17 emerging markets, including Türkiye, and 6 frontier economies from June 2, 2010, to July 27, 2016. Using the Lagrange Multiplier (LM) causality test proposed by Hafner and Herwartz (2006), they find significant volatility spillovers,

particularly from energy and precious metals to sovereign CDS spreads. The results vary by country and over time.

Abed et al. (2019) examines the interdependence between the daily Eurozone sovereign CDS index and four financial market sectors—bank CDS market (CDSb), sovereign bond market (BONDs), stock market (BMI), and the EuroBOBL interest rate benchmark—during different phases of the sovereign debt crisis, from September 20, 2011, to February 12, 2016. Using a dynamic conditional correlation (DCC) model within a multivariate fractionally integrated generalized ARCH (FIGARCH) framework, the study finds a pattern of fluctuating correlations between CDSs and market indicators, reflecting spillover effects and varying vulnerabilities across financial sectors during the crisis.

Aljarba et al. (2024) examine volatility spillovers among sovereign credit default swaps (SCDSs) of emerging economies, including Saudi Arabia, Russia, China, Indonesia, South Africa, Brazil, Mexico, and Türkiye, from January 2010 to July 2023. Using time-domain and frequency-domain connectedness approaches, they find that Indonesia, China, and Mexico are the main transmitters of sovereign credit risk volatility, while global factors like the VIX, economic policy uncertainty (EPU), and global political risk (GPR) significantly affect spillovers.

In summary, while each study highlights the specific context of the countries or regions analyzed, a common theme emerges global financial conditions, particularly the VIX index, U.S. Treasury yields, and broader market volatility, significantly shape sovereign CDS spreads. Country-specific factors, while important, often serve as secondary influences, especially in periods of financial uncertainty and crisis.

3. METODOLOGY

This study investigates impacts of the CBOE VXO Volatility Index (VXO) and the CBOE Volatility Index (VIX) on CDS premium in Türkiye, focusing on volatility spillovers rather than the more traditional first-moment causality techniques. The research specifically examines causality in higher moments, particularly variance, to explore how shocks in oil and market volatility influence credit risk, as reflected in CDS premium. By examining second-moment causality, the study aims to provide a deeper understanding of the indirect effects of oil and market volatility on the credit default swap market, which is a crucial indicator of sovereign credit risk.

To examine these volatility spillovers, two advanced econometric methods are employed. The first method involves multivariate GARCH

(Generalized Autoregressive Conditional Heteroskedasticity) models, which capture the joint volatility dynamics between CDS premium, VXO, and the CBOE Volatility Index. This approach allows for a comprehensive analysis of how VXO and VIX affect CDS premium, while also accounting for the interdependencies between these variables. The second method used is the causality in variance test developed by Hafner and Herwartz (2006), which focuses on univariate GARCH models to investigate the direction and strength of volatility spillovers between VXO, VIX, and CDS premium. Unlike first-moment causality tests, this approach examines how volatility shocks are transmitted across markets, providing a more detailed understanding of risk transmission. The Lagrange Multiplier (LM) approach used in this test helps to overcome issues such as sample size distortions and sensitivity to lead-lag structures, making it a reliable tool for empirical analysis of time-varying volatility spillovers. This method is particularly useful for understanding the changing dynamics of how international financial market uncertainty affect CDS premium in Türkiye.

In conclusion, we apply advanced econometric techniques to analyze the impact of VXO and the VIX on CDS premium in Türkiye, focusing on second-moment causality to capture the volatility transmission effects. By combining multivariate GARCH models and the causality in variance test, the study offers valuable insights into the influence market volatility on sovereign credit risk. The findings are expected to contribute to the understanding of how external volatility factors, such as global market risk, affect sovereign credit markets in emerging economies like Türkiye. This research provides important implications for policymakers, investors, and financial analysts monitoring sovereign risk and the broader financial stability of Türkiye.

3.1. DYNAMIC CONDITIONAL CORRELATION

This study applies a two-step estimation approach to model dynamic conditional correlations (DCC), based on the frameworks of Engle (2002) and Tse and Tsui (2002).

In the first step, univariate GARCH models are estimated for each asset to obtain the residuals and conditional variances. These results are used as inputs for the second step, where the DCC model estimates the time-varying correlations between assets.

The conditional covariance matrix Q_t is computed as:

$$Q_t = (1 - \sum_{m=1}^{M} \alpha_m - \sum_{m=1}^{M} \beta_m)Q + \sum_{m=1}^{M} \alpha_m \left(u_{t-m} u_{t-m}^{'} \right) + \sum_{m=1}^{M} \beta_m Q_{t-m} \quad (1)$$

The conditional correlation matrix R_t is then derived as:

$$R_t = Q_t^{*-1} Q_t Q_t^{*-1} \quad (2)$$

where Q_t^* is the diagonal matrix of the square roots of the diagonal elements of Q_t. The correlation between assets i and j is given by:

$$p_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t} q_{jj,t}}} \quad (3)$$

For improved accuracy, Aielli (2013) proposes the corrected DCC (cDCC) model, which adjusts the second step of the estimation process to provide a more reliable correlation estimator. The corrected covariance matrix is:

$$Q_t = (1 - \sum_{m=1}^{M} \alpha_m - \sum_{m=1}^{M} \beta_m)Q + \sum_{m=1}^{M} \alpha_m \left(Q_{t-n}^{*1/2} u_{t-m} u_{t-m}^{'} Q_{t-m}^{*1/2} \right) + \sum_{m=1}^{M} \beta_m Q_{t-m} \quad (4)$$

Finally, Cappiello et al.'s (2006) asymmetric correlation model is used to account for the differing impacts of positive and negative shocks on asset correlations. The model is specified as:

$$Q_t = (1 - \sum_{m=1}^{M} \alpha_m - \sum_{m=1}^{M} \beta_m)Q - \sum_{k=1}^{K} \tau_k \bar{N} + \sum_{m=1}^{M} \alpha_m \left(u_{t-m} u_{t-m}^{'} \right) + \sum_{m=1}^{M} \beta_m Q_{t-n} + \sum_{k=1}^{K} \tau_k \left(n_t n_{t-k}^{'} \right) + \sum_{m=1}^{M} \beta_m Q_{t-m} \quad (5)$$

3.2. CAUSALITY IN VARIANCE

The volatility spillover test developed by Hafner and Herwartz (2006), based on the concept of the Lagrange multiplier (LM), addresses the limitations of the method proposed by Cheung and Ng (1996) and proves useful in empirical applications. The null hypothesis of no causality in variance is defined as follows:

$$H_0 = Var\left(\varepsilon_{it} | G_{t-1}^{(j)} \right) = Var\left(\varepsilon_{it} | G_{t-1} \right) \; i, j = 1, \ldots\ldots, N, i \neq j \quad (6)$$

where $G_t^{(j)}$ represents the information set containing past residuals from the GARCH model.

Next, the model ε_{jt} is specified as:

$$\varepsilon_{it} = \xi_{it}\left(\sigma_{it}^2 ft\right)^{0.5},\ f_t = \text{ϕ} + z_{jt}^{'} \quad ,\ z_{jt} = \left(\varepsilon_{jt-1}^2,\ \ \sigma_{jt-1}^2\right)^{'} \tag{7}$$

In this context, f_t is an adjustment factor dependent on past squared residuals and conditional variances, where z_{jt} is a vector of these past terms. The GARCH model for the conditional variance σ_{it}^2 is given by:

$$\sigma_{it}^2 = \text{ù}_i + \alpha_i \varepsilon_{j,t-1}^2 + \beta_i \sigma_{j,t-1}^2 \tag{8}$$

A sufficient condition for the null hypothesis to hold is that $\pi = 0$, leading to the null hypothesis $H_0 : \pi = 0$ and the alternative hypothesis $H_0 : \pi \neq 0$.

The test statistic, derived based on the parameter π\pi, is used to evaluate the null hypothesis.

