INTERNATIONAL STUDIES IN

ECONOMICS AND ADMINISTRATIVE SCIENCES

June 2023

EDITORS

PROF. DR. MUSTAFA METE

ASSIST. PROF. DR. AYTAÇ TOPTAŞ

DR. FUNDA MERMERTAŞ

SERÜVEN YAYINEVİ

Genel Yayın Yönetmeni / Editor in Chief • C. Cansın Selin Temana

Kapak & İç Tasarım / Cover & Interior Design • Serüven Yayınevi

Birinci Basım / First Edition • © Haziran 2023

ISBN • 978-625-6450-64-6

Serüven Yayınevi / Serüven Publishing
Türkiye Adres / Turkey Address: Kızılay Mah. Fevzi Çakmak 1. Sokak
Ümit Apt No: 22/A Çankaya/ANKARA
Telefon / Phone: 05437675765
web: www.seruvenyayinevi.com
e-mail: seruvenyayinevi@gmail.com

Baskı & Cilt / Printing & Volume
Sertifika / Certificate No: 47083

INTERNATIONAL STUDIES IN ECONOMICS AND ADMINISTRATIVE SCIENCES

June 2023

Editors
PROF. DR. MUSTAFA METE
ASSIST. PROF. DR. AYTAÇ TOPTAŞ
DR. FUNDA MERMERTAŞ

CONTENTS

Chapter 1

REGIONAL CLASSIFICATION AND ECONOMIC DEVELOPMENT IN TÜRKİYE[1]

Ahmet KADİROĞLU[2]
Esra Sena TÜRKO[3]

1 This study was derived from the doctoral dissertation of the corresponding author. Kadiroğlu, Ahmet (2022). Dezavantajlı Bölgelerde Yerel Ekonomik Kalkınma: Farklı Gelişmişlik Düzeyine Sahip Bölgelerde Karşılaştırmalı Bir Uygulama [Local Economic Development in Disadvantaged Regions: A Comparative Survey in Regions with Different Levels of Development]. (Unpublished doctoral dissertation). Erzurum Technical University Graduate School of Social Sciences, Dept. Of Economics. (Advisor, Assoc. Prof. Dr. Esra Sena Türko)

2 Lecturer. Dr., Bingöl University, Rectorate, Social and Economic Studies Application and Research Center, ORCID: 0000 0002-0818-5324, akadiroglu@bingol.edu.tr

3 Assoc. Prof. Dr., Erzurum Technical University, Faculty of Economics and Administrative Sciences, Department of Economics, ORCID: 0000-0002-9102-6120, esturko@erzurum.edu.tr

1. Introduction

Economic development has never progressed at the same time and speed in all regions of a country. The region that is richer than others in terms of capital accumulation, geographical conditions, human capital, education level, and population will develop faster and earlier from economic and social aspects. This situation will result in various imbalances between the regions of the country. Regional imbalance, from the widest perspective, can be expressed as any kind of inequality in terms of economic and social characteristics. In order to reduce these imbalances, it is necessary to develop policies for the development of underdeveloped regions. To develop an underdeveloped region, all its resources should be analyzed, its capabilities and capacities should be identified, and short, medium, and long-term policy instruments should be developed consistently and implemented in accordance with the current situation of the region and the desired structural foresight (Doğan and Yıldız, 2008: 148). Türkiye has entered a profound process of structural change within the framework of globalization and EU accession process. In this process of structural change, it was aimed to solve the problem of regional imbalance. A common regionalization system has been established to solve the regional imbalance problem among the EU member and candidate countries. The Nomenclature of Units for Territorial Statistics (NUTS) has been created to ensure the comparability of data for regions and to identify interregional differences (Mermer and Tekkenar, 2018: 92).

This study, which addresses economic development and regional classification in Türkiye, consists of five chapters. The types of regions, types of regions in terms of economic structure, and types of regions in terms of economic development are discussed in the second chapter of the study. The third chapter examines regional differentiation from the perspective of the level of economic development. The fourth chapter discusses the disadvantages of regional differences and the final chapter presents the conclusion of the study.

2. Region Types

In works dealing with regional planning and development, various regional distinctions can be observed. The first systematic study on regional distinctions belongs to Von Thunen, the founder of spatial economics (Gündüz, 2006: 3). In order for the spatial dimension to be correctly included in national planning, it is necessary to determine the economic area, in other words, to create a flow chart of sectors among regions and to make a plan based on this chart. For such planning, first of all, the country needs to be divided into planning regions. In the classification of regional planning that needs to be done for a policy that will ensure a balanced distribution of economic development among the regions of a country, three regional terms stand out. These are:

- **Homogeneous region**, in terms of determining the current status,
- **Polarized region**, in terms of functional relationships, and
- **Plan region,** in terms of effectively conducting the regional development policies.

The homogeneous region and the polarized region are study areas that originate from the analyses conducted for determining the planning region (Dinler, 2012: 74).

On the other hand, regions can be classified as developed regions, underdeveloped regions, developing underdeveloped regions, and potentially underdeveloped regions based on their level of economic development (Gündüz, 2006: 3).

2.1. Region Types by Economic Structure

In terms of economic structure, the distinction between regions reflects their situations in a certain period of time and space. According to this analysis, regions are examined in three groups in terms of their economic structures: homogeneous regions, polarized regions, and planned regions (Doğan and Yıldız, 2007: 149).

2.1.1. Homogeneous Region

Homogeneous region is a type of regional distinction used in determining policies to reduce development disparities between the regions of a country. Neighboring provinces with similar development levels form a homogeneous region in terms of development level (Dinler, 2012: 74). In other words, a homogeneous region can be defined as a series of contiguous areas that are more similar to each other in a particular characteristic than to other areas (Davis, 1993: 3).

Homogeneity is considered as a fundamental factor in traditionally defining a region. In fact, all regional classification schemes are based on homogeneity criteria. The type of homogeneity can be related to a combination of or several economic, social, physical, or other characteristic features. The type of homogeneity being sought is crucial for defining a region. Some homogeneous regions are homogeneous in terms of geography or natural resource endowment in terms of physical characteristics. Others are defined as similar in terms of economic or social characteristics. Therefore, the homogeneity factor is a determining factor in defining the region and determining its boundaries (Meyer, 1963: 22). Differences in development between regions are related to both economic and socio-cultural characteristics and demographic characteristics. In addition to these definitions, the homogeneous region is also used in the nomenclature of units for territorial statistics (NUTS) due to changes in regional development and

structural adjustments to the EU. Furthermore, NUTS can also be described as a type of homogeneous region (Erdem, 2019: 61).

In Türkiye, the identification of homogeneous regions began in the early 1970s by the State Planning Organization (SPO) and the Ministry of Reconstruction and Resettlement to provide a basis for regional development studies. After the implementation of the first Five-Year Development Plan (1963-1968) with a sectoral nature, the idea of prioritizing policies aimed at reducing interregional development disparities led planners to work in this direction to identify interregional development disparities. Based on the principle of homogeneous regions, this distinction was made for use in the studies carried out in the 1970s and resulted in the identification of study regions. As a result of this distinction, Türkiye was divided into eight main regions, each of which was further subdivided into fifteen sub-regions, for a total of nineteen regions. Therefore, the nineteen provinces located in five different regions of Eastern Anatolia (Erzurum, Erzincan, Elazığ, Malatya, Bingöl, Tunceli, Kars, Muş, Mardin, Bitlis, Diyarbakır, Siirt, Şanlıurfa, Adıyaman, Kahramanmaraş, Gaziantep, Ağrı, Van, Hakkari) are relatively among the least developed provinces in Türkiye (Gündüz, 2006: 4-5).

2.1.2. Polarized Region

The second approach aiming to define a region is based on the lack of relative homogeneity in spatial economics. Polarized regions are characterized by a series of functionally integrated areas that are defined more by their interdependencies than by their homogeneity (Davis, 1993: 4).

A polarized region consists of a center and its surrounding impact area. While the determination of homogeneous regions emerges from a static examination, polarized regions can be identified through a dynamic process and require a dynamic examination. The main features of a polarized region include the presence of functional relationships among its elements and a settlement ranking that includes villages, towns, medium-sized cities, regional centers, and metropolises (Ersungur, 2016: 113).

Polarized regions are based on the internal structure of economies. Actually, polarized regions consist of two components: a core and a hinterland. The core can represent a service center or a supply point for the hinterland, which would include its own market area. In addition, for some households or firms, the core may be seen as a demand point for goods and services produced in the hinterland. However, both the core and the hinterland can primarily involve economic activities related to areas outside the region. A general characteristic of a polarized region is the mutual interdependence between the core and the hinterland, not only in terms of trade, but also in terms of income levels, capital movements, migration, transportation, and so on (Parr, 2014: 1927).

The concept of a development pole comes to the forefront in explaining polarized regions. The most well-known and commonly used approach among development economic theories and regional planning studies is the growth pole theory proposed by Perroux (1950). As stated by Perroux (1950), the economic space is defined as a power field, in which the relationships among buyers and sellers of a business or an industry and the sum of their mutual interactions take place (Malizia and Feser, 2004, cited in Filiztekin, 2008: 25).

According to the theory of development poles, economic development may not be observed simultaneously in all regions of a country. It is seen in poles or points of development with different degrees of intensity, where it concentrates. After reaching a certain intensity, it spreads to the entire national economy through various channels with different final effects. Growth occurs through mutual interactions and externalities, which is the essence of the growth pole theory. The selection of the leading sector is crucial in the growth pole model. Despite the fact that the results of studies based on this model are mostly unsuccessful, its attractiveness still persists. The fundamental characteristic of the growth pole theory is the connection between the pole and the surrounding area. If there are no close relationships between the central pole and the surrounding areas, growth in the central pole region cannot spread to the periphery (Filiztekin, 2008: 25-26).

A nodal region is seen as a special case of a functional region that has a single focus and introduces the concept of dominance or order. Grouping of positional units results in a functional region if the intra-group interaction is higher than the inter-group interaction, regardless of the role of each entity in the interaction model. On the other hand, if grouping is based on both the interaction between positional units and the ranking or sequential relationship of one positional unit to another, and a single positional unit is defined as dominant over the other, a polarized region is formed. These positional units can be divided into subgroups consisting of hierarchical or ranked units organized around a single center based on the types of relationships that include each of these subgroups. Such a subsystem creates a polarized region (Brown and Holmes, 1971: 387).

The intensity of economic relationships between established centers must be identified in order to determine a polarized region. The intensity of these relationships can be best determined by making use of a regional input-output matrix. The settlement centers are ranked according to the total value of their purchases and sales, and a hierarchy is created. The settlement center with the highest total purchase-sale value has the quality of being the most polarized center. Undoubtedly, the region where this center is located is the first-degree polarized region. To determine a polarized region by preparing a regional input-output table, it is quite difficult due to the lack of data. In this case, flows that can be easily determined even in intermediate regions such

as the intensity of intercity telephone calls, highway, railway and maritime transportation can be taken into consideration (Dinler, 2012: 79).

In the year 1982, studies were carried out by the SPO to identify polarized regions in our country. These regions were determined by specifying the functions of the flows that connect economic poles to each other (Kılıç and Mutluer, 2004: 23).

As seen in Table 1, the central provinces, which are divided into 16 polarized regions, are in a more developed situation compared to other provinces and have influenced the provinces listed in the right column. Istanbul is the most developed central province in Türkiye and is directly or indirectly related to all settlement centers. In the division of polarized regions, Sivas, Bursa, and Malatya provinces were classified as single polarized regions separate from other provinces (Gündüz, 2006: 6).

Table 1: Polarized Region Classification in Türkiye

Region No	Region Center	Cities being affected by Center
Region 1	İstanbul	Çanakkale, Bolu, Tekirdağ, Kırklareli, Edirne, Sakarya, Kocaeli, Kastamonu, Zonguldak
Region 2	Bursa	
Region 3	Eskişehir	Kütahya, Bilecik
Region 4	İzmir	Antalya, Afyon, Burdur, Aydın, Isparta, Denizli, Muğla, Manisa, Balıkesir
Region 5	Ankara	Çorum, Çankırı, Kırşehir
Region 6	Konya	Niğde
Region 7	Adana	İçel, Hatay
Region 8	Samsun	Giresun, Amasya, , Sinop, Ordu, Tokat
Region 9	Kayseri	Yozgat, Nevşehir
Region 10	Sivas	
Region 11	Malatya	
Region 12	Gaziantep	Kahramanmaraş, Adıyaman, Şanlıurfa
Region 13	Trabzon	Giresun, Rize, Artvin
Region 14	Erzurum	Erzincan, Kars, Ağrı, Muş
Region 15	Elazığ	Tunceli, Bingöl
Region 16	Diyarbakır	Van, Mardin, Hakkari, Bitlis, Siirt

Source: Gündüz, 2006: 7

2.1.3. Planning Region

Another region concept originating from regional distinctions by their economic structures is the planning region. In general, the planning region can be defined as a planning and management unit with a democratic, participatory governance and budget, which is smaller than the country but wider than the city, whose local administrative boundaries coincide

with national administrative boundaries but can exceed them in terms of interaction, and can be managed locally (DPT, 2000: 8). According to another definition, the planning region is an area within the authority area of the administration responsible for implementing regional development policies. In other words, it is the whole of the areas, where regional development plans are implemented. Depending on the type of regional planning to be implemented, the administrations responsible for implementing regional policies can be located within or outside the region, that is, in the center. (Dinler, 2012: 84).

Two types of planning regions can be specified here. The first type of planning region is a region concept originating from regional distinctions made for the purpose of incorporating the spatial dimension into the national development plan. The number of these planning regions covering the entire country varies depending on the country's size and socioeconomic structure. To identify planning regions, a homogeneous or polarized regional distinction can be used, or a regional distinction different from these two distinctions can be made by taking both into account. Because determining the boundaries of regions also concern the political structure of countries along with their socioeconomic structure. The planning region boundaries should be in dimensions and widths suitable for many different technical services that may require. In addition, they should be suitable not only for services but also for other activities that the central authority may want to carry out in these common areas, such as the collection of national income, the maintenance of security and order, and elections.

The second type of planning region originates from the regional planning efforts undertaken either before the implementation of the national development plan or to overcome the intense regional problems encountered during the implementation of the national development plan. In the second type of planning region approach, the whole country is not divided into regions. Only the regions, where problems are encountered, are identified as planning regions, and regional planning types that can overcome these problems are implemented (Keleş, 2013: 347).

The preparation of the regional development plan for an economic zone will result in controlling the spatial distribution of all economic activities and ensuring that expanding regions benefit from resources in a fair manner. The plan is applied in countries that implement the regional development plan, and the country is divided into regions to regionalize the national plan. France can be cited as an example of such a plan being divided into regions. Regional planning, initiated to overcome intense regional problems before implementing the regional development plan, resulted in the approach of dividing the entire country into regions not being applicable. Only the regions where problems are observed are identified as plan regions, and regional planning that will solve these problems is applied. (Gündüz, 2006: 8)

The implementation of the plan region plays an important role in the economic development of the region and the country as a whole. It can reduce the development problems of underdeveloped regions, decrease the unemployment rate, prevent migration movements, make rich underground resources useful, solve the problems of rapidly industrializing regions, solve the problems of densely populated metropolitan areas, and provide sustainable development. Generally, in a planning region, several or all of these problems may coexist (Ersungur, 2016: 116).

3. Classification of Regions by Economic Development Level

In every country that enters into economic development, it is understood that economic development will not start at the same time in all regions of the country. Development that occurs in certain privileged points will be concentrated in these centers and, as a result, inter-regional development disparities inevitably emerge. The socio-economic and geographical structures of each country can differ from each other and the problems of the regions it contains can also vary (Dinler, 2012: 116).

The rapid increase in technological advancement nowadays is also differentiating the dimensions of economic development. In the 2000s, countries are classified by different distinctions in terms of development. Considering this typology, the distinctions are classified as follows.

- Countries remaining in the traditional social structure and starting industrialization,
- Countries becoming closer to industrial society structure,
- Countries having the complete industrial society structure,
- Countries advancing to the consumption society structure,
- Post-industrial countries.

The types of problematic regions, which find their source in the inter-regional development disparities, can be classified under four headings (Ildırar, 2004: 12).

3.1. Underdeveloped Region

The development observed at the regional level is referred to as regional underdevelopment, which reveals the phenomenon of underdeveloped regions. Underdeveloped regions are areas that are not only insufficiently developed when compared to the country as a whole, but also differ from the rest of the country in terms of their economic and social structure (Tütengil, 1970: 24).

In underdeveloped regions, the level of income is at lower levels in comparison to the country's level of income and income growth rate. There are significant inequalities in the distribution of income per capita. Economic

activities are generally based on the agricultural sector, but the population growth rate is higher than the country as a whole. Due to the lack of education in underdeveloped regions, the rate of unskilled workers in the region is high. Employment opportunities for the workforce are limited, and the rate of unionization is at a low level (Gündüz, 2006: 12).

Usually, industrial enterprises that use primitive industrial technology and agriculture are active in underdeveloped regions. Industrial facilities migrate towards large industrialized cities, where labor is cheaper and the productivity, wages, demand, health, education, and other social opportunities are higher than in underdeveloped regions, rather than in backward regions where cheap labor is available. This migration wave naturally worsens the physical and especially the economic structure of the migrated cities compared to before. In addition, this migration wave creates a shortage of skilled labor for existing businesses (Kuran, 2019: 16). On the other hand, savings are also low since the income level is low. Since savings are a function of income, insufficient savings result in low investment rates. For this reason, other production factors, especially labor, cannot be efficiently employed (Gündüz, 2006: 12). As a natural consequence of the migration of savings and labor to developed regions, the gap in the level of development between regions continues to widen (Tütengil, 1970: 25).

Underdeveloped regions are not unique to the developing countries. Even in the industrialized countries of Western Europe, there are relatively underdeveloped regions today, and these countries are striving to develop these regions. Wales in the UK, eastern Netherlands, Scotland, southern Italy, southern and southwestern France, northern Sweden, Norway, and Finland, the eastern border regions of Germany, and the Eastern and Southeastern Anatolia Regions in Türkiye can be considered as problematic regions that are less developed when compared to other regions of these countries, despite being the first country to develop during the industrial revolution (Dinler, 2012: 117).

An underdeveloped region can be defined as a region that lacks development advantages or has lost its development potential due to various socio-economic factors (Ildırar, 2004: 12). Underdeveloped regions generally exhibit the following characteristics (Tekeli and İlkin, 1983: 12):

- The efficiency of factors is weak, and their distribution is disrupted,
- Infrastructure investments are at insufficient levels,
- The natural environment does not provide opportunities for development,
- Irregular income distribution in regions accelerates migration to other regions,

- There are not enough scientists in the region,
- The technology used in the region is simple and primitive,
- The population growth rate is high, but the nutrition level is low,
- Education and health levels are at low levels,
- The economic structure is based on agriculture,
- The lands of less developed regions are also not fertile. Therefore, the yield per unit obtained from the land is also low.

3.2. Developing Underdeveloped Region

These regions are below the country's average in terms of income level. Regions that have a higher development rate than the country average can be identified as developing underdeveloped regions. Although these types of regions have development potential, this potential has not been utilized for a long time. Therefore, besides the fact that the resources in the region cannot be utilized adequately, the region cannot draw enough public and private investments, and the existing workforce cannot be utilized effectively. As a result, while the region continues its underdeveloped status on the one hand, it also continues its development on the other hand (Ildırar, 2004: 12-13).

3.3. Underdeveloped Region by Potential

An underdeveloped region in terms of potential is a region that has lost its development potential. The average income per capita in such regions is higher than the country average in certain periods. However, because the per capita income is below the country average and due to the decrease in the welfare level of these regions, they are considered as underdeveloped regions. These regions are classified as underdeveloped because they have lost their development potential (Ildırar, 2004: 13).

3.4. Developed Region

A developed region is a region that has a higher income level and income growth rate when compared to the country average. While the income level and income growth rate in this region are at high levels, the region also shows development characteristics according to cultural and social indicators. In addition, education and average cultural level in the region are also at high levels. While social infrastructure investments such as health, education, road, electricity, and water are sufficient in developed regions, productive investments are also available in the region. In developed regions, the number of people per doctor is low. The number of hospital beds is sufficient according to the region's population. Due to their high cultural and social level, birth rates are at low levels. The proportion of social security insured in the workforce is quite high. On the other hand, the rate of meeting cultural and social needs

such as parks, green areas, hotels, cinemas, restaurants, and theaters is also high (cited from Erkal, 1982 by Palamut, 2005: 20). The characteristics of developed regions can be listed as follows (Yılmaz, 1984: 90):

- Production factors are efficient,
- There is no or little imbalance in factor distribution,
- Infrastructure investments are sufficient,
- Natural environment is conducive to development,
- Income distribution in the region is regular and it attracts immigration from outside,
- Development rates of advanced regions are higher not only than those of underdeveloped regions but also than the country's development rate,
- Investment is high in the region depending on savings and it shows continuous increases.

When compared to developed regions, there are significant gaps in many economic activities that lead to wide disparities in per capita income and the intensity of productive and well-paid employment. Developed regions may emerge due to comparative advantage or as a result of government-allocated funding. In many cases, imbalances arise between developed and underdeveloped regions, which may also be the result of planners' actions. Effective policymakers often disproportionately invest in certain regions, making them much more developed than others. Such development in an economy with scarce resources may come at the expense of denying a legitimate share of investment to other regions. Regions where rapid maximization is possible, i.e., those that can achieve high outputs with relatively lower input levels, attract more attention and become even more developed (Rengasamy, 2014: 11-12).

4. Disadvantages of Regional Disparities

The emergence of regional imbalances is a characteristic that every developing country must reach as its first stage. Therefore, avoiding regional imbalances is almost impossible. At this point, the desired goal is to overcome this unwanted period as quickly as possible and to minimize the imbalances caused by economic development (Ersungur, 2016: 162).

Economic development does not begin simultaneously in different regions of a country. Differences in development arise between regions due to developments occurring in certain points that have certain advantages in terms of economic and natural factors, causing the development to be concentrated in certain poles. As a result of this situation, some problems arise. The increasing difference in development between regions, besides

being contrary to the principle of social equality in economic development, also leads to a bottleneck after a certain process for economic development (Eraydın, 1983: 1).

4.1. Disadvantages of Underdeveloped Regions

In developing regions, there is an increase in scale and efficiency. However, economic and socio-political problems arise as a result of regional imbalance in underdeveloped regions.

Economic disadvantages include the underutilization of production factors and problems with inadequate employment. Production capacity and welfare levels are at low levels. Additionally, hidden and open unemployment problems are widespread.

Socio-political disadvantages include continual migration movements. Education, culture, and healthcare services are at a low level. Public activities are slow and inefficient. There are also terrorist groups based on race, religion, and sectarian differences (Ersungur, 2016: 163).

4.2. Disadvantages of Developed Regions

The regions, where economic development has started, are becoming more crowded every day due to the externalities it provides to businesses. These regions, which seemed good for the country's development in the early days, become regions, where many problems arise, and solutions become very difficult due to uncontrolled migration after a certain stage. As a result of this situation, negative externalities towards businesses occur, and there are some problems in providing services to those living in those regions (Dinler, 2012: 118).

Urban development creates some special costs for both producers and consumers. While transportation and housing expenses increase, working and leisure times are shortened, leading to a decrease in productivity. As a result of inflation, there are also increases in labor costs. On the other hand, urban development leads to significant increases in public expenditures such as transportation (social services, subsidies), housing (infrastructure and land costs), health (cleanliness, food control), and infrastructure expenses (Ersungur, 2016: 163).

4.3. Optimal City Size

In both developed and developing countries, while the urban population ratio increases over time, the concentration of the country's population in certain regions leads to various problems in large cities. Therefore, there are different scales for determining the optimal city size for residents, businesses, and local governments. (Dinler, 2012: 152).

These scales can be summarized as follows (Ersungur, 2016: 164):

- **Optimal City Size for Individuals:** It refers to the size, in which people can carry out their daily routines such as work and shopping by walking and are in harmony with nature without causing environmental pollution.

Individuals, who seek peace, green areas, and silence, also hope to have high levels of income. The growth of cities provides individuals with employment opportunities, high wages, and access to various services. However, contrary to these positive aspects, the disadvantages such as spending working time on the road and environmental pollution result in a decrease in income.

- **Optimal City Size for Businesses:** Urban development can be defined as the scale, at which external economies develop and eventually begin to increase the costs of businesses. It should also be noted that the optimal size of a city may vary depending on the level of agglomeration of the industries, in which businesses are located.

- **Optimal City Size for Local Governments:** The regions, where per capita local government expenses are the lowest, can be identified as the most suitable urban size. However, when determining this size, in addition to per capita public expenditures, the potential participation share to be taken from those residing in the city should also be taken into account.

5. Conclusion

In this study, the types of regions by economic structure, types of regions by economic development, regional differentiation by the level of economic development, and the drawbacks of regional disparities are examined together. The idea of a regional classification approach created to eliminate development disparities between regions is the motivation behind this study.

The identification of homogeneous regions in Türkiye began in the early 1970s by the State Planning Organization (SPO) and the Ministry of Reconstruction and Resettlement to serve as a basis for regional development studies. The prioritization of policies aiming to reduce interregional development disparities followed the implementation of the First Five-Year Development Plan (1963-1968) having a sectoral character, leading planners to work in this direction to identify interregional development disparities. As a result of this distinction, Türkiye was divided into eight main regions and four of these main regions were further divided into fifteen sub-regions, creating a total of nineteen regions. Accordingly, the nineteen provinces located in the five different regions of the Eastern Anatolia Region (Erzurum, Erzincan, Elazığ, Malatya, Bingöl, Tunceli, Kars, Muş, Mardin, Bitlis, Diyarbakır, Siirt, Şanlıurfa, Adıyaman, Kahramanmaraş, Gaziantep, Ağrı, Van, Hakkâri) are relatively among the least developed provinces in Türkiye. On the other hand, in our country, studies were carried out by the SPO in 1982

to identify polarized regions. These regions were determined by defining the relationships between economic poles as the function of the flows that connect these poles. Istanbul is the most developed center in Türkiye. Istanbul, which is at the top of the hierarchy, is in a direct or indirect relationship with all settlement centers. In the classification of polarized regions, separate from other provinces, the provinces of Sivas, Bursa, and Malatya were classified as single-polarized regions.

REFERENCES

Brown, L. A., & Holmes, J. (1971). The delimitation of functional regions, nodal regions, and hierarchies by functional distance approaches. *Ekistics*, 32(192), 387-391. http://www.jstor.com/stable/43617893

Davis, H. C. (1993). *Regional economic ımpact analysis and project evaluation.* Canada: UBC Press

Devlet Planlama Teşkilatı. (2000). *Sekizinci beş yıllık kalkınma planı bölgesel gelişme özel ihtisas komisyonu raporu*. Report No: 2502. Ankara: DPT.

Doğan, S., & Yıldız, Z. (2007). Bölgesel kalkınma, turizmin ilişkisi ve göller bölgesi kalkınmasında alternatif turizm potansiyelinin kullanılabilirliğine yönelik bir araştırma. *Süleyman Demirel Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, *2*(6), 147-181. https://dergipark.org.tr/en/download/article-file/215598

Dinler, Z. (2012). *Bölgesel iktisat*. Bursa: Ekin Kitapevi Yayınları.

Eraydın, A. (1983). Türkiye'de ulusal kalkınma planlarının bölgesel ayrıştırılmasına yönelik bir yaklaşım. *Anadolu Üniversitesi İİBF Yayınları*, 12.

Erdem, M. S. (2019). The new regionalism approach at regional development: a case study of Sinop province. *BİLTÜRK Ekonomi ve İlişkili Çalışmalar Dergisi*, *1*(1), 57-83. https://dergipark.org.tr/en/download/article-file/643863

Ersungur, Ş. M. (2016). *Bölgesel iktisat: Teori, politika ve uygulama*. Ankara: İmaj Yayınevi.

Filiztekin, A. (2008). Türkiye'de bölgesel farklar ve politikalar. *TÜSİAD*, T/2008-09/471. https://research.sabanciuniv.edu/id/eprint/8885/1/bolgeselfarklar.pdf

Gündüz, A. Y. (2006). *Bölgesel kalkınma politikası*. Bursa: Ekin Kitapevi Yayınları.

Ildırar, M. (2004). *Bölgesel kalkınma ve gelişme stratejileri.* İstanbul: Nobel Yayınevi.

Keleş, R. (2013). *Kentleşme politikası*. Ankara: İmge Yayınevi.

Kılıç, S. E., & Mutluer, M. (2004). Coğrafyada ve bölge planlamada bölge kavramının karşılaştırmalı olarak irdelenmesi. *Ege Coğrafya Dergisi*, 13(1-2). https://dergipark.org.tr/en/download/article-file/56800

Kuran, İ. (2019). *Kalkınma ajanslarının kurumsal sorunları ve çözümlerine ilişkin ampirik analiz: Türkiye örneği.* (Unpublished doctoral thesis). İstanbul Üniversitesi Sosyal Bilimler Enstitüsü.

Meyer, J. R. (1963). Regional economics: A survey. *American Economic Review*. *53*(1), 19-54. https://link.springer.com/chapter/10.1007/978-1-349-00460-7_4

Palamut, E. (2005). *Vergisel teşviklerin bölgesel kalkınmadaki rolü: Güneydoğu Anadolu bölgesi üzerine uygulama*. (Unpublished doctoral thesis), Uludağ Üniversitesi, Bursa.

Parr, J. B. (2014). The regional economy, spatial structure and regional urban systems. *Regional Studies*, *48*(12), 1926-1938. doi :https://doi.org/10.1080/00343404.2013.799759

Rengasamy, S. (2014). Regional planning and development part II types of regions and regionalization of India. *Madurai Institute of Social Science*, *4*(18), 163-174.

Tekeli, İ., & İlkin, S. (1983). *1929 Dünya buhranında Türkiye'nin iktisadi politika arayışları*. Orta Doğu Teknik Üniversitesi.

Mermer, H., & Tekkanat, S. S. (2018). Bir planlama sorunsalı olarak bölgelerarası dengesizlik: Türkiye örneği. *Aksaray Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, *10*(4), 91-106.

Tütengil, C. O. (1970). *Az gelişmenin sosyolojisi*. İstanbul: İstanbul Üniversitesi Yayınları.

Chapter 2

THE EFFECTS OF FINANCIAL DEVELOPMENT INDICATORS ON FINANCIAL CONVERGENCE OF OECD COUNTRIES[1]

Julide DAMADOĞLU[2]

Gulten DURSUN[3]

1 This article was produced from the data used in the PhD thesis prepared in Kocaeli University Social Sciences Institute, Department of Economics with the subject of ''Finansal Gelişme Ölçütlerinin Finansal Yakınsamaya Etkisi: AB, OECD ve APEC Ülkeleri Deneyimi''.

2 İstanbul Gedik University, Lecturer Phd Julide Damadoğlu, julide.damadoglu@gedik.edu.tr, ORCID: 0000-0002-2576-6761

3 Kocaeli Üniversity, Assoc. Prof. Dr. Gulten Dursun, dgulten@kocaeli.edu.tr, ORCID: 0000-0003-2430-3412

INTRODUCTION

Financial liberalization, which started in the 1980s with globalization, accelerated in the 2000s, has been significantly increasing the convergence process of world economies. Foreign investments and funds contribute to the economic development of countries by moving from developed countries to developing or underdeveloped countries where profit and interest returns are high. Mergers and acquisitions realized through investments increase the value of companies' stocks, thus enabling the capital markets to develop and become stronger. As financial markets develop and become stronger, as competition in these markets increases, financial instruments become more accessible and applicable, increasing production and thus employment through credits given to the private sector by banks. The risks of economic agents decrease and their yields increase through financial development. Increasing returns allow increased savings and investments, whereas increased investments allow increased production volume and increased employment. Increasing production capacity and increasing diversity of financial instruments also encourage the development of technology.

Income convergence theory, which is based on the Neoclassical Growth Model, forms the basis of this study. According to the income convergence theory, if the countries with the same initial structural conditions and lower initial income converge to the same stable equilibrium state as the countries with higher initial income, as per the law of diminishing returns absolute convergence occurs. Conditional convergence occurs when countries with similar initial structural characteristics and the different initial incomes converge to the same stationary state or to their own stationary equilibrium state.

In conditional convergence, countries converge to a steady-state income level in terms of their structural characteristics; that is, the steady-state income level of each country is different, because the production function of the countries is different, the steady-state income level is also different. In this context, while there is no evidence of convergence in the world income distribution in the post-World War II period, there is some evidence for conditional convergence. The difference in income distribution between countries with similar observable characteristics seems to be getting narrower (Acemoğlu, 2008: 19).

Empirical findings show that the mutually reinforcing relationship between financial development and economic growth is stronger in the first stage of economic growth and this relationship decreases as sustainable economic growth begins (Fung, 2009; Dobson & Ramlogan, 2002; Bahadır & Valev, 2015). Thus, low and high income countries with a relatively well-developed financial sector are more likely to catch up with middle- and high-income countries, and poor countries with a relatively underdeveloped financial sector are less likely to catch up with high-income countries.

The concept of conditional convergence highlights possible differences in the steady state and therefore requires the inclusion of appropriate variables on the right-hand side of the growth-baseline regression to control for these differences. Conditional convergence explains that countries with similar parameters that determine long-term steady-state equilibrium values will converge (Yetkiner, 2012). Barro (1991), Mankiw et al. (1992) and Barro and Sala-i-Martin (1995) argue that the Neoclassical Growth Model leads to the conditional convergence hypothesis rather than the absolute one, and therefore rejecting the absolute convergence hypothesis does not naturally mean rejecting the Neoclassical Growth Model. Conditional and absolute convergences hypotheses coincide only if all economies have the same steady-state equilibrium. When the factors leading to convergence are examined, it is seen that the main ones are globalization and technological diffusion.

The aim of this study is; to evaluate and prove whether there is a financial convergence among OECD countries. The importance of this study is that it gives an opportunity to analyze financial convergence before and after the mortgage crisis that affects all the reel and financial sectors all over the world and digitalization and innovations in financial sector technology and blockchain gave the opportunity to control the financial convergence speed before and after these technological improvements.

The contribution of the study to the literature is; the use and comparison of financial development indicators in the fields of banking and capital markets in two different sectors of financial markets. As advocated in the literature, providing evidence for the argument that countries that are above a financially certain critical value will converge.The use of the Lerner index used in banking sectors. Study clearly demonstrates that economic development will lead to convergence by strengthening financial development. It proves that financial and economic crises will cause a

decrease in the rate of financial convergence rather than causing fragility and divergence in developed countries.

In section the first section the literature is summarized and some examples in section 2 methodology is described in section 3 empirical results are given and in section 4 the results are discussed and the last section concludes the study.

Main Channels Effecting Financial Convergence

There are two main channels that affect financial convergence these are globalization and technological diffusion. Globalization is the process of the beginning of economic dependence by the disintegrating of disappearance of borders between countries (Wagner, 2001). Globalization is the distribution and monopolization of economic resources and power on the international platform (Khor, 2001). According to Galor and Mountford (2006), the increase in world trade due to globalization affects the growth rate of per capita income asymmetrically according to the comparative advantages of nations.

The convergence argument in the globalization debate calls globalization as a structural change. Sachs and Warner (1995) concluded in their empirical studies that the possibility of poor countries to catch up with rich countries can only be achieved by reducing the factors that hinder trade. Smith (1776) in his book “The Wealth of Nations” claims the view that technological development progresses more slowly as the division of labor in agriculture progresses more slowly than in production. This means strengthening the initial technological advantage of a developed nation over a poorer and less productive nation. The rich nation acquires know-how faster. However, technological development stops when capital accumulation ceases.

Hume (1742) argued that technological transfer, through low wages, would create an advantage for relatively poor countries to grow faster than relatively rich countries. Hume predicted that producers would go to poorer countries with low wages and after enriching these places, they would move to places with lower costs (Elmslie, 1995: 210). Veblen (1915) argued that there is a transfer of technology from the developed country to the developing country. Gerschenkron (1952), on the other hand, popularized the idea that technological backwardness provides advantage. The prerequisites to achieve

this advantage are the absence of factors hindering industrialization and having sufficient resources and equipment. Financial convergence can be measured through financial development indicators. Financial development indicators consist of quantity, knowledge and price based indicators. In addition to financial development criteria, economic development, liberalization of foreign trade, financial liberalization, capital account liberalization, structure of institutions and social capital, human capital, effective control and surveillance mechanisms, macroeconomic and financial policies, etc. also play an important role in the realization of financial convergence. Many indicators are needed to evaluate financial development in a multidimensional way (Gupta, 1984; Odedokun, 1989; King and Levine, 1993a; Levine, 1997; Gregorio and Guidotti, 1995; Lynch, 1996; Arestis and Demetriades, 1997; Gelbard and Pereira, 1999; Kar and Pentecost, 2000).

1. LITERATURE REVIEW

The financial convergence literature divides financial convergence into two groups: bank- and market based. Countries with a high- level of economic development generally also have a high level of development in the financial sector. Therefore there is a positive correlation between financial development and economic growth that reinforces each other. In the literature, especially the differences between the USA, England, Germany and Japan, and the distinction between market- and bank-based systems have attracted significant attention (Ryzbczinski, 1985; Dosi, 1990; Berglöf, 1990; Rajan and Zingales, 1995; 1998; Grabel, 1997; Schaberg, 1999). It has been determined that bank- and market-based systems lead to different economic and institutional dynamics. Later, in some studies, it has been proven that countries such as France and Italy are neither bank- nor market-based. The bipolar (bank-based and market-based), one-dimensional emphasis in the discussion about financial systems is lacking because most developed and developing countries can be much closer to the French and Italian examples (Cobham and Serres, 2000).

As time passed, two different views on financial convergence came into sight. On the one hand, some scholars have argued that globalization, deregulation, economic integration, regulatory harmonization and corporate governance rules lead to the convergence of financial system characteristics. However, some studies confirm that continental European financial systems

are more similar to Anglo-Saxon systems and that the classical distinction between bank- and market-based systems is less related to financial development than in the past (Allen and Gale, 1999; Rajan and Zingales, 2003a; 2003b; Hölzl, 2003). According to this view, financial structures converge toward a model that combines elements of the Anglo-Saxon model dominated by markets and investment banks with those of continental European systems dominated by commercial banks. Based on the concept of financial systems as a configuration of complementary elements, convergence of financial systems is best conceptualized as a path-dependent process of institutional change.

