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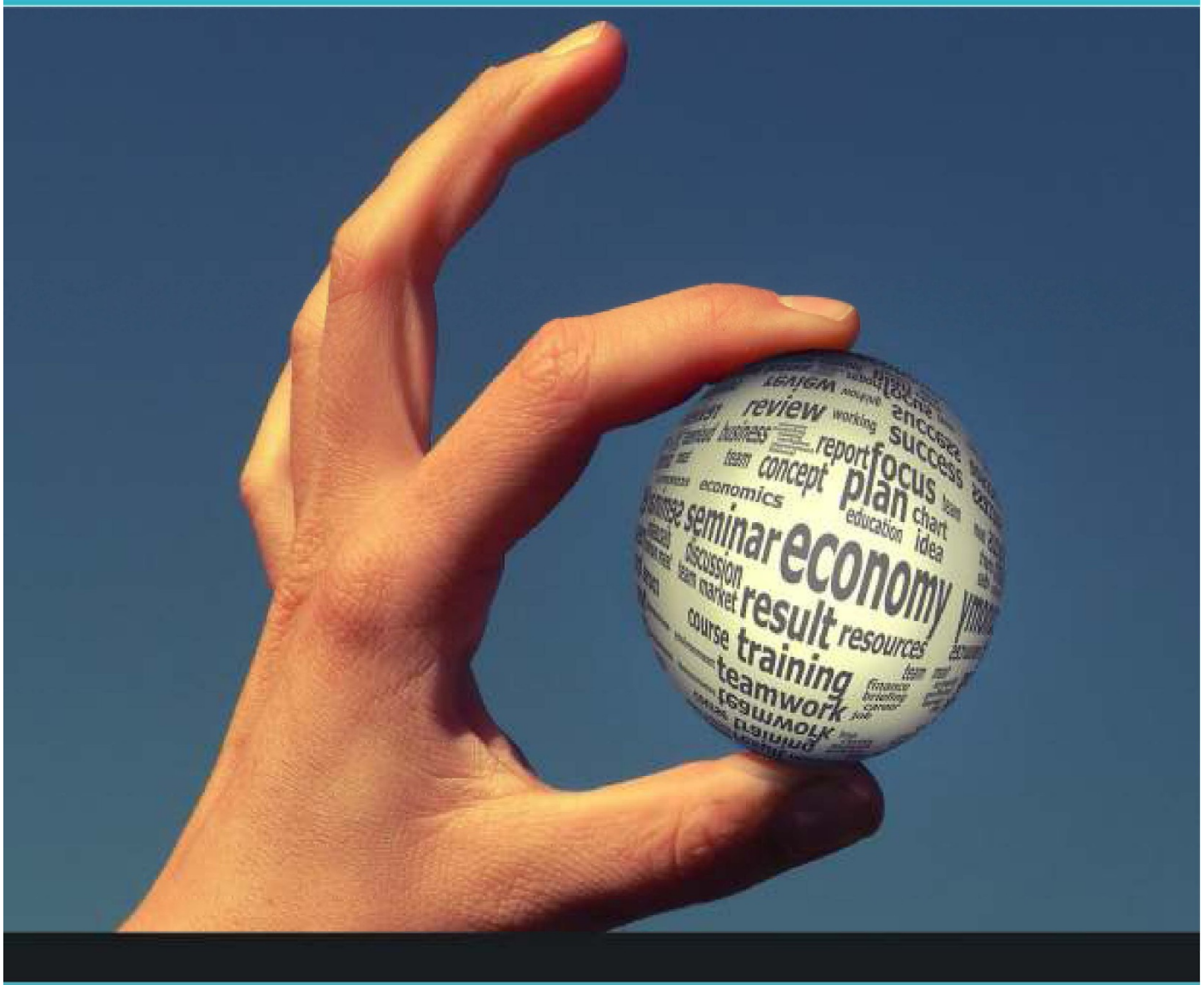

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A DECISION SUPPORT SYSTEM BASED ON GENETIC ALGORITHM FOR VARIABLE SIZED BIN PACKING PROBLEM WITH ITEM CONFLICTS

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Abstract

Bin packing problem (BPP) is a combinatorial NP-hard problem that has variations including one, two and three dimensional packing, variable sized packing and packing with constraints. In the literature, exact and approximation algorithms have been mostly used to solve bin packing problems. Genetic Algorithms are meta-heuristic methods that have been applied to a vast majority of well-known optimization problems including the bin packing problems. In this paper, a variant of bin-packing problem for variable bins is addressed. The capacity constraints including volume and weight are given; moreover, to avoid item conflicts is defined as an additional constraint. A decision support model utilizing the genetic algorithm is introduced for this variant of the BPP. The performance of the model is tested with sample input, the results obtained are presented and discussed in the results section.

Keywords: Variable sized bin-packing problem, Genetic Algorithm, item conflicts, decision support systems
JEL Codes: C02, C6, M11

I. INTRODUCTION

Bin Packing Problem (BPP) is one of the classical combinatorial optimization problems and has received a great deal of attention in the literature due to its various application areas. In the classical BPP, a set of items must be assigned to a finite number of bins of fixed capacity in a way

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that minimizes the number of bins used. Besides classical one-dimensional BPP, there are many variations of BPP such as variable sized (Friesen & Langston, 1986; Kang & Park, 2003; Haouari & Serairi, 2009), two-dimensional (Li, Liu, Wu, & Xu, 2014), three dimensional (Martello, Pisinger, & Vigo, 2000), online (Kinnersley & Langston, 1988) and so on.

The problem addressed in this paper includes different categories of bins and each one contains limited and/or unlimited number of identical bins with the same capacity and cost. In addition, it contains different item categories; each involves finite number of identical and/or non-identical items. As we consider variable sized bin categories, our problem falls into the variable sized bin-packing problem (VSBPP) class with additional constraints that are considering volume capacities of bins in addition to weight capacities and conflicts between items.

VSBPP was first investigated by Friesen & Langston (1986). VSBPP is a generalization of the classical BPP and formally defined (Correia, Gouveia, & Saldanha-da-Gama, 2008) as follows: Given a set J of n items where each item j ($1 \leq j \leq n$) has a weight w_j and m different bin types. Each bin type k (k=1, …, m) includes an infinite number of identical bins, each having a capacity W_k and a fixed cost c_k. The objective is to minimize the total cost of bins used to pack all items.

Even though the classical BPP has been widely investigated in the literature, the VSBPP has received scant attention (Haouari & Serairi, 2011). Kang & Park (2003) addressed the VSBPP with two greedy algorithms they proposed to solve three particular cases of the problem. Correia et al. (2008) studied the VSBPP using a discretized model and obtained good linear programming bounds to solve instances including up to 1000 items. Bang-Jensen & Larsen (2012) investigated real life instances of the VSBPP with a construction and a local search heuristic with the aim of obtaining high quality solutions for large number of bin sizes and adapting fast to online changes in data. Maiza, Labed, & Radjef (2013) analyzed VSBPP with the aim of minimizing the total cost of bins by applying four heuristics they proposed. Dokeroglu & Cosar (2014) analyzed the one-dimensional BPP and applied bin-oriented heuristics in island parallel grouping genetic algorithms.

