UNDERSTANDING NEW CASES IN MICROECONOMICS: MARKETS AND INDUSTRIES

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PREFACE

In this book authors tried to place before interested readers the world economic situation and prospects. Most recently, we have seen measurable improvement in the world economy. The book also have a substantial research and solutions focus.

The first two decades of the XXI century. filled with a variety of new phenomena and trends that have become difficult challenges both for economic theory and for politicians, business person and ordinary people. Turbulence and unpredictability of development have reached unprecedented heights and acuteness in the world economy, regions of the world and individual countries. All this is reflected to varying degrees in the socio-economic development of Turkey and other parts of the world, which is also affected by the COVID-19 pandemic. The unprecedented world economic crisis, which began in 2020, exacerbated the problems of both globalization and individual countries.

The whole complex of these problems is considered by the authors of the book which is distinguished by a systematic approach to the analysis of both general and particular issues of modern development and general economic theory.

The monograph is recommended to everyone who is interested in the state of the world and Turkish economies, the prospects for their development, as well as issues of general economic theory and its

individual parts, schools and programs. It will be useful for analysts, teachers, graduate students and students, everyone who is concerned about the problems of the economy, society and the state, the relationship of international trends and national traditions in market development models.

Dr. Mustafa Latif EMEK

CHAPTER 1

OPTIMIZING THE NUMBER OF STAFF IN TERMS OF COST IN THE DENTAL HEALTH CENTER

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INTRODUCTION

Since healthcare systems are complex and dynamic, many problems arise naturally (Austin & Wetle, 2016). These problems can be the inefficiency of health resources, long patient waiting times, long patients' length of stays, high treatment or examination costs, incorrect drug administration, and high unused medical wastes (Atalan, 2018). Researchers have used many applications and approaches to solve healthcare problems. At the beginning of these applications is optimization, numerical methods, and mathematical modelling, also called operations research (Batun & Begen, 2013). The linear optimization technique, one of the optimization models, was applied for oral and dental health center in this study.

Linear or integer optimization algorithms are the most common optimization models used to solve problems in the field of healthcare (Agarana & Olokunde, 2015; Dibene et al., 2017; Hsueh et al., 2018). The most important reason for choosing these algorithms is that the values of the decision variables in the optimization models must be integers (Shahabi et al., 2019). Because the decision variables represent either the number of employees or the number of products (patients in the health field), the decision variables cannot take rational numbers. Since the decision variables for the subject discussed in this study represent the number of employees, it can be defined as an integer linear optimization model.

Linear optimization models are usually utilized in healthcare to calculate optimum values in many subjects such as shift principles, the number of employees, patient waiting times, treatment costs (Agarana & Olokunde, 2015). However, this technique has been widely used in healthcare, emergency service, polyclinic and medical issues. Optimization models for oral and dental health have rarely been addressed. This study developed a linear optimization model for the number of dentists employed in an oral and dental health center. In this study, the optimization model is not considered for a medical issue.

Optimization models used in the literature for different topics in the healthcare field are commonly created for shifts of health workers (Abdalkareem et al., 2021; Granja et al., 2014; Huang et al., 2019). One study focused on nurse shifts to reduce healthcare costs and optimize the efficiency of healthcare resources. In this study, by developing an integer linear optimization model, nurse shifts, one of the important health resources, were arranged, and productivity levels were increased from the maximum rate (Trilling et al., 2006). Another scientific article created a long-term nurse shift system by developing a linear integer optimization method. The need for nurses in other hospital clinics was reduced, the working hours of the nurses were kept as close to a certain value as possible, and the optimum number of nurses was employed in the extra days with this shift system (Zanda et al., 2018).

Mathematical models are used to create the optimum shift order and calculate the optimum value for the number of healthcare resources employed. Alkhamis et al. calculated the number of doctors, nurses and civil servants who should work in an emergency room using the linear optimization model (Ahmed & Alkhamis, 2009). In another study, the optimum number of healthcare resources was calculated utilizing the linear optimization method, taking into account human health resources and location-based resources such as beds, triage areas, and consultation rooms in an emergency service unit (Atalan & Dönmez, 2020). Health service costs for the health institution is also ensured by optimizing the number of health resources. In one study, health service quality was maximized by optimizing healthcare resources (Crown et al., 2017).

Another reason for preference of optimization models is to solve patients' problems waiting for a long time in health institutions. In a study, it was observed that there was an average of 38% reduction in patient waiting times by using the linear optimization model technique for patients who waited for a long time in a hospital to wait in less time (Granja et al., 2014). In another study, by developing a complex integer linear optimization model, patient waiting times in the emergency department were reduced by an average of 23.24% (Daldoul et al., 2018). Optimization models used for waiting time were used administratively for dental treatment time for oral and dental health. In a study, a linear programming optimization model was developed to ensure that dental treatment times reach optimum

values (Hsueh et al., 2018). Administratively, optimization models were used in this study to employ the optimum number of dentists in the dental clinic.

METHODOLOGY

In this study, the optimum weekly shift table was created with the linear optimization model by examining the shift systems of dentists working in an oral and dental health center. Although linear optimization models are frequently used in healthcare, there are very few studies on dental health.

There are four stages for constructing linear optimization models. These stages are listed as follows:

- Determination of decision variables,
- Defining the objective function,
- Creating constraints,
- It is necessary to determine the direction and type of the values that the decision variables will take.

Let the decision variable be defined as $x_i, i = \{1,2,3, \dots, n\}$ to express the linear optimization model with the following representative mathematical equations. $f(x_i)$ is expressed as linear equations to be included in the optimization model. The equation f $f(x_i)$is shown as a closed formula as follows.

$$f(x_1, x_2, x_3, \dots, x_n)$$

The equation $f(x_i)$ is used for both the objective function and the constraints. According to both types of equations, the equations must be linear, or there is no interaction of the decision variables with each other. The constant coefficients to be used for both the objective function and the constraints are defined as $c_i, i = \{1,2,3, \dots, n\}$ and their interaction with the decision variables are expressed as the following equation:

$$c_1x_1 \pm \ c_1x_1 + c_1x_1 \pm \cdots \pm c_nx_n$$

In an optimization model for which the decision variable and constant coefficients are known, the objective function is defined as the following equation:

$$z = c_1x_1 \pm \ c_1x_1 + c_1x_1 \pm \cdots \pm c_nx_n$$

The symbol z represents objective functions. An optimization model has two types of objectives. In the model, if the objectives are more than a system or process, and if the benefit is desired, the z function is specified as maximum. The following equation represents the maximum objective function:

$$maximum\ z = c_1x_1 \pm \ c_1x_1 + c_1x_1 \pm \cdots \pm c_nx_n$$

In a linear optimization model created for a system or process, the objective function should be defined as a minimum if the objectives

minimize a loss or cost. So, the objective function for the minimum z value should be expressed as the following equation:

$$minimum\ z = c_1x_1 \pm\ c_1x_1 + c_1x_1 \pm \cdots \pm c_nx_n$$

After defining the aspects of the objective functions, the next step that completes the optimization model is to determine the constraints. A model should usually have at least one constraint. For example, since there is a capacity limit in a system for which an optimization model is developed, there are many limits such as human, material, energy and cost. By writing these limits as equations, they form the constraints of an optimization model. The constraint equation of an optimization model is expressed as:

$$c_1x_1 \pm\ c_1x_1 + c_1x_1 \pm \cdots \pm c_nx_n = l$$
$$c_1x_1 \pm\ c_1x_1 + c_1x_1 \pm \cdots \pm c_nx_n \geq l$$
$$c_1x_1 \pm\ c_1x_1 + c_1x_1 \pm \cdots \pm c_nx_n \leq l$$

The value of l in the above constraints indicates the limit of the constraint. Constraints have three limits. Three different equations can be formed for a constraint, provided that it is equal to, more than, or less than a value. Finally, in a linear optimization model, the decision determines the direction and type of variables. In this step, the direction of the decision variables is equated as follows:

$$x_i \geq / = / \leq a$$

A decision variable can be greater than or equal to a value. A decision variable is negative if a value less than zero is desired or positive if desired to take a value greater than zero. However, in optimization models, decision variables usually take values greater than zero, provided they are either zero or positive. If the decision variables are set to a number, which is usually either zero or one [0,1], this decision variable is defined as expressions such as binary or binary. Decision variable values can take rational numbers as well as integer values. However, in an optimization model, the type of decision variables must be expressed as integers in order for the decision variables to take integer values. For example, a maximum number of patients treated is desired in an optimization model. If the decision variable is the number of patients in this model, the decision variable should be an integer. Otherwise, the decision variables will be logically incorrect by taking values such as 11.5, 15.3. After determining the exact stages of an optimization model, the mathematical model is generally constructed as follows:

$$maximum/minimum\ z = c_1x_1 \pm\ c_1x_1 + c_1x_1 \pm \cdots \pm c_nx_n$$

$$c_1x_1 \pm\ c_1x_1 + c_1x_1 \pm \cdots \pm c_nx_n = l$$

$$c_1x_1 \pm\ c_1x_1 + c_1x_1 \pm \cdots \pm c_nx_n \geq l$$

$$c_1x_1 \pm\ c_1x_1 + c_1x_1 \pm \cdots \pm c_nx_n \leq l$$

$$x_i \geq/=/\leq a,$$

$$x_i, [0,1], \text{binary}$$

$$x_i, \text{integer}$$

With the optimization model to be created for this study, it is aimed to employ a minimum number of dentists employed in an oral and dental health center according to five-day working days. This optimization model is defined as the linear optimization model. The oral and dental health center consists of two parts. These departments are defined as general dental treatment and orthodontist treatment. Orthodontists can also perform the general dental treatment.

For this reason, orthodontists come into play when general dental treatment is intense. The number of dentists working in the oral and dental health center for general dental treatment works on different numbers according to the incoming patients. The number of dentists working in this oral and dental center by day is given in **Table 1**:

Table 1: Number of dentists employed in the oral and dental Health Center by day

Day	Dentists	Orthodontist	Total
Monday	6.0	3.0	9.0
Tuesday	7.0	4.0	11.0
Wednesday	9.0	5.0	14.0
Thursday	11.0	3.0	14.0
Friday	11.0	3.0	14.0

According to **Table 1**, the number of dentists working for each day is limited in the optimization model. Dentists working in the oral and dental health center take a vacation three days a week, provided that they work at least four consecutive days. For example, if a dentist starts working on Monday, he works on Tuesdays and Wednesdays and takes a vacation on Thursday. This doctor is back to work on Friday. Oral and dental health center adopts this working principle with the thought that dentists will be more efficient. This principle is

also another limitation of the optimization model. In this study, the LINGO program was used to solve the optimization model. According to this program, the algorithm of the linear optimization model, which takes into account only the number of dentists who perform general dental treatment, was created as follows:

```
SETS:
        Days : required, starts;
                ENDSETS
                        DATA:
                        days = Monday Tuesday Wednesday Thursday Friday
                        required= 6 7 8 9 11;
                ENDDATA
MIN = @SUM( days( I): start( I));
                @FOR(days( J):
                @SUM(days( I) | I #LE# 4:
        start( @WRAP( J - I + 1, 5))) >= required( J);
                @FOR( required(I): @GIN( start(I)));
);
```

Two data types were determined in the linear optimization model. The datasets are specified in the optimization model as the minimum number of dentists that a dentist should work from the day he starts to work. The constraint is defined as $@SUM(\, days(\, I) \mid I\ \#LE\#\ 4$, provided that a dentist works four consecutive days. The other constraint is $[required =\ 6\ 7\ 8\ 9\ 11]$ as the minimum number of dentists required to work on working days of the week. The constraint on which day the dentists will start work is written into the algorithm as the equation $START(\, @WRAP(J\ -\ I\ +\ 1{,}5))\ >=\ required(\, J)$. The purpose of this optimization model is expressed as $MIN\ =\ @SUM(\, days(\, I)\!: start(\, I))$ as the minimum number of dentists to be employed in the oral and dental health center. Since the decision variables of the optimization model

are also integer values, this model can also be called the integer linear optimization model. The solution of this algorithm is discussed in the next section.

DISCUSSION OF THE RESULTS

The optimization model, which is defined and developed as both linear and integer optimization models, is used in this study to calculate the optimum number of healthcare workers. There are no nonlinear equations in the developed optimization model since there is no interaction between the decision variables. The numerical results obtained from the analysis of the linear optimization model created for the oral and dental health center with the LINGO program are shown in **Table 2**.

Table 2: LINGO output of the optimization model

Global optimal solution found. Objective value: 11.00000 Objective bound: 11.00000 Infeasibilities: 0.000000 Extended solver steps: 0 Total solver iterations: 5 Elapsed runtime seconds: 0.09		
Model Class: PILP		
Total variables: 5 Nonlinear variables: 0 Integer variables: 5		
Total constraints: 6 Nonlinear constraints: 0		
Total nonzeros: 25		
Nonlinear nonzeros: 0		
Variable	Value Reduced	Cost
required (Monday)	6.000000	0.000000
required (Tuesday)	7.000000	0.000000
required (Wednesday)	9.000000	0.000000

required (Thursday)	11.000000	0.000000
required (Friday)	11.00000	0.000000
start (Monday)	0.000000	1.000000
start (Tuesday)	5.000000	1.000000
start (Wednesday)	4.000000	1.000000
start (Thursday)	2.000000	1.000000
start (Friday)	0.000000	1.000000

Based on these results, the optimum result was obtained with a minimum of 11 dentists who should work in the oral and dental health center. Table 3 gives information about how many days a dentist will work and which day he will start work. In this table, dentists are coded and defined as DH1, DH2, DH3, …, DH11.

Table 3: Starting working days of Dentists

Dentists	Monday	Tuesday	Wednesday	Thursday	Friday
DH1		DH1	DH1	DH1	DH1
DH2		DH2	DH2	DH2	DH2
DH3		DH3	DH3	DH3	DH3
DH4		DH4	DH4	DH4	DH4
DH5		DH5	DH5	DH5	DH5
DH6	DH6		DH6	DH6	DH6
DH7	DH7		DH7	DH7	DH7
DH8	DH8		DH8	DH8	DH8
DH9	DH9		DH9	DH9	DH9
DH10	DH10	DH10		DH10	DH10
DH11	DH11	DH11		DH11	DH11
Required Dentists	6.00	7.00	9.00	11.00	11.00

According to the optimization model results, the starting days of dentists were determined as Tuesday, Wednesday, and Thursday. Although no dentist started work on Monday, DH6-DH11 dentists are on duty that day. Dentists with the codes DH1, DH2, DH3, DH4, DH5, DH6, DH10, DH11 will be on duty on Tuesday. Among these dentists, DH1-DH5 were determined as the starting days of work on

Tuesday. While four dentists start work on Wednesday, a total of 9 dentists are on duty. A total of 11 dentists will work on Thursdays and Fridays.

With this study, it is understood that the number of dentists employed according to a particular working principle reaches the optimum value, and at the same time, the health center provides cost savings. Unfortunately, health centers cannot employ optimum health resources because they have dynamic and complex systems. As a result of this situation, the increase in treatment and resource costs leads to increased health expenditures. In this study, an optimization example is shown to calculate the number of health resources optimally. With this example, optimization models should be handled more frequently by researchers in health, especially for oral and dental health centers.

CONCLUSION

This study is considered an example of the application of linear optimization techniques in the field of healthcare. Especially in studies on oral and dental health, optimization techniques are handled by very few researchers. Different solutions are sought for the problems that arise due to health systems' dynamic and complex structures. The optimization model, which is one of the solutions, is problem-specific and lays the groundwork for the obtained results to be optimum and accurate data.

This study developed a linear and integer optimization model with the data obtained by choosing an oral and dental health center plot region. The oral and dental health center management provides numerical data about the optimum number of dentists employed per day and how many dentists should be employed for that day with this model. With the optimum values obtained, the costs for employment were reduced to the minimum level, and additional benefits were among the possibilities. Since the optimization models are created specifically for the problems, it should be noted that the results obtained will only be valid for that problem. However, these models can serve as examples of similar problems. This study, aiming to calculate the employment numbers of dentists by days, will form the basis for the employment of dentists in hourly shifts and will guide future studies.

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CHAPTER 2

THE IMPORTANCE OF INTERMODAL TRANSPORT IN TURKEY'S TRADE WITH THE EUROPEAN UNION (EU): A REVIEW IN THE CONTEXT OF THE CORRIDOR

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INTRODUCTION

With the emergence and development of different trade understandings in international trade, different transportation systems have emerged as a result of the application of different transportation types, or specific names have been given to these previously existing systems. One of these transport systems is the intermodal transport system or network. This transportation system is the process of transporting the loads from the starting point to the destination in an integrated way by keeping them in a single transport unit by combining two or more types of transport, that is, road, sea, rail, air and water transport combinations. During transportation, the handling of the transport units is in question, not the handling of goods or traded cargoes. Otherwise, the system turns into a different system with the handling process applied to the cargo subject to direct trade, and a multimodal transportation system is in question (UNECE, 2001; Lowe, 2005; Zeybek, 2007).

The intermodal transportation system in international trade has started to become widespread as a result of the need to develop a sustainable, environmentally friendly transportation system, together with the desire to minimize the negative effects and costs of the transportation and logistics sectors caused by economic, social and ecological factors. For this reason, the main purpose of the intermodal transport system is to use suitable routes with the advantageous aspects of different transport modes, without being tied to a single transport mode or type, and to provide an efficient, cost-effective integrated

system. Thus, the system makes door-to-door transportation possible, which makes the logistics industry attractive (Lowe, 2005; Yersel, 2010). In addition to its main purpose in international trade, the intermodal transportation system brings many conveniences and advantages. One of them is that it is a solution to the problems related to visa and transit document, quotas that countries subject to international trade may encounter during their transition to another country. Similarly, it has been seen that it provides convenience in international trade in terms of using a single transport document, visa fees, depreciation costs of vehicles, waiting at the door, loading of cargoes, not being an obstacle in the use of intermediary companies and focusing on all the needs of the market. Thus, these conveniences create both material and time cost advantages in international trade. While all these make intermodal transportation useful, it strengthens its place and importance in international trade with the convenience it provides to international trade (Boardman, 1999; Slack, 2001, Işıkhan, 2011).

In this study, firstly, the concept of intermodal transportation will be discussed, secondly, the policies applied on the development of intermodal transportation in Turkey will be included, thirdly, the intermodal transportation policy of the European Union will be discussed, and finally, important corridors in Turkey-EU freight transport will be emphasized and a general evaluation will be made.

In order to obtain the highest level of efficiency from the intermodal transportation system in international trade, the advantages should be

used well and the disadvantages that may occur should be ruled out in the best way. In order for these to be carried out correctly, the types of transport to be used in the system should be chosen correctly, and the expected benefits from these choices should be determined correctly. At this stage, it is necessary to pay attention to the fact that the system is effective together with its elements, the right optimization framework is determined and the necessary infrastructure requirements are provided in the choice of intermodal transportation. Thus, the system becomes more accessible and allows higher benefits. In addition, the factors that will affect intermodal transportation, namely political factors (measures and restrictions), economic, customer, compliance, documentation, innovations, developments and environmental factors should definitely be included in the evaluations (Pedersen, 2005; Çancı and Türkay, 2006; Nemoto et al., 2006; Çekerol, 2007; Uyguc and Sevil Oflaç, 2017).

1. INTERMODAL TRANSPORTATION: CONCEPTUAL EXPLANATIONS

The concept of intermodal transportation is used under different names in the literature. For example, Lowe (2005) used the terms "Intermodalism", Zeybek (2007) "Intermodality", and Çekerol (2007) used the terms "Intermodalism" or "Intermodality". Commonly, the names "Intermodal Transportation" is preferred. However, each concept used under different names serves the same purpose. The fact that the concept of intermodal transportation or the concepts used instead of it can be aimed at a single purpose depends on the fulfillment of the transportation system / process in a complete, correct and integrated manner. Otherwise, the system may be damaged by the domino/whip/butterfly effect, and disruptions may occur in the system. This feature of intermodal transportation is hidden in the process that we can describe as the transportation chain. Each basic component in this process must fulfill its task without any problems. In the concept of intermodal transportation, which is considered from this perspective, three basic components appear conceptually. These; actors, activities and resources (Woxenius, 1998; Zeybek, 2007).

The actors, which constitute one of the basic components of intermodal transport, are organized structures that are professionalized in their work. At the same time, these are structures that can create added value by providing time, space, correct use of resources, cost, customer satisfaction, availability, safety and security benefits (Çancı

and Erdal, 2013b; Krajewska and Kopfer, 2006; Baluch, 2006). These structures are located in the management and production parts of the system. While the structures in the management system part are 3PL (Third Party Logistics) and 4PL (Fourth Party Logistics) Companies, which are called Freight Forwarders and Intermodal Companies/Party Logistics Companies; The actors in the production system are the companies and transporters that take on the task between the sender and the receiver. As a result of the responsibilities of all these actors by undertaking certain duties, it is possible to talk about the activities that are the second component of intermodal transportation. Such activities begin with the delivery or collection of the cargo from the delivery point in intermodal transportation, and continue with the use of the necessary connection points, the transfer and the change of transportation types. Finally, the process ends when the cargo is unloaded and delivered at the destination. In this context, the concepts of loading/collecting, connecting, transferring, distribution/unloading are all within the framework of activities in intermodal transportation. All elements or assets used in such activities fall within the scope of resources, which is the third basic component of intermodal transport. These are all kinds of equipment used or to be used, terminals, transport vehicles, Intermodal Transport Units (ITU) and information systems (Woxenius, 1998; Zeybek, 2007). Among the most important resources in intermodal transportation are Intermodal Transport Units/Units, containers, swap bodies (foot containers) and semi-trailers. While these resources provide speed, efficiency and reliability to the process; it reduces the packaging time, cost and risk of damage

of the process (UNECE, 2001; Lowe, 2005). Information-communication systems and electronic data exchange systems provide the integration and simultaneous control system within the intermodal transport process. These have become an important resource for countries in the competitive trade environment for years (Bock, 2009).

The intermodal transport chain is formed by the combination of the basic components of intermodal transport. A simple intermodal transport chain and a multiple transport chain are given in the figure below. It is seen that there are numerical differences in actors, activities and resources between the two figures. However, although there are differences in the basic components of intermodal transport, the basic requirement in both intermodal transport processes is that the level of integration must be quite high and binding. However, this foundation must be sustainable in both processes, either above-ocean or continent-to-continent. In addition to these, system design, service network design and operational planning must be done in an accurate and understandable way in the process. All these elements are closely linked to the integration process in the intermodal transport chain. With the correct protection of this bond, an efficient and cost-effective process emerges, which is beneficial for both countries and businesses (Bektas and Crainic, 2007).

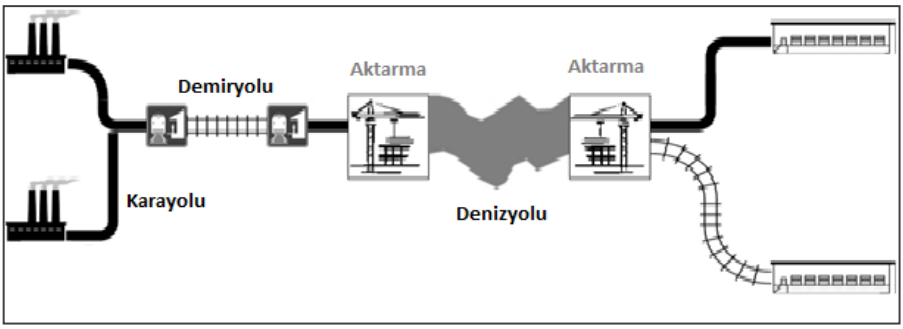


Figure 1: Simple Intermodal Transport Chain (Bektas and Crainic, 2007)

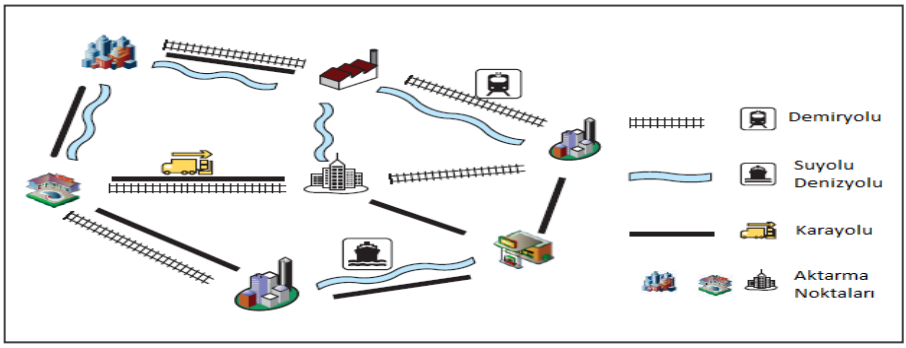


Figure 2: Multiple Intermodal Transport Chain (Quynh Le et al., 2018)

2. TURKEY'S INTERMODAL TRANSPORT POLICY

International logistics and transportation sectors have an important place for Turkey as well as in all countries of the world. However, there are some features that distinguish Turkey from other world countries. These are the enormous position and resources that Turkey has. From this point of view, Turkey is a country with a very strong strategic position with its location to Asian, European and African countries and its maritime border to eight different countries Therefore, Turkey has become a country that hosts transit transportation together with transit trade in an ever-increasing market environment where the countries of the world are included. In this

case, Turkey's environmental, political and strategic conditions have been a driving force in the transition to intermodal transportation, and this mode of transportation has become a necessity rather than a reason for preference. While intermodal transportation has conceptually existed in Turkey's transportation history, unfortunately, it has not found the place and mass it deserves in practice. In addition, the types of transport used in the past have also increased the effect of this situation. For example, instead of taking advantage of railway and seaway opportunities in medium and long distances, there has been a more orientation towards road transport. For this reason, the years between 1950 and 2000 were named as "Highway Weighted Period". In the post-2000 period, the importance of railway transportation and network was understood and railway infrastructure investment projects were developed. This period has been the “Golden Age of Railways” for Turkey. Thus, Turkey has had the opportunity to connect its national and international transport networks and corridors to more international networks and corridors. However, the lack of railway infrastructure has delayed the transition to intermodal transport activities and policies. Thus, Turkey remained underdeveloped in the intermodal transport system. Today, considering Turkey's share in international trade, its special geographical location, and the EU membership process, the development of transportation infrastructure and services belonging to the intermodal transportation system and the establishment or development of intermodal transportation facilities have become obligatory. In this context, it has been evaluated that Turkey is in a

position to raise itself to the highest level in intermodal transportation with the development of regional cooperation and international logistics and transportation policies (Zeybek, 2007; T.C. Ulaştırma ve Altyapı Bakanlığı, 2014; Yılmaz ve Pietrzyk, 2014; Barbanova, 2016; T.C. Ulaştırma ve Altyapı Bakanlığı, 2018; UTİKAD, 2020). When Turkey's air transportation is examined, it is seen that its use for freight transportation was low in the past. Progress has been made as a result of the standardization conditions provided by the transportation policies and the liberalization and modernization of air transport. In this context, there has been an increase in bonded airports, transport fleets, capacities and international market shares in Turkey. Thus, with the establishment of airports suitable for international transportation, airports were included in the logistics center areas, and as a result, the increase in fleet and cargo capacities and temporary storage areas made airline transportation possible in international freight transportation. In addition, Turkey has increased its airline cargo capacity by 656% in the last 17 years, and "Istanbul Airport" has taken its place among the top 20 most developed airports in the last 10 years (UTIKAD, 2020; SHMG, 2020).

Turkey's maritime transport, on the other hand, is the type of transport that has the largest share in our international trade in the past and today. The "Reduced Fuel Application without SCT" implemented by the government was effective in this increase. Thus, the opportunity to connect the continents with Ro-Ro transportation has become easier (T.C. Ulaştırma ve Altyapı Bakanlığı, 2019; İstanbul ve Marmara,

Ege, Akdeniz, Karadeniz Bölgeleri Deniz Ticaret Odası, 2020). Policies and measures regarding intermodal transportation in Turkey take their place under the name of “Transportation Policies”. Therefore, Turkey's intermodal transportation policies can be reached from the five-year development plans, action plans, and the published councils and programs throughout the transportation policies. These are as follows: 2023 Common Intelligent Future Design: Intermodal Transportation Development Project (2013), 10th Five-Year Development Plan (2014-2018), 11th Five-Year Development Plan (2019-2023), Transportation and Communication Strategy: Vision 2023, National Climate Change Action Plan (NCCAP), Road Traffic Safety Action Plan, National Intelligent Transport Systems (ITS) Strategy and Action Plan, Transport Operational Program I (2007-2009), Transport Operational Program II (2010-2013), 10th Transport, Maritime and Communication Council, 11th Transportation, Maritime and Communication Council (See Zeybek, 2007; TR Ministry of Transport and Infrastructure, 2014; TOBB, 2014; SHMG, 2020). In this context, policies aiming at the development of intermodal transportation in Turkey are formed by public administrators, non-governmental organizations, both public administrators and private sector actors. However, the desired momentum for these structures to be regulatory and supervisory structures could not be achieved (TÜSİAD, 2014; Şeker, 2016).

These projects, which started in Europe in the 1960s and started in Turkey in 2010, have had an important place in the intermodal transportation system. In this context, while the existing 12 logistics centers are serving, 2 logistics centers have started to operate with the projects and initiatives. For the future, the construction phase of 2 more logistics centers continues, and the project preparations of 8 logistics centers are underway. In addition, Turkey supports transportation policies including research and/or innovation activities such as these projects and the effectiveness of policies in the transportation system, the creation and use of new investment opportunities (T.C. Ulaştırma ve Altyapı Bakanlığı, 2014; TÜSİAD; 2014; TCDD, 2020).

When Turkey's transportation policies are evaluated from a global perspective, it has been concluded that it is compatible with the Single European Transport Area, which supports major developments in the field of freight transportation. Thus, it is aimed to harmonize Turkish transport legislation with the EU acquis. In the face of this situation, many transportation projects and transportation policies developed by Turkey can benefit from EU grants and aid support. This situation has an important place in the infrastructure and resources needed by Turkey's intermodal transportation system (T.C. Ulaştırma ve Altyapı Bakanlığı, 2014).

3. INTERMODAL TRANSPORT POLICY OF THE EUROPEAN UNION (EU)

The main objective of the general transport policy of the European Union is a reliable, efficient, inexpensive transport system that is free from external influences, as well as a balanced transport system with a sound economic structure, high sustainability, and policies based on reason. The need for a common transportation policy has emerged within the framework of a common market suitable for this purpose. In this context, the Common Transport Policy is basically based on increasing the international trade volume, meeting the energy consumption needed and developing the political field (Dida, 2009).

When the international trade of the European Union in the past years is examined, it is seen that there is a transportation system that uses road transportation intensively. However, when examined structurally, it has been seen that there is a wide railway and inland waterway transportation network and that there is an infrastructure that supports this. Therefore, the integration of EU countries into intermodal transportation was not very difficult, on the contrary, it was supportive. Therefore, this situation has made it possible to maintain a balance between EU countries and between modes of transport and to eliminate the heavy traffic congestion caused by the continuation of the road-intensive transport system. Thus, the transformation of railway, inland waterway and maritime transport systems, which are more environmentally friendly compared to the road transport system, was supported and encouraged. This transformation has brought about

the development of the intermodal transport system and has significantly affected both the European Commission and the EU official policies (Lowe, 2005; Zeybek, 2007). This development was followed by the following developments, respectively: Trans-Europe (TEN-T) Transport Network, White Paper (1992), Action Plan for the 1995-2000 Period, Green Paper on Fair and Efficient Pricing in Transport, Statement Covering the Years 2000-2004 (Lowe, 2005; Cekerol, 2007).

A very important step for the development of EU intermodal transport is the 1996 Diagnosis Report. With this, a number of factors have been reported to reveal the imbalances in the EU transport and transport system and to identify the factors hindering the development of intermodal transport. This has been a very effective method in the EU's intermodal transport policy. In 1997, a communiqué named "Intermodality and Intermodal Freight Transport in The European Union" was published officially using the concept of intermodal transport and the targets were specified (CEC,1997). As a result, the basic strategies of the “EU Common Transport Policies” have emerged. These basic strategies were as follows: regulation of Trans-European Networks and terminals, realization of the Single European Transport Area, avoiding the costs and constraints that hinder intermodal transport, integrating the information network and community into the existing transport network. In 2001, the “White Paper/European Transport Policy for 2010: Time to Decide” was published, which includes the 2001-2010 goals and objectives

(CEC,2001). Thus, the main issues for the development of intermodal transport became clear. These issues were as follows: creation or completion of Trans-European Networks, increasing road safety, revitalizing rail transport, improving the quality of road transport, promoting sea and inland waterway transport, adopting a pricing policy for transport, making intermodal transport a reality. Within the scope of the same policy, 2050 targets aiming to reduce the greenhouse gas emission rate by 60 percent under the name of "Towards a Competitive and Resource Efficient Transport System" were included, considering intermodal transportation in terms of climate change (CEC,2011). The main topics within the scope of these targets are as follows: By 2030, 30 percent of road freight transportation and 50 percent by 2050 will be shifted to rail, sea and inland waterway transportation, and to create the infrastructure within this framework, establishment of the TEN-T Network, which will be fully functional until 2030, which includes more than one mode of transport; connecting all sea ports to railways and sufficient inland waterways in 2050 (CEC,2011). As it can be understood from the aforementioned objectives and policies, the orientation to rail transport has had an important place in the EU's intermodal transport policies. Similarly, in the 1990s, aiming to expand the rail transport and including three separate acquis has made an important place in this field. Thus, the TEN-T railway freight transport network was liberalized in 2003, international freight transport in 2006, and all freight transport in 2007. In addition to all these, some financial support policies have been established for the development of

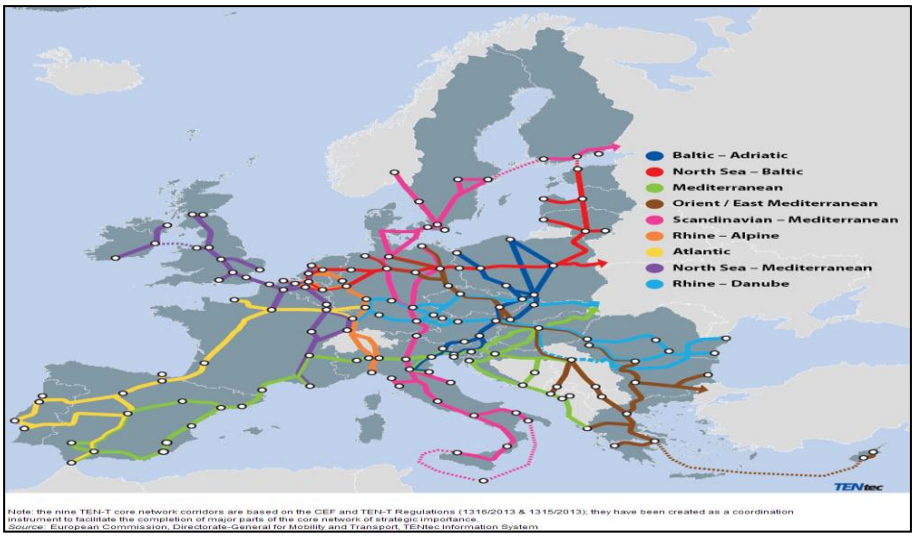
intermodal transport in EU intermodal transport policies (See Lowe, 2005; Zeybek, 2007; TUSIAD, 2014).

4. IMPORTANT CORRIDORS IN TURKEY-EU FREIGHT TRANSPORT: SWOT ANALYSIS

When a comparison is made in terms of country groups for the years 2019-2010, the EU is the country group that has the largest share in Turkey's international trade after OECD countries. Similarly, three of the top five countries in Turkey's 2019 exports are EU countries. Therefore, freight transportation between Turkey and EU countries is inevitable. Despite the fact that both sides carry out the most land transportation in freight transportation according to transportation types, the parties make serious efforts to expand the intermodal transportation system and area every year (Yılmaz and Pietrzyk, 2014; Republic of Turkey Ministry of Commerce, 2020). Therefore, the need for infrastructure to facilitate further integration and international trade or international transport has increased. This need is provided by international networks in international trade or transportation and the international transportation corridors of these networks. This situation increases the number of international transportation and corridors between countries. Developing international transportation network and corridors bring a common purpose. This aim is to provide integration in the transportation/transportation and logistics chain by developing cooperation between countries, unions or regions, and to find effective solutions to the emerging problems in a short time. Thus, it can bring significant advantages by contributing to the

economic development and growth of the regions where it is developed or established (Zeybek, 2007; Korkmaz and Tanyaş, 2014).