Table.1 Literature Summary on Financial Convergence

Authors Name	Countries	Years	Methodology	Sectors	Findings
Calcagnini et al., 2000	8 EU countries and USA	1960-1999	Panel Data Analysis	Banking sector	There is convergence
Aghion et al., 2004	71 countries	1960-1995	GMM estimator	Banking Sector	There is convergence
Murinde et al., 2004	7 EU countries	1972-1996	Panel Data - Dynamic GMM Fixed Effect Model	Banking and Stock Market Sector	There is convergence in stock market.
Tomova, 2005	12 EU countries	1994-2002	Fixed Effect Panel Data Analysis	Banking Sector	There is convergence
Bems, 2007	7 EU countries	1972-1996	Dynamic Panel Data	Direct Capital Flow	There is convergence
Hristov and Rozenov, 2009	10 EU countries	1999-2008	Time Varying Parameter Model	Banking Sector, Bond Market	Mix findings
Fung, 2009	57 Countries	1961-2001	Dynamic Panel GMM Fixed Effect Model	Banking Sector	There is convergence in all except financially underdeveloped ones.
Hermann and Winkler, 2009	EU 16 countries, Asia 11 countries	1994-2006	Applicable Generalized Least Squares Model	Banking Sector	There is convergence.
Heimonen, 2010	5 Developed Countries	1978-1996	Cointegration and ADF Unit Root Test	Stock Market	Mix findings

Veysov& Stolbov, 2011	102 countries	1980-2009	Panel Data, Fixed Effect Model	Banking, Stock and Bond Markets	There is no sigma convergence but there is beta convergence
Antzoulatos et al., 2011	38 Developed and developing countries	1990-2005	Philips and Sul convergence clubs	Banking, insurance stock, bond markets.	Financial systems do not converge.
Canarella et al., 2011	EU 11 countries	2001-2010	Unit root tests	Banking sector	There is convergence
Bruno et al., 2012	G7 and 23 OECD countries	1980-2005	Fixed effects, Random Effects and OLS and Panel Standart Error Correction Method	Banking, insurance, bond market, stock market sectors	There is convergence
Apergis et al., 2011	50 countries	1970-2003	Phillips and Sul, 2007	Banking sector	There is not convergence at all but there is convergence in clubs.
Asongu, 2012	11 Central and West African Countries	1981-2009	Panel Data-GMM, Arellano Bond IV	Banking sector	There is convergence.
Yaseen, 2012	Gulf Countries	2002-2007	Panel Data-Dynamic Model	Banking sector	Except some variables there is convergence in banking variables.
Ibrahim, 2013	29 Asia and Pasific countries	1980-2009	Club Convergence	Banking sector	2 groups converged, there is a low rate of convergence in the underdeveloped country group.
Bahadır and Valev, 2015	45 countries	1969-2005	Panel Data Dynamic GMM Model	Banking and Stock market sector	There is financial convergence
Gallizo et al., 2016	29 EU countries	2000-2013	Bayes Stocastic Model	Banking Sector	There is convergence but after crise it changed to divergence.
Nitoi and Pochea, 2016	11 EU countries	2007-2014	Philips ve Sul, Nonlinear time varying factor model.	Banking and Bond, Stock Market sectors	Only for stock market sectors there is convergence.
Dekle and Pundit, 2016	23 Asia countries	2004-2011	Panel Data Random Effects Model	Banking and Stock Market sectors	There is convergence, they converge to 5 big countries.
Yetkiner et al., 2017	EU 15 countries	1963-2012/ 1988-2012	Dynamic Panel System GMM	Banking and stock market sectors	Absolute β, conditional β there is convergence.

Maxfield et al., 2017	14 EU and OECD countries	1999-2013	Kolmogorow Smirnov Test	Reel sector firms	There is convergence among globalized firms but there is not any convergence in other types of firms.
Ramirez et al., 2018	7 South American Countries	2003-2012	Dynamic Lineer Model, Unit root tests, cointegration,	Stock market sector	There is financial convergence.
Leon, 2018	143 countries	1995-2014	Dynamic Panel Data System GMM Blundel and Blond	Banking sector	There is financial convergence.

Source: The author created the relevant table.

When the financial convergence literature is reviewed there is convergence in banking sectors in many studies (Calcagnini et al., 2000; Aghion et al., 2004; Tomova, 2005; Fung, 2009; Hermann and Winkler, 2009; Canarella et al., 2011). On the other hand some studies have evidenced mix findings (Hristov and Rozenov, 2009; Heimonen, 2010; Nitoi and Pochea, 2016). Some authors have proved that there is no financial convergence (Antzoulatos et al., 2011; Apergis et al., 2011).

When looking at the methodology section, it is observed that there are different approaches. The first is GMM dynamic panel data methods (Murinde, 2004; Bems, 2007; Fung, 2009; Yaseen, 2012; Bahadır and Valev, 2015, Ramirez et al., 2018; Leon,2018). Dynamic panel data methods are used because they include stronger estimators in cases such as endogeneity problems, heteroscadasticity and autocorrelation (Baltagi, 2005). Dynamic panel data methods are preferred because they use more observations, increase the degree of freedom by making the observations more homogeneous, and reduce the problem of cross-section dependency between explanatory variables. In System GMM, more variables are included in the model compared to the difference GMM method, which increases the efficiency of the model. Another reason for choosing dynamic models is that the relationships between economic variables can occur dynamically most of the time, and the effects of independent variables on the dependent variable appear in later periods or spread over more than one period.

2. METHODOLOGY

In this research, the convergence of the economies in the country groups in the banking and capital markets is determined by the financial development criteria approach, apart from the price, quantity and information-based approaches used in the literature so far.

$$FD_{it} = \beta FD_{it-1} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (1)$$

The absolute β convergence equation has been stated above. FD_{it} measures the financial development of country i for the annual period in period t, FD_{it-1} country's financial development level at time t-1 (bank and stock market variables), μ_i country specific effect, τ_t represents the time specific effect and $\varepsilon_{i,t}$ represents the temporary error term. The number of observations i = 1, . . . , N countries (OECD) each t = 1, . . . , T is for years. Here, absolute convergence is considered because, only the independent variables of financial development that affect the dependent variable are used and the control variables are not used.

$$FD_{it} = \beta FD_{it-1} + \gamma X_{it} + \mu_i + \tau_t + \varepsilon_{it} \quad (2)$$

The equation in (2) is a conditional convergence equation and γX_{it} control variables (explanatory variables) are added to the equation while all other variables and coefficients are the same. γ shows the coefficient of the control variables, while X_{it} shows the vector of the control variables. Here, the β coefficient estimator is estimated for both equations. It is expected to be $0< \beta <1$, indicating that countries with lower initial financial development have a higher financial development growth rate and that financial convergence occurred. β=1 indicates that the level of change in financial development in these countries remained constant over time. If β>1 is evidence for divergence, it explains that countries that are already developed in terms of financial development increase their financial development faster than the other countries.

β-1 should be between -1 and 0, providing evidence for financial development convergence. Since the derivative of β in equations (1) and (2) is not known due to the lack of theoretical formulation, it is not possible to calculate the meant financial development convergence rate. However, a

comment can be made about the (meaning) rate of convergence: the smaller the β, the larger the absolute value β-1, and thus the higher the rate of convergence. In addition, macroeconomic control variables are expected to contribute to financial convergence in bank- and stock market-based financial development indicators. Table 2 contains information on the variables and their sources used to analyze financial convergence in terms of the banking and stock market sectors.

Table 2. Variables Used for Financial Convergence

Variables	**Descriptions**	**Reference**
Banking Market-Specific Variables		
LL	Liquid Liability/% of GDP	World Bank, World Development Indicators
PSC	Private credit by deposit money bank % of GDP	World Bank, World Development Indicators
CBA	Central Bank assets /% of GDP	World Bank, World Development Indicators
DBA	Deposit Bank assets/ % of GDP	World Bank, World Development Indicators
LERNER	Lerner Index	World Bank, World Development Indicators
Capital Market-Specific Variables		
SMTV	Stock market trading volume /% of GDP	World Bank, World Development Indicators
SMTR	Stock market turnover/ % of GDP	World Bank, World Development Indicators
SMCR	Stock market capitalization / % of GDP	World Bank, World Development Indicators
SMV	Stock market volatility	World Bank, World Development Indicators
Control Variables		
TO	Trade Openness ratio	World Bank, World Development Indicators
GGDPC	GDP growth rate per capita	World Bank, World Development Indicators
INF	Inflation rate	World Bank, World Development Indicators

Source: Created by the author.

Created dynamic panel data equations for the banking market and the stock market sector are given below to show the convergence with the financial development indicators:

$$FD_{it} = \beta FD_{it-1} + \mu_i + \tau_t + \varepsilon_{i,t} \quad (3)$$

$$FD_{it} = \beta FD_{it-1} + \gamma X_{it} + \mu_i + \tau_t + \varepsilon_{it} \quad (4)$$

The variable on the left FD_{it} represents bank financial development indicators and alternatively stock market financial development indicators for country i in period t with 3-year averaged data. β on the right is the coefficient of the 3-year average financial development variable for the previous period. β is expected to be between 0 and 1, indicating that financial development grows faster in countries/periods with a lower level of financial development. β=1 indicates that the level of change in financial development in these countries does not change over time, that means it is constant. β>1 is evidence for divergence and shows that the financial development rate change of developed countries in terms of financial development increases faster.

$\mu_i \; and \; \tau_t$ indicators country-specific effects and time-specific effects, respectively. In addition, control variables such as trade openness, inflation rate, gross domestic product per capita growth rate, which have the potential to affect the convergence of financial development, were used. X_{it} and γ are the vector of control variables and their coefficients, respectively. Finally, ε_{it} is the temporary error term. Structurally, there is an inherent problem due to the simultaneous existence of the country-specific effect (μ_i) and the lagged dependent variable. It was defined as $\mu_i + \tau_t + \varepsilon_{it} = \mathrm{u}_{i,t}$ to illustrate this endogeneity problem. Then it turns out that $E(\mathrm{u}_{i,t} / FD_{it}) \neq 0$. This is because $\beta FD_{it-2} + \gamma X_{i,t-1} + \mathrm{u}_{i,t-1}$ and also $\mathrm{u}_{i,t-1}$ $\mathrm{u}_{i,t}$ contains μ_i .

In other words, the strict exogeneity hypothesis that excludes the error term for the explanatory variables is rejected because the lagged dependent variable is correlated with the error term. To overcome this problem and to check the endogeneity of other explanatory variables, the System GMM approach was used, which creates a system that includes lagged differences and lagged variable levels as tools in the level equation and the first differenced equation, respectively. Even after removing country-specific effects from the regression with the first difference transformation of equation (2), there is still the possibility that past shocks will predict current regressors.

According to Arellano and Bond (1991), this deviation can be overcome with the following two assumptions.

$$E(X_{i,t-s}\ (\varepsilon_{i,t}\ -\varepsilon_{i,t-1}))=0 \text{ for } s \geq 2;\ t=3,\ldots,n \quad (5)$$

$$E(FD_{it-s}\ (\varepsilon_{i,t}\ -\varepsilon_{i,t-1}))=0 \text{ for } s \geq 2;\ t=3,\ldots,n \quad (6)$$

However, Blundell and Bond (1998) showed that when explanatory variables stay constant over time, the lagged levels of these variables are weak tools for the first-differenced regression equation. This is likely to result in biased coefficients and the problem is often exacerbated in small samples. Blundell and Bond's (1998) solution is to construct a system that includes lagged differences and lagged variable levels as tools in the level equation and the first differenced equation, respectively. There are additional moment conditions as follows.

$$E((FD_{it-s}\ -FD_{it-s-1})\ (\mu_i\ +\varepsilon_{i,t}\ =0))=\ 0 \text{ for } s=1 \quad (7)$$

$$E((X_{i,t-s}\ -\ X_{i,t-s-1})\ (\mu_i\ +\varepsilon_{i,t}\ =0))=\ 0 \text{ for } s=1 \quad (8)$$

The moment conditions given in equations (5) (6) (7) and (8) are used to obtain system GMM estimates. To validate the instruments, the standard Hansen (1982) over-identification test is used; where H_0 hypothesis is that the instrumental variables are not correlated with the error term. Serial correlation test is applied, which indicates that there is no 2nd degree correlation in the error term of the H_0 hypothesis. Arellano-Bond test for autocorrelation (Arellano and Bond, 1991) has the H_0 hypothesis that there is no autocorrelation. In the first differences, the tests for the AR (1) process reject the H_0 hypothesis, because $\Delta\varepsilon_{i,t} = \varepsilon_{i,t} - \varepsilon_{i,t-1}$ and $\Delta\varepsilon_{i,t-1} = \varepsilon_{i,t-1} - \varepsilon_{i,t-2}$ both have $\varepsilon_{i,t-1}$. However, in first differences, the AR (2) test is more important as it detects level autocorrelation. Also, as a rule of thumb, the number of instruments should be less than or equal to the number of groups to avoid finite sample deviation caused by overfitting (Yetkiner, 2017).

3. EMPIRICAL RESULTS

Under this heading, the existence of financial convergence in terms of banking and capital market criteria in OECD countries in the period 1994-2017 will be examined. Models to be estimated for this purpose, has been formed in two groups as bank sector and capital market. Variables used to

measure financial convergence for OECD countries, the ratio of liquid liability to GDP, the ratio of credit to the private sector by deposit bank to GDP, the ratio of central bank assets to GDP, the ratio of deposit bank assets to GDP, Lerner index, stock market trading volume to GDP, stock market turnover to GDP, stock market capitalization to GDP, stock market volatility, trade openness rate, per capita GDP growth rate, inflation rate (explanations on the variables are given in Table 2).

Table 3 contains descriptive statistics for the mentioned variables for OECD countries. According to Table 3, the average ratio of liquid liability to GDP in OECD countries for the period 1994-2017 is 91.86%, and the ratio of domestic credits to the private sector to GDP is 83.08% for the same period. In terms of capital markets, the average ratio of OECD countries' stock market turnover to GDP for the period 1994-2017 is 62.76%, and the average of the ratio of stock market turnover to GDP is 69.06%. In OECD countries, the average ratio of central bank assets to GDP is 3.32%, while the average ratio of deposit bank assets to GDP is 96.53%. In addition, in the 1994-2017 period, the average trade openness rate of OECD countries is 87.78%, the average GDP growth rate per capita is 2.09%, and the average inflation rate is 3.93%. When the skewness values are examined, the skewness value of the LERNER variable is negative and the skewness values of the other variables are positive. Accordingly, the LERNER variable is skewed to the left, and the other variables are skewed to the right. It is seen that the kurtosis values of all variables are greater than 3. Accordingly, all variables have a sharp distribution.

Table 3: Descriptive Statistics for OECD Countries

	LL	PSC	SMTV	SMTR	CBA	DBA	SMCR	LERNER	SMV	TO	GGDPC	INF
Average	91.86260	83.08152	62.76964	69.06130	3.327690	96.53079	43.98862	0.200982	20.79036	87.78473	2.092343	3.939477
Median	69.26318	78.83832	51.91243	58.10808	1.015875	93.51463	25.46233	0.190708	19.35368	70.56760	1.882299	2.172716
Maximum	874.4180	242.7683	240.4577	341.2360	63.73813	245.2947	258.3273	0.494474	59.19910	399.7013	11.15796	91.58015
Minimum	21.82807	12.69363	1.735887	0.154789	1.10E-13	15.38040	0.076119	-0.433804	8.261490	17.10282	-6.383617	-0.947670
Standard Deviation	105.8594	41.78997	46.63975	53.72204	6.554497	43.90055	49.24058	0.104157	8.082597	53.68353	2.101164	8.565436
Skewness	5.340914	0.606972	1.194042	1.430207	5.099898	0.588564	1.806782	-0.535874	1.474613	2.385122	-0.471818	7.365564
Kurtosis	34.48632	3.216154	4.499088	5.979029	38.65088	3.064930	6.555782	7.554204	6.319195	11.43861	5.298341	66.24058
Jarque-Bera	12528.89	17.23098	90.10239	193.3079	15583.58	15.75161	291.2829	248.0801	223.4366	1064.940	69.95864	47785.61
Probability	0.000000	0.000181	0.000000	0.000000	0.000000	0.000380	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

In the Breusch-Pagan LM, Pesaran CD LM1, Pesaran CD LM2 and Pesaran CD tests applied for the LL, PSC, CBA, DBA, SMTV, SMTR, SMCR, TO, GGPDC and INF variables, it is seen that the null hypothesis was rejected at the 5% significance level. Therefore, there is a cross-sectional dependency in the variables in question. To examine the stationarity of the variables, it is necessary to use second-generation panel unit root tests that allow cross-sectional dependency. Therefore, the stationary of the variables used in the study was investigated using the Pesaran CADF unit root test. When the Pesaran unit root test results are examined, it can be expressed that the variables are stationary at their level values. Delta homogeneity test was applied to test the homogeneity in the models created. For the models created, it is seen that the null hypothesis, which expresses that all slope coefficients are identical across cross-section units at the 5% significance level, cannot be rejected. This result indicates that the slope coefficients for all models are homogeneous.

The results of the F test and Breusch-Pagan LM test, which are applied to examine the unobservable heterogeneity in the models created to examine financial convergence in terms of the banking and stock market sectors are included. According to the results of the F test, it is observed that the null hypothesis, which states that the unit effects are equal to zero, is rejected for all models created to examine financial convergence in terms of the banking and the stock market sectors. This result reveals the existence of unit effects. According to the results of the F test, it is observed that the null hypothesis, which states that the unit effects are equal to zero, is rejected for all created models that are examined financial convergence in terms of the banking sector and the stock market sector. This result reveals the existence of unit effects. According to the results of the Breusch-Pagan LM test, it is seen that the null hypothesis, which states that the variance of the random unit effects is zero, is rejected for all models created to determine financial convergence in terms of the banking sector and the stock market. This result indicates that unit effects are valid. To apply the system GMM method, there should be no correlation between units. In the thesis, Friedman's cross-section dependency test was applied to examine the correlation between units on a model basis. This test is used when N>T. When the results are examined, it is observed that the null hypothesis stating that there is no correlation between units cannot be rejected. This result reveals that there is no correlation for all models for the units.

When the results in Table 4 are examined, it is stated that the one-period lagged liquid liability variable (LL(-1)) is statistically significant between 0 and 1 for all models and at the 5% significance level. This result shows that there is strong convergence in OECD countries in terms of the banking sector. The absolute convergence coefficient was obtained as 0.8964. With the addition of control variables, it is observed that the conditional convergence coefficients decrease and thus the convergence rate increases. It is observed that the central bank assets variable (CBA) has a statistically significant and positive effect on the liquid liability at the 5% significance level. Deposit bank assets (DBA) have a positive effect on liquid liability. While trade openness has an increasing effect on liquid liability, growth in GDP per capita has a decreasing effect on liquid liability. The inflation rate variable on the other hand, has a positive effect on liquid liability. In the study, it was observed that the Lerner index, which is believed to affect financial convergence in the banking sector for OECD countries, does not have a significant effect on the banking sector of OECD countries when considering added liquid liability. This was observed in Model 7, where the dependent variable is LL. Based on

the robust Hansen test results for Model 1, Model 2, Model 3, Model 4, Model 5, Model 6, and Model 7, over-identification restrictions are valid. According to the results of the difference Hansen test used to test the exogenity of the instrumental variables, the null hypothesis cannot be rejected, and the tools used in the regression of the instrumental variables are valid. According to the autocorrelation test results of Model 1, Model 2, Model 3, Model 4, Model 5, Model 6 and Model 7, it is observed that there is first-order autocorrelation in all models, but there is no second-order autocorrelation. Hence, GMM estimators are efficient. According to the Wald test results of the models, the models are significant.

According to the results in Table 4, the coefficient of one period lagged variable (PSC(-1)) of the variable of domestic credits to the private sector is between 0 and 1 in all models and is statistically significant at the 5% significance level. In other words, there is a strong financial convergence in the banking sector in terms of credits to the private sector for OECD countries. The absolute convergence coefficient was obtained as 0.8449. It is observed that the conditional convergence coefficients decrease and the convergence rate increases with the addition of control variables. Central bank assets (CBA) and deposit bank assets (DBA) have an increasing effect on credits given to the private sector. Similarly, it is identified that trade openness and per capita GDP growth rate increase the credits given to the private sector. The inflation rate, on the other hand, has a negative effect on credits given to the private sector. Adding control variables to the model increases the speed of financial convergence in terms of the banking sector in OECD countries. Similarly, when the Lerner index is added to Model 14 when credits to the private sector are taken into account, it is identified that the rate of financial convergence decreases slightly (convergence coefficient increases). The Lerner index has a reducing effect on credits given to the private sector. Based on the robust Hansen test results for Model 8, Model 9, Model 10, Model 11, Model 12, Model 13, and Model 14, over-identification restrictions are valid. According to the results of the Difference Hansen test used to test the exogenity of the instrumental variables, the null hypothesis cannot be rejected, and the tools used in the regression of the instrumental variables are valid. According to the autocorrelation test results of Model 8, Model 9, Model 10, Model 11, Model 12, Model 13 and Model 14, it is observed that there is first-order autocorrelation in all models, but there is no second-order autocorrelation. The absolute convergence coefficient was obtained as 0.7462. With the inclusion of control variables, it is observed that the conditional

convergence coefficients decrease and the convergence rate increases. Stock market capitalization has a positive effect on stock market trading volume in all models. The inflation rate (excluding Model 5), GDP growth rate per capita and trade openness (excluding Model 4, Model 5) have positive effects on stock market trading volume. In Model 6, in which stock market volatility is added in Table 4, it is seen that there is financial convergence in OECD countries in terms of capital markets. However, stock market volatility affects the variable negatively and increases the speed of financial convergence when the stock market transaction volume is taken as the dependent variable in terms of capital markets in OECD countries. Based on the robust Hansen test results for Model 1, Model 2, Model 3, Model 4, Model 5, and Model 6, over-identification restrictions are valid. According to the results of the difference Hansen test used to test the exogenity of the instrumental variables, the null hypothesis cannot be rejected, and the tools used in the regression of the instrumental variables are valid. According to the autocorrelation test results of Model 1, Model 2, Model 3, Model 4, Model 5 and Model 6, it is observed that there is first-order autocorrelation in all models, but there is no second-order autocorrelation. Hence, GMM estimators are efficient.

Table 4: Financial Convergence in Terms of Banking Sector (Dependent Variable: LL, PSC)- Arellano and Bover/Blundell and Bond's Two-Stage System Generalized Moments Estimation Results (OECD Countries)

	Constant	LL (-1)	PSC(-1)	CBA	DBA
Model 1	0.2183 (0.000)	0.8964*** (0.000)			
Model 2	0.2392 (0.000)	0.8860*** (0.000)		0.0033** (0.022)	
Model 3	0.0890 (0.000)	0.8413*** (0.000)		0.0018*** (0.000)	0.1190*** (0.000)
Model 4	-0.0201 (0.330)	0.8147*** (0.000)		0.0032*** (0.000)	0.1353*** (0.000)
Model 5	-0.0039 (0.865)	0.8076*** (0.000)		0.0041*** (0.000)	0.1168*** (0.000)
Model 6	-0.0278 (0.260)	0.8117*** (0.000)		0.0036*** (0.008)	0.1272*** (0.000)
Model 7	-0.0269 (0.260)	0.8118*** (0.000)		0.0037*** (0.000)	0.1262*** (0.000)
Model 8	0.3177*** (0.000)		0.8449*** (0.000)		
Model 9	0.3514**** (0.000)		0.8268*** (0.000)	0.3514*** (0.002)	
Model 10	-0.2597*** (0.000)		0.1686*** (0.000)	0.0047*** (0.000)	0.9382*** (0.000)
Model 11	-0.3401*** (0.000)		0.1540*** (0.000)	0.0051*** (0.000)	0.9541*** (0.000)
Model 12	-0.3578*** (0.000)		0.1597*** (0.000)	0.0043*** (0.000)	0.9631*** (0.000)
Model 13	-0.3259** (0.000)		0.1466*** (0.000)	0.0049*** (0.000)	0.9619*** (0.000)
Model 14	-0.3072*** (0.000)		0.1488*** (0.000)	0.0047*** (0.000)	0.9640*** (0.000)

Wald Test	Difference Hansen	Hansen	AR(2)	AR(1)	LERNER	INF	GGDPC	TO
0.00	0.60	28.88	-1.38	-2.11^{***}				
0.00	0.40	28.82	-1.35	-2.13^{**}				
0.00	0.49	31.75	-1.43	-2.10^{**}				
0.00	1.63	30.29	-1.29	-2.12^{***}				(0.000) 0.0673^{***}
0.00	2.92	29.96	-1.31	-2.05^{**}			(0.000) -0.0055^{***}	(0.000) 0.0856^{***}
0.00	2.67	29.66	-1.30	-2.05^{**}		(0.016) 0.0008^{***}	(0.000) -0.0050^{***}	(0.000) 0.0856^{***}
0.00	2.73	29.60	-1.31	-2.05^{**}	((0.0549	(0.024) 0.0008^{**}	(0.000) -0.0050^{***}	(0.000) 0.0854^{***}
0.00	0.35	31.52	-0.77	-2.43^{**}				
0.00	1.24	31.51	-0.65	-2.41^{**}				
0.00	2.97	29.24	1.43	-1.56^{*}				
0.00	2.81	29.95	1.71	-1.56^{*}				(0.000) 0.0398^{***}
0.00	3.43	30.10	-1.47	2.35^{**}			(0.000) 0.0036^{***}	(0.000) 0.0294^{***}
0.00	3.51	29.94	-1.47	-2.47^{***}		(0.000) -0.0012^{***}	(0.000) 0.0033^{***}	(0.000) 0.0292^{***}
0.00	3.37	28.81	-1.48	2.41^{***}	(-0.0513^{***}	(0.000) -0.0013^{***}	(0.000) 0.0033^{***}	(0.000) 0.0221^{***}

Note: *,,*** indicate significance levels at 10%, 5% and 1% significance levels, respectively. The numbers in parentheses indicate the probability value.**

In terms of stock markets, the results of Model 1, Model 2, Model 3, Model 4, Model 5 and Model 6, Model 7, Model 8, Model 9, Model 10, Model 11 and Model 12, which were created to examine financial convergence in OECD countries are shown in Table 5. According to the results in Table 5, the coefficient of the lagged stock market trading volume (SMTV) variable for all models is between 0 and 1 and is statistically significant at the 5% significance level. Accordingly, it shows that there is financial convergence in terms of capital markets in OECD countries. The absolute convergence coefficient was obtained as 0.7462. With the inclusion of control variables, it can be seen that the conditional convergence coefficients decrease and the convergence rate increases. Stock market capitalization has a positive effect on stock market trading volume in all models. Inflation rate per capita, GDP growth rate and trade openness has positive effects on stock market trading volume. In Model 6, in which stock market volatility is added in Table 5, it is observed that there is financial convergence in OECD countries in terms of capital markets. However, stock market volatility increases the rate of financial convergence in OECD countries when stock market trading volume is taken as the dependent variable in terms of capital markets. Based on the robust Hansen test results for Model 1, Model 2, Model 3, Model 4, Model 5, and Model 6, over-identification restrictions are valid. According to the results of the difference hansen test used to test the exogenity of the instrumental variables, the null hypothesis cannot be rejected, and the tools used in the regression of the instrumental variables are valid. According to the autocorrelation test results of Model 1, Model 2, Model 3, Model 4, Model 5 and Model 6, it is observed that there is first-order autocorrelation in all models, but there is no second-order autocorrelation. Hence, GMM estimators are efficient.

In the results in Table 5, the convergence rate of the lagged stock market turnover ratio variable (SMTR) is between 0 and 1 in all models. The stock market turnover rate in the capital market converges in OECD countries. The absolute convergence rate coefficient is 0.8138. With the addition of control variables, the conditional convergence coefficients decrease and the convergence rate increases. Stock market capitalization has an increasing effect on stock market trading volume. Trade openness affects stock market turnover negatively, while GDP growth rate per capita and inflation rate affect stock market turnover positively. In Model 12, in which stock market volatility is added in Table 5, it is seen that there is financial convergence in OECD countries in terms of capital markets. On the other hand, stock market

volatility increases the rate of financial convergence in OECD countries when stock market turnover rate is taken as the dependent variable in terms of capital markets. Stock market volatility creates an effect that reduces the stock market capitalization rate and increases the stock market turnover rate. Based on the robust Hansen test results for Model 7, Model 8, Model 9, Model 10, Model 11, and Model 12, over-identification restrictions are valid. According to the results of the difference hansen test used to test the exogenity of the instrumental variables, the null hypothesis cannot be rejected, and the tools used in the regression of the instrumental variables are valid. According to the autocorrelation test results of Model 7, Model 8, Model 9, Model 10, Model 11 and Model 12, it is observed that there is first-order autocorrelation in all models, but there is no second-order autocorrelation. Hence, GMM estimators are efficient. According to the Wald test results, the models are significant.

4. DISCUSSION

Which of the financial development criteria causes an increase in the rate of convergence and which indicators are the most effective regarding the convergence trend have been determined in this study. In addition, the issue of whether financial convergence is a result of non-financial factors and whether the financial sector criteria of countries with relatively low income within the regions tend to converge to high-income countries will be examined in another study under the effects of other factors on financial convergence and club convergence.

Cloud computing, blockchains, cryptocurrencies and artificial intelligence applications include new technologies to be used in financial systems. Initially, algorithmic trading came with the promise of using faster and cheaper technologies to significantly reduce execution costs and improve price discovery for key market participants. What is needed is "Financial Regulation 2.0," which lays out a set of regulatory principles that supports cyber-centric transparency, enables the creation of additional risk measures, and encourages the implementation of risk management processes and workflows, particularly allowing human knowledge to complement the computational capabilities of machines. Blockchain technology is publicly available, based on proven cryptographic principles, easily applicable and truly global. It can be applied in many ways, including clearing and settlement, record keeping, market design, trade finance, borrowing and lending.

Although it is estimated that financial development between countries will diverge due to the slowdown of the financial markets and economic growth by Covid 19, it is estimated that financial convergence may lead to convergence between the economies of countries with this technology, as digital technologies reduce transaction costs and facilitate access to financial intermediaries. It remains unclear in which direction financial convergence will move in financially underdeveloped or developing countries that cannot integrate with the technologies.

CONCLUSION

Financial convergence is realized at a high rate in OECD countries. Most of the countries within OECD economic integration are countries with high macroeconomic performance, financial stability and low risks. The banks

with the largest assets in the world, excluding China, are located in America, England, Japan, France, Germany and Canada. Because the financial system is more developed in countries with financial development levels above a certain critical value in economically integrated OECD countries, the increase in the rate of financial convergence in the banking sector as control variables are added and it is compatible with our hypothesis because the initial structural characteristics of these countries are similar. Despite the decrease in the number of listed companies, the ratio of the total market value of listed companies to GDP has increased in many developed economies in recent years. This is largely because these markets are home to fewer larger companies. For example, the average market value of listed companies in the USA has doubled in real terms in the last two decades (OECD, 2019). The presence of large companies in the system causes the credits given to the private sector in OECD countries to be used in productive projects, causes the funds to be distributed effectively and accelerates the speed of convergence.

For OECD countries, the priority is to improve existing ones and adapt to the new world system rather than new regulations. In line with the new financial markets, the use of digital financial services has increased in OECD countries, but at the same time, the risks of digital services such as identity theft and fraud have increased. As household incomes decreased after Covid 19, providing necessary information to customers about available remittance options and increasing competition can reduce costs. Setting global targets such as speed, transparency and access to financial instruments to regulate international payments will make things easier. Ensuring coordination with the new normals in regulation, supervision and surveillance frameworks, improving the infrastructures of existing payment systems, and strengthening payment systems on the international platform will support providing added value to all world economies. Governments and development finance institutions should support capital market development by promoting the supply and demand for securities, especially long-term debt instruments.

REFERENCES

Acemoglu, D., Simon J., Robinson, J. A. and Yared, P. (2008). "Income and Democracy." American Economic Review. Volume 98, No:3, 808-42.

Aghion, P., Bacchetta, P., Banerjee, A.V. (2004). "Financial Development and the instability of open economies". Journal of Monetary Economics. Volume 51, Issue 6, 1077-1106.

Allen, F. ve Gale, D. (1999). "Diversity of Opinion and Financing of New Technologies". Journal of Financial Intermediation. Volume 8, 68–89.

Antzoulatos, A. A., Panopoulou, E., Tsoumas, C. (2011). "Do Financial Systems Converge?". Review of International Economics, Volume 19, Issue 1, 122-136.

Apergis, N., Christou, C., Miller, S. M. (2011). "Convergence Patterns in Financial Development: Evidence from Club Convergence". Working Papers 1104, University of Nevada, Las Vegas, Department of Economics.

Arellano, M., Bond, S. (1991). "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations". Rev. Econ. Stud. Volume 58, Issue 2, 277-297.

Arellano, M., Bover, O. (1995). "Another look at the Instrumental Variable Estimation of Errorcomponents Models". Journal of Econometrics. Volume 68, No:1, 29–51.

Arestis, P. ve Demetriades, P. (1997). "Financial Development and Economic Growth: Assesing the Evidence". Economic Journal. c. 107, 442, 783-799.

Asongu, S., (2012). "How Has Mobile Banking Stimulated Financial Development in Africa?" African Governance and Development Institute. WP/12/027.

Bahadır, B., Valev, N. (2015). "Financial Development Convergence". Journal of Banking and Finance. Elsevier, Volume 56(C), 61-71.

Barro, R. J. (1991). "Economic Growth in a Cross Section of Countries". Quarterly Journal of Economics 106, 407–443.

Barro, R. J., Sala-I-Martin, X. (1995). "Economic Growth". McGraw Hill, New York.

Bems, R., Schellekens, P. (2007). "Finance and Convergence: What's Ahead for Emerging Europe?". IMF Working Paper, No: 07/244, International Monetary Fund.

Berglöf, E. (1990). "Capital Structure as a Mechanism of Control: A Comparison of Financial Systems". In: Aoki, M. et al. (eds.), The Firm as a Nexus of Treaties, London, 237-262.

Blundell, R., Bond, S. (1998). "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models". Journal of Econometrics, Volume 87, 115–143.

Bruno, G., De Bonis, R., Silvestrini, A. (2012). "Do Financial Systems Converge? New Evidence from Financial Assets in OECD Countries". Journal of Comparative Economics, Volume 40, 141- 155.

Calcagnini, G., Farabullini, F., Hester, D. D. (2000). "Financial Convergence in the European Monetary Union?" (November 2000). U of Wisconsin at Madison,

SSRI Economics Dept. WP, Available at SSRN: https: //ssrn.com/abstract =253358.

Canarella G., Miller, S. M., Pollard, S. K. (2011). "The Global Financial Crisis and Stochastic Convergence in the Euro Area". International Atlantic Economic Society.

Cobham, D., Serres, J. M. (2000). "A Characterization of the French Financial System". Manchester School, Volume 68, 44-67.

Dekle, R., Pundit, M. (2016). "The Recent Convergence of Financial Development in Asia". Emerging Markets Finance and Trade, 52:5, 1106-1120, DOI: 10.1080/1540496X. 2015.1103142.

Dobson S., Ramlogan, C. (2002). "Economic Growth and Convergence in Latin America". Journal of Development Studies, Volume 38, No:6, 83-104.DOI: 10.1080/00220380412331322591.

Dosi, G. (1990). "Finance, Innovation and Industrial Change". Journal of Economic Behavior and Organization, Volume 13, 299-319.

Elmslie, B. T., (1995). "The Convergence Debate Between David Hume and Josiah Tucker". Journal of Economic Perspectives, Volume 9, No:4, 207–16.

Fung, M. K., (2009). "Financial Development and Economic Growth: Convergence or Divergence?". Journal of International Money and Finance, Volume 28, Issue 1, 56-67.

Gallizo, J. L., Moreno J., Salvador, M. (2016). "Banking Efficiency in the Enlarged European Union: Financial Crisis and Convergence". https://doi.org/10.1111/infi.12083.

Galor, O., Mountford A. (2006). "Trade and the Great Divergence: The Family Connection". American Economic Review, Volume 96, 229-303.

Gelbard, E. A., Pereira, L. S. (1999). "Measuring Financial Development in Sub-Saharan Africa". IMF Working Paper, No: WP/99/105, August.

Gerschenkron, A. (1952). "Economic Backwardness in Historical Perspective. In B. F. Hoselitz (eds.). The Progress of Underdeveloped Areas. Chicago, IL: University of Chicago Press, 3–29.

Grabel, I. (1997). "Savings, Investment, and Functional Efficiency: a Comparative Examination of National Financial Complexes". In: R. Pollin (ed): The Macroeconomics of Savings, Finance and Investment. Ann Arbor: University of Michigan Press.

Gregorio, J. D., Guidotti, P. E. (1995). "Financial Development and Economic Growth". World Development, C. 23, S. 3, 433-448.

Gupta, K. L. (1984). "Finance and Economic Growth in Developing Countries". London: Croom Helm.

Hansen, L. (1982). "Large Sample Properties of Generalized Method of Moments Estimators". Econometrica, 1982, Vol. 50, Issue 4, 1029-54.

Heimonen, K. (2010). "Money and Equity Returns in the Euro Area". Global Finance Journal, Volume 21, Issue 2, 152–169.

Herrmann S., Winkler, A. (2009). "Real Convergence, Financial Markets, and the Current Account- Emerging Europe versus Emerging Asia". European Economy- Economic Papers 2008- 2015, 362, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Hölz, W. (2003). "Convergence of Financial Systems: Towards An Evolutionary Perspective". Working Papers Series: Growth and Employment in Europe.

Hristov K., Rozenov, R. (2009). "Financial Convergence in the New EU Member States, Project Funded under the Socio-economic Sciences and Humanities". Working Paper, D.1.2.

Hume, D. [1742] (1985). "Of the Rise and Progress of the Arts and Sciences (1742)." In David Hume, Essays: Moral, Political and Literary. Edited by Eugene F. Miller. Indianapolis: Liberty Fund.

Ibrahim, J., Habibullah, M. S. (2013). "Financial Convergence in the Asia Pacific Economies". Prosiding Perkem VIII, Jilid 2, 1051 – 1058. ISSN: 2231-962X.

Kar, M. ve Pentecost, E., (2000). "The Direction of Causality Between Financial Development and Economic Growth in Turkey: Further Evidence", Economic Research Paper, Department of Economics, Loughborough University, No. 00/27, Loughborough.

King, R. G., Levine, R. (1993a). "Finance and Growth: Schumpeter must be Right". Quarterly Journal of Economics, Volume 108, 717–737.

Khor, M. (2001). "Rethinking Globalization: Critical Issues and Policy Choices, Zed Books, London.

Leon, F. (2018). "Convergence of Credit Structure around the World". Economic Modelling**,** Volume 68, 306-317.

Levine, R. (1997). "Financial Development and Economic Growth: Views and Agenda". Journal of Economic Literature, Vol. 35, No:2.