The authors propose the following Lagrange Multiplier (LM) test statistics to test for volatility spillovers:

$$\lambda_{LM} = \left(0.25\left(\sum_{t=1}^{T}\left(\xi_{it}^2 - 1\right)z_{jt}^{'}\right)\right)v\left(\frac{1}{\theta_i}\right)\left(\sum_{t=1}^{T}\left(\xi_{it}^2 - 1\right)z_{jt}\right) \xrightarrow{d} x^2 \tag{9}$$

where ξ_{it} represents the standardized residuals, z_{jt} is a vector of explanatory variables, and the statistic follows a chi-squared distribution with 2 degrees of freedom.

The variance of the LM test statistics is given by:

$$V\left(\theta_i\right) = 0.25\frac{K}{T}\left(\sum_{t=1}^{T} z_{jt} z_{jt}^{'} - \sum_{t=1}^{T} z_{jt} x_{it}^{'}\left(\frac{1}{\sum_{t=1}^{T} x_{it} x_{it}^{'}}\right)\sum_{t=1}^{T} x_{it} z_{jt}^{'}\right) \tag{10}$$

where $K = \frac{1}{T}\sum_{t=1}^{T}\left(\xi_{it}^2 - 1\right)^2$, and x_{it} denotes the explanatory variables used in the model.

4. DATA

This study investigates the impact of global market volatility indices, specifically the CBOE OEX Volatility Index (VXO) and the CBOE SPX Volatility Index (VIX), on Türkiye's five-year Credit Default Swaps (CDS). The VIX data, covering the period from February 28, 2008, to November 27, 2024, and the VXO data, spanning from February 28, 2008, to August 30, 2021, reflect global market volatility and investor sentiment. Given that CDS premium are influenced by a country's perceived sovereign credit risk, this study explores how changes in global market volatility, as captured by these indices, can impact the fluctuations in Türkiye's CDS premium. Since global financial conditions and investor sentiment can affect emerging markets like Türkiye, examining this relationship helps to understand the broader context of Türkiye's sovereign risk and borrowing costs. All data used in this study, including CDS, VIX, and VXO indices, are sourced from DataStream.

The figure 1 shows the levels of the CDS premium, VIX, and VXO over time. Additionally, the variables CDS2, VIX2, and VXO2 represent the logarithmic differences of these indices, respectively. Between 2008 and 2022, significant fluctuations were observed in the CDS premium, VIX, and VXO indices. Following the 2008 global financial crisis, the CDS premium, VIX, and VXO reached their peaks; for example, in September 2008, the CDS premium rose to 283.09, and the VIX reached 31.16. This period reflects a high level of uncertainty and risk triggered by the bankruptcy of Lehman Brothers. In 2018, during Türkiye's currency crisis, the CDS premium rose to 311 due to concerns over the depreciation of the Turkish lira and external debt. In 2020, following the COVID-19 pandemic, global uncertainty led the CDS premium to increase to 518, while the VIX surged to 54.46. By 2022, during a period of economic crisis in Türkiye, the CDS premium peaked at 838, with both the VIX and VXO indices increasing, signaling heightened volatility. During this period, the rise in Türkiye's CDS premium became more pronounced due to a combination of domestic factors such as exchange rate fluctuations, inflation, and external debt payments, alongside global risk perceptions. Since 2016, while there have been periodic increases in the CDS premium, years such as 2017 and 2021 displayed more stable trends, shaped by global economic recoveries and domestic economic adjustments.

Figure 1: Time-series plots of level of volatility indices and the CDS premium

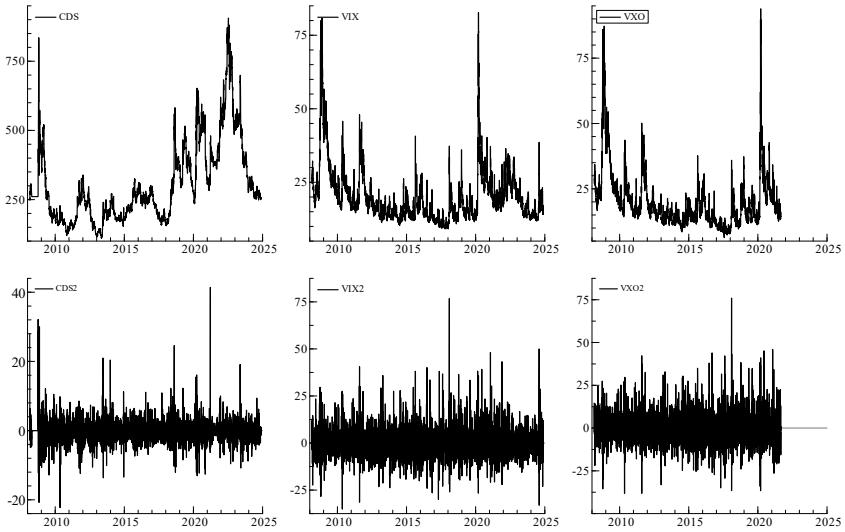


Table 1 shows the descriptive statistics for the VIX, VXO, and CDS premium datasets over different time periods. The VIX has an average value of 0.018 and a median of 0, with a standard deviation of 3.34, indicating moderate variability. In contrast, the VXO has a slightly negative average of -0.017, a median of -0.23, and a higher standard deviation of 8.66, reflecting more volatility. Both series have a positive skew, with the VIX being more positively skewed (1.55) compared to the VXO (0.75), suggesting that the VIX tends to have larger positive movements. The kurtosis values are also high for both series, especially for the VIX (22.05), which suggests the presence of extreme values more frequently than would be expected in a normal distribution. The Jarque-Bera tests indicate significant departures from normality for both datasets. For the CDS data, two distinct periods are analyzed: the first period has an average of -0.011, a median of -0.43, and a standard deviation of 7.48, while the second period has an average of 0.006, a median of 0, and a lower standard deviation of 3.18. These results highlight the significant variability and non-normality in the data. Finally, the results of the Augmented Dickey-Fuller (ADF) unit root test indicate that all series are stationary.

Tablo 1: Descriptive Statistics

	28.02.2008-30.08.2021		28.02.2008-27.11.2024	
	VXO	CDS	CDS	VIX
Mean	0.018	-0.017	-0.011	0.006
Median	0	-0.23	-0.43	0
Maximum	41.40	75.92	76.82	41.40
Minimum	-22.27	-38.14	-35.05	-22.27
Std. Dev.	3.33	8.65	7.48	3.18
Skewness	1.54	0.75	1.101	1.47
Kurtosis	22.05	7.64	9.60	22.06
Jarque-Bera	54670.6***	3503.18***	8821.82***	67769.19***
ADF Unit Root Test	-53.79***	-68.17***	-59.67***	-71.52***
Observations	3522	3522	4369	4369

Note: *** indicates significance at the 1% level

Tablo 2: Descriptive Statistics

	CDS	VIX	VXO
Constant (Mean)	-0.0337 (0.450)	-0.15736*** (0.000)	-0.20211** (0.014)
AR(1)	0.05593 (0.370)	0.823785*** (0.000)	0.73759*** (0.000)
MA(1)	0.095517 (0.124)	-0.90315*** (0.000)	-0.84468*** (0.000)
Constant (Variance)	1.022673*** (0.004)	9.034056*** (0.000)	11.98113*** (0.000)
ARCH	0.15864*** (0.000)	0.164429*** (0.000)	0.158835*** (0.000)
GARCH	0.732556*** (0.000)	0.673495*** (0.000)	0.677902*** (0.000)
$Q(20)$	(0.388)	(0.272)	(0.033)**
$Q_s(20)$	(0.999)	(0.184)	(0.467)

Note: *** and ** indicate statistical significance at 1 and 5%, respectively. $Q(20)$ and $Q_s(20)$ show the Box-Pierce test for standardized residuals and the Box-Pierce test for squared standardized residuals, respectively.