One of the important international transportation networks and corridors that will address a common purpose between Turkey and the EU is the Trans-European Transport Network for Transport/TEN-T. There are 9 corridors in this network, which is very important for ensuring the European East-West single market, and these corridors are supported by many airports, ports and railway lines. For Turkey, which is at the far end of the network, it is of great importance in terms of logistics targets. In addition, it increases accessibility to EU countries by being located at the end of the corridor, that is, in the East-East Mediterranean corridor. This situation, on the other hand, will have a positive impact on Turkey's international trade and trade volume, while increasing intermodal freight transportation. (Zeybek, 2007; Dıda, 2009; TÜSİAD, 2014).



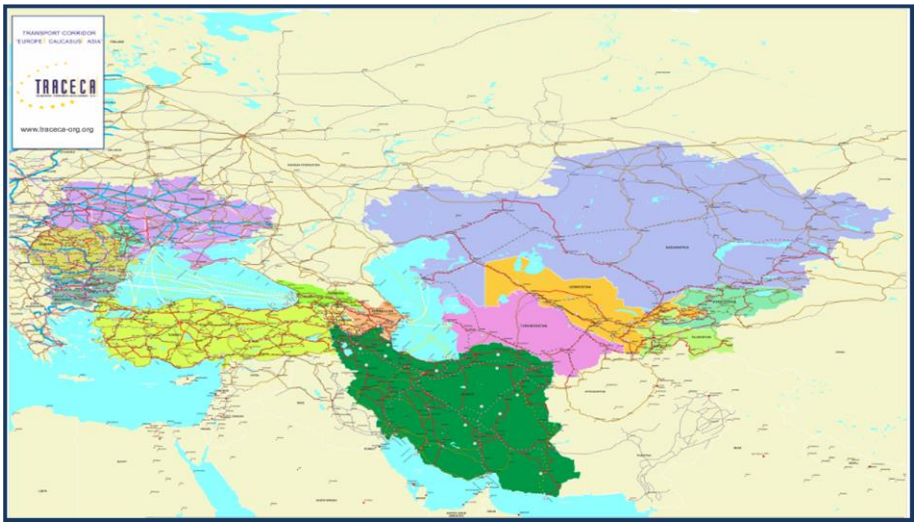
Map 1: International Trans-European Transport Network (EC, https://sgm.gr/pUJnn, Accessed on 04.07.2020)

Another important network contributing to Turkey and EU intermodal freight transport has been the Pan-European Network/Corridors. This network was developed as a result of the need arising from the absence of the EU's commercially connected peripheral countries in the Trans-European Transport Network. It can also be seen as an infrastructure preparation for the EU's expansion towards central and eastern European countries (Papadaskalopoulos et al., 2005). Turkey, on the other hand, is located in Corridors IV and X, taking place in the Black Sea and Mediterranean areas with the advantage of its current position within these corridors (European Commission, 2000).

Map 2: International Pan-European Transport Network and Corridors **(**Ilić and Orešić, 2004)

An important corridor that emerged as a result of the EU's further expansion of its transportation networks and corridors is TRACECA, that is, Transport Corridor Europe-Caucasus-Asia. In other words, it is the "Historical Silk Road" or the "Silk Road Project of the 21st Century". Although it emerged with the aim of reviving the Silk Road, its main purpose is to reach the target of wide market share by including the countries that left the Union of Soviet Socialist Republics (USSR), namely the Caucasus and Central Asian countries. In this respect, TRACECA has been seen as an intense integration of the Caucasus and Central Asia into the World Economy (Gorshkov and Bagaturia, 2001). In addition, the Black Sea, Caucasus, Caspian Sea and Central Asian corridors were created, and within this scope, the right to benefit from EU funds was given to establish infrastructures that facilitate access to valid countries. In this transportation corridor, which also includes a large trade market like China, Turkey is a transit country between the EU and China, and can

also benefit from EU funds. This situation is an important opportunity to develop Turkey's international intermodal transportation (Dida, 2009; Çetin, 2013; T.C. Ulaştırma ve Altyapı Bakanlığı,2020).



Map 3: International TRACECA Transport Corridor (TRACECA, https://sgm.gr/UnHHA, Erişim Tarihi: 04.07.2020)

Due to its location and the corridors in which it is located, Turkey has the power to connect East and West, Europe and Asia.At this point, the importance of intermodal transportation for Turkey emerges once again. The transportation types, infrastructure and resources that it will develop for intermodal transportation activities will significantly affect Turkey on the way to becoming a logistics base. Therefore, it is very important for Turkey to make progress both in intense international competition markets and in the domestic, foreign and transit trade environment and to engage in logistics activities (Istanbul and Marmara, Aegean, Mediterranean, Black Sea Regions Chamber of Shipping, 2020; UTIKAD, 2020). Considering all these factors, the

corridors that Turkey is involved in in the freight trade with the EU reveal some strengths-weaknesses and opportunities-threats for both Turkey and the EU. The "SWOT Analysis" of freight transport used by Turkey in trade with the EU in the context of international corridors is as follows (T.C. Ulaştırma Denizcilik ve Haberleşme Bakanlığı, 2014; TOBB, 2014; TÜSİAD, 2014; Fulser, 2015; Depe, 2019).

Strengths:

- Many countries such as Turkey can be connected to EU countries in trade by using existing corridors along with Turkey's location to Europe, Asia and Africa continents. This situation increases the feature of being a logistics center that makes transit trade possible for Turkey.
- Turkey has a large and developed road system and a road transport fleet. Fleets, on the other hand, have environmentally friendly motor vehicles that comply with the EU harmonization process.
- Turkey has a railway network that is compatible with corridors and can connect Europe and Asia (with improvements and extensions).
- Turkey has a large and developed road system and a road transport fleet. Fleets, on the other hand, have environmentally friendly motor vehicles that comply with the EU harmonization process.
- Turkey has a railway network that is compatible with corridors and can connect Europe and Asia (with improvements and extensions).
- Turkey has many transportation agencies and services that will provide trade between Europe and Asia on the corridors.

- Turkey is involved in many renewal and development activities within the scope of the EU harmonization process.
- Financial support and incentives are planned to enable intermodal transportation on the corridors.
- Container transport is common in the railway network over the corridors and the railway network is suitable for container block train transport.
- Intelligent Transportation Systems are used in transportation on corridors.

Weaknesses:

- Most of the international trade with the EU is done by road and some EU countries impose some restrictions and additional fees for vehicles belonging to Turkey during transit.
- Delays occur as a result of complex and long-term bureaucratic procedures in customs clearance during freight transport with the EU within the scope of corridors.
- Seaway, port and railway infrastructures used in the context of corridors are insufficient. These infrastructure costs are high.
- The bulk carriers used on the corridors are quite old and below certain standards.
- Most of the ships are foreign flagged in the international trade carried out on the corridors.
- There is no National Logistics Master Plan to connect international corridors to corridors in the local transport network.

- The North and South transport corridors are not sufficiently developed.
- Turkey's "Central Transport Network", "Information-Communication and Information Systems", which can also be valid in corridors, are not sufficient in terms of infrastructure.

Opportunities:

- Turkey acts as a bridge in the corridors between Europe and Asia.
- International trade and freight transportation between the countries located on the corridors is increasing.
- It has become an important transfer country and connection point due to its location on the corridor.
- Turkey's international trade is increasing every year.
- In the Eleventh Five-Year Development Plan, there are regulations and plans that can affect the transportation and trade on the corridors.
- Turkey's EU membership process has not ended and continues. It is trying to fulfill certain acquis regarding the accession process. In this context, it benefits from some grants and aids.
- Projects and legal regulations are created to ensure uninterrupted transportation between the EU and Asia.
- Renovation and development works continue on the Turkish transport lines located on the corridors.
- In Turkey, liberalization studies are carried out in road transport with some EU member states.

Threats:

- Turkey's infrastructure costs, which are in need of development, are very high.
- In international trade with the countries located on the corridor, bureaucratic procedures are quite high during customs clearance. As a result, delays occur and the freight transport is interrupted.
- Political problems that may occur between countries on the corridors can directly affect international trade and transportation. This situation can cause disruptions in international trade.
- With the construction of the International North-South Transport Corridor by India, Russia and Iran, Turkey's location advantage is likely to be damaged. This situation threatens the logistics base that it has undertaken between Europe and Asia.
- Turkey's large-scale transit ports are insufficient within the scope of TEN-T.
- Turkey's inadequacies in the "Information, Communication and Information System" may be reflected in the intermodal transportation system implemented in international corridors.
- Due to the prolongation of Turkey's EU membership process, funds and policies that will be effective in the corridors cannot be included in the development of intermodal transportation.
- Restrictive and protective measures are applied to Turkey by the countries on the corridor.
- There was a delay in compliance with safety and security rules, which would affect trade in the corridors.

- There is a transportation network planned to be built between the EU and Russia. This network will be able to act as a bridge between Europe and Asia. This situation may cause damage to Turkey's logistics base advantage.

CONCLUSION

In international trade, different transportation systems have emerged with the change of all market and competition conditions over time. Intermodal transportation has become one of these transportation systems. Turkey, on the other hand, has tended to participate in this development in international freight transportation. Due to reasons such as Turkey's role in transit and trade, especially its geographical location, its desire to increase international trade volume, and its intense trade with EU countries since the past, the tendency towards intermodal transportation has increased. Turkey's position in important transportation networks and corridors such as Trans-European, Pan-European, and TRACECA, which the EU has implemented to develop transportation policies, has been a driving force in Turkey's transition to intermodal transportation. However, this situation has not only been of great importance in Turkey-EU trade, but has also become an important factor in Turkey's harmonization process with the EU acquis. Therefore, in order to correct its backwardness in the field of intermodal transportation and to take great steps forward, Turkey includes laws, regulations and drafts that will improve intermodal transportation in its transportation policies.

Considering Turkey's location and trade, its inclusion in the international transport corridors developed and being developed by the EU will provide great benefits for Turkey in becoming a logistics center. In addition, this situation will be possible with the plans and arrangements to be made by evaluating the strong-weak and opportunity-threats as a result of SWOT analyzes as in the study. However, it will be very important for Turkey's international intermodal transport to transform weaknesses into strengths and threats into opportunities with the results that will emerge. Thus, necessary transportation policies for the development of intermodal transportation in Turkey will be put forward.

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CHAPTER 3

AN ECONOMIC ANALYSIS OF COMMUNITY PARTICIPATION IN SOLID WASTE MANAGEMENT PROGRAM IN MEKONG RIVER DELTA VIETNAM

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While Starting

This research aims to identify an economic solution based on community participation for solid waste (SW) management. The determinants of the decision to participate in the at-source separation program were analyzed by employing the binary Logit model. The dataset in this research was collected from 450 observations in the Mekong River Delta (MRD) Vietnam. The research results reveal that the SW management service has been improved such as the increasing quantity of SW collected, the people's high awareness of the benefits of waste separation, the proportion of respondents supporting the program. The results of the binary Logit model confirm the influence of the time, the respondents supporting the environmental protection program, the income, and the area without the pilot program affecting the decision to participate in the classification program. From this result, local authorities should pay special attention to the dissemination of information about the program to all residents, especially in urban areas. In addition, in the future, when implementing the program in the remaining areas, authorities need to perform well and obey standards in order to increase the trust of current and potential participating households.

1. INTRODUCTION

Currently, the impact of urbanization, industrialization, and rapid population growth, especially in urban areas results in solid waste generation issues. In addition, the demand for the production of goods and the needs of the people are increasing, leading to a large amount of waste that is increasing and will be discharged into the environment causing serious pollution (Ministry of Natural Resources and Environment, 2020). In fact, the increase in the amount of waste has caused many consequences to degrade the quality of the environment, potentially harming human health as well as affecting the sustainable development of the country. To manage this issue, the Vietnam Prime Minister's Decision number 2149/QD-TTg approving the National Strategy on Integrated Solid Waste Management to 2025, Vision to 2050, dated December 17, 2009, states that “solid waste management must be implemented in an integrated manner, to prevent and minimize waste generation at source as the top priority task, to increase reuse and recycling to reduce the volume of waste to be buried. In addition, thoroughly implementing Directive 41/CT-TTg of the Prime Minister on a number of urgent solutions to strengthen solid waste management dated December 1, 2020, also directed "focusing on the classification of solid waste”, if there are not enough conditions to classify solid waste at source, priority should be given to the investment in treatment facilities with a centralized sorting stage before treatment. Thus, to successfully implement the direction from the central Government, reducing the amount of SW released into the environment requires more attention from the community and

awareness of the people from the classification of SW program. It is expected that community participation contributing to improving the effectiveness of any policy program established and implemented. Therefore, it is necessary to identify the current status and factors affecting the decision of SW classification and propose policy implications to assist policy-makers. This also contributes to improving the personal awareness of life as well as the awareness of the surrounding environment of people in urban areas in Vietnam and developing countries. The following content in the paper will (i) present the theoretical basis and research methods, (ii) analyze the perception and behavior and factors affecting the SW sorting behavior at the source of households and finally (iii) conclusions and recommendations are drawn from the analysis.

2. CONCEPTUAL FRAMEWORK AND RESEARCH METHODOLOGY

2.1 Conceptual framework

2.1.1 The definition of solid waste

According to the Government of Vietnam (2007; 2015) with Decrees number 38 and 59 stipulating that solid waste (SW) is any kind of garbage in solid form, discharged from the process of production, service, daily life, or other activities. SW includes normal CTR and hazardous CTR. Solid waste emitted in personal activities, households and public places is collectively referred to as domestic solid waste. Solid waste emitted from industrial production, craft villages, business, service, or other activities is collectively referred to as

industrial solid waste. According to the Ministry of Natural Resources and Environment (2016), urban solid waste includes solid wastes generated from households, public areas, commercial areas, construction works, medical facilities, and other wastes from production facilities in the inner city. Other classifications are also quite similar, as Schubeler (1996) defines urban solid waste as defined to include waste from households, non-hazardous solid waste from industrial, commercial, and institutional areas (including hospitals), waste from markets, from street cleaning activities. In addition, the classification of Beede and Bloom (1995) considers municipal solid waste to include all solid waste generated in the community except industrial and agricultural waste. Based on this group of definitions, this study focuses on the concept of domestic solid waste to study because it is difficult to calculate and determine emissions and large scale but difficult to manage due to many reasons while source emissions are households.

2.1.2 The concept of classification of solid waste

The Government of Vietnam (2015) stipulates that domestic waste classification is the practice of separating (allocated) waste in order to divide it into different categories for different management processes. SW is classified at source suitable for management and treatment into groups such as food waste (group of leftovers, leaves, vegetables, tubers, fruits, animal carcasses); groups with the ability to reuse and recycle (paper, plastic, metal, rubber, nylon, glass) and the other groups.

The classification of solid waste must be complied with by households according to regulations, ensuring convenient requirements for collection, transportation, and treatment. SW classified at source can be according to the above groups or groups according to criteria suitable to specific natural, socio-economic conditions of each locality. For example, according to the Department of Construction of Can Tho city (2018), domestic solid waste is classified into three groups, including (i) combustible group, (ii) non-burnable group, and (iii) hazardous group to ensure safety requirements and reach favorable demand for solid waste treatment by incineration. Meanwhile, some provinces piloted a classification model at the source of scrap, organic, and the rest (Ben Tre Province People's Committee, 2019). Therefore, depending on the actual conditions of each locality, the management orientation of each area, and the applied theoretical framework, appropriate policy proposals are needed. When considering resource solid waste management models, the 3R management model is often mentioned as follows.

2.1.3 3R solid waste management model (Reduce - Reuse - Recycle)

Reduce

Reducing waste is a useful technique to prevent waste, also known as "*reduction at source*", which is the production, sale, or use of materials (such as products and packaging) in a way that reduces the quantity or toxicity of the generated waste. Reducing or minimizing waste at the source is the most desirable activity because the community does not have to bear the costs of waste disposal and recycling. From an

economic perspective, minimizing waste in the production and business process will reduce social costs in the exploitation and use of national resources and physical assets (Nguyen Dinh Huong, 2006).

Reuse

Reuse refers to the use of products obtained from solid waste for further use (Gray, 1997) or to reuse the waste directly or after primary processing without changing the properties of the waste (Government of Vietnam, 2015). For example, old baby bottles and clothes are reused many times (Gray, 1997). Reuse is also considered a measure to prevent and reduce waste through prolonging the life of products and raw materials, helping to save production costs and disposal costs (Nguyen Dinh Huong, 2006).

Recycle and Compost

Recycling is the collection and purification of by-products of production or consumption for use as inputs into productive activities (Beede and Bloom, 1995). The waste recycling process uses technological solutions, techniques to recover valuable components from waste (Government of Vietnam, 2015) It requires sorting, collection, and treatment of materials to manufacture and sell them as new products. Energy recovery or composting is a process that includes bioremediation that uses microorganisms to break down the biodegradable components of waste. Two types of processes are used, namely aerobic and anaerobic processes (Beede and Bloom, 1995; Penido et al., 2009). In the aerobic process, the usable product is organic fertilizer

(for soil improvement) while in the anaerobic process the usable product is methane as an energy source.

2.1.4 Overview of the solid waste separation program at-source

Based on the 3R management model, previous studies suggest a solid waste separation program at the source as a necessary measure to improve the efficiency of domestic solid waste management. In Vietnam as well as in some developing countries, waste reduction activities are closely linked to waste management activities and waste management policies because waste management is the primary responsibility of local authorities (Schübeler et al., 1996). Solid waste management is a complex task that requires organizational capacity and cooperation between many stakeholders in the private and public sectors. Although solid waste management activities have an impact on public health and environmental protection, this practice in most cities of developing countries is still unsatisfactory.

The increasing amount of SW due to population growth and consumer demand has become a big challenge for local authorities, especially in waste management. Several policies have been implemented to reduce waste. For example, institutional and control policies (Slack et al., 2009) provide regulations related to solid waste and have sanctions to deal with violations. However, a number of institutional policies have been implemented that have not resulted in compliance and improved environmental quality (Stafford, 2002). Market-based policies are more effective than institutional ones (Driesen, 2006) because they provide incentives for individuals. Negative incentives such as paying

sales tax or the 'pay as you throw' policy, paying a fee based on the volume of solid waste discharged; positive incentives such as sponsorship opportunities or tax breaks for individuals and organizations that reduce waste (Gellynck and Verhelst, 2007). Some policies combine positive and negative incentives such as deposit return systems (Wagner and Arnold 2008; Mckerlie et al., 2006), voluntary policies (e.g., voluntary participation in recycling) have also been implemented in many communities (Werner et al., 1995; Palatnik et al., 2005). Zhuang et al. (2008) mentioned that segregation of SW at source is an effective policy to reduce waste.

Although there are many policy tools related to solid waste management, the effectiveness of these tools can vary between communities. For example, the *'pay as you throw'* policy may not be successful in some developing countries due to the failure to collect the volume of household solid waste (*Longe and Ukpebor, 2009*). Therefore, the selection of policies or activities to reduce the amount of solid waste of households should consider based on specific conditions of each locality or each country.

The evidence shows that solid waste separation at source has contributed to reducing the amount of solid waste discharged into the environment by taking advantage of a large amount of solid waste for reuse and recycling. Although the classification of SW at source in Vietnam in general and the MRD in particular has not been carried out on a mass basis and according to regulations, a part of people have classified MSW in their way. People do this separation for recycling

purposes through the sale of scrap in their solid waste. This is a favorable condition to carry out recycling activities to reduce the amount of SW in Vietnam. On the other hand, currently, each household is paying about 15,000 to 20,000 VND/month for waste collection services (Note that US$1 was equal to 22,890 Vietnamese Dong (VND) on June 30th, 2021) (Ministry of Natural Resources and Environment, 2020). With this level of payment, the government is having to implement a policy of compensating for losses with a relatively large amount of money while households are responsible for this compensation according to the principle of "*polluters must pay*". Therefore, it is necessary to study the factors affecting participation in the garbage classification program in order to make scientific arguments and propose policy solutions to implement this program most effectively.

2.1.5 The concept of household solid waste management

Solid waste management has evolved over a long period from the development of landfill sites in ancient civilizations around the world to the modern collection and treatment systems in use today. In Vietnam, solid waste management activities include management planning activities, investment in the construction of solid waste management facilities, activities of classification, collection, storage, transportation, reuse, recycle and treat solid waste to prevent and minimize harmful impacts on the environment and human health (Government of Vietnam, 2007). In general, solid waste management is a process of various waste-related activities from collection to treatment that is coordinated to reduce the possible negative effects of solid waste.

2.1.6 Situation of solid waste management in the Mekong River Delta

The data from the Ministry of Natural Resources and Environment show that the amount of SW collected is 88.3% of the SW generated in urban areas and 49% of the SW generated in the rural areas, and the treated SW accounts for 71% of the SW collected. Thus, there is still a large amount of generated solid waste that has not been collected and treated. The amount of generated SW that has not been collected together with the amount of SW that has not been collected and has not been treated and the amount of SW that has not been treated properly are the main causes of environmental pollution. The Ministry of Natural Resources and Environment (2020) stated that the impact of solid waste can be seen through the loss of urban beauty, polluting the land, water, and air environment, and greenhouse gas emissions.

2.2 Data collection and analysis

The study uses primary data collected from households 2020 in two regions of the Mekong Delta with a total of 450 household observations. Currently, one area has a pilot program of garbage classification while another has not yet implemented it. Therefore, the research results are expected to find out the difference between the two groups of households. In addition, the large number of observations collected in these two areas is expected to increase the reliability and representativeness of the analysis results. Besides, the paper also uses secondary data collected from the reports of the Department of Natural Resources and Environment of provinces in the MRD. The research results and

proposed policy were also consulted by officials from these Departments.

This study employed descriptive statistics including criteria such as mean, maximum, minimum, and standard deviation to interpret the characteristics of the households. In addition, these indicators are also used to describe the behavior and awareness of households when implementing waste management at the household and the level of support for the waste classification program. Finally, the binary Logit model is used to analyze the factors influencing the decision to implement the classification of SW at source of households. The model has the following form:

$$Ln\left[\frac{P(Y=1)}{P(Y=0)}\right] = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_i X_i$$

Previous studies on the factors affecting the decision to participate in the chapter on waste separation at source such as Yusuf et al. (2007), Niringiye and Omortor (2010), Rahji and Oloruntoba (2009) have indicated the criteria measures of age, income, household size, occupation, and educational attainment have a significant impact. The study in Pakistan by Alta and Deshaz (1996) also showed that factors such as the quantity of waste, household size, and age were influential. In general, these factors are mainly related to the demographic characteristics of the household, the income level, and the amount of waste generated by the household. However, based on consultation with experts who are local managers and reports from the Ministry of Natural Resources and Environment, these factors may differ between

countries, different regions, and affect by a pilot program of garbage segregation. Therefore, the variables used in the Logit model in this study include the dependent variable (Y) which is the decision of people to participate in the SW classification program at the source. This is a dummy variable that takes on two values, Y = 1 if the respondent agrees to participate in the program, and vice versa, Y = 0, if the respondent does not agree to participate in the program. The independent variables in the model are selected based on the A-B-C (attitude-behavior-context) theory (Guagnano et al., 1995). A basic interpretation of this theory can be found in well-known studies in the bibliography (Gardner & Stern, 1996; Stern, 1992a, 1992b) and other empirical studies. The predictive value of baseline variables for environmental behavior depends on aspects of the context, in particular the amount of effort, cost, or inconvenience required to change the target behavior (e.g. Black et al., 1985; Derksen & Gartrell, 1993; Guagnano et al., 1995). Accordingly, the independent variables selected to be included in the model in this study include Kyphongvan, Trinhdohocvan, Thunhap, Thidiem, Dichvuthugom, Tuphanloai and Ungho. Specifically, the variable Kyphongvan is a dummy variable that receives two values, Kyphongvan = 1, surveyed households in 2020, and Kyphongvan = 0, surveyed households in 2019. The Trinhdohocvan variable is the number of respondents attending school (unit: years). The Thunhap variable is the respondent's income (unit: million VND/month). Thidiem variable is a dummy variable with two values, Thidiem = 1, the survey area has piloted the SW classification program at the source, and Thidiem = 0, the survey area does not pilot

the SW classification program. at source. The variable Dichvuthugom is a dummy variable that takes two values, Dichvuthugom = 1, the area with solid waste collection service, and Dichvuthugom = 0, the area without solid waste collection service. The variable Tuphanloai is a dummy variable with two values, Tuphanloai = 1, the household has self-classified SW at the source, and Tuphanloai = 0, the household does not self-classify SW at the source. The Ungho variable is a dummy variable with two values, Ungho = 1, the respondent supports the MSW classification program at the source, and Ungho = 0, the respondent does not support the MSW classification program at the source.

3. RESULTS AND DISCUSSION

3.1 Characteristics of households in the survey

Waste management activities have an impact on all people (Ministry of Natural Resources and Environment, 2020; World Bank, 2018). Therefore, the study conducted interviews with respondents with diverse demographic characteristics. The proportion of male respondents is about 29%. A number of respondents with education level at primary level 25.04%, lower secondary level 33.04%, upper secondary education 30.09%, and above high school level 11.83%. The respondents' age of about 49 years and the average monthly income of the respondents about 4, 5 million. These criteria are consistent with the general characteristics of households in MRD.

3.2 Analysis of households behavior in solid waste classification

The situation of SW management and understanding of the SW classification program at the source of the people in the study area are shown in the following results (Table 2).

Table 1. The situation of daily-life solid waste management

	Unit	Amount
Proportion of households provided with collection service	%	98,11
SW collection frequency	Day/time	1,12
Amount of SW	Kg/day/households	1,97
Proportion of households doing classification	%	62,17
Proportion of households who know information about the classification program	%	23,66
Proportion of households supporting the program	%	84,63
Proportion of households participating in the program	%	69,02

Source: Survey data, 2020

The research results clearly show that solid waste management is getting more and more attention among households. This contributes to a change in the quality of solid waste management. Typically, collection services are covered throughout the study area with 98% of households provided with collection services. Besides, the frequency of collection is quite regular with about 1 time/day with the daily amount of SW about 2kg/day/household. Along with the change in the quality

of SW management, people's understanding related to SW management is improved. Specifically, the number of households carrying out the classification of SW at source in 2020 (accounting for 75.24%) significantly increased compared to the number of households implementing the classification of MSW at source in 2019 (accounting for 46.09%.). In addition, the number of households who fully know the contents of the MSW classification program at source in 2020 (30.99%) is higher than the number of households who know the information about the MSW classification program at source in 2019. The number of households supporting the program is quite high at nearly 85% and the number of households supporting the program increases from 80.08% (in 2019) to 88.49% (in 2020). In addition, the community's interest in SW management is also reflected in the increase in the number of households participating in the SW classification program, 60.52% of households supporting the program (2019) increased to 76.19% of households supporting the program (in 2020).

The study investigating the reasons that 84.63% of households support the program of classifying MSW at the source. This result also shows some interesting points. The reasons given by the households focused on the program's environmental protection benefits and convenience for SW management. Because, when the solid waste is classified, it is convenient for the next activities, especially the treatment of solid waste. SW is treated in several common ways, such as landfilling, recycling, composting, natural incineration, and incineration for electricity generation. It is important that no matter which method is used to treat SW, the classification of SW still plays a decisive role

(Ministry of Natural Resources and Environment, 2020). Besides the support for the program to classify SW at source, there are still 15.37% of households not supporting the program. The reason that the majority of households do not support the program is that the solid waste classification is time-consuming and takes up storage space. This means that when classifying solid waste people have to spend time remembering each component in the solid waste to classify it into the corresponding group and the different components are placed in different containers instead of just putting all the waste into the same container. Another reason for concern is that there is no information on the SW classification scheme at the source. This may be due to the limited communication of the SW classification program to the population (Ministry of Natural Resources and Environment, 2020).

Table 2. Reasons why households support and do not support the program of segregation of solid waste at source

Reason		**2020**	
		Number	Percentage (%)
Households support the program to classify solid waste at source	Protect the landscape	33	12.55
	Environmental Protection	169	64.26
	Protecting public health	7	2.66
	Advantages for solid waste management	38	14.45
	Raise awareness of the community	16	6.08
	Total	**263**	**100.00**
Households do not support the program to classify SW at	Waste of time and space	23	71.88
	Collection equipment is not invested to collect classified SW	1	3.13

source	No information about the program	8	25.00
	Total	**32**	**100.00**

Source: Survey data, 2020

3.3 Determinants of the decision to participate in the program of solid waste separation at source

Table 3. Logit regression results analyze the factors affecting the household's decision to participate in the SW management program

Varibales	**Coefficient**	**Std. Err.**
Kysolieu	0.4338***	0.2102
Trinhdohocvan	0.0236ns	0.0187
Thunhap	0.0842**	0.0273
Thidiem	-0.3563**	0.2286
Dichvuthugom	0.2662ns	0.6208
Tuphanloai	0.4474ns	0.1258
Ungho	1.4654***	0.1569
Hằng số	-1.4238*	0.8708
	Observation	450
	Chi-square	63.38
	P-value	0.0000
	Pseudo value	0.1158
	Log-likelihood	-302.1232

Source: Survey data, 2020

Note: (ns) = no statistical significance, (*) = significance level 10%, (**) = significance level 5%, (***) = significance level 1%

The regression results show that the significance level is 0.000, which is less than 1%, showing that the model is significant and the dependent variable is explained by the independent variables included in the regression model. The results show that households surveyed in 2020 have a higher probability of participating in the program than households surveyed in 2019 (with statistical significance of 1%). This is

consistent with the statistical results described above when most of the evaluation criteria in 2020 are higher than in 2019. In addition, the probability of participating in the program is higher among the respondents who support the program. This is consistent with the model's expectations and the economic rules of behavior.

However, it is important to note that households living in areas that have not piloted the SW classification program at source have a higher probability of participating in the program than households living in areas where the program has been piloted the SW classifier at the source. This can be explained in the expectations and beliefs of the people in the area where the classification program has not been implemented. Based on this result, in the coming time when the program is implemented in the remaining areas, stakeholders need to do well and follow the standards to gain the trust of participating and non-participating households to program can be extended in the long run. Thus, the above analysis results are relatively consistent with previous results when studying garbage classification or participating in a garbage classification program. In addition, collecting a large number of observations and using two provinces as representatives, for areas with and without the implementation of the pilot garbage classification is expected to contribute to the research in this area. However, in the future, in order to increase the reliability of the results from this study, the research team will expand the survey area to other provinces in the Mekong River Delta.

CONCLUSION

This study surveyed 450 households in MRD to analyze the current situation and factors affecting the decision of households to participate in the classification program at the source. Research results show that in 2020, all awareness about the program's information on solid waste separation at source, the amount of waste collected, and the amount of waste being recycled all increase, showing the attention of the community to this issue. In addition, the positive signal that the number of households supporting the classification program also increased over the past 2 years. However, there are also about 15% of households who have not supported the program because of the waste of time and space for waste storage and unclear information about the program. The results of the Logit model show that 4 significant variables are affecting the classification decision, including time, perceived support for the program, income, and location of the program. Based on this result, the study proposes some policy implications as follows. Firstly, people's awareness is increasing and they are willing to protect the living environment very actively, however, the reality shows that the propaganda and implementation programs of the local authorities, in reality, are not effective. Therefore, it is necessary to expand the information and propaganda of the garbage classification program to let households know, especially to raise people's awareness, preferential policies, handle violations and demand urban authorities must continuously implement, the awareness of the people must also have training, guidance, encouragement, distinguishing for them the benefits of waste separation at source, the main waste treatment depending on

local sanitation companies and with the increasing amount of waste, these sanitation companies can only take waste to landfills and cannot perform sorting. Secondly, the most difficult thing in the classification of waste at source in Vietnam in general and the Mekong River Delta, in particular, is the lack of solutions on management and technical apparatus for people to carry out the separation of waste at source and the stages of waste treatment after sorting. If this stage is done well, it will contribute to increasing people's confidence when participating in the program according to the results of the Logit model in the variable where people live. Therefore, relevant managers need to complete legal documents on solid waste management, which clearly define the functions, tasks, and powers of state management with urban and rural solid waste.

Finally, future studies need to focus on related issues in order to investigate and find a reasonable willingness to pay for the waste separation program at the source of people in the area in order to provide a relevant fee for the program.

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CHAPTER 4

REGIONAL INVESTIGATION OF HOUSING DEMAND IN TURKEY BY SPATIAL PANEL DATA ANALYSIS

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INTRODUCTION

Housing demand can be defined as individuals having sufficient financial power to purchase or rent a house in order to meet their housing needs. That is, it is the support of individuals' desire to rent and purchase housing with sufficient purchasing power (Uysal and Yiğit, 2016: 188). In other words, housing demand means meeting the household's demand for shelter or investment (Yıldız, 2018: 20). The desire of the household to own a house constitutes the housing demand and there are many reasons for demanding it. The most important of these is that the house is a consumption and investment tool. The purpose of housing demand as an investment tool, the house is for the purpose of accumulating wealth. The purpose of housing demand as a consumption tool is avoiding paying rent to the house and meeting people's housing needs (Durkaya, 2002: 10).

Housing demand, in short, is the accumulation of capital by people in need of housing and buying house for various reasons. There are many factors that affect the house that people want to own. It is possible to examine these factors in three groups as economic, demographic and other factors. Economic factors are factors such as income, income distribution, interest rates and prices. Demographic factors include population, population growth, age distribution, gender, household size, marital status, family structure, migration, etc. Other factors are earthquakes, infrastructure, housing cooperatives, land policies, social demand, need for renewal, rental income, etc. (Özlük, 2014: 40). While factors such as the price of the house, rent, household income,

expectations, preferences, and interest rate determine the housing demand for a standard household for consumption, the housing demand for investment is determined by other factors such as the rate of return of the house, financial policies, inflation rate, and household wealth (İğdeli, 2020: 147). From a microeconomic perspective, housing demand is affected by the financial strength of economic units, price/income expectations, prices of related goods, and taste/preferences. When considered from a macroeconomic perspective, many factors such as housing investment/production, organized/unorganized housing market, financing/monetary policies, housing/environmental policies, technology/innovation affect the housing demand (Bilik and Aydın, 2019: 186).

Housing is a multi-component whole consisting of social, economic, cultural, legal and technological components. Housing has functions such as being a shelter, a manufactured good, a consumption good, capturing speculative value increases as an investment, providing economic and legal assurance, being a tool in the reproduction of social relations, and being a cultural structure in the creation of the urban environment (Lebe and Akbaş, 2014: 58).

The housing market has been the cause or trigger of many crises. The Mortgage crisis, which emerged in the USA in 2007 and affected the world, also affected Turkey, although not so much compared to other countries. The risk that the repayments of housing loans poses has led to an increase in costs, a decrease in housing prices and a contraction in housing demand. The crisis experienced negatively affected the

growth rate of the housing sector in 2008 and 2009. Looking at recent years, it is necessary to say that the Covid-19 virus, which emerged in Wuhan, China in 2019, has been negatively affected economically in our country with its arrival in Turkey in March 2020. The epidemic has caused fluctuations in the housing sector, as in all areas.

The housing market has an important place in the economies of both developed and developing countries. In Turkey, which is a developing country, the share of housing activities in GDP is high. In addition, a large part of household expenditures consists of expenditures for housing. The biggest reason for this is that people's need for shelter is the basic need. In this context, the necessity of examining the housing demand has emerged. Although there are many studies in the literature investigating the housing demand in Turkey, only a few studies have been found that examine the housing demand regionally and take into account the spatial interaction using panel data. In this sense, it is thought that the study is important both because it fills the gap in the literature and because it is an original study. The aim of this study is to determine the factors that may affect the housing demand of Turkey by regions that are classified according to the Nomenclature of Units for Territorial Statistics (NUTS) Level-2 (26 sub-regions). For this purpose, the factors affecting the housing demand between regions were investigated for the years 2013-2019 using spatial panel data analysis, which takes into account the spatial interaction. Thus, in addition to the variables that affect the housing demand of the households, it has also been tried to reveal whether there is a spatial

dependence in the interregional demand.

The rest of the study consists of the following sections. In the first section regional housing demand in Turkey was studied; in the second section literature review was presented; in the third part data and model were introduced, the method was explained and the empirical findings were interpreted; finally in the fourth section conclusions and recommendations were given.

1. REGIONAL HOUSING DEMAND AND ITS DETERMINANTS

The effects of the housing sector, which has become the locomotive of the economy in developed and developing countries, on the regional economies are evaluated through regional housing demands. The fact that the demand for housing varies between regions indicates that the determinants of housing demand will also differ according to regions. In this study, total population, industrialization level, net migration rate, unemployment rate, marriage rate and GDP per capita were taken as the determinants of housing demand. In this section, the relations between the housing demand and these variables will be explained.

One of these factors is population and literature shows that the housing demand is influenced by population both qualitatively and quantitatively. The economic and socio-demographic factors affecting the housing demand demonstrates variability at different countries and even at different regions of a country (İğdeli, 2020: 148). Literature also shows that population growth has a positive impact on housing

demand (Yıldız, 2018: 21). In other words, as the population increases, the demand for housing is expected to increase (Öztürk and Fitöz, 2009: 28).