Lynch, D. (1996). "Measuring Financial Sector Development: A study of Selected Asia-Pacific countries". The Developing Economies, Volume 34, March: 3–33.

Mankiw, N. G., Romer, D., Weil, D. N. (1992). "A Contribution to the Empirics of Economic Growth". The Quarterly Journal of Economics, Vol. 107, 407-437.

Maxfield, S., Winecoff, W. K., Young, K. (2017). "An Empirical Investigation of the Financialization Convergence Hypothesis". Review of International Political Economy, Volume 24, No:3, 1-26.

Murinde V., Agung, J.and Mullineux, A. (2004). "Patterns of Corporate Financing and Financial System Convergence in Europe". Review of International Economics, Volume,12, No:4, 693–705.

Nitoi, M., Pochea, M. M. (2016). "Testing Financial Markets Convergence in Central and Eastern Europe: A Non-linear Single Factor Model". Economic Systems Volume 40, Issue 2, June 2016, 323-334.

Odedokun, M. O. (1989). "Causalities Between Financial Aggregates and Economic Activities in Nigeria: The Results from Granger's Test". Savings and Development, C. 23, S. 1, 101-111.

OECD (2019). "Financing Infrastructure in APEC Economies". APEC/OECD Report on Selected Effective Approaches.

Rajan, R. G., Zingales, L. (1995). "What Do We Know about Capital Structure? Some Evidence from International Data, Journal of Finance, Volume 50, 1421-1460.

Rajan, R. G., Zingales, L. (1998a). "Financial Dependence and Growth," American Economic Review, Volume 88, Issue 3.

Rajan, R. G., Zingales, L. (1998b). "Which Capitalism? Lessons from the East Asian Crisis". Journal of Applied Corporate Finance, Volume 11, No. 3, 40–48.

Ramirez, G. L., Skott, P. (2018). "Credit Constraints and Economic Growth in a Dual Economy". Structural Change and Economic Dynamics. Volume 45, 64-76.

Ryzbczinski, T. (1985). "Financial Systems, Risk and Public Policy". The Royal Bank of Scotland Review, December, 35-45.

Sachs, J., Warner, A. M. (1995). "Economic Convergence and Economic Policies". NBER Working Paper, No. 5039.

Schaberg, M. (1999). "Globalization and the Erosion of National Financial Systems". Is declining Autonomy Inevitable?, Edward Elgar.

Tomova, M. (2005). "X-efficiency of European Banking: Inequality and Convergence". EcoMod 2005: International Conference on Policy Modeling, Istanbul, 29 June–1 July.

Veblen, T. (1915). "Imperial Germany and the Industrial Revolution". Macmillan, London.

Veysov, A., Stolbov, M. (2011). "Do Financial Systems Converge? A Comprehensive Panel Data Approach and New Evidence From A Dataset For 102 Countries". MPRA, No: 36103, https://mpra.ub.unimuenchen.de/36103. Erişim: 30.12.2019.

Wagner, H. (2001). "Implications of Globalization for Monetary Policy". IMF Working Paper, WP01/184, Washington, DC.

Yaseen, H. (2012). "The Convergence of Financial Institutions in GCC Countries". The Journal of Global Business Management. Volume 8, Number 1.

Yetkiner, H. (2012). "Industrial Dynamics, Innovation Policy, and Economic Growth through Technological Advancements". (Edited book, together with Erkan Erdil and Teoman Pamukçu-English). Hersher: IGI Global.

Yetkiner H., Kılınç, D., Seven, Ü. (2017). "Financial Development Convergence: New Evidence for the EU". Central Bank Review 17, 47-54.

Chapter 3

RELATEDNESS, SECTORAL HETEROGENEITY, AND REGIONAL DISPARITIES IN TURKEY: AN EMPIRICAL ANALYSIS FOR NUTS-2 REGIONS

İbrahim Tuğrul ÇINAR[1]

1 Ph. D., Department of Economics, Faculty of Economics,
Anadolu University, ORCID: 0000-0001-8913-7166, itcinar@anadolu.edu.tr

Introduction

MAR externalities, with reference to Marshall (1890), Arrow (1962), and Romer (1986), advocated specialization in a particular economic activity (within sector), and the externalities from diversified concentration (between sectors) advocated by Jacobs (1962), were among the issues of interest to economists as two competing knowledge spillover theories. However, this dichotomy between specialization and diversification does not fully capture the complexity of agglomeration externalities (Cortinovis and van Oort, 2015). The related and unrelated variety concept introduced by Frenken et al. (2007) allowed us to obtain additional information about agglomeration externalities by dividing sectoral diversity into related and unrelated, thus bridging this gap between MAR and Jacobs externalities (Hidalgo, 2021). Studies on related and unrelated variety continued with Saviotti and Frenken (2008) and at the regional level for Italy (Boschma and Iammarino, 2009), Great Britain (Bishop and Gripaios, 2010), Turkey (Falcıoğlu, 2011; Akgüngör et al., 2013), Spain (Boschma et al., 2012), European NUTS-2 regions (Caragliu et al., 2016), Germany (Fritsch and Kublina, 2018), Pakistan (Haq and Zhu, 2019), and for Poland (Tomasz and Pawel, 2021). Frenken et al. (2007) recognized that the effect of related and unrelated variety may be different for different sectors, although they did not take into account regional imbalances and the sectoral decomposition of economic performance. Following Frenken et al. (2007), Bishop and Gripaios (2010) revealed that the relationship between related variety and regional economic growth does not exhibit a homogeneous structure at the sectoral level. In addition, Content and Frenken (2016) backed up this finding and pointed out that the relationship between related variety and regional growth is supported in most studies, but when sectoral decomposition is included, this relationship may only be specific to some knowledge-intensive sectors.

The issues highlighted here are particularly important for policymakers for implementing much more successful policy measures. For this reason, it would be much more favorable for studies on relatedness and regional economic growth, for countries with persistent regional economic development differences, to consider the sectoral decomposition and the regional disparity phenomenon. As an example, Turkey has been struggling with regional economic inequalities for many years (Gezici and Hewings, 2004; Celebioglu and Dall'Erba, 2010; Karahasan et al., 2016; Aşık et al., 2023). One of the areas where this inequality is most noticeable is the unequal distribution of current agglomeration of production activities across regions. Istanbul, Ankara, Izmir, and Adana, defined as traditional industry centers by Eser and Köse (2005), host approximately 70% of the manufacturing workforce as the provinces where production activities in Turkey are concentrated (Eraydın, 2002; Akgüngör, 2006; Falcıoğlu and Akgüngör, 2008). For this reason, policymakers have for decades implemented various

measures to help both a more balanced distribution of economic activity within the country and for more regions to benefit from the positive externalities provided by agglomeration economies.

However, neither sectoral decomposition nor regional disparities between the east and the west were taken into account in the studies for Turkey by Falcıoğlu (2011) and Akgüngör et al. (2013). In addition, these two studies used Frenken et al.'s (2007) entropy approach for their related and unrelated variety calculations. However, as expressed by Boschma et al. (2012) and Content and Frenken (2016), the proximity measure proposed by Hidalgo et al. (2007) allows for better results for the related and unrelated variety as an ex-post approach.

This study aims to contribute to the literature in several ways. First of all, the study produces a new data set for the 2007-2020 period for 26 NUTS-2 regions of Turkey by calculating related and unrelated variety based on the proximity approach. Furthermore, it will test whether previous studies relying on ex-ante relatedness measures by Falcıoğlu (2011) and Akgüngör et al. (2013) can be validated on an ex-post measure. Finally, by taking into account regional and sectoral heterogeneity, we aim to avoid introducing "one-size-fits-all" style policy implications which, according to Dulupçu (2005) largely dominate the understanding of regional development policies in Turkey.

The rest of the study is organized as follows. In the second section, we will outline the regional disparity problem in Turkey from a historical perspective. In the third and fourth sections, the data and the analysis method will be introduced, respectively. In the fifth section, we will report the analysis findings, and the final section will be devoted to the discussions and conclusions.

Lingering Regional Disparities in Turkey: A Brief History

Regional disparities between the eastern and the western part of Turkey manifest themselves through economic indicators such as per capita income, as well as demographic indicators such as migration, literacy rate, and birth rate (see Figure 1 below).

The economic development gap between the eastern and the western regions in Turkey has existed since before World War I (Aşık et al., 2023). In the first years of the Republic in the 1920s, emphasis was placed on the reconstruction of the national economy through a state-led industrialization policy approach and therefore infrastructure investments were prioritized (Göymen, 2008). However, ethnic polarization and industrialization differences, especially started in the second half of the 20th century, caused regional imbalances to be taken seriously, and regional level planning became a priority (Dulupçu et al., 2010; Aşık et al., 2023). As a matter of fact, in the early 1960s, Turkey switched to the planned economy model and put its first five-year

development plan into practice between 1963 and 1967. In this period, the State Planning Organization (SPO) was held responsible for working to eliminate regional imbalances (Göymen, 2008). Specific policies have been implemented against regional imbalances, especially after this period. In this context, Priority Provinces for Development, which was first announced in 1968, was implemented as an important policy tool to eliminate regional economic differences. This is followed by regional incentives for investments, cross-border trade regulations for eastern and southeastern provinces, Southeastern Anatolia (GAP), and Eastern Anatolia (DAP) projects to enhance agricultural and infrastructure investments in the east, and more recently regional development agencies (Gezici and Hewings 2004; Çınar et al., 2022). However, most of these policy measures, other than GAP, DAP, and regional development agencies, have been carried out within the one-size-fits-all perspective (Dulupçu, 2005).

Efforts to benefit from positive externalities provided by agglomeration economies go back to the early years of planned development. Although these policies are not designed directly to address regional imbalances, they have contributed to increase economic growth and employment at the national and regional levels. In the 1960s first examples of agglomeration economies, Organized Industrial Zones (OIZs) that offer readily available infrastructure for producers, were implemented. The early 2000s were defined by Dulupçu et al. (2010) as the third stage of the regional policy approach in Turkey, following the state-led growth and the planned economy stages. In this period, regional policies have gained momentum thanks to the accession negotiations with the European Union. Furthermore, the successful implementation of OIZs encouraged agglomeration efforts to expand into more innovative areas by the introduction of industrial economic zones and technology development zones.

The first efforts related to clustering started in 1999 with the Competitive Advantage of Turkey (CAT) project (Sungur et al. 2013). The first clusters identified in the CAT project were tourism clusters (focusing on touristic destinations such as Sultanahmet, Fethiye, and Kuşadası), ceramics cluster (Eskişehir-Bilecik-Kütahya), and textile and ready-to-wear cluster (Çorlu) (Akgüngör, 2006; Falcıoğlu and Akgüngör, 2008).

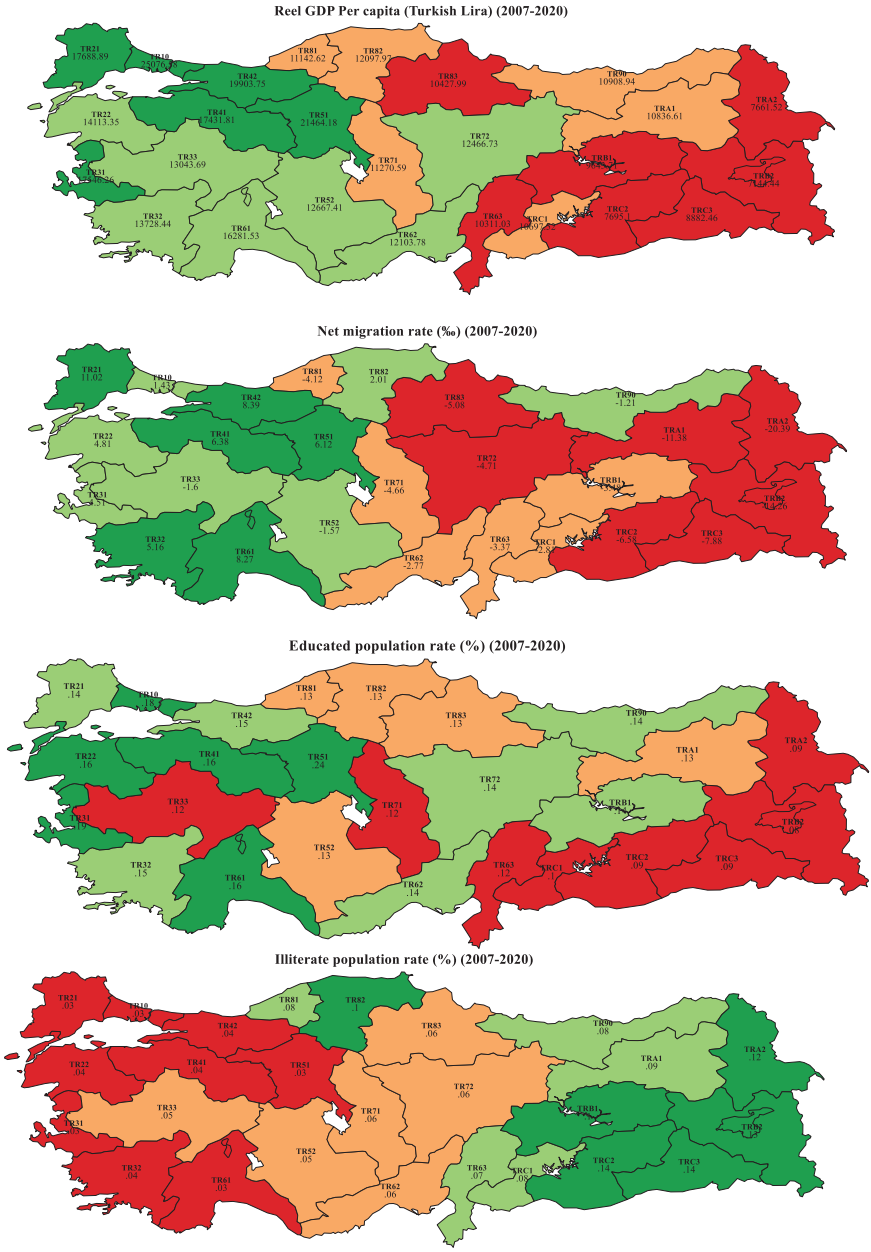

Figure 1: Average GDP per capita, net migration rate (‰), educated population rate (‰), and illiteracy rate (%) of NUTS-2 regions (2007-2020)

Finally, regional development agencies were introduced in Izmir and Adana-Mersin regions in 2006. Following 2009, they were established as organizations responsible for regional development to provide unique solutions to problems specific to their regions in all 26 NUTS-2 regions

covering 81 provinces of Turkey. Development agencies have also given importance to agglomeration and clustering. For example, Eastern Anatolia Development Agency have prepared regional clustering strategies and action plans for their region. In addition, they also support agglomeration and clustering by focusing their financial and technical support instruments on prominent sectors in their regions.

Data

We used International Trade Database at the Product Level (BACI) dataset to obtain the global proximity values. Although the BACI data set contains export data for more than 200 countries and territories, Hidalgo (2021) recommends removing countries with exports below $ 1 billion, countries with a population of less than 1 million, and products with a global export value of less than $ 500 million from the dataset to eliminate noise and thus to obtain more accurate values. In this context, after the data cleaning process, the global product proximity values were calculated over approximately 970 product groups (4-digit HS classifications) for 132 countries. Then, we used the global proximity values and the regional export dataset (4-digit HS classifications) from the Turkish Statistical Institute (TURKSTAT) to calculate related and unrelated variety from 2007 to 2020 for 26 NUTS-2 regions in Turkey.

In this study, we used employment growth and labor productivity growth as dependent variables. For labor productivity, we first converted the nominal gross domestic product (GDP) values into real terms using the Consumer Price Index (2003=100). Then, labor productivity values have been calculated as the ratio of the real GDP values to employment. Since regional employment data are available from 2009, our statistical estimations are restricted to cover the period between 2009-2020.

We also used several control variables such as education, urbanization, and capital formation. As for education, following Baldwin (1971), we used the ratio of the total number of faculty, masters, and doctoral graduates to the total population. Urbanization is calculated as the ratio of the number of non-residential buildings to the total population. TURKSTAT classifies public, entertainment, educational, health care, office, hotel, industrial buildings, and warehouses as non-residential buildings. Accordingly, we thought that the ratio of the number of non-residential buildings to the total population in a region would be a good indicator for urbanization. In addition, we also used population density as an alternative proxy for urbanization. Another control variable used in economic growth studies is the capital formation variable. This variable is not available at the regional level for Turkey. Therefore, following Moody (1974), electricity consumption per capita was used as a proxy. As an alternative, we obtained nominal tangible fixed assets data derived from the balance sheets of production facilities from the Ministry of

Industry and Technology Enterprise Information System (EIS). We first, converted this data into real values using Consumer Price Index (2003=100) and then aggregated it for NUTS-2 regions. Tangible fixed assets cover the assets such as land, buildings, machinery, and equipment which are usually held for investment purposes.

Methodology

Many factors such as labor, capital, technological sophistication, and inputs included in the value chain of a product or institutional infrastructure were counted in theory on the relatedness of products. All these elements make an a priori order of importance of relatedness (Hidalgo et al. 2007). In contrast, Hidalgo et al.'s (2007) proximity approach is based on the idea that two products most likely be produced together if they need, without attributing priority to any of them, similar institutional structures, infrastructure, input composition, technological sophistication, and thus, abandons those a priori assumptions. An important consequence of this idea is that if a country becomes capable of producing a product such as X, it will be more likely to produce Y, which is closely related to X.

In the proximity approach, Hidalgo et al. (2007) used Revealed Comparative Advantages (RCA) matrix developed by Balassa (1965) to match the relationship between economic activities and the location where these activities take place. One advantage of using RCA is that it allows for adjusting monetary effects such as prices and exchange rates, as well as seasonal effects (Hidalgo, 2021). Export data, on the other hand, is a good measure to show the industrial structure and level of specialization when production or employment data are not available. Export data can also be easily used in international comparisons as it has a standard classification at the global level (Boschma and Iammarino, 2009).

Accordingly, whether country *c* has a comparative advantage in a product such as *p* is calculated as the ratio of the share of product *p* in the total exports of country *c* to the ratio of total exports of the same product in the world in total world trade. More formally, this can be shown as in equation (1).

$$RCA_{cp} = \frac{\frac{q_{cp}}{\sum_{c} q_{cp}}}{\frac{\sum_{p} q_{cp}}{\sum_{cp} q_{cp}}},\ RCA_{cp} \geq 1 \Rightarrow RCA_{cp} = 1,\ otherwise\ RCA_{cp} = 0 \qquad (1)$$

In equation (1), RCA_{cp}, representing each element of the RCA matrix, takes the value of one if the result of the above calculation is greater than or equal to one, otherwise zero. Hidalgo et al. (2007) claim that if countries have a

comparative advantage in the export of two products such as *i* and *j* at the same time, these two products are proximate to each other. They show this by the minimum pairwise conditional probabilities of having a comparative advantage in the product *i* and *j* as shown in equation (2).

$$\varphi_{ijt} = \min\{P(RCA_{i,t}|RCA_{j,t}), P(RCA_{j,t}|RCA_{i,t})\} \quad (2)$$

Boschma et al. (2012) indicate that perhaps the most ambiguous side of the proximity approach is the lack of clarity on the value of φ. Although Hidalgo et al. (2007) do not have an explicit statement they imply that the proximity values below 0.20 can be neglected for relatedness. Thus, Boschma et al. (2012) considered two products are related if the proximity value is equal to or greater than 0.25, and unrelated otherwise. In this study, we also accepted 0.25 as the threshold proximity value for the relatedness of product pairs.

In what follows, we calculated related and unrelated variety at the NUTS-2 level by using the entropy measure. For this purpose, we first defined the related variety set, S_{ir}, for each product. S_{ir} refers to the product group composed of the rest of the products other than *i* that have a proximity value equal to or greater than 0.25 with the product *i*. The entropy values (H_r) for the related variety set can be calculated as in equation (3).

$$H_r = \sum_{i \in S_{ir}} \frac{P_i}{P_{ir}} \log_2 \left(\frac{1}{P_i/P_{ir}}\right) \quad (3)$$

In Equation (3), P_i shows the export share of product *i* in total exports of a region, while P_{ir} shows the share of the sum of exports of all products included in S_{ir} in total export of a region. Next, we can calculate the related variety index as in equation (4).

$$RV = \sum P_{ir} H_r \quad (4)$$

Equation (4), gives us the related variety (RV) values for each region and each year. For the unrelated variety values of regions, we follow the same calculation procedure except that we now defined the unrelated variety set for each product, S_{iur}, instead of the related variety set. S_{iur} refers to the product group composed of products in which product *i* have a proximity value below 0.25. Thus, following equation (5) and equation (6) below, entropy values (H_{ur}) for the unrelated variety set (S_{iur}) and unrelated variety values (URV) can be obtained.

$$H_{ur} = \sum_{i \in S_{iur}} \frac{P_i}{P_{iur}} \log_2 \left(\frac{1}{P_i/P_{iur}}\right) \quad (5)$$

$$URV = \sum P_{iur} H_{ur} \quad (6)$$

In Equation (5) and equation (6), P_{iur} shows the share of the sum of exports of products included in S_{iur} in the total exports of a region.

After obtaining the related and unrelated variety values for the 2009-2020 period, we estimate the linear models given in equation (7) and equation (8) by the fixed effects estimator. Fixed effects is an appropriate specification if we are focusing on a specific set of firms, regions, or countries and our inference is restricted to the behavior of these sets (Baltagi, 2021: 16). Alternatively, following Caselli et al. (1996), we also estimate equation (7) and equation (8) by the System General Method of Moment (GMM) estimator to overcome the possible endogeneity problem.

$$\ln Em_{i,t+1} - \ln Em_{i,t} = \beta_0 + \beta_1 \ln Em_{i,t} + \beta_2 RV_{i,t} + \beta_3 URV_{i,t} + \beta_4 E_{i,t} + \beta_5 U_{i,t} + \beta_6 C_{i,t} + \beta_7 Dagr + \beta_8 East + \varepsilon_{i,t} \quad (7)$$

$$\ln Lp_{i,t+1} - \ln Lp_{i,t} = \beta_0 + \beta_1 \ln Lp_{i,t} + \beta_2 RV_{i,t} + \beta_3 URV_{i,t} + \beta_4 E_{i,t} + \beta_5 U_{i,t} + \beta_6 C_{i,t} + \beta_7 Dagr + \beta_8 East + \varepsilon_{i,t} \quad (8)$$

In equation (7) and equation (8) *Em*, *Lp*, *RV*, and *URV* represent employment, labor productivity, related variety, and unrelated variety, respectively. The log differences in the equations give the growth of relevant variables for subsequent years. As for our control variables, *E* represents education, *U* represents alternative, population density and the ratio of non-residential buildings to population, urbanization variables. *C* stand for the alternative, per capita electricity consumption and tangible fixed assets, capital formation variables.

Equation (7) and equation (8) are extended in two ways. First, we wanted to test whether there is a difference between the eastern and western regions in Turkey. To do that, we used a dummy variable, *East*, which takes the value of one for the regions located in the east and zero for the other regions. Although the regional development gap between the eastern and western regions in Turkey has been an important agenda for policymakers for a very long time, no formal definition or geographical representation of the eastern and western regions has been made so far. However, Ankara, the capital of Turkey, is generally accepted as the geographical reference and the regions in the east of Ankara are considered underdeveloped eastern regions and others as western regions (Özyıldırım and Özlem, 2008). The east-west classification by Dulupçu (2005), over seven geographical regions of Turkey is also very much overlap with Özyıldırım and Özlem (2008). Following Özyıldırım and ÖzIem (2008), our *East* dummy takes the value of one for 13 regions on the east and zero for 13 regions on the west. The geographical representation of the East dummy is shown in Figure 2 below.

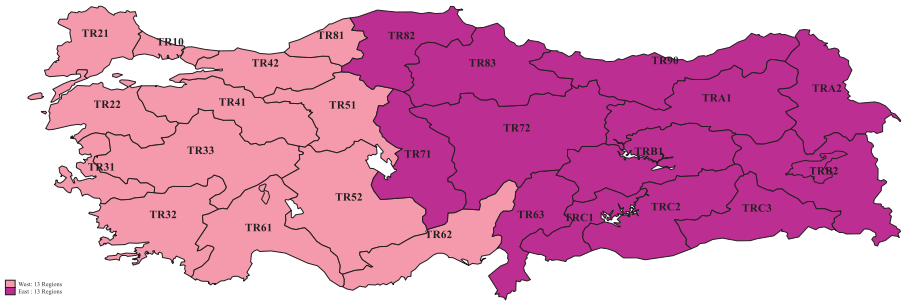

Figure 2: Geographical representation of the *East* dummy

The second extension was made to account for sectoral decomposition. Following Çınar et al. (2022) we expanded our fixed effect and system GMM models to include the sectoral dummy variable and the interaction of the sectoral dummy with related and unrelated variety. *Dagr*, takes the value one for the agricultural sector and zero for the industrial sector.

Results

Figure 3, shows the rank of average values of related and unrelated variety for the 2007-2020 period. traditional industrial centers such as Istanbul, Ankara, İzmir, and Adana, are ranked on the upper side of the figure both for unrelated and related variety. These four provinces are also defined as the four major industry districts by Eraydın (2002) and Akgüngör (2006). Another item that attracts attention in Figure 3 is that the TRA2 region (Ağrı, Kars, Iğdır, and Ardahan provinces) ranks relatively higher for both related and unrelated variety despite its low GDP per capita and high emigration rates. The main reason for this is that the provinces in the TRA2 region are all covered by the Decree on the Regulation of Cross-Border Trade, which aimed to increase the border provinces' export levels by facilitating export procedures in those provinces. However, cross-border trade in Turkey is defined through exports rather than production. This allows the products produced in other provinces to be exported to neighboring countries through the border provinces, causing the export figures and diversity of border provinces to increase without contributing to their productive capabilities and income levels (Çınar et al., 2022). The same is also valid for TR63, TRC1, TRC2, TRC3, and TRB2 regions, where some of their provinces, such as Hatay, Gaziantep, Kilis, Mardin, Şırnak, Van, Şanlıurfa, Hakkari, are within the scope of cross-border trade regulation.

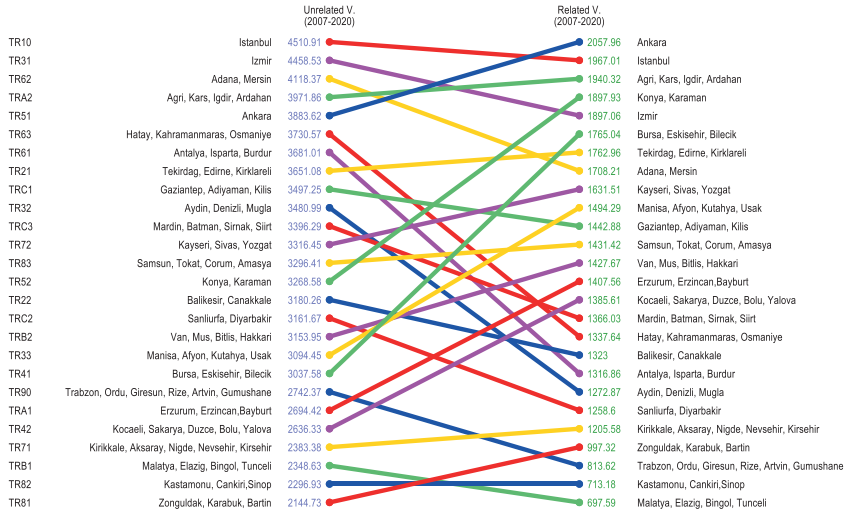

Figure 3: Related and unrelated variety index rankings of NUTS-2 regions (2007-2020 Average)

Table 1 and Table 2 present the results of fixed effect and system GMM estimations for labor productivity, respectively. According to the fixed effect estimations in Table 1, the effect of unrelated variety on labor productivity is insignificant for all estimations. Besides, the related variety seems to have a positive significant effect only on agricultural labor productivity in the western regions of Turkey (Dagr*Related V.). It shows an insignificant coefficient for industrial labor productivity both in the western and eastern regions (Related V. and East*Related V.).

System GMM results in Table 2 show positive and significant effects for related and unrelated variety on agricultural labor productivity when eastern and western disparity is not taken into account. However, when the *East* dummy is included in the models, only the positive relationship between related variety and agricultural labor productivity (Dagr*Related V.) persists as in Table 1. No significant coefficient can be obtained for the eastern regions.

Table 1: Fixed Effect Results: Labor productivity growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Labor productivity (ln)	-0.470***	-0.477***	-0.473***	-0.478***	-0.461***	-0.468***	-0.464***	-0.469***	-0.459***	-0.467***	-0.462***	-0.466***
	(0.072)	(0.072)	(0.072)	(0.073)	(0.073)	(0.073)	(0.073)	(0.074)	(0.069)	(0.069)	(0.071)	(0.071)
Related V.	-0.00003	-0.00002	-0.00004	-0.00002	-0.00010	-0.00008	-0.00010*	-0.00009	-0.00009	-0.00007	-0.00010	-0.00008
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unrelated V.	0.00003	0.00003	0.00004	0.00004	0.00002	0.00002	0.00004	0.00004	0.00002	0.00003	0.00002	0.00003
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education	0.825	1.793	-0.635	0.340	0.850	1.802	-0.593	0.367	1.168	2.070	-0.278	0.640
	(2.266)	(2.429)	(2.165)	(2.333)	(2.290)	(2.461)	(2.156)	(2.335)	(2.265)	(2.403)	(2.146)	(2.296)
Dagr*Related V.					0.00013	0.00013	0.00013	0.00013	0.00032*	0.00031*	0.00032*	0.00031*
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dagr*Unrelated V.					0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
East*Related V.									-0.00001	-0.00001	0.00001	0.00001
									(0.000)	(0.000)	(0.000)	(0.000)
East*Unrelated V.									0.00000	-0.00000	0.00002	0.00001
									(0.000)	(0.000)	(0.000)	(0.000)
East*Dagr*Related V.									-0.00029	-0.00029	-0.00029	-0.00029
									(0.000)	(0.000)	(0.000)	(0.000)
East*Dagr*Unrelated V.									-0.00001	-0.00001	-0.00001	-0.00001
									(0.000)	(0.000)	(0.000)	(0.000)
Non-residential	0.067		0.102		0.067		0.101		0.064		0.097	
	(0.069)		(0.070)		(0.068)		(0.069)		(0.069)		(0.070)	
Population density (ln)		-0.537*		-0.487*		-0.528*		-0.479*		-0.520*		-0.471*
		(0.307)		(0.285)		(0.306)		(0.284)		(0.301)		(0.280)
Electric cons. percapita (ln)	0.174*	0.184*			0.172*	0.182*			0.192*	0.202**		
	(0.099)	(0.099)			(0.099)	(0.099)			(0.096)	(0.097)		
Tangible fixed assets (ln)			-0.085*	-0.063			-0.084*	-0.062			-0.079*	-0.057
			(0.045)	(0.041)			(0.046)	(0.042)			(0.045)	(0.042)
Observations	572	572	572	572	572	572	572	572	572	572	572	572
R2	0.360	0.364	0.360	0.362	0.364	0.368	0.364	0.365	0.372	0.376	0.371	0.372
F-stat.	14.896	14.581	14.827	15.485	16.368	14.301	16.611	15.334	19.471	16.791	18.710	17.248
F-prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard errors are in parentheses. Constant term and year dummies are not reported. * p < 0.10, ** p < 0.05, *** p < 0.01

Table 2: System GMM Results: Labor productivity growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
labor productivity (ln)	-0.118	-0.022	-0.174*	-0.134	-0.264	-0.192**	-0.170**	-0.343**	-0.249**	-0.260	-0.322**	-0.297
	(0.119)	(0.056)	(0.098)	(0.158)	(0.166)	(0.094)	(0.078)	(0.154)	(0.117)	(0.166)	(0.125)	(0.199)
Related V.	-0.00007	-0.00015	-0.00004	-0.00007	-0.00034*	-0.00060**	-0.00038	-0.00043	-0.00049**	-0.00046**	-0.00014	-0.00057**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unrelated V.	0.00010	0.00011**	-0.00003	0.00009	-0.00019	-0.00030	-0.00037**	-0.00031	-0.00004	0.00002	0.00002	-0.00002
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education	-0.435	-0.065	-2.539	-0.424	0.342	0.489	-1.238	-0.924	-0.107	0.109	3.834	-0.367
	(0.772)	(0.399)	(1.643)	(1.118)	(1.489)	(1.446)	(2.957)	(2.420)	(3.714)	(3.214)	(3.627)	(5.842)
Dagr					-3.246***	-3.583***	-3.357***	-3.674***	-3.277***	-2.555***	-1.726*	-2.291***
					(0.909)	(0.778)	(0.751)	(0.860)	(0.943)	(0.792)	(0.893)	(0.741)
East									0.200	1.419	-0.652	0.400
									(2.426)	(2.730)	(0.783)	(3.298)
East*Dagr									0.058	-1.943	1.460	-1.335
									(4.115)	(4.916)	(1.097)	(6.735)
Dagr*Related V.					0.00068**	0.00082***	0.00065***	0.00064**	0.00095***	0.00096***	0.00093***	0.00102***
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dagr*Unrelated V.					0.00052***	0.00057***	0.00060***	0.00063***	0.00038	0.00016	-0.00007	0.00005
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
East*Related V.									0.00029	-0.00006	-0.00005	0.00042
									(0.000)	(0.001)	(0.000)	(0.001)
East*Unrelated V.									-0.00022	-0.00040	0.00013	-0.00034
									(0.001)	(0.001)	(0.000)	(0.001)
East*Dagr*Related V.									-0.00056	-0.00021	-0.00019	-0.00059
									(0.001)	(0.001)	(0.000)	(0.001)
East*Dagr*Unrelated V.									0.00032	0.00076	-0.00011	0.00079
									(0.001)	(0.001)	(0.000)	(0.001)
Non-residential	0.493**		0.432*		0.344		0.159		0.231		0.447	
	(0.198)		(0.222)		(0.221)		(0.234)		(0.354)		(0.271)	
Population density (ln)		-0.037		-0.167		-0.001		-0.223		0.113		0.058
		(0.058)		(0.235)		(0.098)		(0.228)		(0.167)		(1.092)
Electric cons. percapita (ln)	-0.133	0.012			-0.019	0.113			-0.014	0.114		
	(0.151)	(0.135)			(0.141)	(0.165)			(0.174)	(0.208)		
Tangible fixed assets (ln)			0.127	0.131			0.023	0.208			-0.201	0.084
			(0.091)	(0.189)			(0.114)	(0.167)			(0.189)	(0.736)
Observations	572	572	572	572	572	572	572	572	572	572	572	572
Number of groups	52	52	52	52	52	52	52	52	52	52	52	52
Number of instruments	27	38	30	34	35	36	35	36	41	42	47	42
AR(1)	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.006	0.000	0.002	0.000	0.020
AR(2)	0.640	0.704	0.662	0.725	0.539	0.646	0.580	0.616	0.595	0.628	0.557	0.666
Sargan-Hansen overid. test	0.646	0.492	0.744	0.529	0.828	0.964	0.661	0.595	0.640	0.594	0.426	0.592

Windmeijer's (2005) robust standard errors are in parentheses. Constant term and year dummies are not reported. * p < 0.10, ** p < 0.05, *** p < 0.01

Table 3 and Table 4 provide the fixed effects and system GMM estimation results for employment growth, respectively. Table 3 shows us a positive and significant relationship between related variety and employment growth for all our base (Model 1-4) and sectoral (Model 5-8) models. In addition, the effect of related variety on industrial and agricultural employment growth substantially differs for eastern and western regions. It seems that related variety has a statistically positive effect on employment growth in the western regions, while there seems to be no association in the east. Considering the coefficients of related variety (Related V.) in Models 1-12, we can observe that the coefficients for the industrial employment growth in the west (Models 9-12) are higher than the coefficients of Models 5-8 and Models 1-4. Accordingly, while the relationship between related variety and employment growth in Turkey is stronger for the industrial sector, the degree of this relationship increases in the western regions. System GMM results for employment growth in Table 4 also confirm those findings.

In summary, we have found insufficient evidence to assert the presence of a statistically significant effect of both related and unrelated variety on industrial labor productivity for both in western and eastern regions of Turkey. But there is little evidence that the relationship between related variety and labor productivity growth in Turkey seems to be valid only for western regions and for the agricultural sector. This finding is partially consistent with Falcıoğlu (2011), who found a positive and significant relationship between related variety and labor productivity for 26 NUTS-2 regions in Turkey. According to Ayaş (2002), productivity increases in the traditional economic activity areas, such as the agricultural sector, agglomeration or clusters support regional development by the extra value generated through cost reductions rather than innovation. In this respect, related variety is beneficial for agricultural labor productivity, especially by providing lower input costs.

We have also found strong evidence in favor of a statistically positive relationship between related variety and industrial employment growth for the western regions of Turkey. Our findings coincide with the findings of Frenken et al. (2007), Boschma et al. (2012), and Tomasz and Pawel (2021). In addition, our findings are also consistent with Bishop and Gripaios (2010) and Content and Frenken (2016) in the sense that the relationship between employment growth and related variety does not exhibit a homogeneous structure, and the relationship between related variety and the industrial - which can be considered as more knowledge-intensive than the agricultural sector- employment growth is clearer.

We also cannot get robust findings and sufficient evidence on the effect of our alternative urbanization variables on both labor productivity and employment growth. However, this finding is consistent with Boschma and Iammarino (2009) and Frenken et al. (2007). Accordingly, we can state that related

variety, not urbanization, is more important in increasing industrial employment, especially in the western region of Turkey.