In the literature, there have also been studies addressing the BPP and VSBPP with item conflicts. Jansen (1999), Epstein & Levin (2008), Sadykov & Vanderbeck (2013) and Bodis (2015) have studied the BPP with conflicts. Epstein, Favrholdt, & Levin (2011) analyzed the online VSBPP with conflicts between items, which express that if there is a conflict on a pair of items, they cannot be assigned to the same bin and investigated online algorithms using mainly the asymptotic competitive ratio.

The BPP is an NP-hard problem (Korte & Vygen, 2006) and thus, the VSBPP is NP-hard as well. In the literature, exact and approximation algorithms are used to solve this problem. Monaci (2003) applied a branch-and-bound procedure to solve instances with 3 or 5 types of bins and up to 500 items. Alves and Valerio de Carvalho (2008) presented a branch-and-price-and-cut algorithm and used the instances of Belov & Scheithauer (2002) and Monaci (2003). Haouari & Serairi (2009) proposed a branch and bound algorithm to solve the test instances including three bin types, up to 500 items and randomly generated weights from discrete uniform distribution. Since the VSBPP is NP-hard these exact methods might require excessive computing time to solve large-scale instances. Many heuristic and meta-heuristic algorithms have been applied to the BPP and its extensions in the literature. In this paper, we proposed a genetic algorithm (GA) to solve the analyzed VSBPP.

GA is one of the most popular meta-heuristics that has been applied to a vast majority of well-known optimization problems including the BPP and its variants successfully. Falkenauer (1996) addressed the BPP by applying the Grouping GA of Falkenauer (1994). The Grouping GA is a group-oriented approach and it focuses on bins instead of items. Reeves (1996) used an approach hybridizing the GA with existing simple heuristics to solve the BPP. Iima & Yakawa (2003) proposed a new design of GA to solve one-dimensional BPP focusing on the item combinations in a bin. They designed a GA in a way that offspring inherit the combination of items. They solved 1210 benchmark instances to test the performance of their GA. According to their results, their GA performed better than Variable Neighborhood Search and BISON that is an approach combining the tabu search method and the branch-and-bound method in terms of accuracy of solutions. Mohamadi (2010) addressed the one dimensional BPP applying the GA with a new representation scheme. This scheme was constructed by combining the strong features of bin-based, object-based and group-based representation schemes. Quiroz-Castellanos, Cruz-Reyes, Torres-Jimenez, Gomez, Huacuja, & Alvim (2015) handled the one dimensional BPP with a method based on a grouping GA. Their method, which is referred to as the Grouping Genetic Algorithm with Controlled Gene Transmission, aimed the transmission of the best genes in the chromosomes with balancing the selective pressure and population diversity. Their approach improved the performance of grouping GA and was comparable to the best state of the art algorithms.

The paper is organized as follows. In Section 2, we present the formulation of the problem. Our solution algorithm is given in Section 3. Results of computational experiments are provided in Section 4. In Section 5, we discuss the results and draw conclusions.

II. FORMULATION OF THE PROBLEM

The problem analyzed can be defined as a VSBPP with conflicts including assignment of items to the variable sized bin categories considering weight and volume capacity of heterogenous bins while avoiding co-existence of conflicting item categories. The objective is to minimize the total cost of bins used to assign all items.

Indices, parameters, variables and formulation of the model are as follows:

Indices:

j, i= 1,2,…,n Index of items

m, r =1,2,…,M Index of item categories

k=1,2,…,K Index of bin types

Parameters:

c_k: Cost of bin type k

w_{mj}: Weight of item j in m category

v_{mj}: Volume of item j in m category

W_k: Weight capacity of bin type k

V_k: Volume capacity of bin type k

l_{mr} : A parameter used to avoid joint assignment of item categories m and r which are in conflict. It equals to 1 if item category m and r can be placed into the same bin, 0 otherwise

Decision Variables

y_k: $\begin{cases} 1 & \text{if bin type k is used} \\ 0 & \text{otherwise} \end{cases}$

x_{mjk} : $\begin{cases} 1 & \text{if item j in category m is assigned to bin type k} \\ 0 & \text{otherwise} \end{cases}$

Mathematical Model

$$\text{Min} \sum_{k=1}^{K} y_k * c_k \quad (1)$$

$$\text{s.t.} \sum_{m=1}^{M} \sum_{j=1}^{n} w_{mj}\, x_{mjk} \leq W_k y_k \qquad k = \{1, \dots, K\} \quad (2)$$

$$\sum_{m=1}^{M} \sum_{j=1}^{n} v_{mj}\, x_{mjk} \leq V_k y_k \qquad k = \{1, \dots, K\} \quad (3)$$

$$\sum_{k=1}^{m} x_{mjk} = 1 \qquad m=\{1, \dots, M\};\ j=\{1, \dots, n\} \quad (4)$$

$$l_{mr} \geq x_{mjk} + x_{rik} - 1 \qquad \text{for all } m; r; i; j; k;\ m \neq r \quad (5)$$

$$x_{mjk} \in [0,1] \qquad m=\{1, \dots, M\};\ j=\{1, \dots, n\};\ k=\{1, \dots, K\} \quad (6)$$

$$y_k \in [0,1] \qquad k = \{1, \dots, K\} \quad (7)$$

This formulation includes volume capacity and item categories' conflict constraints in addition to classical VSBPP formulation of Correia et al. (2008). The objective function (1) is to minimize the cost of the bins used for packing all the items. Constraints (2) and (3) ensure that items are always assigned to bins without violating the weight and volume capacity of bins. Constraint (4) guarantees that each item is packed and assigned to only one bin. Constraint (5) ensures that when item category m and r are in conflict, the items in these categories can not be in the same bin. Constraints (6) and (7) are domain constraints.

Since the problem is NP-Hard, obtaining optimal results using exact algorithms may not be possible within a reasonable time due to those problems' size and complexity. For complex variable sized bin packing problems, approximation algorithms and many metaheuristic approaches have been used (Delorme, Iori, & Martello, 2016). From this point of view, Genetic Algorithm, one of the most successful metaheuristics, is applied in this paper.

III. SOLUTION MODEL

III.I. Genetic Representation for VSBPP

Genetic algorithms are discovered as useful tools for search an optimization problems; such algorithms are classified as stochastic since randomness has an essential role (Sivanandam, & Deepa, 2008). In genetic algorithms, the term 'chromosome' refers to a candidate solution to a problem; the chromosomes are populated, selected according to fitness, and crossed over to generate new offspring of chromosomes (Mitchell, 1998).

In a VSBPP problem, the solution is essentially an arrangement of items into bins. Since the bins have limited capacity, each arrangement must satisfy the capacity constraints. Moreover,

each item appears exactly once in a valid chromosome (Falkenauer, 1996). The genetic model developed for VSBBP problems should utilize a genetic representation that can formulate any valid solution that conforms to the constraints.

Given an input that consists of *m* bins and *n* items, the genetic representation of VSBPP can be generalized as a chromosome that consists of *m* x *n* genes. Since the bin capacity can be hypothetically large enough to contain all of the items, such a genetic representation is sufficient to represent every feasible solution. Table-I exhibits a chromosome that formulates the genetic representation of a VSBBP with an input of two bins and five items.