The level of industrialization is a demographic factor that affects housing demand. Thanks to industrialization, metropolitan cities have become centers of attraction with the job opportunities and high living standards they offer. The development of production and service sectors in metropolises has led to an increase in migration from rural areas and cities where industrialization is insufficient, and therefore the demand for housing in these metropolitan cities. (Durkaya, 2002: 23).

In addition to economic factors, migration influence housing demand. The phenomenon of migration, which is based on the mobility of the population in order to maintain its economic, social, cultural and individual life in another place, is under the influence of regional development differences (Durkaya, 2002: 23). Migration is not only from the village to the city, but also from the city to the city. In parallel with the economic development, the economic activities concentrated in the cities attract the population to the cities. Especially in Turkey, this phenomenon is very common. As the migration to the cities increases, the need for housing is expected to increase, because when the existing houses do not meet the need, additional housing demand arises. Therefore, it is accepted that there is a positive relationship between the rate of migration and the housing demand (Öztürk and Fitöz, 2009: 29).

Another variable expected to have an impact on housing demand is umeployment. Positive interactions can be found between urbanization and development if the individuals coming to the city is not unemployed and can work in the industry or services sector. However, at this point, the expected income increases may increase the demand for housing. A demand that may arise in terms of rental or property housing demand may manifest itself as a slum in an urban environment where the unemployed or those working in temporary jobs are concentrated. The difference in the unemployment rate in terms of settlements can be shown as the reason why the housing prices and the amount of housing demanded are different in different places. In addition, decreases in participation in the labor market according to gender may have a reducing effect on the total income of the household. This, in turn, may adversely affect housing demand (Durkaya, 2002: 20-23).

Another demographic factor affecting the housing demand is the rate of marriage. In terms of marital status, housing demand can be examined within the scope of marriage and celibacy process. The periods of celibacy can often be explained by family-related and sharing the same residence. This situation, which includes the potential demand for housing, can also exist in the case of marriage in societies where the traditional family structure is dominant. Not settling in another residence together with marriage keeps the housing demand under pressure. In modern societies, leaving the family with marriage and choosing a new residence will increase the demand for

housing (Durkaya, 2002: 20). It is seen in the literature that the increase in marriage rates leads to an increase in the demand for housing (Öztürk and Fitöz, 2009: 26).

On the other hand, the most important economic factor affecting the housing demand is GDP per capita. Household income, obtained from production factors such as wages, profit, interest and rent, is very important determinant of housing demand (İğdeli, 2020: 147). How much the increase in income increases the demand for housing is explained by the income elasticity of the demand. The household makes a demand for housing for consumption and investment purposes with their level of income. Housing demand, whether for consumption or investment, is shaped not by the current income level of the household, but by the income they expect to obtain throughout their lives. However, due to the difficulties in determining permanent income, analyzes are mostly made with GNP and per capita GDP values in practice (Durkaya, 2002: 12). Accordingly, a positive correlation is expected between household income and housing demand (Öztürk and Fitöz, 2009: 27).

2. LITERATURE REVIEW

In the literature, there are many studies in which housing demand is analyzed with the help of different econometric methods by using cross-section, time series and panel data for many different countries and country groups, evaluating aggregate data, regional data and

household data on the housing market. Studies examining regional housing demand in Turkey are summarized below:

İğdeli (2020) examined the determinants of regional housing demand for the NUTS Level 2 regions of Turkey using spatial econometric methods in the period 2010-2017. The analysis findings show that the income elasticity of regional housing demand varies between 0.790 and 1.400, and the price elasticity of regional housing demand varies between 0.014 and 0.019. It has been concluded that the industrialization levels, population growth and the number of enterprises of the regions have a positive effect on the housing demands. İğdeli (2021) analyzed the factors that determine the housing prices in the TR71 region, where Aksaray, Kırıkkale, Kırşehir, Nevşehir and Niğde provinces are located, for the January 2021 period using the least squares method. The findings showed that the width of the house, the number of rooms, the floor where the house is located, the number of floors of the building and the number of bathrooms have an increasing effect on the house prices. In addition, it has been observed that the age of the house and the fact that the house is sold by the real estate agent instead of being sold by the owner have a reducing effect on the house prices. Besides the physical properties of the house, the spatial characteristics of the house are also determined as effective on the house price. On the other hand, it has been determined that the effect of spatial factors on housing prices is more than the physical characteristics of the house. Akseki and Türkcan (2016) analyzed the causality relationships

between regional migration, housing and labor markets in NUTS Level 3 regions in Turkey during the 2008-2013 period using panel data methods. According to the empirical findings, while no causality relationship was found between regional migration and unemployment rate in Turkey, bi- directional causality was found between regional migration and house sales. Aktürk and Tekman (2016) investigated the factors affecting the housing decisions of individuals residing in Erzurum city center by conducting a simple random sampling survey. The population of the research consisted of individuals living in Erzurum city center and considering buying a house, and 640 people were surveyed. ANOVA and t tests were used. As a result of the research, it has been determined that factors such as price, the reliability of the contractor company, the fact that the house is in a secure site, its size, the quality of the materials used, its proximity to the center, its durability and its spaciousness are important. Alkay and Övenç (2019) investigated the level of affordability of households belonging to 20% income quintile to buy a house of 100 square meters among new houses and how this has changed over the years. They calculated the housing affordability index for the years 2006-2014 and for five different NUTS Level 1 regions. The index values showed that it is not possible for low income groups to buy a standard house by using the available financial instruments. Five different NUTS Level 1 region index values also showed that housing affordability levels varied by regions. It has been determined that the index values are against the low-income people in the regions where the population movements are higher and therefore the demand for housing is higher.

Çelik and Kıral (2018) tried to determine the provinces with similar characteristics in housing demand and the factors affecting housing sales in Turkey during the 2008-2015 period. They used SWOT analysis and panel data clustering analysis. According to the findings obtained from the study, it has been determined that deposit interest rate, urbanization rate, number of household cars, average household income, housing gross return rate, Borsa Istanbul 100 index and housing loan interest rate have significant effects on housing demand. Kangallı Uyar and Kılıç (2017) examined the existence of the spatial effect in house sales in Turkey at the regional level (Level 2), using spatial econometric models for 2015. The population growth rate at the regional level, income distribution, housing price index and the number of foreigners with residence permit in Turkey were included in the model. Spatial tests displayed that there is a spatial effect in regional housing sales in Turkey. It was concluded that the population growth rate, the injustice in income distribution and the increase in the number of foreigners with residence permits increased the house sales, while the increase in the house price index decreased the demand for housing. Yıldırım and Kaya (2020) analyzed whether changes in regional house prices converge to changes in national house prices in NUTS Level 2 regions in Turkey. In the analysis, it has been determined that the changes in housing prices diverge. This showed that the price changes in the regional housing markets, which are in the lower market position, are independent of the price changes in the national housing market. In addition, it was observed that the changes

in housing prices in TR22, TR41 and TR42 regions converged to the changes in national housing prices with the structural break.

Apart from the housing demand examined regionally, there are many studies examining the housing demand for Turkey. Some of these are briefly described below:

Durkaya and Yamak (2004) investigated the factors affecting the housing demand in Turkey by using the data from 1964-1997. They included income, general level of prices, real housing costs, population and industrialization variables in 7 different models. It has been determined that there is a positive and strong relationship between income and housing demand. Accordingly, it has been concluded that the income elasticity of housing demand is between 1.9 and 3.8, the cost elasticity is between -0.1 and -0.5, and the price elasticity is between -0.03 and -0.10. Solak and Kabadayı (2016) examined the housing demand in Turkey for the period of 1964-2014 with a bound test approach. They determined the total square meter of the houses sold as housing demand, and they took the explanatory variables as the real price of one square meter of housing, the real income level and the urban population. They found that there is a positive relationship between prices and housing demand in Turkey. They explained this by the fact that houses are a kind of investment property in Turkey. Halıcıoğlu (2007) tried to estimate the demand function for new houses in Turkey by using the ARDL approach with the data from 1964-2004. He calculated the short-term and long-term income and price elasticities. According to the results of the analysis,

the most important explainer of the demand for new houses in Turkey is income. Income elasticity is estimated to be approximately 1 and price elasticity as -0.2. Öztürk and Fitöz (2009) investigated the effects of housing supply and demand in Turkey using regression analysis. In the study, a positive relationship was found between housing demand and per capita income, interest rates, housing prices, and an insignificant relationship between demographic factors and housing demand. Housing supply also had a positive realationship with per capita income, housing prices and the increase in M2 (liquidity expansion). Güriş et al. (2011) used Logit, Probit and Gompit models to determine the factors affecting the housing demand in urban and non-urban residential areas. They found that variables such as the employment status of the person responsible for the family, other demographic factors, the quality of the housing and income have significant effects on the demand for housing and the Logit model gave more accurate results. Uysal and Yiğit (2016) used per capita income, prices, urbanization rate, interest rate and M2 monetary size as factors affecting housing demand in Turkey during the 1970-2015 period. They applied Johansen (1988) and Johansen-Juselius (1990) cointegration tests and the VECM model. As a result, a positive relationship was obtained between housing demand and per capita income, urbanization rate, and interest rates, and a negative relationship between housing demand and M2 and CPI. On the other hand, it has been determined that the variable that has the most impact on housing demand is income. Lebe and Akbaş (2014) tried to reveal the short-term and long-term effects of housing demand in Turkey

with the help of cointegration and VECM model, using annual data for the period 1970-2011. It was found that the housing demand was positively affected by marital status and the increases in per capita income and industrialization while negatively affected by the increases in interest rate, housing prices and agricultural sector employment. It has been concluded that the factor affecting the housing demand in Turkey in the long run is income, the second is industrialization and the third is employment in the agricultural sector. On the other hand, it has been determined that there is a one-way causality relationship from per capita income, housing prices, interest rate and industrialization to housing demand.

3. EMPIRICAL ANALYSIS

3.1. Data Set and Model

In the study, spatial panel data analysis was conducted for NUTS Level 2 regions (26 sub-regions) for the years between 2013-2019 for income related to GDP per capita in order to analyze the factors affecting the housing demand in Turkey. The model of the study was inspired by the studies of İğdeli (2020), Kangallı Uyar and Kılıç (2017) and Çelik and Kıral (2018). Within the scope of the study, socio-economic variables affecting the housing demand are included. In the study, the annual data of 26 sub-regions were obtained from TURKSTAT. The study covers the period 2013-2019 since the data used in the study is only available for the relevant years.

The abbreviations and definitions of the variables used in the analysis are given in Table 1.

Table 1: Variable Descriptive

Variables	Definition
LHS	Number of house sales in NUTS-2 regions
LPOP	Population of NUTS-2 regions
LIND	The level of industrialization =Number of employment in industrial sectors + Number of employment in services sectors of NUTS-2 regions
NMR	Net migration rate in NUTS-2 regions
LUNER	Unemployment rate in NUTS-2 regions
LMAR	Marriage rate in NUTS-2 regions
LPGDP	GDP per capita in NUTS-2 regions

Due to the negative values in the net migration rate within the scope of the study, except for this variable, the logarithm of all other variables was taken. The use of variables with their logarithmic forms allows the coefficients estimated in the analysis to be interpreted as direct measures of elasticity.

The model for the study is as follows.

$$LHS_{it} = \beta_0 + \beta_1 LPOP_{it} + \beta_2 L\dot{I}ND_{it} + \beta_3 NMR_{it} + \beta_4 LUNER_{it} + \beta_5 LMAR_{it} + \beta_6 LPGDP_{it} + \varepsilon_{it} \quad (1)$$

i=1,2,…,N N=26

t=1,2,…,T T=7

As the population, which is one of the variables explaining the model, increases, the housing demand is expected to increase. Another variable is the level of industrialization (LIND). Industrialization which is an important indicator of production and welfare, is expected to increase the income of the employee as well as increase the housing demand. The net migration rate is another important variable affecting

the demand of housing. The net migration rate for a province is the net number of immigrants for every thousand people who can migrate to the province. While the net migration rate is positive in the provinces receiving immigration, the net immigration rate is negative in the provinces sending immigration. Since the immigrant-receiving provinces generally have a high level of welfare and various working conditions, it is expected that the advantage of owning a home will increase due to the increase in earnings. The rate of marriage is also another variable that is expected to increase the housing demand. Especially in Turkish conditions, family has an important place in terms of traditions and customs. The most important elements of the family phenomenon are movable and immovable properties. One of the most important purposes of the family structure formed after marriage is to own a house. The other factor used in the model that is expected to have a positive impact on the demand of housing is GDP per capita. Even if a country's GDP is growing at a high growth rate, we can draw misleading conclusions about that country's growth if its population is growing at a rate close to its GDP growth rate. In order to avoid such and similar situations, GDP per capita is calculated by dividing the GDP by the population number, and as we mentioned above, commenting on these data allows us to reach healthier results. Since the increase in GDP per capita will increase the income level of individuals, it is expected that the demand of housing will increase. Based on the model of the study, β_1, β_2, β_3, β_5 and β_6 are expected to be economically positive. When considered as a model, the increase in unemployment rate, which is one of the socio-economic variables, is

expected to decrease the housing demand. As individuals do not have income due to unemployment, their purchasing power will decrease. For this reason, the coefficient β_4 is expected to be negative economically.

3.2. Method

The most important difference of spatial econometrics from classical econometrics is that there is spatial correlation between observations and spatial heterogeneity in the models created. If the extent of spatial heterogeneity is significant or the units interact with each other due to their geographical location, the determination of spatial dependence should be determined. Accordingly, spatial econometric models should be used (Anselin, 1998: 18).

In spatial econometrics, the data set is defined by spatial neighborhood weight matrices (W), even if it is a cross-sectional or panel data set. The weight matrix W, calculated depending on the spatial proximity of the units, shows the nxn-dimensional boundary or distance relationship. Spatial dependency is included in the analysis with the delay operator (Çetin, 2012: 70).

$$Wy_i = \sum_{j=1}^{N} w_{ij} y_i \qquad (2)$$

In Equation 2, W is a positive and symmetric weight matrix, it is used to correlate the y observation based on its neighbor, and thus the delay operator is created. In spatial econometrics, there are two types of models that involve dependency. The Spatial Autoregressive Model

(SAR) is the first of these. It assumes that the neighboring y variables also have an effect on the y dependent variable of units with geographic dependence. The representation of this model is as follows:

$$y = \rho W_y + X\beta + \varepsilon \text{ , } \varepsilon \sim N(0, \sigma^2 I) \quad (3)$$

The weight matrix based on the correlation between the spatial correlation value (ρ) in the model and the spatially related observations is also W. The Spatial Error Model (SEM) is the second model that includes spatial dependence. It examines the autoregressive structure present in the error terms of the econometric model. The representation of this model is as follows:

$$y = X\beta + \varepsilon \text{ , } \quad \varepsilon = \lambda W\varepsilon + \vartheta \text{ , } \vartheta \sim N(0, \sigma^2 I) \quad (4)$$

λ is the measure of spatial dependence on error terms (Anselin, 1998: 100).

Since spatial panel data analysis is applied in the study, it is possible to expand the models in the form of panels. In panel data analysis, series are created in both cross-section and time dimensions. It is estimated in three different ways as pooled, fixed effects and random effects model according to the assumptions included in panel data analysis.

In the pooled model, heterogeneity between sections is not taken into account. Spatial interaction is included in Equation 1 and shown in the figure below.

Pooled Spatial Autoregressive Model (PSAR)

$$LHS_{it} = \theta + \rho wLHS_{it} + \beta_1 LPOP_{it} + \beta_2 L\dot{I}ND_{it} + \beta_3 NMR_{it} + \beta_4 LUNER_{it} + \beta_5 LMAR_{it} + \beta_6 LPGDP_{it} + \varepsilon_{it}$$

$$\varepsilon_{it} \sim N(0, \sigma^2 I) \quad (5)$$

Pooled Spatial Error Model (PSEM)

$$LHS_{it} = \theta + +\beta_1 LPOP_{it} + \beta_2 L\dot{I}ND_{it} + \beta_3 NMR_{it} + \beta_4 LUNER_{it} + \beta_5 LMAR_{it} + \beta_6 LPGDP_{it} + \varepsilon_{it}$$

$$\varepsilon_{it} = \lambda \mathrm{W} \varepsilon_{it} + \vartheta_{it}$$

$$\vartheta_{it} \sim N(0, \sigma^2 I) \quad (6)$$

In the Fixed Effects model, on the other hand, with the assumption of heterogeneity between sections, the differences between units are determined by adding a constant term for each section. φ_i reveals the unobservable effect between cross-sections. The models in which spatial interaction is included regarding this model are shown below, again with the help of Equation 1.

Fixed Effects Spatial Autoregressive Model (FSAR)

$$LHS_{it} = \phi_i + \rho wLHS_{it} + \beta_1 LPOP_{it} + \beta_2 L\dot{I}ND_{it} + \beta_3 NMR_{it} + \beta_4 LUNER_{it} + \beta_5 LMAR_{it} + \beta_6 LPGDP_{it} + \varepsilon_{it}$$

$$\varepsilon_{it} \sim N(0, \sigma^2 I) \quad (7)$$

Fixed Effects Spatial Error Model (FSEM)

$$LHS_{it} = \phi_i + +\beta_1 LPOP_{it} + \beta_2 L\dot{I}ND_{it} + \beta_3 NMR_{it} + \beta_4 LUNER_{it} + \beta_5 LMAR_{it} + \beta_6 LPGDP_{it} + \varepsilon_{it}$$

$$\varepsilon_{it} = \lambda \mathrm{W} \varepsilon_{it} + \vartheta_{it}$$

$$\vartheta_{it} \sim N(0, \sigma^2 I) \quad (8)$$

In the Random Effects Model, the changes in the cross-section units or according to the units and time are included in the model as a component of the error term. The random effects model estimators in which spatial interaction is included are given below with the help of Equation 1.

Random Effects Spatial Autoregressive Model (RSAR)

$$LHS_{it} = \rho wLHS_{it} + \beta_1 LPOP_{it} + \beta_2 L\dot{I}ND_{it} + \beta_3 NMR_{it} + \beta_4 LUNER_{it} + \beta_5 LMAR_{it} + \beta_6 LPGDP_{it} + \tau_{it} + \varepsilon_{it}$$

$$\tau_{it} = \sigma_N^2/\sigma^2$$

$$\varepsilon_{it} \sim N(0, \sigma^2 I) \quad (9)$$

Random Effects Spatial Error Model (RSEM)

$$LHS_{it} = \beta_1 LPOP_{it} + \beta_2 L\dot{I}ND_{it} + \beta_3 NMR_{it} + \beta_4 LUNER_{it} + \beta_5 LMAR_{it} + \beta_6 LPGDP_{it} + \tau_{it} + \varepsilon_{it}$$

$$\varepsilon_{it} = \lambda \mathrm{W} \varepsilon_{it} + \vartheta_{it}$$

$$\vartheta_{it} \sim N(0, \sigma^2 I) \quad (10)$$

After the spatial panel models, the important thing is which model is the most appropriate estimator. In order to determine this, some model determination tests need to be applied. The first of these tests is the Moran I test. In this test, which is based on the spatial sequential correlation, the content of the spatial correlation in the alternative hypothesis is not clear. For this reason, only the existence of spatial sequential correlation is investigated. The Moran I statistic, which is made under the assumption that the distribution of error terms is normal, is calculated as follows:

$$I = \frac{N}{S_0}\left(\frac{e'We}{e'e}\right) \quad (11)$$

In the equation, N represents the number of observations and S_0 represents the sum of the units of the spatial weight matrix. The convergence of Moran I statistical value to +1 value indicates positive -1 value and negative strong spatial dependence. If this value is 0, it is concluded that there is no spatial dependence.

Another model determination test is the Lagrange Multiplier Test. Unlike the Moran I test statistic, tests based on the Maximum Likelihood Method are created based on alternative hypotheses. The hypotheses regarding the spatial lag model are given below. The same hypothesis can be written in the spatial error model for the coefficient λ.

$H_0: \rho = 0$ (there is not spatial autoregressive)

$H_a: \rho \neq 0$ (there is spatial autoregressive)

The Lagrange Multiplier Test statistics (LM_{ERR} and LM_{LAG}) created for the Spatial Error Model and the Spatial Autoregressive Model are obtained as follows (Anselin and Florax, 1995: 5).

$$LM_{ERR} = LM_{\lambda} = \left(\frac{e'We}{\sigma^2}\right)^2 / tr(W'W + W^2) \quad (12)$$

$\sigma^2 = e'e/n$ has been defined as. This is the test stat χ^2 represents the distribution and the degree of freedom is 1.

$$LM_{LAG} = LM_{\rho} = [e'Wy/\sigma^2]/[(Wxb)'MWxb/\sigma^2 + tr(W'W + W^2)] \quad (13)$$

Here $M = I - x(x'x)^{-1}x$. This statistic also shows the χ^2 distribution and the degree of freedom is 1.

If both of these tests are significant, robust transformations should also be applied and tested. By making robust transformations, it can be determined from which model the spatial effect originates and the final model obtained can be compared with the OLS (Ordinary Least Squares) model (Anselin, 2003: 157).

3.3. Empirical Analysis Results

At this section, in the light of the models created on the determinants of this situation for the housing demand in Turkey, the spatial model determination tests for whether there is a spatial neighborhood relationship and then the predicted model results are included.

In the study, spatial model determination tests were carried out to determine whether the effects of the variables used in determining the subject demand of NUTS-2 regions on the housing demand of the region create spatial dependence in terms of neighborhood relations. The results of the Spatial Error Model (LM_{ERR}) and Spatial Autoregressive Model (LM_{LAG}) tests carried out in this respect are given in Table 2.

Table 2: Spatial Dependency Test Results

Tests	Hypothesis	Test Statistic	Probability Value
LM_{LAG}	$H_0: \rho = 0$ $H_a: \rho \neq 0$	8.043	0.033
LM_{ERR}	$H_0: \lambda = 0$ $H_a: \lambda \neq 0$	9.275	0.026

According to Table 2, the probability values calculated for both the Spatial Autoregressive Model and the Spatial Error Model are statistically significant at the 5% significance level. In this respect, it can be said that both types of models are valid. In this case, the robust (Resistant) LM test results in Table 3 below should be checked.

Table 3: Robust Spatial Dependency Test Results

Tests	Hypothesis	Test Statistic	Probability Value
RLM_{LAG}	$H_{0:}\rho = 0$ $H_{a:}\rho \neq 0$	4.092	0.057
RLM_{ERR}	$H_{0:}\lambda = 0$ $H_{a:}\lambda \neq 0$	5.473	0.046

According to the results obtained from Table 3, it was concluded that the Robust LM_{ERR} test statistics were significant at the 5% significance level and the Robust LM_{LAG} test statistics were significant at the 10% significance level. Due to the higher rejection power of Robust LM_{ERR}, it was decided that the Spatial Error Model for housing demand was valid.

Until this stage, the existence of a spatial effect based on neighborhood relations on the determinants of housing demand has been determined. Since spatial panel analysis is applied in the study, it is necessary to calculate the test statistics for obtaining the appropriate panel model. Due to the assumptions of the panel data models, the determination of the appropriate estimation method is important for the consistency and effectiveness of the estimation results. The results of the F test, LR test and Hausman test, which were used to decide

which of these models are suitable for the model used in the study, are given in the table below.

Table 4: Fixed Effects and Random Effects Spatial Model Determination Tests for Models

Test	Test Statistics Value	Probability Value
F-Test (Fixed Effect Constraint)	13.782	0.000
LR-Test (Rassal Effect Constraint)	8.114	0.001
Hausman Test	-10.390	0.000

In Table 4, the null hypothesis (pooled spatial error model is valid) was rejected as the probability value was significant at the 1% significance level as a result of the F test performed between the spatial pooled and fixed effects model for housing demand. Again, as a result of the LR-test in the choice between the pooled and random effects model, the probability value was significant at the 1% significance level, so the null hypothesis was rejected and it was decided that the pooled model was not valid. In this case, the Hausman Test statistics for the choice between fixed effects spatial error and random effects spatial error model gained importance. According to the probability value obtained, the null hypothesis at the 1% significance level (random effects spatial error model is valid) was rejected and it was decided that the Fixed Effects Spatial Error Model was valid as the appropriate spatial panel data model.

It was decided that the Fixed Effects Spatial Error Model was valid as the appropriate spatial panel data model. It has been determined that there is a spatial spillover effect among the 26 sub-regions in NUTS

Level-2 of Turkey, in other words, housing demand has a dynamic relationship by creating a significant effect between neighboring regions. It has been observed that this effect is due to spatial error. Spatial panel data models suitable for the panel data model used in the analysis were also determined. Accordingly, fixed effects spatial error model on Level 2 regions is given in Table 5. In addition, the Table 5 shows the estimation results when the effect of space is not taken into account. Here, when the spatial effect is not taken into account, it has been determined that the estimated β coefficients are quite biased compared to the models with the spatial effect. Because spatial interaction is not taken into account in explaining the model, the estimator coefficients are biased and the model results are not valid (Anselin, 1988).

Table 5: Estimation Results for Housing Demand

Dependent Variable: LHS_{it}	**Fixed Effect Spatial Error Model**	**OLS Model Without Spatial Effect**
ϕ_i	0.872 [0.003***]	1.823 [0.046**]
$LPOP_{it}$	0.401 [0.025**]	0.762 [0.037**]
$L\dot{I}ND_{it}$	2.772 [0.006***]	1.263 [0.284]
NMR_{it}	1.239 [0.058*]	-0.328 [0.331]
$LUNER_{it}$	-0.991 [0.007***]	-2.826 [0.166]
LMR_{it}	0.054 [0.088*]	1.032 [0.293]
$LPGDP_{it}$	4.781 [0.049**]	0.783 [0.003*]
λ (Spatial Dependency)	0.571 [0.032**]	-
R^2	0.91	0.78
Adjusted R^2	0.89	0.74
Number of Observations	182	182
Cross-Sections	26	26
Wald Tests	χ^2 = 4.566, Prob: 0.033	χ^2 = 1.309, Prob: 0.096
Bhargava Adjusted Durbin Watson Test	1.027, Prob: 0.486	13.982, Prob: 0.078

*, **,*** shows respecitvely 10%, 5% and 1% statistical significance. Values in square brackets [ ] indicate probability values.

It has been obtained that the spatial interaction of the model is significant. In other words, positive spatial dependence was obtained between NUTS Level-2 regions in housing demand in Turkey. Therefore, an increase in the demand for housing in a region also increases the demand for neighboring regions. The 1% increase in the housing demand of the neighboring region creates a positive effect of 0.571% on the housing demand of the other neighboring region.

The effect of population variable, which is one of the explanatory variables, on housing demand is positive as expected. In other words, as the population in Level-2 regions is higher than the average population in Turkey, the demand for housing, that is, the number of house sales, increases. The industrialization level as an explanatory variable met the expectations statistically and economically. It was concluded that the increasing number of employment in the industry and service sector for the research period increased the sales of housing. The coefficients of the net migration rate and marriage rate variables, which are among the socio-economic variables that affect the housing demand, were found to be positive in line with the expectations. In other words, as the net migration rate and marriage rate in NUTS Level-2 sub-regions are higher than the average in Turkey, the demand for housing increases. Another variable in the model is the unemployment rate. Especially in rural and undeveloped areas, the lack of sufficient job fields affects the income situation and the demand for housing. The result of the analysis proved the economic expectation and the increase in unemployment rate

decreased the demand for housing. The last explanatory variable in the model is GDP per capita. This variable, which represents the income group, was found to be positive in line with economic expectations. It has been concluded that the increase in the GDP per capita increases the housing demand.

When the results obtained are compared with the studies in the literature, Öztürk and Fitöz (2009) found that the GDP per capita increases the demand for housing. While the study is similar in this respect, the authors' inability to find a significant relationship between population and housing demand revealed the different finding of the study. Findings related to the studies of Solak and Kabadayı (2016), İğdeli (2020), Kıral and Çelik (2018) support the findings of the study. As the common points of the studies, income, population growth and industrialization level are among the factors that increase the demand for housing.

CONCLUSIONS AND RECOMMENDATIONS

In this study, the social and economic variables affecting the housing demand in Turkey between the years 2013-2019 are discussed with spatial panel data models for NUTS Level-2 regions, which take into account spatial interaction. As a result of the analysis, it has been obtained that there is a spatial interaction in the housing demand in Turkey. This situation can be interpreted as housing sales in the related region will increase as housing sales in the neighboring region

increase. This interaction actually shows that the increase in housing demand in Turkey occurs between regions with similar characteristics.

Along with the spatial relationship, the effect of the factors affecting the housing demand is also discussed. In the model estimated for the housing demand, it was determined that GDP per capita variable increased the demand of housing. Other variables that increased housing demand were population, industrialization level, marriage rate and net migration rate. In the study, the only variable that reduced the demand for housing was the unemployment rate.

As a result of the research, it is seen that the households' investments in housing purchases are successful. Especially in recent years, it is known that real estate investments are the most profitable investments. In order for the housing demand to be balanced among the regions, investments can be made in the industrial sector in regions with low socio-economic development level. In this way, migration movements that will take place can be prevented. It is known that economic and demographic factors have a very important role on housing demand. Factors such as the young population, increases in marriage and birth rates are expected to increase the demand for housing. The population between the ages of 15-64, which can be described as the working age population in Turkey, has been seen especially in recent years. In addition, the rate of urbanization and industrialization, which has increased in recent years, is thought to contribute to the revival of the sector. Apart from economic developments, the housing sector can also be affected by factors that are more difficult to measure

quantitatively, such as future expectation, risk perception and taste. Despite the fact that demographic and economic factors are closely related to housing demand, there is very limited data that can be used in the analysis for Turkey. As a result, the housing sector is highly affected by macro and micro economic conditions, and it is one of the business lines in which the changes that will occur in the relevant conditions are felt the most. Therefore, it is recommended to analyze the macroeconomic developments of our country in order to understand the ″sensitivity″ and ″trends″.

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CHAPTER 5

RESEARCH OF VOLATILITY SPREAD BETWEEN CRYPTO ASSETS AND OTHER FINANCIAL INSTRUMENTS WITH THE BEKK GARCH MODEL

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INTRODUCTION

Money, which is as old as the human history, has evolved in parallel with the changes in information and technology. Virtual currencies, emerged as a result of this evolution, do not exist physically unlike traditional payment instruments. All the transactions made with virtual currencies are made in a digital environment. Although virtual currencies are very diverse, the use of crypto currencies, which is one of these currencies, is increasing day by day. Cryptocurrency is a virtual currency that is not related to a central authority or an intermediary institution and is used over the internet. The value of cryptocurrencies is determined instantly in the market according to the supply and demand situations.

The low transaction costs of cryptocurrencies, which have become increasingly popular especially after 2008, have paved the way for the use of these assets as investment instruments. Since cryptocurrencies were introduced into the market, they have been a subject of difficulties and opportunities for policymakers, consumers, entrepreneurs, and economists.

In the cryptocurrency market, there are many cryptocurrencies like Bitcoin, Ethereum, Cardano, Binance-Coin, Tether, XRP, Dogecoin and Polkadot. However, Bitcoin, which has the highest trade volume with 36%, and Ethereum, which has the second highest trade volume with 18%, will be analyzed in this research. These two cryptocurrencies' having the highest market share makes them the leading indicator in the market of cryptocurrency.

Cryptocurrencies, with their structure and with opportunities and threats they create, are accepted different than the other assets in financial market. Therefore, new situations emerge in portfolio analysis and risk management. For this reason, the main purpose of this research is to present the variance relationship that will guide the diversification strategy in portfolio which will be created with cryptocurrencies that have attracted the attention of many investors in recent years, and thus to provide basic information to the investor. When it is taken into consideration that portfolio diversification is made with the motivation of reducing the risk, it is clear that modeling on the return shocks and volatility structure of the assets to be included in any portfolio will be useful at this point.

The research consists of four main titles. In the first part, a descriptive framework about cryptocurrencies was drawn, and information was given about Bitcoin and Ethereum, which have the highest investment volume and will be examined in this study. In addition, a literature review on the subject is also included in the same section. In the second part, information about the data set and model of the study is given, while the third part is the application and findings. In the fourth section, the conclusion section, there is a general evaluation.

1. CRYPTOCURRENCIES

As the information communication and technology developed, transactions that are carried out in electronic environment have shaken the confidence of the users, who make transactions in electronic environment, for they are not carried out in a safe environment. In the

sense of resolving this trust issue, cryptology has become a revolutionary innovation; it also has become available only for users with its encryption method. As cryptology is defined the science of encryption, it has three missions: security, data integrity and authentication. Cryptocurrency is a currency that is based on cryptology basics due to security issues, encrypted, can be used in digital and virtual environments, is not related to a central authority, and is used via internet. Cryptocurrencies, as well as being the most up-to-date of digital currencies, provide the convenience of making a transaction without intermediary. Cryptocurrencies, which are qualified as virtual, digital and electronic currencies, have low cost because they are not related to a central authority due to their blockchain structure. (Dizkırıcı and Gökgöz, 2018: 94).

The value of cryptocurrencies is determined according to supply and demand conditional like traditional money and commodities in market (Eğilmez, 2017). As individuals learn about the functioning of the crypto money system, they ensure the rapid spread of the system by become involved in this system. The fact that the current monetary system does not distribute resources effectively among its participants is one of the important factors in the emergence of cryptocurrencies (Maurer, Nelms and Swartz, 2013). The general qualities of cryptocurrencies are:

- Cryptocurrencies are decentralized. The control mechanism of this structure is provided by the blockchain database.

- The amount of cryptocurrency in circulation is determined during the establishment phase of the system. (Çarkacıoğlu, 2016: 6).
- The control mechanism in the crypto money system is provided by the Distributed Ledger (DL) encryption algorithm. Transactions are made publicly and are added to the blockchain database after all transactions are confirmed (Dağtekin, 2018: 70).
- The cryptocurrency system works without intermediaries, the security and accuracy of the ledgers are realized through miners.
- First generation cryptocurrencies cannot survive without mining. For this reason, algorithms have been produced so that the mining system is not used in new generation cryptocurrencies in order to reduce the costs.

Although there are different opinions about cryptocurrencies, knowing their advantages is important in making future decisions. Cryptocurrencies are very advantageous in terms of low transaction costs and fast transfer. The transaction cost is low as no commission is paid as in credit cards or other payment systems. Cross-border transfers are processed at a lower cost, while at the same time, a portion of the fee is awarded to the miner for solving the transaction block during the transfer process (Demartino, 2018: 285). Unlike traditional payment methods, transactions are carried out very quickly since there is no intermediary institution during the transfer process. This situation is very important in terms of cash flows of international

companies (Aljohani, 2017:11). The use of cryptocurrencies in crisis situations, regime changes is important for people who want to protect the value of their money. The predictability of some cryptocurrencies increases with certain supply and eliminates the possibility of causing inflation by printing money in case of need. By reducing the use of cash, the tax loss of the government can be reduced with electronic payments. It is easy to carry as cryptocurrencies will be stored in portable wallets called cold wallets. In addition, with the use of crypto money, situations such as identity theft are prevented (Bunjaku, Trajkovska and Kacarski, 2017: 38).

Cryptocurrency has some advantages as well as some risks. The first is that cryptocurrencies have very high volatility. Cryptocurrencies, which have high transaction volume and market value, have exhibited very high volatility until the end of 2019. Another risk is that cryptocurrencies are not subject to any control. If it is used in illegal activities, there may be a situation such as money laundering. It is thought that even if the users of the system oppose this situation, it can be used as an element of crime. In addition, electricity consumption used in the production of first-generation cryptocurrencies is among the disadvantages of cryptocurrencies.

1.1. Bitcoin and Ethereum

Cryptocurrency emerged in 1998 with Wei Dai's contribution to the field of cryptography. While Wei Dai defined cryptocurrency as encrypted currency, he explained that it would be developed by methods such as cryptographic methods that are not dependent on the

central authority. In 2008, the infrastructure foundations of today's cryptocurrency system were introduced to the whole world by Satoshi Nakomota with the article "Bitcoin: A Peer-to-Peer Electronic Cash System". The pioneer of hundreds of cryptocurrencies, Bitcoin has a high usage rate due to low transaction costs, globality, and ease of access to the market, increasing use every day, being safe, providing financial freedom. (Çarkacıoğlu, 2016: 16).

The economic crises experienced throughout the world have shaken the confidence in the economic system. The global uncertainties experienced especially after the 2008 crisis have shaken the confidence in the monetary system and increased the confidence in digital currencies. Seen as a haven thanks to its innovative nature, transparency and reliability, Bitcoin has become popular during a time of economic uncertainty (Urquhart, 2016: 80). As a result of the monetary expansion that occurred during the crisis periods, the wealth of individuals lost value due to inflation. These losses in value have caused the popularity of Bitcoin to increase. Different from previous policies, Bitcoin is built on decentralized management and record keeping (Raskin and Yermack, 2016: 1-2).