Table 3: Fixed Effect Results: Employment growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employment (ln)	-0.392***	-0.402***	-0.398***	-0.405***	-0.401***	-0.411***	-0.407***	-0.414***	-0.410***	-0.421***	-0.416***	-0.423***
	(0.060)	(0.061)	(0.059)	(0.060)	(0.064)	(0.064)	(0.064)	(0.064)	(0.063)	(0.063)	(0.063)	(0.064)
Related V.	0.00010**	0.00009*	0.00011**	0.00009*	0.00018***	0.00017***	0.00019***	0.00017***	0.00020**	0.00019**	0.00021***	0.00019**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unrelated V.	-0.00006	-0.00006	-0.00006	-0.00006	-0.00001	-0.00001	-0.00001	-0.00001	0.00003	0.00003	0.00004	0.00003
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education	0.660	-0.243	1.237	0.318	0.684	-0.235	1.275	0.338	0.772	-0.148	1.363	0.426
	(1.828)	(1.813)	(1.803)	(1.767)	(1.846)	(1.859)	(1.819)	(1.835)	(1.844)	(1.862)	(1.789)	(1.819)
Dagr*Related V.					-0.00016**	-0.00016**	-0.00016**	-0.00016**	-0.00022*	-0.00022*	-0.00022*	-0.00022*
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dagr*Unrelated V.					-0.00009	-0.00010*	-0.00010	-0.00010*	-0.00021**	-0.00022**	-0.00022**	-0.00022**
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
East*Related V.									-0.00003	-0.00003	-0.00004	-0.00004
									(0.000)	(0.000)	(0.000)	(0.000)
East*Unrelated V.									-0.00007	-0.00007	-0.00008	-0.00008
									(0.000)	(0.000)	(0.000)	(0.000)
East*Dagr*Related V.									0.00010	0.00010	0.00010	0.00011
									(0.000)	(0.000)	(0.000)	(0.000)
East*Dagr*Unrelated V.									0.00019*	0.00020*	0.00020*	0.00020*
									(0.000)	(0.000)	(0.000)	(0.000)
Non-residential	-0.070		-0.087		-0.070		-0.088		-0.072		-0.089	
	(0.058)		(0.059)		(0.056)		(0.058)		(0.056)		(0.057)	
Population density (ln)		0.499*		0.471*		0.510*		0.481*		0.528**		0.498**
		(0.282)		(0.275)		(0.276)		(0.269)		(0.248)		(0.241)
Electric cons. percapita (ln)	-0.045	-0.055			-0.046	-0.056			-0.054	-0.065		
	(0.070)	(0.074)			(0.069)	(0.072)			(0.067)	(0.071)		
Tangible fixed assets (ln)			0.057	0.038			0.059	0.039			0.059	0.038
			(0.045)	(0.042)			(0.047)	(0.044)			(0.045)	(0.042)
Observations	572	572	572	572	572	572	572	572	572	572	572	572
R2	0.382	0.386	0.384	0.387	0.400	0.404	0.402	0.405	0.409	0.414	0.411	0.414
F-stat.	17.932	21.626	18.250	21.519	14.104	14.797	14.135	14.825	16.176	18.698	17.102	19.572
F-prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Robust standard errors are in parentheses. Constant term and year dummies are not reported. * p < 0.10, ** p < 0.05, *** p < 0.01

Table 4: System GMM Results: Employment growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Employment (ln)	-0.291***	-0.338***	-0.254***	-0.288***	-0.153**	-0.206***	-0.153***	-0.240***	-0.116**	-0.161**	-0.104**	-0.281**
	(0.104)	(0.095)	(0.094)	(0.038)	(0.069)	(0.063)	(0.046)	(0.070)	(0.048)	(0.068)	(0.047)	(0.138)
Related V.	-0.00000	0.00022*	0.00001	0.00009	0.00016***	0.00022***	0.00015**	0.00020***	0.00017**	0.00030***	0.00016***	0.00034**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Unrelated V.	0.00006	-0.00011*	0.00005	0.00006	0.00012**	0.00009*	0.00012**	0.00010*	0.00005	0.00003	0.00008*	0.00005
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education	1.762	1.264	0.954	-0.453	0.466	0.183	0.600	0.617	0.380	-1.369	-0.254	-0.186
	(1.248)	(0.838)	(1.810)	(0.917)	(0.811)	(0.686)	(1.350)	(0.825)	(0.590)	(1.383)	(1.070)	(1.704)
Dagr					0.824***	1.181***	0.872***	1.079***	0.957**	1.071**	0.879***	1.650*
					(0.278)	(0.399)	(0.314)	(0.322)	(0.444)	(0.424)	(0.315)	(0.942)
East									-0.044	-0.775**	-0.397*	0.086
									(0.315)	(0.385)	(0.223)	(0.862)
East*Dagr									-0.457	1.026	0.499	-0.721
									(0.625)	(0.681)	(0.411)	(1.086)
Dagr*Related V.					-0.00021**	-0.00024**	-0.00025***	-0.00022**	-0.00021***	-0.00038***	-0.00021**	-0.00038*
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Dagr*Unrelated V.					-0.00017***	-0.00024***	-0.00016**	-0.00022***	-0.00019	-0.00013	-0.00017**	-0.00030
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
East*Related V.									0.00004	0.00012	0.00012	-0.00011
									(0.000)	(0.000)	(0.000)	(0.000)
East*Unrelated V.									0.00001	0.00012	0.00006	0.00003
									(0.000)	(0.000)	(0.000)	(0.000)
East*Dagr*Related V.									-0.00009	-0.00020	-0.00021	0.00022
									(0.000)	(0.000)	(0.000)	(0.000)
East*Dagr*Unrelated V.									0.00012	-0.00022	-0.00010	0.00006
									(0.000)	(0.000)	(0.000)	(0.000)
Non-residential	-0.205		-0.154		-0.192*		-0.225**		-0.199		-0.231**	
	(0.141)		(0.111)		(0.108)		(0.100)		(0.119)		(0.093)	
Population density (ln)		0.158		0.005		0.088		0.173		0.073		0.203
		(0.112)		(0.077)		(0.071)		(0.143)		(0.079)		(0.162)
Electric cons. Pc. (ln)	0.045	-0.033			0.047	-0.078			0.023	-0.149		
	(0.078)	(0.104)			(0.082)	(0.074)			(0.081)	(0.112)		
Tangible fixed assets (ln)			0.015	0.017			0.030	-0.064			0.018	-0.060
			(0.074)	(0.049)			(0.063)	(0.068)			(0.048)	(0.103)
Observations	572	572	572	572	572	572	572	572	572	572	572	572
Number of groups	52	52	52	52	52	52	52	52	52	52	52	52
Number of instruments	32	34	31	33	41	40	40	38	49	48	53	40
AR(1)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
AR(2)	0.157	0.165	0.183	0.167	0.204	0.177	0.202	0.185	0.217	0.184	0.226	0.186
Sargan-Hansen overid. test	0.949	0.661	0.854	0.889	0.989	0.977	0.981	0.941	0.928	0.914	0.975	0.812

Windmeijer's (2005) robust standard errors are in parentheses. Constant term and year dummies are not reported. * p < 0.10, ** p < 0.05, *** p < 0.01

Pinheiro et al. (2022) claim that, while related or unrelated variety may have positive effects on regional economic development through knowledge spillover externalities and portfolio effect, it could also have a dark side as it possibly contributes to regional inequalities, especially for countries where regional development disparities in terms of human capital and innovation infrastructure are evident. Pinheiro et al. (2022) based their claim on their findings that higher-income regions are better equipped in terms of human capital and innovation infrastructure, and are therefore more likely to reap the externalities from increased related variety. On the other hand, due to inadequate human capital and innovation infrastructure less developed regions, one way or another, do not sufficiently benefit from knowledge spillover externalities. can lead to a widening of the economic gap between developed and underdeveloped regions. Based on our findings, this dark side is also valid for Turkey. High-income regions in the west of Turkey are much better equipped in terms of human capital and innovation infrastructure, so they can benefit more from the positive externalities associated with the related variety. Less developed eastern regions, on the other hand, do not seem to have achieved sufficient employment gains due to insufficient human capital and innovation infrastructure as compared to the west.

Conclusions and Discussions

In this study, the relationship between related and unrelated variety, and regional economic performance indicators such as labor productivity growth and employment growth were examined based on 26 NUTS-2 regions for Turkey. According to our findings, the positive relationship between related variety and employment growth is stronger for the more knowledge-intensive industrial sector in the more developed western regions. In addition, unrelated variety has no impact on regional economic performance in Turkey. In other words, no sufficient evidence has been found in favor of the portfolio effect.

As it manifests itself through illiteracy rate and education level, Turkey also suffers from an east-west divide in terms of human capital and innovation capacity. More developed western regions are much more advantageous to benefit from local knowledge spillover externalities provided by the related variety than the least developed eastern regions. Therefore, there exists a risk of fostering income differences between the eastern and western regions in Turkey. In other words, despite its bright side, there is also a high risk of confronting the dark side of related variety for Turkey. In this respect, priority should be given to reducing the regional disparities in capability measures, such as human capital, knowledge infrastructure, and institutional quality rather than economic measures such as cross-border trade regulation to increase exports, or regional investment incentives.

Urbanization manifests itself in the form of an increase in the total population and population per square kilometer in a given location. Urban places with

more population are more likely to host universities, research laboratories, chambers of commerce, and institutions that can act as intermediaries for sharing of knowledge (Frenken et al., 2007). However, Turkey has not been able to sufficiently develop cooperation between universities, the private sector, and public authorities. The main reason for this is that until the 2000s "inter-regional redistribution" approach, based on national transfers and incentives for regions, dominated regional policies in Turkey and cooperation and partnerships for innovation and technology were significantly ignored. The first official document to make significant reference to these issues was the eighth national development plan covering the 2001-2005 period (Keskin and Sungur, 2010). Following the eighth development plan, the ninth and the tenth development plans also attached importance to local knowledge transfer and partnerships in line with the new regionalism approach. However, Turkey has not been able to develop examples of successful implementation of partnerships between universities, the private sector, and public authorities for innovation and technology. In this respect, policymakers should go beyond planning and support successful examples of partnerships.

In this study, following Boschma et al. (2012), 0.25 was accepted as the threshold value for proximity. Clearly, this value is ad-hoc and in this context, the effects of related and unrelated variety on regional growth should also be tested over different threshold values for proximity for further studies.

References

Akgüngör, S. (2006). Geographic concentrations in Turkey's manufacturing industry: identifying regional highpoint clusters, *European Planning Studies*, 14(2), https://doi.org/10.1080/09654310500418002

Akgüngör, S., Kuştepeli, Y. & Gülcan, Y. (2013). An overview on industry clusters and the impact of related variety on regional performance in Turkey. *European Review of Industrial Economics and Policy*, 5, Retrieved from: http://revel.unice.fr/eriep/index.html?id=3533

Arrow, K. J. (1962). The economic implications of learning by doing. *The Review of Economic Studies,* 29, 155-173. https://doi.org/10.2307/2295952

Aşık, G., Karakoç, U. & Pamuk, Ş. (2023). Regional inequalities and the West–East divide in Turkey since 1913. *Economic History Review*. 1–28. https://doi.org/10.1111/ehr.13245.

Ayaş, N. (2002). Bölgesel Rekabet Gücünün Geliştirilmesinde Verimliliğin Rolü. *Muğla Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*, (9), 1-24. Retrieved from: https://dergipark.org.tr/tr/pub/musbed/issue/23505/250436

Balassa, B. (1965). Trade Liberalisation and "Revealed" Comparative Advantage. The Manchester School, 33(2), 99–123. https://doi.org/10.1111/j.1467-9957.1965.tb00050.x

Baldwin, R. E. (1971). Determinants of the commodity structure of US trade. *The American Economic Review*, 61(1), 126-146.

Baltagi, B. H. (2021). Econometric Analysis of Panel Data. Sixth edition, Switzerland: Springer Texts in Business and Economics.

Bishop, P. & Gripaios, P. (2010). Spatial externalities, Relatedness and Sector Employment Growth in Great Britain. *Regional Studies*, 44(4), 443-454. https://doi.org/10.1080/00343400802508810

Boschma, R. & Iammarino, S. (2009). Related Variety, Trade Linkages, and Regional Growth in Italy. *Economic Geography*, 85, 289–311. https://doi.org/10.1111/j.1944-8287.2009.01034.x

Boschma, R., Minondo, A. & Navarro, M. (2012). Related variety and regional growth in Spain. *Papers in Regional Science*, 91(2), 241–256. https://doi.org/10.1111/j.1435-5957.2011.00387.x

Caragliu, A., de Dominicis, L. & de Groot H. L. F. (2016). Both Marshall and Jacobs were Right!. *Economic Geography*. 92(1), 87-111. https://doi.org/10.1080/00130095.2015.1094371

Caselli, F., Esquivel, G., & Lefort, F. (1996). Reopening the convergence debate: a new look at crosscountry growth empirics. *Journal of Economic Growth*, 1(3), 363-389.

Celebioglu, F. & Dall'Erba, S. (2010). Spatial disparities across the regions of Turkey: an exploratory spatial data analysis. *Annals of Regional Science*, 45, 379–400

Content, J. & Frenken, K. (2016). Related variety and economic development: a literature review. *European Planning Studies*, 24, 2097–2112. https://doi.org/10.1080/09654313.2016.1246517

Cortinovis, N. & van Oort, F. (2015). Variety, economic growth and knowledge intensity of European regions: a spatial panel analysis. *Annals of Regional Science*, 55(7), 7-32. https://doi.org/10.1007/s00168-015-0680-2

Çınar, İ. T., Korkmaz, İ. & Baycan, T. (2022). Regions' economic fitness and sectoral labor productivity: Evidence from Turkey. *Regional Science Policy & Practice*, 14(3), 575-598, https://doi.org/10.1111/rsp3.12529

Dulupçu, M. A. (2005). Regionalization for Turkey: An Illusion or a Cure?. *European Urban and Regional Studies*, 12(2), 99-115. https://doi.org/10.1177/0969776405048496

Dulupçu, M. A., Sungur, O. & Keskin, H. (2010). Bölgesel Kalkınmada Yeni Yaklaşımlar ve Türkiye'de Kalkınma Planlarına Yansımaları: Kalkınma Planlarının Yeni Teoriler Açısından Değerlendirilmesi. 6. Ulusal Coğrafya Sempozyumu Ankara Üniversitesi Türkiye Coğrafyası Araştırma ve Uygulama Merkezi, Ankara

Eraydın, A. (2002) *Yeni Sanayi Odakları: Yerel Kalkınmanın Yeniden Kavramlaştırılması*, Ankara: ODTU Mimarlık Fakülltesi Basım İşliği.

Eser, U. & Köse, S. (2005). Endüstriyel Yerelleşme ve Yoğunlaşma Açısından Türkiye Sanayii: İl İmalat Sanayiilerinin Analizi. *Ankara Üniversitesi SBF Dergisi*, 60(2), 97-139.

Falcıoğlu, P. & Akgüngör, S. (2008). Regional Specialization and Industrial Concentration Patterns in the Turkish Manufacturing Industry: An Assessment for the 1980–2000 Period, *European Planning Studies*, 16:2, 303-323

Falcıoğlu, P. (2011). Location and Determinants of Productivity: The Case of the Manufacturing Industry in Turkey. *Emerging Markets Finance and Trade*, 47, 86–96. https://doi.org/10.2753/REE1540-496X4706S506

Frenken, K., van Oort, F. & Verburg, T. (2007). Related Variety, Unrelated Variety and Regional Economic Growth. *Regional Studies*, 41, 85–697. https://doi.org/10.1080/00343400601120296

Fritsch, M. & Kublina, S. (2018). Related variety, unrelated variety and regional growth: the role of absorptive capacity and entrepreneurship. *Regional Studies*, 52(10): 1360-1371. https://doi.org/10.1080/00343404.2017.1388914

Gezici, F. & Hewings, G. J. (2004). Regional convergence and the economic performance of peripheral areas in Turkey. *Review of Urban & Regional Development Studies*, 16(2), 113–132.

Göymen, K. (2008). Milestones of Regional Policy in Turkey. Paper Presented at the International Association of Schools and Institutes of Administration (IASIA) Annual Conference, Kampala, Retrieved from: https://research.sabanciuniv.edu/8875/1/MILESTONES_OF_REGIONAL_POLICY_IN_TURKEY.doc

Haq, I. U. & Zhu, S. (2019). Does export variety determine economic growth in Pakistan?. *Applied Economic Letters*. 26 (7): 533-536. https://doi.org/10.1080/13504851.2018.1488036

Hidalgo, C. A. (2021). Economic complexity theory and applications. *Nature Reviews Physics*, 3(2), 92-113.

Hidalgo, C. A., Klinger, B., Barabási, A. L. & Hausmann, R. (2007). The Product Space Conditions the Development of Nations. *Science*, 317, 482–487. https://doi.org/10.1126/science.1144581

Jacobs, J. (1969). *The Economy of Cities*. Random House, New York

Karahasan, B. C., Dogruel, F. & Dogruel, A. S. (2016). Can Market Potential Explain Regional Disparities in Developing Countries? Evidence from Turkey. *The Developing Economies*, 54(2), 162-197. https://doi.org/10.1111/deve.12105

Keskin, H., & Sungur, O. (2010). Bölgesel politika ekseninde yaşanan dönüşüm: Türkiye'de kalkınma planlarında bölgesel politikaların değişimi. *Süleyman Demirel Üniversitesi Fen-Edebiyat Fakültesi Sosyal Bilimler Dergisi*, 2010(21), 271-293.

Marshall, A. (1920). *Principles of economics*. Macmillan, London

Moody, C. E. (1974). The measurement of capital services by electrical energy. *Oxford Bulletin of Economics and Statistics*, 36, 45–52. https://doi:10.1111/j.1468-0084.1974.mp36001003.x

Özyıldırım, S. & Önder, Z. (2008). Banking Activities and Local Output Growth: Does Distance from Centre Matter?. *Regional Studies*, (42)2, 229-244. https://doi.org/10.1080/00343400601142829

Pinheiro, F. L., Balland, P. A., Boschma, R. & Hartmann, D. (2022). The Dark Side of the Geography of Innovation. Relatedness, Complexity, and Regional Inequality in Europe. *Papers in Evolutionary Economic Geography*, 22.02. Retrieved from: http://econ.geo.uu.nl/peeg/peeg2202.pdf

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Policital Economics,* 94, 1002-1037. https://doi.org/10.1086/261420

Saviotti, P. P. & Frenken, K. (2008). Export variety and the economic performance of countries. *Journal of Evolutionary Economics*, 18, 201-218. https://doi.org/10.1007/s00191-007-0081-5

Sungur, O., Keskin, H., Demirgil, H., Şentürk, C. & Dulupçu, M. A. (2013). *Kümelenme: Bölgesel Kalkınmada Anahtar mı? Kilit mi? "Batı Akdeniz Bölgesi Orman Ürünleri Endüstrisi Deneyimi"* [Clustering: Is it a key in regional development? Or is it a lock? "Western Mediterranean Region Forestry Products Industry Experience"]. Nobel Academic Publications, Ankara.

Tomasz, M. & Paweł, D. (2021). Related and unrelated variety vs. basic labuor market variables-regional analysis for Poland. *European Planning Studies*, 29(2), 221-240. https://doi.org/10.1080/09654313.2020.1728520

Chapter 4

COULD GLOBAL INDICES SIGNAL AN ECONOMIC CRISIS FOR BRIC COUNTRIES? EXAMINING THE INDEX OF CURRENCY MARKET TURBULENCE

Savaş TARKUN [1]

1 DR. Independent Researcher, savastarkun@gmail.com,
Orcid ID: 0000-0002-2684-184X

1 Introduction

Investors and experts in monetary policy frequently monitor global indexes on international markets. Some of these indices are: the Baltic Dry Index (BDI), which represents almost all of the world's maritime transport volume. Another index is the Volatility Index (VIX), which is considered an important indicator for financial markets, especially stock markets. The Merrill Lynch Option Volatility Expectations (MOVE) index is another significant index that represents market expectations for the volatility of US Treasury bonds. This index, which is weighted in the stock markets of various nations across the world, and the Morgan Stanley Capital International (MSCI) index, which gauges corporate performance on international stock markets, are both significant indexes that are recognized in the worldwide markets. Undoubtedly, there are other indices that global markets and investors follow or examine.

The market where one country's currency is exchanged for another country's currency is known as the "foreign exchange market." On the other hand, a foreign exchange crisis manifests as a significant decline in the exchange rate over a brief period of time (Akkaya 2021). These crises are speculative attacks on the foreign exchange value of a country's currency. Foreign exchange crises force the country's currency to decline in value or force monetary policy makers to sell their foreign exchange reserves and/or raise interest rates to defend the currency. Fiscal imbalances, current account deficits, overvaluation of the exchange rate, and structural weaknesses in the sectors can all be categorized as causes of foreign exchange crises.

Each nation's internal dynamics may be different. However, one of the most important or paying attention to every country and investors is the economic crisis. Because each nation tries to forecast the crisis signals by focusing on the variables that may trigger the crisis and their leading indicators, depending on the factors that cause the economic crisis. All segments will undoubtedly be impacted if the actions or measures needed to avert a potential economic crisis are delayed. Because of this, both academics and policymakers have worked to create various early warning systems to foretell crises.

Since the 2008 fiscal crisis originating in the USA reached global dimensions and caused the depreciation of the currencies of most countries' economies, interest in studies on early warning systems in order to measure the signals during the financial crisis periods began to intensify. Undoubtedly, due to the intense volatility in international foreign exchange, trade, and stock markets due to the COVID-19 epidemic in 2019, signal approach studies continued to contribute to the literature.

In this study, the Index of Currency Market Turbulence, developed by Kaminsky and Reinhart (1999), was calculated for each of the BRIC countries.

The ability of the global indices BDI, MSCI, MOVE, and VIX to serve as an early warning system has been examined. The studies conducted centered on identifying the leading indicators for crisis signals using the unique macroeconomic variables of each nation. An economic crisis affects not only the nation where it originated but also other nations due to contagion or spillover. In this study, which was carried out with BRIC countries, the evaluation of global indices as a leading indicator for currency crises as an alternative to the macroeconomic variables examined in the literature for crisis signals was examined.

1.2 Global Indices Used in the Study

Financial indices that are recognized as indicators in worldwide markets and global indices that serve as leading indicators for investors' and monetary policy practitioners' financial decisions are both available. These study-related indices are briefly mentioned.

1.2.1 Baltic Dry Index

Baltic Dry Index (BDI), worldwide; It is an important index that tracks transportation products such as coal, iron ore, steel, cement, and grain (Höl et al. 2022). It is a significant indicator that is determined by taking into consideration a number of factors, including tonnage, routes, and the cargoes carried by ships of different sizes, including Capasize, Panamax, Supramax, and Handysize bulk carriers (Angelopoulos 2017). It is an index that can be used to predict the future course of the real economy (Apergis and Payne 2013). Changes in the freight price are correlated with changes in the level of freight demand. This index, which is significant to global trade, can reveal shifts in the amounts of tradeable goods and variations in economic activity (Bakshi, Panayotov, and Skoulakis 2012). It is one of the crucial global indexes that is regarded as the engine of maritime trade and maintains the pulse of the world's economies.

1.2.3 Morgan Stanley Capital International (MSCI) World

It is the index in which the weight of the corporations listed on international stock exchanges is positioned. This index is calculated by Morgan Stanley Capital International. It is used as a common benchmark for world and global equity funds, aiming to represent a broad audience of global markets (Sartorius, Sartorius, and Zuccollo 2018). This index is a crucial measure that aids foreign investors in assessing investment opportunities abroad, minimizing risk, and forecasting future outcomes. The MSCI index consists of several indices that track the performance of businesses (stocks) on international stock exchanges. It is a crucial index for international investors since it enables investment decisions and analysis of stock market performance on a country- or region-by-country basis.

1.2.4 Merrill Lynch Option Volatility Expectations (MOVE) Index

This index is the volatility expectation index developed by the Merrill Lynch investment bank (Öner 2018:174). The index reflects market forecasts for the 30-day volatility of US Treasury bonds. Bond investors' general attitude toward risk and the degree of uncertainty can be summarized by MOVE alone (Kumar et al. 2022). This index, which measures bond volatility, is significant because it captures both investors' risk aversion and their uncertainty about bond prices in the future.

1.2.5 Chicago Board Options Exchange Volatility Index (VIX)

This index, which is more widely used and known than other indices, is unquestionably a financial benchmark and a real-time index created to be a current market estimate of the anticipated volatility of the S&P 500 index. To put it another way, the objective of this index is to give a rapid indication of how much the S&P 500 market index will fluctuate over the course of a 30-day period. This information, commonly referred to as the "fear index," displays the likelihood that a risk is low or high, taking into account investor and market behavior. It is an indicator that both big and small investors should pay close attention to. This index;

- $VIX < 20$ the risk is very low
- $20 < VIX < 30$ normal values
- $30 < VIX < 60$ volatility is high and uncertainty is high
- $60 < VIX$ large chaos

is interpreted as. The VIX index has recently made two important measurements. The first measured reading was 89.32 on October 24, 2008, characterized as “Bloody Friday”. The second one peaked at 83.71 on March 16, 2020, when the COVID-19 outbreak prompted the declaration of a pandemic. These values thus demonstrated that there was significant turbulence and panic in the markets.

2. Literature Review

In the literature on the Index of Currency Market Turbulence, numerous studies can be found. However, extensive research has shown that if this index rises above a particular level, it can signal an impending economic crisis. Additionally, a crisis is defined as existing when the crisis signals rises above the pertinent threshold value; conversely, when it falls below the threshold value, there is no crisis or economic contraction, and the dependent variable is categorical and subject to logistic model analysis.

Global indices are indices that most investors and/or countries are interested in and evaluate. Studies on these indices in the literature have focused on the relationships between financial markets. Undoubtedly, one of the most studied topics is volatility spillover between BRIC countries and the global indices

BDI, MSCI, MOVE, and VIX. The reviews focused on recent and relevant literature.

In 2011, Kenourgius et al. investigated the BRIC nations' five financial crises as well as those of the USA and the UK, two industrialized nations. In their research, they looked at both the asymmetric generalized dynamic conditional correlation and the multivariate regime-changing Gaussian copula model. On the other hand, the study's findings showed that BRIC markets are more vulnerable to financial contagion and that industry-specific turmoil has a bigger impact than national risks (Kenourgios, Samitas, and Paltalidis 2011). A similar study was taken up by Chittedi (2014). In his study, he looked at how the developed markets of the United States, the United Kingdom, and Japan affected the stock markets in the BRIC countries. He underlined in his analysis that a diversification-focused investment approach does not actually help in times of crisis. Additionally, he said that, because markets and countries respond to shocks in different ways, stocks of various emerging countries will only offer advantages over other stocks (Chittedi 2014). Another study on this subject was handled by Yıldırım (2021). The study looked at the integration between the US and BRIC stock markets and the long- and short-term asymmetric consequences of the COVID-19 epidemic and the 2008 economic crisis. The study's findings indicate that for all countries in the short term, positive increases in risk aversion levels promote integration and negative changes decrease correlation (Yıldırım 2021).

Various financial assets, macroeconomic factors, and the BDI forecasting content were examined by Apergis and Payne (2013). The study's findings showed that there is a link between macroeconomics, financial asset markets, and the actual economy's function in forecasting its future trajectory (Apergis and Payne 2013).

In 2013, Bianconi et al. looked into how the BRIC nations were affected by the US financial crisis. According to the results, in the long run, BRIC bond markets deviated much more from the US financial stress measure than BRIC bonds and stocks that diverged among themselves (Bianconi, Yoshino, and Machado de Sousa 2013).

Lin and Sim (2013) created a new trade cost measure based on the BDI, a trade tool that measures the income level of poor and underdeveloped countries. According to the results of the study, they found that a 1% expansion in trade increases GDP by 0.5% on average, where the least developed countries (LDC) dominate the manufacturing and export sectors (Lin and Sim 2013).

Chkili and Nguyen (2014) examined the dynamic relationships between exchange rates and stock market returns for the BRICS countries. The findings of the study, on the other hand, determined that stock markets have a greater effect on exchange rates in both calm and turbulent periods (Chkili and Nguyen 2014).

Syzdykova (2016) examined the relationship between inflation and exchange rates in BRIC countries. The study's conclusions indicate that, with the exception of China, nominal exchange rates and inflation have a long-term relationship in every BRIC nation (Syzdykova 2016).

Öner (2019) used the VIX to analyze the impact of developing nations on bond prices. According to the findings, one-way causality has been established between the VIX index and the Russian and Mexican 10-year bond prices (Öner 2019). Öner (2018), in his study, analyzed the VIX, US dollar and MOVE indices with the exchange rates of developed and developing countries. According to the findings, the VIX index; Euro, Hungarian forint, Indonesian rupee, Japanese yen, and Polish zloty exchange rates; the US dollar index; Brazilian real and Japanese yen exchange rates; and the MOVE index found that the Indian rupee and Russian ruble exchange rates were Granger causes (Öner 2018).

Tekbaş (2019), in his study, in which he examined the effects of globalization on economic growth regarding the BRICS-T countries, determined the existence of a bidirectional causal relationship between per capita capital accumulation and economic growth, a one-way causal relationship from globalization to economic growth, and a one-way causal relationship from per capita capital accumulation to globalization (Tekbaş 2019).

Bektaş and Babuscu (2019), in their study examining the effects of the VIX index and CDS risk premiums on growth and exchange rates, concluded that the volatility index is the Granger cause of the industrial production index (Bektaş and Babuşcu 2019).

Alpdoğan and Akal (2020) used the KLR (1998) method to investigate the financial crises in BRIC nations using diverse macroeconomic variables. As a result of the study, they identified Brazil, Russia, and China as the leading indicators of joint export, import, and net indebtedness for financial crises (Alpdoğan and Akal 2020).

In their work, Kaya and Yarbaş (2020) looked at the predecessor and antecedent relationship between MSCI and BIST 100. They found that the BIST100 index was affected positively by the 1 and 2 lagged values of the MSCI index, while the MSCI index was negatively affected by the 1 lagged value of the BIST100 index and positively affected by the 2 lagged values (Kaya and Yarbaşı 2020). In a similar study, İltaş and Güzel (2021), in their study examining the relationship between BIST100, VIX, and CDS premium, found one-way causality from the VIX index to the BIST100 index (İltaş and Güzel 2021).

Güneş (2020), in his study examining VIX, the US dollar index, and US 10-year government bonds, revealed a one-way causality relationship from the VIX index to the US 10-year government bond interest rate (Güneş 2020).

Ercan and Demirbaş (2020) examined the effects of the VIX, MOVE, and US dollar indices on the exchange rates of developed and developing countries. According to the findings of the study, they emphasized the existence of a long-term relationship between the Dollar index and the VIX index, and that there is unidirectional causality from the VIX to the Dollar index (Ercan and Demirbaş 2020).

In their study, McIver and Kang (2020) looked at the dynamic spillover relationship between the US and the BRICS nations. The findings are the net volatility transmitters of the US, Brazilian, and Chinese markets after the onset of crisis periods; they concluded that the Russian, Indian, and South African markets have net buyers (McIver and Kang 2020).

Han et al. (2020) gathered information about economic fundamentals and concluded that the BDI is a useful estimator for exchange rates (Han, Wan, and Xu 2020).

Balcilar and Usman (2021) examined the exchange rate and oil price pass-through in the BRICS countries. According to the findings, they concluded that the net spreads of inflation and production growth in India are positive, while the net spreads of oil price and production growth in China are negative because they have positive net spillovers (Balcilar and Usman 2021).

In their study, Höl et al. (2022) examined the volatility spillover between the global indicators BDI, oil price, gold price, dollar index, and MSCI world index. As a result of the study, BDI, Brent oil price and MSCI World index spread volatility; gold and dollar index were obtained as variables taking volatility (Höl et al. 2022).

An et al. (2022) proposed an early warning system for the risk of an external liquidity shock in BRICS countries. The findings show that the index peaked during the financial crisis. They showed that Brazil, India, and South Africa are at major shock risk, while China and Russia are at relatively moderate risk (An et al. 2022).

Kumar et al. (2022) stated in their study that VIX and MOVE shocks loosened the monetary policy of the central bank and resembled negative demand shocks, albeit with different intensities. They also associate a contraction in output with a flattening or steepening of the yield curve, depending on the type of volatility affecting the economy (Kumar et al. 2022).

3. Data, Method and Application

3.1. Obtaining Index of Currency Market Turbulence (ICMT)

Definitions were brought to the literature, and various index studies were carried out (Almahmood, Munyif, and Willett 2018; Ari and Cergibozan 2016; Bucevska 2015; Bussiere and Fratzscher 2002; Candelon, Dumitrescu, and Hurlin 2014; Edison 2000; Eichengreen, Rose, and Wyplosz 1997; Kaminsky, Lizondo, and

Reinhart 1998; Kaminsky and Reinhart 1999; Kumar, Moorthy, and Perraudin 2003; Licchetta 2009; Milesi-Ferretti and Razin 2000; Nakatani 2018). In this study, Index of Currency Market Turbulence, which was introduced to the literature by Kaminsky & Reinhart (1999), is examined for the BRIC countries. The ICMT Equation-1 proposed by Kaminsky and Reinhart (1999) is as follows (Kaminsky and Reinhart 1999):

$$ICMT = \frac{\Delta K}{K} - \left[\left(\frac{\sigma_K}{\sigma_R}\right) * \left(\frac{\Delta R}{R}\right)\right] \quad (1)$$

In this equation, K is the value of the relevant country against the US dollar, R represents the international reserve of the relevant country, and σ represents the standard deviation.

In the study, instead of total international reserves, international reserves other than gold were considered. Data on the relevant countries were obtained from the central banks of the countries, Investing, and Federal Reserve Economic Data (FRED). While observation values for international reserves consist of monthly observations, exchange rate data are published daily. Therefore, the data related to the relevant exchange rate data were obtained with monthly average values. The monthly average values of the observations related to the global indices BDI, MSCI, MOVE, and VIX used in the study cover the period January 2008–January 2022, adjusted for seasonal effects.

3.2. Application: Short-Term Relationship Analysis: Vector Autoregressive Model (VAR)

Since the economic and financial time series are in mutual interaction, the Vector Autoregressive Model (VAR), which was introduced to the literature by Sims (1980) and accepts all the variables in the system as endogenous (internal) or exogenous (external), constitutes the application of the study. The VAR model can be defined as an equation system in which each endogenous variable in a system of equations includes both its own and the lag values of the variables in the system(Sims 1980). In addition, it is used for the interaction between variables and for the purpose of predicting the future rather than determining policy (Özgen & Güloğlu, 2004; Sevüktekin & Çınar, 2014: 459). These models are used more frequently in crisis economies (Tarı, 2014). Accordingly, a bivariate VAR model (Brooks 2008:320):

$$y_{1t} = \beta_{10} + \beta_{11}y_{1t-1} + \cdots + \beta_{1k}y_{1t-k} + \alpha_{11}y_{2t-1} + \cdots + \alpha_{1k}y_{2t-k} + \varepsilon_{1t} \quad (2)$$

$$y_{2t} = \beta_{20} + \beta_{21}y_{2t-1} + \cdots + \beta_{2k}y_{2t-k} + \alpha_{21}y_{1t-1} + \cdots + \alpha_{2k}y_{2t-k} + \varepsilon_{2t} \quad (3)$$

β_{10} and β_{20} in Equations-2 and 3 are the constant terms; k is the number of delays; and ε_{1t} and ε_{2t} represent the white noise error terms.

Before proceeding to the VAR analysis, ADF and PP unit root tests were carried out for the relevant variables. The unit root test results of the variables in the study are shown in Table-1.

Table-1: Augmented Dickey-Fuller and Phillips-Perron Unit Root Test

Variable	PP		ADF	
At Level	With Constant	With Constant & Trend	With Constant	With Constant & Trend
BDI_SA	-5.4416	-4.9267	-5.5399	-4.9454
	(0.0000)	(0.0004)	(0.0000)	(0.0004)
MOVE_SA	-3.3386	-3.9993	-3.6327	-4.2993
	(0.0147)	(0.0105)	(0.0061)	(0.0040)
MSCI_SA	0.9264	-2.6269	0.8776	-2.5905
	(0.9957)	(0.2690)	(0.9950)	(0.2853)
VIX_SA	-4.0794	-4.236	-4.2927	-4.4300
	(0.0014)	(0.0050)	(0.0006)	(0.0026)
Brazil	-8.8226	-8.8105	-8.9814	-8.9774
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
China	-7.5801	-7.5682	-7.5853	-7.5693
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
India	-9.7356	-9.7427	-9.8628	-9.9128
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Russia	-10.1339	-10.0957	-10.3900	-10.3595
	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Note: Values in parentheses are probe values.

According to the unit root test results in Table-1, all variables were found to be stationary at level values, except for the MSCI variable.

One of the accepted methods to determine the optimum delay length in a VAR model is to determine it according to information criteria. Information criteria is a family of methods used to choose between competing models that include autocorrection penalties when more parameters are included (Brooks

2008:680). In this study, the results obtained for the FPE, AIC, SC, and HQ criteria are shown in Table-2 in order to determine the appropriate lag length for the VAR model and causality test.

Table-2: VAR Lag Order Selection Criteria

	Brazil				China			
Lag	FPE	AIC	SC	HQ	FPE	AIC	SC	HQ
1	9.24E+08	34.83354	35.41014*	35.06768	38971592	31.66763	32.14812*	31.86274
2	7.41E+08	34.61228	35.66937	35.04153*	32085858*	31.47250*	32.43349	31.86272*
3	7.29e+08*	34.59280*	36.13039	35.21716	32209919	31.47441	32.9159	32.05975
4	7.62E+08	34.63286	36.65095	35.45234	34793609	31.54776	33.46974	32.32821
5	8.30E+08	34.71134	37.20992	35.72593	38767879	31.64958	34.05206	32.62515
6	9.05E+08	34.78848	37.76756	35.99818	41653558	31.71183	34.59481	32.88251
7	8.93E+08	34.76084	38.22041	36.16565	39703335	31.6504	35.01387	33.01619
8	1.03E+09	34.88677	38.82683	36.48669	46899754	31.79878	35.64275	33.35968
	India				Russia			
Lag	FPE	AIC	SC	HQ	FPE	AIC	SC	HQ
1	2.05E+08	33.32988	33.81037*	33.52499*	1.36E+09	35.22226	35.79885*	35.45639
2	1.75e+08*	33.16882	34.12981	33.55905	9.84E+08*	34.89500*	35.95209	35.32425*
3	1.78E+08	33.18264	34.62413	33.76798	1.07E+09	34.97603	36.51361	35.60039
4	1.76E+08	33.16807*	35.09005	33.94852	1.10E+09	34.99907	37.01715	35.81854
5	1.86E+08	33.21675	35.61923	34.19231	1.20E+09	35.08107	37.57965	36.09566
6	2.10E+08	33.32976	36.21274	34.50044	1.34E+09	35.18217	38.16124	36.39186
7	2.19E+08	33.35654	36.72001	34.72233	1.42E+09	35.22311	38.68268	36.62792
8	2.60E+08	33.51041	37.35438	35.07131	1.68E+09	35.37438	39.31444	36.9743

Note: * indicates lag order selected by the criterion; FPE: Final prediction error; AIC Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion

The AIC information criterion was taken into account when determining the VAR Lag Order Selection Criteria Accordingly, Brazil: 3, China: 2, India: 4,

and Russia: 2; it was determined as a 2-day delay, and the related VAR model was created according to this delay value.