Table I. The Genetic Representation of a VSBBP for 2 Bins & 5 Items

	Item#1		Item#4		Item#3	Item#5			Item#2
BIN #1					BIN #2				

According to the genetic representation above, a random solution would be a random distribution of items into the slots in the chromosome. Such a distribution would result in a vast number of permutations, since the value of permutation (n, m x n) is huge as the values of m and n get considerably larger. However, such permutations often represent the same solution. For instance, swapping Item #3 and Item #5 would change the genetic representation in the sample chromosome exhibited in Table I; however, such a modification in the chromosome would represent exactly the same solution. Minimization of redundancy is an important design principle for constructing genetic representations; in this regard, each solution should be represented by as few distinct chromosomes as possible (Falkenauer, 1996).

III.II. Initial Population Generation

In genetic algorithms, the initial population usually consists of valid individuals generated at random (Falkenauer & Delchambre, 1992). In VSBPP, the validity criteria consist of the problem capacity constraints defined for the bins. Moreover, as shown in problem formulation, a valid individual should contain an arrangement of all items into the bins.

The solution model involves the initial population generation at random. This step requires a random distribution of items into the bins. Each random chromosome is evaluated according to the constraints specified in the input. In our problem, the capacity constraints are separately defined in terms of volume and weight. Furthermore, the existence of item conflicts requires additional controls on the individuals. As an example, one might define a rule such as “Items of food category should not be placed in a bin that has already contained chemicals”. The model

also takes account of such rules as constraints. The randomly generated valid chromosomes that satisfy all constraints are included in the initial population.

III.III. Crossover and Offspring Generation

A new generation of chromosomes is formed through crossover in each iteration. Population diversity is crucial to the genetic algorithm's ability to continue fruitful exploration (Nsakanda, Price, Diaby, & Gravel, 2007). In this regard, selection of crossover operators is important. Various strategies are employed for crossover, such as single-point crossover, two-point crossover, multi-point crossover, uniform crossover, three parent crossover, shuffle crossover, ordered crossover, etc. (Sivanandam & Deepa, 2008). In single-point, two-point or N-point crossover strategies the new individuals are generated with chunks of genes copied from the parents. On the other hand, each gene is inherited randomly from one of the parents in uniform crossover strategy. In our study, a uniform crossover strategy was used to promote population diversity.

The objective of the crossover is to generate a number of healthy individuals in the new offspring. In our study, tests were executed with population sizes of 50, 100 and 200. Each test includes a random population of individuals and 50 consecutive crossovers. The newly bred chromosomes are checked against capacity constraints, conflict criteria, and finally checked to avoid redundancy. Before the next iteration, the ancestors and newly populated offspring is combined, and the individuals with the minimum cost are selected for the next crossover phase.

III.IV. Fitness Function

In a bin-packing problem, the quality of a solution can be intuitively expressed in terms of the number of bins used. Burke, Hyde, Kendall, & Woodward (2012) argued that using simply the number of bins lead to problem of plateaus in the search space. However, the assumptions of our problem involve that the cost of the bins varies as well as bin capacity. Since the objective of the problem is to find solutions with minimum cost, the fitness of a solution is formulated as the total cost of bins used.

III.V. Input Data and Criteria

The input consists of sample data with 50 items of seven categories. The inputs vary in terms of weight and volume. As an assumption, item category is used to define the item conflicts. The weight, volume and category of items are listed in Table II.

Table II. Weight, Volume and Category of the Items

Item No	Category	Weight (kg)	Volume (cm^3)	Item No	Category	Weight (kg)	Volume (cm^3)	Item No	Category	Weight (kg)	Volume (cm^3)
0	1	1100	500	**17**	4	440	200	**34**	5	45	1500
1	1	240	450	**18**	4	100	200	**35**	5	300	600
2	1	200	500	**19**	4	1600	400	**36**	6	100	200
3	1	300	600	**20**	4	80	125	**37**	6	115	100
4	2	1300	2000	**21**	4	160	275	**38**	6	635	100
5	2	260	500	**22**	4	1600	200	**39**	6	120	110
6	3	250	350	**23**	4	40	100	**40**	6	310	170
7	3	200	600	**24**	4	90	225	**41**	6	90	120
8	3	440	200	**25**	4	100	600	**42**	6	500	200
9	3	300	200	**26**	5	150	430	**43**	6	220	100
10	3	520	800	**27**	5	145	1000	**44**	6	145	600
11	3	230	400	**28**	5	90	160	**45**	6	600	100
12	3	600	400	**29**	5	560	750	**46**	7	300	180
13	3	300	590	**30**	5	220	1270	**47**	7	180	90
14	3	400	500	**31**	5	140	1500	**48**	7	200	225
15	3	600	300	**32**	5	180	200	**49**	7	380	400
16	4	210	200	**33**	5	120	400				

Table III exhibits the bins with variable sizes that differ in capacity and cost.

Table III. Constraints for Bins and Bin Costs

Bin Type	Available Number	Cost (units)	Maximum Volume (cm^3)	Maximum Weight (kg)
1	4	350	16000	7000
2	4	250	7000	4500
3	4	180	4800	2200
4	4	525	26330	19000

Since the VSBP problem addressed has item conflicts, a list of rules that define the co-existence of items is required. It is assumed that the items conflicts exist among item categories. The conflict constraints across item categories is exhibited in Table IV.

Table IV. Item Conflicts Defined In Terms of Categories

Category	1	2	3	4	5	6	7
1		X					
2	X						X
3							
4							
5							
6							
7		X					

IV. EXPERIMENTAL RESULTS AND DISCUSSION

In order to test the genetic model presented, an application has been developed using C# in Microsoft Visual Studio 2015. Sample data provided in Table I, Table II, Table III were used in order to generate results. At the end of each iteration, the software provides a copy of the population as well as the duration of the calculations in a file. The application is designed to use the population size and iteration count provided as parameters. In addition, all tests are executed without the item conflicts.

Initially, the model was used to generate results with 50 items 16 bins. In the initialization and offspring generation phases, the number of individuals was supplied as 50, 100 and 200. For each of the population size, 100 tests were carried out. In addition, the items and bins were simply duplicated to perform the tests for larger scale. Resultantly, 600 tests were performed with various combinations of inputs and population sizes. Test results with conflicts are included in Table V.

Table V. Results of Tests for Various Population Sizes (With Conflicts)

	50 Items, 16 Bins, With Conflicts			**100 Items, 32 Bins, With Conflicts**		
Population Size	**50**	**100**	**200**	**50**	**100**	**200**
Min. Cost Obtained (units)	1650	1300	1050	3465	2400	2080
Min. Cost Avg. (units)	2173	1712	1404	4857	3284	2378
Avg. # of Iteration for Min. Cost	19,18	22,47	24,41	23,08	28,37	29,95
Avg. Duration / Iteration (ms)	74	144	294	379	897	2559

In order to compare the effect of conflicts on the results, all tests were performed without the conflicts. The results are given in Table VI.

Table VI. Results of Tests for Various Population Sizes (Without Conflicts)

	50 Items, 16 Bins, No Conflicts			**100 Items, 32 Bins, No Conflicts**		
Population Size	**50**	**100**	**200**	**50**	**100**	**200**
Min. Cost Obtained (units)	1550	1050	1050	2760	2330	2080
Min. Cost Avg. (units)	2078	1645	1318	4225	2870	2376
Avg. # of Iteration for Min. Cost	19,61	22,99	25,63	24,60	27,70	31,56
Avg. Duration / Iteration (ms)	72	106	230	257	674	5128

In a typical optimization problem, an increase in costs can be expected, as the constraints get tighter. Therefore, it can be argued that the tests executed without conflicts must result in average smaller costs. Indeed, the average minimum costs obtained in tests without conflicts are smaller in both input scales and all population sizes. Moreover, the tests without item conflicts mostly performed

faster. Exceptionally, tests with 100 items and population size of 200 performed faster with conflicts. The subsequent tests to check the consistency of this finding evaluated in similar results. A possible explanation of this finding is that the conflicts lead to more separately arranged items where the fail possibility due to capacity constraints is lower.