Bitcoin is a digital currency written in open-source code and readable by anyone, with no physical counterpart, no intermediary, no broker. Thanks to each user's digital account and wallet, transfers with a digital signature are carried out provided that the miners verify the signatures. There is no time problem during transfer transactions, and

transactions can be performed on weekends and at night (Moser, 2013:4).

Despite being accepted as a medium of exchange, Bitcoin's being decentralized has caused it to not be accepted in the markets. Due to its sudden reaction to the news around the world, it has a risk in its use for the purpose of accumulating value. It is not generally seen as money because of having a high level of volatility and is somewhere between money and commodities (DugCampbell, 2019). The increase in digitalization in recent days, the young generation who closely follow technological developments being investors, and the Covid-19 outbreak are among the reasons for the increase in the value of Bitcoin (Karaçayır and Afşar, 2021: 65).

When Bitcoin emerged, the number of individuals who had information about its infrastructure was quite small. Over time, individuals who saw the potential for progress in this area have made attempts to create coins with different names. As a result of these initiatives, many types of coins such as Ethereum, Litecoin, Bitcoin-Cash, Monero, Tether, Ripple, Stellar and Tron have been produced and released as altcoins. While producing altcoins, the best features of Bitcoin were imitated, and at the same time, improvements and developments were made considering its shortcomings. The operation process of altcoins, whose infrastructure features are also improved, is faster and more reliable (White, 2018: 390).

Ethereum is a decentralized currency with smart contracts, designed by Vitalik Buterin in 2013 and implemented by the joint venture of

Gavin Wood and Vitalik Buterin. Ethereum, which has its own programming language, also pioneers new types of open-source applications (Buterin, 2015). After Bitcoin, the altcoin with the highest market value in the crypto money market is Ethereum (Ethereum, 2019). Ethereum provides its users advantages such as cryptocurrencies, banking systems, websites, social networks, games and blockchain software (Yakupoğlu, 2016: 90). Ethreum is superior to Bitcoin in terms of transaction speed and production amount. In addition, Bitcoin is seen as digital gold and Ethereum as digital money (Kılınç, 2018).

1.2. Literature Review

Bitcoin has been the subject of many researches after its market value increased over time, the transaction volume increased and it was seen as an investment tool. There are studies examining the relationship of Bitcoin with gold, exchange rates and stock markets.

Bouri, Azzi and Dyhrberg (2013), examined the relation between price returns and volatility changes in the Bitcoin market and in various currencies. The analysis showed a negative relation between the VIX and Bitcoin volatility.

Georgoula et al. (2015) examined the relationship between Bitcoin prices and the SP500 index using the data between October 27, 2014 and January 12, 2015 and found that there is a negative relationship between Bitcoin prices and SP500. As a result of the study, it is

suggested that when the SP 500 index falls, they sell their stocks and switch to Bitcoin.

Baek and Elbeck (2015) investigated the relationship between Bitcoin prices and the SP 500 between July 2010 and February 2014, and as a result of the study, they concluded that there is no relationship between Bitcoin price and SP 500.

Dirican and Canöz (2017) investigated the cointegration relationship between Bitcoin prices and the New York Stock Exchange, NASDAQ, London Stock Exchange, Tokyo Stock Exchange, Shanghai Stock Exchange, SP500 index and Borsa Istanbul (BIST100) indices for the period 24 May 2013-05 November 2017 with the ARDL (Autoregressive Distributed Lag Bound Test) bounds test approach. As a result of the study, while no relationship was found between the London, Tokyo and Istanbul markets and Bitcoin prices, they found the existence of a cointegration relationship between the US and Chinese stock market indices.

Kılıç and Çütcü (2018) investigated the relationship between Bitcoin prices and Borsa Istanbul index with the data set between February 02, 2012 and March 06, 2018, and as a result of the study, there was no cointegration relationship in the medium and long term, at the same time, according to the Toda-Yamamoto causality test, they found that there is a one-way causality relationship from Borsa Istanbul to Bitcoin prices.

Vardar and Aydoğan (2019) analyzed the volatility spread among Bitcoin, US Dollar and Turkish Lira, Euro and Turkish Lira, bond

assets with VAR-BEKK-GARCH model. In the study examining the period of 2010-2018, there is evidence of two-way cross-market shock and volatility spillover effects in shock and volatility spillovers between all financial asset classes except Bitcoin and the US Dollar exchange rate.

Tiwari, Raheem and Kang (2019) investigated time-differentiated correlations between the SP 500 and Ripple, Dash, Stellar, Litecoin, Ethereum, Bitcoin of cryptocurrencies. They used the copula-ADCC-EGARCH model. According to the findings, cryptocurrencies are perceived to be a hedge against the risks of the SP 500 and the findings showed that volatilities respond more to negative shock as compared to positive shock in both markets.

Charfeddine, Benlagha, Maouchi (2020) researched the dynamic relationship between cryptocurrencies that are Bitcoin and Ethereum and conventional assets that are Crude Oil, Gold and SP500 via GARCH Models. According to the findings of this study, they found that the cross-correlation with conventional assets is changing over time but is weak, supporting the idea that these cryptocurrencies can be suitable for financial diversification.

Ghorbel and Jeribi (2020) analyzed the volatilities of cryptocurrencies and other financial assets. They used to BEKK GARCH Model and DCC GARCH Model in their research. According to the results of BEKK-GARCH model, cryptocurrencies and lower volatility spillover between cryptocurrencies and financial assets. The results of the

DCC-GARCH model identify an important effect of the launch of Bitcoin futures.

As can be seen in the literature, there are many different studies on cryptocurrencies. This study contributes to both the crypto money literature and portfolio diversification studies.

2. DATA SET AND MODEL

2.1. Data Set

In this study, Bitcoin and Ethereum were examined as crypto assets, while gold, SP500 and BIST100 index were taken into account in other financial assets. The review period for the variables is 08/07/2015-12/08/2021. Taking into account the closing days of the stock market indices, a data set of 1508 days was created over the trading day. Since the use of return series in financial time series is more explanatory, return series are obtained from closing prices. When using yield series:

$$r_{t=} \frac{P_t - P_{t-1}}{P_{t-1}} * 100 \tag{1}$$

basic return formula was used. The time path graphs of the return series are given in Figure 1.

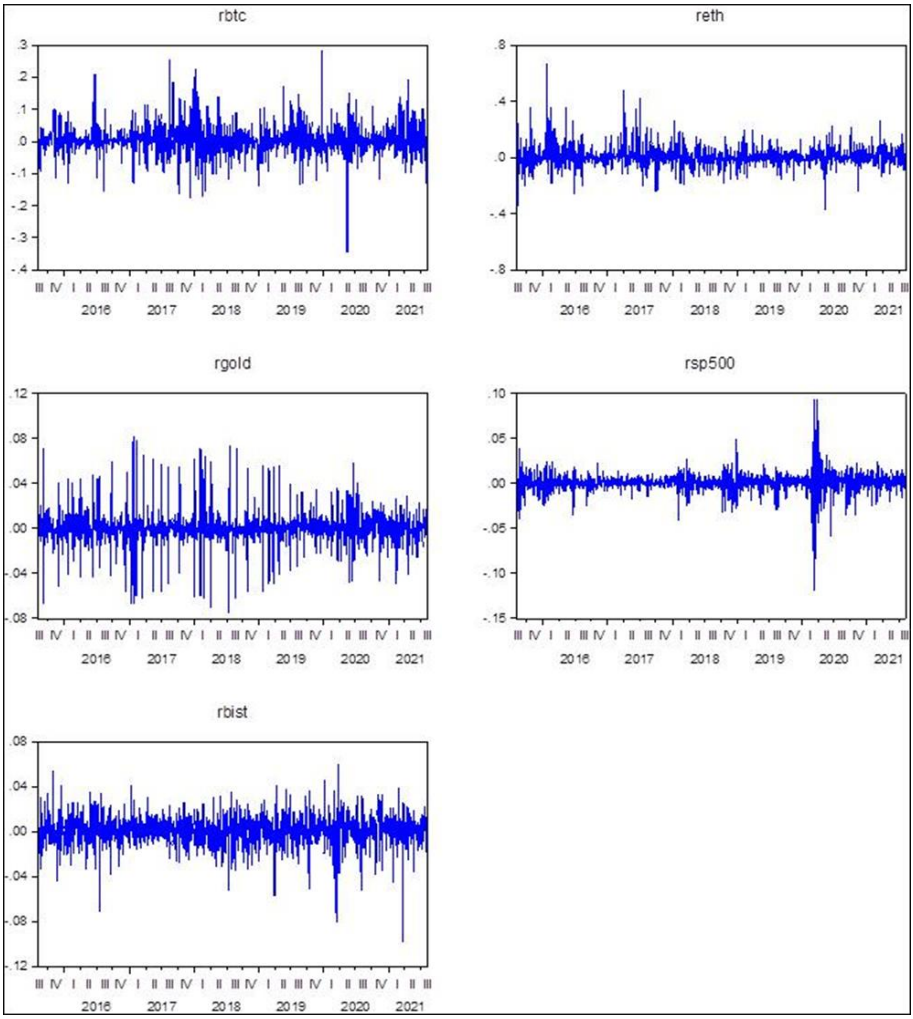

Figure 1. Time Path Charts of Asset Returns

When the time path graphs of the return series in Figure 1 are examined, it is understood that there is a large deviation in all series in 2020. Descriptive statistics including data on whether the return series exhibit mean, and normal distribution are given in Table 1.

Table 1. Descriptive Statistics

Statistics& Assets	Bitcoin (rbtc)	Ethereum (reth)	S&P500 (rsp500)	Gold (rgold)	BIST100 (rbist)
Mean	0.004386	0.007843	0.000572	0.000385	0.000496
Maksimum	0.283846	0.664770	0.093828	0.081360	0.059825
Minimum	-0.346864	-0.744438	-0.119841	-0.074758	-0.097934
Std. Dev.	0.045562	0.077963	0.011817	0.014849	0.013652
Skewness	0.188480	0.744486	-0.688151	0.264582	-0.737079
Kurtosis	8.969950	17.29277	22.03214	11.74276	7.606953
J-B	2246.836	12966.50	22863.49	4817.116	1469.146

In the analyzed period, Ethereum has the highest rate of return with 66%, while the lowest rate of return is Ethereum with 74%. When the standard deviation of Ethereum is examined, it is seen that it has the highest standard deviation of 7% among all series examined. From this point of view, it can be said that Ethereum is the most volatile series. Bitcoin is the second variable with the highest return among the assets examined with a maximum return of 28%. Again, Bitcoin is the second series with a high loss with a loss of 34%. When the standard deviation of Bitcoin is examined, with a standard deviation of 4%, Bitcoin is the second series with the highest standard deviation among the examined asset series. When other financial assets are analyzed, it is seen that the standard deviations are very close to 1%. Considering the skewness and kurtosis coefficients of all financial time series, the hypothesis[3] that the series has a leptokurtic distribution is accepted. In fact, one of the prerequisites for autoregressive modeling in financial time series is the leptokurtic distribution of the series. From this point of view, it is assumed that the examined time series are suitable for

[3]A leptokurtic distribution has excess positive kurtosis, where the kurtosis is greater than 3.

modeling with ARCH group models. However, the LM-ARCH test is used to pre-test whether the ARCH (Autoregressive Conditional Heteroskedasticity) effect, which is used in modeling volatility and assumes that the variance of the error term in the current period is a function of the variance of the error terms in the previous period, is valid in the series.

The ARCH test is a Lagrangian Multiplier (LM) test for autoregressive conditional variance (ARCH) in residuals.

$$\varepsilon_t^2 = \beta_0 + \left(\sum_{\delta}^{q} \beta_\delta \varepsilon_{t-\delta}^2 \right) + v_t \tag{2}$$

Accordingly LM-ARCH[4]test are given in Table 2.

Table 2. ARCH LM EffectTesting

	F-Statistic	**Obs*R-squared**	**Prob**
rbtc	9.496713	9.449642	0.0021
reth	8.68792	8.649483	0.0033
rsp500	282.4214	238.0638	0.0000
rgold	36.20154	35.39713	0.0000
rbist	0.896617	0.897275	0.3438

When the test results of the variables were examined, the alternative hypothesis was accepted that there was an ARCH effect in all variables except the “rbist” variable. Since the null hypothesis cannot be rejected in the “rbist” variable, it is not possible to model this

[4]H_0= There is no ARCH

variable with ARCH group models. The “rbist” variable was excluded from the model because it did not meet the prerequisite.

2.2. The Model

Multivariate GARCH models are used in volatility spread. MGARCH models are very wide, and in this study, the BEKK GARCH model was preferred which was used in the studies of Ghorbel and Jeribi (2020); Vardar and Aydoğan (2019); Varghese and Raju (2020); Wang, Pan and Wu (2018); Katsiampa, Corbet and Lucey (2019). The GARCH basic part of the model is expressed with the conditional variance equation (Bollerslev, 1986);

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} \tag{3}$$

of the GARCH (1,1) model. Here,$h_t$is the conditional variance, ωis the constant term, α is the ARCH term (short term effect), $\varepsilon_{t-1}^2$is the unexpected past shocks andβis the long-run effect of past volatility. From this point of view, the conditional variance equation for the variables of this study is written as follows:

$$h_t = \beta_0 + \beta_1 h_t RBTC + \beta_2 h_t RETH + \beta_3 h_t RSP500 + \beta_4 h_t RGOLD$$

BEKK GARCH Model is developed by Baba, Engle, Kraft and Kroner (1990).

$$H_t = C'C + A'\varepsilon_{t-1}\varepsilon'_{t-1}A + B'H_{t-1}B \quad (4)$$

Here, H_t is the conditional covariance matrix of shocks in asset returns. C is a sub-triangular matrix representing constant components and A and B are the matrix of ARCH and GARCH coefficients (m*m), respectively. A is a (m*m) coefficient matrix capturing the effects of own and cross-market shocks, while B is a (m*m) coefficient matrix capturing its own volatility persistence and volatility transfers between returns on financial assets. However, in equation 4 *"Since the FULL BEKK GARCH model is not derived from a known stochastic process, it has no regularity conditions and asymptotic properties other than the assumption. However, the estimate of the full BEKK model includes 3m(m+1)/2 parameters. As the number of parameters increases, the convergence of the estimation algorithm becomes problematic."* (Chang, McAleer and Wang, 2016). The diagonal BEKK GARCH model (a special version of the FULL BEKK model) is useful in overcoming this situation. It can be derived from the stochastic process when matrices A and B are diagonal or scalar matrices and it can be shown that the Quasi-Maximum Likelihood Estimates (QMLE) of the parameters of the Diagonal BEKK model is consistent and asymptotically normal. Thus, standard statistical inferences will apply. The diagonal BEKK model A and B matrices are as follows:

$$A = \begin{matrix} a_{11} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & a_{mm} \end{matrix}, B = \begin{matrix} b_{11} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & b_{11} \end{matrix}$$

The diagonal BEKK model allows testing the volatility spillover effects of a shock at t-1 in the return of asset j between the return of another asset at time j and another asset at time t (Chang et al. 2016: 16). The model parameters of this study are simply expressed as (Ghorbel and Jeribi, 2020):

$$H_t = (h_{it}) with\ i = 1, \ldots\ldots n \tag{5}$$

$$C = \left(C_{i,j-t}\right) with\ i = 1, \ldots . n \tag{6}$$

$$A_t = \left(\alpha_{ij,t}\right) with\ i = 1, \ldots . n \tag{7}$$

$$B_t = \left(\beta_{ij,t}\right) with\ i = 1, \ldots \ldots n \tag{8}$$

Broyden-Fletcher-Goldfarb-Shanno (BFGS) and simplex algorithms are used to estimate the parameters of the diagonal BEKK GARCH model. The aim of this study is to predict the above models and examine the volatility relationship between cryptocurrencies and the SP500 and gold returns. Therefore, the coefficients α_{ij} and β_{ij} will be examined to examine the spillover effect.

Diagonal BEKK GARCH model between 2 assets is expressed as follows (Katsiampa et al. 2019: 69-70):

$$\begin{pmatrix} h_{11,t} & h_{12,t} \\ h_{21,t} & h_{22,t} \end{pmatrix}$$

$$= C'C + \begin{pmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{pmatrix} \begin{pmatrix} \varepsilon_{1,t-1}^2 & \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{1,t-1}\varepsilon_{2,t-1} & \varepsilon_{2,t-1}^2 \end{pmatrix} \begin{matrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{matrix}$$

$$+ \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix} \begin{pmatrix} h_{11,t-1} & h_{12,t-1} \\ h_{21,t-1} & h_{22,t-1} \end{pmatrix} \begin{pmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{pmatrix} \tag{9}$$

According to this;

$$h_{11,t} = C_{11}^2 + a_{11}^2\varepsilon_{1,t-1}^2 + 2a_{11}a_{21}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + a_{21}^2\varepsilon_{2,t-1}^2 + b_{11}^2 h_{1,t-1} + 2b_{11}b_{21}h_{1,2,t-1} + b_{21}^2 h_{2,t-1} \tag{10}$$

$$h_{22,t} = C_{12}^2 + C_{22}^2 + a_{12}^2\varepsilon_{1,t-1}^2 + 2a_{12}a_{22}\varepsilon_{1,t-1}\varepsilon_{2,t-1} + a_{22}^2\varepsilon_{2,t-1}^2 + b_{12}^2 h_{11,t-1} + 2b_{11}b_{22}h_{12,t-1} + b_{22}^2 h_{22,t-1} \tag{11}$$

$$h_{12,t} = h_{21,t} = C_{12}C_{11} + a_{11}a_{12}\varepsilon_{1,t-1}^2 + (a_{12}a_{21} + a_{11}a_{12})\varepsilon_{1,t-1}\varepsilon_{2,t-1} + a_{21}a_{22}\varepsilon_{2,t-1}^2 + b_{11}b_{12}h_{11,t-1} + (b_{12}b_{21} + b_{11}b_{22})h_{12,t-1} + b_{21}b_{22}h_{22,t-1} \tag{12}$$

After estimating the model parameters, the conditional correlation between two assets or cryptocurrencies can be also estimated by the following equation:

$$r_{12,t} = \frac{h_{12,t}}{\sqrt{h_{11,t}}\sqrt{h_{22,t}}} \quad (13)$$

Here, $h_{11,t}$ ve $h_{12,t}$ represent the two cryptocurrencies' conditional variances, while $h_{12,t}$ notes the corresponding conditional covariance.

3. EMPIRICAL FINDINGS

The volatility spread between crypto assets and SP500 and gold return series is derived from the Diagonal BEKK GARCH model. The findings of the model related to the volatility spread of Bitcoin, SP500 and gold variables are given in Table 3, including the mean equation Panel A and the volatility spread Panel B.

Table 3. Diagonal BEKK Model's Results[5]

	BTC-ETH	BTC-SP500	BTC-GOLD	ETH-SP500	ETH-GOLD
Panel A. Mean Equation					
C1	0.004388* (4.13190)	0.004446* (4.20573)	0.004073* (3.93037)	0.00419** (2.57161)	0.004143** (2.436392)
C2	0.004005* (2.82195)	0.00096* (5.64425)	-0.00046 (-1.3430)	0.000924* (5.437053)	-0.00064*** (-1.8928)
Panel B. Variance Equation					
C_{11}	7.85E-05* (12.90946)	7.09E-05* (6.544595)	6.65E-05* (6.983424)	0.000421* (9.113139)	0.000381* (8.984047)
C_{12}	9.84E-05* (11.48721)	-5.53E-08 (-0.039584)	-2.10E-06 (-0.505657)	-1.99E-06 (-0.862985)	1.27E-06 (0.182894)
C_{22}	0.000217* (11.21925)	4.88E-06* (9.543903)	7.32E-05* (16.31997)	4.80E-06* (9.301693)	7.28E-05* (17.2156)
a_{11}	0.377101* (32.44535)	0.240588* (15.61574)	0.244372* (18.67154)	0.302102* (20.09811)	0.315489* (25.76105)
a_{12}	0.144301* (1079.614)	0.12038* (349.119)	0.12731* (358.497)	0.14795* (441.258)	0.16714* (499.397)
a_{22}	0.382659* (33.27485)	0.500368* (22.35686)	0.520982* (19.20019)	0.489722* (21.95519)	0.529765* (19.38574)
b_{11}	0.954746* (233.0042)	0.954656* (169.9114)	0.954995* (196.6199)	0.91292* (125.8339)	0.912653* (137.7901)
b_{12}	0.844835* (46219.389)	0.811134* (12141.87)	0.620650* (5485.125)	0.78071* (9085.749)	0.59408* (4070.023)

[5]Significant at: *1, * *5, and * * *10 percent levels; z values given in parentheses

b_{22}	0.913586* (198.3629)	0.849661* (71.46003)	0.649899* (27.8971)	0.855173* (72.2043)	0.650941* (29.53785)
LogLikelihood	4983.852	7666.855	6918.957	6950.529	6208.461

In the Variance equation parameter estimates, the GARCH (b_{11}, b_{22}) coefficient values are less than 1 and positive. Therefore, the coefficients are considered to be consistent. The β_{ij} coefficients show the persistence of high volatility inherent in the variables. On the basis of variables, the long-term volatility persistence in Bitcoin is 95%, while the long-term volatility persistence in Ethereum is 92%. Based on this, it can be said that the long-term volatility persistence in Bitcoin is higher than the volatility persistence of Ethereum.

The a_{12} and b_{12} coefficients represent the volatility spread. The spread is bidirectional between the variables and is statistically significant at the 1% level. While a_{12} measures the effect (ARCH) of the past shock of the return of a coefficient variable in the period t-1 on the current return of the other variable, b_{12} measures the long-term effect of the volatility spillover. According to the findings in Table 3, the short-term volatility spread between Bitcoin and Ethereum is 14%, and the long-term volatility spread is 84%. The short-term volatility spread between Bitcoin and SP500 index returns is 12%, and the long-term volatility spread is 81%. The short-term volatility spread between Bitcoin and the gold return series is 13%, and the long-term volatility spread is 62%. From this point of view, although the persistence of short-term shocks is not a big difference on average between Bitcoin and other financial assets, the fact that the lowest rate in the

permanence of long-term shocks is in the Bitcoin-Gold series with 62%, while creating a portfolio with these variables, it seems more reasonable for risk-averse investors to diversify with Bitcoin gold than with other financial assets. When the volatility spread of Ethereum and other financial assets is examined; Short-term volatility spread between Ethereum and SP500 return series is 14%, long-term volatility spread is 84%, short-term volatility spread between Ethereum and gold series is 16%, and long-term volatility spread is 59%. The conditional correlation graphs of the variables are given in Figure 2.

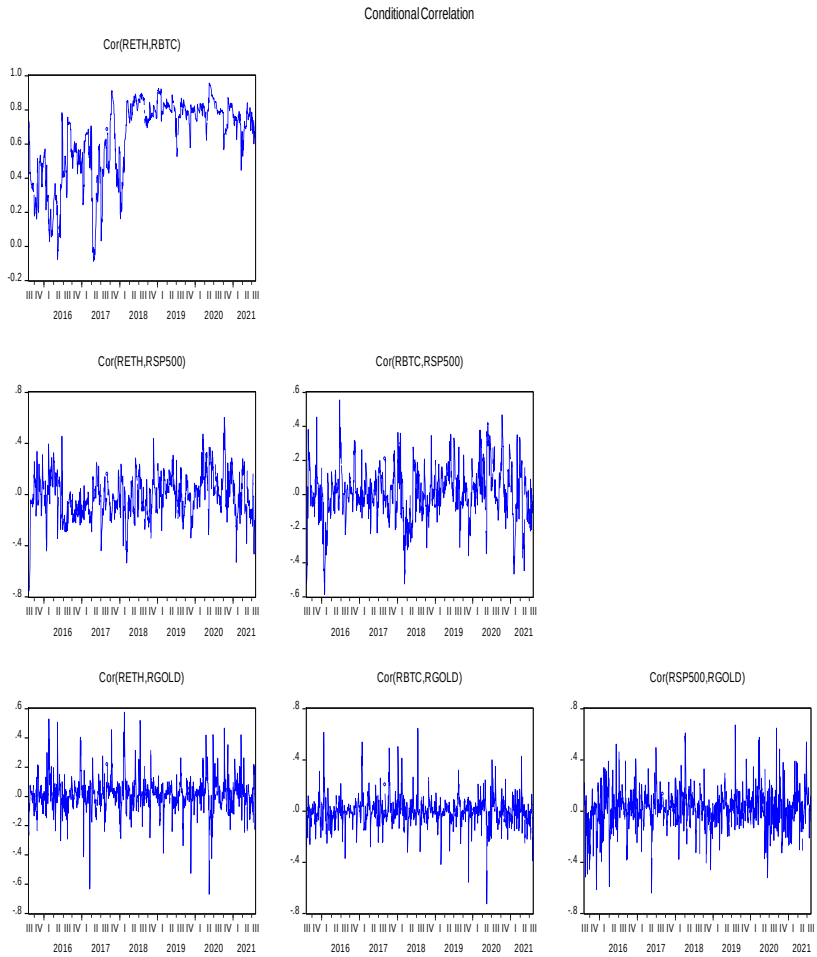

Figure 2. Conditional Correlation

When the conditional correlation graphs are examined, the existence of dynamic conditional correlations between the variables is seen. The course of the shocks observed in the graphs is consistent with the Diagonal BEKK model. The results and graph spread for the Bitcoin and Ethereum series are in line with the studies of Ghorbel and Jeribi (2020).

CONCLUSION

The fact that cryptocurrencies, which started to be used with the technology transformation, became an investment tool especially after 2008, and the high amounts of transaction volumes today, made cryptocurrencies worth examining. The risk of a portfolio to be created with cryptocurrencies, which attracts the attention of individual and small investors thanks to both low transaction costs and accessibility, is examined in both theoretical and applied research. In this study, the volatility spread between cryptocurrencies and some financial assets has been tried to be modeled. Thus, it is desired to obtain results that will form the basis of the diversification strategy in a portfolio to be created with the assets examined. In the study, Bitcoin and Ethereum were included in the analysis in the representation of cryptocurrencies due to the high transaction volumes and market shares. The SP500 index, which is a developed market as financial assets, is considered as the indicator index for the stock investor and the gold variable as the other asset.

In the study, the Diagonal BEKK GARCH model was used to model the volatility spillover. This model is useful in examining the reciprocal propagation effect between variables. According to the findings, there is mutual volatility spillover between all variables in both the short and long term. While the variables with the highest volatility spread are Ethereum and gold in the short run, this spread is between Bitcoin and Ethereum in the long run. Therefore, it can be said that the permanence of long-term shocks is higher for a portfolio

that will be created with only Bitcoin-Ethereum variables compared to other portfolios. The findings of this study, which examines 1508-day data for the 2015-2021 period, say that the short- and long-term volatility spread between Bitcoin and SP500 index returns is less than the volatility spread among all other variables. This result is similar to the Georgoula et al. (2015) results. As a matter of fact, a negative relationship was found between these two variables in the other study. Considering that it is known to add two negatively correlated variables to the portfolio in reducing portfolio risk, it can be argued that it would be rational to include variables with the least volatility spread into the portfolio.

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CHAPTER 6

EVALUATION OF THE PERFORMANCE OF BELT AND ROAD COUNTRIES USING INTEGRATED ENTROPY-TOPSIS METHODS

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INTRODUCTION

Upon the proposal of the President of China Xi Jinping to revive the historical Silk Road in line with the needs of the modern age in his speech at Nazarbayev University during his visit to Kazakhstan in 2013, he has largely aroused the interest of the global public on the subject. The Silk Road Economic Belt has a vision that includes energy transmission lines to increase the trade flow from Asia to Europe in the historical Silk Road geography and infrastructure projects to facilitate transportation. On the other hand, President Xi made another proposal during his visit to Malaysia in 2013 to realize another road, like the Silk Road on land, but this time on the sea. In this regard, he has called for joint cooperation for the 21st Century Maritime Silk Road in order to eliminate the infrastructure deficiencies in port operators and port logistics where large ships can dock (National Development and Reform Commission, 2015).

Silk Road Economic Belt and 21st Century Maritime Silk Road projects have then started to use the term Belt for the line on land and Road for the line on the sea within the framework determined through common denomination. The Chinese equivalent of One Belt and One Road project is "Yi Dai Yi Lu". Later, due to its widespread use as the Belt and Road Initiative, its literature has developed rapidly. Thanks to the diplomatic relations carried out by China with regard to supporting the project, the agreements of direct cooperation were signed with 139 countries in a short time, due to the increased interest

from the countries not included in the scope of Belt and Road (Meng, 2021).

Sea-shipment has still been the most important logistic connection of world trade. In the Road aspect of the Belt and Road Initiative, China's desire is to eliminate the occasional disruptions in trade experienced due to the infrastructure deficiencies arising from the port country through the loans offered within the scope of the project. In this regard, one of the most important projects of the Belt and Road Initiative is the China - Pakistan Economic Corridor. With the agreement made in 2015, the plan was to improve Pakistan's Gwadar Port in terms of infrastructure, to connect the Gulf of Oman to Western China in terms of trade, transportation and energy sectors with the construction of Karakurum Highway (Fazal-ur-Rahman 2007). Also, Gwadar, which is of great importance in terms of its strategic location, is 120 km far from Iran. The port included in the scope of the corridor has the potential to reduce theshipping time of the crude oil sent from the Middle East to China by 85% (Chan & Lee, 2017).

Within the scope of the study, it aims to fill the gap in the literature by conducting a comparative analysis of port countries with a container handling capacity of 5 million TEU at the scale of the Maritime Silk Road proposal of the Belt and Road Initiative through using Entropy-TOPSIS method. With these concerns in mind, the purpose of this research is to mark the first step towards evaluating the rankings of

Belt and Road countries in terms of income, logistics and trade values by using the Entropy-TOPSIS method.

First of all, we presented a detailed relevant literature review and then explained the selection of the criteria used in the current study. After that, we presented the solution steps of Entropy and TOPSIS methods. In the application part, the performance of those selected Belt and Road countries was evaluated with the integrated Entropy-TOPSIS method and the countries were listed by rank. In the conclusion part later, we discussed the results of the research and provided suggestions for future studies.

1. LITERATURE

It is an undeniable fact that there has been a positive effect of the Belt and Road Initiative on international trade. However, in order for the project to be successful, it is necessary to establish cooperation as stated above. Following this, countries' common interests are expected to be harmonized and their trade potentials to develop. As a matter of fact, the increasing number of publications on this subject matter in recent years points out the arousing interest on this line of research area. In this section, we reviewed the literature about Belt and Road Initiative. Table 1 indicates the scope of the studies determined at the end of this screening process to the literature as a list.

Table 1: Studies Conducted on the Belt and Road Initiative and Their Contribution to the Literature

Author	Publication Year	Scope
Fallon	2015	General evaluations were made on the possible effects of the Belt and Road Initiative on Russia, India, Pakistan in Central Asia and Europe.
Chia	2016	The difficulties and opportunities presented by the Belt and Road Initiative and the Asian Infrastructure Investment Bank in providing economic integration and logistic connection specific to ASEAN were evaluated.
Chen and Yang	2017	In the trade models that would occur with the Belt and Road Initiative, the change of manufacturing centers with the port investment in the industry transfer was examined.
Herrero and Xu	2017	The decrease in transportation costs in increasing the trade volume towards Europe due to Belt and Road Initiative was evaluated.
Chen and Yang	2018	Port cluster networks were examined in terms of production location and production capacities within the scope of Belt and Road Initiative.
Cullinane et al.,	2018	The restructuring of the logistics network, facilitation of e-commerce by Belt and Road Initiative and its effects on logistics system design were examined.
Jiang et al.,	2018	China's subsidies for rail networks in Sino-European trade were evaluated.
Lam et al.,	2018	In the maritime logistics of the Belt and Road Initiative projects, the risks and uncertainties in the ship network, port competition and logistics performance were examined.
Li et al.,	2018	The reflection of the logistics infrastructure, which is the driving force of economic growth in the inner regions of China, towards CPEC within the scope of Belt and Road Initiative was evaluated.
Liu et al.,	2018	Supply chain coordination problem in logistics services with Belt and Road Initiative was examined.
Mou et al.,	2018	The competitiveness of the ports covered by Belt and Road Initiative in international trade was evaluated.
Yii et al.,	2018	Within the scope of Belt and Road Initiative, the effect of transportation infrastructure capacity on economic growth in Asian countries was examined.
Yang et	2018	The transportation service of the Budapest-Piraeus

al.,		railway in Belt and Road Initiative economic corridors was evaluated.
Andrić et al.,	2019	Classification of risk factors and fuzzy-sensitivity analysis in planned railway projects with Belt and Road Initiative and their relative importance were investigated.
Chan and Reiner	2019	The inter-company management structures in the biofuel industry of China, Thailand, Vietnam and the Philippines, which are within the scope of Belt and Road Initiative, were researched.
Wen et al.,	2019	Possible six economic corridors of the Belt and Road Initiative: potential routes in terms of cost, environmental impact, transit time and infrastructure security were evaluated.

To to best of our knowledge, there has not been any studies aiming to evaluate the performance of countries with seaway connection and handling 5 million TEU containers annually within the scope of the Belt and Road project using the integrated Entropy-TOPSIS management in terms of income, logistics and trade values. This study aims to address the gap in this regard by implementing a comparative analysis using integrated Entropy-TOPSIS management. For this purpose, we determined the countries that have a seaway connection and handle 5 million TEU containers annually within the scope of the Belt and Road Initiative and then investigated them in the current study. The implications were also provided both for decision makers and researchers after the analysis of the findings obtained from the research. Thus, our purpose was to provide a baseline and pave the way for the evaluation of Belt and Road countries by using the integrated Entropy-TOPSIS.

The reason behind the selection of Entropy method in this study was to enable the calculation of the importance weights of the criteria

determined according to the literature without resorting to the personal judgments and opinions of the experts. However, to sort the ports, we preferred TOPSIS method due to its ease in calculation and being one of the most frequently used methods in the literature as a sorting method (Çakır & Perçin, 2013: 80).

2. METHOD

In the study, the performance ratings of the countries that have a seaway connection and handle 5 million TEU containers per year within the scope of the Belt and Road Initiative were made separately for each year in the 2013-2019 time period, based on the criteria of the annual amount of TEU handled, national income per capita and trade volume.

In the literature, the following methods were the mostly used methods for performance evaluation; Entropy and TOPSIS, multi-criteria decision-making approaches and their integrated application. However, as an evaluation factor, both the ratios calculated in the study and integrated Entropy-TOPSIS multi-criteria decision-making methods were utilized.

In the studies examined in the literature, we observed various criteria to have been utilized. Table 2 indicates those criteria used in the relevant literature. After examining them, we determined the criteria to be used in the present study (e.g., the annual amount of TEU handled, per capita national income and trade volume).

Table 2. Evaluation Criteria in the Literature

Criterion	Literature
Handled Container Amount (TEU)	Ha et al., (2017: 109), Ha &Yang, (2017: 270), Asgari et al., (2015: 38), Yang & Chang (2013: 72), He et al., (2017: 401), Yang & Lin (2013: 11), Teerawattana & Yang, (2019: 66)
National Income ($) / Population	An et al., (2020), Hussain et al., (2020), Meng & Wang, (2020: 68), Zhou et al., (2020), Zhao et al., (2021), Li et al., (2021)
Total Trade Volume ($) / Population	Zhou et al., (2020), Zhao et al., (2021)

As stated above, the reason of choosing Entropy method for this study was due to its enabling the calculation of the importance weights of the criteria determined according to the literature. However, the reason for the selection of TOPSIS method was because of making listing the countries easy in calculation and being one of the most frequently used methods in the literature as a listing method (Çakır, Perçin, 2013: 80). Deng et. al (2000) stated that the TOPSIS approach modified with objective weights obtained from the entropy method was suitable for the comparison problem.

In order to evaluate the obtained data regarding the countries with the TOPSIS method, we will calculate criterion weights with the entropy method. In addition, the annual amount of TEU handled, per capita national income and trade volume criteria will be maximized in the method. Table 3 shows the evaluation criteria and countries used in the study.