According to the unit root test results of the variables in the study, all of them were found to be stationary at the same level, except for the MSCI variable. In this case, instead of Granger (1969) causality test, Toda-Yamamoto (1995) causality test was performed for the causality test. In the next chapter, information about the Toda-Yamamoto causality analysis is given, and the causality test findings of each country are included.

3.3. Toda – Yamamoto Causality Test

It is a test method based on the $k + d_{max}$ VAR model with increased lag so that causality can be analyzed regardless of the stationarity level and cointegration relationship between the variables. This test was introduced to the literature by Toda-Yamamoto (1995) (Toda and Yamamoto 1995). The Toda-Yamamoto (1995) test is expressed as in Equation 4 and Equation 5:

$$Y_t = \beta_0 + \sum_{i=1}^{k+d_{max}} \beta_{1i} Y_{t-i} + \sum_{i=1}^{k+d_{max}} \beta_{2i} X_{t-i} + \varepsilon_{1t} \quad (4)$$

$$X_t = \beta_0 + \sum_{i=1}^{k+d_{max}} \beta_{1i} X_{t-i} + \sum_{i=1}^{k+d_{max}} \beta_{2i} Y_{t-i} + \varepsilon_{2t} \quad (5)$$

The k shown in Equations-4 and 5 is the lag length obtained from the VAR model, and d_{max} shows the maximum degree of integration. Here d_{max} includes the maximum stationarity degree of any of the variables in the system. In the light of these explanations, the results of the causality test between each BRIC country and the global indices are shown in Table-3.

Table-3: Toda-Yamamoto Causality and Consequences

Dependent variable: Brazil				**Dependent variable: China**			
Excluded	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**
BDI_SA	7.894009	3	0.0483*	BDI_SA	0.102741	2	0.9499
MOVE_SA	8.129592	3	0.0434*	MOVE_SA	0.96739	2	0.6165
MSCI_SA	7.591199	3	0.0553**	MSCI_SA	15.75176	2	0.0004*
VIX_SA	2.539474	3	0.4682	VIX_SA	8.809191	2	0.0122*
Dependent variable: India				**Dependent variable: Russia**			
Excluded	**Chi-sq**	**df**	**Prob.**	**Excluded**	**Chi-sq**	**df**	**Prob.**
BDI_SA	10.97508	4	0.0268*	BDI_SA	0.096797	2	0.9528

MOVE_SA	7.627898	4	0.1062	MOVE_SA	1.444936	2	0.4856
MSCI_SA	4.279727	4	0.3695	MSCI_SA	7.579568	2	0.0226*
VIX_SA	6.873604	4	0.1427	VIX_SA	3.505967	2	0.1733

Note: * indicates the 5% significance level; ** indicates the 10% significance level.

The causality test was carried out by Toda-Yamamoto (1995), since the degree of stability of the MSCI index, which is one of the variables examined in the study, is different. According to the findings from Table-3, causality was found at the 5% significance level from the BDI and MOVE indices to Brazil's ICTM, while a causality relationship was found at the 10% significance level from the MSCI index. A causality finding was obtained from the VIX and MSCI indices for China's ICTM at the 5% significance level. It has been determined that there is a causal relationship at the 5% significance level from the BDI index to the ICTM of India and finally to the ICTM of Russia from the MSCI index.

3.4. Variance Decomposition

It has been analyzed by variance decomposition in order to investigate how much of the changes between the ICTM of the relevant country and the global indices are caused by itself or other variables in the system. Forecast error variance decomposition is an analysis method that shows the ratio of the sequence in the system to the shocks caused by the self-induced shocks and the shocks caused by the other variable (Enders 2014). Table-4 shows the variance decomposition results for Brazil.

Variance decomposition can also be achieved by making use of the forecast error (Enders, 2014, s. 301):

$$Y_{t+s} - E_t(Y_{t+s}) = \sum_{i=0}^{s-1} \Psi_i u_{t+s-i} \tag{6}$$

$$Y_{t+s} - E_t(Y_{t+s}) = \Psi_0 u_{t+s} + \Psi_1 u_{t+s-1} + \cdots + \Psi_{s-1} u_{t+1} \tag{7}$$

Here, Ψ_i is the impulse-response function obtained from the forecast errors. The impulse response functions obtained by Cholesky decomposition can be used. If the relationship between shocks is weak, then the discrimination problem is not so important. If the $l.$ row $m.$ column element of Ψ_i is specified by $\Psi_{l,m}(i)$, then the predictive error variance of variable $k.$ will be as follows:

$$Y_{k,t+s} - E_t\left(Y_{k,t+s}\right) = \sum_{i=0}^{s-1} \left(\Psi_{k,1}(i) u_{1,t+s-i} + \cdots + \Psi_{k,K}^{(i) u_{1,t+s-i}}(i) u_{K,t+s-i}\right)$$

$$\sigma_k^2(s) = \sum_{i=0}^{s-1} \left(\Psi_{k1}^2(i) u_{1,t+s-i} + \cdots + \Psi_{kK}^{(2)}(i) \right)$$
$$= \sum_{j=1}^{K} \left(\Psi_{kj}^2(0) + \cdots + \Psi_{kj}^2(s-1) \right)$$

Where, the term $\left(\Psi_{kj}^2(0) + \cdots + \Psi_{kj}^2(s-1) \right)$ is j. the variable k. can be considered as the coefficient of the forecast error variance of the variable. In the VAR model, since each shock in the equations is matched with the relevant variable, this term is the k of the shock to each variable. will give the contribution of the variable to the forecast error variance. When this term is proportional to the term $\sum_{j=1}^{K} \left(\Psi_{kj}^2(0) + \cdots + \Psi_{kj}^2(s-1) \right)$ the shock to each variable is k. the percentage share of the variable in the predictive error variance is obtained as follows:

$$\omega_{kj}(s) = \frac{\left(\Psi_{kj}^2(0) + \cdots + \Psi_{kj}^2(s-1) \right)}{\sum_{j=1}^{K} \left(\Psi_{kj}^2(0) + \cdots + \Psi_{kj}^2(s-1) \right)} * 100 \quad (8)$$

Accordingly, the variance decomposition results evaluated separately for each country are shown in Table 4–7.

Table 4. Variance Decomposition of Brazil

Period	BRAZIL	BDI_SA	MOVE_SA	MSCI_SA	VIX_SA
1	100.0000	0.000000	0.000000	0.000000	0.000000
2	81.91338	4.635759	5.648710	7.800688	0.001468
3	72.97940	5.116282	11.17911	10.70578	0.019424
4	72.41662	5.356379	11.28071	10.72173	0.224569
5	72.40486	5.333305	11.26875	10.71508	0.278017
6	71.48688	5.983796	11.12781	10.93958	0.461930
7	70.89441	6.560310	11.05987	10.93411	0.551294
8	70.55275	6.906964	11.08398	10.89472	0.561582
9	70.31011	7.091905	11.07851	10.95925	0.560229
10	70.11383	7.160170	11.05265	11.10805	0.565312

According to the results in Table-4, the changes in the variance of Brazil's ICTM are all explained by its lagged value in the first period. However, after the second and third periods, 81,91% and 72,97% of this level were explained by their own lagged values, respectively, while in the second period, it was explained by the variables BDI with 4,63%, MOVE with 5,64%, and MSCI with 7,80%. When analyzed over the periods discussed, 11% of the changes in the variance of Brazil's ICMT are explained by the MOVE index on average, while this level of explanation is explained by the MSCI with an average of 10% and the BDI indices with 6%.

The results of the variance decomposition of the ICMT of another country, China, are shown in Table-5.

Table 5. Variance Decomposition of China

Period	CHINA	BDI_SA	MOVE_SA	MSCI_SA	VIX_SA
1	100.0000	0.000000	0.000000	0.000000	0.000000
2	92.51737	0.058025	1.302925	3.675446	2.446239
3	87.97464	0.181516	1.577578	3.949938	6.316326
4	84.00319	0.196818	1.887447	4.182492	9.730057
5	80.27429	0.212388	2.315116	4.854555	12.34365
6	76.12355	0.423570	3.037531	6.269941	14.14541
7	71.22124	0.993966	4.119089	8.414357	15.25135
8	65.56981	2.012745	5.580378	11.06684	15.77022
9	59.38871	3.485614	7.365941	13.93669	15.82305
10	52.97563	5.343368	9.379278	16.77211	15.52961

According to the findings in Table-5, all the changes in the first period variance of the ICMT for China are explained by its lag value. However, 9,73% of the changes in the variance of China's ICMT, especially after the third and fourth periods, are explained by the VIX index. While the rate of disclosure by China's own lagged values has decreased significantly since the fifth period, this rate, which has decreased to 52.97% in the last period, has recently been announced by MSCI as 16.77%; the level of disclosure by VIX is 15.52 percent, the level of disclosure by MOVE is 9.37%, and the level of disclosure by BDI rises to 5.34%.

The variance decomposition results for another country, India, are shown in Table-6.

Table 6. Variance Decomposition of India

Period	INDIA	BDI_SA	MOVE_SA	MSCI_SA	VIX_SA
1	100.0000	0.000000	0.000000	0.000000	0.000000
2	84.42290	2.954834	6.410527	6.159551	0.052185
3	76.50269	2.855996	12.27827	8.124279	0.238770
4	74.11855	3.654195	12.89818	8.511653	0.817422
5	73.12789	3.640485	12.82713	8.505637	1.898857
6	71.47665	3.834215	12.60487	8.757560	3.326708
7	70.36792	4.251624	12.44600	8.678384	4.256070
8	69.49538	5.242993	12.31596	8.587200	4.358473
9	69.09426	5.793056	12.23657	8.540188	4.335924
10	68.77202	6.188733	12.17855	8.545197	4.315496

According to the findings obtained from Table-6, it is seen that all the changes in the first period variance of the ICTM for India are explained by themselves. However, in the second period, this level of disclosure decreased by approximately 15.58%. When examined in terms of the periods discussed, it is observed that the level of self-disclosure is 70% on average, especially from the third period to the last period. As of similar periods, 12% of the changes in the variance of India's ICTM were explained by the MOVE index, while the second index, which had a significant percentage of the change in its variance, was found to be MSCI with an average of 8.5%.

In Table-7, variance decomposition results for Russia, another BRIC country, are shown.

Table 7. Variance Decomposition of Russia

Period	RUSSIA	BDI_SA	MOVE_SA	MSCI_SA	VIX_SA
1	100.0000	0.000000	0.000000	0.000000	0.000000
2	77.76904	0.049066	1.523884	19.21096	1.447047
3	77.53604	0.246674	1.516720	19.18191	1.518647
4	77.25517	0.504845	1.556860	19.16032	1.522805
5	77.03522	0.682245	1.577593	19.13087	1.574080
6	76.90208	0.773292	1.595019	19.09811	1.631501
7	76.79462	0.821259	1.598605	19.08430	1.701215
8	76.67210	0.854092	1.596398	19.10153	1.775875
9	76.51087	0.885901	1.594802	19.15468	1.853751
10	76.29474	0.926422	1.601924	19.24158	1.935339

According to Table-7, which shows the variance decomposition results of the Russian ICTM, it is observed that all of the changes in the variance of the first period are explained by her. However, as of the second period, the level of disclosure decreased to 77.76%, which explains the changes in the variance of the MSCI index and Russia's ICTM with 19.21% in this period. From the third period to the last period, the MSCI index has been found to have an explanatory power of approximately 19%. During these periods, it was observed that the BDI, MOVE, and VIX indices did not have a significant level of explanation for the changes in the variance of Russia's ICTM.

Conclusion

Due to the consequences of economic crises, all individuals, institutions, organizations, and companies in the economy are directly affected negatively. Therefore, identifying leading indicators that may cause crises is of great importance for those interested in the subject. Undoubtedly, these models, which are modeled depending on past macroeconomic variables for economic crises and attract the attention of the academic community, have increased efforts to develop early warning systems that are expected to predict future crises. However, the emergence of each new crisis depending on its own different dynamics has made it necessary to update the early warning systems and/or leading indicators created with the experienced crises after each new crisis.

In this study, it is aimed to examine the ICMT proposed by Kaminsky and Reinhart (1999) with global indices for BRIC countries. When the studies are examined, different threshold values are determined according to the ICMT, the study, or the country. The periods when this threshold value exceeds the ICMT are coded as "crisis periods," transformed into a categorical model, and analyzed by logistic regression. In the studies, apart from the economic variables of the countries that are tried to be determined as the leading indicator during the crisis periods, it has been tried to be obtained with the global indices that are thought to produce a crisis signal.

In this study, which is characterized as a rising power and which may have global effects in the near future, each BRIC country is examined with global indices. The empirical findings, on the other hand, are as follows: Causality was determined from the BDI, MOVE, and MSCI indices for the Brazilian ICMT. At the same time, these indices explain the changes in the variance of the MSCI and MOVE indices at a rate of 9.47% and the BDI index Brazil at a rate of 5.41%, on average, during the period under consideration. Causality was determined from the MSCI and VIX index to the Chinese ICMT. MSCI, with an average rate of 7.31%, and the VIX index, with a rate of 10.74%, explain the changes in the variance of the ICMT for China. A causal relationship was found between the BDI index and the Indian ICMT. Similarly, this index explains an average of 3.84% of the changes in the variance of India for the periods considered. While the causality is determined from the MSCI index to the Russian ICMT, which is the last country, this index also explains the changes in Russia's variance at an average rate of 17.24% as of the analyzed periods.

In future studies, the effects of various globally accepted indices on the foreign exchange market pressure indices of BRIC countries can be examined. Similarly, this index can be applied to different countries. In addition, the determination of global indices and various macroeconomic variables that can signal a crisis for each country and the variables that can be leading indicators, together with the indices used in the study, will contribute both to this study and to the literature.

REFERENCE

Akkaya, Murat. 2021. "Döviz Piyasası Baskı Endeksi ve Kriz Göstergelerinin Tahmini: Türkiye Uygulaması. [Index of Curreny Market Turbulance and Estimation of Crisis Indicators: Turkey Case]." *Ankara Hacı Bayram Veli Üniversitesi* 23(1):67–92.

Almahmood, Hassan, Munif Al Munyif, and Thomas D. Willett. 2018. "Most Speculative Attacks Do Not Succeed: Currency Crises and Currency Crashes." *Journal of International Commerce, Economics and Policy* 9(1–2):1–9. doi: 10.1142/S1793993318500011.

Alpdoğan, Hilal, and Mustafa Akal. 2020. "BRIC-3 Ülkelerinde Finansal Krizler ve Öncü Göstergeler [Financial Crises and Signal Indicators in BRIC-3 Countries]." *Sosyoekonomi* 28(43):213–28. doi: 10.17233/sosyoekonomi.2020.01.12.

An, Hui, Hao Wang, Sarath Delpachitra, Simon Cottrell, and Xiao Yu. 2022. "Early Warning System for Risk of External Liquidity Shock in BRICS Countries." *Emerging Markets Review* 51(PA):100878. doi: 10.1016/j.ememar.2021.100878.

Angelopoulos, Jason. 2017. "Time-Frequency Analysis of the Baltic Dry Index." *Maritime Economics and Logistics* 19(2):211–33. doi: 10.1057/s41278-016-0052-6.

Apergis, Nicholas, and James E. Payne. 2013. "New Evidence on the Information and Predictive Content of the Baltic Dry Index." *International Journal of Financial Studies* 1(3):62–80. doi: 10.3390/ijfs1030062.

Ari, Ali, and Raif Cergibozan. 2016. "The Twin Crises: Determinants of Banking and Currency Crises in the Turkish Economy." *Emerging Markets Finance and Trade* 52(1):123–35. doi: 10.1080/1540496X.2016.1105683.

Bakshi, Gurdip S., George Panayotov, and Georgios Skoulakis. 2012. *The Baltic Dry Index as a Predictor of Global Stock Returns, Commodity Returns, and Global Economic Activity*.

Balcilar, Mehmet, and Ojonugwa Usman. 2021. "Exchange Rate and Oil Price Pass-through in the BRICS Countries: Evidence from the Spillover Index and Rolling-Sample Analysis." *Energy* 229:120666. doi: 10.1016/j.energy.2021.120666.

Bektaş, Nil Çağlar, and Şenol Babuşcu. 2019. "VIX Korku Endeksi ve CDS Primlerinin Büyüme ve Döviz Kuruna Etkisi, Türkiye Örneği [The Effect of Fear Index and Credit Default Swap on Industrial Production Index and Exchange Rates. A Case of Turkey]." *Ufuk Üniversitesi Sosyal Bilimler Enstitü Dergisi* 8(16):97–111.

Bianconi, Marcelo, Joe A. Yoshino, and Mariana O. Machado de Sousa. 2013. "BRIC and the U.S. Financial Crisis: An Empirical Investigation of Stock and Bond Markets." *Emerging Markets Review* 14(1):76–109. doi: 10.1016/j.ememar.2012.11.002.

Brooks, Chris. 2008. *Introductory Econometrics for Finance*. New York.

Bucevska, Vesna. 2015. "Currency Crises in EU Candidate Countries: An Early Warning System Approach." *Panoeconomicus* 62(4):493–510. doi: 10.2298/PAN1504493B.

Bussiere, Matthıeu, and Marcel Fratzscher. 2002. *Towards a New Early Warning System of Financial Crises*. 145.

Candelon, Bertrand, Elena Ivona Dumitrescu, and Christophe Hurlin. 2014. "Currency Crisis Early Warning Systems: Why They Should Be Dynamic." *International Journal of Forecasting* 30(4):1016–29. doi: 10.1016/j.ijforecast.2014.03.015.

Chittedi, Krishna Reddy. 2014. "Global Financial Crisis and Contagion: Evidence for The 'BRIC' Economies." *The Journal of Developing Areas* 48(4):243–64.

Chkili, Walid, and Duc Khuong Nguyen. 2014. "Exchange Rate Movements and Stock Market Returns in a Regime-Switching Environment: Evidence for BRICS Countries." *Research in International Business and Finance* 31:46–56. doi: 10.1016/j.ribaf.2013.11.007.

Edison, Hali j. 2000. "Do Indicators of Financial Crises Work? An Evaluation of an Early Warning System." *Board of Governors of the Federal Reserve System* 350.

Eichengreen, Barry, Anderew Rose, and Charles Wyplosz. 1997. *Contagious Currency Crises*. 5681. doi: 10.1142/9789814749589_0010.

Enders, Walter. 2014. *Applied Econometric Time Series*. 4th ed. England: Wiley.

Ercan, Seden, and Buhari Demirbaş. 2020. "ABD Dolar Endeksi Ile VIX Korku Endeksi Arasındaki Ilişki: ARDL Sınır Testi Yaklaşımı [Relationship Between the US Dollar Index and VIX Fear Index: ARDL Bound Test Approach]." *Beyder* 15(2):115–29.

Güneş, Hidayet. 2020. "VIX, Dolar Endeksi ve ABD 10 Yıllık Devlet Tahvili Faizi Arasındaki Nedensellik İlişkisi [Causality Relationship Between VIX, Dollar Index and US 10-Year Government Bond Rate]." Pp. 248–53 in *4th International Congress on Multidiciplinary Social Sciences*. Vol. 5.

Han, Liyan, Li Wan, and Yang Xu. 2020. "Can the Baltic Dry Index Predict Foreign Exchange Rates?" *Finance Research Letters* 32. doi: 10.1016/j.frl.2019.04.014.

Höl, Arife Özdemir, Erdinç Akyıldırım, Şerife Kılıçaslan, and Kader Çınar. 2022. "Baltık Kuru Yük Endeksi, Petrol, Altın, Dolar, MSCI Dünya Endeksi Arasındaki Volatilite Yayılımı [Volatility Spillover between Baltic Dry Index, Oil, Gold, Dollar, and MSCI World Index]." *Ekonomi, Politika & Finans Araştırmaları Dergisi* 7(2):386–406. doi: 10.30784/epfad.1089836.

İltaş, Yüksel, and Fatih Güzel. 2021. "BİST-100 Endeksi ve Belirsizlik Göstergeleri Arasındaki Nedensellik İlişkisi: Türkiye Örneği [The Causality Relationship Between Srock Exchange Index and Uncertainty Indicators: The Case of Turkey]." *Hacettepe Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi* 39(3):411–24. doi: 10.17065/huniibf.821072.

Kaminsky, Graciela L., and Carmen M. Reinhart. 1999. "The Twin Crises: The Causes of Banking and Balance-of-Payments Problems." *American Economic Review* 89(3):473–500. doi: 10.1257/aer.89.3.473.

Kaminsky, Graciela, Saul Lizondo, and Carmen M. Reinhart. 1998. "Leading Indicators of Currency Crises." *IMF Staff Papers* 45(1):1–48.

Kaya, Abdulkadir, and İkram Yusuf Yarbaşı. 2020. "MSCI Endeksi ve BIST 100 Endeksi Öncül Ardıl İlişkisi [The Lead-Lag Relationship between MSCI Index and BIST 100 Index]." *Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi* 34(3):749–67. doi: 10.16951/atauniiibd.701477.

Kenourgios, Dimitris, Aristeidis Samitas, and Nikos Paltalidis. 2011. "Financial Crises and Stock Market Contagion in a Multivariate Time-Varying Asymmetric Framework." *Journal of International Financial Markets, Institutions and Money* 21(1):92–106. doi: 10.1016/j.intfin.2010.08.005.

Kumar, Abhishek, Sushanta Mallick, M. S. Mohanty, and Fabrizio Zampolli. 2022. *Market Volatility, Monetary Policy and The Term Premium*. 606.

Kumar, Mohan, Uma Moorthy, and William Perraudin. 2003. "Predicting Emerging Market Currency Crashes." *Journal of Empirical Finance* 10(4):427–54. doi: 10.1016/S0927-5398(02)00068-3.

Licchetta, Mirko. 2009. *Common Determinants of Currency Crises: Role of External Balance Sheet Variables*. 366. Lonfon.

Lin, Faqin, and Nicholas C. S. Sim. 2013. "Trade, Income and the Baltic Dry Index." *European Economic Review* 59:1–18. doi: 10.1016/j.euroecorev.2012.12.004.

McIver, Ron P., and Sang Hoon Kang. 2020. "Financial Crises and the Dynamics of the Spillovers between the U.S. and BRICS Stock Markets." *Research in International Business and Finance* 54:101276. doi: 10.1016/j.ribaf.2020.101276.

Milesi-Ferretti, Gian-Maria, and Assaf Razin. 2000. "Current Account Reversals and Currency Crisis: Empirical Regularities." Pp. 285–323 in *IMF Working Papers*. Vol. 98, edited by P. Krugman. University of Chicago Press.

Nakatani, Ryota. 2018. "Real and Financial Shocks, Exchange Rate Regimes and the Probability of a Currency Crisis." *Journal of Policy Modeling* 40(1):60–73. doi: 10.1016/j.jpolmod.2017.10.004.

Öner, Hakan. 2018. "Uluslararası Finansal Endekslerin Döviz Kurları Üzerine Etkileri: Ampirik Bir Analiz [The Effects of International Financial Indexes on Foreign Exchange Rates: An Emprical Analysis]." *Selçuk Üniversitesi Sosyal Bilimler Meslek Yüksekokulu Dergisi* 21(2):173–85. doi: 10.29249/selcuksbmyd.426973.

Öner, Hakan. 2019. "Korku Endeksi Ile Gelişmekte Olan Ülke Tahvil Piyasaları Arasındaki İlişkinin Ampirik Analizi [Empirical Analysis of the Relationship between Fear Index and Emerging Countries Bond Markets]." *Muhasabe Bilim Dünyası Dergisi* 21(1):140–54.

Özgen, Ferhat Başkan, and Bülent Güloğlu. 2004. "Türkiye'de İç Borçların İktisadî

Etkilerinin VAR Tekniğiyle Analizi." *ODTÜ Gelişme Dergisi* 31:93–114.

Sartorius, Kurt, Benn Sartorius, and Dino Zuccollo. 2018. "Does the Baltic Dry Index Predict Economic Activity in South Africa? A Review from 1985 to 2016." *South African Journal of Economic and Management Sciences* 21(1):1–9. doi: 10.4102/sajems.v21i1.1457.

Sims, Christopher A. 1980. "Macroeconomics and Reality." *Econometrica* 48(1):1. doi: 10.2307/1912017.

Syzdykova, Aziza. 2016. "Döviz Kuru ve Enflasyon Arasındaki İlişki : BRİC Ülkeleri Örneği [The Relationship between Inflation and Exchange Rate: The Case of BRIC Countries]." *Uluslararası Yönetim ve Sosyal Araştırmalar Dergisi* 3(6):1–14.

Tekbaş, Murat. 2019. "BRICS-T Ülkelerinde Ekonomik Büyüme ve Küreselleşme İlişkisi [Relationship Between Economic Growth and Globalization in The BRICS-T Countries]." *Finans Ekonomi ve Sosyal Araştırmalar Dergisi* 4(3):397–412. doi: 10.29106/fesa.615249.

Toda, Hiro Y., and Taku Yamamoto. 1995. "Statistical Inference in Vector Autoregressions with Possibly Integrated Processes." *Journal of Econometrics* 66(1–2):225–50. doi: 10.1016/0304-4076(94)01616-8.

Yıldırım, Ecenur Uğurlu. 2021. "Covid-19 Pandemi ve 2008 Ekonomik Kriz Dönemlerinde Riskten Kaçınma Düzeyinin ABD ve BRIC Piyasa Entegrasyonu Üzerindeki Değişen Etkisi [The Changing Effect of the Risk Aversion on US and BRIC Market Integration During The COVID 10 Pandemic and 2008 Econo." *Muhasebe ve Finansman Dergisi* 866684(90):185–208. doi: 10.25095/mufad.866684.

https://www.investing.com/

https://fred.stlouisfed.org/

https://www.boc.cn/en/

https://www.cbr.ru/eng/

https://www.bcb.gov.br/en

https://www.centralbankofindia.co.in/en

Chapter 5

THE EFFECT OF TAX POLICIES ON CORPORATE CAPITAL STRUCTURES: A STUDY ON COMPANIES LISTED IN BORSA ISTANBUL[1]

Kemal Faruk YAZGAN[2]

Arif SALDANLI [3]

1 This study is derived from the thesis titled "The Tax Effect in Determining Companies' Capital Structures: An Application on Borsa Istanbul" presented by Kemal Faruk Yazgan in the Business Administration Doctorate program at Istanbul University Social Sciences Institute. Thesis advisor Assoc Prof. Dr. Arif SALDANLI. PhD dissertation acceptance date: 08.03.2023.

2 Phd.,Tax Inspector, Republic of Türkiye Ministry of Treasury and Finance, The Presidency of Tax Inspection Board, İstanbul, Türkiye
EMAIL: kemal.faruk.yazgan@vdk.gov.tr ORCID: 0000-0003-4084-2969

3 Assoc. Prof. Dr., Istanbul University, Faculty of Economics, Department of Business, İstanbul, Türkiye
EMAIL: saldanli@istanbul.edu.tr ORCID: 0000-0001-9990-9510

1. INTRODUCTION

The financial and investment decisions made by company managers affect the value of companies. When making investment decisions, the expected return and the risks of projects are evaluated. Financing investment costs can be done through internal or external sources. In internal financing, companies finance investments from their funds without choosing to distribute profits. In external financing, companies can obtain financing by borrowing from banks or financial institutions or issuing shares. Since all these decisions company managers make affect the company's value, they are essential. However, internal and external sources have different advantages and disadvantages for companies due to their specific characteristics. External sources allow interest payments to be written off as financing expenses and deducted from companies' taxable income. This reduces the tax companies pay, making borrowing costs lower than equity costs and increasing the tendency of companies to finance through borrowing.

Equity financing is an essential need for both companies and the national economy. In this context, an incentive system was introduced in the Corporate Tax Law to encourage cash capital increases, which will help increase cash ratios, a vital element of the company's capital structure, and strengthen equity. With the relevant regulation, the interest calculated over cash capital increases of existing and newly established companies, in compliance with the stated conditions, can be deducted from taxable income. This prevents companies from turning to borrowing for financial advantages and reduces financial risk. Additionally, it eliminates the superiority of borrowing over equity financing. This practice results in a decrease in the financial leverage ratio, strengthening the capital structure and preventing the financial fragility of companies.

Companies' short- and long-term financing levels are significantly influenced by tax regulations. This study aims to determine if the tax deduction application for cash capital increase, a tax regulation affecting the capital structures of companies in Turkey, influences the capital structures of companies and the changes in their financial leverage ratios. In the literature, studies have been conducted on the factors determining the capital structures of countries, company-specific and macroeconomic factors and characteristics affecting the capital structures of companies, and the influence of taxation on determining the capital structures of companies. However, studies evaluating the impact of tax on the capital structures of publicly traded companies on the Istanbul Stock Exchange in Turkey have yet to be available and primarily focus on legal analyses.

This study includes company-specific factors and the tax deduction application for cash capital increase. Companies' financial leverage ratio

changes were investigated by considering the tax deduction application for cash capital increase and company-specific factors.

2. LITERATURE REVIEW

2.1 Studies on the Capital Structure Theories

There is a substantial body of both domestic and international research that explores capital structure theories. Some studies focus on the impact of these theories on a company's capital structure, while others examine the various factors that influence them. In two studies conducted in 1958 and 1963, Modigliani-Miller used data from electricity and petroleum companies to analyze the relationship between the debt-equity ratio, cost of capital, and average cost of capital using cross-sectional regression analysis. In the first study, they concluded that there was no relationship between a company's market value, cost of capital, and capital structure. In the second study, considering taxes, they argued that taking advantage of tax benefits by borrowing could reduce a company's financing costs and increase its market value. However, they noted that companies do not have unlimited borrowing capacity, and individual taxes should be considered alongside corporate taxes (Modigliani & Miller, 1958; 1963).

Masulis (1983) examined the effect of security changes announced by companies when raising capital on the financial leverage ratio. It was observed that an increase in the financial leverage ratio positively affected the company's market value and stock prices. Moreover, the company's market value increased as the financial leverage ratio approached the industry average. Titman and Wessels (1988) investigated the components affecting capital structure in companies' short and long-term borrowing preferences. The study found only a significant negative correlation between the financial leverage ratio and the company’s profitability.

Shyam-Sunder and Myers (1994) examined the validity of the balance theory and financing hierarchy theories using financial data from companies operating in the United States. The results of the study showed that the explanatory effect of the financing hierarchy theory on companies' financing decisions was higher. Rajan and Zingales (1995) studied the capital structures of public companies in G7 countries and attempted to identify the factors affecting the capital structure. As a result of the study, a positive connection between the financial leverage ratio and the company's profitability indicator was found for Germany. In contrast, a negative association was found for all other countries except France.

Goswami, Noe, and Rebello (1995) investigated the effect of information asymmetry on borrowing and financing maturity. If long-term borrowing causes asymmetric information, companies will finance through long-term

borrowing by restricting dividend distribution. If short-term borrowing causes asymmetric information, companies prefer financing through short-term or long-term borrowing that does not restrict dividend distribution.

When examining the studies conducted to determine the variables affecting a company's capital structure decisions, Durukan (1997) found a positive association between financial leverage ratio and firm size, growth rate, and tax rate, and a negative association between other variables and financial leverage ratio. Yener (2002) used panel data analysis and found a statistically negative relationship between financial leverage, growth rate, risk, and tax shield. It was concluded that macroeconomic variables influence companies' capital structures more than firm-specific variables. Chen (2004) identified a positive relationship between the financial leverage ratio and a firm's growth opportunities and asset structure and a negative relationship between the financial leverage ratio and firm profitability. The study showed that the assumptions of modern capital structure approaches needed to be revised for companies operating in China. Acaravcı and Doğukanlı (2004) found that asset structure, banking sector, growth rates, tax rates, inflation, and GDP ratio statistically positively affected capital structure. At the same time, a negative correlation was observed between the structure of property, plant, and equipment and the capital structure. Fıratoğlu (2005) identified a negative relationship between a company's profitability and debt ratio, indicating that internal resources are preferred to meet financing needs as profitability increases. Sayılgan, Karabacak, and Küçükkocaoğlu (2006) revealed a statistically significant positive association between capital structure and firm size as well as growth opportunities. Additionally, it identified a negative relationship between corporate profitability, wealth structure, and tax shield. Kandır, Karadeniz, and Önal (2007) found that profitability and sales affected companies' capital structures.

Heyman, Deelof, and Ooghe (2008) determined that companies with higher growth rates and lower tangible fixed asset ratios had lower financial leverage ratios. It was found that asymmetric information affected the financing decisions of the company. Furthermore, companies provided risk-free and short-term borrowing for financing new investments. Terim and Kayalı (2009) found a statistically positive relationship between financial leverage ratio and firm size and growth rate, and a statistically negative relationship between financial leverage ratio and wealth structure, firm profitability, and tax protection. Okuyan and Taşçı (2010) found a statistically positive relationship between the financial leverage ratio and added value created.

Additionally, company size and profitability positively affected the financial leverage ratio. Companies' profitability and size increased, so they preferred financing with less debt. This situation indicates that companies prefer to use internal resources primarily. Sheikh and Qureshi (2014) found that company

profitability, the collateral value of assets in the balance sheet, and size affected companies' financing decisions. A negative relationship was found between taxes and long-term debt and a positive relationship between taxes and current debt and total debt. Correia et al. (2015) found a statistically positive association between financial debt and firm size, and a positive association between tax shield and asset structure on the firm's balance sheet. A statistically negative relationship was found between the financial leverage ratio and corporate profitability.

In their 2000 paper, Chirinko and Singha investigated the validity of the results obtained by Shyam-Sunder and Myers in their study. They concluded that the model was not valid and needed to be reconsidered. They also found that the validity of the financial hierarchy theory and the balancing theory should be examined through different modeling approaches. Fama and French (2002), Mazur (2007), Yıldız et al. (2009), Sayılgan and Uysal (2011), Burucu and Öndeş (2016), Cansız and Sayılgan (2017), and Bilgin (2018) have researched the validity of financial hierarchy theory and the balancing theory through debt financing and dividend distribution. Their findings support the validity of the financial hierarchy approach.

Frank and Goyal (2003) used panel data analysis to examine the financial information of 157 publicly traded companies between 1971 and 1998. They found that companies preferred to finance their investments using external sources rather than internal ones, which contradicts the financial hierarchy approach in capital structure decisions. Tong and Green (2005) investigated the validity of the financial hierarchy theory and the balancing theory by examining the financial data of 50 large companies operating in China and listed on the stock exchange. Their results show a statistically negative relationship between leverage and corporate profitability according to financial hierarchy theory. They also found a positive relationship between current debt levels and dividends paid in previous periods.

Frank and Goyal (2005) tested the validity of the financial hierarchy and balancing theories. They found that companies met their financing needs with internal resources and borrowed from banks. They observed that small companies relied on equity financing, while large companies used cash flows from internal resources and private sector debt financing. They also discovered that transaction, financial distress, and bankruptcy costs influenced financing decisions. They concluded that only some of the capital structure approaches could fully explain the determination of the optimal capital structure. Zeitun and Tian (2007) examined the relationship between the capital structure and financial performance of 167 companies operating in Jordan's service and manufacturing sectors. The financial data of the companies from 1989 to 2003 were used in the panel data analysis. The study found a positive association between firm size and financial performance and

a negative association between Tobin's Q and firm risk. The negative relationship between company size and risk suggests that larger companies face lower bankruptcy risks and costs.

Pouraghajan and Malekian (2012) examined the impact of funding decisions on the financial performance of 80 companies traded on the Tehran Stock Exchange between 2006 and 2010. They found a negative relationship between the financial leverage ratio and a company's financial performance. Yener and Karakuş (2012) investigated the effect of financial leverage ratios on the market value of 63 companies listed on the BIST100 index between 2004 and 2009. The results of their study indicated that the capital structure did not affect the market value of the companies, and their findings did not align with widely accepted approaches suggesting that debt financing reduces the average cost of capital.

Yücel (2014) investigated the relationship between the industrially diversified capital structures and agency costs of companies operating in Turkey between 2006 and 2012. According to the analysis results, it was found that debt ratio, profitability, tax shield, and company size were statistically significant in companies with industrial diversification. A statistically positive relationship was identified between financial leverage ratios, industrial diversification, and agency costs. In contrast, a negative relationship was found between financial leverage ratios, tax shields, and company profitability. Coşkun and Güngör (2015) examined the factors influencing the capital structure decisions of 110 companies operating in the industrial sector in Turkey between 2003 and 2013. In the study, three separate models were established, and the results of the first model revealed a statistically positive relationship between financial leverage ratios and growth rates, current ratios, and asset structures.

In contrast, a statistically negative relationship was found between financial leverage and cash flow ratios. According to the results of the second model, a statistically positive relationship was observed between financial leverage ratios and financial risk and cash flow ratios. The final model detected a statistically negative relationship between financial leverage ratios, current ratios, and tax shields.

Karadeniz et al. (2016) examined the impact of capital structure decisions on the profitability of eight companies operating in the tourism sector in Turkey using financial data. The study found that long-term financial leverage ratios did not affect profitability, but long-term financial leverage ratios significantly impacted company profitability. It was suggested that companies should prefer equity financing for their assets and avoid debt financing to increase profitability levels. Kocaman et al. (2016) investigated whether there was a relationship between the financial indicators and profitability of 15 companies operating in the industrial sector in Turkey between 1997 and 2013 using

financial data. As a result of the analysis found a statistically significant relationship between profitability and net profit margin, financial leverage ratio, receivables turnover, and the ratio of fixed assets to total assets.

In a study conducted by Eralp (2017), financial data was utilized to examine the influence of stock market development levels on the capital structure decisions of 120 companies operating in Turkey during the period spanning from 2005 to 2015. Three models were established as a consequence of the study. The initial model has established a statistically significant inverse correlation between the financial leverage ratios, which serve as the dependent variable, and the level of capital market development. The findings of the second model indicate the absence of a statistically significant correlation between the long-term debt/equity ratio and firm-specific variables. The third and ultimate model has ascertained an inverse correlation between the ratio of short-term debt to equity, the degree of development in the capital market, and a company's profitability ratios. The study conducted by Bortych (2017) investigated the influence of financing decisions on the financial performance of 1,476 private companies and 217 public companies that were operational in the Netherlands from 2010 to 2016. The study's results suggest that total debt positively impacted the capital structures and performance of both private and public companies. The study found an inverse correlation between public companies' short-term debt and their return on investments (ROA), and privately held companies' long-term debt and ROA.

Guo et al. (2018) investigated the validity of modern capital structure approaches using financial data from 1,057 companies operating in China between 2000 and 2011. The analysis results suggest that the pecking order theory is more effective than the trade-off theory in determining the financing decisions of companies operating in China. Aksoy and Kandil Göker (2018) and Onatça Engin et al. (2019) studied the factors affecting the capital structure of manufacturing companies in Turkey using financial data. They found that as the company size changes, the relationship between financial leverage and company performance also varies. Therefore, companies need to consider their size when making financing decisions. Using financial data, Yıldız and Demireli (2019) examined the variables affecting the capital structure of retail companies in Turkey between 2009 and 2017. They found that the impact of short-term debt can be explained by total debt/equity, equity/total assets, and growth-related variables. In contrast, the effect of long-term debt can be explained by the company's age, equity/total assets, and total debt/equity ratio variables.