Table 2 presents the ARMA(1,1)-GARCH(1,1) model estimation results. In the assessment of stability criteria for the GARCH models estimated, it was observed that the parameters Constant (Variance), ARCH, and GARCH are statistically significant. Additionally, all coefficients in the variance equation are positive, and the sum of ARCH and GARCH parameters is less than one. These results suggest that the model demonstrates stability. ARCH parameter represents the impact of past volatility shocks, while the GARCH parameter measures the persistence of volatility in future periods. For the CDS series, the ARCH coefficient of 0.1586 indicates that past volatility shocks have a moderate impact on future volatility. The GARCH coefficient of 0.7326 suggests a high persistence of volatility, meaning past volatility has a substantial influence on future volatility. In the VIX series, the ARCH coefficient of 0.1644 shows that past volatility significantly impacts future volatility. The GARCH coefficient of 0.6735 also indicates strong volatility persistence, though slightly lower than that of the CDS series, suggesting volatility remains influential over time but with a somewhat weaker effect. Similarly, for the VXO series, the ARCH coefficient of 0.1588 and the GARCH coefficient of 0.6779 indicate that past volatility plays a significant role in explaining future volatility, with a high persistence in volatility similar to the other two series.

Tablo 3: Akaike Information Criteria for Different DCC-GARCH Model Results

	DCC	cDCC	ADCC	cADCC
AIC for CDS-VIX	11.15326	11.15453	11.15346	11.15307
AIC for CDS-VXO	11.5357	11.5350	No Converge	No Converge

Table 3 presents the Akaike Information Criterion (AIC) results for the four different DCC-GARCH models estimated, including DCC, cDCC, ADCC, and cADCC. To determine the optimal model, AIC values for each model were compared for both the CDS-VIX and CDS-VXO. For the CDS-VIX, the AIC values were very close across all models, with the lowest AIC value of 11.15307 obtained from the cADCC model. For the CDS-VXO, the cDCC model yielded the lowest AIC value of 11.5350, while the ADCC and cADCC models failed to converge. Based on the AIC criterion, the cADCC model for CDS-VIX and the cDCC model for CDS-VXO are considered the most appropriate models.

Tablo 4: Akaike Information Criteria for Different DCC-GARCH Model Results

	CDS-VIX	CDS-VXO
alpha	0.038924*** (0.000)	0.00534*** (0.000)
beta	0.846096*** (0.000)	0.993341*** (0.000)
gamma	-0.06813*** (0.000)	-
$Q(20)$	(0.000)	(0.000)
$Q_s(50)$	(0.06)	(0.362)

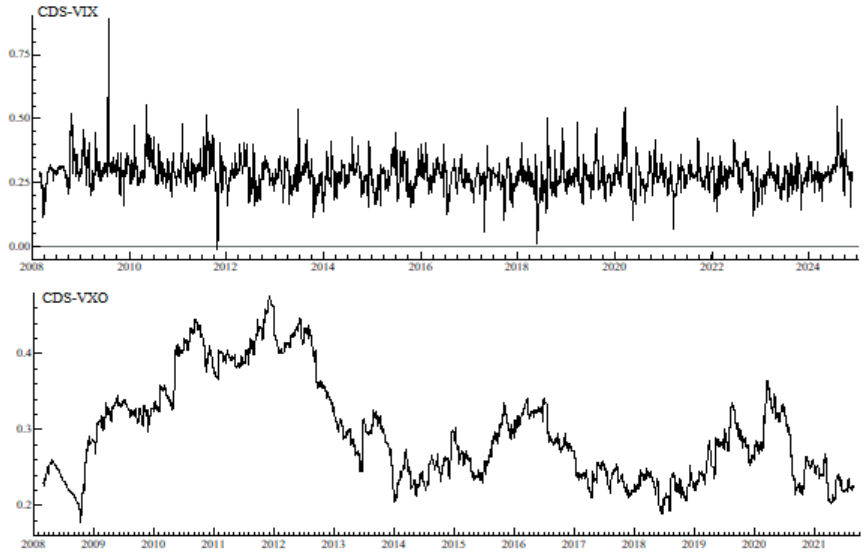
Note: The values in parentheses represent the probability values. *** indicates significance at the 1% level

Table 4 shows DCC-GARCH model estimation results. Upon examining the DCC parameters for CDS-VIX and CDS-VXO, it is evident that both the Alpha and Beta parameters are statistically significant at the 1% significance level. The Alpha coefficient, which represents the short-term dynamics of volatility, is positive for both series, indicating that past volatility shocks significantly influence future volatility. The Beta coefficient, reflecting the persistence of volatility over time, is high for both (0.8461 for CDS-VIX and 0.9933 for CDS-VXO), suggesting that volatility shocks have a long-lasting effect. A high Beta value, particularly for CDS-VXO, implies a strong persistence of volatility over time. The Gamma parameter for CDS-VIX is negative and statistically significant, indicating that negative information shocks tend to reduce the conditional correlation between the volatility of two series.

Figure 2 presents the dynamic correlations for the CDS-VIX and CDS-VXO. The time-varying correlation between Türkiye's five-year CDS premium and the VXO, derived from a corrected DCC-GARCH model, exhibits a positive relationship over the sample period. The correlation was lowest in 2009, after which it showed a significant upward trend, peaking at approximately 0.5. However, starting in 2013, the correlation began to decline, which could indicate a decoupling of Türkiye's financial markets from global risk factors. During the COVID-19 pandemic, the correlation rose again, reaching around 0.4, suggesting that the global crisis heightened the interconnectedness between Türkiye's sovereign credit risk and global risk sentiment. This pattern reflects a shift in the relationship dynamics, particularly following the global financial crisis and during the COVID-19

period, illustrating that both markets became more responsive to global risk factors in times of heightened uncertainty. A similar trend can be observed in the dynamic correlation between the CDS premium and VIX, where the correlation surged following the 2008 financial crisis, reaching levels as high as 0.8. During the COVID-19 period, this correlation was approximately 0.6, further indicating that, like Türkiye's CDS and the VXO, the global risk sentiment—as captured by the VIX—had a substantial impact on credit risk during periods of global financial distress.

Figure 2: Time Varying Correlation



The causality-in-variance test results presented in Table 5 show a significant causal relationship from VIX (global financial market volatility) to Türkiye's CDS premium, with an LM statistic of 43.541 and a p-value of 0.0000, which is significant at the 1%, 5%, and 10% levels. This indicates that increases in global financial market volatility are associated with higher CDS premiums for Türkiye, reflecting heightened concerns about its credit risk. In contrast, the causality from CDS to VIX is not significant, with an LM statistic of 1.215 and a p-value of 0.5447, suggesting that fluctuations in Türkiye's CDS premium do not influence global market volatility. Furthermore, the variance causality test results in Table 5 reveal a significant causal relationship from VXO to CDS premium, with an LM statistic of 43.541 and a p-value of 0.0000. However, the causality from CDS premium to VXO is not significant, as indicated by an LM statistic of 1.215 and a

p-value of 0.5447. These findings suggest that global volatility indices (VIX and VXO) influence Türkiye's CDS premium, but Türkiye's CDS premium does not have a significant impact on global market volatility.

Tablo 5: Causality-in-variance Test Results

	LMstat	p-value
VIX → CDS	81.126***	0.0000
CDS → VIX	1.652	0.4379
VXO → CDS	43.541***	0.0000
CDS → VXO	1.215	0.5447

Note: *** indicates significance at the 1% level

CONCLUSION

This study investigates the impact of global market volatility indices, specifically the CBOE OEX Volatility Index (VXO) and the CBOE SPX Volatility Index (VIX), on Türkiye's five-year Credit Default Swaps (CDS). The VIX data, covering the period from February 28, 2008, to November 27, 2024, and the VXO data, spanning from February 28, 2008, to August 30, 2021, reflect global market volatility and investor sentiment during these periods. The analysis utilizes advanced econometric techniques, including multivariate GARCH models and the causality in variance test, to investigate volatility spillovers and causal relationships between the volatility indices and CDS premium. The findings reveal a significant time-varying correlation between Türkiye's CDS premium and global volatility indices, particularly during periods of heightened global financial uncertainty, such as the 2008 Global Financial Crisis and the 2020 COVID-19 pandemic. The results show that global financial conditions, as reflected in the VIX and VXO, play a critical role in determining fluctuations in Türkiye's CDS premium. The dynamic correlations suggest that during global financial crises, there is a heightened interconnectedness between Türkiye's sovereign credit risk and global market volatility. This relationship becomes particularly pronounced during times of crisis, highlighting the importance of considering both domestic and international factors in assessing sovereign risk. Furthermore, the study's use of second-moment causality analysis emphasizes the role of volatility transmission, rather than simply first-moment causality, providing deeper insights into how market volatility shocks influence sovereign credit

risk. The findings contribute to the literature by exploring the asymmetric effects of global market volatility on sovereign CDS premium and offering a more comprehensive understanding of the dynamics at play. Overall, this research highlights the growing significance of global financial volatility as a determinant of sovereign credit risk, particularly for emerging markets like Türkiye. The results have important implications for policymakers and investors, suggesting that global risk factors must be closely monitored to manage sovereign credit risk effectively, especially during periods of market instability. By considering both time-varying correlations and causal relationships, this study provides valuable insights into the evolving dynamics of Türkiye's CDS premium in response to global financial volatility.