Table 3: The Evaluation Criteria and Countries

Criterion	Countries	Abbreviation
Handled Container Amount (TEU)	China	CHN
National Income ($) / Population	Egypt	EGY
Total Trade Volume ($) / Population	Greece	GRC
	Hong Kong	HKG
	India	IND
	Indonesia	IDN
	Italy	ITA
	Malaysia	MYS
	Philippines	PHL
	Russia	RUS
	Saudi Arabia	SAU
	Singapore	SGP
	Thailand	THA
	Turkey	TUR
	United Arab Emirates	ARE
	Vietnam	VNM

2.1. Entropy-TOPSIS Method

The modeling steps of the Entropy-TOPSIS method are as follows. The original evaluation index matrix for the number of containers handled, amount of national income per capita, and trade score in the countries listed in Table 2 can be formulated as an information decision matrix. The original evaluation index matrix for the annual amount of TEU handled in the countries, per capita national income and trade volume is A (a_i is the original value of the data), here, i = 1,2, ..., m; number of evaluation indicators is j = 1,2, ..., n; and as follows (Tian et al., 2019, s. 6-7);

$$A_{ij} = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{m1} & \cdots & a_{mn} \end{bmatrix}$$

The equation is used to run a normalized evaluation matrix:

$$r_{ij} = \frac{\boldsymbol{a_{ij}}}{\sqrt{\sum_{k=1}^{m} \boldsymbol{a_{kj}^2}}}$$

The weighted matrix is calculated with the following equations:

$$w_{ij} = \frac{1 - H_i}{m - \sum_{i=1}^{m} H_i}$$

$$H_i = -\frac{1}{ln\, n} \sum f_i \, ln\, f_i$$

w_i, is the Entropy weight of i indicator and wi ∈ [0,1]. H_i is information entropy, f_i is the characteristic weight of the index and $f_i = r_i / \sum r_i$

Next, a weighted normalized evaluation matrix is constructed based on the entropy weight wi. The index Entropy weight wi constitutes the weight vector W and the weighted normalized matrix V is calculated in relation with the normalized matrix R. The calculation is as follows:

$$V = R \times W = [v_{ij}]_{m.n}$$

A^+ and A^- represent the positive solution (ideal solution) in the sample countries and the negative solution for index i. Calculation methods are shown in equations:

$$A^* = \{(max_i\, v_{ij} | j \in J), (min_i v_{ij} | j \in J'|\}\, A^* = \{v_1^*, v_2^*, \ldots v_n^*\}$$

$$A^- = \{(min_i\, v_{ij} | j \in J), (max_i v_{ij} | j \in J'|\}\, A^- = \{v_1^-, v_2^-, \ldots v_n^-\}$$

For each j country, the geometric distance from the positive ideal solution (S^+) and the negative ideal solution (S^-) are calculated as follows:

$$S_i^* = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - V_j^*\right)^2}$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} \left(V_{ij} - V_j^-\right)^2}$$

Finally, the performance evaluation of countries is calculated as follows:

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*}$$

3. APPLICATIONS

Table 4 indicates the TEU amount handled each year, per capita national income and trade volume criteria values for the 2013-2019 period of 16 countries that have seaway connections and handle 5 million TEU containers per year within the scope of the Belt and Road Initiative.

Table 4: Countries and Their Values

Country	Year	TEU Number/10^6	National Income / Population ($)	Trade Volume / Population ($)	Country	Year	TEU Number/10^6	National Income / Population ($)	Trade Volume / Population ($)

China	2013	174.393	7050.65	3063.99	Malaysia	2013	21.137	10970.12	14731.80
	2014	185.136	7678.60	3152.99		2014	22.368	11319.08	14831.25
	2015	193.734	8066.94	2882.86		2015	24.012	9955.24	12433.88
	2016	197.849	8147.94	2673.28		2016	24.570	9817.74	11660.15
	2017	222.155	8879.44	2962.48		2017	23.784	10259.18	13259.68
	2018	233.201	9976.68	3323.84		2018	24.956	11377.46	14738.43
	2019	242.030	10216.63	3267.85		2019	26.215	11414.21	13865.34
Egypt	2013	7.344	3262.66	1079.65	Philippines	2013	5.825	2871.43	1238.00
	2014	7.896	3379.56	1085.43		2014	6.176	2959.65	1288.67
	2015	7.185	3562.93	1036.61		2015	7.210	3001.04	1261.36
	2016	7.276	3519.87	991.27		2016	7.421	3073.65	1371.95
	2017	6.104	2444.29	966.36		2017	8.095	3123.23	1622.10
	2018	6.369	2537.13	1137.20		2018	8.653	3252.09	1711.41
	2019	6.306	3019.21	1088.68		2019	8.983	3485.08	1740.47
Greece	2013	3.486	21874.82	8883.53	Russia	2013	5.208	15974.64	5868.78
	2014	3.935	21760.98	8991.21		2014	5.252	14095.65	5454.62
	2015	3.679	18167.77	6982.17		2015	3.909	9313.01	3655.11
	2016	4.026	18116.46	6997.60		2016	3.923	8704.90	3527.87
	2017	4.546	18930.22	8131.85		2017	4.515	10720.33	4423.44
	2018	5.332	20324.30	9748.73		2018	5.059	11370.81	4787.73
	2019	6.098	19582.54	9339.36		2019	5.311	11585.00	4667.63
Hong Kong	2013	22.290	38403.78	161111.54	Saudi Arabia	2013	6.743	24844.74	17914.45
	2014	22.300	40315.29	155567.88		2014	6.852	24463.90	16501.82
	2015	20.114	42431.89	146730.80		2015	7.783	20627.93	11932.61
	2016	19.58	43731.11	144987.13		2016	7.677	19879.30	9979.90
	2017	20.760	46165.86	154115.95		2017	8.082	20803.75	10766.27
	2018	19.641	48543.40	160573.45		2018	8.683	23338.96	12752.15
	2019	18.360	48713.47	148427.04		2019	8.905	23139.80	11559.72
India	2013	11.718	1449.61	626.66	Singapore	2013	33.388	56967.43	149648.84
	2014	11.319	1573.88	599.65		2014	34.688	57562.53	145044.96
	2015	12.031	1605.61	500.04		2015	31.710	55646.62	120336.52
	2016	12.083	1732.56	465.86		2016	31.688	56828.30	112352.16
	2017	12.829	1981.65	551.61		2017	33.667	60913.75	124898.91
	2018	16.946	2005.86	613.70		2018	37.388	66188.78	138728.81
	2019	14.763	2099.60	587.03		2019	37.983	65233.28	131375.00
Vietnam	2013	8.452	1886.67	2909.70	Thailand	2013	8.362	6168.26	7032.64
	2014	10.009	2030.26	3249.82		2014	9.202	5951.88	6655.65
	2015	11.089	2085.10	3536.93		2015	9.463	5840.05	6067.88
	2016	11.086	2192.21	3754.42		2016	9.983	5994.23	5938.37
	2017	11.965	2365.62	4528.00		2017	9.938	6592.91	8253.83
	2018	13.008	2566.60	5029.99		2018	10.243	7295.48	7225.54
	2019	13.658	2715.28	5370.53		2019	10.755	7806.74	6470.02
Indonesia	2013	10.632	3623.91	1466.13	Turkey	2013	8.326	12614.48	8773.69
	2014	11.637	3491.62	1388.38		2014	8.468	12157.34	5176.45
	2015	11.883	3331.70	1134.21		2015	8.297	11006.25	7481.32
	2016	12.431	3562.85	1071.07		2016	8.851	10895.32	4273.87
	2017	15.429	3837.65	1230.83		2017	10.094	10591.47	5649.04
	2018	14.060	3893.85	1378.32		2018	10.887	9455.59	4750.53
	2019	17.053	4135.57	1252.50		2019	11.679	9126.56	8123.85
Italy	2013	9.537	35549.97	16559.29	United Arab Emirates	2013	18.693	42412.63	43864.74
	2014	9.683	35518.42	16509.71		2014	20.224	43751.84	69637.47
	2015	9.436	30230.23	14291.35		2015	21.233	38663.38	37899.24
	2016	9.774	30939.71	14322.52		2016	20.413	38141.85	60445.15
	2017	9.894	32406.72	15874.88		2017	19.128	40644.80	41191.55
	2018	9.922	34615.76	17435.58		2018	19.054	43839.36	65679.43
	2019	10.014	33228.24	16795.18		2019	19.171	2566.60	5029.99

Table 4, as we have mentioned, shows the decision matrices used in the study. In this regard, Table 5 indicates the normalized decision matrix of the countries included in the analysis for the years 2013-2019.

Table 5: Normalized Decision Matrix for 2013-2019

Year	Country	TEU Number/10^6	National Income / Population ($)	Trade Volume / Population ($)	Year	Country	TEU Number/10^6	National Income / Population ($)	Trade Volume / Population ($)
2013	CHN	0.952	0.072	0.014	2014	CHN	0.954	0.078	0.014
	EGY	0.040	0.033	0.005		EGY	0.041	0.034	0.005
	GRC	0.019	0.224	0.039		GRC	0.020	0.220	0.040
	HKG	0.122	0.393	0.711		HKG	0.115	0.407	0.003
	IND	0.064	0.015	0.003		IND	0.058	0.016	0.005
	IDN	0.058	0.037	0.006		IDN	0.060	0.035	0.006
	ITA	0.052	0.364	0.073		ITA	0.050	0.359	0.006
	MYS	0.115	0.112	0.065		MYS	0.115	0.114	0.073
	PHL	0.032	0.029	0.005		PHL	0.032	0.030	0.066
	RUS	0.028	0.164	0.026		RUS	0.027	0.142	0.024
	SAU	0.037	0.254	0.079		SAU	0.035	0.247	0.073
	SGP	0.182	0.583	0.660		SGP	0.179	0.582	0.642
	THA	0.046	0.063	0.031		THA	0.047	0.060	0.029
	TUR	0.045	0.129	0.039		TUR	0.044	0.123	0.308
	ARE	0.102	0.434	0.194		ARE	0.104	0.442	0.023
	VNM	0.046	0.019	0.013		VNM	0.052	0.021	0.014
2015	CHN	0.959	0.087	0.015	2016	CHN	0.960	0.087	0.014
	EGY	0.036	0.039	0.005		EGY	0.035	0.038	0.005
	GRC	0.018	0.197	0.036		GRC	0.020	0.194	0.036
	HKG	0.100	0.460	0.751		HKG	0.095	0.469	0.745
	IND	0.060	0.017	0.003		IND	0.059	0.019	0.002
	IDN	0.059	0.036	0.006		IDN	0.060	0.038	0.006
	ITA	0.047	0.328	0.073		ITA	0.047	0.331	0.074
	MYS	0.119	0.108	0.064		MYS	0.119	0.105	0.060
	PHL	0.036	0.033	0.006		PHL	0.036	0.033	0.007
	RUS	0.019	0.101	0.019		RUS	0.019	0.093	0.018
	SAU	0.039	0.224	0.061		SAU	0.037	0.213	0.051
	SGP	0.157	0.603	0.616		SGP	0.154	0.609	0.577
	THA	0.047	0.063	0.031		THA	0.048	0.064	0.031
	TUR	0.041	0.119	0.038		TUR	0.043	0.117	0.022
	ARE	0.105	0.419	0.194		ARE	0.099	0.409	0.311
	VNM	0.055	0.023	0.018		VNM	0.054	0.023	0.019

2017	CHN	0.966	0.090	0.014	2018	CHN	0.965	0.094	0.015
	EGY	0.027	0.025	0.005		EGY	0.026	0.024	0.005
	GRC	0.020	0.191	0.040		GRC	0.022	0.191	0.043
	HKG	0.090	0.466	0.754		HKG	0.081	0.455	0.716
	IND	0.056	0.020	0.003		IND	0.070	0.019	0.003
	IDN	0.067	0.039	0.006		IDN	0.058	0.037	0.006
	ITA	0.043	0.327	0.078		ITA	0.041	0.325	0.078
	MYS	0.103	0.103	0.065		MYS	0.103	0.107	0.066
	PHL	0.035	0.032	0.008		PHL	0.036	0.031	0.008
	RUS	0.020	0.108	0.022		RUS	0.021	0.107	0.021
	SAU	0.035	0.210	0.053		SAU	0.036	0.219	0.057
	SGP	0.146	0.614	0.611		SGP	0.155	0.621	0.619
	THA	0.043	0.066	0.040		THA	0.042	0.068	0.032
	TUR	0.044	0.107	0.028		TUR	0.045	0.089	0.021
	ARE	0.083	0.410	0.201		ARE	0.079	0.411	0.293
	VNM	0.052	0.024	0.022		VNM	0.054	0.024	0.022
2019	CHN	0.966	0.097	0.016					
	EGY	0.025	0.029	0.005					
	GRC	0.024	0.186	0.046					
	HKG	0.073	0.463	0.726					
	IND	0.059	0.020	0.003					
	IDN	0.068	0.039	0.006					
	ITA	0.040	0.316	0.082					
	MYS	0.105	0.108	0.068					
	PHL	0.036	0.033	0.009					
	RUS	0.021	0.110	0.023					
	SAU	0.036	0.220	0.057					
	SGP	0.152	0.620	0.643					
	THA	0.043	0.074	0.032					
	TUR	0.047	0.087	0.040					
	ARE	0.077	0.410	0.196					
	VNM	0.055	0.026	0.026					

Table 5 shows the normalized decision matrices for 2013-2019 time period. In this step, all rows of decision matrices were squared and summed, and then the value in each column was also proportioned to the sum of squares of the columns. By applying the entropy method, we firstly calculated criteria weights and then as a second step by applying TOPSIS method we evaluated the countries. In this respect, Table 6 shows the criterion weights calculated by the entropy method.

Table 6: Criterion Weights Calculated by the Entropy Method

	Year	TEU Number/10^6	National Income / Population ($)	Trade Volume / Population ($)	Year	TEU Number/10^6	National Income / Population ($)	Trade Volume / Population ($)
Criterion Weights	2013	0.3526	0.1861	0.4613	2017	0.3696	0.1891	0.4413
	2014	0.3545	0.1884	0.4571	2018	0.3703	0.1934	0.4363
	2015	0.3559	0.1879	0.4561	2019	0.3762	0.1889	0.4349
	2016	0.3561	0.1890	0.4549				

In the third step, the normalized standard matrix values were multiplied by the entropy weighting coefficients and then a weighted decision matrix was formed. In this regard, Table 7 indicates the weighted decision matrix for the years 2013-2019.

Table 7: Weighted Decision Matrix for 2013-2019

Year	Country	TEU Number/10^6	National Income / Population ($)	Trade Volume / Population ($)	Year	Country	TEU Number/10^6	National Income / Population ($)	Trade Volume / Population ($)
2013	CHN	0.336	0.0134	0.006	2014	CHN	0.338	0.015	0.006
	EGY	0.014	0.0062	0.002		EGY	0.014	0.006	0.002
	GRC	0.007	0.0417	0.018		GRC	0.007	0.041	0.018
	HKG	0.043	0.0732	0.328		HKG	0.041	0.077	0.001
	IND	0.023	0.0028	0.001		IND	0.021	0.003	0.002
	IDN	0.020	0.0069	0.003		IDN	0.021	0.007	0.003
	ITA	0.018	0.0677	0.034		ITA	0.018	0.068	0.003
	MYS	0.041	0.0209	0.030		MYS	0.041	0.022	0.033
	PHL	0.011	0.0055	0.003		PHL	0.011	0.006	0.030
	RUS	0.010	0.0304	0.012		RUS	0.010	0.027	0.011
	SAU	0.013	0.0473	0.036		SAU	0.013	0.047	0.033
	SGP	0.064	0.1085	0.305		SGP	0.063	0.110	0.293
	THA	0.016	0.0118	0.014		THA	0.017	0.011	0.013
	TUR	0.016	0.0240	0.018		TUR	0.015	0.023	0.141
	ARE	0.036	0.0808	0.089		ARE	0.037	0.083	0.010
	VNM	0.016	0.0036	0.006		VNM	0.018	0.004	0.007
2015	CHN	0.341	0.016	0.007	2016	CHN	0.342	0.017	0.006
	EGY	0.013	0.007	0.002		EGY	0.013	0.007	0.002
	GRC	0.006	0.037	0.016		GRC	0.007	0.037	0.016
	HKG	0.035	0.086	0.343		HKG	0.034	0.089	0.339
	IND	0.021	0.003	0.001		IND	0.021	0.004	0.001
	IDN	0.021	0.007	0.003		IDN	0.021	0.007	0.003
	ITA	0.017	0.062	0.033		ITA	0.017	0.063	0.033
	MYS	0.042	0.020	0.029		MYS	0.042	0.020	0.027
	PHL	0.013	0.006	0.003		PHL	0.013	0.006	0.003
	RUS	0.007	0.019	0.009		RUS	0.007	0.018	0.008
	SAU	0.014	0.042	0.028		SAU	0.013	0.040	0.023

	SGP	0.056	0.113	0.281		SGP	0.055	0.115	0.263
	THA	0.017	0.012	0.014		THA	0.017	0.012	0.014
	TUR	0.015	0.022	0.017		TUR	0.015	0.022	0.010
	ARE	0.037	0.079	0.089		ARE	0.035	0.077	0.141
	VNM	0.020	0.004	0.008		VNM	0.019	0.004	0.009
2017	CHN	0.357	0.017	0.006	2018	CHN	0.357	0.018	0.006
	EGY	0.010	0.005	0.002		EGY	0.010	0.005	0.002
	GRC	0.007	0.036	0.018		GRC	0.008	0.037	0.019
	HKG	0.033	0.088	0.333		HKG	0.030	0.088	0.312
	IND	0.021	0.004	0.001		IND	0.026	0.004	0.001
	IDN	0.025	0.007	0.003		IDN	0.022	0.007	0.003
	ITA	0.016	0.062	0.034		ITA	0.015	0.063	0.034
	MYS	0.038	0.020	0.029		MYS	0.038	0.021	0.029
	PHL	0.013	0.006	0.004		PHL	0.013	0.006	0.003
	RUS	0.007	0.020	0.010		RUS	0.008	0.021	0.009
	SAU	0.013	0.040	0.023		SAU	0.013	0.042	0.025
	SGP	0.054	0.116	0.270		SGP	0.057	0.120	0.270
	THA	0.016	0.013	0.018		THA	0.016	0.013	0.014
	TUR	0.016	0.020	0.012		TUR	0.017	0.017	0.009
	ARE	0.031	0.078	0.089		ARE	0.029	0.080	0.128
	VNM	0.019	0.005	0.010		VNM	0.020	0.005	0.010
2019	CHN	0.364	0.018	0.007					
	EGY	0.009	0.005	0.002					
	GRC	0.009	0.035	0.020					
	HKG	0.028	0.087	0.316					
	IND	0.022	0.004	0.001					
	IDN	0.026	0.007	0.003					
	ITA	0.015	0.060	0.036					
	MYS	0.039	0.020	0.030					
	PHL	0.013	0.006	0.004					
	RUS	0.008	0.021	0.010					
	SAU	0.013	0.042	0.025					
	SGP	0.057	0.117	0.280					
	THA	0.016	0.014	0.014					
	TUR	0.018	0.016	0.017					
	ARE	0.029	0.077	0.085					
	VNM	0.021	0.005	0.011					

Table 7 shows the weighted standard decision matrices for 2013-2019 time period. In order to create the matrices, we firstly calculated the weighting degrees. By dividing the sum of each column of the normalized decision matrix by the sum of the other columns, the weighting degree was obtained. Then, each element of the normalized decision matrix was multiplied by the weight degree found by the Entropy method and weighted standard decision matrices were thus formed.

In the fourth step, we created ideal positive (A^+) and ideal negative (A^-) solution sets. The number of containers (TEU) handled, national income and trade volume values of the Belt and Road countries were maximized in the method. Table 8 indicates the positive ideal A^+ and negative ideal A^- solution sets for the years 2013-2019.

Table 8: The Positive Ideal A^+ and Negative Ideal A^- Solution Sets

Year		TEU Number/10^6	National Income / Population ($)	Trade Volume / Population ($)
2013	A^+	0.3357	0.1085	0.3280
	A^-	0.0067	0.0028	0.0013
2014	A^+	0.3381	0.1096	0.2934
	A^-	0.0072	0.0030	0.0012
2015	A^+	0.3413	0.1134	0.3427
	A^-	0.0065	0.0033	0.0012
2016	A^+	0.3419	0.1151	0.3389
	A^-	0.0068	0.0035	0.0011
2017	A^+	0.3570	0.1162	0.3326
	A^-	0.0073	0.0038	0.0012
2018	A^+	0.3574	0.1201	0.3125
	A^-	0.0078	0.0036	0.0012
2019	A^+	0.3635	0.1171	0.3159
	A^-	0.0080	0.0038	0.0012

In Table 8, while we selected the largest value in each column in the weighted decision matrix for the ideal positive solution set, we chose the smallest value in each column for the ideal negative solution set. Then, we calculated the deviations (S^+ ve S^-) of each decision point from the positive ideal solution and the negative ideal solution points. Table 9 shows the positive and negative ideal solution sets for the years 2013-2019 for each country.

Table 9: Distance Measures between the Alternatives for 2013-2019

Country		Year						
		2013	2014	2015	2016	2017	2018	2019
CHN	S^+	0.335	0.302	0.350	0.347	0.341	0.323	0.324
	S^-	0.329	0.331	0.335	0.335	0.350	0.350	0.356
EGY	S^+	0.469	0.447	0.485	0.483	0.492	0.480	0.486
	S^-	0.008	0.008	0.007	0.007	0.003	0.002	0.002
GRC	S^+	0.457	0.436	0.474	0.472	0.477	0.464	0.469
	S^-	0.042	0.042	0.037	0.037	0.036	0.038	0.037
HKG	S^+	0.295	0.418	0.307	0.309	0.325	0.329	0.337
	S^-	0.336	0.081	0.353	0.349	0.343	0.323	0.326
IND	S^+	0.465	0.444	0.481	0.479	0.485	0.469	0.478
	S^-	0.016	0.014	0.015	0.014	0.013	0.018	0.014
IDN	S^+	0.464	0.442	0.479	0.477	0.481	0.471	0.474
	S^-	0.014	0.015	0.015	0.015	0.018	0.014	0.018
ITA	S^+	0.435	0.435	0.451	0.449	0.456	0.445	0.451
	S^-	0.074	0.065	0.067	0.068	0.067	0.068	0.066
MYS	S^+	0.428	0.405	0.443	0.443	0.451	0.439	0.443
	S^-	0.048	0.050	0.048	0.047	0.044	0.044	0.045
PHL	S^+	0.471	0.432	0.485	0.483	0.489	0.476	0.482
	S^-	0.005	0.029	0.007	0.007	0.007	0.006	0.007
RUS	S^+	0.460	0.441	0.482	0.481	0.486	0.473	0.479
	S^-	0.030	0.026	0.017	0.016	0.019	0.019	0.019
SAU	S^+	0.439	0.421	0.460	0.462	0.469	0.455	0.462
	S^-	0.057	0.054	0.048	0.043	0.043	0.046	0.045
SGP	S^+	0.272	0.275	0.292	0.297	0.309	0.303	0.309
	S^-	0.326	0.316	0.305	0.288	0.295	0.297	0.305
THA	S^+	0.458	0.437	0.473	0.471	0.476	0.466	0.472
	S^-	0.018	0.018	0.019	0.019	0.021	0.018	0.018
TUR	S^+	0.453	0.367	0.470	0.473	0.478	0.468	0.468
	S^-	0.029	0.141	0.026	0.022	0.022	0.018	0.023
ARE	S^+	0.384	0.414	0.398	0.367	0.409	0.379	0.408
	S^-	0.121	0.086	0.120	0.161	0.117	0.149	0.114
VNM	S^+	0.466	0.442	0.477	0.475	0.480	0.468	0.472
	S^-	0.011	0.012	0.015	0.015	0.015	0.015	0.016

Table 9 shows the distances of the alternatives from the positive and negative ideal solution for the years 2013-2019. In the last step of the method, we calculated the relative proximity of each decision point to the ideal solution (C) shown in Table 10. By arranging C^+ values in a descending order, we determined the performance rankings of the countries. The country with the highest C^+ value is the country to be

selected first, while the country with the lowest C^+ value is the country to be selected last.

Table 10: Relative Proximity to the Ideal Solution

Country	Value	Year 2013	2014	2015	2016	2017	2018	2019
CHN	C_1^+	0.495	0.523	0.489	0.492	0.507	0.520	0.523
EGY	C_2^+	0.017	0.018	0.015	0.014	0.006	0.005	0.005
GRC	C_3^+	0.085	0.088	0.072	0.072	0.071	0.075	0.072
HKG	C_4^+	0.533	0.162	0.535	0.530	0.514	0.496	0.492
IND	C_5^+	0.033	0.030	0.030	0.029	0.027	0.037	0.029
IDN	C_6^+	0.030	0.032	0.030	0.031	0.036	0.029	0.037
ITA	C_7^+	0.145	0.131	0.130	0.132	0.129	0.133	0.128
MYS	C_8^+	0.101	0.110	0.099	0.096	0.089	0.092	0.093
PHL	C_9^+	0.011	0.063	0.014	0.014	0.013	0.013	0.013
RUS	C_{10}^+	0.061	0.055	0.035	0.032	0.037	0.038	0.038
SAU	C_{11}^+	0.115	0.114	0.094	0.086	0.083	0.091	0.088
SGP	C_{12}^+	0.545	0.535	0.511	0.492	0.488	0.495	0.497
THA	C_{13}^+	0.039	0.039	0.038	0.038	0.042	0.037	0.037
TUR	C_{14}^+	0.059	0.278	0.053	0.045	0.043	0.037	0.046
ARE	C_{15}^+	0.240	0.172	0.231	0.305	0.222	0.283	0.218
VNM	C_{16}^+	0.022	0.027	0.030	0.030	0.030	0.031	0.033

Table 10 shows the relative proximity values of the countries to the ideal solution for 2013-2019. In Table 11, the performance rankings of the countries are created according to the size of their C^+ values.

Table 11: Performance Rankings between 2013-2019

Rank	2013 C Value	Country	2014 C Value	Country	2015 C Value	Country	2016 C Value	Country	2017 C Value	Country	2018 C Value	Country	2019 C Value	Country
1	0.545	SGP	0.535	SGP	0.535	HKG	0.530	HKG	0.514	HKG	0.520	CHN	0.523	CHN
2	0.533	HKG	0.523	CHN	0.511	SGP	0.492	SGP	0.507	CHN	0.496	HKG	0.497	SGP
3	0.495	CHN	0.278	TUR	0.489	CHN	0.492	CHN	0.488	SGP	0.495	SGP	0.492	HKG
4	0.240	ARE	0.172	ARE	0.231	ARE	0.305	ARE	0.222	ARE	0.283	ARE	0.218	ARE
5	0.145	ITA	0.162	HKG	0.130	ITA	0.132	ITA	0.129	ITA	0.133	ITA	0.128	ITA

6	SAU 0.115	ITA 0.131	MYS 0.099	MYS 0.096	MYS 0.089	MYS 0.092	MYS 0.093
7	MYS 0.101	SAU 0.114	SAU 0.094	SAU 0.086	SAU 0.083	SAU 0.091	SAU 0.088
8	GRC 0.085	MYS 0.110	GRC 0.072	GRC 0.072	GRC 0.071	GRC 0.075	GRC 0.072
9	RUS 0.061	GRC 0.088	TUR 0.053	TUR 0.045	TUR 0.043	RUS 0.038	TUR 0.046
10	TUR 0.059	PHL 0.063	THA 0.038	THA 0.038	THA 0.042	IND 0.037	RUS 0.038
11	THA 0.039	RUS 0.055	RUS 0.035	RUS 0.032	RUS 0.037	TUR 0.037	THA 0.037
12	IND 0.033	THA 0.039	VNM 0.030	IDN 0.031	IDN 0.036	THA 0.037	IDN 0.037
13	IDN 0.030	IDN 0.032	IDN 0.030	VNM 0.030	VNM 0.030	VNM 0.031	VNM 0.033
14	VNM 0.022	IND 0.030	IND 0.030	IND 0.029	IND 0.027	IDN 0.029	IND 0.029
15	EGY 0.017	VNM 0.027	EGY 0.015	PHL 0.014	PHL 0.013	PHL 0.013	PHL 0.013
16	PHL 0.011	EGY 0.018	PHL 0.014	EGY 0.014	EGY 0.006	EGY 0.005	EGY 0.005

The closer the solutions are to the ideal solution, the better they are. Table 11 indicates the ranking results. According to the ranking results, Singapore ranked first in 2013 and 2014, second in 2015, 2016 and 2019, and third in 2017 and 2018, thus making it the best performing country. China became the country with the second best performance, ranking third in 2013, 2015 and 2016, second in 2014 and 2017, and first in 2018 and 2019. Hong Kong ranked second in 2013 and 2018, fifth in 2014, first in 2015, 2016 and 2017, and third in 2019, making it the second-best country together with China. The

United Arab Emirates ranked fourth in 2013-2019 and was one of the high performing countries. Italy was one of the countries with high performance, ranking sixth in 2014 and fifth in other years. Malaysia ranked sixth in 2015-2019, seventh in 2013 and eighth in 2018, and thus was among the high performing countries.

Saudi Arabia ranked sixth in 2013 and seventh in 2014-2019, and was among the medium-level performing countries. Greece was ninth in 2014 and eighth in other years, and was also among the medium-level performing countries. Turkey ranked tenth in 2013, third in 2014, eleventh in 2018, and ninth in other years, and was among the countries with a medium-level performance as well. While Russia ranked ninth in 2013 and 2018, tenth in 2019, and eleventh in 2014-2017, Thailand ranked tenth in 2015-2017, eleventh in 2013 and 2019, and twelfth in 2014 and 2018. Both of them were among the countries with a medium performance.

Indonesia was one of the underperforming countries, ranking twelfth in 2016, 2017 and 2019, thirteenth in 2013-2015, and fourteenth in 2018. India ranked tenth in 2018, twelfth in 2013 and fourteenth in other years. Vietnam ranked twelfth in 2015, thirteenth in 2016-2019, fourteenth in 2013 and fifteenth in 2014. The Philippines ranked tenth in 2013 and 2015, fifteenth in 2016-2019, and sixteenth in 2014. They all were among the countries with low performance. Egypt was the lowest performing country, ranking fifteenth in 2013 and sixteenth in 2014-2019. Table 12 indicates performance changes of countries in more detail.

Table 12: Performance Changes of Countries between 2013-2019

Country	2013	2014	Increase/Decrease	2015	Increase/Decrease	2016	Increase/Decrease	2017	Increase/Decrease	2018	Increase/Decrease	2019	Increase/Decrease
CHN	0.495	0.523	↑	0.489	↓	0.492	↑	0.507	↑	0.520	↑	0.523	↑
EGY	0.017	0.018	↑	0.015	↓	0.014	↓	0.006	↓	0.005	↓	0.005	__
GRC	0.085	0.088	↓	0.072	↓	0.072	__	0.071	↓	0.075	↑	0.072	↓
HKG	0.533	0.162	↓	0.535	↑	0.530	↓	0.514	↓	0.496	↓	0.492	↓
IND	0.033	0.030	↓	0.030	__	0.029	↓	0.027	↓	0.037	↑	0.029	↓
IDN	0.030	0.032	↑	0.030	↓	0.031	↑	0.036	↑	0.029	↓	0.037	↑
ITA	0.145	0.131	↓	0.130	↓	0.132	↑	0.129	↓	0.133	↑	0.128	↓
MYS	0.101	0.110	↑	0.099	↓	0.096	↓	0.089	↓	0.092	↑	0.093	↑
PHL	0.011	0.063	↑	0.014	↓	0.014	__	0.013	↓	0.013	__	0.013	__
RUS	0.061	0.055	↓	0.035	↓	0.032	↓	0.037	↑	0.038	↑	0.038	__
SAU	0.115	0.114	↓	0.094	↓	0.086	↓	0.083	↓	0.091	↑	0.088	↓
SGP	0.545	0.535	↓	0.511	↓	0.492	↓	0.488	↓	0.495	↑	0.497	↑
THA	0.039	0.039	__	0.038	↓	0.038	__	0.042	↑	0.037	↓	0.037	__
TUR	0.059	0.278	↑	0.053	↓	0.045	↓	0.043	↓	0.037	↓	0.046	↑
ARE	0.240	0.172	↓	0.231	↑	0.305	↑	0.222	↓	0.283	↑	0.218	↓
VNM	0.022	0.027	↑	0.030	↑	0.030	__	0.030	__	0.031	↑	0.033	↑

Table 12 shows the change in the performances of the Belt and Road countries over the years. According to the methods applied, performance changes were determined according to the results of the performance evaluation of the countries between 2013-2019. Table 13 indicates the ranking changes of countries between 2013-2019.

Table 13: Ranking Changes of Countries between 2013-2019

Country	2013	2014	Increase/Decrease	2015	Increase/Decrease	2016	Increase/Decrease	2017	Increase/Decrease	2018	Increase/Decrease	2019	Increase/Decrease
CHN	3	2	↑	3	↓	3	—	2	↑	1	↑	1	—
EGY	15	16	↓	15	↑	16	↓	16	—	16	—	16	—
GRC	8	9	↓	8	↑	8	—	8	—	8	—	8	—
HKG	2	5	↓	1	↑	1	—	1	—	2	↓	3	↓
IND	12	14	↓	14	—	14	—	14	—	10	↑	14	↓
IDN	13	13	—	13	—	12	↑	12	—	14	↓	12	↑
ITA	5	6	↓	5	↑	5	—	5	—	5	—	5	—
MYS	7	8	↓	6	—	6	—	6	—	6	—	6	—
PHL	10	16	↓	10	↑	15	↓	15	—	15	—	15	—
RUS	9	11	↓	11	—	11	—	11	—	9	↑	10	↓
SAU	6	7	—	7	—	7	↓	7	—	7	↑	7	↓
SGP	1	1	—	2	↓	2	—	3	↓	3	—	2	↑
THA	11	12	↓	10	↑	10	—	10	—	12	↓	11	↑
TUR	10	3	↑	9	↓	9	—	9	—	11	↓	9	↑
ARE	4	4	—	4	—	4	—	4	—	4	—	4	—
VNM	14	15	↓	12	↑	13	↓	13	—	13	—	13	—

Table 13 shows the ranking changes of countries between 2013-2019.

CONCLUSION

The purpose of this research is to evaluate the performance rankings of Belt and Road countries in terms of income, logistics and trade values. With this purpose in mind, the countries that have a seaway connection and handle 5 million TEU containers annually within the scope of the Belt and Road project were chosen and examined in the study. We implmented Integrated Entropy-TOPSIS approach to evaluate the performance of countries by using 3 criteria according to literature and data availability: (Handled Container Amount (TEU), National Income ($) / Population, Total Trade Volume ($) / Population).

The most important criterion for the results of each year in Table 6 following the steps of the entropy method was found to be the Total Trade Volume ($) / Population. Also National Income / Population ($) criterion was determined to be the least important criterion. Then, TOPSIS method was used to rank the countries.

As an island nation, Singapore earns most of its income through logistics and trade. Therefore, the reason behind Singapore's bening the best country in performance evaluation was due to its being the second best in the amount of container handling and also the high rate of total trade per person. China ranked high due to being the pioneer of the Belt and Road Initiative. In addition, due to the high population of China, per capita national income is low. However, China became the second best country in performance evaluation because of the increase in trade as a result of being the world's manufacturing center

and having the highest amount of container transportation in the world. Hong Kong, being the third best country in terms of container handling and having high rate of total trade per capita, was successful in performance evaluation due to factors such as high per capita national income.

The United Arab Emirates was successful in the performance evaluation thanks to its high income obtained from the crude oil trade, the high amount of container handling, and the low population compared to the income. Due to factors such as the high per capita national income, the high trade rate, and also being the gateway to Europe in container transportation, the European Union member Italy was successful in the performance evaluation. Malaysia was successful in the evaluation due to the high amount of container handling and trade per capita.

According to the results obtained in the present study, the fact that the high performing countries have 21% of the world trade volume and the port capacity where large merchant ships can dock (TEU handling figures) have provided an advantage for them to be more successful. In addition, the low population of some countries has caused their per capita income to be high, leading them to be among the successful countries. The location of the frequently used transportation networks on the routes of these countries have also caused them to increase their performance and to differentiate positively from other selected countries.

Saudi Arabia was moderately successful in its performance evaluation due to its high income from crude oil trade and average per capita trade, per capita national income, and number of containers handled. Due to the effect of Greece's being a member of the EU, the national income per capita was high, but the per capita trade value was at a medium level, so its performance was at a medium level in its performance evaluation.

Thanks to the logistics potential of Turkey with its location that connects Asia and Europe, it was moderately successful in its performance evaluation due to the high number of containers handled and the average national income per capita. Due to the fact that Russia's per capita national income and trade value was at a medium level, its performance was moderately successful. Thailand was moderately successful in its performance evaluation because of the high number of containers handled, but medium level of per capita national income and trade value.

Semi-peripheral countries with a moderate performance in the evaluation benefit from the trade volume of the central countries in their capacity ratio. Countries can improve their performance by increasing their share of trade with the potential benefits of investments made and to be made in logistic infrastructures.