When considering the studies in the literature, it is observed that the factors affecting capital structure vary from country to country and over time. When examining the variables affecting the capital structure, it has been determined that the accepted independent variables are size, asset structure, profitability,

growth rate, and liquidity ratios. The accepted dependent variable, on the other hand, is the financial leverage ratio, asset, and equity profitability. The studies found that companies base their funding decisions on the pecking order theory, one of the modern approaches to capital structure, and their behavior is partially consistent with the trade-off theory.

2.2 Studies on the Effect of Taxes on Determining the Capital Structure of Companies

Graham (1996) showed that between 1980 and 1992, companies with high marginal tax rates also had high debt-to-equity ratios. Huang and Song (2006) investigated the factors influencing capital structure using data from 1,216 firms listed on the Chinese stock exchange from 1994 to 2003. Using Tobit regression analysis and the least squares method, they discovered a positive correlation between the financial debt ratio, company size, property, plant, and equipment. In contrast, there was a negative correlation between the financial leverage ratio, corporate profitability, ownership structure, and growth prospects. Buettner, Overesch, Schreiber, and Wamser (2009) analyzed the financial statements of German companies and found that high tax rates led to increased borrowing.

Tzioumis and Klapper (2012) studied the financial statements of Croatian companies, concluding that reduced tax rates encouraged firms to use more equity. Faccio and Xu (2015) aimed to differentiate the impacts of income and corporate tax on capital structure, discovering that companies preferred higher borrowing as corporate tax and personal income tax rates on dividends increased. They also observed that rising income tax rates on interest income lowered firms' financial leverage ratios. Devereux, Maffini, and Xing (2018) investigated the effect of tax rates on companies' borrowing levels by examining financial statements of UK firms between 2001 and 2009, determining that tax rate changes influenced firms' financial leverage ratios. Aksoy (2020) examined the impact of the equity tax shield on companies' financial policies in Turkey after a legal amendment allowed firms to deduct interest expenses related to cash capital increases from their tax base, revealing that the equity tax shield positively affected firms' investment, financing, and dividend policies.

Kandir and Yakar (2022) highlighted that Turkish Corporate Tax Law No. 5520 limited financing expenses, restricting the deduction of interest, commission, and other costs related to foreign financing sources exceeding equity by 10%. Their study analyzed companies' financial statements in the Istanbul Chamber of Industry (ISO) 500 and the Istanbul Stock Exchange (BIST) Industry and Services sectors, finding that most firms had more debt than equity and that the financing expense limitation would influence capital structure decisions. Yazgan and Saldanlı (2022) discovered that companies' increased reliance on debt financing through their passive structure led to

heightened financial vulnerability. The financing expense limitation would affect firms' financing decisions by disallowing a 10% portion of interest, commission, exchange rate differences, and other costs related to foreign financing sources exceeding equity from being deducted from their tax base. Their research aimed to uncover the effects of the financing expense limitation on firms' capital structure, concluding that the limitation would positively impact firms' financing policies.

3. CAPITAL STRUCTURE THEORIES AND TAX REGULATIONS IN TURKEY THAT AFFECT THE CAPITAL STRUCTURES OF COMPANIES

Multiple capital structure theories concentrate on how businesses should arrange their debt (short-term and long-term liabilities) and equity mix, the effect on company value, and the factors that influence it. The two main capital structure methods—classical capital structure approaches and current capital structure approaches—divide these theories. Modern approaches concentrate on identifying the variables that affect capital structure, while traditional approaches seek to determine the debt and equity mix that positively effects a company's value. Before describing the numerous capital structure theories that may be found in the literature, this section will first define the idea of capital structure.

3.1. Concept of Capital Structure

Choosing the quantities and maturities of the resources needed for businesses to maintain their operations, as well as how these resources will be acquired and employed, is one of the key jobs of enterprises. This financing can be provided by either debt or equity. Debt is acquired from outside sources and can be divided into short-, medium-, and long-term liabilities. In contrast, equity can come from both internal sources within the organization (such as reserves and retained earnings) and external sources (such as preference shares and new partners). Capital structure can be described as the relationship between debt and equity (Akgüç, 1986: 481). In other words, it is the composition of debt and equity in a company's long-term financing structure (Megginson, 1997, p. 305). Capital structure is the blend of capital allocated as short/long-term debt and equity (Mishkin & Eakins, 2011, p. 320).

The decisions made regarding allocating financing sources in a capital structure are crucial for companies. While short/long-term liabilities represent borrowing connections, equity signifies ownership connections. Consequently, these two sources possess different characteristics (Türko, 2002: 489). These distinct features create a delicate balance between the risks companies undertake and their profitability. Hence, the benefits and drawbacks of debt and equity in the financing sources used for company assets should be considered when determining capital structure. Debt advantages include reducing the actual cost of debt through the deduction of interest on

short and long-term liabilities when calculating taxable income and the ability to obtain profits without sharing them. Disadvantages include the risk of increasing interest burdens due to higher borrowing levels and potential issues that may lead to the company's bankruptcy if profits cannot cover interest expenses (Okka, 2009, p. 411).

As a result, a company's risk and return levels should be considered when determining an optimal capital structure that will enhance the company's market value and keep its capital costs at the lowest level (Aydın et al., 2011, p. 171).

Capital structure theories seek to establish how companies should arrange their capital and work toward determining the optimal capital structure. Financial managers' ultimate goal is to maximize the company's market value. Over time, various approaches have been employed to identify the optimal capital structure that impacts a company's value.

3.2. Capital Structure Theories

Capital structure theories can be categorized into two primary groups: classical capital structure theories and modern capital structure theories. Classical capital structure theories encompass the net income, net operating income, traditional, and Modigliani-Miller approaches. Modern capital structure theories include the Trade-off Theory, Financial Hierarchy Theory, Signaling Theory, Dynamic Capital Structure Theory, and Tax Approach.

The net income approach posits that as a company raises its debt, its cost of capital diminishes, leading to an increase in market value. Conversely, the net operating income approach asserts that a company's debt-to-equity ratio has no bearing on its value. The traditional approach contends that when a company employs debt until it reaches its optimal capital structure level, its average cost of capital will decline, resulting in a corresponding increase in market value. Like the Net Operating Income technique, the Modigliani-Miller approach assumes no correlation between a company's capital structure and value.

According to the trade-off theory, companies assess the tax advantages and costs associated with debt financing in order to determine their optimal capital structure. According to the theory of financial hierarchy, organizations first finance their needs with internal resources, then with debt financing when internal resources are insufficient, and finally with equity financing. According to the signaling theory, companies are influenced by asymmetric information when determining their capital structures. Creditors providing debt or equity financing, as well as shareholders and managers of the company, all need information about the company. Dynamic capital structure theory posits that companies optimize their capital structures within a range of predetermined debt levels. The tax approach has shown that companies

need an optimal capital structure, taking corporate and income tax into account.

3.3. Tax Regulations in Turkey That Affect the Capital Structures of Companies

Specific tax regulations exist to deter companies from relying on debt financing and to encourage equity financing instead. One such regulation in the Corporate Tax Law pertains to the possibility of a tax deduction for cash capital increases. This regulation incentivizes companies to finance through equity. This section elaborates on the legal regulations concerning tax deductions for cash capital increases.

The Law on Making Amendments to Some Laws and Decree Laws (No. 6637), published in the Official Gazette on March 27, 2015, introduced subclause (i) to the first paragraph of Article 10 titled "Other Deductions" in the Corporate Tax Law (No. 5520). This regulation enabled the deduction of interest amounts calculated for cash capital increases from the corporate tax base, provided that capital companies declare it. The provisions of this regulation are generally outlined in the law. The "Communiqué on the Amendment of the Corporate Tax Communiqué (Serial No: 9)" containing implementation details was published in the Official Gazette No. 29643 on March 4, 2016, and became effective. The tax deduction's scope, information about taxpayers who can benefit from the deduction, and the deduction's calculation are included in the Corporate Tax Communiqué.

The rationale behind offering this deduction opportunity to companies is emphasized in the law's justification as promoting capital increases by deducting interest calculated on cash-increased capital from the corporate tax base for capital companies. Furthermore, the deduction regulation that permits both cash and paid-in capital increases serves to strengthen companies' capital structures, allowing them to elevate production levels, keep pace with evolving and advancing technologies, benefit from economies of scale, and ultimately generate positive effects on the country's economy, such as increased employment levels and reduced unemployment rates (Akçay, 2017, p. 362).

The provision in the Corporate Tax Law permits the amounts calculated for cash capital increases by companies to be deducted from the corporate profits of the relevant year. The critical aspects of the regulation include the taxpayers who can/cannot benefit from the deduction, the deduction's scope, the information required to calculate the deduction amount, and the accurate determination of the deduction amount. These aspects are crucial for a comprehensive understanding of this regulation and are explained in detail below

- **Taxpayers who will benefit and who will not benefit from Tax Deduction**

As outlined in the Corporate Tax Law and the Communiqué, only capital companies that fulfill the conditions stipulated in the regulation can take advantage of the deduction. However, organizations functioning in the financial, banking, and insurance sectors and public economic entities are not eligible for the law's benefits, even if they are corporate taxpayers. Article 124(2) of the Turkish Commercial Code No. 6102 classifies capital firms as corporations, limited liability companies, and limited partnerships with shares. Taxpayers who meet the conditions specified in the law among these companies can benefit from the tax deduction resulting from cash capital increases.

Additionally, the Communiqué imposes certain restrictions under the title "Restrictions on the Application of the Deduction," where no tax deduction will be applied at 0%.

- **Scope of Tax Deduction**

According to the Corporate Tax Communiqué, a cash capital increase refers to the amount of paid-in capital or the cash increase in capital amounts issued by companies registered in the commercial register during the accounting period in which the cash capital increase occurs. For newly established capital companies, it pertains to the cash portion of the paid-in capital. To benefit from the tax deduction resulting from cash capital increases, it is not enough for companies to have a cash capital increase decision; they must also be registered in the commercial register. As stated in the Communiqué, only the cash portion deposited into the company's bank account will be valid for the tax deduction calculation. The commercial loan interest rate mentioned in the same communiqué is the weighted average annual interest rate banks charge for commercial loans denominated in Turkish lira. It represents the latest "Commercial Loans (Except Corporate Credit Cards and Legal Entity KMH) (Opened in TL)" interest rate announced by the Central Bank, applicable for the year in which the deduction is claimed. Lastly, the period specified in the Communiqué refers to the proportion of the period from the month in which the cash capital increase registered in the commercial register is deposited into the company's bank account until the end of the accounting period, limited to 12 months.

- Only cash capital increases in capital companies are included in the calculation of the amount subject to the deduction, so it is impossible to benefit from the deduction for capital increases resulting from non-cash asset transfers. The Communiqué specifies the following cases where capital companies cannot benefit from the tax deduction:
- Increases resulting from non-cash asset transfers to capital companies,

- Increases resulting from merger-acquisition-division transactions of capital companies,
- Increases resulting from adding equity items in the balance sheet to the capital of the company,
- Increases resulting from using loans or borrowing from shareholders or related parties of the company,
- Increases resulting from issuing securities such as stocks-bonds-notes other than cash capital to the company,
- Increases arising from netting items in the company's balance sheet a re not factored into the deduction calculation.

➢ **Data Used in Calculating Tax Deduction**

Various data are used to calculate the tax deduction for cash capital increases. These data include the period to be used as the basis for the tax deduction calculation, the applicable tax deduction rate, and the commercial loan interest rate. Detailed explanations regarding these data are provided below.

➢ **Calculation Period**

The start date of the deduction application, which is included in the tax legislation, is considered to be July 1, 2015, if all the conditions in the regulation are met. However, different approaches consider the regulation to create injustice among taxpayers, as the tax deduction application provides an advantage to companies that carry out cash capital increases before July 1, 2015, compared to companies that were established before that date or that made cash capital increases (Yazar, 2015, p. 137).

In the period after July 1, 2015, it is of great importance for the tax deduction applies to determine the date when the calculation will start, how much period will be utilized for the tax deduction, and the limitation period that will be used in the calculation for the first year that the tax deduction will be applied. There may be two distinctive situations in determining the start date of the tax deduction calculation.

These are:

• For the portion deposited into the company's bank account before the date on which the decision on cash capital increase is registered with the trade registry, the registration date should be considered.

• For the amounts deposited into the company's bank account after the registration date with the trade registry, the deposit date to the company's bank account should be considered.

Therefore, more is needed to have made a decision about cash capital increase and registered it with the trade registry to benefit from the deduction. The capital increase must also have been deposited into the bank account. No

calculation is made for the amount of cash capital increase not deposited into the bank account. The calculation period for the deposited amount is taken into account starting from the month in which the capital increase was deposited in the bank. On the other hand, if the money has been deposited into the bank, but the registration with the trade registry still needs to be completed, the registration date is considered in calculating the period.

When calculating the total period during which the tax deduction can be claimed under the law, companies can claim this deduction for five separate accounting periods, including the accounting period in which the capital increase decision is entered in the articles of association or the incorporation phase of society. It is possible to benefit from the tax deduction separately for each of the following four periods starting from the accounting period in which the cash capital increase was made.

In the following years, companies may reduce their increased cash capital. The regulation states that "it is not possible to benefit from this deduction for the portion of the cash capital reduction decision registered with the trade registry, following the month in which the decision for the reduced amount of cash capital increase was registered." In addition, if a capital reduction is made before a cash capital increase, the portion corresponding to the reduced capital will not be considered in the deduction calculation.

- **Tax Deduction Rate**

The condition for being deductible from corporate income is stated in Article 10 of the Corporate Tax Law, where 50% of the interest amount calculated until the end of the relevant accounting period must be indicated in the annual declaration. However, the President is authorized to reduce this 50% rate to zero or increase it up to 100% and to determine different rates for publicly traded companies up to 150% depending on their public disclosure rate. The factors that the President should consider in determining these rates include the companies' asset size, the legal status of their partners, the number of employees, and their annual net sales revenues. These factors are expressed as follows:

- Based on whether the income from the investment made with the capital consists of passive income such as interest, profit sharing, rent, license fees, and securities sales revenue that are not within the scope of the company's main activities,
- Whether the investment made with the capital is subject to incentive certificates,
- The areas where the capital is used for investments in machinery and equipment or land,
- Depending on the regions, sectors, and business lines.

According to the Corporate Tax General Communiqué, "in publicly traded companies whose shares are traded on the stock exchange, the discount rate will be applied by adding 25 points for companies whose ratio of the nominal amount of shares that are being monitored as a tradable share at the Central Securities Depository to the paid-up or issued capital registered in the trade registry is 50% or less, and 50 points for companies whose ratio is above 50%." Therefore, the ratio of the nominal amount of shares being monitored at the Central Securities Depository to the paid-up or issued capital registered in the trade registry is significant. If the determined ratio is 50% or less, the total discount rate to be applied will be 75%, and if it is above 50%, the discount rate will be applied as 100%.

In the same communiqué, it is stated that if the cash capital is used for investment incentives, production, and industrial facilities, machine and equipment investments related to these facilities, and land investments allocated for the construction of these facilities, there are opportunities to benefit from this tax discount by adding 25 points limited to the fixed investment amount specified in the investment incentive certificate.

Therefore, if the ratio of the nominal value of shares that can be traded on the Central Securities Depository to the issued capital is 70%, and a part of the cash capital increase is evaluated in investment incentive-certified industrial facility investments, the discount rate will be applied as 125% for the limited part specified in the investment incentive certificate (%50 + %50 + %25). For the part above the fixed investment amount specified in the investment incentive certificate, the discount rate will be 100% (%50 + %50). (Coşgun, 2016: 169).

- **Commercial Credit Interest Rate**

Under Article 10 of the Corporate Income Tax Law, subparagraph (i), the interest rate for commercial loans is calculated based on the weighted average annual interest rate applied to commercial loans in Turkish lira opened by banks, which is announced by the Central Bank of the Republic of Turkey (CBRT) for the year in which the discount is applied. The Corporate Tax General Communiqué defines the interest rate on commercial loans that will be taken into account as "the interest rate on commercial loans (applied in Turkish Lira) which will be calculated according to the weighted average interest rates applied to commercial loans opened by banks announced by the Central Bank for the year in which the discount is applied."

Furthermore, companies that have opted for a particular accounting period will benefit from the discount by calculating it based on the latest interest rate on commercial loans announced by the Central Bank at the end of the month in which their accounting period ends, provided that the conditions specified in the regulation are met (Çetin, 2017, p. 38).

- **Calculation of Tax Deduction**

The amount deductible from corporate income for companies that increase their capital in cash requires calculation based on the cash capital increase amount, the calculation period, the latest announced commercial loan interest rate by the Central Bank, and the discount rate. According to the Corporate Tax General Communiqué, the discount amount to be calculated for the discount application is calculated by considering the remaining period of the accounting period, taking into account the restriction period, by considering the whole month for the month in which the cash capital is paid. The amount deductible from corporate income is calculated as follows based on the specified data:

Deductible Amount from Corporate income = Cash Capital Increase Amount x Commercial Loan Interest Rate x Discount Rate x Calculation Period

4. EMPIRICAL APPLICATION OF THE TAX EFFECT ON DETERMINING THE CAPITAL STRUCTURES OF COMPANIES

4.1 Scope and Dataset of the Research

The scope of this research includes public companies traded on Borsa Istanbul. However, the research scope has excluded finance, banking, and insurance sectors that cannot benefit from a tax deduction in cash capital increase due to regulation. Quarterly period-end ratios of companies such as current ratio, accounts receivable turnover ratio, return on assets ratio, net sales growth rate, and asset growth rate were used between 2010 and 2022. The research aims to investigate the relationship between the financial leverage ratio of the companies operating in Borsa Istanbul except for finance, banking, and insurance sectors and tax deduction in cash capital increase and the factors selected from the characteristics of the companies. The companies' data included in the research scope were obtained from Finnet Electronic Publishing Data Communication Inc. The research utilized the data of public and traded companies between 2010 and 2022. Within the scope of the research, the quarterly data of 12 companies that increased their cash capital before and after 2015, the year when the regulation on tax deduction in cash capital increase was made, were used between 2010 and 2022.

4.2 Determining the Variables of the Research

This study examines the impact of tax reduction practices in cash capital increase on the financial leverage ratio of companies with unique characteristics. In this section, the dependent and independent variables have been determined. The financial leverage ratio (KALDIRAC), was selected as the dependent variable by analyzing variables obtained through a literature review. The independent variables selected were the current ratio (CARI), accounts receivable turnover ratio (ALACAKHIZ), return on assets ratio (AKTIFKAR), net sales growth rate (NETSATBUY), asset growth rate

(AKBUY) and dummy variables for cash capital increases subject to tax reduction practices on specific dates for companies.

The table 1 contains the codes and titles of companies that increased paid-in capital before and after the tax deduction regulation in the cash capital increase application made on July 1, 2015, and the dates they increased capital.

Table 1: Companies that Conduct Cash Capital Increases

No	Code	Title	Cash Capital Increase Dates	
			Before 01.07.2015	After 01.07.2015
1	AFYON	Afyon Cement Industry Inc.	22.06.2015	16.04.2020
2	CEMAS	Çemaş Casting Industry Inc.	04.11.2011	28.01.2020
3	DOGUB	Doğusan Pipe Industry and Trade Inc.	30.11.2010	14.05.2019
4	KARSN	Karsan Automotive Industry and Trade Inc.	13.09.2011, 16.07.2013	13.10.2016, 14.11.2019
5	KRSTL	Kristal Cola and Beverage Industry Trade Inc.	11.08.2010	27.12.2018
6	MAKTK	Machine Tool Industry Inc.	27.05.2010 25.07.2013	23.11.2016
7	MIPAZ	Milpa Commercial and Industrial Products Marketing Industry and Trade Inc.	25.09.2013	15.02.2019
8	PENGD	Penguen Food Industry Inc.	25.10.2010	21.07.2020
9	TEKTU	Tek-Art Construction Trade Tourism Industry and Investments Inc.	01.09.2010	04.04.2018
10	USAK	Uşak Ceramic Industry Inc.	30.04.2012	18.12.2018, 10.06.2020
11	VKING	Viking Paper and Cellulose Inc.	02.12.2011	28.08.2015, 29.08.2017
12	ZOREN	Zorlu Energy Electricity Generation Inc.	15.05.2012	09.11.2015

4.3 Research Methodology

Unit root tests will be applied to determine the degree of stationarity of the dependent and independent variables included in the model to be created for each company as the econometric method of the research. In the next step, the ARDL Bounds Test method was examined to reveal the existence of a long-term relationship between the dependent and independent variables of the model. Finally, the long-term and error correction coefficients are estimated using the ARDL, and the results are interpreted. Unit root tests and ARDL tests were performed using the Eviews 10 program.

4.4 Theoretical Explanations and Analysis Results on Econometric Methodology

If a time series does not have static properties, the results of the analyzes to be performed according to this time series will be erroneous for providing a general result for periods outside the selected periods in the scope of the analysis. For this reason, unit root tests have been performed on the variables to be included in the analysis.

The long-term properties of a time series can be determined by revealing the relationship of any period value that the series has with previous period values.

In this context, regression calculations must be performed to determine the relationship between the value of a time series at any point of the research scope period and the previous period value. Unit root tests are performed to reveal these properties of the series. If a time series does not contain a unit root, it is considered stationary.

The relationship between the value of a variable in one period and its value in the previous period is as follows in the following equation:

$$Y_t = P\,Y_{t-1} + u_t \quad (1)$$

The symbol (u_t) in the above equation represents the error term. If the coefficient shown as (P) in the model is 1, the series is unit-root and not stationary. Thus, the relationship between the variables is as follows in the equation below:

$$Y_t = Y_{t-1} + u_t \quad (2)$$

The above equation represents that all instant shocks that could affect the variable's value in the previous and current periods have been eliminated and transferred to future periods. This way, eliminating all shocks and their transfer to future periods causes the sum of shocks to form the variable's value and the series to be unit-rooted. In other words, the series contains a trend and is not stationary. If (P) <1, it means that although the shocks from the previous period exhibit a short-term effect, their effects will decrease and become insignificant in influencing the variable's value. Subtracting (Y_{t-1}) from both sides of equation 1 results in:

$$\Delta Y_t = (P-1)\,Y_{t-1} + u_t \quad (3)$$

The resulting equation becomes as follows. In this new equation, ($\Delta Y_t = Y_t - Y_{t-1}$). In other words, the first difference has been taken. If the symbol represents the coefficient (P-1) ϕ, the following equation is formed:

$$\Delta Y_t = \phi\,Y_{t-1} + u_t \quad (4)$$

When P=1, ϕ will be zero. If ϕ is zero, $\Delta Y_t = (Y_t - Y_{t-1}) = u_t$, and the variable ($Y_t$) will be stationary in its first difference. Thus, since the series has become stationary in its first difference, it will be expressed as I(1). If a series becomes stationary after taking its second difference, it will be expressed as I(2). In summary, a series with a unit root can be made stationary by taking its difference.

The t-statistic cannot be used in unit root tests, and instead, the τ-tau statistic used in calculations in Dickey-Fuller's (1979) studies should be used. Dickey-Fuller has calculated the critical values of the τ-tau statistic mentioned. If the absolute value of the τ-tau statistic is above the critical threshold values (MacKinnon, 1991), the series is stationary. If it is not above the critical

threshold values, it will be concluded that the series is non-stationary (Tarı, 2016, pp. 387-389).

There are three different forms of the Dickey-Fuller test as follows:

$$\Delta Y_t = \phi Y_{t-1} + u_t$$

$$\Delta Y_t = b_0 + \phi Y_{t-1} + u_t \quad (5)$$

$$\Delta Y_t = b_0 + b_1 t + \phi Y_{t-1} + u_t$$

To eliminate the autocorrelation problem in the Dickey-Fuller test, they expanded it to include more lagged terms of the dependent variable (Dickey & Fuller, 1981, p. 1070). The expanded test aims to include the error term (u_t) in the equation as having the least autocorrelation possible. Here, H_0 = (P=1) or (ϕ=0). Therefore, the dependent variable is unit-rooted and not stationary (Tarı, 2016, p. 390). There are three different forms of the ADF test. These are the form without a constant term and trend, the form with a constant term but no trend, and finally, the form with both. The equations are as follows:

$$\Delta Y_t = \phi Yt - 1 + \sum_{i_1}^{p} \beta_i \Delta Y_{t-i} + u_t$$

$$\Delta Y_t = b_0 + \phi Yt - 1 + \sum_{i_1}^{p} \beta_i \Delta Y_{t-i} + u_t \quad (6)$$

$$\Delta Y_t = b_0 + b_1 + \phi Yt - 1 + \sum_{i_1}^{p} \beta_i \Delta Y_{t-i} + u_t$$

The independence and equal distribution of (u_t) is the most crucial assumption in the Dickey-Fuller unit root test. The expanded Dickey-Fuller (ADF) unit root test added the lagged difference term of the regression to the Dickey-Fuller unit root test. This way, it prevented the occurrence of possible autocorrelation in the Dickey-Fuller unit root test. Phillips and Perron (1988) apply non-parametric methods to detect autocorrelation in the unit root test without adding the lagged difference term to their model. (Gujarati, 2004: 818).

Although the effect of the trend is not present on the variables in the Dickey-Fuller unit root test, the standard error can be found due to the effect of the trend. This shortcoming criticized by Phillips and Perron has been resolved with the unit root test they developed. The assumptions adopted in the Dickey-Fuller unit root test for (u_t) were not considered in this test. In other words, the assumptions about the absence of autocorrelation between (u_t) in the Dickey-Fuller unit root test and homogeneity were not considered in the Phillips and

Perron unit root test. The following regression equations are used for the Phillips and Perron unit root test:

$$Y_t=a_0+a_1y_{t-1}+\mu_t$$

$$Y_t=a_0+a_1y_{t-1}+a_2(t-T/2)+\mu_t \quad (7)$$

In the regression equation above, (T) represents the number of observations. (t) represents the distribution of the error term and has a mean value of zero. The assumptions about the error terms in the Dickey-Fuller unit root test have been abandoned in the Phillips and Perron unit root test (Tarı, 2016, p. 399).

In models representing economic activity, the response of the dependent variable to the independent variables occurs after a certain period. This period is called a lag or time lag. For example, household consumption expenditures are influenced not only by the income earned in the current period but also by the income earned in previous periods or accumulated wealth. The effects of changes in macroeconomic factors, such as interest rates, inflation, etc., can continue in subsequent periods and the period in which the changes occurred.

In time series analysis studies, the relationship between variables does not usually co-occur. Sometimes, the values of the independent variable that occur in different periods can affect the dependent variable. The dependent variable (Y_t) can be influenced by the independent variable's (X) values that occur at different times, such as X_t, X_{t-1}, X_{t-2}, and X_{t-3}. This shows the dependent variable's lagged response to various independent variable values over a specific period. When an independent variable's values from different time periods are included in a time series analysis regression model, the model is said to be a distributed lag model. An equation for a distributed lag model is given below:

$$Y_t=\propto_0+\beta_0X_t+\beta_1X_{t-1}+\beta_2X_{t-2}+\beta_3X_{t-3}+...+\beta_zX_{t-z}+u_i \quad (8)$$

Because the relationship between the independent variable (X) and the dependent variable (Y_t) is dispersed across a wide range of time values, this model is known as a distributed lag model. If the model contains one or more lagged values of the explanatory variable, it is referred to as autoregressive or lagged dependent. The following equation describes an autoregressive model:

$$Y_t=\propto_0+\beta_0Y_t+\beta_1Y_{t-1}+\beta_2Y_{t-2}+\beta_3Y_{t-3}+...+\beta_zY_{t-z}+u_i \quad (9)$$

The reason for constructing an autoregressive model in this study is the assumption that the effects of tax incentives may not appear simultaneously on the financial leverage ratio when cash capital increases are made. It is assumed that the effects of tax incentives may occur gradually over time (Dikmen, 2018, p. 240).

Cointegration tests are econometric analyses widely used to identify the relationship between economic indicators. The most commonly used cointegration tests are those developed by Johansen (1988) and Engle and

Granger (1987). These tests are characterized by the non-stationarity of the series at the level values and the equal degree of integration of the variables. However, in practice, macroeconomic indicators likely have a different degree of integration. The ARDL Test reveals the association between variables even when the variables in the research have varying degrees of stationarity. The fact that the stationarity degrees of the variables used in the analysis are I(0) or I(1), in other words, that the stationarity degrees are different, is not an obstacle to applying the ARDL Bound Test. Another factor that makes the ARDL Bound Test reliable is the ability to use an unrestricted error correction model (Akel & Gazel, 2014, pp. 23-41).

The application of the ARDL bound test is a dynamic model in which the values of the dependent variable in the previous period have an influence, and short and long-term analyzes can be carried out via the model. To estimate the ARDL Bound Test model, the appropriate lag length is first determined using different information criteria. The model is estimated using the least squares method in the next step, and the results are interpreted.

The equation for an ARDL model with a dependent variable (Y) and an independent variable (X) is as follows:

$$\Delta Y_t = \beta_0 + \sum_{i_1}^{p} \beta_i \Delta Y_{t-i} + \sum_{i_1}^{p} \beta_j \Delta X_{t-j} + \lambda_1 Y_{t-1} + \lambda_2 Y_{t-1} + \varepsilon_t \qquad (10)$$

The equation represents the model's short-term coefficients (β) and long-term coefficients (λ). The first part of the equation reveals the short-term relationship between the dependent and independent variables in the model. In contrast, the second part reveals the long-term relationship between them. The (Δ) in the formula represents the first-order differences of the series. Before applying the model, it is necessary to determine the lag length (p) in the equation (Ucal, 161: 2006).

The hypotheses established for determining cointegration in the ARDL bound test model are as follows;

H_0: $\lambda 1 = \lambda 2 = 0$ (There is no cointegration)

H_1: $\lambda 1 \neq \lambda 2 \neq 0$ (There is cointegration)

A Wald test is applied to the level values of the dependent and independent variables. The F statistic values from the Wald test are compared to those reported by Pesaran et al. determined critical values compared. (2001). Suppose the F-statistic value is greater than the critical value. In this case, a cointegrated relationship exists between the dependent and independent variables, i.e., H. There is a long-term relationship between the variables. If the F-statistic value is less than the critical value, the variables have no long-

term relationship. However, there is uncertainty if the F-statistic value is between the critical values, and no definitive conclusion about the cointegration relationship can be made.

In the study, the first stage will be to estimate the long-term ARDL model if a cointegrated relationship is identified between the dependent and independent variables due to the boundary test conducted to assess the long-term relationship. In the next step, a short-term error correction model will be estimated to reveal the short-term relationship between the variables and whether the short-term imbalance will be re-balanced in the long term.

In time series analysis, the first step is determining the stationarity, in other words, whether the dependent and independent variables have unit roots. In ARDL Bound Test analysis, if the dependent and independent variables are second-order stationary I(2), it will hinder the analysis's application so that stationarity tests will be applied. In order to determine the stationarity degrees of the included dependent and independent variables, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) stationarity tests were utilized. The following hypotheses were used in both tests:

H_0: The variable is non-stationary (contains a unit root in the series).

H_1: The variable is stationary (does not contain a unit root in the series).

The analysis showed that when the Augmented Dickey-Fuller (ADF) test statistic values were smaller than the critical values of MacKinnon (1991) in absolute terms, the H_0 hypothesis was not rejected. This indicates that the series is non-stationary and contains a unit root. If the absolute value of the test statistic is greater than the crucial value, the H_0 hypothesis is rejected. This indicates that the series is stationary and lacks a unit root. As a result of the test, if the variables are stationary at the level, they are expressed as I(0), and if they are stationary after taking the first difference, they are expressed as I(1).

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) stationarity test results for the variables used in the study for 12 companies are presented in the following tables:

Table 2: Variable Unit Root Test Results

No	Firm	Kaldırac		Akbuy		Aktifkar		Alacakhiz		Cari		Netsatbuy	
		Stationary at		Stationary at		Stationary at		Stationary at		Stationary at		Stationary at	
		level I(0)	level I(1)	level I(0)	level I(1)	level I(0)	level I(1)	level I(0)	level I(1)	level I(0)	level I(1)	level I(0)	level I(1)
1	AFYON		✓	✓			✓		✓		✓	✓	
2	CEMAS		✓	✓		✓			✓		✓		✓
3	DOGUB		✓	✓			✓		✓		✓		✓
4	KARSN		✓	✓		✓		✓		✓			✓
5	KRSTL		✓	✓		✓			✓		✓		✓
6	MAKTK		✓	✓			✓	✓			✓		✓
7	MIPAZ		✓	✓		✓		✓		✓		✓	
8	PENGD		✓	✓		✓			✓		✓		✓
9	TEKTU		✓	✓		✓		✓			✓		✓
10	USAK		✓	✓			✓		✓		✓		✓
11	VKING		✓	✓		✓			✓		✓		✓
12	ZOREN		✓	✓		✓			✓		✓		✓

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests determined the series stationarity degrees. The dependent variable Financial Leverage Ratio and the other independent variables were checked for stationarity. According to the results of the stationarity tests conducted separately for each company, the variables have different stationarity degrees, and different results were obtained for some variables in terms of stationarity degrees in both tests. However, all series included in the analysis are either stationary I(0) on the plane or stationary I(1) after taking the first difference. None of the series has a stationarity degree of stationary I(2) or higher when taking the second difference. Therefore, the results obtained regarding the degrees of stationarity allow using the ARDL bound test method to determine the relationship between the variables. The ARDL Bound Test results investigating the long-term relationship between the Financial Leverage Ratio, company-specific variables, and the variable of cash capital increase are summarized in the following table.

Table 3: The Effect of Company-Specific Variables and Cash Capital Increase Variable on Financial Leverage Ratio

No	Firm	Independent Variable and Corelation					
		Akbuy	Aktifkar	Alacakhız	Carı	Dummy	Netsatbuy
1	AFYON						
2	CEMAS	(+)	(-)		(-)	(-)	(+)
3	DOGUB	(+)		(-)	(+)	(+)	
4	KARSN						
5	KRSTL	(-)	(+)				(+)
6	MAKTK		(-)	(+)	(-)	(-)	
7	MIPAZ	(+)	(-)	(+)		(-)	
8	PENGD						
9	TEKTU						
10	USAK				(-)		
11	VKING		(-)	(-)			
12	ZOREN						

The tax reduction application in cash capital increases mentioned in the first paragraph of Article 10 (ı) of the Corporate Tax Law came into effect with the regulation made on 01.07.2015. The reason for providing this opportunity to companies is to encourage capital increases by deducting the interest calculated on the cash-increased capital from the corporate tax base, as stated in the justification of the law.

The Dummy variable in the table above represents the cash capital increase made by the company. Since the financial leverage ratio will decrease after financing with equity, it is expected that cash capital increase will have a negative effect on the financial leverage ratio. According to the results of the study investigating the effect of the tax reduction incentive in cash capital increases on the determination of the capital structures of companies, only three out of the 12 companies included in the study were found to be negatively affected by the tax reduction in cash capital increases in the long term, in other words, their capital structures were affected negatively.

5. CONCLUSION AND RECOMMENDATIONS

There is a connection between the financing decisions of companies through equity or debt capital and tax regulations. However, there needs to be a literature study on the effect of tax regulations on companies' capital structures. Nevertheless, there needs to be a study using econometric methods to reveal the effect of tax regulations on companies' capital structures. Studies

conducted in Turkey on this subject have been limited to legislation evaluations. The Corporate Tax Law in the Turkish Tax System includes three different regulations that affect companies' capital structures. These regulations include tax reduction in cash capital increases, hidden equity applications, and finance expense limitation applications. This study only investigates the tax reduction effect of cash capital increases on companies' capital structures.

Companies can reduce their tax base by deducting interest payments related to financing through debt as expenses. Due to the leverage effect of debt, companies tend to use debt heavily in their financing decisions. However, this situation causes financial difficulties and representation costs. The disadvantage caused by debt, along with its advantage, is the transformation of companies and, thus, the country's economy into a fragile structure. To eliminate the impact of this disadvantage, measures that will make equity use more attractive for companies need to be taken. In this context, the tax reduction in cash capital increases was introduced in Turkey in 2015 to make equity use more attractive.

The regulation stipulates that companies that meet the conditions specified in the regulation can deduct the interest amount calculated according to the commercial credit interest rate on a particular portion of their cash capital increases as an expense in determining the tax base. As a result, the increase in the cash levels of companies will increase the liquidity ratio in the assets and, at the same time, the equity ratio in the liabilities. This study presents the tax reduction in cash capital increases in general terms and explains the effect of tax regulations on companies' capital structures.

The dummy variable that defines the tax effect on the companies' capital structures in the study represents the dates of cash capital increases. In addition to the tax variable, variables specific to companies, such as the asset growth rate (Akbuy), asset profitability (Aktifkar), accounts receivable turnover ratio (Alacakhız), current ratio (Cari), and net sales growth (Netsatbuy), are expected to affect the financial leverage ratio. When the literature is examined, it is revealed that these variables positively or negatively affect the financial leverage ratio.

The ratios obtained from the quarterly balance sheet and income statement data of 12 selected companies that are publicly traded and whose shares are traded on the stock exchange between 2010-2020 are used in this study. Significant results have been obtained from the study, which investigates the effect of tax on the capital structures of companies and the effect of variables specific to companies. The study's cointegration results indicate that just four companies exhibit a cointegration relationship (long-term association) between the tax reduction on cash capital rises and the financial leverage ratio. Moreover, according to the error correction model used to demonstrate a

short-term relationship among the included variables, the short-term imbalance returns to equilibrium over the long term. This situation shows that the model established for the four companies is stable.

The results show a cointegration relationship between the asset growth rate (Akbuy) and the financial leverage ratio for Cemas, Dogub, Mıpaz, and Krstl companies. It is found that there is a statistically significant positive relationship between the financial leverage ratio and the asset growth rate for Cemas, Dogub, Mıpaz, and Viking companies. In contrast, Krstl company has a negative relationship with statistical significance. Regarding asset profitability (Aktifkar) and the financial leverage ratio, it is found that there is a cointegration relationship between the two for Cemas, Krstl, Maktk, Mıpaz, and Viking companies. While there is a statistically significant positive connection between the debt ratio and the return on assets at Krstl, there is a statistically significant negative connection between the other companies. The results for the receivable turnover ratio (Alacakhız) and the financial leverage ratio show a cointegration relationship for Dogub, Maktk, Mıpaz, and Viking companies. Dogub and Viking companies have a statistically significant negative relationship between the financial leverage and the receivable turnover ratios, while the other companies have a statistically significant positive relationship. As for the current ratio (Cari) and the financial leverage ratio, it is found that there is a cointegration relationship between them for Cemas, Dogub, Maktk, and Usak companies. While the Dogub company shows a statistically significant positive correlation between financial leverage and the current key figures, there is a statistically significant negative correlation for the other companies. Finally, the results show a cointegration relationship between the net sales growth rate (Netsatbuy) and the financial leverage ratio for Cemas and Krstl companies, with a statistically significant positive relationship.