In Table V and Table VI, it can be noticed that in most tests the minimum score is obtained at iterations between 20 and 30. Due to preliminary tests, each test was planned with 50 consecutive crossovers after the initialization. It can be claimed that in the tests with a higher population size, the results improve in more iterations.

In the results given in Table V and Table VI, it is noticeable that the minimum costs are obtained in the tests with largest population size. On the other hand, the time required to complete better results are significantly longer. In fact, it was predictable to notice trade-offs between minimum costs obtained in the tests and average duration of iterations. Such a relationship is exhibited in Figures I and II.

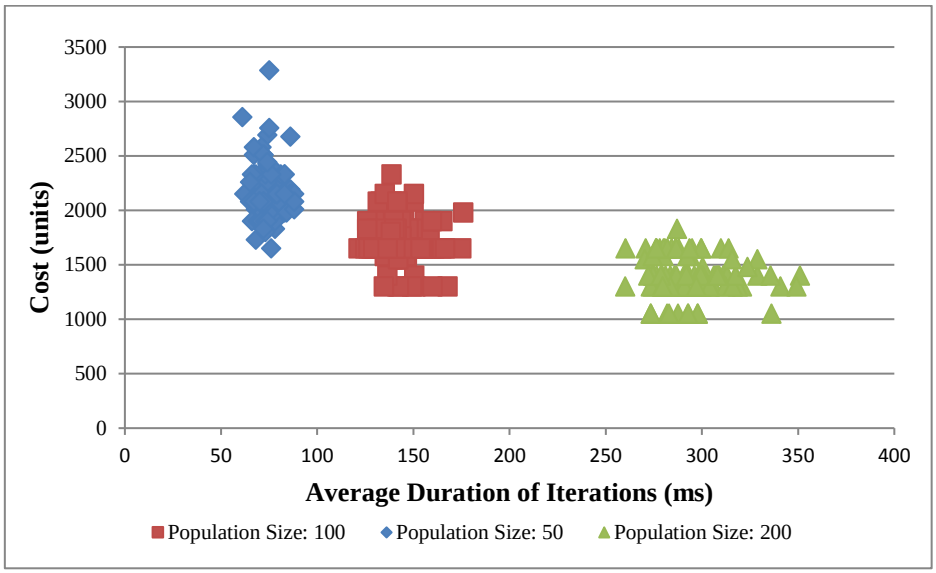

Figure I. Tradeoff between best cost with duration (50 Items, 16 Bins, With Conflicts)

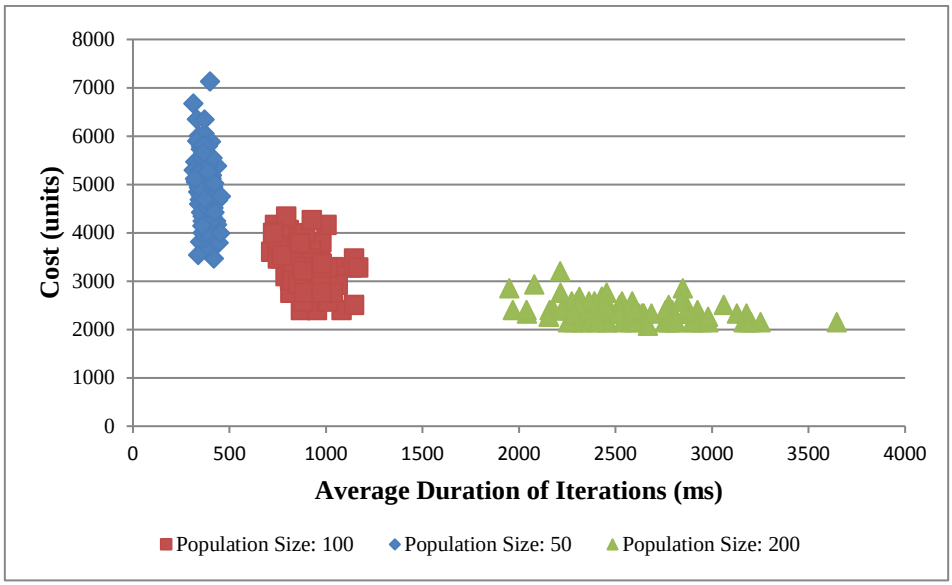

Figure II. Tradeoff between best cost with duration (100 Items, 32 Bins, With Conflicts)

Each test consists of an initialization phase and 50 offspring generated with consecutive crossovers. As each offspring is generated, it is aimed to obtain individuals with better fitness score. In our model, it can be observed that the minimum costs decrease in further crossovers.

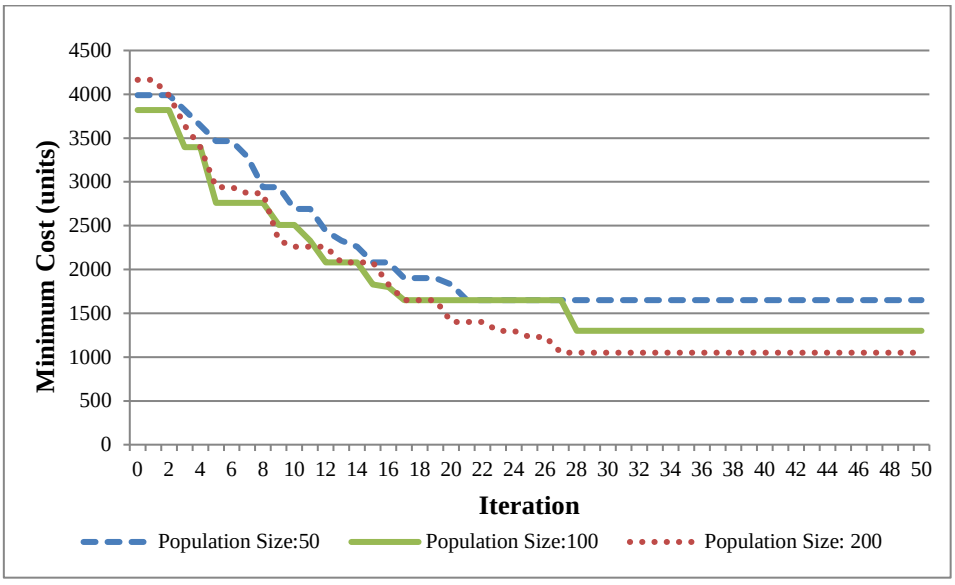

Figure III. Min. Cost by Iteration (50 Items, 16 Bins, With Conflicts)

In Figure III and Figure IV, the graph of minimum costs achieved in each iteration are depicted, from the initial population to the last offspring.