The performance of Indonesia, India, Vietnam, Philippines and Egypt was low due to the high number of containers handled, but low level of per capita national income and trade value.

According to the results of the present study, the political risks of low performing countries may have affected their successful performance. Underperforming countries can display a successful performance by focusing on value-added trade activities and increasing use of their logistic capacity. In addition, these countries can increase their trade share by participating in regional trade integrations to avoid the disadvantages of globalization.

In terms of country performance evaluation criteria, similar findings have been found out between the results of the current study and the studies conducted by Li et al. (2021) and An et al. (2020). For example, the per capita national income criterion was the most important criterion in all of the studies.

There are some limitations in this study. The findings are restricted to the 16 countries with a container handling capacity of 5 million TEU on the Road scale of the Belt and Road Initiative. Thus, the results cannot be generalized to other countries. Further research with different countries may enable us to obtain varied results regarding their performance evaluation. Future studies would expand the scope of their study by incerasing the number of Belt and Road countries. Also, the use of selected criteria would affect the evaluation of their performance, as there is missing data on each criterion. A fruitful area of inquiry would be to evaluate the performance of Belt and Road countries by using multi-criteria decision-making methods. Such studies would enable better understanding of their performance of countries and would bring more depth to the results of this study.

As a result, the results represent a cruical step forward in better understanding the performance evaluation of Belt and Road countries. Thus, the current study paves the way for a deeper examination into the research area. Implications would be drawn by decision makers and other reseearchers interested in this line of research area.

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CHAPTER 7

ANALYSIS OF AQUACULTURE PRODUCTION TRENDS IN OECD AND KEY PARTNER COUNTRIES

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INTRODUCTION

World fishery resources (refers to all aquatic organisms including fish, molluscs, crustaceans and aquatic plants) that comes from fishing and aquaculture reached 178.6 million metric tons in 2018, of which 96.4 million metric tons (54%) came from fishing (54%) and 82.1 million metric tons (46%) from aquaculture (Food and Agriculture Organization [FAO], 2018). According to estimations based on statistical data, it is predicted that world fisheries and aquaculture productions will be equal until 2030.

Fisheries resources have high protein food with their polyunsaturated fatty acids in their structure, they meet the body's basic nutritional needs, and they contain one of the most important nutrients in maintaining a healthy life with its positive effect on human physiology and metabolic functions, (FAO, 2018). As the fish production from fishing have been limited and the human population continues to increase on a global scale, finding alternative ways to feed the growing population is one of the most important challenges faced worldwide. At that point, aquaculture has been emerged to compensate the growing demand for animal protein in the world. Reports published by the Organization for Economic Cooperation and Development (OECD) and United Nations Food and Agriculture Organization (FAO, 2018) point out that aquaculture sector has been the fastest and continuously growing sector among all food sectors. It has increased approximately 12 times in the last 50 years, with an annual average increase of 8.8% in the world. The sector also

contributes the income of the peoples significantly, such that directly and indirectly employs approximately 26.1 million full-time workers, including manufacture of fish processing equipment, packaging, marketing and distribution in worldwide. China is the leader in world fisheries production, accounting for 35% of the total production (62.2 million tons), followed by Indonesia, India, Vietnam and Peru.

Three main factors are effective in the growth of aquaculture development; these are such as 1) continued growth of freshwater aquaculture in volume and value chains, 2) advances in fish nutrition, feed formulation, genetic studies and alternative aquaculture, 3) advances in production technology and the potential to provide industrial services. This has created a more integrated situation in the Global food system. Due to the growth of aquaculture, it is easier for consumers in low- and high-income countries to have year-around access to aquaculture rich in protein and micronutrients. Industry produces much more than fish, shellfish and algae for direct human consumption. It also contributes to a range of ecosystem services by producing products used in food processing, feed, fuel, cosmetics, pharmaceuticals and various other industrial products (Rosamond et al 2021).

The Organization for Economic Co-operation and Development (OECD) is an international organization that works to build better policies for better lives. Its goal is to shape policies that foster prosperity, equality, opportunity and well-being for all. Together with governments, policy makers and citizens, it has been established

evidence-based international standards and find solutions to a range of social, economic and environmental challenges. OECD has 37 member countries span the globe, from North and South America to Europe and Asia-Pacific. The last country to join the OECD was Colombia, in April 2020. Accession negotiations began with Costa Rica in April 2015, and in May 2020, the Council invited Costa Rica to become an OECD member. The OECD also works with some of the world's largest economies: Brazil, China, India, Indonesia, and South Africa, which are OECD Key Partners. They participate in the OECD's daily work, bringing useful perspectives and increasing the relevance of policy debates.

METHOD

There was a report dealing with fisheries and aquaculture status of OECD and key partner countries in 2016 (OECD Review of Fisheries 2017 General Survey of Fisheries Policies), but due to the dynamic structure of aquaculture sector, we tried to evaluate the aquatic production trends of OECD and key partner countries based on the up to date available data that derived from FAO statistics. We considered the aquaculture productions of those countries from 2010 to 2019 years. Evaluation was carried out by the following manner: First, a descriptive methodology was used to explore the "Annual average change in production (ton ± SE)" and "Annual average changing values (%)" of each country. Second, the significant level of annual average change in production was determined by regression analysis. Third, hierarchical clustering based on correlation was used to classify

the countries in terms of trends in aquaculture production of OECD and key partner countries. Forth, a Growth Curve Modeling (GCM) approach was used just only for OECD countries to determine whether the overall increasing in the aquaculture was in linear fashion during the year 2010 to 2019. GCM was carried out by using "lavaan" package in R software.

RESULTS

In Table 1, aquaculture production values (tons) in OECD and key partner countries from 2010 to 2019 and the annual average change in production during this period (ton ± SE) and annual average change values (%) were given. When all OECD countries are taken into account, it is seen that there is an annual average increase of 2.74% in aquaculture production in the relevant period. While the change in key countries is increasing at the level of 5.91%, similarly, when OECD and key countries are considered together, it is seen that the change in production is at the level of 5.64%. In other words, the rate of increase in aquaculture in key countries is slightly more than twice the rate of increase in OECD countries.

Countries with an average annual increase in aquaculture production (from largest to smallest) were; Iceland (57.25%), Slovakia (28.30%), Slovenia (17.59%), Indonesia (15.32%), Turkey (12.15%), Columbia (11.28%), India (10.58%), Mexico (9.92%), Chile (9.73%), Estonia (8.53%), S. Africa (8.15 %), Portugal (6.64%), Switzerland (6.24%), Brazil (4.57%), Poland (4.54), China (4.31%), Norway (4.25 %) %), Lithuania (3.17 %), Finland (2.99 %), Spain (2.20 %), Hungary (2.13

%), Australia (2.11 %), Canada (1.53%), Denmark (1.11 %), Latvia (1.09), UK (0.90), Sweden (0.80),

Greece (0.62 %), New Zealand (0.36 %), Czechia (0.27 %), and Germany (0.01 %).

Table 1. Aquaculture Production Values (tons), Annual Average Change in Production (ton ± SE), and Annual Average Changing Values (%) in OECD and Key Partner Countries from 2010 to 2019.

	Year										**Annual Average Change in Production (ton ± SE)**	**Annual Average Changing Values (%)**	**P= 0.05**
Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019			
Australia	73827	73127	78992	76417.00	73678	83725	92450	89825	96799	89453	2537.3± 499.98	2.12	***
Belgium	539	101	277	212	214	82	44	75	111	86	-34.26 ± 12.45	-8.40	n.s
Canada	162341	169706	184910	168015	139732	187374	200765	191616	191373	187226	3364± 1761	1.53	n.s
Chile	713241	969539	1075547	1045718	1227359	1057742	1050117	1219747	1287233	1407286	54757 ± 11469	9.73	***
Colombia	80367	83681	89654	89398	92002	95857	106685	118485	132756	171025	8238.3± 1506.6	11.28	***
Costa Rica	26839	27714	27287	30352	26766	23560	23370	22280	23160	23250	-687.07± 195.7	-1.34	**
Czechia	20420	21010	20763	19357	20135	20200	20952	21685	21751	20986	119.64±73.69	0.28	n.s
Denmark	36175	35918	34586	37707	34382	35867	36337	37498	36453	40221	315.72± 160.94	1.12	n.s

Estonia	573	388	581	733	870	799	868	870	944	1062	61.04 ± 9.56	8.53	***
Finland	11772	11275	12659	13613	13465	14877	14412	14587	14164	15296	396.29± 69.11	2.99	***
France	203409	193662	205152	200401	180390	163353	180611	188606	187465	196151	-1623.3± 1376.4	-0.36	n.s
Germany	40694	39141	26360	25289	26032	29909	—	35979	34196	40756	408.76± 761.16	0.02	n.s
Greece	121244	110809	110973	114000	104663	107162	123707	125525	132365	128822	1960.4± 886.3	0.63	n.s
Hungary	14245	15584	15133	14918	15326	17337	16248	18258	17852	17283	392.99± 81.97	2.13	**
Iceland	5050	508	7431	7053	8434	8383	15129	20859	19185	33959	2922.6± 500.48	57.25	***
Ireland	46490	44266	36102	34198	31200	39650	40244	45433	36896	37914	-336.55± 570.98	-1.84	n.s
Israel	19895	20817	20342	22252	20166	19640	18914	17997	17025	16950	-456.45± 114	-1.48	**
Italy	153494	164151	137041	140879	148730	148763	157000	157000	143338	143600	-524.52± 972.17	-0.64	n.s
Japan	1151101	907972	1073821	1027951	1021849	1105652	1068034	1023192	1034920	943748	-6222± 8042.9	-1.80	n.s
Latvia	549	546	575	643	686	863	788	808	830	609	26.09 ± 10.97	1.09	n.s
Lithuania	3191	3280	3582	4211	3836	4450	4393	3749	3750	4202	87.17 ± 41.4	3.17	n.s
Mexico	126238	137128	143747	111500	194230	211622	221327	243307	247222	251242	16608 ± 2375.4	9.90	***

Table 1. (Continued)

	Year										Annual Average Change in Production (ton ± SE)	Annual Average Changing Values (%)	P=0.05
Country	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019			
Netherlands	67040	43895	46224	46620	63084	62795	62185	52185	53335	46350	-266.18±1006.8	-3.09	n.s
New Zealand	110592	117266	100161	97123	109874	91275	109016	116530	104549	114582	277.67±1007.6	0.36	n.s
Norway	1019802	1143893	1321119	1247865	1332497	1380890	1326216	1308634	1355117	1453042	33932±8224.8	4.25	**
Poland	30751	29037	32261	35208	40110	36971	38293	38800	43361	44719	1604.8±214.15	4.54	***
Portugal	8225	9165	10318	10067	11339	9563	9787	12509	13991	13691	553.42±117.23	6.65	**
Slovakia	702	834	1311	1106	1231	1309	2169	2646	2224	2688	227.55±31.52	28.29	***
Slovenia	778	1397	1154	1226	1396	1617	1859	1750	1944	2144	128.62±16.63	17.56	***
Spain	252352	271963	264163	223710	282242	289821	283831	311032	347825	308033	8814.8±2516.9	2.21	**
Sweden	10644	13441	13757	13366	12899	12020	15747	14793	13095	11502	101.48±171.57	0.81	n.s
Switzerland	1261	1466	1471	1593	1593	1593	1733	1733	1843	2048	69.41±7.41	6.24	***
Turkey	167721	188890	212805	233864	234302	238964	250331	273477	311681	371494	18490±2269.5	12.15	***
UK	201364	198968	205595	203263	214707	211749	194492	222611	184932	219500	732.01±1335.4	0.90	n.s
USA	496699	397292	420386	429011	421189	426014	444698	439698	466174	490305	3473.2±3532.8	-0.13	n.s
OECD-total	***5379625***	***5447830***	***5936240***	***5728839***	***6110608***	***6141448***	***6174553***	***6393779***	***6579859***	***6851225***			
Brazil	411777	436084	480880	477634	564222	578373	542977	565176	581618	600280	20284±3053.9	4.58	***
China	47789757	49147606	52082586	55029058	57320504	59368942	62318378	64358481	66135059	68423859	2.36E06±49371	4.32	***
India	3790	3677	42139	45552	4893	5263	57020	6184	7181	7800	4.50E05	10.5	**

	021	584	80	09	002	002	02	869	302	300	± 35264	8	*
Indonesia	6277924	7937072	9599765	13301408	14375287	15649311	16002319	16118238	15771806	15893400	1.11E06 ± 1.91E05	15.32	***
South Africa	5148	5343	5927	6613	7222	6730	8094	6338	7868	9344	372.39 ±76.40	8.15	**
Key Countries-total	***58274627***	***61203689***	***66383138***	***73369922***	***77160237***	***80866358***	***84573770***	***87233102***	***89677653***	***92727183***			

Countries with a decrease (from largest to smallest) were; Belgium (8.40 %), Netherlands (3.08 %), Ireland (1.84%), Japan (1.80 %), Israel (1.48%), Costa Rica (1.33%), Italy (0.64 %), France (0.35 %), and USA (0.12 %). Although there were increases and decreases in the amount of aquaculture production according to countries, regression analyses showed that some of these values were not significant ($p>0.05$, ns), significant ($p\leq 0.05$, *), very significant ($p\leq 0.01$) for countries. , **) and highly significant ($p\leq 0.001$, ***) levels (Table 1).

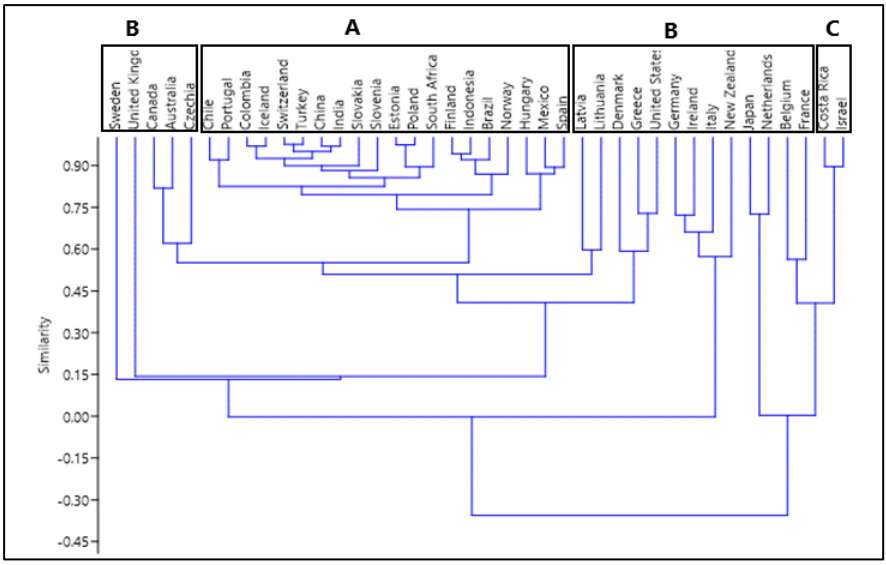

Figure 1. Hierarchical Clustering for Aquatic Productions of OECD and Key Partner Countries. Letter "A" Indicates the Countries (Called As "Increasing Countries") That Increasing In The Production was Positive and Statistically Significant (P<0.05), Letter "B" Indicates No Significant Change In Production Both Positive Or Negative Way (Called As "Stable Countries"), and Letter "C" Indicates There was A Negative and Statistically Important (P<0.05) Trend (Called As "Decreasing Countries") In Production Between 2010 and 2019 Years.

Growth curve modeling (GCM) just for OECD countries yielded a 28743.30 ± 5862.34 (estimate ± se) estimate of slope (s), which was statistically significant from zero ($p < 0.001$). Thus, we concluded that there was positive linear change in aquatic production over time, and that from one year to the next the average amount of such growth was 28173.30 tones. The mean starting production value-intercept (i) on the assessment (year of 2010) was 6690.89 ± 29356.25 tons (i ± se), and based on the non-statistically significant positive covariance ($r= 0.21$; $p > 0.05$), we inferred that whether higher or lower starting production values were not affected on the linear growth in aquatic production of the countries (Figure 2). However, this is not meant that

there is not any relationship between the starting year and change over time. Effects of different starting years on the linear growth was shown on the Figure 2.

As can be clearly seen from Figure 3, both the slope values (s), that is, the average production value between consecutive years, and their standard error (se) values also increase with the increase in the starting years, and this increase has gradually become exponential. It was observed that the exponential growth became more pronounced, especially when the standard error values were taken into account. This situation, for example, was 58862.34 when the starting year of 2010 was taken, while it was 18297.85, that is, 3 times when the starting year of 2015 was taken. This result is a clear indication that there have been serious leaps in aquaculture production in some countries in recent years (Figure 3).

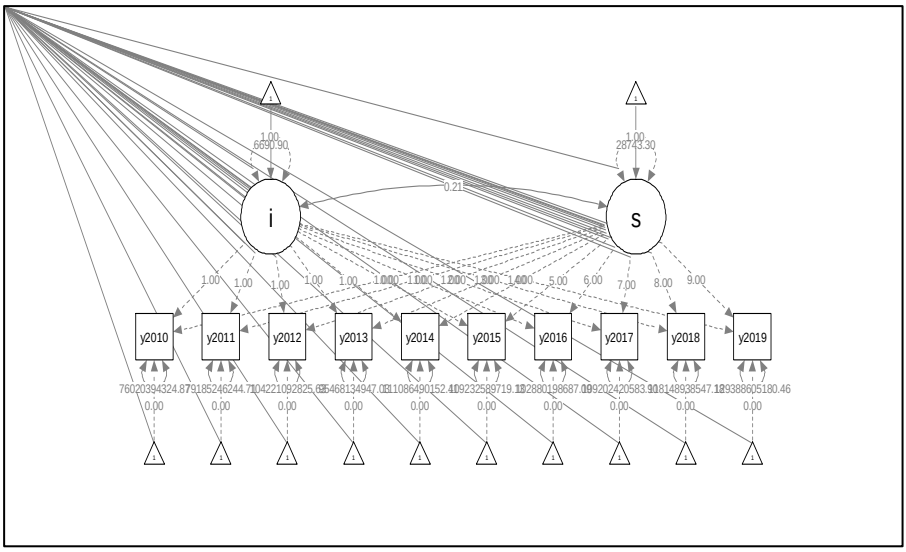

Figure 2. Graphical Representation of Growth Curve Modeling (GCM) Just For OECD Countries. The Letter "S" And "I" Indicate The Slope and Intercept of The GCM Model.

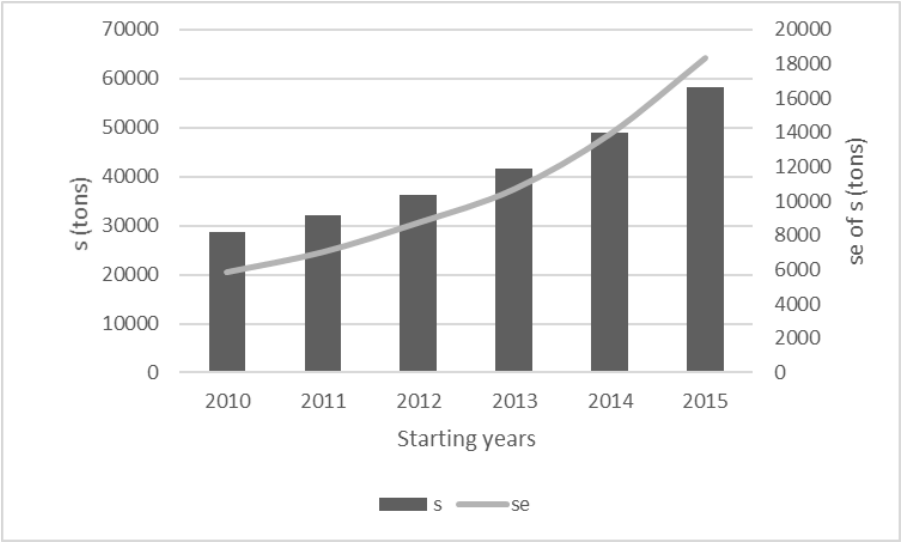

Figure 3. Effects of Different Starting Years on The Linear Growth in Aquatic Production (S= Slope, Se= Standard Error of S)

OVERVIEW OF THE AQUACULTURTE SECTOR ACCORDING TO THE COUNTRIES WITH INCREASING PRODUCTION

Iceland:

Production of the main species is salmon, Arctic char and rainbow trout. The amount of farmed fish produced has increased fourfold in the last 10 years, reaching 21 thousand tons in 2018. The actual main growth was in salmon farming, which was 292 tons in 2008 increased to 13.5 thousand tons in 2018. It has been stable over the last ten years. About 5 thousand tons were produced in 2018 compared to 3.1 thousand tons in 2008. While rainbow trout farming peaked at 4,600 tons in 2017, production decreased to 295 tons in 2018.

Slovakia:

Aquaculture production in Slovakia was 2.2 thousand tons in 2018. It comes from only freshwater species. The main species is Rainbow trout accounting for 51% of the total production produced by the Slovak aquaculture sector. North African catfish accounts for the second largest share of production, 37% by weight and 30% of production value. This is followed by carp, which accounts for 15% of the total production. In 2019, the Slovak aquaculture sector contributed to the economy with a gross added value of £8.6 million.

Slovenia:

Slovenian aquaculture sector are mainly Sea Bass, Sea Bream and Mussel. The aquaculture sector contributed to the Slovenian economy in 2018 with GVA, EBIT and Net profit of €0.1 million, €-1.3 million

and €-1.3 million. The most cultivated species are mussel and sea bass.

Indonesia:

Indonesia's aquaculture industry dominated by freshwater fish. Cultured species are tilapia, clarias catfish, carp and pangasius catfish. Total production in 2017 was reported as 3 277 k MT. This is followed by shrimp and dairy farming (1 621 k MT) in brackish waters. The contribution of seafood farming (excluding seaweed farming (10 547 k MT) and bivalves (50 k MT)) remains marginal (approximately 78 k MT). Shrimps are the most frequently exported farmed seafood, both by volume and value, followed by tilapia (FAO 2019). In the past five years, white-legged shrimp production (*Litopenaeus vannamei*) has more than doubled, making it the fastest growing aquaculture species (FAO 2019).

Turkey:

Total Aquaculture production in 2019 is 373.4 thousand tons. Of this, 256.9 thousand tons (68.82%) were procured from marine aquaculture facilities, and 116.4 thousand tons (31.18%) from inland fisheries facilities. The most commonly farmed species are European sea bass (*Dicentrarchus labrax*), sea bream (*Sparus aurata*) and Rainbow trout (*Oncorhynchus mykiss*). The most commonly farmed species is Rainbow Trout, accounting for 56% of all production. This is followed by sea bass and sea bream farming with 29% and 15% shares, respectively.

Colombia:

Freshwater aquaculture dominates about one-third of the total volume in the aquaculture sector. Three species make up a significant portion of production: of these, silver and red tilapia contribute about two-thirds of the total volume, while rainbow trout and white and black cachama each account for about 13%. Although shrimp is one of the main species cultivated, production has dropped to very low levels recently due to the white spot disease epidemic and unfavorable exchange rates.

India:

India accounts for 7.58% of the global production. Between 2019 and 2020, fish production reached an all-time high with 14.16 million metric tons. The fisheries sector contributes 1.24% to the gross value added (GVA) and 7.28% to the agricultural GVA. India is one of the most important countries in the world that produces fish through aquaculture. India aquaculture industry dominated by freshwater, brackish water production.. Freshwater aquaculture consists of carp culture, catfish culture, freshwater shrimp culture, pangasius culture and tilapia culture. In addition, in the brackish water sector, in aquaculture, there is a culture of shrimp varieties, especially the local giant tiger shrimp (*Penaeus monodon*) and the whiteleg shrimp (*Penaeus vannamei*). Therefore, the production of carp in freshwater and shrimp in brackish water constitutes most of the main areas of aquaculture activity.

Mexico:

According to the National Fisheries Chart data, a total of 61 species are cultivated in Mexico, of which 40 are native and 21 are of introduced or exotic origin. Among these species, finned fish such as carp, rainbow trout or salmon, mollusks such as white shrimp, oysters or oysters, and bivalves are the most produced species (OECD, 2019). White shrimp (*Penaeus vannamei*) is the most produced species, accounting for 53% of the total crustaceans produced worldwide. With a production of 53,000 tons, tilapias contribute about 20 percent of the total aquaculture production of 247,000 tons in 2018, and tilapia is the second largest species group in Mexican aquaculture.

Chile:

The Chilean aquaculture industry generated a total revenue of $11.2 billion in 2019. This amount corresponds to a compound annual growth rate (CAGR) of 13.1% between 2015 and 2019. Atlantic salmon (*Salmo salar*), Pacific salmon (*Oncorhynchus kisutch*), rainbow trout (*Onchorynchus mykiss*), Chilean blue mussel (*Mytilus chilensis*) and Gracilaria algae (*Gracilaria spp*) together account for more than 90% of aquaculture production.

Estonia:

Estonia only has freshwater aquaculture. Estonian aquaculture production is not large; it is mostly done in ponds and lakes. The main cultivated species (about 90%) is rainbow trout. Carp, sturgeon, freshwater crayfish and eel are farmed in limited quantities. In 2018

aquaculture production were calculated 944 tonnes valued €4.2 million (FAO 2018).

South Africa:

The distribution of aquaculture species in South Africa is predominantly Rainbow trout, brown trout, Koi carp, crocodile, Ornamental fish, African catfish, Mozambique and Nile tilapia and freshwater species such as Marron. While the necessary infrastructure services have been completed for species such as trout, crocodile, catfish, abalone, shrimp and oyster, there are still shortages of mussels for species such as eel, tilapia, cob, tuna and seaweed. In South Africa, abalone has an important place in aquaculture. In 2015, a total of 5418 tons (excluding seaweed) production was recorded in the aquaculture sector in South Africa, including marine and freshwater. The maritime sector was recorded at 3592 tonnes (72%) worth R 696 million (US$ 48.2 million), while the freshwater aquaculture sector was recorded at 1826 tonnes (DAFF 2015a; Britz and Venter 2016; DAFF 2017a).

Portugal:

The Portuguese aquaculture sector generated revenue of 11,768 tons in 2018, and 96 806 million Euros, an increase of approximately 8% from 2017 to 2018. Production takes place in brackish and marine waters and remained the most important, accounting for about 97% of total production until 2018. 90% of the fish production in brackish and marine waters was sea bream and turbot, which denoted 36% of the aquaculture production.

Switzerland:

The principal species of fish cultivated commercially in Switzerland are rainbow and brown trout.

Brazil:

The Brazilian Production sector produced 800,000 tons in 2019 and the estimated production value was US$1 billion. Brazilian has freshwater fish predominantly, followed by sea shrimp. Leading species cultivated by the Brazilian aquaculture sector are Tilapia (*Oreochromis niloticus*), tambaqui (*Colossoma macropomum*) and Pacific white leg shrimp (*Litopenaeus vannamei*).

Poland:

Production in Poland is provided from fresh water. Two species contributed significantly to production. These are carp and trout. Carp 48%, rainbow trout 37% and other fish species 15% are the dominant species in total aquaculture. In 2018, the value share of carp in production was 41%, while the share of rainbow trout was 40%.

China:

China is the leader in world aquaculture production, accounting for 70% of the total production (62.2 million tons) in 2018. The output per unit of aquaculture has also increased significantly. This rate increased to US$6,305/ha in 2017. In addition, the aquaculture yield increased from 4.3 t/ha to 6.6 t/ha. Major species groups included seaweed, carp, bivalves, tilapia and catfish (Edwards et al. 2019) and contributed 75% of aquaculture production in 2017.

Norway:

Salmon and rainbow trout account for the largest portion of aquaculture production in Norway, followed by cod and halibut, scallops, European lobster (sea farm) and blue mussel. Norway is one of the world's largest exporters of seafood with Atlantic salmon production. The aquaculture industry has become an important industry in Norway. Norway's total aquaculture production was 1.289. 808 tons in 2017.

Lithuania:

The most important species in terms of production weight and value is carp, accounting for 74% and 63% of the national total, respectively, in 2019. In second place is African catfish in terms of production weight. In 2019, the Lithuanian aquaculture sector produced 2311 tonnes of African catfish. Rainbow trout was the third largest species produced by the aquaculture industry, with an annual production of 182.4 tons. Rainbow trout production volume produced 4.2 thousand tons of freshwater fish in 2019, corresponding to 13.5 million Euros (FAO, 2020).

Finland:

Finland fish production consisted mainly of rainbow trout. The total production weight was almost 90% and 76% of the production value was generated by rainbow trout in 2018. There are twenty species of fish in Finland, and crayfish are grown through fry production. Finland's aquaculture sector produced 11.9 thousand tonnes of fish and fry in 2018 generating a total turnover of €79 million.

Spain:

The Spain aquaculture sector produced 329.7 thousand tons in 2018 and achieved a turnover of 719 million Euros. It corresponds to marine aquaculture, which represents more than 94% of the quantities produced, while only 6% is freshwater aquaculture in Spain in 2018. The four main species produced İn Spain in terms of production weight (European seabass, Atlantic Bluefin Tuna, Mediterranean mussel, and Gilthead seabream) and value accounting for 89% and 74% in 2018, respectively.

Hungary:

In 2018, the Hungarian aquaculture industry produced 17.9 thousand tons of fish. The value of this production was approximately €38.4 million (FAO, 2020b). Hungary produces only freshwater species. Carp is the most widely produced species, accounting for 80% of the total pond-based fish production in 2018.

Australia:

There are 10 fish species farmed in Australia and the main species are dominated by southern bluefin tuna, Atlantic salmon and barramundi. Aquaculture in Australia consists mainly of rock lobsters, tuna and abalone. In 2018, Australia produced 0.3 million tonnes of fish worth US$2248.4 million. 44% of this value came from aquaculture.

Canada:

45 species are grown commercially in Canada, including finfish, shellfish, and marine plants. The main fish species are Atlantic

Salmon, Arctic Char, Mussels, oysters and Rainbow Trout. In 2019, 187,026 tonnes of seafood worth over $1.2 billion were produced by Canada's aquaculture industry.

Denmark:

There are three main species produced in the Danish aquaculture sector. These are rainbow trout, blue mussel and European eel. The main species farmed in Denmark is rainbow trout (*Onchorhynchus mykiss*), which accounted for about 93% of the total production of 45,590 tonnes and €156 million in 2018.

Latvia:

The Latvian aquaculture sector mainly consists of species in freshwater aquaculture. The main species cultured in 2019 are carp, Rainbow trout and sturgeon. The total production volume in 2019 was 689 tons, corresponding to 4.4 million Euros.

UK:

In the UK Aquaculture production is dominated by salmon farming, followed by mussel production, with trout being the third most important business. In the UK Aquaculture production denotes important business for the UK, generating over 200,000 tonnes (220,000 tonnes) of fish while generating over £700 million (€793 million) in 2012. Aquaculture in UK dominated to three main species; finned fish (salmon, trout, carp, etc.), shellfish (mussels, oysters, lobsters, etc.) and seaweed (seaweed).

Sweden:

The Swedish aquaculture industry produced 13.8 thousand tons of fishery products in 2018, worth 63.5 million Euros. Most of the production is done in fresh waters and rainbow trout is the dominant species. The sector consists of 93 enterprises employing 412 people. The sales value of the production is constantly growing and saw an increase of 0.4 million euros for 2018 compared to the previous year.

Greece:

There are two main species in aquaculture in Greece, sea bass (*Dicentrarchus labrax L.*) and sea bream (*Sparus aurata L.*) accounting for about 82.5% by volume and 96.3% of the value of total aquaculture production in Turkey. . It has a dominant position that creates its reputation (FAO 2016). In 2018, the sector's sales weight and sales value increased by 130.8 thousand tons and 556.3 million Euros. In addition, there are 650 businesses with 3,584 employees for 2018 and the sector shows a financial loss of € 52.4 million despite sales growth.

New Zealand:

New Zealand aquaculture production consists of Greenshell mussel, Chinook salmon and Pacific oyster production. The primary focus of shellfish culture across New Zealand, green-shelled mussels are grown from wild seed (spittle) caught on pick-ropes or from drifting seaweed covered with mussel seeds (Ren et al. 2019). In 2019 the fishing and aquaculture industry contributed £446m to the UK economy in terms of Gross Value Added (GVA similar to GDP).

Czechia:

Carp account for 85% by weight and 82% by value of total aquaculture production. Other species farmed in the country include other carp such as grass or silver carp, as well as rainbow and brook trout. Rainbow trout has the second highest share in production value with 7% and 4% weight shares.

Germany:

In German aquaculture sector mainly produced Blue mussel, salmonids (trout and char) and carp are the main species. The production of blue mussels was 15 871 tonnes in 2018. In Germany, Carp and salmonids together have a share of more than 80% of the total volume of freshwater fish production. In 2018 of salmonids were produced 4 746 tonnes in 2018.

OVERVIEW OF THE AQUACULTURTE SECTOR ACCORDING TO THE COUNTRIES WITH DECREASING PRODUCTION

Costa Rica:

In Costa Rica the main freshwater species are tilapia, rainbow trout and freshwater shrimp. Costa Rica, exports increased by 42% between 2007 and 2017, while imports increased by 338% in total. The increase in imports of fish (tilapia and pangasius catfish) from Asia between 2013 and 2017 resulted in a decrease in tilapia production. In addition, the disease appearing in shrimp farming reduced production by about 50 percent between 2009 and 2015.

Israel:

In 2017, fish and aquaculture imports amounted to US$627.5 million, compared to US$19.5 million in exports. Nile tilapia (Oreochromis niloticus) is the most important species and was estimated at 4.5 million tons in 2018 (FAO, 2020a). The main aquaculture species produced in Israel is tilapia. Annual production in 2017 was 7 thousand tons and 6.3 thousand tons in 2018, and 5.1 thousand tons in 2019, corresponding to 45%, 44% and 41% of the total aquaculture production, respectively.

CONCLUCSION

This chapter provides an overview of trends in aquaculture production year from 2010 to 2019 for the OECD and key partner countries. The average rate of growth in aquaculture has been in a linear fashion with 28743.30 ± 5862.34 tons per year since 2010 for the OECD countries. However, there is a clear indication that there have been serious leaps (in an exponential pattern) in aquaculture production in some countries in recent years.

Considering with key partner countries, China still dominates aquaculture production with an almost 10 times higher value then OECD' s totals for the year of 2019. For Indonesia and India, these values were 2.3 and 1.13 times, respectively. But, in terms of average annual increase in aquaculture production, Iceland (57.25%), Slovakia (28.30%), Slovenia (17.59%), Indonesia (15.32%), Turkey (12.15%) are the five most producers from the year 2010 to 2019. In OECD and key partner countries, 20 of them are classified as "increasing

countries", 18 of them classified as "stable countries", 2 of them are classified as "decreasing countries" in terms of trend in production between 2010 and 2019 years.

According to the total production values, in the countries with the highest production (China, Indonesia, India), it is seen that both the total population is high, the number of cultivated species is high, and the generally grown species are freshwater fish. On the other hand, in countries where the production increase rate is high (Iceland, Slovakia, Slovenia), it is seen that the number of species grown in general is less. Therefore, after a certain period, it should be expected that the rate of increase may decrease due to resource (area, feed raw materials, etc.) constraints in countries where the production rate is high. The same trend would be valid for countries with the highest production values in some countries.

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CHAPTER 8

THE RELATIONSHIP BETWEEN R&D EXPENDITURE, INNOVATION AND ECONOMIC GROWTH: A PANEL DATA ANALYSIS FOR OECD COUNTRIES

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INTRODUCTION

Technological development, education, research and development (R&D), innovation, human capital, and information technologies have all begun to be acknowledged as determinants of economic growth as a result of recent changes and advances. With the pace of technological development, new growth theories, known as endogenous growth models, have arisen, particularly after the 1980s. Technology is included as an endogenous element in these theories, and R&D has become the most important source of economic growth.

Using scientific methods and processes in production, transmission, and marketing, research-development activities are the most important and effective way of accomplishing the work at a lot lower cost and in a much more efficient way. R&D, in other words, is the access of countries, companies, and companies to new and effective information through the efficient and effective use of qualified and quantitative personnel, science and technology, and the production of new products, tools, and equipment using existing information (Cankaya, 2003: 143).

R&D is the most important source of technical change that results in new products, new processes, and new knowledge, according to the Frascati Manual, which establishes the basic rules for R&D expenditure figures for OECD countries. Research and experimental development (R&D) is described as "creative work carried out on a systematic basis to expand knowledge of people, culture, and society and to apply this knowledge to design new applications" in the OECD

Frascati Guide (OECD, 2002: 30; TÜBİTAK, 2005:47). The guide classifies R&D activities in three areas (OECD, 2002:79; TÜBİTAK, 2005:49; OECD, 2016: 152):

• Basic Research: Experiments or theoretical studies that appear to have no particular applicability and are largely conducted to discover more about the fundamentals of phenomena and observable events.