The findings obtained in this study and the recommendations below are expected to have a reducing impact on the financial leverage ratio, thus contributing to the functioning of the financial system and affecting the country's economy:

Regulations should be made to increase the discount amount benefitted by companies that increase their cash capital. Thus, this regulation will make the cash capital increase more attractive for companies.

The discount period to be benefited by companies that increase their cash capital has been determined to benefit separately for five accounting periods, including the accounting period in which the decision to increase capital or the registration of the articles of association in the first establishment phase was made. Increasing or eliminating the limit on the benefit period of companies that increase their cash capital can lead companies to increase their cash capital.

Other regulations should be made in tax laws to encourage equity financing by companies. For example, by limiting financing through debt and providing tax incentives for financing through equity, it has been supported to encourage capital increase after the tax deduction application in cash capital increase.

In applying financing cost limitation, 10% of the amount corresponding to the excess of foreign sources of companies over equity is added to the tax base as an expense not legally accepted. To reduce the tax leverage effect of financing through debt and encourage capital increase, adding the total amount corresponding to the excess of equity to the tax base as an expense not legally accepted will direct companies to finance through equity.

When evaluated, it was determined that there was a long-term relationship between tax deduction application in cash capital increase and financial leverage ratio in four companies. A negative relationship between a tax deduction and financial leverage ratio was statistically significant in three companies. Tax deductions did not affect the financial leverage ratio in most companies that increased their cash capital because companies resisted changing their financial financing habits and embedded financing policies.

In this context, implementing the above recommendations and tax regulations can significantly improve companies' capital structures.

In future studies, companies listed on the stock exchange that benefit from tax deduction application in cash capital increase can also be included in the scope of the research together with those subject to financing cost limitation application. Empirical studies can be conducted to analyze changes in the capital structure to what extent the benefit of regulations is achieved and the effectiveness of the regulation.

REFERENCES

Acaravci, S. & Doğukanli, H. (2004). Testing on manufacturing sector of determinants of capital structure in Turkey. *Economics, Business and Finance*, (19), 15-32.

Akçay, S. (2017). Cash Capital Encourages Opportunity To Capital Companies Engaged In Production, Evaluation According To Japan Sample. *The Journal of Social Sciences*, 4 (10), 361-376.

Akel, V. & Gazel, S. (2014). The Cointegration Linkages Between Exchange Rates And Bist Industrial Index: An Ardl Bound Testing Approach. *Erciyes University Journal of Faculty of Economics and Administrative Sciences*, (44), 23-41.

Akgüç, Ö. (1986). *Finansal Yönetim*. İstanbul: Avcıol Basım-Yayın.

Aksoy, E. E. & Göker Kandil, İ. E. (2018). Determination Of The Effect Of Firm Size On The Relationship Between Financial Leverage And Firm Performance: An Application On Bist Manufacturing Sector. *22nd Finance Symposium Proceeding Book*, 241-254.

Aksoy, E. E. (2020). Equity Tax Leverage Effect Against Debt Tax Leverage Effect: The Application Of Incentive To Cash Capital Increase. *Journal of Accounting and Taxation Studies*, 13 (1), 151-173.

Aydin, N., Başar, M. & Coşkun, M. (2011). *Finansal Yönetim.* Ankara: Detay Yayıncılık.

Bilgin, R. (2018). Capital Structure Determinants In Developing Countries: Hierarchical Linear Model Approach. *Hacettepe University Journal of Economics and Administrative Sciences,* 36 (3), 1-27.

Bortych, N. (2017). Capital Structure İnfluence on Firm's Financial Performance: Differences in Public and Private Firm's, Evidence From the Netherlands., 1–12.

Buettner, T., Overesch, M., Schreiber, U. & Wamser, G. (2009). Taxation and Capital Structure Choice - Evidence from a Panel of German Multinationals. *Economics Letters,* 105 (3), 309-311.

Burucu, H. & Öndeş, T. (2016). Analyzing the Factors That Influence Capital Structure of Turkish Manufacturing. *Journal of the Faculty of Economics and Administrative Sciences*, 6 (1) , 201-225.

Cansiz, S. & Sayilgan, G. (2017). Testing Capital Structure Theories On Non Financial Sector Firms. *Journal of Productivity*, 2, 135-161.

Chen, J. (2004). Determinants of Capital Structure of Chinese-listed Companies. *Journal of Business Research,* 57, 1341-1351.

Chirinko, R. S. & Singha, A. R. (2000). Testing Static Trade-Off Against Pecking Order Models of Capital Structure: A Critical Comment. *The Journal of Financial Economics*, 58 (3), 417–425.

Correia, A., Cerqueira, A. & Brandão, E. (2015). Determinants of Corporate Capital Structure: Evidence from Non-financial Listed French Firms.

Coşgun, O. (2016). Nakit Sermaye Teşvikine İlişkin Notlar. *Vergi Dünyası Dergisi*, 416, 163-171.

Coşkun, A. & Güngör, B. (2015). Factors That Affect the Capital Structure: An Application on Bist Industrial Sector with Panel Data Analysis. *The journal of Social Sciences Institute of Ataturk University*, 19 (3), 337-356.

Coşkun, A. & Güngör, B. (2015). Factors That Affect the Capital Structure: An Application on Bist Industrial Sector with Panel Data Analysis. *The journal of Social Sciences Institute of Ataturk University*, 19 (3), 337-356.

Çetin, İ. (2017). Nakit Sermaye Artırımlarına İlişkin Vergisel Teşvik Uygulaması. *Vergi Dünyası Dergisi*, 426, 35-43.

Devereux, M. P., Maffini, G. & Xing, J. (2018). Corporate Tax Incentives and Capital Structure: New Evidence from UK Firm-Level Tax Returns. *Journal of Banking and Finance,* 88 (C), 250-266.

Dickey, D.A. & Fuller, W.A. (1979). Distribution Of The Estimators For Autoregressive Time Series With A Unit Root. *Journal of the American Statistical Association,* 74, 427–431.

Dickey, D.A. & Fuller, W.A. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. *Econometrica,* 49 (4), 1057 - 1072.

Dikmen, N. (2018). *Ekonometriye Giriş*, Ankara: Seçkin Yayıncılık.

Durukan, M. B. (1997). *An Empirical Investigation Of The Determinants Of Corporate Capital Structure.* Unpublished Doctoral Thesis. Dokuz Eylul University Institute of Social Sciences, İzmir.

Engle, R. F. & Granger, C. W. J. (1987). Cointegration and Error Correction: Representation, Estimation and Testing. *Econometrica,* 55 (2), 251-276.

Eralp, B. (2017). *Stock market development effect on firms financing decisions: An application on Borsa İstanbul*. Published Doctoral Thesis. Istanbul University Institute of Social Sciences, Istanbul.

Faccio, M. & Xu, J. (2015). Taxes and Capital Structure. *Journal of Financial and Quantitative Analysis*, 50 (3), 277–300.

Fama, E. F. & French, K. R. (2002). Testing Trade-Off, and Pecking Order Predictions About Dividends and Debt. *The Review of Financial Studies,* 15 (1),1–33.

Firatoğlu, B. (2005). *Factors Affecting the Capital Structure of Companies and Changes in Company Behaviors in Crisis Periods.* Capital Markets Board Research Report.

Frank, Z. M. & Goyal, K. V. (2003). Testing the Pecking Order Theory of Capital Structure. *Journal of Financial Economics,* 67 (2), 217-248.

Frank, Z. M. & Goyal, K. V. (2005). *Trade-off and Pecking Order Theories of Debt.* Center for Corporate Governance Tuck School of Business at Dartmouth Working Paper, 60-64.

Guo, L., Liu, Y., Dai, Y. & Zhang, H. (2018). A Re-Examination of the Capital Structure Theory: Evidence from Chinese Listed Companies. *Theoretical Economics Letters,* 935–959.

Gujarati, D. N.(2004). *Basic Econometrics*, The McGraw Hill Companies.

Goswami, G., Noe, T. & Rebello, M. J. (1995). Debt Financing Under Asymmetric Information. *The Journal of Finance,* 50 (2), 633–659.

Graham, J. R. (1996). Debt and the Marginal Tax Rate. *Journal of Financial Economics,* 41(1),41-73.

Heyman, D., Deloof, M. & Ooghe, H. (2008). The Financial Structure of Private Held Belgian Firms. *Small Business Economics*, 30, 301–313.

Johansen, S. (1998). Statistical Analysis of Cointegration Vectors. *Journal of Economics Dynamic and Control,* 12 (2-3), 231–254.

Kandir, S. Y., Karadeniz, E. & Önal, Y. B. (2007). Analysis of Factors Affecting Capital Structure in Large Industrial Enterprises in Turkey. *The World of Accounting Science*, 9 (2), 145-165.

Kandir, S. Y. & Yakar, S. (2022). Examining The Impact Of General Interestdisallowance On Capital Structure Decisions. *Vergi Raporu*, 278, 11-25.

Karadeniz, E., Kaplan, F. & Günay, F. (2016). The Effect of CapitalStructure Decisions on Profitability: A Research on Borsa İstanbul Tourism Companies. *Journal ofTravel and Hospitality Management,* 13(3), 38-55.

Kocaman, M., Altemur, N., Aldemir, S. & Karaca, S. S. (2016). The Factors Affecting Economics Profitability: A Case Study Of Iso 500 Industry Firms. *Mustafa Kemal University Journal of Social Sciences Institute*, 13 (35), 320-332.

Mackinnon, J. G. (1991). *Critical Values for Cointegration Tests.* In R. F. Engle ve C. W. J. Granger (Eds.), Long-Run Economic Relationships: Readings in Cointegration, Oxford University Press.

Masulis, W. R. (1983). The Impact of Capital Structure on Firm Value: Some Estimates. *The Journal Of Finance,* 38 (1), 107–126.

Mazur, K. (2007). The Determinants of Capital Structure Choice Evidence From Polish. *International Advances in Economic Research,* 13 (4), 495–514.

Megginson, W. L. (1997). Corporate Finance Theory. US: Addison Wesley.

Mishkin, F. S. & Eakins, S. G. (2011). *Financial Markets and Institutions (7th Edition),* USA: Pearson International Edition.

Modigliani, F. & Miller, H. M. (1958). The Cost of Capital, Corporation Finance and the Theory of Investment. *The American Economic Review*, (3), 261–297.

Modigliani, F. & Miller, H. M. (1963). Corporate Income Taxes and The Cost of Capital: A Correction. *The American Economic Review*, 53 (3), 433–443.

Onatça Engin, Ş. N., Ünver, C. & Sökmen, A. G. (2019). Pecking Order Theory in Determining The Capital Structure: A Panel Data Analysis Of Companies in Turkey. *Busıness and Economics Research Journal*, 10 (3), 687-698.

Okka, O. (2009). *Finansal Yönetim: Teori ve Çözümlü Problemler*, Ankara: Nobel Yayınevi.

Okuyan, H. A. & Taşçi, H. M. (2010). Determinants of Capital Structure: An Analysis on the Largest 1000 Industrial Firms in Turkey. *BDDK Bankacılık ve Finansal Piyasalar*, 4 (1), 105-120.

Pal, A., & Prakash, P. (2017). *Practical Time Series Analysis*, Packt Publishing Ltd.

Pesaran, M. H. & Shin, Y. (1998). An Autoregressive Distributed-Lag Modelling Approach to Cointegration Analysis. *Econometric Society Monographs*, (31), 371–413.

Pesaran, M. H., Shin, Y. & Smith, R. J. (2001). Bounds Testing Approaches To The Analysis of Level Relationships. *Journal of Applied Econometrics*, 16, 289–326.

Phillips, P. C. B. & Perron, P. (1998). Testing For a Unit Root İn Time Series Regression. *Biometrika*, 75, 335–346.

Pouraghajan, A. & Esfandiar, M. (2012). The Relationship Between Capital Structure and Firm Performance Evaluation Measures: Evidence from The Tehran Stock Exchange. *International Journal of Business and Commerce,* 1 (9), 166–181.

Rajan, R. & Zingales, L. (1995). What Do We Know about Capital Structure? Some Evidence From International Data. *The Journal of Finance*, 50 (5), 1421–1460.

Sayilgan, G., Karabacak, H. & Küçükkocaoğlu, G. (2006). The Firm-Specific Determinants of Corporate Capital Structure: Evidence from Turkish Panel Data. *Investment Management and Financial Innovations*, 3 (3), 125–139.

Sayilgan, G. & Uysal, B. (2011). An Analysis of Determinants of Capital Structure of Turkish Firms Based on Turkish Central Bank Industrial Balance Sheets:1996 –2008. *Ankara University SBF Journal*, 66 (4),101-124.

Sheikh, N. A. & Qureshi, M. A. (2014). Crowding-out or Shying-Away: Impact of Corporate Income Tax on Capital Structure Choice of Firms in Pakistan. *Applied Financial Economics,* 24 (19), 1249-1260.

Shyam-Sunder L. & Myers, S. C. (1994). Testing Static Trade-Off Against Pecking Order Models of Capital Structure. *NBER Working Paper*, No.:4722, 1–32.

Tari, R. (2016). *Ekonometri,* Kocaeli: KÜV Yayınları.

Terim, B. & Kayali, C. A. (2009). Determinants of Capital Structure: Manufacturing Industry Case in Turkey. *Manisa Celal Bayar University Journal of Social Sciences*, 7(1), 125-154.

Titman, S. & Wessels, R. (1988). The Determinants of Capital Structure Of Choice. *The Journal of Finance,* 43(1), 1-19.

Tong, G. & Green, C. J. (2005). Pecking Order or Trade-Off Hypothesis? Evidence on the Capital Structure of Chinese Companies. *Journal of Applied Economics*, 37 (19), 2179-2189.

Türko, M. R. (2002). *Finansal Yönetim*. İstanbul: Alfa Yayınevi.

Ucal, M. Ş. (2006). A Brief Survey of Econometrics Model Selection Criteria. *Cumhuriyet University Journal of Economics and Administrative Sciences*, 7(2), 41-57.

Yazar, A. S. (2015). Nakit Sermaye Artırımı İle Gelen Vergi Teşvikinde Özellikli Durumlar İle Düzenleme Ve Tebliğ Taslağına İlişkin Önermeler. *Vergi Dünyası Dergisi*, 411, 129-139.

Yazgan, K. F. & Saldanli, A. (2022). Financing Expense Restrictions' Effects on Capital Structur. *Istanbul Journal of Economics*, 72(2), 877-900.

Yener, A. L. (2002). *Türk Firmalarının Sermaye Yapısını Etkileyen Faktörler: Beş yüz Büyük Firmadan Hisse Senetleri İMKB'de İşlem Görenler İçin Bir Analiz*. Published Doctoral Thesis. Ankara University Institute of Social Sciences, Ankara.

Yener, E. & Karakuş, R. (2012). Review Of Relationship Between Capital Structure And Firm Values In Different Asset Values: An Application On Ise 100 Firms. *Gazi University Journal of Faculty of Economics and Administrative Sciences*, 14 (2), 75-98.

Yildiz, M. E., Yalaman, A. & Sevil, G. (2009). Testing Capital Structure Theory Using Panel Data Regression Analysis: An Empirical Evidence From Istanbul Stock Exchange Manufacturing Firms. *Economics, Business and Finance*, 24 (278), 25-45.

Yildiz, B. & Demireli, E. (2019). The Examination of Capital Structure Decisions By Micro PanelData Method in Borsa Istanbul Retailing Trade Sector. *The Journal of Selcuk University Social Sciences Institute*, 41, 220-234.

Yücel, E. (2014). Capital Structure, Agency Cost And Corporate Diversification: A Dynamic Panel Data Analysis. *METU Studies in Development*, (41), 223-253.

Zeitun, R. & Tian, G. (2007). Capital Structure and Corporate Performance: Evidence from Jordan. *Australasian Accounting Business and Finance Journal*, 1(4), 40–60.

Chapter 6

MPSI-MCRAT MODEL FOR SOLVING THE BANK SELECTION PROBLEM IN MONTENEGRO

Naci YILMAZ[1]

1 Assoc.Prof., Doğuş University, Economics. ORCID: 0000-0003-0107-6448.
nyilmaz@dogus.edu.tr .

1.Introduction

Within the banking sector, there are many domestic as well as foreign investors and bank customers who are interested in the question of selecting the best bank based on some criteria in a country. The most convenient methods used to solve this selection problem are the multicriteria decision-making models (MCDM). In this study, the performance of deposit banks operating in Montenegro will be compared by using the integrated MPSI-MCRAT method. The purpose of this research is to rank the banks operating in Montenegro and to select the best performing bank based the selected criteria by applying the method. While the MPSI method (the Modified Preference Selection Index) is used to determine the importance (weight) of the criteria, the MCRAT method (Multiple Criteria Ranking by Alternative Trace) is used to rank the banks based on their financial performances.

2.Literature Review

Since MPSI, which is the weighting method, and MCRAT, which is the ranking method, are the new methods that have been used in the literature, no scientific studies have been found in the field of bank performance in which both methods are used together. However, scientific studies in areas other than bank performance where these two methods are used together or separately are summarized below.

Gligorić et al. (2022) proposed the novel MPSI method to solve the support system selection problem in underground mining sector. In order to solve the selection problem, they improved the PSI method by creating the novel MPSI method. The novel MPSI method is used to determine the weight coefficients. They also presented another novel method (MARA-Magnitude of the Area for the Ranking of Alternatives) to rank the alternatives.

Urošević et al.(2021) proposed the novel MCRAT method to solve the selection problem of the most proper blasting pattern in mining. They also presented another novel method called as RAPS (Ranking Alternatives by Perimeter Similarity). In the paper, the novel RAPS and MCRAT methods were employed to choose the optimal pattern based on 5 criteria in the process of mining. In both ranking, alternative coded as A3 was the best solution.

Gligorić et al. (2021) used the MCRAT method to solve the selection problem of coal supplier for a power plant. They tested the model by creating a hypothetical example related to coal supplier selection. MCRAT method was applied with ENTROPY and MEREC weighting methods. The high correlation between ENTROPY and MEREC methods caused to same ranking by using MCRAT method.

Ulutaş et al. (2023a) used the MCRAT method to evaluate the efficient natural fibre for the materials of commercial building insulation. They also used the preference selection index (PSI), method based on the removal effects of criteria (MEREC) and logarithmic percentage change-driven objective weighting (LOPCOW) methods for this purpose.

Ulutaş et al. (2023b) used the fuzzy MCRAT method to solve the problem of a forklift selection for a cargo company. In the research, fuzzy BWM was used for determining the criteria weights and the fuzzy MCRAT method was applied for ranking forklift alternatives. The research result indicated that the forklift with the code FLT-3 performed the best. Another result was that the fuzzy MCRAT produced the same results as the fuzzy ARAS.

3. Methodology

3.1. MPSI Method

This method was designed by Gligorić et al. (2022) to calculate the objective weights of criteria. It was developed to modify the PSI method (Preference Selection Index). PSI method was first applied by Maniya and Bhatt (2010). MPSI is based on the variation, namely the distance between normalized and mean value in the preference value for each criterion. The variation is calculated by employing the Euclidean distance. MPSI method gives the weights of criteria in an objective way. It is very easy for calculation of the weight coefficients. In addition, it is flexible and applicable method for solving decision-making problems. The method has the following steps (Maniya and Bhatt, 2010; Gligorić et al. 2022):

Step 1. Construction the initial decision matrix.

In the first step, the decision matrix $X = \left[\mathrm{x_{ij}}\right]_{\mathrm{mxn}}$ is formed. In the matrix, (m) indicates the quantity of alternatives, (n) means the quantity of criteria and (x_{ij}) shows to the performance of the alternative (i) based on the criterion (j).

Step 2. Formation of the normalized matrix.

Based on the criterion direction, a simple linear normalization is applied to transform the data of different inputs into the [0, 1] distrubition . Equation 1 is used for the benefit criteria and Equation 2 is applied for cost criteria:

$$r_{ij} = \frac{x_{ij}}{mak\, x_{ij}} \quad (1)$$

$$r_{ij} = \frac{\min x_{ij}}{x_{ij}} \quad (2)$$

In these equations, (r_{ij}) represents the normalized value of the corresponding criterion, $0 < r_{ij} < 1$.

Step 3. Calculation of the mean value of the normalized values.

The mean value of criterion (v_j) is found by Equation 3:

$$v_j = \frac{1}{m}\sum_{i=1}^{m} r_{ij} \quad (3)$$

Step 4. Finding out the preference variation value (p_j) by using following equation:

$$p_j = \sum_{i=1}^{m} (r_{ij} - v_j)^2 \quad (4)$$

Step 5. The weights of criteria (w_j) are calculated as follows:

$$w_j = \frac{p_j}{\sum_{j=1}^{n} p_j} \quad (5)$$

3.2. MCRAT Method

As said previously, the MCRAT (Multiple Criteria Ranking by Alternative Trace) method was first used by Urošević, et.al (2021). This method calculates the performance evaluations of alternatives as weighted sum scores. It calculates the weighted performance score of each alternative by multiplying its performance on each criterion by the weight of the criterion. Then, it sums up the weighted performance scores for each alternative and ranks the alternatives based on these sums. The MCRAT method has some advantages compared to other methods used in multi-criteria decision-making problems. These advantages include ease of understanding, ease of computation, and the ability to incorporate expert opinions into the decision-

making process. However, the use of the MCRAT method also has some limitations. This method requires the accurate determination of the weights of each criterion. The steps of the Multiple Criteria Ranking by Alternative Trace (MCRAT) method are shown below (Urošević, et.al, 2021; Ulutaş, et al., 2023a; Ulutaş, et al., 2023b):

Step 1. Formation of the decision matrix.

$$X = \left[x_{ij}\right]_{mxn} = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \quad (6)$$

Where (m) shows the quantity of alternatives and (n) refers the quantity of the criteria. Each element in the matrix (X_{ij}) indicates to the performance value of the alternative (i) based on the criterion (j) in the equation above.

Step 2. Normalized matrix.

For normalization, a simple linear normalization technique is used. For the benefit criteria, Equation 7, for the cost criteria, Equation 8 are applied:

$$r_{ij} = \frac{x_{ij}}{\text{mak}\, x_{ij}} \quad (7)$$

$$r_{ij} = \frac{\min x_{ij}}{x_{ij}} \quad (8)$$

Step 3. Weighted matrix (u_{ij}).

The weighted matrix is constructed by multiplying the values of the normalized matrix by the corresponding weights. For that, Equation 9 is used.

$$u_{ij} = r_{ij} * w_j \quad (9)$$

Step 4: Optimal alternative (OA).

Each element of the optimal alternative (OA) is determined with the help of Equation 10:

$$q_j = \max\left(u_{ij} \mid 1 \leq j \leq n\right), \forall i \in [1,2,..,m] \quad (10)$$

OA can be represented by the set below:

$$Q = \{ q_1 , q_2 ,... q_j \} , j = 1\ 2\ ,...n \quad (11)$$

Step 5: Decomposition of OA.

Decomposition of OA is realized by two sub-sets. The set Q is the sum of the two sub-sets:

$$Q = Q^{max} \cup Q^{min} \quad (12)$$

If the term (k) refers the sum of benefit criteria, the term h (h= n– k) indicates the sum of cost criteria. Thus, OA can be represented as follows:

$$Q = \{ q_1 , q_2 ,... q_k \} \cup \{ q_1 , q_2 ,... q_h \};\ k + h = j \quad (13)$$

Step 6: The alternative decomposition.

Decomposition of each alternative is made with the help of Equation 14 and 15:

$$U_i = U_i^{max} \cup U_i^{min} , \forall i \in [1,2,.. , m] , \quad (14)$$

$$U_i = \{ u_{i1} , u_{i2} ,... u_{ik} \} \cup \{ \{ u_{i1} , u_{i2} ,... u_{ih} \}; \quad \forall i \in [1,2,.. , m] \quad (15)$$

Step 7: The **c**omponent magnitude.

The magnitude of each component in OA is calculated by employing Equation 16 and 17:

$$Q_k = \sqrt{q^2_1 + q^2_2 + .. + q^2_k} \quad (16)$$

$$Q_h = \sqrt{q^2_1 + q^2_2 + .. + q^2_h} \quad (17)$$

The similar transaction is done for each alternative

$$U_{ik} = \sqrt{u_i^2_1 + u_i^2_2 + .. + u_i^2_k} \quad ,\forall i \in [1,2,.. , m] \quad (18)$$

$$U_{ih} = \sqrt{u_i^2_1 + u_i^2_2 + .. + u_i^2_h} \quad ,\forall i \in [1,2,.. , m] \quad (19)$$

Step 8: Building the F matrix.

F matrix is composed of optimal alternative components:

$$F = \begin{bmatrix} Q_k & 0 \\ 0 & Q_h \end{bmatrix} \quad ,\forall i \in [1,2,..,m] \qquad (20)$$

Step 9: Creating the G matrix.

G matrix is composed of alternative components:

$$G_i = \begin{bmatrix} U_{ik} & 0 \\ 0 & U_{ih} \end{bmatrix} \quad ,\forall i \in [1,2,..,m] \qquad (21)$$

Step 10: Obtaining the T_i matrix.

T_i matrix is obtained by multiplying F matrix and G_i matrix:

$$T_i = F\ x\ G_i = \begin{bmatrix} t_{11;i} & 0 \\ 0 & t_{22;i} \end{bmatrix} \quad ,\forall i \in [1,2,..,m] \qquad (22)$$

Step 11: Building the ranking.

After obtaining the T_i matrix, the trace of T_i matrix $tr\ (T_i)$is formed as follows:

$$tr\ (T_i) = t_{11;i} + t_{22;i} \quad ,\forall i \in [1,2,..,m] \qquad (23)$$

The ranking of alternatives is realized by applying the descending order of $tr\ (T_i)$.

4. Application of the Method to the Data

The data used in the research concerning the performance of the banks operating in Montenegro were obtained from the TheBanks.eu webpage. The research aims to solve the bank selection problem and to determine the best performing bank in the country by comparing the financial data of the banks for 2022. In order to solve the problem, an integrated MPSI-MCRAT model was applied. Both are among the novel MCDM methods. Some financial data relevant to 11 deposit banks (alternatives) operating in the country were arranged and compared by the new integrated MPSI-MCRAT model. The banks (alternatives) in the research are shown in the table below:

Table 1. The Banks in Montenegro in 2022

Bank name	Code	Origin Country	Asset Share
Addiko Bank AD Podgorica	ADD	Austria	0,0341
Adriatic Bank AD Podgorica	ADR	Montenegro	0,0816
Crnogorska komercijalna banka AD Podgorica	CMO	Hungary	0,2590
ERSTE Bank AD Podgorica	ERS	Austria	0,1174
Hipotekarna banka AD Podgorica	HIP	Italy	0,1285
Lovćen banka AD Podgorica	LOV	Montenegro	0,0540
NLB Banka AD Podgorica	NLB	Slovenia	0,1331
Prva banka Crne Gore AD Podgorica	PRV	Montenegro	0,0518
Universal Capital Bank AD Podgorica	UNI	Montenegro	0,0742
Zapad banka AD Podgorica	ZAP	Montenegro	0,0539
ZIRAAT Bank Montenegro AD Podgorica	ZIR	Turkey	0,0124

Source: TheBanks.eu. https://thebanks.eu/banks/10767/financials

The asset share of the banks operating in Montenegro can be seen in Table 1. In fact, it indicates the market share or market size of a bank in the sector. According to the table, Crnogorska komercijalna banka AD Podgorica which is originated from Hungary has the highest market share with 25,90 percent in 2022. Hipotekarna banka AD Podgorica which is originated from Italy follows it. has the lowest market share in 2022. ZIRAAT Bank Montenegro AD Podgorica which is originated from Turkey has the lowest share in the banking sector. Almost half of the banks are owned by the locals. Adriatic Bank AD Podgorica ist the biggest bank among them with its share of 8.16 percent.

Seven different financial indicators were selected as the performance criteria of the banks. The names, codes and the optimal direction of the criteria are presented in Table 2.

Table 2. Financial Indicators Selected as Criteria

Name	Code	Direction
Asset Share	AS	Benefit (Max)
Total Assets	TA	Benefit
Total Equity	TE	Benefit
Cash and Central Bank Deposits	CD	Benefit
Loans	LO	Benefit
Deposits	DE	Benefit
Net Income	NI	Benefit

There are not the cost criteria. All the criteria in the table are the benefit criteria. It means that the higher value is the better and the lower value is the worse for the performance. The 2022 performance results of the banks based on the criteria were presented below in Table 3.

Table 3. Financial Indicators of the Banks in Montenegro- Initial Decision Matrix

Bank Code	AS	TA	TE	CD	LO	DE	NI
	Max	Max	Max	Max	Max	Max	Max
ADD	0,034	218,5	32,0	39,9	161,8	163,5	3,88
ADR	0,082	522,7	17,2	250,5	64,8	496,6	7,12
CMO	0,259	1658,6	240,9	371,7	1062,6	1319,9	30,86
ERS	0,117	751,9	108,0	126,3	454,1	465,6	11,59
HIP	0,129	822,8	62,5	328,2	236,8	701,4	6,04
LOV	0,054	345,9	24,3	116,2	194,8	274,3	2,37
NLB	0,133	852,1	108,2	128,9	531,0	692,9	15,50
PRV	0,052	331,6	30,0	88,3	166,7	285,4	0,06
UNI	0,074	474,9	26,0	194,3	152,2	436,3	5,21
ZAP	0,054	345,1	9,9	106,2	68,7	324,8	0,66
ZIR	0,012	80,2	16,6	13,2	44,6	52,2	0,01
Max	*0,259*	*1658,6*	*240,9*	*371,7*	*1062,6*	*1319,9*	*30,9*
Min	*0,012*	*80,2*	*9,9*	*13,2*	*44,6*	*52,2*	*0,01*

Source: TheBanks.eu. https://thebanks.eu/banks/10767/financials.

In Table 3, the values in the table show “million EUR” except for AS criterion. AS is the asset share. All the data belong to the financial year of 2022. After building the initial decision matrix as the first step of the MPSI method, the matrix was later transformed to the normalized matrix and thus different input data values discounted to the values between [0, 1]. The initial decision matrix in Table 3 was normalized by employing Equation 1. Equation 2 was not applied because there is not any cost criterion in the matrix. The normalized matrix is shown in Table 4 below.

Table 4. Normalized Decision Matrix

Code	AS	TA	TE	CD	LO	DE	NI
	Max	Max	Max	Max	Max	Max	Max
ADD	0,1317	0,1318	0,1327	0,1073	0,1523	0,1239	0,1257
ADR	0,3151	0,3151	0,0712	0,6739	0,0610	0,3762	0,2307
CMO	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
ERS	0,4533	0,4533	0,4482	0,3398	0,4273	0,3528	0,3756
HIP	0,4961	0,4961	0,2592	0,8830	0,2228	0,5314	0,1957
LOV	0,2085	0,2085	0,1009	0,3126	0,1833	0,2078	0,0768
NLB	0,5139	0,5138	0,4492	0,3468	0,4997	0,5250	0,5023
PRV	0,2000	0,1999	0,1246	0,2376	0,1569	0,2162	0,0020
UNI	0,2865	0,2864	0,1079	0,5227	0,1432	0,3306	0,1688
ZAP	0,2081	0,2081	0,0409	0,2857	0,0647	0,2461	0,0214
ZIR	0,0479	0,0483	0,0689	0,0355	0,0420	0,0395	0,0003

After creation of the normalized matrix, the mean value (vj), the preference variation (pi) and the weights of criteria were calculated respectively.

Table 5. Mean Value(vj), preference variation (pi) and weights of criteria by MPSI method (wj)

Criterion	AS	TA	TE	CD	LO	DE	NI
vj	0,3510	0,3510	0,2549	0,4314	0,2685	0,3590	0,2454
p_i	0,6882	0,6879	0,8217	0,9446	0,8007	0,6826	0,8731
Sum pi	5,4989						
	w_1	w_2	w_3	w_4	w_5	w_6	w_7
wj	0,1252	0,1251	0,1494	0,1718	0,1456	0,1241	0,1588

The outcome of the MPSI method applied in the study has shown that the most significant criterion for the financial performance of the banks is the Cash and Central Bank Deposits (CD) criterion. It was followed by NI, TE and LO criterion respectively. CD has the highest the weight coefficient with 17,18 percent. The lowest importance belongs to the DE criterion. Its weight coefficient is 12,41 percent. It can be said that the difference between the highest weight and the lowest one is not huge.

The MCRAT method was used to rank the bank performances in Montenegro. At first, initial decision matrix was built and then normalized. The way of normalization is similar to the MPSI method. The initial decision matrix was normalized is by applying Equation 1. The matrix can be seen in Table 9.

Table 6. Normalized Matrix

Code	AS	TA	TE	CD	LO	DE	NI
	Max	Max	Max	Max	Max	Max	Max
ADD	0,1317	0,1318	0,1327	0,1073	0,1523	0,1239	0,1257
ADR	0,3151	0,3151	0,0712	0,6739	0,0610	0,3762	0,2307
CMO	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000	1,0000
ERS	0,4533	0,4533	0,4482	0,3398	0,4273	0,3528	0,3756
HIP	0,4961	0,4961	0,2592	0,8830	0,2228	0,5314	0,1957
LOV	0,2085	0,2085	0,1009	0,3126	0,1833	0,2078	0,0768
NLB	0,5139	0,5138	0,4492	0,3468	0,4997	0,5250	0,5023
PRV	0,2000	0,1999	0,1246	0,2376	0,1569	0,2162	0,0020
UNI	0,2865	0,2864	0,1079	0,5227	0,1432	0,3306	0,1688
ZAP	0,2081	0,2081	0,0409	0,2857	0,0647	0,2461	0,0214
ZIR	0,0479	0,0483	0,0689	0,0355	0,0420	0,0395	0,0003

After the normalized matrix, the weighted decision matrix was formed by employing Equation 9. The weighted decision matrix can be seen in Table 7.

Table 7. Weighted Normalized Matrix (uj)

Code	AS	TA	TE	CD	LO	DE	NI
	Max	Max	Max	Max	Max	Max	Max
wj	0,1252	0,1251	0,1494	0,1718	0,1456	0,1241	0,1588
ADD	0,016	0,016	0,020	0,018	0,022	0,015	0,020
ADR	0,039	0,039	0,011	0,116	0,009	0,047	0,037
CMO	0,125	0,125	0,149	0,172	0,146	0,124	0,159
ERS	0,057	0,057	0,067	0,058	0,062	0,044	0,060
HIP	0,062	0,062	0,039	0,152	0,032	0,066	0,031
LOV	0,026	0,026	0,015	0,054	0,027	0,026	0,012
NLB	0,064	0,064	0,067	0,060	0,073	0,065	0,080
PRV	0,025	0,025	0,019	0,041	0,023	0,027	0,000
UNI	0,036	0,036	0,016	0,090	0,021	0,041	0,027
ZAP	0,026	0,026	0,006	0,049	0,009	0,031	0,003
ZIR	0,006	0,006	0,010	0,006	0,006	0,005	0,000

The weight coefficients in the table are the coefficients calculated by the MPSI method previously. After building the weighted normalized decision matrix, the ideal alternatives were found by using Equation 10 and Equation 11. The results were shown in Table 11 below.

Table 8. Ideal Alternatives

	AS	TA	TE	CD	LO	DE	NI
Ideal Alternative/Criteria	y_1	y_2	y_3	y_4	y_5	y_6	y_7
Y	0,1252	0,1251	0,1494	0,1718	0,1456	0,1241	0,1588

Then the decomposition of ideal alternatives was found by using equations between 12-15. The result can be seen in Table 9 below.

Table 9. De-composition of Ideal Alternatives

	AS	TA	TE	CD	LO	DE	NI
Ideal Alternative/Criteria	Max	Max	Max	Max	Max	Max	Max
	y_1	y_2	y_3	y_4	y_5	y_6	y_7
Y^{max}	0,1252	0,1251	0,1494	0,1718	0,1456	0,1241	0,1588
Y^{min}	-	-	-	-	-	-	-

After finding the decomposition, the magnitude of ideal alternatives was calculated by employing equations between 16-19. The result was shown in Table 10.

Table 10. Magnitude Levels of Ideal Alternatives

	Magnitude
$\mathbf{Y_k}$	0,3808
$\mathbf{Y_h}$	0,0000

Following obtaining the magnitude levels of ideal alternatives, the E_k, E_h, $z_{11;i}$, $z_{22;i}$ and tr(Z) values were calculated by using equations between 20-23. The result was shown in Table 11 below:

Table 11. Ek, Eh, z11;i, z22;i and tr(Z) values

Banks	$\mathbf{E_k}$	$\mathbf{E_h}$	$\mathbf{z_{11;i}}$	$\mathbf{z_{22;i}}$	**tr(Z)**
ADD	0,0490	0,0000	0,0187	0,0000	0,0187
ADR	0,1422	0,0000	0,0542	0,0000	0,0542
CMO	0,3808	0,0000	0,1450	0,0000	0,1450
ERS	0,1539	0,0000	0,0586	0,0000	0,0586
HIP	0,1964	0,0000	0,0748	0,0000	0,0748
LOV	0,0775	0,0000	0,0295	0,0000	0,0295
NLB	0,1795	0,0000	0,0683	0,0000	0,0683
PRV	0,0671	0,0000	0,0256	0,0000	0,0256
UNI	0,1172	0,0000	0,0446	0,0000	0,0446
ZAP	0,0695	0,0000	0,0265	0,0000	0,0265
ZIR	0,0166	0,0000	0,0063	0,0000	0,0063

Finally, the performance ranking of the banks was made according to the descending order of the values of $tr\ (\mathrm{Z})$ in Table 12.