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Chapter 13

Market Linkages and Their Impact on G7 Economies: Exploring Network Connectedness

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Abstract

This project departs from the well-established finding in macrofinance literature that financial variables have a significant impact on macroeconomic variables. Building on this, we investigate the volatility connectedness among the stock markets of the Group of Seven (G7) countries, which account for a significant portion of global economic output and stock market capitalization. Using the Diebold-Yilmaz Connectedness Index (DYCI) framework, we analyze the connectedness of the G7 stock markets over the period from January 2010 to June 2024. We assess how volatility spills across these markets, particularly in response to major global events such as the 2011 U.S. credit rating downgrade, the 2013 "Taper Tantrum," the 2016 U.S. presidential election, and the COVID-19 pandemic. The findings reveal that market connectedness is highly dynamic, with the U.S. consistently acting as the primary connectedness source, followed by Germany and France during times of market stress. Japan, in contrast, is predominantly a net receiver of volatility. The results further highlight the varying roles of the G7 markets in volatility connectedness, indicating limited roles for the UK, Italy and Canada. The study also explores the relative importance of each market as a shock propagator, finding that the U.S. has the highest shock propagation capacity, while Japan consistently has the lowest. Consistent with the literature, our findings reveal a strong relationship between market volatility and the macroeconomic policy impacts of G7 economies, particularly during key market and economic episodes. These insights contribute to the understanding of economic and financial market interaction and provide valuable implications for policymakers and investors navigating the interconnected global markets.

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1. INTRODUCTION

Recent financial crises and the subsequent recessions, including the 2007-2009 Global Financial Crisis and the COVID-19 pandemic, have underscored the need to better understand the linkages between the financial sector and key macroeconomic variables, such as GDP and unemployment. These linkages have been explored using various approaches in both developing and developed countries. For example, Abildgren (2016) examines the interaction between financial shocks and business cycles in Denmark, the USA, and Canada over the past century. While Karanasos, Yfanti, and Hunter (2022) and Ngene (2021) focus on the effects of financial shocks on the U.S. economy, Joaqui-Barandica, Gomez Daza, and Lopez-Estrada (2024) and Biswas et al. (2024) investigate similar dynamics in emerging economies. Wang and Huang (2022) attempt to forecast the Chinese macroeconomy by analyzing the volatility connectedness of financial institutions. Given the understanding that financial shocks impact the real economy, we explore the volatility connectedness among the stock markets of the Group of Seven (G7) countries, offering valuable insights into the interactions of major global economies and their stock markets.

G7 is an informal forum comprising of seven advanced economies: the United States of America (U.S. or USA), Germany (GER), the United Kingdom (U.K.), France (FRA), Japan (JAP), Italy (ITA), and Canada (CAN). As of the end of 2023, G7 countries account for approximately 44% of global GDP (World Bank, n.d.; authors' calculations). An indicative value of their stock market capitalization represents approximately 60% of the global total as of 2022 (see Section 2).

G7 countries are highly integrated through political, regional, and trade channels, and they host the world's largest financial markets. These nations are also home to some of the most innovative firms that drive global trends in manufacturing and technology, and often feature cross-listed companies across their stock markets. Due to their strong economic ties and interdependence, it is well-known that the stock markets of G7 countries are closely linked, with fluctuations in these markets having significant implications for both developed and developing economies. The relationship between economic growth and financial integration has been extensively discussed, with Bekaert and Harvey (1995) arguing that the two are closely connected. Additionally, Tahai, Rutledge, and Karim (2004) find significant comovement in G7 stock market returns, suggesting a higher degree of market integration.

More recently, Attilio, Faria, and Prado (2024) examined the impact of the U.S. stock market on the BRICS (Brazil, Russia, India, China, and South Africa) and G7 economies. They found that greater financial integration amplifies the influence of the U.S. stock market on both the BRICS and G7. Furthermore, they observed that, compared to the BRICS countries, G7 stock markets and policy rates are more sensitive to shocks originating from the U.S. These studies collectively highlight the significant interconnectedness of G7 stock markets, which is central to understanding the dynamics we explore in this paper. In another study, Zhang, Sha, and Xu (2021) examined volatility spillovers between the G7 and BRIC countries. They found that key events, such as the European Debt Crisis, the China-US Trade War, and the Covid-19 Pandemic, significantly strengthened volatility spillovers in global financial markets. Ma, Wang, and He (2022) investigate the spillovers between economic policy uncertainty (EPU) and stock market realized volatility in G7 countries using the methods of Diebold and Yilmaz (2012) and Barunik and Krehlik (2018). They find that the strongest spillovers from EPU to stock market volatility occur within a 3–18 month period, indicating that policy uncertainty has a gradual impact on market risk over time. This suggests that, when making investment decisions, investors should focus not only on recent economic policies but also on macroeconomic conditions from the past 18 months.

Building on the existing literature, this paper aims to investigate volatility connectedness among the G7 stock markets and analyze how these dynamics have evolved over time. Additionally, we assess the relative importance of each market as a shock propagator. Our approach is based on a well-established and widely used methodology, specifically the Diebold-Yilmaz Connectedness Index (DYCI), introduced in a series of papers by Diebold and Yilmaz (2009, 2012, 2014). Furthermore, we incorporate an extension of the DYCI methodology developed by Schmidbauer, Roesch, and Uluceviz (2013, 2017), and Schmidbauer, Roesch, Uluceviz, and Erkol (2016). Schmidbauer et al. (2013, 2017; 2016) introduce a centrality measure, derived from the DYCI framework, to quantify the relative importance of each G7 market as a shock propagator. For additional insights into centrality measures within the network literature, see Newman (2010).

The close relationship between the real and financial sectors of selected developed economies, including Switzerland and the U.S., has been studied within the connectedness index framework by Uluceviz and Yilmaz (2020, 2021). Their findings suggest that when the real side of the economy is represented solely by real variables, it acts as a net receiver of connectedness from the financial variables including the stock markets. Therefore,

representing the G7 countries with their major stock indices indirectly allows us to explore the interactions between the economies of these nations as well.

Our analysis reveals that market connectedness is highly dynamic, responding to major global events such as the 2011 U.S. credit rating downgrade, the 2013 "Taper Tantrum," Donald Trump's 2016 election, and the COVID-19 pandemic. The U.S. emerged as the primary source of volatility spillovers, while Europe, particularly Germany and France, played significant roles during crises. In contrast, Japan was predominantly a net receiver of volatility. Italy's contribution was limited, with no substantial role in transmitting or receiving shocks compared to other G7 countries. Canada and the U.K., had a relatively minor impact on overall volatility connectedness among the G7 markets. The findings also highlight the varying roles of the G7 countries as shock propagators. The U.S. consistently emerges as the most significant shock propagator, followed by Germany and France, which also play substantial roles. The U.K. and Italy contribute moderately to shock transmission, while Canada has a relatively smaller impact. Japan, despite its economic stature, is found to be the least significant shock propagator throughout the analysis period.

Our findings demonstrate a strong association between market volatility and the macroeconomic policy impacts of G7 economies, especially during critical market and economic events.

Our main contribution in this study, from both policy and investment perspectives, is to provide a clearer understanding of the interrelations among major developed economies and their stock markets through an approach that is both easy to interpret and apply.

The remainder of the chapter is organized as follows: Section 2 provides an overview of the data used in the analysis. Section 3 outlines the methodological approach. Section 4 presents the empirical findings, while Section 5 concludes with a summary and final remarks.