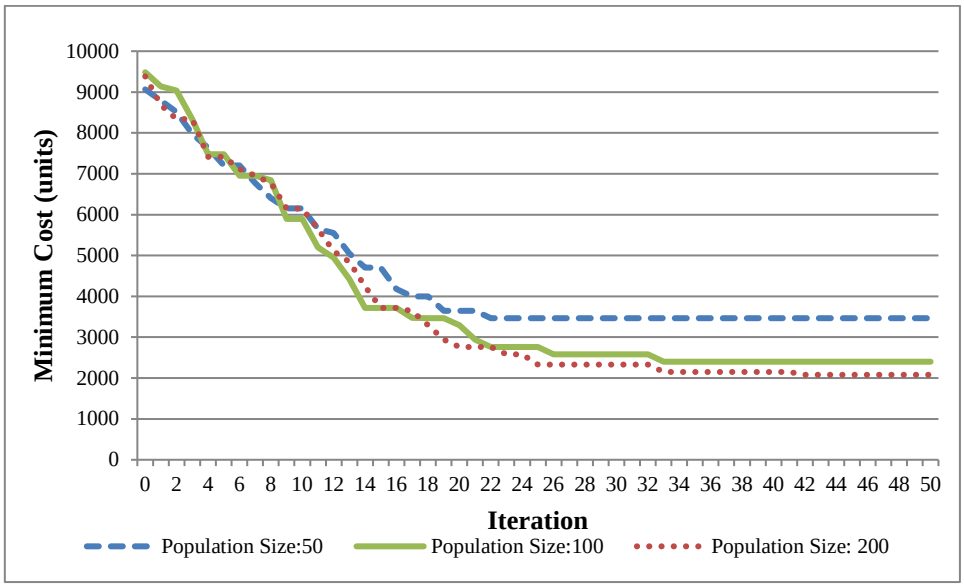

Figure IV. Min. Cost by Iteration (100 Items, 32 Bins, With Conflicts)

To demonstrate the performance of the genetic approach in our problem, each attempt to produce a valid chromosome was logged to generate statistics. The validity of an individual is checked against the capacity and conflict constraints. Moreover, chromosomes eliminated due to redundancy were also reported in Table VII.

Table VII. Statistics on the Validity of Individuals at Initialization and Crossover

Phase	Items	Population	Attempts	Failures	Conflicts	Redundant	Success	Failure Rate (%)	Conflict Rate (%)	Redundancy Rate (%)	Success Rate (%)
Initialization	50	50	3.213.624	1.822.609	944.596	441.506	4.913	56,7151	29,3935	13,7386	0.1529
Initialization	50	100	6.078.831	3.423.945	1.794.209	850.799	9.878	56,3257	29,5157	13,9961	0.1625
Initialization	50	200	10.769.452	6.069.206	3.151.620	1.528.975	19.651	56,3558	29,2644	14,1973	0.1825
Initialization	100	50	5.281.637	4.228.397	923.886	124.341	5.013	80,0585	17,4924	2,3542	0.0949
Initialization	100	100	9.602.425	7.641.973	1.712.083	238.381	9.988	79,5838	17,8297	2,4825	0.1040
Initialization	100	200	17.791.196	14.148.533	3.187.221	435.443	19.999	79,5255	17,9146	2,4475	0.1124
Crossover	50	50	295.556	10.057	25.334	10.192	249.973	3,4027	8,5716	3,4484	84.5772
Crossover	50	100	627.340	55.502	64.514	7.365	499.959	8,8472	10,2837	1,1740	79.6951
Crossover	50	200	1.374.464	221.329	149.593	3.593	999.949	16,1029	10,8837	0,2614	72.7519
Crossover	100	50	333.105	35.876	40.594	6.650	249.985	10,7702	12,1865	1,9964	75.0469
Crossover	100	100	834.197	215.145	115.790	3.282	499.980	25,7907	13,8804	0,3934	59.9355
Crossover	100	200	2.600.237	1.305.399	293.473	1.407	999.958	50,2031	11,2864	0,0541	38.4564

In Table VII, it can be noticed that the count of attempts required to generate the same number of valid individuals is dramatically lower in the crossover phase. Accordingly, the success rate of

individuals is dramatically higher, while the conflict rate and failure rate is significant lower in crossovers.

Another prominent finding is that the failure rate due to capacity is higher when the input scale is larger. When the item count is scaled up by two, the complexity of the problem greatly increases due to the permutation of twice number of items into twice number of bins.

V. CONCLUSION

VSBP problems have various application areas including packing, cutting, loading and scheduling (Haouari & Serairi, 2009). In this paper, a model based on GA was proposed for a VSBP problem with item conflicts. The genetic model was tested on a sample case. Tests were executed with various input scales and population sizes. Additionally, the problem is solved without item conflicts to observe the behavior of the genetic model in both scenarios.

The findings mostly overlap with previous GA and VSBP studies. As expected, the test results indicated that iterations with crossovers generate offspring with better fitness scores than brute force approach. Mostly, the fitness scores improve over 20-30 iterations. Figures III and IV demonstrate the improvement through consecutive iterations with crossover for different population sizes.

The scalability of the model was tested with two different sets of inputs. For the first sample input that consists of 50 items and 16 bins, the best result was a minimum of 1050. As the input was duplicated, the best result obtained was 2080 resulting in a slight improvement on the cost per item. Both scores were obtained in the tests with largest population size. In general, it has been noticed that larger population sizes lead to individuals with better fitness scores. However, the decline in cost was accompanied with an increase in calculation time. The tradeoff between the time of computation and costs obtained was exhibited in discussion.

It has been noticed that the existence of conflicts in the constraints mostly increases the duration of the iterations. Besides, with a decent population size and sufficient iterations for crossover, the model helped to obtain the same results without the conflicts. Considering the limitations of the study, it can be claimed that such a finding is limited for the inputs in our case.

The genetic algorithms mostly rely on the use of selection, crossover and mutation operators (Sivanandam & Deepa, 2008). Various crossover strategies have been proposed including Simplex crossover (Tsutsui, Yamamura, & Higuchi, 1999), multi-parent partially mapped crossover (Ting, Su, & Lee, 2010). In further studies, GA solutions for VSBP problems with conflicts can be reinforced

with mutation operators, and tested with adoption of different crossover operators. Furthermore, the efficiency of genetic models for VSBP problems can be enhanced with the use of heuristics.

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TRADE RULES FOR UNCLEARED MARKETS WITH A VARIABLE POPULATION*

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Abstract

We analyze markets in open economies in which the price of a traded commodity is fixed and as a result of this stickiness, the demand and the supply are possibly unequal. In our model, the agents have single peaked preferences on their consumption and production choices. For such markets, we analyze the implications of population changes as formalized by the well-known "consistency" property. We first characterize the subclass of "Uniform trade rules" that satisfies Pareto optimality, no-envy, and consistency. Next, we add an informational simplicity property which is called "independence of trade volume" and we show that among the "Uniform trade rules" that satisfy Pareto optimality, no-envy, and consistency, only the one that clear either the short or long side of the market satisfies independence of trade volume.

Keywords: market disequilibrium, trade rule, variable population, efficiency, consistency

JEL Classification numbers: D5, D6, D7

I. INTRODUCTION

We analyze markets in open economies in which (i) the price of a traded commodity is fixed, (ii) the demand and the supply are possibly unequal, and (iii) the population is variable.

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There are many examples of such non-clearing markets. Mostly, these are regulated markets, that is, the price is determined by a central authority.