Table 12. Ranking of the Banks in Montenegro in 2022

Bank name	**Code**	**Ranking**
Crnogorska komercijalna banka AD Podgorica	CMO	1
Hipotekarna banka AD Podgorica	HIP	2
NLB Banka AD Podgorica	NLB	3
ERSTE Bank AD Podgorica	ERS	4
Adriatic Bank AD Podgorica	ADR	5
Universal Capital Bank AD Podgorica	UNI	6
Lovćen banka AD Podgorica	LOV	7
Zapad banka AD Podgorica	ZAP	8
Prva banka Crne Gore AD Podgorica	PRV	9
Addiko Bank AD Podgorica	ADD	10
ZIRAAT Bank Montenegro AD Podgorica	ZIR	11

The table above shows the performance rank of 11 banks in Montenegro based on their financial indicators in 2022. The ranking was made by integrating the MPSI weighting model and the MCRAT ranking model. According to Table 12, the most performing bank is Crnogorska Komercijalna Banka. Its success caused by all the selected criteria such as especially was based on its superiority in terms of asset share, total assets, total equity, cash and Central bank deposits, loans, deposits and net income. In all these criteria, it has an absolute superiority over the others. Hipotekarna Banka is the second best performing bank in this country. Following the second bank, NLB Banka is the third high performing bank. However, ZIRAAT Bank Montenegro is the least performing in the year of analysis.

Another outcome of the analysis is that the high performing banks are not the domestic banks but the foreign banks. For example, the first three banks in the ranking list are from Hungary, Italy and Slovenia respectively. The best bank among the domestic banks is Adriatic Bank AD Podgorica with its rank of 5th place. Another result is that the bank with the biggest market share is also the most successful bank even if this criterion has not the highest weight coefficient.

5. Conclusion

There are many domestic as well as foreign investors who are interested in the question of selecting the best bank in a certain country. In this study, the performance of banks in Montenegro was evaluated by the integrated MPSI-MCRAT model for 2022. The MPSI method is applied to determine the weight of the selected criteria and the MCRAT method is used to rank the banks. According to the result of the MPSI method the most significant criterion is the size of Cash and Central Bank Deposits of the banks. According to the MCRAT method based on MPSI weighting, the most performing bank is Crnogorska Komercijalna Banka in Montenegro for 2022. Hipotekarna Banka is the second best bank and NLB Banka is the third high performing bank. In addition, the high performing banks are not the domestic banks.

REFERENCES

Doumpos, M.; Figueira, J.R.; Greco, S.; Zopounidis, C. (Eds.) (2019). *New Perspectives in Multiple Criteria Decision Making: Innovative Applications and Case Studies*; Springer: London, UK.

Figueira, J.; Greco, S. (2010). *Trends in Multiple Criteria Decision Analysis*, 1st ed.; Springer: Boston, MA, USA.

Gligorić, M., Urošević, K., Lutovac, S., Halilović, D. (2021). Optimal coal supplier selection for thermal power plant based on MCRAT method, *eNergetics*. Conference Paper. 263-271.

Gligorić, M., Gligorić, Z., Lutovac, S., Negovanović, M., Langović, Z. (2022). Novel hybrid MPSI–MARA decision-making model for support system selection in an underground mine. *Systems,* 10, 248.

Greco, S.; Figueira, J.; Ehrgott, M. (2016). *Multiple Criteria Decision Analysis*. 2nd ed.; Springer: New York, NY, USA.

Urošević, K., Gligorić, Z., Miljanović, I., Beljić, Č., Gligorić, M. (2021). Novel methods in multiple criteria decision-making process (MCRAT and RAPS)-application in the mining industry. *Mathematics*, 9 (16).

Maniya, K.; Bhatt, M.G. (2010). A selection of material using a novel type decision-making method: Preference selection index method. *Mater*. 31, 1785–1789.

Munier, N.; Hontoria, E.; Jiménez-Sáez, F.(2019). *Strategic Approach in Multi-Criteria Decision Making*. Springer: Cham, Switzerland.

Shannon, C.E. (1948). A mathematical theory of communication. Bell Syst. Tech. Journal. 27, 379–423.

Ulutaş, A., Balo, F., Topal, A.(2023a). Identifying the most efficient natural fibre for common commercial building insulation materials with an integrated PSI, MEREC, LOPCOW and MCRAT model. *Polymers*, 15, 1500.

Ulutaş, A., Topal, A., Karabasevic, D., Balo, F. (2023b). Selection of a forklift for a cargo company with fuzzy BWM and fuzzy MCRAT methods. *Axioms*, 12, 467.

Chapter 7

THE IMPORT DEPENDENCY OF INTERMEDIATE INPUT AND FINAL DEMAND IN THE FOOD INDUSTRY IN TURKEY: SECTORAL FORWARD AND BACKWARD LINKAGE EFFECTS

Hakan SÖNMEZ [1]

1 PhD, Dokuz Eylül University, Efes Vocational School, Department of Transportation Services, e-mail: hakan.sonmez@deu.edu.tr, ORCID No: 0000-0001-6126-327.

1. INTRODUCTION

In recent years, significant developments have occurred in the structure of production as a result of the removal of barriers to the free movement of goods and services. Expeditious advancements in logistics and supply chains have facilitated easier integration of world economies. Furthermore, the flow of goods and services between countries and regions has accelerated, paving the way for the internationalization of production with the adoption of an open economy model. As a consequence of these developments, mutual interdependencies between countries have increased, and a fragmented production structure has become predominant worldwide. Particularly, the trade of intermediate inputs, which constitute a significant portion of total imports, has gained even more crucial in developing countries. As a result of these global developments, Turkey has also initiated to implement economic policies aimed at liberalization as seen across the world. The main objectives of these policies have been to meet the need for external resources, address deficits in the balance of payments, and achieve progress in external payments (Kundak and Aydoğuş, 2018: 252).

The transition, which involves a shift from labor-intensive sectors such as agriculture and textiles to capital-intensive manufacturing, has accelerated in line with these goals. For instance, it is stated that since 1980, the share of agriculture in exports has significantly decreased from 53% to 3%, whereas the share of manufacturing has swift increased from 37% to 94%. This situation is considered to affect the demand for inputs in manufacturing production (Özcan, Tok and Sevinç, 2019: 2). Moreover, it is known that the import-substitution industrial production policy, which was implemented before 1980, has been replaced by an export-led growth model. There has been a rise in demand for imported raw materials and intermediate goods in industries where domestic production is not feasible but cheaper and higher-quality imports are available following this decision, along with the increasing export figures. The increasing demand for imported raw materials has led to significant consequences on economic activities.

It has been known that fluctuations in exchange rates impact production in economies characterized by a high level of import dependency directly. Also, if the increase in exports necessitates a higher usage of imported intermediate inputs in the production process, a significant portion of foreign exchange inflows is allocated for production purposes. Subsequently, the increasing costs of imported inputs are reflected in product prices, creating a pressure on inflation. As a result, the current account and balance of payments has been affected significantly. Therefore, the dependence of production on imports can demonstrate its impact through multiple mechanisms, both directly and indirectly. Figure 1 reveal that the

values of food sector imports and the share of food product imports within total imports in Turkey between 2013 and 2020. As seen in Figure 1, Turkish food sector imports, which amounted to 5.8 billion USD in 2013, has experienced a decrease of approximately 5% by the end of the period compared to 2013. However, the share of food sector imports within total imports has been consistently increasing especially in the last three years. The highest food product import occurred in 2014 with a value of 6.7 billion USD. The food sector has reached its highest share within total imports in 2020 with a value of 2.9% over the 8 year period. This result also indicates an increase in food product imports following the global spread of the Covid-19 pandemic in 2019. On the other hand, it can be observed that the value of food product imports reached 5.6 billion USD in 2018. Furthermore, the total value of food product imports, which was 48 billion USD, has been amounted to 1.8 trillion USD throughout the analyzed period. Moreover, the average share of food product imports within total imports has been recorded at approximately 2.6% during the time period.

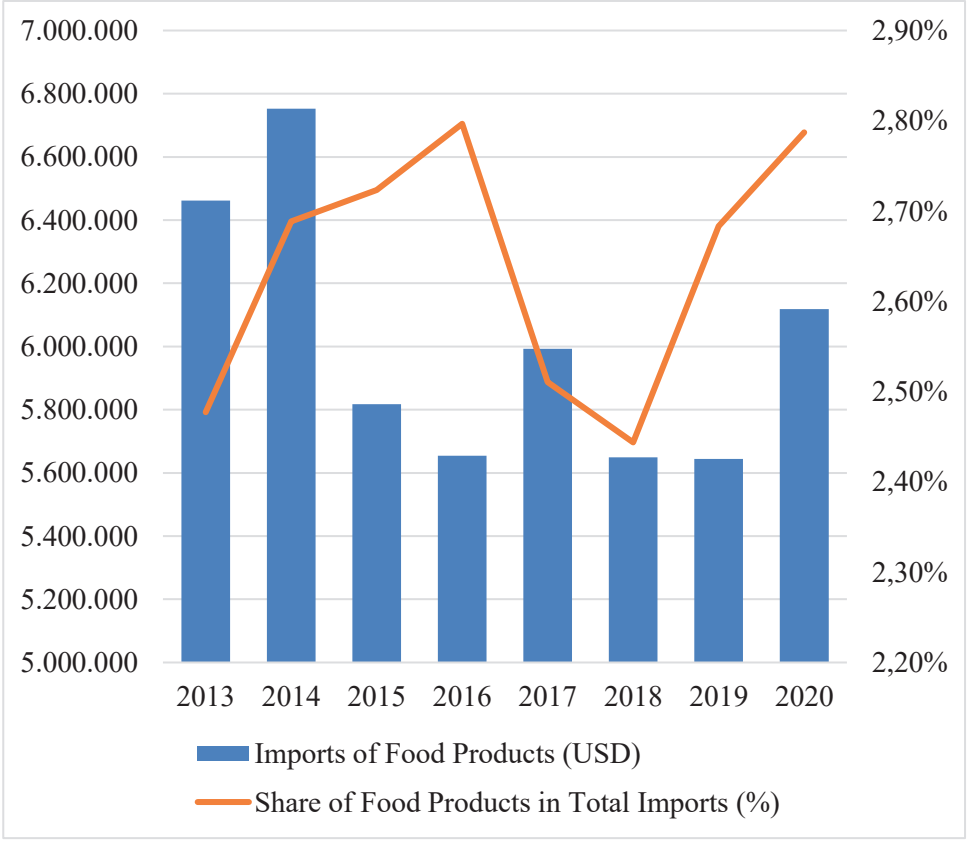

Figure 1. *Import Values of the Food Sector between 2013-2020*
Source: *TURKSTAT; Own processing.*

It has been known that a significant portion of raw materials and intermediate inputs in the food industry are imported. Many materials, which are used in the processing, packaging, and other stages of agricultural products, has been sourced from abroad, particularly. This situation has affected the production costs and competitiveness of the food industry. The detailed evaluation of the relationship between imported inputs used in the food industry and other industries on a sectoral basis has been important due to these reasons. Furthermore, the analysis of Turkey's import dependency in the food industry at a sectoral level plays a crucial role in assessing the effectiveness of industrialization policies and determining strategic decisions for policymakers.

Recently, the increase in inflation has been attributed to the rise in food prices, which have caused significant deviations from the annual inflation targets. Furthermore, it has been established that multiple factors associated with supply and demand contribute to the observed price increases in the food sector. Therefore, it is necessary to investigate the impact of import-based inputs on the economic activities of the food sector through different methods within the context of these factors. It is important to identify the sectors in the food industry where the dependency on imports in production is highest, which will enable taking significant measures to reduce the utilization of imported inputs. The main objective of this study, which examines the utilization rate of intermediate inputs and changes in final demand, is to analyze the import dependency of the food sector in Turkey.

The study is divided into five sections. After the introduction section, the second section provides information about the relevant literature. The third section, which provides theoretical information about the dataset and the econometric method, focuses on the Leontief inverse import matrix method. In the fourth section, the findings obtained are presented and discussed. The conclusion section includes the evaluation of the significance of these findings for the Turkish food sector and the provision of policy recommendations.

2. LITERATURE REVIEW

It has been possible to categorize the studies conducted on the use of imported inputs in the Turkish economy into three main groups, which examine specific sectors and utilize input-output tables specific to a particular year, analyze sectoral changes over different periods, and compare Turkey with various groups of countries. However, the initial group of studies, which has mostly investigated import dependence, concentrates on the manufacturing, automotive, tourism, and textile sectors. For instance, Yükseler and Türkan (2006:31) have found that the use of imported inputs in the manufacturing industry in Turkey was above average in seven sectors and

below average in four sectors. Atan (2011:73) analyzed Turkey's sectoral production structure under three categories: overall, domestic, and imported production. The findings of the study indicate that the use of imported inputs is particularly high in the manufacturing industry compared to other sectors. Ersungur et al. (2011:10) ranked the import dependence of all sectors using the input-output table from the year 2002. The study highlights significant import dependence in the energy and information technology sectors and suggests that identifying alternative energy sources could potentially reduce import dependence in the production sectors. Ayaş, (2017:2) emphasized that the production structure is significantly dependent on the use of imported inputs related to the Turkish economy.

The literature frequently includes studies in which the effects of sectoral changes are analyzed through input-output tables published in specific periods, instead of relying on input-output tables from a single period. For instance, Duman and Özgürer (2013:45) analyzed import dependence for 12 selected sectors utilizing input-output tables from 1998 and 2002. The study result reveal that wholesale and retail trade, motor vehicle and household appliance repair industries a higher level of import dependence compared to the manufacturing industry. The number of studies conducted in conjunction with the updated input-output tables published by the Turkish Statistical Institute (TURKSTAT) has also increased in the following years. Alp, Kök, and Başkol (2017:20) investigated the import dependence of industries with two different input-output tables from 2002 and 2012. They found that the import dependence of production increased in the sector of chemical manufacturing, while decreased in the primary metals industry. Erduman, Eren, and Gül (2019:20) denoted that import dependence was high in the sectors of coal and refined petroleum products, basic metals, and motor vehicles while it was low in the sectors of agriculture, forestry and fishing, mining, and services. Özcan, Tok, and Sevinç (2019:10) computed that the overall import intensity of total production in the economy increased from 16.1% in 2002 to 19.3% in 2012.

Import dependency is investigated in numerous sectors within the manufacturing industry. Inançlı and Konak (2011:360) examined the level of external dependence in the automotive sector using the input-output tables for 1998 and 2002 provided by the TURKSTAT. The findings of the study indicated an increase in the use of imported inputs in the automotive sector and its related sectors within the total production. There are also studies conducted on the tourism sector, in addition to the automotive sector. Maden and Ertürk (2018:983) analyzed the changes in the tourism sector's import dependence, which were done utilizing input-output tables prepared by TURKSTAT for the years 2002 and 2012. The study, which revealed an increase in import dependence, attributed it to a decrease in domestically

sourced inputs in the tourism sector, resulting in an increased demand for imported inputs. Özdil and Yılmaz (2009:105) demonstrated that the increased consumption and exports in the electrical-electronics sector were reflected in the import values at the same rate with the input-output tables published by TURKSTAT for the years 1996 and 1998.

Several studies have been conducted on the subject of import dependence in numerous sectors within the manufacturing industry. These studies utilized input-output tables prepared by TURKSTAT, as well as the World Input-Output Database (WIOD), to examine the import dependence between 1995 and 2011. Uğurlu and Tuncer (2017:151) determined that import dependence is high in sectors with a high capital intensity, but low in labor-intensive sectors. Ayaş, (2017:13) analyzed the sector-specific import dependence in the Turkish economy utilizing diffrent input-output tables for the same period, which were published by WIOD. The findings denoted overall increase in import dependence in different sectors, particularly after 1998. Ersungur et al. (2017:410) investigated the import dependence in the energy sector using the same database and input-output tables for the corresponding period. The study demonstrated that import dependence persists in the energy sectors. Dağıstan (2019:17) studied that the sectors with the highest rate of imported input utilization within exports. The study results show that that the main metal industry, metal goods industry exhibited a significant reliance on imported inputs as well as motor vehicles and trailers, and other transport equipment sectors.

Some studies have also compared the production structure and import dependence between Turkey and various groups of countries. For instance, Ersungur and Ekinci (2015:747) analyzed the trade relations between Turkey and East Asian countries using different input-output tables prepared by WIOD in different years. According to the findings, it has been indicated that the demand for imported intermediate inputs will increase in order to meet the growing export of industrial products, leading to an increase in external dependency. Topcuoğlu (2020:130) conducted a comparative examination of import input utilization between Turkey and the G4 countries. The study emphasized the existence of an import-dependent economic structure in the energy and industrial sectors across all country groups. Furthermore, it was noted that the sectors of computer, electronic, and optical product manufacturing, basic metals manufacturing exhibited the highest demand for imported inputs in the Turkish economy as well as motor vehicle and trailer manufacturing, coal and refined petroleum products manufacturing. Nas, (2021:89) analyzed the import dependence between Turkey and the MINT country group employing input-output tables published by the OECD for the year 2018. According to the study results that the import dependence of final demand has been found to be13% in Turkey.

Turkish economy has a high dependence on imported inputs in production. Particularly in the manufacturing industry, it has been shown to have the highest intensity of imported inputs as seen in the literature. Numerous studies have attempted to identify key sectors by including all sectors and utilizing input-output tables published in different periods.

However, to the best of our knowledge, no study has been found that examines the import dependence of the food industry's production structure through direct, indirect, and total linkages. Therefore, it is important to conduct a detailed analysis of the sectors that contribute the most to the formation of these linkages. The study provides an important contribution to the literature in this regard.

3. DATA AND ECONOMETRIC MODEL

The input-output table used in this study, which was based on current year prices for 2016, was prepared at the national level by WIOD and encompassed a total of 56 sectors. The subject of the research is "food products, beverages, and tobacco products manufacturing" which is expressed in detail with the codes C10-C12 in Appendix Table 1.

The forward and backward linkage effects have been calculated utilizing the matrix of import and domestic input-output coefficients, along with the values of the Leontief Inverse Import Matrix.

The input-output analysis method allows for the analysis of how changes in final demand for a particular sector will affect other sectors in the economy. The input-output model is mathematically expressed as shown in Equation 1.

$$X = (I - A_t)^{-1}.Y \quad (1)$$

X, Y, A_t and $(I - A_t)^{-1}$ represent the final demand vector, production vector, technical coefficients matrix, and Leontief inverse matrix, respectively. With the data provided in Equation 1, the import inverse matrix calculated, and the sector's import structure, the mutual input sharing of sectors operating domestically and abroad can be determined.

The bilateral input sharing of sectors operating domestically and abroad can be determined by analyzing the sector's import structure and the import inverse matrix, which are calculated using the data provided in Equation 1. Additionally, the dependency coefficient on imports between sectors can be identified through forward and backward linkage effects.

In the stage of determining sectoral production and import input dependency, the intermediate inputs used by each sector for their production are categorized into domestic and imported inputs. Let (a_{ij}^{d}) represent the portion of i commodity that needs to be domestically produced in order to produce 1 unit in sector j, and (a_{ij}^{m}) represent the portion that needs to be imported. The direct production of commodity i in sector j is expressed using Equation 2.

$$a_{ij} = a_{ij}^{d} + a_{ij}^{m} \tag{2}$$

The matrix of technical coefficients (total input coefficients matrix) A_t, is composed of the domestic technical coefficients matrix (domestic input coefficients matrix) A_d and the imported technical coefficients matrix (imported input coefficients matrix) A_m as expressed in Equation 3, (Ersungur and Ekinci, 2015:734).

$$A_t = A_d + A_m \tag{3}$$

The elements of the domestic input coefficients matrix (A_d) and the imported input coefficients matrix (A_m) are computed using Equation 4. The amount of domestic and imported inputs that a sector requires from other sectors to produce one unit can be determined with these equations, (Bocutoğlu, 1990:153; İlhan, 2008:61; Aydoğuş, 2010: 49-51).

$$A_d = \frac{{X_{ij}}^{d}}{X_J} \quad ; \quad A_m = \frac{{X_{ij}}^{m}}{X_J} \tag{4}$$

The technical coefficients matrix (A_t), as shown algebraically in Equation 2, is expressed in matrix format as described in Equation 5.

$$\begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{bmatrix} = \begin{bmatrix} a_{11}^{d} & \cdots & a_{1n}^{d} \\ \vdots & \ddots & \vdots \\ a_{n1}^{d} & \cdots & a_{nn}^{d} \end{bmatrix} + \begin{bmatrix} a_{11}^{m} & \cdots & a_{1n}^{m} \\ \vdots & \ddots & \vdots \\ a_{n1}^{m} & \cdots & a_{nn}^{m} \end{bmatrix} \tag{5}$$

The sectoral import dependence in an economy can be calculated with the help of the Leontief inverse matrix utlizing the technical coefficients matrix. For this purpose, the inverse import matrix (R) for a given year is obtained by multiplying the matrix of import coefficients for that year (A_m) as expressed in Equation 6, with the inverse matrix of domestic input coefficients for the same year $[I - A_d]^{-1}$ (Bocutoğlu, 1990:53).

$$R = A_m . [I - A_d]^{-1} \tag{6}$$

The elements of the inverse import matrix, calculated using Equation 6, are represented by (r_{ij}). the sum of each row and each column corresponds to the backward and forward linkage effects in imports in the inverse import matrix denoted by (R), respectively.

$$R_j = \sum_{j=1}^{n}(r_{ij}) \quad (7)$$

$$R_i = \sum_{i=1}^{n}(r_{ij}) \quad (8)$$

The backward linkage effect in imports (R_j), calculate using Equation 7, which indicates the total amount of imported inputs (both direct and indirect) that should be sourced from all other foreign sectors when the final demand of sector j increases by 1 unit. Similarly, the forward linkage effect in imports (R_i), calculated using Equation 8, denoted the amount that needs to be imported from foreign sector i when the final demand of all sectors increases by 1 unit. If a sector exhibits a high (low) backward linkage effect in imports, its dependence on imports is correspondingly high (low) (Ersungur and Kızıltan, 2015: 269-270).

4. FINDINGS AND DUSCUSSIONS

The findings regarding the import contents of intermediate inputs and final goods demand in the food sector are presented in Table 1 and Table 2. Table 1 shows the backward linkage effects, while Table 2 includes the coefficient values of forward linkage effects, which are disaggregated into direct linkage, indirect linkage, and total linkage effects. The first column values in both tables represent the linkage effects associated with the matrix of direct import input coefficients(A_m), indicating the direct effects of imported intermediate inputs. The values in the third column represent the total linkage effects related to changes in final demand, associated with the inverse import matrix (R). Table 1 provides the values for the import input coefficients matrix (A_m), which are computed to analyze the quantity of directly imported inputs used in the food sector. The direct import input usage rate in the food sector, which is calculated as 11.08%, can be observed from the coefficient values in the first column of Table 1, representing the direct backward linkage effect. The first five sectors with the highest direct backward linkage effect values in the food sector are, respectively, the “A01 sector” with a value of 4.85%, the “C10-C12 sector” with a value of 2.27%, the “C20 sector” with a value of 1.26%, the “C17 sector” with a value of 0.53%, and the “C22 sector” with a value of 0.5%. This finding indicates that the first five sectors account for 9% of the direct import input usage in terms of imported inputs.

Table 1. *Shares of the Top 25 Sectors with the Highest Direct, Indirect, and Total Backward Linkage Effects on Imports in the Food Sector*

No	Sector Name	Direct Backward Linkage	Direct Forward Linkage	Total Backward Linkage
1	A01	0.0485	0.0152	0.0637
2	C20	0.0126	0.0218	0.0343
3	C10-C12	0.0227	0.0059	0.0286
4	C19	0.0042	0.0149	0.0190
5	C17	0.0053	0.0030	0.0083
6	C22	0.0050	0.0023	0.0073
7	C22	0.0019	0.0034	0.0052
8	C24	0.0014	0.0029	0.0043
9	C28	0.0022	0.0019	0.0041
10	G46	0.0003	0.0027	0.0030
11	C29	0.0004	0.0019	0.0023
12	B	0.0005	0.0014	0.0019
13	H49	0.0010	0.0007	0.0017
14	C25	0.0009	0.0006	0.0015
15	H50	0.0004	0.0010	0.0014
16	C13-C15	0.0003	0.0010	0.0012
17	C23	0.0007	0.0005	0.0012
18	C27	0.0001	0.0009	0.0011
19	G47	0.0006	0.0004	0.0010
20	C31-C32	0.0003	0.0004	0.0008
21	K64	0.0001	0.0005	0.0006
22	C21	0.0002	0.0003	0.0005
23	C18	0.0001	0.0003	0.0004
24	C16	0.0001	0.0003	0.0004
25	C30	0.0001	0.0003	0.0004
.	.	.	.	.
.	.	.	.	.
56	.	.	.	.
	Total	**0.1108**	**0.0861**	**0.1970**

Source: *WIOD input-Output Table; Own processing*

When the final demand of the food sector increases by 1 unit, the total (direct and indirect) amount of imported inputs required, or in other words, the total backward linkage coefficient for imports, is calculated as 0.1970 as seen in Table 1. In other words, the dependency of the food sector on imports in terms of final demand is approximately 20%. Ersungur et al. (2011:6) calculated the total backward linkage coefficient as 0.2899 using input-output tables for the year 2002 published by TURKSTAT in their study. According to the findings of this study, the total backward linkage effect has decreased by 9.29% compared to the year 2002. Moreover, when examining the sectors in the food industry that have the highest total backward linkage, the first position is held by the sector "A01" which accounts for 6.3653%. The second position is occupied by the sector "C20" with a value of 3.4339%. In the third position is the sector "C10-C12" contributing 2.8642%. The fourth and fifth positions are held by the sectors "C19" with 1.9045% and "C17" with 0.8288%, respectively. Another notable observation is that the import dependency of the food sector, which accounts for 11%, is formed by the imported inputs of the first three sectors.

Table 2. *Shares of the Top 25 Sectors with the Highest Direct, Indirect, and Total Forward Linkage Effects on Imports in the Food Sector.*

No	Sector Name	Direct Forward Linkage	Direct Forward Linkage	Total Forward Linkage
1	C10-C12	0.0227	0.0059	0.0286
2	I	0.0221	0.0044	0.0265
3	A01	0.0048	0.0016	0.0065
4	A03	0.0050	0.0011	0.0062
5	C20	0.0041	0.0012	0.0053
6	C13-C15	0.0022	0.0023	0.0045
7	C22	0.0033	0.0010	0.0043
8	Q	0.0024	0.0011	0.0035
9	C17	0.0019	0.0013	0.0031
10	H51	0.0003	0.0023	0.0025
11	C16	0.0015	0.0010	0.0025
12	H52	0.0002	0.0022	0.0024
13	O84	0.0014	0.0008	0.0022
14	H50	0.0011	0.0008	0.0019
15	M74-M75	0.0011	0.0007	0.0018
16	E37-E39	0.0012	0.0006	0.0018
17	C18	0.0006	0.0011	0.0017
18	M72	0.0002	0.0012	0.0015
19	C27	0.0007	0.0007	0.0014
20	C31-C32	0.0005	0.0009	0.0014

21	R-S	0.0005	0.0009	0.0014
22	C23	0.0006	0.0007	0.0013
23	C29	0.0006	0.0007	0.0013
24	C26	0.0005	0.0007	0.0012
25	G46	0.0003	0.0009	0.0012
.	.	.	.	.
.	.	.	.	.
56	.	.	.	.
	Total	**0.0852**	**0.0477**	**0.1330**

Source: *WIOD input-Output Table; Own processing.*

The food sector has direct forward linkage effect coefficient of 8.52% as seen in Table 2. Furthermore, the first five sectors with the highest direct forward linkage effect are as follows: "C10-C12 sector (2.27%)", "I sector (2.21%)", "A01 sector (0.48%)", "A03 sector (0.50%)", and "C20 sector (0.41%)". The total forward linkage effect coefficient in imports, which is calculated by summing the row values of the Leontief inverse import matrix, has been determined as 0.1330. This finding reveals that when the final demand of all sectors in Turkey increases by one unit, the total quantity of products that needs to be imported from the foreign food sector, both directly and indirectly, is increased by 0.1330 units. In other words, the demand for imported inputs from the foreign food sector accounts for approximately 13% of the total demand of all sectors. When examining the total forward linkage of the sector, the first five sectors are respectively identified as "C10-C12 sector (2.270%)", "I sector (2.211%)", "A03 sector (0.50%)", "A01 sector (0.483%)", and "C20 sector (0.407%)". Another notable finding is that, following the food sector itself, the "I sector" receives the highest amount of imports in response to the increase in final demand of all sectors.

5. CONLUSIONS

The significant reliance on imports for the necessary intermediate inputs in any sector's production increases a country's dependence on imports in the global economy. The input-output analysis method is used to comprehensively examine the sectoral production's dependence on imports. In this study, unlike other studies, the dependency of the production structure of the food sector in Turkey on imported inputs has been evaluated using the method of the inverse import matrix calculated through national input-output tables. The direct backward linkage coefficient in the food sector which known as the dependency on imported intermediate inputs, has been calculated as 11%. According to the findings obtained from the study, it has been determined that the highest direct import input to the food sector is made from the "agriculture and livestock sector". Additionally, it is noteworthy that the second-highest import occurs within the food sector itself. Chemical

product imports rank third in terms of direct input imports. When evaluating the overall direct import usage rate in the food sector, it can be concluded that imports from the first five sectors, which account for 9% of the 11% direct import usage rate, make up a significant portion.

The total backward linkage coefficient for imports, which represented by the column sum of the inverse import matrix for the food sector, has been found to be 0.197. This result indicates that when the final demand for the food sector increases by 1 unit, the total amount of products to be imported (directly and indirectly) would increase by 19.70%. The total share of these top five sectors, which have the highest backward linkage effects, has been determined to be 15.37% of the total food imports, representing 78% of the total share within the food sector.

The total forward linkage effect coefficient, which is calculated as 0.1330 and represents the sum of the row values in the Leontief input-output matrix, has been determined. This result has been denoted that when the final demand of all sectors in the economy increases by one unit, a total of 13.30% of products need to be imported from foreign food sectors, both directly and indirectly. The total share of the top five sectors, which have the highest forward linkage effect (7.31%), accounts for 55% of the total foreign food imports (13.30%), indicating that more than half of the imported food products originate from these sectors. In other words, more than half of the imported food products are accounted for by these top five sectors, which have the highest total forward linkage effect.

It has been significant result that the import of raw materials from the agriculture sector, which supplies raw materials to the food sector, ranks first according to the findings of the study. In addition, the ranking of important agricultural inputs, which are chemicals, in the sector of “manufacture of chemicals and chemical products” has a detrimental effect on the dependency of food production on imports such as pharmaceuticals and fertilizers. Petroleum products, impact input costs in the stages of soil cultivation and transportation of agricultural products in the agricultural sector both directly and indirectly. In this context, another notable result of the study is that the “manufacture of coke and refined petroleum products” is the input category that the food sector imports the most, following its own sector. The high ranking of petroleum product imports in the food sector increases the dependency on imports in production. Therefore, it is recommended to prioritize investment planning in agriculture, chemical products, and petroleum products sectors, which have high import dependency in the food sector, in order to reduce reliance on imports. This would enable the prioritization of macroeconomic policies aimed at reducing external dependency in the food sector.

REFERENCES

Alp, E., Kök, R., & Başkol, M. Ozan. (2017). Türkiye ekonomisinde sürükleyici endüstri analizi: 2002-2012 karşılaştırması. KAÜİİBFD, 8(16), 211-241.

Atan, S. (2011). Türkiye'deki sektörel bağlantı yapısının girdi-çıktı yaklaşımı ile incelenmesi: yurtiçi üretim ve ithal ara girdi ayrıştırması. Ekonomik Yaklaşım, 22(80), 59- 78.

Ayaş, N. (2017). Import dependency of sectors and major determinants: an ınput output analysis. European Journal of Sustainable Development Research, 2(1), 1-16.

Aydoğuş, O. (2010). Girdi-çıktı modellerine giriş, 3. basım, Ankara:Efil Yayınevi.

Bocutoğlu, E. (1990). Endüstrilerarası iktisat, teori ve türkiye uygulamaları, Trabzon: Karadeniz Teknik Üniversitesi Basımevi.

Dağıstan, N. (2019). Türkiye'nin dış ticaretindeki dikey uzmanlaşmanın girdi-çıktı modeli ile analizi. Fiscaoeconomia, 3(2), 1-20.

Duman, A., & Özgüzer, G. (2013). An ınput-output analysis of rising ımports in Turkey. Ekonomik Yaklaşım, 23(84), 39-54.

Erduman, Y., Eren, O., & Gül, S. (2019). The evolution of import content of production and exports in Turkey: 2002-2017. Working Paper No: 19/09. Ankara: Türkiye Cumhuriyet Merkez Bankası.

Ersungur, Ş. M., Ekinci, D. E., & Takım, A. (2011). Türkiye ekonomisinde ithalata bağımlılıktaki değişme: girdi-çıktı yaklaşımıyla bir uygulama. Atatürk Üniversitesi, İktisadi ve İdari Bilimler Dergisi, 10.Ekonometri ve İstatistik Sempozyumu Özel Sayısı, 25,1-11.

Ersungur, Ş. M., & Kızıltan, A. (2007). Türkiye ekonomisinde ithalata bağımlılığın girdi-çıktı yöntemiyle analizi. Atatürk Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 9 (1), 267-278 .

Ersungur, Ş. M., & Ekinci, E. D. (2015). Türkiye ve doğu asya ülkeleri arasındaki dış ticaret ilişkileri: girdi-çıktı yöntemi ile bir analiz. İktisadi ve İdari Bilimler Dergisi, 29(4),721-748.

Ersungur, Ş. M., Boz, F. Ç., & Çınar, Ö. (2017). Türkiye ile BRICS ülkeleri arasındaki dış ticaret ilişkileri: girdi-çıktı yöntemi ile bir analiz, Business and Economics Research Journal, 8(3), 395-412.

İlhan, B. (2008). Türk inşaat sektörünün girdi-çıktı analizi ve ithalata bağımlılığı, yayınlanmamış yüksek lisans tezi. İstanbul Teknik Üniversitesi Fen Bilimleri Ensititüsü, İstanbul.

İnançlı, S., & Konak, A. (2011). Türkiye'de ihracatın ithalata bağımlılığı: otomotiv sektörü. Eskişehir Osmangazi Üniversitesi İİBF Dergisi, 6(2), 343-362.

Kundak, S,, & Aydoğuş, İ. (2018). Türkiye'de imalat sanayinin ithalata bağımlılığının analizi. Gaziantep Üniversitesi Sosyal Bilimler Dergisi, 17(1), 252 - 266.

Maden, S. I. & Ertürk, M. (2019). Türk turizm sektörünün Türkiye ekonomisine olan etkilerinin girdi-çıktı analiziyle incelenmesi. Doğuş Üniversitesi Dergisi, 20(2), 69-87.

Özcan-Tok, E., & Sevinç, O. (2019). Üretimin ithal girdi yoğunluğu: girdi-çıktı analizi. TCMB Ekonomi Notları(2019-06). Ankara: Türkiye Cumhuriyet Merkez Bankası.

Özdil, T., & Yılmaz, C. (2009). Elektrik elektronik sektörünün Türkiye ekonomisi içindeki öneminin girdi çıktı analizi ile incelenmesi, Kırgızistan-Manas Üniversitesi, Sosyal Bilimler Dergisi, 21, 95-105.

Nas, Ş. (2021). MINT ülkelerinde ara girdi ve nihai talebin ithalat bağımlılığı: girdi-çıktı analizi, Bulletin of Economic Theory and Analysis, 7(1), 69-95.

Topçuoğlu, A., & Ayyıldız, F. V. (2020). E7 ülkelerinde kilit sektör analizi, MANAS Sosyal Araştırmalar Dergisi, 9(2), 822-833.

Uğurlu, A. A., & Tuncer, İ. (2017). Türkiye'de sanayi ve hizmet sektörlerinin büyüme ve istihdama katkıları: girdi-çıktı analizi, Dokuz Eylül Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 32(1), 131-166.

Yükseler, Z., & Türkan, E. (2006). Türkiye'nin üretim ve dış ticaret yapısında dönüşüm:küresel yönelimler ve yansımalar, Ekonomik Araştırma Formu Çalışma raporları, TÜSİAD, Koç Üniversitesi.

APPENDIX

Appendix 1: *Sectors and Codes Included in the Input-Output Table*

No	Nace Code	Sector Name
1	A01	Crop and animal production, hunting and related service activities
2	A02	Forestry and logging
3	A03	Fishing and aquaculture
4	B	Mining and quarrying
5	C10-C12	Manufacture of food products, beverages and tobacco products
6	C13-C15	Manufacture of textiles, wearing apparel and leather products
7	C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
8	C17	Manufacture of paper and paper products
9	C18	Printing and reproduction of recorded media
10	C19	Manufacture of coke and refined petroleum products
11	C20	Manufacture of chemicals and chemical products
12	C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
13	C22	Manufacture of rubber and plastic products
14	C23	Manufacture of other non-metallic mineral products
15	C24	Manufacture of basic metals
16	C25	Manufacture of fabricated metal products, except machinery and equipment
17	C26	Manufacture of computer, electronic and optical products
18	C27	Manufacture of electrical equipment
19	C28	Manufacture of machinery and equipment n.e.c.
20	C29	Manufacture of motor vehicles, trailers and semi-trailers
21	C30	Manufacture of other transport equipment
22	C31-C32	Manufacture of furniture; other manufacturing
23	C33	Repair and installation of machinery and equipment
24	D35	Electricity, gas, steam and air conditioning supply

25	E36	Water collection, treatment and supply
26	E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; remediation activities and other waste management services
27	F	Construction
28	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles
29	G46	Wholesale trade, except of motor vehicles and motorcycles
30	G47	Retail trade, except of motor vehicles and motorcycles
31	H49	Land transport and transport via pipelines
32	H50	Water transport
33	H51	Air transport
34	H52	Warehousing and support activities for transportation
35	H53	Postal and courier activities
36	I	Accommodation and food service activities
37	J58	Publishing activities
38	J59-J60	Motion picture, video and television programme production, sound recording and music publishing activities; programming and broadcasting activities
39	J61	Telecommunications
40	J62-J63	Computer programming, consultancy and related activities; information service activities
41	K64	Financial service activities, except insurance and pension funding
42	K65	Insurance, reinsurance and pension funding, except compulsory social security
43	K66	Activities auxiliary to financial services and insurance activities
44	L68	Real estate activities
45	M69-70	Legal and accounting activities; activities of head offices; management consultancy activities
46	M71	Architectural and engineering activities; technical testing and analysis
47	M72	Scientific research and development
48	M73	Advertising and market research
49	M74-75	Other professional, scientific and technical activities; veterinary activities

50	N	Administrative and support service activities
51	O84	Public administration and defence; compulsory social security
52	P85	Education
53	Q	Human health and social work activities
54	R-S	Other service activities
55	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
56	U	Activities of extraterritorial organizations and bodies

Source: *WIOD Input-Output Table*