2. DATA

This paper examines the stock markets of the G7 countries, using the major indices to represent each market. The data were obtained from Yahoo Finance through its free-tier access.[2] We downloaded daily Open, High, Low, and Close (OHLC) data using the quantmod package (Ryan & Ulrich,

2 https://finance.yahoo.com. Yahoo Finance is part of the Yahoo network and offers a range of financial data, news, commentary, and personalized financial management services.

2024) in R (R Core Team, 2024). The sample period spans from January 5, 2010, to June 28, 2024, covering a total of 3,770 trading days.

Detailed information about the selected indices, their corresponding Yahoo Finance tickers, and the total market capitalizations for each market are provided in Table 1. It is important to note that the total market capitalization values for the respective countries are sourced from the World Bank, and the most recent data for each country may vary. Therefore, these values should be interpreted with caution. To provide an indicative value for the share of G7 stock markets in the global economy, we also include the total world market capitalization. We find that the G7 countries account for approximately 60% of the global market capitalization.

Given the downloaded OHLC data, we compute daily volatilities using the Garman and Klass (1980) approach, as applied in Diebold and Yilmaz (2009). We then compute the natural logarithm of each volatility series before proceeding with the estimation procedure outlined in Section 3. It is well documented that volatilities are serially correlated and skewed (Bates, 1991; Cont, 2001; Bollerslev, Gibson, & Zhou, 2011). Taking the logarithm helps approximate the volatility series to normality (Diebold & Yilmaz, 2014).

Table 1: Selected G7 Markets

Country	Index	Ticker	Market cap (USD mn)	Data Year
USA	S&P 500	^GSPC	40,297,980	2022
Germany	DAX	^GDAXI	1,889,664	2022
UK	FTSE 100	^FTSE	3,095,983	2022
France	CAC 40	^FCHI	2,365,950	2018
Japan	Nikkei 225	^N225	5,380,475	2022
Italy	FTSE MIB	FTSEMIB.MI	587,312	2014
Canada	S&P/TSX Composite	^GSPTSE	2,744,720	2022
G7 (total)			56,362,086*	
World			93,960,000	2022
G7/World			60%	

: This sum is indicative due to the differences in the data years.

Source: Worldbank, Market capitalization of listed domestic companies (current USD) and author's calculations. https://data.worldbank.org/indicator/CM.MKT.LCAP.CD.

3. DIEBOLD-YILMAZ CONNECTEDNESS INDEX APPROACH

In this section, we provide a brief introduction to the DYCI methodology, originally developed by Diebold and Yilmaz (2009, 2012, 2014), along with one of its extensions, as applied in this paper, by Schmidbauer et al. (2013, 2017; 2016). For a more detailed overview, interested readers are encouraged to refer to the original papers.

A covariance-stationary N -variable $VAR(p)$ model is given by:

$$x_t = \sum_{i=1}^{p} \varnothing_i x_{t-i} + \varepsilon_t,\ \varepsilon_t \sim iid(0, \Sigma),$$

which has a moving average (MA) representation of the form:

$$x_t = \sum_{i=0}^{\infty} A_i \varepsilon_{t-i},$$

where the $N \times N$ coefficient matrices A_i are determined by the recursive formula:

$$A_i = \varnothing_1 A_{i-1} + \varnothing_2 A_{i-2} + \cdots + \varnothing_p A_{i-p},\ A_0 = I_n,\ A_i = 0 \text{ for } i < 0.$$

These coefficient matrices govern the model dynamics. Our focus is on the variance decompositions, which estimate the proportion of the h -step ahead forecast error variance for x_i that is attributable to shocks to x_j, $\forall i \neq j$, for each i. The calculation of variance decompositions requires orthogonal innovations, typically achieved through identification schemes like Cholesky decomposition. However, this approach results in variable-ordering dependent outcomes. To address this issue, Diebold and Yılmaz (2012) use the generalized VAR approach, developed by Koop, Pesaran and Potter (1996) and Pesaran and Shin (1998), which accounts for correlated shocks and produces ordering-invariant results.

Pesaran and Shin (1998) demonstrate that, under the assumption of a multivariate normal distribution for the error term, ε_t, the h -step generalized impulse response function, scaled by the variance of the variable, represents node j's contribution to node i's h -step ahead generalized forecast error variance, denoted $\theta_{ij}^{g}(h)$ for $h = 1, 2, \ldots$, as follows:

$$\theta_{ij}^{g}(h) = \frac{\sigma_{jj}^{-1} \sum_{k=0}^{h-1} \left(e_i' A_k \Sigma e_j \right)^2}{\sum_{k=0}^{H-1} \left(e_i' A_k \Sigma A_k' e_i \right)^2} \tag{1}$$

where Σ is the variance-covariance matrix of the error vector ε, σ_{jj} is the standard deviation of the error term in the j th equation, and e_j is the selection vector with a 1 in the j th position and zeros elsewhere. By

normalizing each element of the variance decomposition matrix by the respective row sum, we obtain:

$$C_{i\leftarrow j}^{h}=\frac{\theta_{ij}^{g}(h)}{\sum_{j=1}^{N}\theta_{ij}^{g}(h)} \tag{2}$$

$C_{i\leftarrow j}^{h}$ is referred to as pairwise directional connectedness. In network theory, it is interpreted as the adjacency matrix of a weighted directed network, denoted by C, where the ij th element is c_{ij}.

The normalized entries of the generalized variance decomposition matrix in Equation 2 are used to construct a summary measure of the connectedness matrix C. Diebold and Yilmaz (2012) define the total connectedness index as:

$$C^{h}=\frac{\sum_{i,j=1}^{N}C_{i\leftarrow j}^{h}}{\sum_{i,j=1}^{N}C_{i\leftarrow j}^{h}}=\frac{\sum_{\substack{i,j=1\\ i\neq j}}^{N}C_{i\leftarrow j}^{h}}{N} \tag{3}$$

The direct connectedness from node i (to node i) is given by the column (row) sums in C, excluding the node's connectedness to itself:

$$\text{from node } i \text{ to others}: C_{\bullet\leftarrow i}=\sum_{k=1,i\neq k}^{N}c_{ki} \tag{4}$$

$$\text{to node } i \text{ from others}: C_{i\leftarrow\bullet}=\sum_{k=1,k\neq i}^{N}c_{ik} \tag{5}$$

The difference between shocks originating from and directed to node i provides a measure of the net directional connectedness transmitted from node i to all other nodes. This is referred to as:

$$C_{i}=C_{\bullet\leftarrow i}-C_{i\leftarrow\bullet} \tag{6}$$

To extend the DYCI framework, Schmidbauer et al. (2013, 2017; 2016) assume that all available information about the network throughout day t is contained in C. Additionally, if an initial hypothetical shock of unit size hits node k on day t, it will propagate across the nodes of the network throughout day t as follows:

$$n_{s+1}=C.n_{s}\ ,\ s=0,1,2,\ldots \tag{7}$$

A hypothetical shock is denoted as $n_0 = (0,\ldots,0,1,0,\ldots,0)$, where 1 is the k th element of n_0 (with step $s = 0$ representing the initial shock). By iterating Eq. (7) and examining the steady-state properties of the model as $s \to \infty$, we obtain:

$$\mathbf{v}' = \mathbf{v}'.C \tag{8}$$

When the left eigenvector $\mathbf{v} = (v_1,\ldots,v_N)'$ of C is normalized so that $\sum_{k=1}^{N} v_k = 1$, v_k is referred to as the propagation of node k. Intuitively, v_k represents the power of node k as a volatility transmitter within the network. A closely related concept in social network analysis, eigenvector centrality, is also widely used, as discussed in Bonacich (1987).

Empirically, we fit a standard VAR(3) model to $N = 7$ endogenous variables, representing the volatility of major stock market indices from the G7 countries. We use rolling data windows of size 250 (i.e., the sample for day t includes data from days $t-249$ to t). Following Diebold and Yilmaz (2012), we apply the ordering-invariant impulse response function identification approach proposed by Pesaran and Shin (1998). Forecasting $h = 20$ steps ahead, we compute the forecast error variance decomposition. This procedure is repeated for each *t*, generating a sequence of connectedness matrices.