• Applied Research: Original research undertaken with the intention of obtaining new knowledge for a specific practical purpose or goal.

• Experimental Development: Systematic effort aimed at developing new materials, products, or devices, as well as establishing new processes, systems, and services, or improving current ones, based on research and/or practical applications.

R&D and patent activities, which are innovation indicators, have an essential relationship with growth. Innovations resulting from R&D efforts help to economic growth by boosting companies' and countries' competitiveness by lowering prices and energy consumption, expanding into new markets, improving product quality, and inventing new products and manufacturing methods. Patents assure innovators that they can legally protect the commercial value of their ideas and the resulting profit. The creator, on the other hand, discloses all the details of his invention through the patent process. The large amount of information that emerges becomes openly available thanks to the details provided in the patent application. As a result, other individuals may be encouraged to produce more helpful items as a result of the invention's idea (Miller et al., 2012: 102). Patents will promote

economic growth in both circumstances by stimulating invention (the generation of new ideas) and innovation (successful commercial application of new ideas).

R&D activities intended to promote economic innovation have an impact on the economy's long-term viability, employment creation potential, competitiveness, productivity growth, and socio-economic changes (Kutlu, 2005: 98). R&D is described as any activity involving technology that has the potential to renew or extend an existing business or to start a new one, and includes stages like competency development, innovation, invention, product development, and process improvement. In addition, R&D is considered as an investment in which knowledge capital is converted into production and income. R&D is the sum of all regular and creative studies that emerge as a result of new applications of knowledge in order to raise the degree of knowledge. It is an activity that involves knowledge of society, culture, and people. R&D refers to the systematic and creative work done by the corporation to create a new product and manufacturing process (Yaylalı, 2010: 14).

Technology and innovation play a vital role in increasing productivity and economic growth. R&D expenditures are expected to encourage innovation and thus contribute to the economic growth process (Bilbao-Osorio and Rodriguez-Pose, 2004: 434). One of the most important markers of international competitiveness is the increase in these expenditures. The development of new products and new technologies as a result of the expenditures made for innovation in a

country will improve the production capacity of not only that country but also other countries. Furthermore, investments in innovation will improve economic and human capital, allowing countries to acquire a competitive advantage on the global stage.

According to recent studies, R&D spending is one of the most significant factors in closing and reducing the income and growth rate disparities across countries. R&D expenditures make an important contribution to the increase in the number of patents and GDP (Kılıc et al., 2014: 120).

Within the scope of the study, the relationship between R&D expenditure, innovation and economic growth between the years 2000-2019 for 20 OECD countries (Turkey, USA, Austria, Canada, France, Netherlands, Luxembourg, Germany, Italy, England, Belgium, Denmark, Ireland, Greece, Switzerland, Sweden, Spain, Iceland, Norway, and Portugal) will be examined using pane data analysis. The first section of the research focused on studies that investigates the relationship between R&D, economic growth, and innovation. The data was evaluated and interpreted in the second and third sections, and the results were discussed in the last section. When looking at the literature, the absence of a study with these variables to cover all OECD countries shows the importance of this study.

1. CONCEPTUAL FRAMEWORK

While most of the empirical research in the literature focuses on the impact of R&D expenditure as an indication of innovation on economic growth, there are fewer studies that investigate the relationship between R&D expenditure and patents and economic growth (Schmookler, 1966; Devinney, 1994; Crosby, 2000; Poddar and Sinha, 2008; Saini and Jain, 2011; Josheski and Koteski, 2011; Guo et al., 2013; Işık, 2014). This research will examine the long and short-term links between these two factors and economic growth, utilizing both innovation indicators - patent and R&D data - that are commonly utilized in the literature.

Using dynamic panel data and VAR analysis, Güloğlu and Tekin (2012) investigated the relationship between R&D investments, innovation, and economic growth in high-income OECD nations. The findings show that, as predicted by endogenous growth models, there is a causal relationship between R&D investments and the number of patents received as an indicator of innovation, and technological innovations affect economic growth.

Dam and Yıldız (2016) used annual data from 2000 to 2012 and a panel data analysis approach to examine the influence of R&D and innovation on economic growth for the BRICS-TM countries (Brazil, Russia, India, China, South Africa, Turkey, and Mexico). Two models were estimated using the percentage change in GDP, the share of public and private sector R&D spending in GDP, and the total number of domestic and international patents as variables. According to the

findings of the empirical investigation, R&D and innovation have a positive and statistically significant impact on economic growth.

Sadraoui and Zina (2009) determined that the association between R&D and economic growth is positive and substantial for all nations after conducting a panel data analysis utilizing data from 1992 to 2004 for 23 countries.

According to Altıntas and Mercan (2015), who used data from 1996 to 2011 in a sample of 21 OECD countries to assess the impacts of R&D spending on economic growth using the production function, it was determined that increasing R&D expenditures had a significant impact on economic growth. Furthermore, it was determined that increasing R&D expenditure by one unit enhanced economic growth by 3.4 units.

Gülmez and Yardımcıoglu (2012) used the Panel FMOLS and DOLS methodologies to evaluate 1990-2010 data for 21 OECD nations and showed that a 1% increase in R&D expenditure would have a 0.77 percent long-run impact on economic growth. Furthermore, it was discovered that in the long run, R&D expenditures and economic growth variables had a mutually significant relationship.

Ülger and Durgun (2017) investigated the relationship between R&D expenditures and GDP in OECD countries using 1996-2015 data and VAR analysis. According to the results of the study, the increase in these expenditures increases the GDP. Turkmen et al. (2019) studied the link between R&D expenditures and economic growth using new econometric methodologies developed for 20 OECD nations using data from 1991 to 2016 and found that the relationship was positive.

Ulku (2004) used the GMM approach to investigate the relationship between innovation (number of patents) and economic growth, and she found that innovation boosts GDP per capita using data from 1981 to 1997. Furthermore, Karakaş and Adak (2015) found that the relationship between patent applications and economic growth is in a long-term equilibrium relationship in their analysis utilizing data on annual patent applications and production levels for Turkey from 1970 to 2012.

R&D expenditures and patent applications were used as innovation indicators in Çütçü and Bozan (2019)'s study, which focus on the relationship between innovation and economic growth for the G-7 countries. Panel data analysis was used with annual data from 1981 to 2016. According to the findings of the research, there is a long-term association between innovation and economic growth.

2. METHODOLOGY

2.1. Data Set and Research Model

In the study, data on the percentage share of R&D expenditures in GDP, innovation (represented as annual percentage changes in the total number of patents), and annual percentage changes in economic growth of the 20 OECD founding countries for the years 2000-2019, also known as the technology age, were used in the study. All information was obtained from the World Bank's official website. The impact of R&D expenditures in 20 OECD founding countries on innovation and economic growth was explored as part of the study. For this purpose, the following models were established.

$$\Delta total\_patents_t = \beta_0 + \beta_1 \Delta r\&d_t + \varepsilon_t \quad (1)$$

$$\Delta economic\_growth_t = \beta_0 + \beta_1 \Delta r\&d_t + \varepsilon_t \quad (2)$$

The "Δ" sign in the models denotes that the first-order difference of the variable with this sign is taken. Since there are many negative values in the variables and there are not excessive differences between the values, logarithmic transformation was not applied to the series. The units of all variables are taken as percentages. R&D expenditures are included in the research as the percentage share of the GDP of the relevant country and the economic growth variable as the annual percentage change in the GDP of the relevant country, as found on the World Bank website. The patent numbers variable was not included in the research in the form of domestic and foreign patent numbers as stated on the World Bank's website, and some calculations were made about this variable: To begin with, the number of patents, which were included as two separate variables as the number of domestic and foreign patents, was summed up and converted into a single variable as the total number of patents. Then, the total number of patents of the previous year is subtracted from the total number of patents of that year, and the difference is divided by the total number of patents of the previous year to obtain the annual percentage change in the total number of patents.

2.2. Analysis of Data

The analysis of the data used the Microsoft Excel 2013, Eviews 10, and Stata 15 programs. Firstly, the highest value, lowest value, mean

and standard deviation values were calculated from the descriptive statistics of the data of the 20 OECD founder countries for the years 2000-2019. Afterwards, cross-section dependency tests were used to determine which generation root unit tests would be used to evaluate stationarity of the variables. Since the cross-section dependence of the variables was determined, the stationarity of the variables was tested with the CADF root unit test, which is one of the second-generation root unit tests. The long-term relationships between the variables in the models were tested with the Westerlund co-integration test, since there was a cross-section dependence in the variables after the root unit tests and all the variables were stationary at the first level I(1).

3. EMPIRICAL FINDINGS

3.1. Descriptive Statistics of Data

Descriptive statistical values of the variables are demonstrated in the tables in this section.

Table 1. Descriptive Statistical Values for R&D Expenditures of 20 OECD Founding Countries for the Years 2000-2019

Country	Lowest Value	Highest Value	Mean	Standard Deviation
Austria	%1.89	%3.19	%2.63	%0.43
Belgium	%1.78	%2.89	%2.19	%0.37
Canada	%1.54	%2.04	%1.82	%0.16
Denmark	%2.21	%3.10	%2.77	%0.32
France	%2.02	%2.27	%2.16	%0.08
Germany	%2.39	%3.17	%2.70	%0.26
Greece	%0.53	%1.27	%0.75	%0.24
Iceland	%1.87	%2.92	%2.45	%0.33

Ireland	%0.78	%1.61	%1.26	%0.23
Italy	%1.01	%1.45	%1.21	%0.14
Luxembourg	%1.19	%1.71	%1.47	%0.18
Holland	%1.64	%2.16	%1.87	%0.15
Norway	%1.46	%2.15	%1.71	%0.22
Portugal	%0.70	%1.58	%1.15	%0.31
Spain	%0.88	%1.35	%1.18	%0.15
Sweden	%3.16	%3.94	%3.43	%0.22
Switzerland	%2.33	%3.37	%2.90	%0.34
Turkey	%0.48	%1.06	%0.78	%0.20
England	%1.61	%1.76	%1.69	%0.04
USA	%2.49	%3.07	%2.70	%0.14

Between 2000-2019, the two countries with the highest average R&D expenditure ratio are Sweden (3.43%) and Switzerland (2.90%), respectively. The two countries with the lowest R&D expenditure average are Greece (0.75%) and Turkey (0.78%), respectively.

Table 2. Descriptive Statistical Values for the Increase Rates of Total Patent Numbers of 20 OECD Founding Countries for the Years 2000-2019

Country	**Lowest Value**	**Highest Value**	**Mean**	**Standard Deviation**
Austria	%-11.14	%9.73	%0.47	%5.44
Belgium	%-13.64	%26.65	%2.86	%11.40
Canada	%-10.20	%33.14	%0.24	%9.05
Denmark	%-15.30	%10.45	%-0.75	%7.35
France	%-3.81	%5.32	%0.01	%2.18
Germany	%-4.78	%2.90	%-0.37	%2.07
Greece	%-17.82	%5.82	%-2.97	%13.13
Iceland	%-28.79	%55.56	%2.10	%27.07

Ireland	%-11.23	%32.35	%0.41	%18.31
Italy	%-12.28	%9.89	%0.96	%8.27
Luxembourg	%-60.98	%120	%12.52	%36.33
Holland	%-14.40	%16.45	%-0.03	%6.62
Norway	%-11.55	%9.47	%-1.62	%7.01
Portugal	%-21.73	%52.40	%13.50	%19.95
Spain	%-29.63	%11.17	%-3.67	%9.91
Sweden	%-14.92	%14.17	%-0.79	%8.36
Switzerland	%-10.75	%6.70	%-1.75	%4.93
Turkey	%-12.46	%28.84	%9.57	%13.67
England	%-7.01	%1.50	%-3.07	%2.32
USA	%-4.04	%9.67	%3.26	%4.43

Between 2000-2019, Portugal (13.50%) and Luxembourg (12.52%) are the two countries with the highest average patent number increase rate, respectively. The two countries with the lowest average patent number increase are Spain (-3.67%) and Greece (-2.97%), respectively.

Table 3. Descriptive Statistical Values for the Economic Growth of 20 OECD Founding Countries for the Years 2000-2019

Country	**Lowest Value**	**Highest Value**	**Mean**	**Standard Deviation**
Austria	%-3.76	%3.73	%1.63	%1.63
Belgium	%-2.02	%3.72	%1.70	%1.32
Canada	%-2.93	%6.87	%2.69	%2.03
Denmark	%-4.91	%3.91	%1.46	%1.93
France	%-2.87	%3.92	%1.42	%1.36
Germany	%-5.69	%4.18	%1.35	%2.15
Greece	%-10.15	%5.79	%0.34	%4.39

Iceland	%-7.66	%8.45	%3.17	%3.70
Ireland	%-5.07	%25.18	%4.99	%6.26
Italy	%-5.28	%3.79	%0.40	%1.97
Luxembourg	%-4.36	%8.35	%3.10	%2.90
Holland	%-3.67	%4.20	%1.55	%1.79
Norway	%-1.73	%3.97	%1.65	%1.24
Portugal	%-4.06	%3.82	%0.90	%2.10
Spain	%-3.76	%5.25	%1.85	%2.45
Sweden	%-4.34	%5.95	%2.31	%2.29
Switzerland	%-2.08	%4.02	%2.00	%1.52
Turkey	%-5.75	%11.20	%4.94	%4.43
England	%-4.11	%3.51	%1.80	%1.63
USA	%-2.54	%4.13	%2.11	%1.47

Between 2000-2019, the two countries with the highest economic growth averages are Ireland (4.99%) and Turkey (4.94%), respectively. The two countries with the lowest economic growth averages are Greece (0.34%) and Italy (0.40%), respectively.

3.2. Cross-Section Dependency

It is must be sure that the research data is stationary in order to ensure the dependability of the analysis to be undertaken (Guris et al., 2017). Root unit tests are used to check for data stationarity. To determine whether to employ the first- or second-generation root unit tests, cross-sectional dependency tests were used to see whether there was any cross-sectional dependency in the data.

Table 4. Results of Cross-Sectional Dependency Tests

Related Variable	Pesaran CDLM2 Test	
	Test Statistics	**p**
R&D	84.67689	0.0000
total_patents	76.83475	0.0000
economic_growth	62.47982	0.0000

The results of the cross-sectional dependency tests are shown in Table 4. Since the time dimension (T=20 years) and cross-sectional dimension (N=20 countries) were equal in the study, the Pesaran CDLM2 test, one of the cross-sectional dependency tests, was preferred (Pesaran, 2004). As can be seen in Table 4, R&D expenditures (Test St.= 84.67689, p= 0.0000 < 0.05), total number of patents (Test St.= 76.83475, p= 0.0000 < 0.05) and economic growth (Test St.= 62.47982, p= 0.0000 < 0.05) variables have cross-sectional dependence on all three.

3.3. Root Unit Tests

Since the cross-sectional dependence was determined in the data of the research variables, the stationarity test was carried out with the CADF root unit test, which is one of the second-generation root unit tests (Pesaran, 2007).

Table 5. Results of CADF Root Unit Tests

Related Variable	CADF					
	t-bar	**cv 10**	**cv 5**	**cv 1**	**Z[t-bar]**	**p**
R&D	-1.487	-2.100	-2.210	-2.400	1.066	0.857
Δ R&D	-3.336	-2.100	-2.210	-2.400	-7.039	0.000
total_patents	-1.423	-2.100	-2.210	-2.400	0.982	0.873
Δtotal_patents	-3.134	-2.100	-2.210	-2.400	-6.156	0.000
economic_growth	-1.386	-2.100	-2.210	-2.400	0.769	0.912
Δeconomic_growth	-3.022	-2.100	-2.210	-2.400	-5.983	0.000

As can be seen in Table 5, R&D expenditures (t= -3.336, p= 0.000 < 0.05), total number of patents (t= -3.134, p= 0.000 < 0.05) and economic growth (t= -3.022, p= 0.000 < 0.05)variables become stationary when subjected to first-order difference operation.

3.4. Westerlund Panel Co-Integration Tests

The long-term cointegration relationships between the variables in the models determined in the study were tested with Westerlund co-integration tests. Westerlund co-integration test was preferred among the co-integration tests because all three of the research variables have cross-section dependence and become stationary when the first-degree difference is taken (Westerlund, 2007).

Tablo 6. Results of Westerlund Panel Cointegration Tests

Model-1 (R&D Expenditures*Total Patents)			
Statistic	**Value**	**Z Statistic**	**p**
Gt	-3.400	-8.075	.000
Ga	-10.369	-2.651	.004
Pt	-15.280	-8.857	.000
Pa	-10.549	-6.365	.000
Model-2 (R&D Expenditures*Economic Growth)			
Statistic	**Value**	**Z Statistic**	**p**
Gt	-3.615	-9.147	.000
Ga	-9.931	-2.291	.011
Pt	-15.603	-9.182	.000
Pa	-10.082	-5.895	.000

As can be seen in Table 6, all of the statistical values for both the first model (G_t = -3.400, p= 0.000 < 0.05; G_a = -10.369, p= 0.004 < 0.05; P_t = -15.280, p= 0.000 < 0.05; P_a = -10.549, p= 0.000 < 0.05) and the second model (G_t = -3.615, p= 0.000 < 0.05; G_a = -9.931, p= 0.011 < 0.05; P_t = -15.603, p= 0.000 < 0.05; P_a = -10.082, p= 0.000 < 0.05) are less than 0.05. This shows that there is a long-term co-integration relationship between R&D expenditures in the first model and the total number of patents, as well as between R&D expenditures and economic growth variables in the second model.

CONCLUSION

Many studies have demonstrated that innovation investments and R&D expenditures are vitally crucial for countries' current economies, and that innovative activities with high costs are the key to economic growth and development for both developing and developed economies.

The long-term relationships between R&D expenditures, innovation (annual percentage changes in the total number of patents), and economic growth are examined in this study using data from 20 OECD countries' R&D expenditures (Turkey, USA, Austria, Canada, France, Netherlands, Luxembourg, Germany, Italy, England, Belgium, Denmark, Ireland, Greece, Switzerland, Sweden, Spain, Iceland, Norway, and Portugal) from 2000 to 2019. As a consequence of the research, it was discovered that R&D spending and innovation, as well as R&D expenditures and long-term economic growth, had a cointegration relationship. In other words, R&D expenditures and innovation, as well as R&D expenditures and economic growth move together in the long term.

According to the results of econometric analysis, the relationship between R&D expenditures and economic growth is consistent with many studies in the literature (Griliches, 1998; Sylwester 2001; Sadraoui and Zina, 2009; Horvath 2011; Özcan and Arı, 2014; Gülmez and Akpolat 2014; Ülger and Durgun 2017; Türkmen et al. 2019). When looking at the patent variable, the results are also

consistent with the studies of the literature. (Ulku 2004; Gulmez and Akpolat, 2014; Sungur et al., 2016; Alper, 2017).

According to the findings of the econometric analysis, the rise in R&D investments made by OECD countries will accelerate patent applications, laying the route for sustainable economic growth, As a result, it is critical that OECD economies continue to boost their R&D investments in order to maintain long-term economic growth. As a result, policymakers should evaluate the long-term observability of the effects of innovation on economic growth, and it should be underlined that policies designed to stimulate R&D and innovation should be created in this direction.

The studies have empirically demonstrated that technology is one of the sources of economic growth, which is one of the governments' key aims. As a result, it is vital to elevate the significance of R&D and patent activities within the context of national economic strategies. Furthermore, it has been revealed that countries who invest in technology and enhance their technological competencies as a result of these investments have increased economic growth. The research was carried out for OECD countries of various economic sizes and development levels. As a result, it is anticipated that the study will provide more acceptable and comprehensive outcomes to policymakers.

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CHAPTER 9

INVESTIGATION OF FACTORS AFFECTING FOOD SECURITY IN TURKEY

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While Starting

Although the food produced on a global scale is sufficient to feed the world population, more than 1.5 billion people in the world do not have access to essential nutrients. Moreover, more than 820 million people experience hunger in 2018. Moreover, these people are not concentrated in a certain part of the world, but live all over the world. For this reason, food insecurity has become a problem not only for certain countries, but for all humanity. For this reason, especially after the 20th century, food security has started to be seen as one of the main problems for countries with various levels of development and numerous organizations have been established to work in this field. In addition, the fact that food security is extremely vulnerable to shocks in areas such as global economic conditions, commercial activities, ecological situation and climate change forces countries to take action for a sustainable solution to this problem. There is a similar situation in Turkey as it has recently experienced climate change due to global warming, decreased agricultural production due to the migration of rural people to the city by leaving their agricultural lands, being exposed to various economic and political crises, and being one of the countries receiving the most immigration in the world. The reduction of water resources along with the waste of food seriously threatens the future of people living in Turkey. In order to ensure food security in a sustainable way, the factors affecting food security must be dealt with effectively. However, when the current literature is examined, it is seen that the studies on food security in

Turkey are quite limited. The aim of this study is to determine the factors affecting food security in Turkey. For this purpose, agricultural land, fertilizer use, food price index, real income and unemployment rate were selected among the variables that are thought to affect food security in the 1991-2018 period and analyzed with ARDL (Autoregressive Distributed Lag) Boundary Test approach. According to the results of the analysis, all variables except unemployment were found to be significant. Increasing inputs in agricultural production will also increase food security. In addition, increasing the efficiency of these inputs will be an important factor in ensuring food security.

INTRODUCTION

Although feeding and meeting the basic needs for the continuation of life is one of the basic human rights that people are born with as a human being, about 720 to 811 million people cope with starvation in 2020. This number is 161 million more people than the previous year. However, 2.37 billion individuals did not have to eat proper subsistence in 2020, a raise of 320 million compared to 2019. There is a similar situation for every region of the world and no place can be separated from these severe conditions. The rising cost of healthy eating and the chronically excessive degrees of poverty and income inequality have made nutritious eating unreachable for nearly 3 billion individuals around the globe. Combined with the impact of COVID-19, after preserving nearly constant for 5 years, the prevalence of undernourishment raised by 1.5% in a single year (FAO, 2021).

Food insecurity has been increasing continuously since 2015, although it has recorded a certain decline until 2015 on a global scale. Although African countries are most likely to face food crises, this problem is seen in every region of the world at varying levels (GFRC, 2021). A similar situation is also valid for Turkey. Food insecurity has increased, especially because of recent migrations, economic turmoil, and pandemic. Cooperations have been made with various international organizations being that develop food security. However, together with the aforementioned problems, the high food waste makes it difficult to eliminate the problem (FAO, 2021). For this reason, it is vital to investigate the influencing factors of food security in Turkey and to present various policy recommendations in line with the results.

Food security does not only mean that people have enough food to fill their stomachs. According to the description made by the World Food Summit in 1996, "Food security occurs when all people, at all times, have physical and economic access to adequate, safe and nutritious food that meets their nutritional needs and food preferences for an active and healthy life". Accordingly, food security depends on the quantity, its nutritiveness and affordability of food. For this reason, focusing only on physical agricultural production does not provide sufficient information when examining food security. At the same time, determinants, such as individuals' income and food prices, should be examined in order to measure affordability (FAO, 2006). In this direction, a holistic view of food security has been tried to be

formed in the present study. The goal of this research is to determine the factors affecting food security in Turkey. For this purpose, cropland, fertilizer use, food price index, real income and unemployment rate, which are thought to affect food security between the years 1991-2018, were selected and analyzed with the ARDL (Autoregressive Distributed Lag) Boundary Test approach. The current study is unique in terms of considering food security as a whole, period and analysis method. In the next part of the study, first the theoretical background will be given, it will be followed by the analysis. Finally, there will be a discussion section.

THEORETICAL BACKGROUND

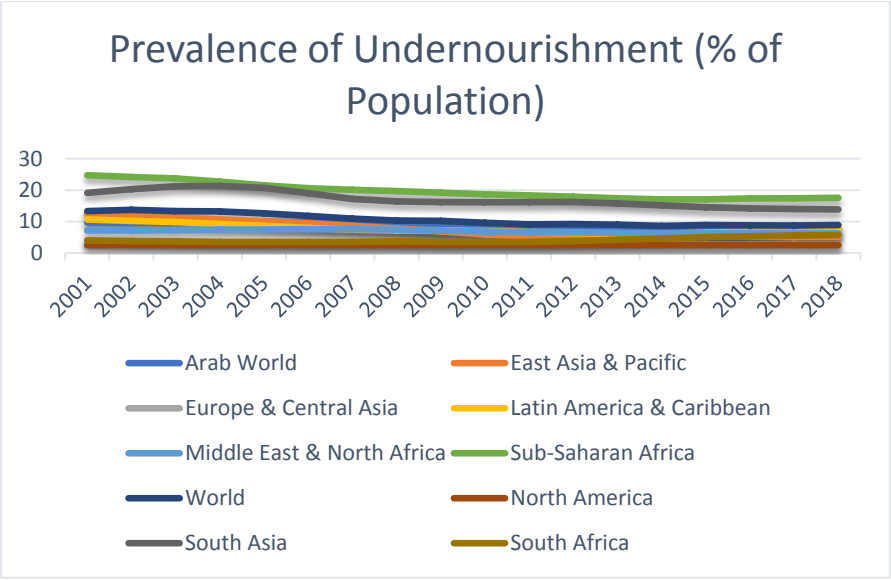
Thomas Malthus can be seen as one of the first writers to reveal the food security problem, although it is not put forward with the name used today. Thomas Malthus (1798) suggested that the population would increase geometrically, but that food on a global scale would increase arithmetically. For this reason, if population growth is not controlled, scarcity will occur in resources. Malthus stated that under no circumstances could any equality be achieved. However, thanks to the technological developments and the opening of new places to agriculture, Malthus's prediction was not realized and sufficient food production was provided. Although there is sufficient food to feed more than all people on a global scale today, food insecurity is increasing day by day (Lukášková and Pitrová, 2018). Therefore, a series of measures have been taken for establishing food security in the international arena at various times. With the proposal of

Yugoslavia to the League of Nations in the 1930s, this issue was brought to the political arena for the first time. The dimensions of food insecurity were firstly revealed with the report of Nutrition and Public Health (1935).

The United Nations World Food Program (WFP) was established in 1961 by the United Nations General Assembly and the United Nations Food and Agriculture Organization (FAO) to provide food supplies in war and disaster areas. Since 1975, it has been suggested by the FAO that malnutrition is not only a problem in the availability of food but also a function of poverty and deficiency. Accordingly, it has been stated that malnutrition may continue despite the increase in the general food supply (Akdoğan Gedik, 2020). With the increasing global trade since the 1980s, agricultural products have also been subject to intense trade. With the agricultural development in the USA and EU countries, production increased rapidly, and they began to dominate the global markets with the cheapening of goods. During this period, there were wars over subsidies and agricultural product prices on a global scale. In order to put an end to these wars, GATT stepped in and Uruguay started multilateral negotiations in 1986. With the reforms made in 1992, price supports were replaced by direct supports to farmers. With the WTO Agreement on Agriculture in 1995, it was aimed to clear agricultural policies from state intervention and leave production and trade to the functioning of the market mechanism. This agreement was not only limited to the framework of international agreements concerning foreign trade; has

also taken domestic agricultural supports under control (Şahinöz, 2016).

In 2002, the World Food Summit: Five Years Later Meeting was held with the participation of delegates from 179 countries, and a declaration was adopted to reduce the number of famished people to 400 million by 2015. This meeting was essentially a continuation of the World Food Summit held in 1996 with the highest participation. Although the leaders accentuated the significance of food security, the measures taken between the two meetings were quite limited (FAO, 2002). Although the importance given to food security has increased over time, the steps taken within the scope of preventive policies are still quite limited. Table 1 shows the change in prevalence of undernourishment over time around the world. Although the severity of malnutrition over time recorded small decreases until 2015, the decrease has stopped since then. Moreover, the difference between low and high-income countries is still very high. While the prevalence of undernourishment was 8.9% worldwide in 2018, this rate was 2.5% in North America and 17.5% in sub-Saharan Africa.



Graph 1: Prevalence of Undernourishment (Source: WB)

While the problem of food security is at the forefront, this interest has also been reflected in studies and a deep literature has emerged that examines the impact of various situations related to each region of the world on food security. There are many studies examining Africa and MENA regions where food insecurity is highest (Clover, 2003; Paeth, Capo-Chichi and Endlicher, 2008; Garrity et al., 2010; Koç, Ozdamar and Uysal, 2017, Zolfaghari and Jariani, 2021). However, there are also studies examining the positive and negative consequences of trade on food security (Abdullateef and Ijaiya, 2010; Dithmer and Abdulai, 2017; Mary, 2019). There are also studies that bring out the contradictory effects of inequality and poverty on food security (Zakaria, Junyang and Fida, 2016; IUWA, FAO, 2019; 1-25).

When the situation in Turkey is examined, it is seen that it is not much different from other countries that have food security problems. One

of the most important problems in Turkey is that agricultural policies cannot provide a sufficient increase in production. This problem is exacerbated by continuous and unstable support policies. In addition, migration from rural areas to cities decreased production. The cost increase in inputs and foreign dependency makes the sector fragile, leaving producers and consumers vulnerable to price fluctuations (Kıymaz and Şahinöz, 2010). The recent exacerbation of the food security issue has also been reflected in the literature. Studies on food security in Turkey have shown a rapid increase in recent years. Especially recently, several theoretical studies have been published (Ören, Alemdar, and Bahadır, 2008; Eraktan and Yelen, 2012; Niyaz, 2016; Karaman, 2018; Gürsoy, 2020). However, there are also studies that cover only certain products (Demirbaş and Atış, 2005; Beşer and Sürek, 2012; Gürer and Ören, 2013; Eren and Pekşen, 2016; Yılmaz and Avkıran, 2019; Güneş and Turmuş, 2020). In addition, there are studies examining the impact of climate change (Türkeş, 2014; Dellal and Unuvar, 2019) and the COVID-19 pandemic process (Atalan-Helicke and Abiral, 2021) on food security.

Studies in the literature have generally intensified in the last period. This situation also shows the perception of food security in Turkey. In addition, although there are few empirical studies in the literature, some of these studies have been applied to a specific region and agricultural product (Evrendilek and Ertekin, 2002; Gürlük and Ward, 2009; Esturk and Oren, 2014; Şengül and Lopcu, 2018; Abiyev et al. al., 2018; Şahin, 2019; Niyaz, 2020). When the literature is examined,

no study has been found that investigates the factors affecting food security in Turkey with a holistic perspective. The present study aimed to fill this gap in the literature.

ANALYSIS

Data

The aim of this research is to determine the factors affecting food security in Turkey in the period of 1991-2018. Explanations of the variables used to determine these factors are given in Table 1. These are variables that are frequently used in the literature and are thought to affect food security.

Table 1: Variables Used in Analysis

Variable Name	Definition	Source
lnades	log of average dietary energy supply adequacy	FAOSTAT
crpl	permanent cropland (% of land area)	WB-WDI
lnfert	Fertilizer consumption (kilograms per hectare of arable land)	WB-WDI
lnprc	log of food price index-reel	FAOSTAT
lnrgdp	Real GDP at constant 2017 national prices (in mil. 2017 US$)	Penn-World Table
unemp	Unemployment, total (% of total labor force)	WB-WDI

The explanatory statistics of the variables used in the analysis are as seen in Table 2.

Table 2: Descriptive Statistics

	lnades	**crpl**	**lnfert**	**lnprc**	**lnrgdp**	**unemp**
Mean	5.047159	3.779831	4.487775	4.464425	13.95967	9.145357
Median	5.036953	3.828463	4.495188	4.416316	13.93925	8.835000
Maximum	5.105945	4.498265	4.925319	4.777494	14.61413	12.55000
Minimum	5.003946	3.197640	4.111094	4.205380	13.39003	6.500000
Std. Dev.	0.028895	0.396590	0.196353	0.173439	0.374954	1.552259
Skewness	0.534172	0.023997	0.309104	0.253008	0.238895	0.049009
Kurtosis	2.432289	1.760732	2.709258	1.751695	1.825165	2.257355
Jarque-Bera	1.707599	1.794436	0.544497	2.116703	1.876607	0.654651
Probability	0.425794	0.407702	0.761665	0.347027	0.391291	0.720849
Sum	141.3205	105.8353	125.6577	125.0039	390.8708	256.0700
Sum Sq. Dev.	0.022542	4.246654	1.040968	0.812190	3.795934	65.05670
Observations	28	28	28	28	28	28

MODEL AND RESULTS

Autoregressive Distributed Lag (ARDL) model was used to analyze the factors affecting food security in Turkey. The ARDL model was created by Pesaran and Shin (1999) and Pesaran et al. (2001). This model has been chosen because it provides long-term analysis opportunity where the series is stationary at different degrees. For this reason, first, Extended Dickey-Fuller (ADF) unit root test was applied to determine the degree of stationarity. ADF unit root test results are shown in Table 3.

Table 3: ADF Unit Root Test Results

	Level Value		First Difference	
Variable	**t- Statistics**	**p value**	**t- Statistics**	**p value**
lnades	-2.460344	0.0162**		
crpl	0.605501	0.8410	-4.653842	0.0000***
lnfert	-4.195062	0.0138**		
lnprc	-3.993684	0.0257**		
lnrgdp	-2.171761	0.4853	-3.099379	0.0033***
unemp	-3.444562	0.0672	-4.337470	0.0001***

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

As a result of the unit root test, it shows that the data sets are integrated with I(0) or I(1), which shows that it is appropriate to use ARDL estimators. After the unit root test, the Akaike information criterion was used to determine the lag lengths. The lag length with the smallest value and without autocorrelation was determined as the criterion. Akaike criteria values and Breusch-Godfrey autocorrelation test statistics are presented in Table 4.

Table 4: Optimal Lag Length

Lag Length	AIC	LM(1)
1	-8.306611	0.0949*
2	-8.904168	0.0342

Note: AIC, Akaike Criterion Value; LM(1) is the Breusch-Godfrey autocorrelation test statistic. * indicates the optimal lag length.

Boundary test was applied after determining the lag length. Table critical values Pesaran et al. (2001) study. These table values are compared with the calculated F values. If the F statistic is above the upper critical value, it can be said that there is a cointegration relationship between the series. F statistics results and critical values are as in Table 5.

Table 5: Bounds Tests for The Long-Term Relationship

		%1 Value	**Critical**	**%5 Value**	**Critical**	**%10 Value**	**Critical**
k	**F-Statistics**	**Lower Value**	**Upper Value**	**Lower Value**	**Upper Value**	**Lower Value**	**Upper Value**
5	12.60185***	3.06	4.15	2.39	3.38	2.08	3

Note: k is the number of independent variables. Critical value indicators were obtained from Pesaran et al. (2001) Table CI(iii). *** indicates the 1% significance level.

The fact that the F statistic value calculated in the analysis is greater than the upper critical value at all significance levels indicates that the model is significant at all significance levels. Thus, the existence of a cointegrated relationship between the variables was determined. Then the ARDL model was created to determine the long- and short-term relationships. The ARDL model created to examine the long-term relationship between the series is as follows:

$$lnades_t=\beta_0 + \sum_{i=1}^{m} \beta_{1i}crpl_{t-i} + \sum_{i=1}^{m} \beta_{2i}lnfert_{t-i} + \sum_{i=1}^{m} \beta_{3i}lnprc_{t-i} + \sum_{i=1}^{m} \beta_{4i}lnrgdp_{t-i} + \sum_{i=1}^{m} \beta_{5i}unemp_{t-i} + u_t \quad (1)$$

The long-term coefficients obtained under the ARDL model are given in Table 6:

Tablo 6: Estimation of Long-Term Coefficients

Variable	Coefficient	Standard Error	t-statistic	p-value
crpl	0.029830	0.003720	8.019585	0.0000***
lnfert	0.016452	0.009225	1.783298	0.0924*
lnprc	0.039193	0.008816	4.445506	0.0004***
lnrgdp	-0.106222	0.006462	-16.43837	0.0000***
unemp	-0.001746	0.001032	-1.692027	0.1089
c	6.184273	0.045554	135.7576	0.0000***

Note: *, ** and *** indicate significance at the 10%, 5% and 1% significance level, respectively.