The agricultural sector such as the hazelnut market provides a typical example. For political reasons, the markets in this sector are usually regulated and because of these regulations, the demand and the supply may not be equal. In fact, there is usually an excess supply. For example, in hazelnut market, the prices are determined by the government and as a result, there is usually an excess supply. For example, in Turkey, the government sets a maximum amount of production for each farmer and up to that amount, it purchases all the supply. The public health sector provides another example. The prices of public hospitals are determined by a central authority and by law, the hospitals have to attend all the patients even though there is usually excess demand.

The main question is the following: in such markets, how should a central authority design a mechanism (hereafter, a trade rule) that determines the trade? In this paper, we characterize trade rules satisfying some good properties.

In our model, there is only one commodity to be traded. There are differentiated sets of buyers and sellers. We assume that buyers have single peaked preferences on their consumption of the commodity. This assumption is derived from a general assumption that buyers have strictly convex preferences on consumption bundles. Similarly, we assume that sellers have single peaked preferences on their production of the commodity. This is also derived from a general assumption that the sellers have strictly convex production sets.

A trade rule maps each economy to a feasible trade. In our model, it is made up of two components: a trade-volume rule and an allocation rule. The trade-volume rule determines the trade-volume that will be carried out in the economy and thus, the total consumption and the total production. Then, the allocation rule allocates the total consumption among the buyers and the total production among the sellers.

A trade-volume rule takes single peaked preferences of the buyers and sellers and it determines the trade-volume. When there are only one buyer and one seller in our model, this is like determining the level of public good production level when agents have single peaked preferences. In this sense, our model is related to (Moulin, 1980). However, when there are more than one buyer or seller, our model is more complicated because of the interaction or buyers and sellers.

An allocation rule takes the single peaked preferences of the buyers and sellers and also the trade volume and it allocates this volume among buyers and sellers. This problem is extensively analyzed by (Sprumont, 1991) who proposed and analyzed a "uniform rule" which later became a central rule of that literature (for example, see (Dagan, 1996), (Ching, 1992, 1994), (Thomson, 1994)). Since we analyze markets with multiple buyers and sellers, our domain is an extension of Sprumont's domain.

Our model is also related to (Thomson, 1995) and (Klaus, Peters & Storcken, 1997, 1998). They analyze the reallocation of an infinitely divisible commodity among agents with single peaked preferences and individual endowments. Suppliers are the agents whose endowments are greater than their peaks and demanders are the agents whose endowments are less than their peaks. Note that, in their model the suppliers and the demanders are not differentiated. A supplier by misrepresenting his preferences can turn into a demander or a demander can turn into a supplier. In our model, however, buyers and sellers are differentiated. This difference has important implications over the properties analyzed. For example, fairness properties are much weaker in our model since they only compare agents on the same side of the market. Also, in our model the agents do not have exogenously given endowments.

The following papers study the design of a mechanism that determines the trade in nonclearing markets. (Bénassy, 2002) analyzes nonclearing markets and the following properties: Pareto optimality, voluntary trade, and strategy proofness. However, he does not study designing a mechanism satisfying those properties. He rather uses a trade rule that clears the short side of the market and uniformly rations the long side of it.

(Barbera & Jackson, 1995) analyze allocation of goods in exchange economies with a finite number of agents and commodities. Each agent has a positive endowment of the commodities and a continuous, strictly convex, and monotonic preference relation on his consumption. The authors look for strategy proof rules that facilitate trade in this exchange economy.

Our model is closely related to (Kıbrıs & Küçükşenel, 2009). They analyze a class of trade rules each of which is a composition of the Uniform rule with a trade-volume rule that picks the median of total demand, total supply and an exogenous constant. They show that this class uniquely satisfies Pareto optimality, strategy proofness, no-envy, and an informational simplicity axiom called independence of trade-volume.

In all these papers, the authors analyze markets with a fixed population. In this paper, we allow the population to be variable and analyze the implications of these population changes. We introduce a class of Uniform trade rules each of which is a composition of the Uniform rule and a trade-volume rule. We axiomatically analyze Uniform trade rules on the basis of a property concerning variations of the population, namely, consistency and standard properties such as Pareto optimality and no-envy, and an informational simplicity property, strong independence of trade volume.

Our main objective in this paper is to understand the implications of an important property, consistency that is about the possible variations in the number of agents. Informally, a rule is consistent if any recommendation it makes for an economy always agrees with its recommendations for the associated reduced economies obtained by the departure of some of the agents with their promised shares. Consistency has been analyzed in many contexts such as bargaining, coalitional form games, and taxation (for a detailed discussion, see our Model). Consistency, however, is not well-defined for closed economies. Therefore, we analyze a specific type of an open economy by allowing possible transfers to/from outside the economy (for a detailed discussion, see our model).

We show in Theorem 1 that a particular subclass of Uniform trade rules uniquely satisfies consistency together with Pareto optimality and no-envy. Next, we add strong independence of trade volume to the list and characterize a smaller subclass that satisfies those properties. We note that each member of this subclass either clears the short side or the long side of any given market.

The paper is organized as follows. First, we introduce the model and then we analyze the implications of consistency.

II. MODEL

There are countable infinite universal sets, $\mathcal{B}$ of potential buyers and $\mathcal{S}$ of potential sellers. Let $\mathcal{B} \cap \mathcal{S} = \emptyset$. There is a perfectly divisible commodity that each seller produces and each buyer consumes. Let $\mathbb{R}_{++}$ be the consumption/ production space for each agent. Let R be a preference relation over $\mathbb{R}_{++}$ and P be the strict preference relation associated with R. The preference relation R is **single-peaked** if there is $p(R) \in \mathbb{R}_{++}$ called the peak of R, such that for all $x, y \in \mathbb{R}_{++}$, $x < y \leq p(R)$ or $x > y \geq p(R)$ implies y P x. Each $i \in \mathcal{B} \cap \mathcal{S}$ is endowed with a continuous single-peaked preference relation R_i over $\mathbb{R}_{++}$. Let $\mathcal{R}$ denote the set of all continuous and single-peaked preference relations on $\mathbb{R}_{++}$.

Given a finite set $B \subset \mathcal{B}$ of buyers and a finite set $S \subset \mathcal{S}$ of sellers such that either $B \neq \emptyset$ or $S \neq \emptyset$, let $N = B \cup S$ be a **society**. Let $\mathcal{N}$ be the set of all societies. A preference profile R_N for a society N is a list $(R_i)_{i \in N}$ such that for each $i \in N$, $R_i \in \mathcal{R}$. Let $\mathcal{R}^N$ denote the set of all profiles for the society N. Given $N' \subset N$ and $R_N \in \mathcal{R}^N$, let $R_{N'} = (R_i)_{i \in N'}$ denote the restriction of R_N to N'.

A **market for society** $\mathbf{N} = B \cup S$ is a list (R_B, R_S, T) where $(R_B, R_S) \in \mathcal{R}^N$ is a profile of preferences for buyers and sellers and $T \in \mathbb{R}$ is a **transfer**. Note that T can both be positive and negative. A positive T represents a transfer made from outside. Thus, it is added to the production of the sellers and together they form the total supply. On the other hand, a negative T represents a transfer that must be made from the economy to the outside. Thus, it is considered as an addition to the total demand.

Given a market (R_B, R_S, T) for a society $N = B \cup S$, a **(feasible) trade** is a vector $z \in \mathbb{R}^N_{++}$ such that $\sum_B z_b = \sum_S z_s + T$. Let $Z(R_B, R_S, T)$ denote the set of all trades for (R_B, R_S, T).