4. EMPIRICAL RESULTS

This section presents the empirical results of our estimations based on the DYCI approach outlined in Section 3. We focus exclusively on the dynamic results, as they are more pertinent to our analysis. These results offer an overview of key events from 2010 to 2024 that contributed to unprecedented structural changes in the global economy, including the COVID-19 pandemic.

Since the DYCI approach relies on rolling windows of VAR estimations, selecting the appropriate lag length is a crucial first step in any connectedness analysis. To determine a suitable lag length, we performed estimations for lag lengths ranging from 1 to 5 using a 250-day rolling window. A 250-day window is commonly used in daily analysis, as it roughly corresponds to one year of trading days (around 252 days). Additionally, since the DYCI methodology involves the decomposition of forecast error variance, it is important to choose a forecast horizon that allows for stabilization of the forecast error variance decomposition. Shorter forecast horizons often fail to

achieve this stabilization; however when we selected h = 20 days, our results were sufficiently stable. Given these choices, we plot the connectedness index results and select the appropriate lag length based on the most suitable outcome. Figure 6 displays the total connectedness results, including the maximum and minimum index values for each day within the shaded region, corresponding to VAR lag lengths ranging from 1 to 5. The VAR(3) model results are plotted as a dark line. We observe that the VAR(3) model fits well and is sufficiently parsimonious, leading us to select a lag length of 3.

Proceeding with the selected model, we first plot the connectedness index series in Figure 1 which is estimated using Equation 3. The index starts at 64.20% on December 20, 2010 and ends at 45.37% on June 28, 2024. It fluctuates between a minimum of 37.83% on December 14, 2017 and a maximum of 76.16% on June 15, 2020. The dynamics of the index are more relevant than the index values, and we briefly discuss key episodes observed during the analysis period.

The index value at the beginning of the analysis period represents the highest point throughout the entire period, excluding the COVID-19 pandemic. After this, the index begins to decrease throughout 2011, until it experiences a sharp increase at the beginning of August 2011, following the S&P downgrade of the U.S. credit rating from AAA to AA+ on August 5, 2011.[3] It oscillates above 60% until June 2012. The index starts decreasing, and further fueled, by the annoucement of a third round of Quantitative Easing (QE3) by Federal Reserve (Fed).[4] The decrease in the index lasted until, end of May 2013, the time Fed Chairman Bernanke testified before the U.S. Congress' Joint Economic Committee, where he revealed the Federal Open Market Committee's (FOMC) intention to taper bond purchases. His testimony triggered a rise in bond yields and a decline in global stock prices, an event known as the "Taper Tantrum."[5] Increase of the index lasted until early November 2016 when Donald Trump was elected the President of the U.S. Expectations of fiscal stimulus and tax cuts under a Republican-controlled Congress led to a surge in equity markets.[6] By the end of 2017, the index had reached an all-time low. It then rose until February 2018,

3 https://www.nytimes.com/2011/08/06/business/us-debt-downgraded-by-sp.html. Accessed November 25, 2024.

4 https://money.cnn.com/2012/09/13/news/economy/federal-reserve-qe3/index.html. Accessed November 25, 2024.

5 https://www.reuters.com/article/us-usa-fed-2013-timeline-idUSKCN1P52A8. Accessed on November 25, 2024.

6 https://www.ft.com/content/6d24125c-c066-11e6-9bca-2b93a6856354. Accessed November 25, 2024.

fluctuating within the 50%-56% range, until the end of 2019. During the onset of the COVID-19 pandemic[7], the index peaked at 76.02% on March 16, 2024, just below its all-time high of 76.16%, which occurred on June 16, 2024. The index remained above 70% until December 2020, before falling to the high 50% range, likely due to significant gains in the U.S. stock markets. The year 2020 ended with the Dow rising by 7.2%, the S&P 500 gaining 16.3%, and the Nasdaq surging 43.6%.[8] The index fluctuated around, and often exceeded, 60% until the end of May 2023, after which it began to decline through the remainder of the analysis period. This decline coincided with the end of the COVID-19 pandemic, as the World Health Organization (WHO) declared on May 5, 2023, the cessation of COVID-19 as a public health emergency, while stressing that the disease remains a global threat.[9]

Figure 2 consists of sub-figures of size 8 × 8, summarizing the time series of the total and directional dynamic connectedness indices. This figure contains the time series of all the connectedness matrices that form the basis of the analysis. The time series of the 7 × 7 sub-figures created by the first 7 rows and 7 columns in Figure 2 correspond to Equation 1. The connectedness index calculated using Equation 3 is also shown in the bottom-right corner of this figure. The last row ("to others") in Figure 2, excluding the right-most plot, corresponds to Equation 4, while the last column ("from others"), excluding the bottom plot, corresponds to Equation 5. We focus diagonal sub-figures of the first 7 × 7 sub-figures. These plots represent the own shares of connectedness, i.e., the connectedness arising from and directed towards itself. A higher level of own connectedness indicates a lower impact of these markets on others. Japan appears to have the highest own share of connectedness throughout the analysis period, suggesting that it acts as a lower volatility connectedness source with the rest of the G7 markets. It ranks first with an average own connectedness value of 63.79%, while France ranks last with an average value of 31.36%.

To assess the connectedness to (from) markets, we focus on the "to others" ("from others") columns in Figure 1 and present a concise version of these in Figure 3. Additionally, we compute and plot the net effect using Equation 6. The results indicate that, on average, the U.S. is the largest net source of volatility connectedness towards the other G7 markets. With

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7 https://time.com/5791661/who-coronavirus-pandemic-declaration/. Accessed November 25, 2024.

8 https://www.npr.org/2020/12/31/952267894/stocks-2020-a-stunning-crash-then-a-record-setting-boom-created-centibillionaire. Accessed November 25, 2024.

9 https://news.un.org/en/story/2023/05/1136367. Accessed 2024-11-25.

a net connectedness of 13.10%, the U.S. contributes significant volatility connectedness to the rest of the G7. In contrast, Japan is the market that receives the most connectedness from others, with an average net connectedness of -21.15%. The U.S. was also a major source of connectedness during the end of May and early June 2019, with net connectedness from the U.S. to other markets peaking at 66.81% on June 6, 2019. This surge is likely linked to the large sell-offs in May 2019 and U.S. President Trump's tweets about escalating trade tensions between the U.S. and China, as well as concerns about global economic growth.[10] Continental European countries—Germany, France, and Italy—also experienced significant spikes in connectedness to other markets following the onset of the Russia-Ukraine war in late February 2022. They acted as net sources of connectedness, with average values of 3.85%, 6.70%, and 0.63%, respectively. In contrast, the UK was a net receiver, with a connectedness value of -5.59%. Meanwhile, Canada functioned as a net source, contributing a connectedness value of 2.47%.

To analyze the net connectedness from the major net connectedness source, the U.S., we present Figure 4, which illustrates the net directional connectedness from the U.S. to the respective G7 stock markets. Excluding the COVID-19 and the mid-2013 "Taper Tantrum" periods, the U.S. predominantly acts mostly as a net source of connectedness. Referring back to our earlier discussion of Japan in Figure 2, where we noted that Japan mostly transmits connectedness to itself rather than to others, we observe that the U.S. plays a significant role in transmitting connectedness to Japan. The U.S. is almost always a net source to Japan, with only a few brief exceptions. European markets typically act as receivers of connectedness, except during the COVID-19 period, when they function as net sources of connectedness towards the U.S.