When the long-term coefficients were examined, the cropland, price, GDP variables were significant at the 1% significance level, while the fertilizer variable was significant at the 10% significance level. In addition, unemployment was found to be statistically insignificant. While cropland, price, and fertilizer had a positive impact on food security, GDP had a negative impact. The results found are in parallel with the literature. The fact that agricultural land and fertilizers are the primary tools used in food production ensures that the increase in these inputs increases food security. However, the productivity increase in these inputs can contribute to food security (Stewart and Roberts, 2012). The decrease in food security with the increase in food prices may result from the increase in the income of food producers and sellers. In addition, the fact that people meet their food needs from the fields they own makes them less resilient to increases in food prices. The increase in food prices creates demand for unskilled agricultural labor, and accordingly the income of the rural poor increases (Grace, Brown and McNally, 2014). GDP has negatively affected food security. This situation may be related to the reduction of agricultural production in Turkey and its shift to industry (Polat, 2016). The shift from local production to

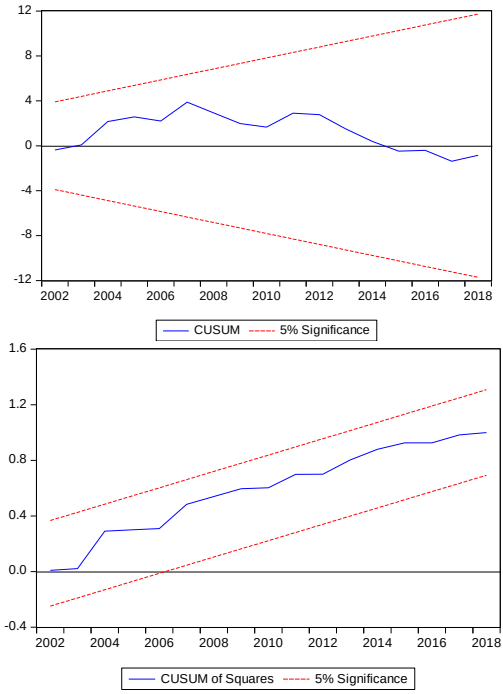
foreign trade in meeting the need for food may cause a decrease in food security while GDP increases.

Then, a series of diagnostic tests were applied to test the suitability of the model. Diagnostic test results are given in Table 7.

Tablo 7: Diagnostic Test Results

Tests	**Value (Prob)**
Jarque-Bera	1.301999 (0.521524)
Breusch-Godfrey Serial Correlation LM Test	4.710306 (0.0949)
Heteroskedasticity Test: Breusch-Pagan-Godfrey	12.71250 (0.1761)
Ramsey RESET Test	0.360004 (0.5569)

As a result of the tests, it was determined that the model did not have normal distribution, autocorrelation, varying variance problems and specification error. In Graph 2, CUSUM and CUSUMQ tests are presented to investigate the stability of the model. The fact that the line is within the critical limits indicates that the coefficients obtained as a result of the model are stable at the 5% significance level in the long run.



Graph 2: CUSUM and CUSUMQ Test Results

After revealing the long-term relationship, the short-term relationship was estimated. The short-run model is as follows:

$$\Delta lnades_t = \beta_0 + \beta_1 Eq_{t-1} + \sum_{i=1}^{m} \beta_{2i} \Delta lnades_{t-i} + \sum_{i=1}^{m} \beta_{3i} \Delta crpl_{t-i} + \sum_{i=1}^{m} \beta_{4i} \Delta lnfert_{t-i} + \sum_{i=1}^{m} \beta_{5i} \Delta lnprc_{t-i} + \sum_{i=1}^{m} \beta_{6i} \Delta lnrgdp_{t-i} + \sum_{i=1}^{m} \beta_{7i} \Delta unemp_{t-i} + u_t$$

(2)

The variable Eqt-1 is the one period lagged value of the error terms obtained as a result of the long-term relationship. This variable shows the degree of improvement of the short-term imbalance in the long-term and its coefficient is expected to be significant and negative. Short-term coefficients and error correction model results are as in Table 8.

Table 8: Error Correction Model Results

Variable	Coefficient	Standard Error	t-statistic	p-value
D(CRPL)	0.012358	0.003351	3.687690	0.0018
D(LNPRC)	0.007078	0.007073	1.000683	0.3310
D(UNEMP)	-0.004824	0.000581	-8.310337	0.0000
Eq_{t-1}	-0.782071	0.071588	-10.92460	0.0000

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

The error term coefficient meets expectations. The coefficient of the error correction term is -0.782. 78% of an imbalance that may occur is eliminated in the next period.

DISCUSSIOIN

Although a series of studies have been carried out to ensure food security, it has not been possible to end hunger yet. In order to solve the problem, global, national and sub-national steps must be taken. Therefore, a strong political will is a prerequisite for the process of ending hunger. Governments should implement effective policies to eliminate this problem. In addition, international organizations should also support these policies and be the driving force (Beckmann and Byers, 2004). Eliminating food insecurity is likely to be resolved with dedication to the problem. For this, a global reform should be implemented without using food as a political weapon (Sassi, 2018).

One of the most significant elements that threatens food security is the waste of food by going to waste. This wasted food could save 12.5% of the world's population from malnutrition and relieve the high pressure on food production (FAO, 2012). Wasting food does not only endanger food

security, but also causes the water and energy used in production to not be used effectively. In addition, this way of wasting food also causes environmental damage during the production phase to be wasted. With the increase in urbanization, food waste is increasing more and more rapidly. However, the importance of the issue is not yet fully understood, especially in developing countries. Although the recycling of food waste has gained importance on a global scale, there is not enough awareness yet (Lang et al., 2020).

The implementation of long-term sustainable agricultural systems plays a key role in assuring food security. Agriculture must stop being a driver of environmental and global climate change and become the basis of sustainability. For this purpose, food losses in the vegetable production field should be prevented (Vågsholm, Arzoomand and Boqvist, 2020). In this context, establishing the economic, social, and environmental aspects of sustainability as a whole is important in ensuring food security. Economic and social development plays a critical function in eradicating poverty, malnutrition and hunger. Nevertheless, the chronicity of hunger and malnutrition creates a long-run burden on societies (Berry et al., 2015).

Recently, various steps have been taken to ensure food security in Turkey. However, in order to ensure the effectiveness of the policies created by the government, the dimensions of the problem must first be determined well. For this reason, farmers, agricultural opportunities, and production outputs should be kept under strict control. Although the farmer monitoring system has been established, the inspection needs to be expanded. In addition, the policies to be implemented should be created, considering geographical and regional conditions, and should be aimed at reducing the food insecurity of the disadvantageous groups. Although there are significant legislative changes, especially in the EU harmonization process, it is important to

implement these policies effectively (Koç and Uzmay, 2015). Also, keeping industrial productions away from the lands where food agriculture is made will contribute to the provision of food security by affecting the healthy content of these foods. The limitation of the study is the lack of food security data at the regional level. Regional-level data can offer a more detailed analysis. In future studies, the effect of industrialization on agricultural policies can be examined and the consenquences of industrialization on food security can be investigated.

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CHAPTER 10

HISTORY OF MONEY: FROM BARTER TO CRYPTOCURRENCIES

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While Starting

In today's global world, money is not just a physical tender that has a backing of a regulatory authority; it expands far beyond fiat money to virtual currencies, mobile payments, or even virtual goods. Cryptocurrencies have joined this revolution since 2009. This chapter focused on the historical development of money from barter to crypto money. It discusses the Barter System, the problem of the Barter System, the evolution of money, types of money, the evolution of Cryptocurrencies, types of Cryptocurrencies, advantages, and disadvantages of Cryptocurrencies, trend of Cryptocurrencies in Nigeria. The bitcoin, the advantages, and disadvantages of bitcoin. The study concludes that cryptocurrency is still in its relative infancy. Bitcoin – which is the first form of cryptocurrency has achieved some level of success and popularity in Nigeria. However, Bitcoin has a long way to go before it's a legitimate currency on par with the U.S. dollar, euro, pound, or Naira. Despite the seductiveness of cryptocurrency as a means of exchange, there's no guarantee that Bitcoin – or any other decentralized, virtual currency not controlled by a national bank – will ever be a viable alternative to fiat currencies

INTRODUCTION

Money is often called to be a measure of value and a medium of exchange. It has become a critical element of the economy. Money, as we know it today, is the result of a long evolution process. Can we imagine a world without money now? It has become a part and parcel of human lives. There is no longer a time we have to wait hours in a bank or in front of the ATMs to get our transactions done. Everything has become digital. We can send money to anyone at any time or we can purchase anything from any part of the world using digital banking facilities. In all these cases there is some clause we need to follow, which are set by these third parties. They also charge us for this service they provide. With the invention of cryptocurrencies, these problems have also been removed. Historically, money has either had intrinsic value or derived value from government decree.

After World War II, at the Bretton Woods Conference, most countries adopted fiat currencies that were fixed to the US dollar. The US dollar was in turn fixed to gold. In 1971 the US government suspended the convertibility of the US dollar to gold. After this many countries de-pegged their currencies from the US dollar, and most of the world's currencies became unbacked by anything except the governments' fiat of legal tender and the ability to convert the money into goods via payment.

Money serves three interrelated economic functions: it is a medium of exchange, a unit of account, and a store of value. How well cryptocurrencies can serve those functions relative to existing money

and payment systems likely will play a large part in determining crypto currencies' future value and importance. Proponents of the technology argue cryptocurrency can effectively serve those functions and will be widely adopted. They contend that a decentralized system using cryptocurrencies ultimately will be more efficient and secure than existing monetary and payment systems. Skeptics doubt that cryptocurrencies can effectively act as money and achieve widespread use. They note various obstacles to the extensive adoption of cryptocurrencies, including economic (e.g., existing trust in traditional systems and volatile cryptocurrency value), technological (e.g., scalability), and usability obstacles (e.g., access to the equipment necessary to participate). In addition, skeptics assert that cryptocurrencies are currently overvalued and under-regulated

Cryptocurrencies are digital money in electronic payment systems that generally do not require government backing or the involvement of an intermediary, such as a bank. Instead, users of the system validate payments using certain protocols. Since the 2008 invention of the first cryptocurrency, Bitcoin, cryptocurrencies have proliferated. In recent years, they experienced a rapid increase and subsequent decrease in value. One estimate found that, as of March 2020, there were more than 5,100 different cryptocurrencies worth about $231 billion. Given this rapid growth and volatility, cryptocurrencies have drawn the attention of the public and policymakers. This article gives a deeper insight into how cryptocurrencies function.

Historical Development of Money- The Barter System

Throughout the history of trade, barter has been used as a system of exchange for thousands of years. Long before the concept of currency was even conceived, people all over the world were exchanging goods and services with each other.

The roots of the barter trade can be traced to 6000 BC when Mesopotamian tribes freely practiced the custom. It was later adopted by the Phoenicians who traded goods with other distant cities. The Babylonians also developed an improved system for bartering.

By the Middle Ages, bartering was practiced by world-traveling Europeans who traded crafts and furs for perfume, spices, and silk. In Colonial America, immigrants and Native Americans exchanged goods with each other.

Even today, bartering exists in various forms. Along with traditional methods that are practiced around the world, there are more sophisticated bartering methods that take place over the internet.

Problems of the barter System

In primitive societies, goods and services were exchanged for others, a man who has tubers of yam but needs eggs must look for another who has eggs and also needs eggs must look for another who has eggs and also needs tubers of yam for exchange to take place. This system is known as the 'Barter System' that is exchanging goods for goods and services for services. Let us consider this advertisement- 'Man with twenty (20) tubers of yam needs a quarter bag of rice in exchange'.

The difficulties in such an advert are obvious. These difficulties include:

i. Double Coincidence of Want: There must be an agreement as to the type of products and quantity of products to be exchanged. The man in the advert must not only look for another who has rice (first coincidence), but for one who has rice and also needs to exchange his rice (a quarter bag) for tubers of yam (second coincidence).

ii. Divisibility: The goods offered in barter faces the problem of divisibility. How will a shepherd, who needs small quantities of yam, eggs, 'tomatoes, divide his sheep or goat in exchange?

iii. Storability: The absence of storage facilities makes the barter system unattractive as most goods used in exchange for each other are perishable ones. How do you store the fresh portion of meats for further transactions?

iv. Cumbersomeness: The goods used in the barter system could not be carried from one place to another for exchange. Goods such as cows, camels, sheep, yams, etc are too cumbersome to be carried from one place to another.

In the modern economy, barter or direct exchange is comparatively rare. A high degree of specialization now operates in the world today. The exchange must take place smoothly and quickly. Money serves to eliminate the problems of barter as significantly make smooth exchange possible in the modern economy**.**

Evolution of Money

Long before money was invented, people were happy-making, doing, and growing things by one another in small communities. They could remember the payments and receipts of the items exchanged. We call it the barter system. People exchanged commodities for other commodities. It was not just the abundant thing that was available that they exchanged, but scarce ones, like cattle, grains, etc. As the communities grew in number these transactions became difficult. 0ver the year's barter was not possible. Conflicts arose between people regarding the worth of commodities that were exchanged. Also, there was this problem of commodities getting rotten, etc. Portability of the commodities also arose to be a major limitation of the system.

People then started using precious metals instead of commodities. Over time they began parking their metals especially gold, with the goldsmiths to prevent theft from their homes and these goldsmiths became the first bankers and they started issuing them paper receipts. The earliest forms of coins appeared in China around 1000 B.C. during the Stone Age. It was then those imitations of cowrie shells made out of bronze and copper were used as a form of currency. Along with these were metal tools that were used to purchase goods. These later developed into rounded coins that, although primitive, looked more like the coins that are in use today.

The earliest coins in China were made from base metals. They had holes that enabled them to be strung together with twine. By 500 B.C., round coins made of silver were prevalent around the world. Lydia –

which was a part of modern-day Turkey – was one of the first to adopt these coins. Soon afterward, the Greeks, Persians, Macedonians, and Romans developed their coins. Unlike the coins in China, these were made of precious metals, such as gold, silver, and bronze. It is the Chinese rulers who were said to have accepted these metals from the common people and they issued certificates to them. Though it had no intrinsic value, people started trusting them. Trade started flourishing with the advent of these changes and rulers found that it's easier to print currencies that had the value of these gold metals parked with them. The first known currency is said to be created in Lydia by king Alyattes around 600 BC. These helped countries make their trade more systematic and easier In the 7th century, China progressed toward paper notes. These first appeared during the Tang Dynasty. China began circulating paper money as general currency almost 700 years before the first banknotes appeared in Europe.

The shift toward paper money was brought about by the challenges associated with transporting large numbers of coins. To make it easier – and safer – to bring sizeable amounts of money with them, merchants developed the practice of depositing coins with each other. They were then issued certificates in the equivalent value of the coins they deposited.

The use of paper money continued in China over the next 200 years. This was later changed over to gold reserve-backed paper money due to a shortage of copper, which was previously used to back the earlier paper money. The new gold reserve-backed paper notes issued by the

Song Dynasty administration are now recognized as the world's first form of legal tender. It is when Lydia was taking lead in developing the currency system that the Chinese moved from coins to paper money. Eventually, banks started accepting deposits in the form of paper currencies which helped people from carrying coins all way along.

By the mid-1800s, the gold standard had become firmly established in many countries around the world. The fact that paper money now had tangible value helped bring about a period of profitable global trade. But associating the value of the currency with gold posed some unique challenges and problems. For one thing, the value of gold – and its associated currencies – fell with every discovery of a substantial amount of gold.

Later on, the concept of being backed by the gold standard was removed and as we have now, the fiat money came into play which follows a flexible exchange rate. It does‟t have any intrinsic value. We accept it only because a central authority says so. With the advent of paper currencies, international trade increased in volume, and currency markets were introduced. There still existed the problem of portability. Up till a few decades back we had to physically hand over the currency from one person to another. It is then that the electronic payment system came up. But the problem with these kinds of electronic transactions is that we have to rely on a third party, like a clearinghouse or a bank. And it is these third parties who authorize the transactions. And confirm it by making a note in their ledger. We are

forced to pay them a fee for their services. Also when it comes to making a transaction in another currency, things become even more difficult. The kinds of taxes or fees we need to pay to these merchants are also very high.

Paper money and coins remain widely used today and are still the most prevalent forms of currency around the world. Fiat money started to dominate in the 20th century. Since the decoupling of the US dollar from gold by Richard Nixon in 1971, a system of national fiat currencies has been used globally.

From the history we have discussed, we can see that fiat currency is not coming out suddenly. Countries have tried to tie to the gold standard but eventually failed because the government needs flexibility and tools to regulate the economy, and the cost of sovereignty insolvency may cost far more than allowing the government to control the money supply.

However, allowing the government to print new money creates another problem, the inflation tax. Suppose you are holding one dollar, and one dollar can buy you an apple. If the government is printing out one more dollar, the total dollar supply in the market becomes two, and now you can only buy half an apple. Issuing new currency is considered a tax on holders of existing currency. Even so, the advent of the internet has given rise to the practice of monetary transactions taking place online. As a result, electronic money and cryptocurrencies have been developed. Some people who partake in forex trading are even starting to use cryptocurrency as a form of

payment for trading. You can check out different major forex brokers to see which ones allow you to trade with cryptocurrency. One of the most widely recognized of these new currencies is Bitcoin, which is a form of cryptocurrency that isn't subject to regulation by any government or financial agency. Bitcoin can be freely exchanged over the Bitcoin network to pay for goods and services. A growing number of merchants now accept Bitcoin and other types of cryptocurrencies as payment, and it seems that the market will continue to grow in size and scope well into the future.

Types of Money

In economics, money is defined as a generally accepted medium of exchange for goods and services. Virtually anything can be considered money, as long as it performs what we call the three major functions of money (i.e., medium of exchange, store of value, unit of account). With this in mind, it is not surprising that there were different types of money throughout history.

Commodity Money

The origins of commodity money link back to the Lydian merchants, who produced a gold coin mixed with silver – otherwise known as 'electrum'. This became a standardized unit of value to help traders convert money and trade between countries. The electrum coin later achieved royal ascent in 550 B.C., as it went into full circulation under the order of King Croesus of Lydia.

Commodity money is the simplest and, most likely, the oldest type of money. It builds on scarce natural resources that act as a medium of exchange, store of value, and unit of account. Commodity money is closely related to (and originates from) a barter system, where goods and services are directly exchanged for other goods and services. Commodity money facilitates this process because it acts as a generally accepted medium of exchange. The critical thing to note about commodity money is that its value is defined by the intrinsic value of the commodity itself. In other words, the commodity itself becomes money. Examples of commodity money include salt, gold, silver, tobacco, and even seashells

Fiat Money

The origins of fiat money come from the Chinese Tang dynasty in the 11th Century. By the 12th Century, fiat money had become widely used throughout the country. It came under various names such as; jiaozi, huizi, and guanzi. During the 13th century, Marco Polo described the fiat money of the Yuan Dynasty in his book The Travels of Marco Polo. All these pieces of paper are issued with as much solemnity and authority as if they were of pure gold or silver; and on every piece, a variety of officials, whose duty it is, have to write their names, and to put their seals.

Fiat money gets its value from a government order (i.e., fiat). That means, the government declares fiat money to be legal tender, which requires all people and firms within the country to accept it as a means of payment. If they fail to do so, they may be fined or even put in

prison. Unlike commodity money, fiat money is not backed by any physical commodity. By definition, its intrinsic value is significantly lower than its face value. Hence, the value of fiat money is derived from the relationship between supply and demand. Most modern economies are based on a fiat money system. These usually cover banknotes and coins. Such examples include the Euro, the US dollar, and the Great British Pound.

Commercial Bank Money

Its origins date back to the medieval period. The Bardi, Peruzzi, and Acciaiuoli companies of Florence were among the first banks to use fractional reserve banking. Dating back to the beginning of the 12th century, they became among the leading lenders in Europe. This system is essentially what banks use today, with them lending out a proportion of what they receive from deposits.

Commercial Bank money is debt that has been created by banks with customers' fiat money. It is essentially an 'IOU' created by the bank, with the ledger marking some figures in the customer's account. Commercial Bank money is debt that has been created by banks with customers' fiat money. It is essentially an 'IOU' created by the bank, with the ledger marking some figures in the customer's account.

Fiduciary Money

Fiduciary money depends on its value on the confidence that it will be generally accepted as a medium of exchange. Unlike fiat money, it is not declared legal tender by the government, which means people are

not required by law to accept it as a means of payment. Instead, the issuer of fiduciary money promises to exchange it back for a commodity or fiat money if requested by the bearer. As long as people are confident that this promise will not be broken, they can use fiduciary money just like regular fiat or commodity money. Examples of fiduciary money include cheques, banknotes, or drafts.

Digital currency (**digital money**, **electronic money**, or **electronic currency**) is a balance or a record stored in a distributed database on the Internet, in an electronic computer database, within digital files, or a stored-value card. Examples of digital currencies include cryptocurrencies, virtual currencies, central bank digital currencies, and e-Cash.

Digital currencies exhibit properties similar to other currencies but do not have a physical form of banknotes and coins. Not having a physical form, they allow for nearly instantaneous transactions. Usually not issued by a governmental body, virtual currencies are not considered legal tender and they enable ownership transfer across governmental borders.[2]

These types of currencies may be used to buy physical goods and services, but may also be restricted to certain communities such as for use inside an online game.[3] One type of digital currency is often traded for another digital currency using arbitrage strategies and techniques.

Digital money can either be centralized, where there is a central point of control over the money supply, or decentralized, where the control over the money supply can come from various sources.

The evolution of Crypto Money

Hyper-inflation is yet another villain when it comes to fiat money. When the currency is made abundant in the economy, by the central bank, the money we have in our hands loses its value. So the currency should be something that must not lose its purchasing power just like that. The 21st century came in with two revolutions in the era of money, virtual currency, and mobile payments. Mobile payment is a wide term where it could be paying a petrol bill just through your phone or transferring money to any ones account without having a single penny in physical form. We have a lot on the list like pay time, SBI pay that assists us in this. Virtual currencies, on the other hand, are digital currencies that use encryption technology to regulate the units of currencies and verify and transfer funds to another person who is also a part of the so-called blockchain.

In 2008, an unknown computer programmer or group of programmers using the pseudonym Satoshi Nakamoto created a computer platform that would allow users to make valid transfers of digital representations of value.1 The system, called Bitcoin, is the first known cryptocurrency. A cryptocurrency is a digital money in an electronic payment system in which payments are validated by a decentralized network of system users and cryptographic protocols instead of by a centralized intermediary (such as a bank).

Since 2009, cryptocurrencies have gone from little-known, niche technological curiosities to rapidly proliferating financial instruments that are the subject of intense public interest.3 Recently, they have been incorporated into a variety of other financial transactions and products. For example, cryptocurrencies have been sold to investors to raise funding through initial coin offerings (ICOs), 4 and the terms of certain derivatives are now based on cryptocurrencies.5 Some government central banks have examined the possibility of issuing cryptocurrencies or other digital currencies.6 Media coverage of cryptocurrencies have been widespread, and various observers have characterized cryptocurrencies as either the future of money and payment systems that will displace government-backed currencies or a fad with little real value.7

Just like any other currency which serves the purpose of a medium of exchange, cryptocurrencies are also legally accepted currencies but what makes it different from any other currency is that it doesn't have a physical form, but it is completely digital. Cryptocurrencies use the technique of cryptography to secure all their transactions and also to create additional units of it. Cryptocurrencies are also called virtual currencies and are considered to be a subset of digital currencies. These are completely decentralized which means there no central authority is regulating them. Cryptocurrency acts as money in an electronic payment system in which a network of computers, rather than a single third-party intermediary, validates transactions. Cryptocurrency platforms often use blockchain technology to validate changes to the ledgers. Blockchain technology uses cryptographic

protocols to prevent invalid alteration or manipulation of the public ledger. Specifically, before any transaction is entered into the ledger and the ledger is irreversibly changed, some member of the network must validate the transaction. In certain cryptocurrency platforms, validation requires the member to solve an extremely difficult computational decryption. Once the transaction is validated, it is entered into the ledger.

These protocols secure each transaction by using digital signatures to validate the identity of the two parties involved and to validate that the entire ledger is secure so that any changes in the ledger are visible to all parties. In this system, parties that otherwise do not know each other can exchange something of value (i.e., a digital currency) not because they trust each other but because they trust the platform and its cryptographic protocols to prevent double-spending and invalid changes to the ledger. Cryptocurrency platforms often incentivize users to perform the functions necessary for validation by awarding them newly created units of the currency for successful computations (often the first person to solve the problem is given the new units), although in some cases the payer or payee also is charged a fee that goes to the validating member. In general, the rate at which new units are created—and therefore the total amount of currency in the system—is limited by the platform protocols designed by the creators of the cryptocurrency. 39 These limits create scarcity to ensure the cryptocurrency retains value. Because users of the cryptocurrency platform must perform work to extract the scarce unit of value from the platform, much as people do with precious metals, it is said that

these users mine the cryptocurrencies. Alternatively, people can acquire cryptocurrency on certain exchanges that allow individuals to purchase cryptocurrency using official government-backed currencies or other cryptocurrencies.

Cryptocurrencies are mainly of seven different types

1. Bitcoins
2. Litecoin
3. Ethereum **(**ETH**)**
4. Zcash(ZEC)
5. Dah (DASH)
6. Ripple(XRP)
7. Monero(XMR)
8. EOS (EOS)
9. Binance Coin (BNB)
10. Tether (USDT)
11. Libra (LIBRA)

Advantages of Cryptocurrency:

1. **Protection from inflation** –Inflation has caused many currencies to get their value declined with time. Almost every cryptocurrency, at the time of its launch, is released with a fixed amount. The source code specifies the amount of any coin; like, there are only 21 million Bitcoins released in the world. So, as

the demand increases, its value will increase which will keep up with the market and, in the long run, prevent inflation.

2. **Self-governed and managed –**Governance and maintenance of any currency is a major factor for its development. The cryptocurrency transactions are stored by developers/miners on their hardware, and they get the transaction fee as a reward for doing so. Since the miners are getting paid for it, they keep transaction records accurate and up-to-date, keeping the integrity of the cryptocurrency and the records decentralized.

3. **Secure and private –**Privacy and security have always been a major concern for cryptocurrencies. The blockchain ledger is based on different mathematical puzzles, which are hard to decode. This makes a cryptocurrency more secure than ordinary electronic transactions. Cryptocurrencies, for better security and privacy, use pseudonyms that are unconnected to any user, account, or stored data that could be linked to a profile.

4. **Currency exchanges can be done easily –**Cryptocurrency can be bought using many currencies like the US dollar, European euro, British pound, Indian rupee, or Japanese yen. With the help of different cryptocurrency wallets and exchanges, one currency can be converted into the other by trading in cryptocurrency, across different wallets, and with minimal transaction fees.

5. **Decentralized –**A major pro of cryptocurrency is that they are mainly decentralized. A lot of cryptocurrencies are controlled by

the developers using it and the people who have a significant amount of the coin, or by an organization to develop it before it is released into the market. The decentralization helps keep the currency monopoly free and in check so that no one organization can determine the flow and the value of the coin, which, in turn, will keep it stable and secure, unlike fiat currencies which are controlled by the government.

6. **Cost-effective mode of transaction –**One of the major uses of cryptocurrencies is to send money across borders. With the help of cryptocurrency, the transaction fees paid by a user are reduced to a negligible or zero amount. It does so by eliminating the need for third parties, like VISA or PayPal, to verify a transaction. This removes the need to pay any extra transaction fees.

7. **A fast way to transfer funds –**Cryptocurrencies have always kept themselves as an optimal solution for transactions. Transactions, whether international or domestic in cryptocurrencies, are lightning-fast. This is because the verification requires very little time to process as there are very few barriers to cross.

Disadvantages of Cryptocurrency :

1. **Can be used for illegal transactions –**Since the privacy and security of cryptocurrency transactions are high, it's hard for the government to track down any user by their wallet address or keep tabs on their data. Bitcoin has been used as a mode of

exchanging money in a lot of illegal deals in the past, such as buying drugs on the dark web. Cryptocurrencies are also used by some to convert their illicitly obtained money through a clean intermediary, to hide its source.

2. **Data losses can cause financial losses –**The developers wanted to create virtually untraceable source code, strong hacking defenses, and impenetrable authentication protocols. This would make it safer to put money in cryptocurrencies than physical cash or bank vaults. But if any user loses the private key to their wallet, there's no getting it back. The wallet will remain locked away along with the number of coins inside it. This will result in the financial loss of the user.

3. **Decentralized but still operated by some organizations –**The cryptocurrencies are known for its feature of being decentralized. But, the flow and amount of some currencies in the market are still controlled by their creators and some organizations. These holders can manipulate the coin for large swings in its price. Even hugely traded coins are susceptible to these manipulations like Bitcoin, whose value doubled several times in 2017.

4. **Some coins not available in other fiat currencies –**Some cryptocurrencies can only be traded in one or a few fiat currencies. This forces the user to convert these currencies into one of the major currencies, like Bitcoin or Ethereum first and then through other exchanges, to their desired currency. This

applies to only a few cryptocurrencies. By doing this, the extra transaction fees are added to the process, costing unnecessary money.

5. **Adverse Effects of mining on the environment** –Mining cryptocurrencies requires a lot of computational power and electricity input, making it highly energy-intensive. The biggest culprit in this is Bitcoin. Mining Bitcoin requires advanced computers and a lot of energy. It cannot be done on ordinary computers. Major Bitcoin miners are in countries like China that use coal to produce electricity. This has increased China's carbon footprint tremendously.

6. **Susceptible to hacks** –Although cryptocurrencies are very secure, exchanges are not that secure. Most exchanges store the wallet data of users to operate their user ID properly. This data can be stolen by hackers, giving them access to a lot of accounts. After getting access, these hackers can easily transfer funds from those accounts. Some exchanges, like Bitfinex or Mt Gox, have been hacked in the past years and Bitcoin has been stolen in thousands and millions of US dollars. Most exchanges are highly secure nowadays, but there is always a potential for another hack.

7. **No refund or cancellation policy** –If there is a dispute between concerning parties, or if someone mistakenly sends funds to a wrong wallet address, the coin cannot be retrieved by the sender. This can be used by many people to cheat others out of their

money. Since there are no refunds, one can easily be created for a transaction whose product or services they never received.

The Trend of cryptocurrency in Nigeria

Nigeria, the biggest source of Bitcoin (BTC) trading volume in Africa, is one of the fastest-growing crypto markets in the world, according to a new report.

According to a new study by major crypto wallet Blockchain.com, Nigeria has seen the largest influx of activity on its wallet app since April 2020.

The decision to keep an eye on the activities in the "digital asset" space was needed, as Nigeria is currently undergoing a "crypto boom". Despite the warning calls by the Central Bank of Nigeria (CBN) on the risks associated with cryptocurrencies and rebuking it as a legal tender in Nigeria in 2018, its adoption has become increasingly widespread. According to data from Useful tulips, a Bitcoin (BTC) analytics data provider, Nigeria led Sub-Saharan Africa in terms of peer-to-peer (P2P) Bitcoin trading volumes on two major bitcoin trading platforms, Local bitcoin and Paxful. For the 12 months up to September 2020, Nigeria accounted for a transaction value of US$342mn, with the next closest SSA country, Kenya, reporting volumes five times less, at US$70mn. However, we note that in the past year, the growth in transactions from the likes of Kenya (+146%) and Ghana (+624%), outweighed that of Nigeria (+17%).

Relatively, the Nigerian government has attempted to place a ban on cryptocurrency, although its legal status remains ambiguous unlike in countries like Morocco and Algeria where there is a clear ban on trading in Bitcoins such that a breach attracts heavy fines.

The various warnings issued also project the opportunities that cryptocurrencies create for illegal activities, such as money laundering and terrorism, illegal drug trafficking, human trafficking, and support for radical movements. In January 2017, the CBN issued a statement banning any transactions in Bitcoins, this was carried out by the banks' regulator circulating a statement to all banks in the country warning them against facilitating the trading of Bitcoins in the country. The CBN stated that traders risked losing all their money when they trade in a currency that is not regulated. This risk is largely associated with the volatile nature of cryptocurrencies. However, a lot did not heed this warning as most cryptocurrency exchanges continued to operate as usual. Nigeria's SEC also made a statement in 2017 warning Bitcoin traders to exercise extreme caution. Again in March 2018, the CBN reiterated its stance on cryptocurrencies warning traders that digital assets are a mere gamble

What are Bitcoins?

The first public record of Bitcoin dates to October 2008, when a pseudonymous person or organization known as Satoshi Nakamoto published a white paper with the technical outlines for a new, decentralized cryptocurrency. Nakamoto’s identity remains unknown, though speculation centers on a handful of U.S.-based individuals (or

various groupings thereof) who were active in the cryptocurrency movement of the 1990s and 2000s. Nakamoto released Bit coin's open-source code in January 2009, marking the beginning of public mining and trading, and ceased public communication shortly thereafter. Bitcoins are invented for the era of innovation, Digital money for a digital era. Suppose, a villager doesn't have the access to a bank account, if he is with a smartphone, using it he can open a bitcoin account so easily. The moment he opens a bitcoin account what he gets is an international account and he becomes powerful enough to transfer money to anyone around the world. He becomes a part of a global chain. Unlike any other currencies, bitcoin is a global currency. Just like the internet which no one can shut down, or no one holds the authority of it, the same is the case with bitcoins. In general, we can say that it serves all purposes of a currency that is a medium of exchange, a store of value, and a unit of account. Since it does"t have the ownership right by any central authority, there exists no confusion of how much to produce whom to produce and for what to produce.

Bitcoin is a decentralized currency that uses the principle of a peer-to-peer network, which makes it possible to collectively issue, process, and verify transactions. Due to the lack of a central authority, Bitcoin is independent of the intervention or manipulation of any government, however, this, in turn, is the absence of guarantees of the smooth operation of the network or any kind of support for the value of the cryptocurrency. Bitcoin appears in digital form during the mining process. For bitcoin mining, powerful computers are used. At the moment, the total mining performance is 25 bitcoins in 10 minutes.

According to the algorithm established for bitcoin mining, the total amount of cryptocurrency is limited to 21 million units of bitcoin. According to estimates, this amount will be reached in 2140.

Bitcoin does not have such restrictions and insurance mechanisms. Its value directly depends on the intentions of investors to pay for it at the current time. In case of bankruptcy of the Bitcoin exchange, account holders have very little chance of returning their funds.

Bitcoin, due to the lack of a central regulator and anonymity of transactions, has become especially popular among money laundering, smuggling, and other areas of illegal activities. Very often, statements are made that the cryptocurrency Bitcoin is used to finance terrorism.

The Advantages of Bitcoins

Bitcoins are defined to be scarcest, most divisible, most transportable „most verifiable and the most recognizable form of money.

1. They are the scarcest because at any time there will not be more than 21 million bitcoins circulating.
2. It is divisible because the one-bit coin is made of one million bits.
3. It is frictionless, which means we can send bitcoins through emails, text messages, or even paper 4. Bitcoins are verifiable. It uses the technique of cryptography to verify the transactions.
5. It is global. Like the internet, bitcoins can reach any part of the world. One can transfer their bitcoins to any person in any part of the globe.

6. It is open-source. It doesn't have an owner. Anyone can get into transactions through bitcoins.

7. International Transactions Easier Than Regular Currencies-Like any other digital transaction, bitcoin doesn't need any third-party authentication.

The Negative impacts of bitcoins

Like any other technological innovation, bitcoins also have their negative side. Some of the main disadvantages are explained below.

1. Though bitcoins are legally accepted, only a few online merchants have accepted them.

2. There are chances for governments to set a hold on these merchants from accepting bitcoins. 3. Since there is no central authority controlling its use, there are chances of money laundering and other illegal activities to route through this network.

4. Recovery of bitcoins, if anything wrong happens with the hardware, cannot be promised.

5. The rates of bitcoins fluctuate widely. This makes online payments and refunds a difficult job. Prices of commodities also will not be stable.

6. Since only a 21millions bitcoins are available, there are chances for deflation to occur over time, and the problem of when to use them becomes a matter of question.

7. Since it is completely decentralized, there is no minimum guarantee promised for the value of the bitcoins. So the risk involved in trading using bitcoins is high.
8. Proper understanding of the whole system is very important while dealing with digital currencies.
9. The transaction costs of the bitcoin ATMs are said to be very high, at around 7 percent. Bitcoin ATMs were reported by Brian Krebs in 2016 to be rising in popularity for money mulling, a type of money laundering where money is moved out of banks to exporters.

CONCLUSION

Looking at the history of money as a whole, cryptocurrency is still in its relative infancy. Bitcoin – which is the first form of cryptocurrency to have achieved such a level of success and popularity – is still just over a decade old. Nevertheless, it is already being touted as the next global currency in many online news sources. Although coins and paper money will likely remain in widespread use for many years, the shift toward cryptocurrencies like Bitcoin is something that seems to be inevitable. To conclude, bitcoin fulfills most qualities as ideal money. Its supply is also fixed in contrast to that of fiat currency. However, before you rush out and cash in your dollars for Bitcoin, remember that Bitcoin has a long way to go before it's a legitimate currency on par with the U.S. dollar, euro, or pound. And despite the seductiveness of cryptocurrency as a means of exchange, there's no guarantee that Bitcoin – or any other decentralized, virtual currency

not controlled by a national bank – will ever be a viable alternative to fiat currencies. It may take longer for bitcoin to become a true medium of exchange, but the process for mankind to search for better money never stopped, and we believe that bitcoin (and cryptocurrencies in general) will be a very strong candidate to position itself as the future of money.

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