There are two special subclasses of markets.

A market (R_B, R_S, T) is a **just-buyer market** if $B \neq \emptyset$ and $S = \emptyset$. For such markets, the feasible trades are as follows: If $T > 0$, $Z(R_B, R_S, T) = \{z \in \mathbb{R}^B_{++} : \sum_B z_b = T\}$. If $T \leq 0$, then $Z(R_B, R_S, T) = \emptyset$. This is trivial because if there is no seller, all the agents are demanders, and thus, the supply is zero. Thus, if the outside transfer is positive, it would be equal to the total supply and it is divided among the buyers. However, if there is a negative transfer (that is, a transfer must

be made to outside), since there is no seller, the transfer cannot be realized. Thus, in that case there is no trade. Similarly, if there is no outside transfer, then the total supply is zero. Thus, there is again no trade.

A market $(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T})$ is a **just-seller market** if $\mathrm{B} = \emptyset$ and $\mathrm{S} \neq \emptyset$. For such markets, the feasible trades are as follows: If $\mathrm{T} < 0$, $\mathrm{Z}(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T}) = \{\mathrm{z} \in \mathbb{R}_{++}^{\mathrm{S}} : \sum_{\mathrm{S}} \mathrm{z_s} + \mathrm{T} = 0\}$. If $\mathrm{T} \geq 0$, then $\mathrm{Z}(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T}) = \emptyset$. The explanation is similar to above. Note that just-buyer markets and just-seller markets mathematically coincide with the allocation problems analyzed by (Sprumont, 1991). Thus, his domain is a restriction of ours.

Since the markets with no feasible trade are trivial, we restrict ourselves to the set of markets for which the set of trades is nonempty. Let $\mathcal{M}^{\mathrm{N}} = \{(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T}) : (\mathrm{R_B}, \mathrm{R_S}) \in \mathcal{R}^{\mathrm{N}}, \mathrm{T} \in \mathbb{R}, \text{and } \mathrm{Z}(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T}) \neq \emptyset\}$ be the set of all markets for society $\mathrm{N} = \mathrm{B} \cup \mathrm{S}$ and let be the set of all markets.

$$\mathcal{M} = \bigcup_{N \in \mathcal{N}} \mathcal{M}^N$$

Let $\mathcal{M}_{\mathcal{B}} = \{(R_B, R_S, T) \in \mathcal{M} : B \neq \emptyset,\ S = \emptyset, and\ T > 0\}$ be the set of just-buyer markets and $\mathcal{M}_{\mathcal{S}} = \{(R_B, R_S, T) \in \mathcal{M} : S \neq \emptyset,\ B = \emptyset, and\ T < 0\}$ be the set of just-seller markets.

Let $h(R_B, R_S, T)$ denote the **short side of the market** $(\boldsymbol{R_B}, \boldsymbol{R_S}, \boldsymbol{T})$, that is,

$$h(R_B, R_S, T) = \begin{cases} B, & \sum_B p(R_b) \leq \sum_S p(R_s) + T, \\ S, & \sum_S p(R_s) + T \leq \sum_B p(R_b). \end{cases}$$

A trade $z \in Z(R_B, R_S, T)$ is **Pareto optimal with respect to** $(\boldsymbol{R_B}, \boldsymbol{R_S}, \boldsymbol{T})$ if there is no $z' \in Z(R_B, R_S, T)$ such that for all $i \in B \cup S$, $z_i' \, R_i \, z_i$ and for some $j \in B \cup S$, $z_j' \, P_j \, z_j$. The following lemma shows that in our framework, *Pareto optimality* is equivalent to the following three properties: (i) each agent in the short side of the market receives a share greater than or equal to his peak, (ii) each agent in the long side of the market receives a share less than or equal to his peak, and thus (iii) the total consumption is between the total supply and the total demand. Its proof is simple, see (Kıbrıs & Küçükşenel, 2009).

Lemma 1. For each $\boldsymbol{B \cup S} \in \boldsymbol{\mathcal{N}}$ and $(\boldsymbol{R_B, R_S, T}) \in \boldsymbol{\mathcal{M}^{B \cup S}}$, a trade $\boldsymbol{z} \in \boldsymbol{Z(R_B, R_S, T)}$ is Pareto optimal with respect to $(\boldsymbol{R_B, R_S, T})$ if and only if for $\boldsymbol{K} \in \{\boldsymbol{B}, \boldsymbol{S}\}$, $\boldsymbol{h(R_B, R_S, T) = K}$ implies

(i) for each $k \in K$, $p(R_k) \leq z_k$,

(ii) for each $l \in N \backslash K$, $z_l \leq p(R_l)$,

(iii) $$\sum_B z_b = \begin{cases} \sum_B p(R_b) & if \;\; h(R_B, R_S, T) = B, \\ \sum_S p(R_s) + T & if \;\; h(R_B, R_S, T) = S. \end{cases}$$

A trade rule first determines the volume of trade that will be carried out in the economy and therefore, the total production and the total consumption. Then, it allocates the total production among the sellers and the total consumption among the buyers. Before defining a trade rule, we will first define a trade-volume rule.

A **trade-volume rule** $\Omega: \mathcal{M} \to \mathbb{R}^2_{++}$ associates each market (R_B, R_S, T) with a vector $\Omega(R_B, R_S, T) = (\Omega_B(R_B, R_S, T), \Omega_S(R_B, R_S, T))$ whose first coordinate, $\Omega_B(R_B, R_S, T)$ is the total consumption of the buyers and the second coordinate, $\Omega_S(R_B, R_S, T)$ is the total production of the sellers. Note that, for each market (R_B, R_S, T) and a trade-volume *rule* Ω, $\Omega_B(R_B, R_S, T) = \Omega_S(R_B, R_S, T) + T$. Thus, the volume of Ω_B determines the volume of Ω_S. Therefore, with an abuse of notation, we will sometimes call Ω_B a trade-volume rule.

In a market in which there are only buyers, the transfer is divided among the buyers. Thus, the total consumption is equal to the transfer. In a just-seller market, however, the sellers produce an amount that corresponds to the transfer. Thus, in that case, the total production is equal to the absolute value of the transfer.

Let $\mathcal{V}$ be the set of all trade-volume rules. Let $\mathcal{V}^{[\text{short,long}]}$ be the set of trade-volume rules, Ω each of which chooses a trade-volume between the total demand and supply of the market, that is, for each market $(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T})$, $\Omega(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T}) \in [\sum_{\mathrm{B}} \mathrm{p}(\mathrm{R_b}), \sum_{\mathrm{S}} \mathrm{p}(\mathrm{R_s}) + \mathrm{T}]$.

The following subclass of $\mathcal{V}^{[\text{short,long}]}$ will be used extensively in rest of the paper. Let $\mathcal{V}^{\{\text{short,long}\}}$ be the set of trade-volume rules, Ω each of which alternates between picking the total demand/supply of the short and the long side of the market, that is, for each market $(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T})$, $\Omega(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T}) \in \{\sum_{\mathrm{B}} \mathrm{p}(\mathrm{R_b}), \sum_{\mathrm{S}} \mathrm{p}(\mathrm{R_s}) + \mathrm{T}\}$.