To quantify the relative importance of each market as a shock propagator, we present Figure 5, which displays the propagation values estimated using Equation 8. These values sum to 1, and the larger the value for a country, the more significant its market as a shock propagator. Interestingly, despite Japan being one of the wealthiest countries in the G7, it has the lowest importance as a shock propagator throughout most of the analysis period. Schmidbauer et al. (2013) demonstrated that propagation values can be interpreted as probabilities, representing the stationary distribution of a Markov chain derived from a suitable transformation of the connectedness

10 https://www.cnbc.com/2019/05/31/the-markets-drop-in-may-felt-serious-but-it-is-normal-for-stocks.html. Accessed 2024-11-27.

matrix C. As a result, the sum of the propagation values provides a valid measure. When grouping countries by continent, the relative importance of markets becomes even more apparent, likely due to the influence of trade channels on market importance. Averaging the propagation values over time, we find that the U.S. has the largest propagation value at 0.18, followed by Germany (0.16), the UK (0.14), France (0.16), and Italy (0.15). Canada has a propagation value of 0.15, while Japan has the smallest at 0.07. When grouped by continent, Europe (Germany, France, Italy, and the UK) has a combined propagation value of 0.60, the Americas (U.S. and Canada) have 0.33, and Asia (Japan) has 0.07. Averaging over different periods yields similar results. However, when we focus on the period from the beginning of the analysis until the end of May 2013, European propagation value rises to 0.66, while the American value is 0.29, and Japan's value drops to 0.05. This shift is likely attributable to the European sovereign debt crisis during the 2009-2012 period post global financial crisis.

5. SUMMARY AND CONCLUSIONS

This paper examines the stock markets of the G7 countries (the U.S., Germany, France, the U.K., Japan, Italy, and Canada) from 2010 to 2024, using their major indices as proxies for each market. The analysis focuses on daily volatility connectedness, employing the Diebold-Yilmaz Connectedness Index methodology (Diebold and Yilmaz, 2009, 2012, 2014), which applies rolling Vector Auto Regressive models to estimate volatility connectedness. Additionally, the study incorporates an extension by Schmidbauer et al. (2013, 2017; 2016) to assess the relative importance of each G7 market as a shock propagator.

The goal is to uncover patterns of financial connectedness and identify significant global events that led to structural shifts in the connectedness behavior of these stock markets.

The study reveals that volatility connectedness among the G7 markets is highly dynamic and fluctuates significantly in response to major global events, including the U.S. credit rating downgrade in 2011, the Federal Reserve's announcement of the prospective "Taper Tantrum" in May 2013, the election of Donald Trump as U.S. president in 2016, and the global disruption caused by the COVID-19 pandemic in 2020. These events are marked by substantial fluctuations in the total connectedness index, with notable peaks and following troughs.

The U.S. consistently emerged as the primary source of volatility spillovers, playing a central role in shaping connectedness across the G7

markets, particularly during geopolitical crises such as the U.S.-China trade tensions in 2019 and the COVID-19 pandemic from from early 2020 to mid-2023. In contrast, Japan, despite being one of the wealthiest G7 nations, played a more passive role in volatility connectedness, often serving as a net receiver from other markets, particularly during periods of market stress.

The study also highlights the significant role of European countries, particularly Germany and France, in contributing to market connectedness during key events such as the European sovereign debt crisis (2009-2012), the Russia-Ukraine war that began in late February 2022, and the COVID-19 pandemic from early 2020 to mid-2023. These countries became major sources of increased volatility connectedness, reflecting the substantial impact of regional economic and policy uncertainties on global marketsIn contrast, markets like the UK were primarily net receivers of volatility connectedness, with relatively smaller contributions. Italy and Canada, on the other hand, had a minimal impact on overall connectedness among the G7 countries.

The results suggest that global economic shocks, such as the COVID-19 pandemic, had a profound impact on market connectedness, significantly raising the levels of connectedness among the G7 markets. The study concludes that the U.S. stock market is the most influential driver of global volatility connectedness and shock propagator, with European countries following the U.S. in terms of their impact. In contrast, Japan remains less influential both as a source of volatility connectedness and as an important shock propagator.

Overall, the paper provides valuable insights into the dynamics of G7 market connectedness, highlighting the shifting roles of different G7 markets in responding to and transmitting global economic shocks. These findings underscore the importance of understanding market dynamics for policymakers and investors as they navigate an increasingly interconnected global financial system. Future research could explore subgroups within the G7, incorporate their trade relations, and apply alternative volatility measures to gain a deeper understanding of the various dimensions of G7 connectedness.

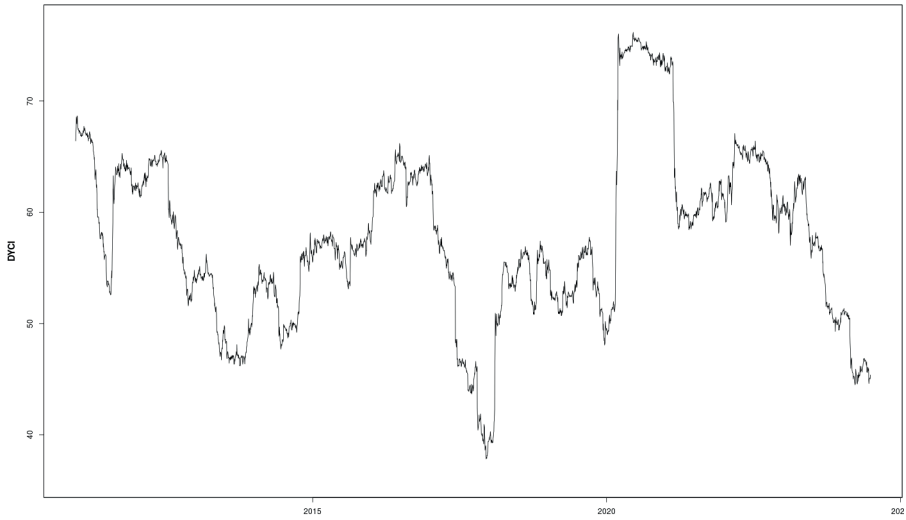

Fig. 1 Total connectedness index

Fig. 2 Total and pairwise dynamic connectedness indices

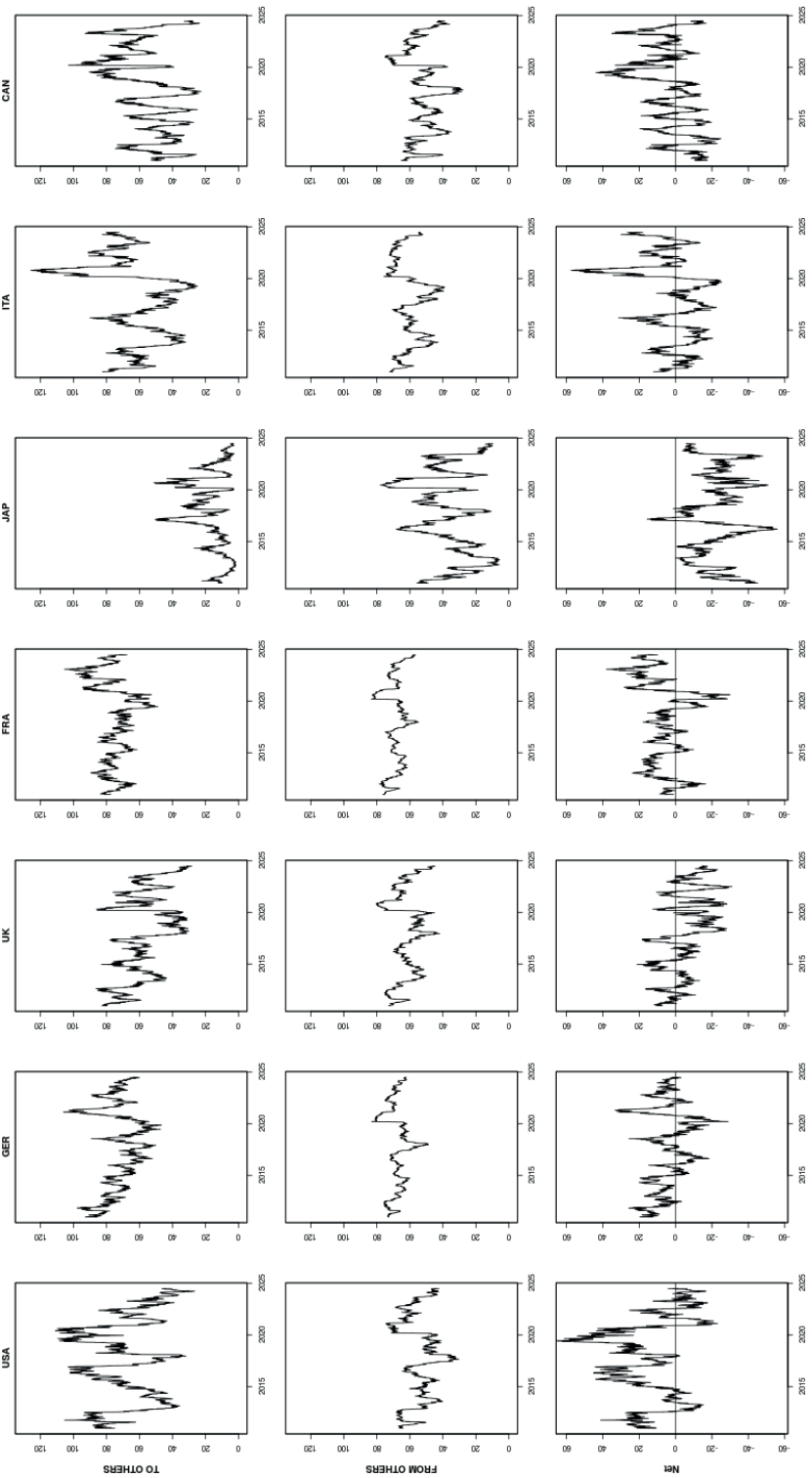

Fig. 3 Dynamic total directional and net connectedness indices

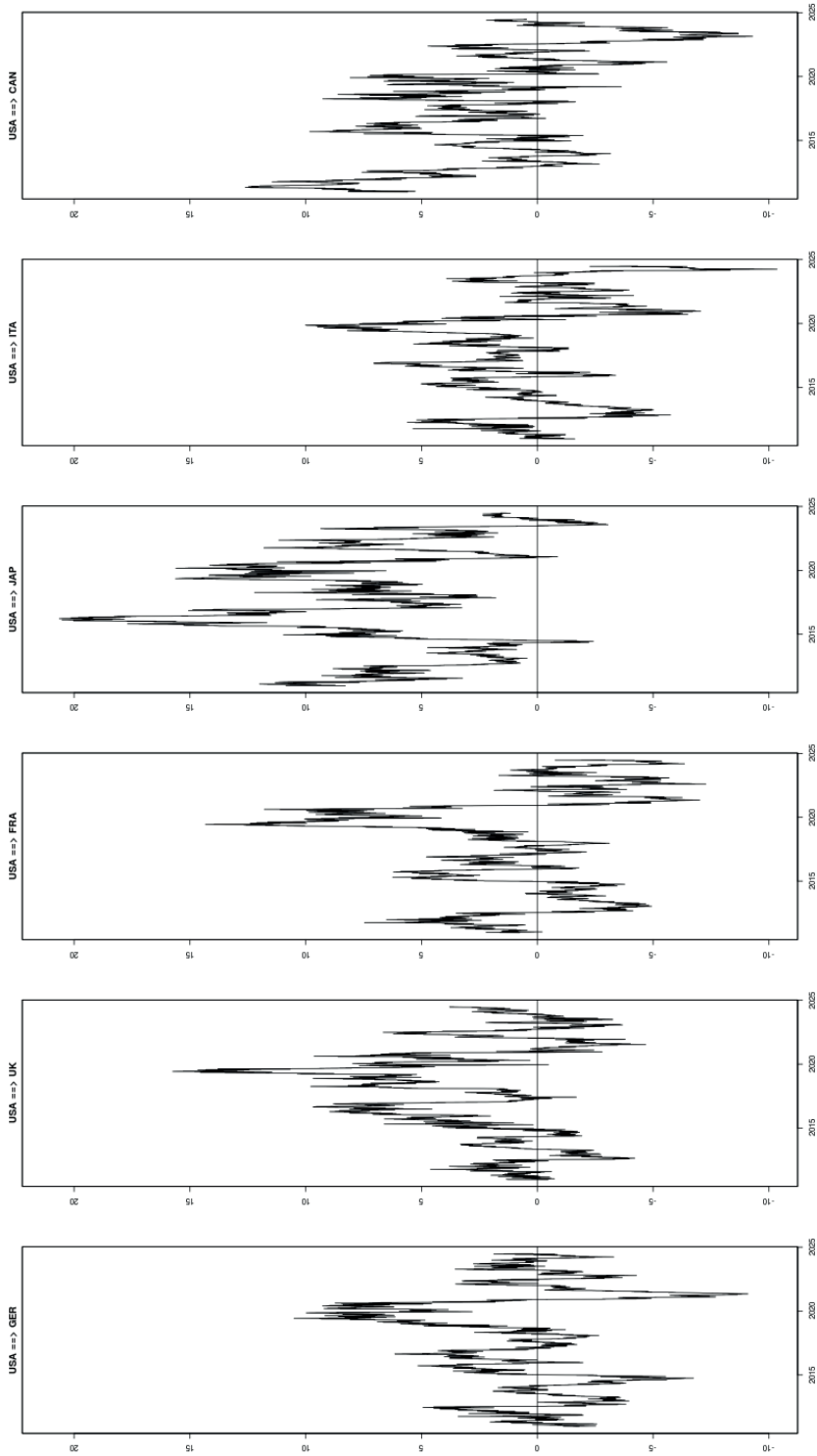

Fig. 4 Net connectedness from the USA to the other G7 countries

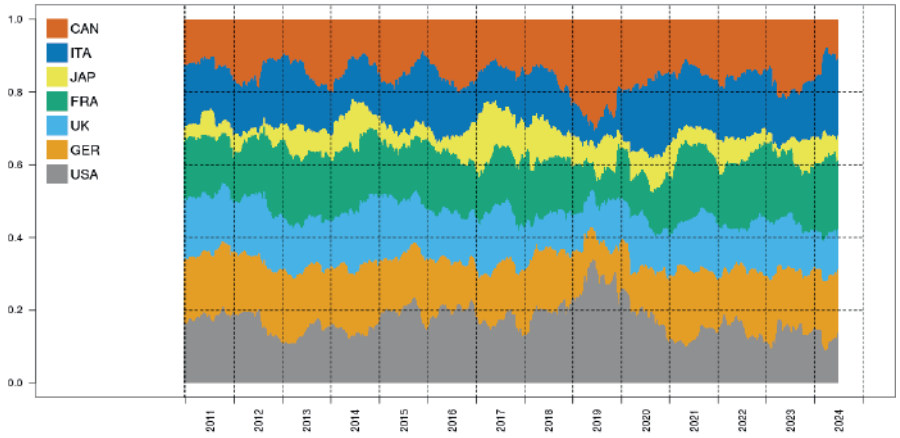

Fig. 5 Propagation values

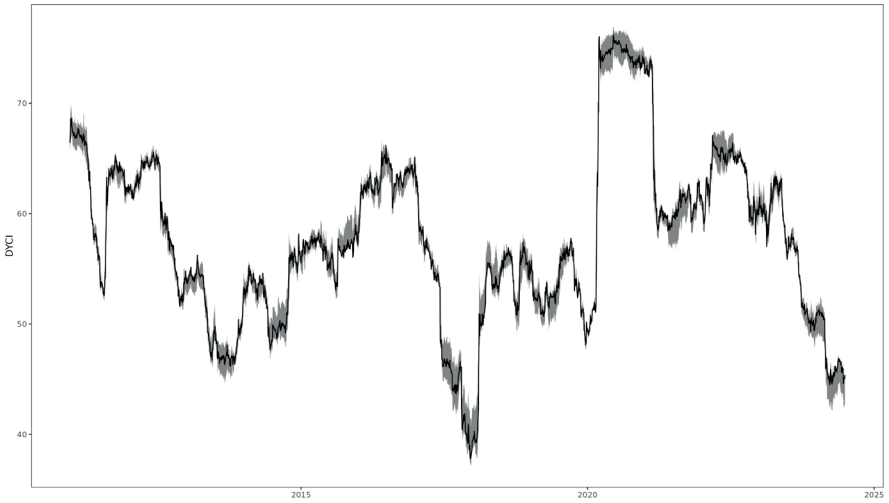

Fig. 6 DYCI: (shaded area: min & max of laglength 1-5), (solid line: VAR(3), selected)

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