An **allocation rule** $f: \bigcup_{N \in (2^{\mathcal{B}} \cup 2^{\mathcal{S}}) \backslash \{\emptyset\}} \mathcal{R}^N \times \mathbb{R}_{++} \to \bigcup_{N \in (2^{\mathcal{B}} \cup 2^{\mathcal{S}}) \backslash \{\emptyset\}} \mathbb{R}^N_{++}$ allocates each trade volume among buyers and sellers in such a way that for each $N \in (2^{\mathcal{B}} \cup 2^{\mathcal{S}}) \backslash \{\emptyset\}$, $R_N \in \mathcal{R}^N$, and

$w \in \mathbb{R}_{++}$, $\sum_N f_i(R_N, w) = w$. For example, *uniform rule*, *U*, introduced by (Sprumont, 1991) is very central in the literature. In our paper, also, it will be used extensively. Formally, it is defined as follows: for each $N \in (2^{\mathcal{B}} \cup 2^{\mathcal{S}})\backslash\{\emptyset\}$, $R_N \in \mathcal{R}^N, w \in \mathbb{R}_{++}$, and $i \in N$,

$$U_i(R_N, w) = \begin{cases} \min\{p(R_i), \lambda\}, & if \quad \sum_N p(R_i) \geq w \\ \max\{\mathrm{p}(R_i), \mu\}, & if \quad \sum_N p(R_i) \leq w \end{cases}$$

where λ and μ are uniquely determined by the equations, $\sum_N \min\{p(R_i), \lambda\} = w$ and $\sum_N \max\{p(R_i), \mu\} = w$.

A **trade rule** $\mathrm{F}: \mathcal{M} \to \bigcup_{\mathrm{M} \in \mathcal{M}} \mathrm{Z(M)}$ is a composition of a trade-volume rule Ω and an allocation rule f: $\mathrm{F} = \mathrm{f} \circ \Omega$. More precisely, for each market $(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T})$ and $\mathrm{K} \in \{\mathrm{B}, \mathrm{S}\}$, $\mathrm{F_K}(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T}) = \mathrm{f}(\mathrm{R_K}, \Omega_{\mathrm{K}}(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T}))$. A trade rule, $\mathrm{F} = \mathrm{U} \circ \Omega$, that is composed of the uniform rule and a trade-volume rule Ω is called the **uniform trade rule with respect to Ω**. (Kıbrıs & Küçükşenel, 2009) characterize a particular class of uniform trade rules for which Ω is the median of total demand, total supply, and an exogenous constant.

Now, we introduce properties of a trade rule. We start with efficiency. A trade rule F is **Pareto optimal** if for each $(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T}) \in \mathcal{M}$, the trade $\mathrm{F}(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T})$ is Pareto optimal with respect to $(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T})$. Pareto optimality of an allocation rule is defined in a similar way.

Now, we present a fairness property. A trade is envy free if each buyer (respectively, seller) prefers his own consumption (respectively, production) to that of every other buyer (respectively, seller). A trade rule satisfies no-envy, if it always chooses an envy free trade. Formally, a trade rule satisfies **no-envy** if for each $\mathrm{N} = (\mathrm{B} \cup \mathrm{S}) \in \mathcal{N}$, $(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T}) \in \mathcal{M}^{\mathrm{N}}$, $\mathrm{K} \in \{\mathrm{B}, \mathrm{S}\}$, and $\mathrm{i}, \mathrm{j} \in \mathrm{K}$, $\mathrm{F_i}(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T})\ \mathrm{R_i}\ \mathrm{F_j}(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T})$. Since in our model the agents on different sides of the market are exogenously differentiated, this property only compares agents on the same side of the market.

Next, we present a property concerning variations in the number of agents. It is an adaptation of the standard consistency property to our domain. To explain consistency, consider a trade rule F and a market $(\mathrm{R_B}, \mathrm{R_S}, \mathrm{T})$. Suppose that F chooses the trade z. Imagine that some buyers and sellers leave with their shares they have been already assigned. This leads to a reduced market

that the remaining agents are now facing. Consistency is about how the remaining agents' shares should be affected in this reduced market. If F is consistent, it should assign to them the same shares as in the initial market. However, without a transfer from outside, the recommendation for an economy may not be feasible for its reduced markets. This is one reason we consider open economies. This practice is similar to the analysis of consistency in economies with individual endowments (see (Thomson, 1992)). This leads to a reduced problem in which the remaining agents, $(B' \cup S')$ are now facing an updated transfer from T to $T - \sum_{B \setminus B'} z_b + \sum_{S \setminus S'} z_s$. Formally, given a trade rule F, for each $N = (B \cup S) \in \mathcal{N}$, $(R_B, R_S, T) \in \mathcal{M}^N$, and $N' = (B' \cup S') \subseteq N$, a reduced market of (R_B, R_S, T) for N' at $z \equiv F(R_B, R_S, T)$ is $r^z_{N'}(R_B, R_S, T) = (R_{B'}, R_{S'}, T - \sum_{B \setminus B'} z_b + \sum_{S \setminus S'} z_s)$. A trade rule F is **consistent** if for each $N = (B \cup S) \in \mathcal{N}$, $(R_B, R_S, T) \in \mathcal{M}^N$, and $N' = (B' \cup S') \subseteq N$, if $z = F(R_B, R_S, T)$, then $z_{N'} = F(r^z_{N'}(R_B, R_S, T))$.

Consistency of a trade-volume rule can be defined in a similar way. It is about how the trade volume should be affected in the reduced market. If the trade-volume rule is consistent with respect to $F = f \circ \Omega$, then the trade volume in the reduced market should be the total consumption of the remaining buyers in the initial market (or equivalently, the total production of the remaining sellers in the initial market). Formally, a trade-volume rule Ω is **consistent with respect to $F = f \circ \Omega$** if for each $N = (B \cup S) \in \mathcal{N}$, $(R_B, R_S, T) \in \mathcal{M}^N$, $N' = (B' \cup S') \subseteq N$ and $z = F(R_B, R_S, T)$, $\Omega\left(r^z_{N'}(R_B, R_S, T)\right) = \sum_{B'} z_b$, if $B' \neq \emptyset$ and $\Omega\left(r^z_{N'}(R_B, R_S, T)\right) = \sum_{S'} z_s$, otherwise.

Lastly, we present the following informational simplicity property. Strong independence of trade volume requires the trade volume rule only to depend on the total demand and total supply but not on their individual components and the agents' identities. Formally, Ω satisfies **strong independence of trade volume** if for each $N = (B \cup S) \in \mathcal{N}$, $N' = (B' \cup S') \in \mathcal{N}$, $(R_B, R_S, T) \in \mathcal{M}^N$, $(R_{B'}, R_{S'}, T) \in \mathcal{M}^{N'}$, $\sum_B p(R_b) = \sum_{B'} p(R_{b'})$, and $\sum_S p(R_s) = \sum_{S'} p(R_{s'})$ imply $\Omega(R_B, R_S, T) = \Omega(R_{B'}, R_{S'}, T)$.

III. RESULTS

The following theorem shows that the subclass of Uniform trade rules $F = U \circ \Omega$ where $\Omega \in \mathcal{V}^{[\text{short,long}]}$ is consistent with respect to F uniquely satisfies Pareto optimality, no-envy and consistency.

Theorem 1. A trade rule $F = f \circ \Omega$ satisfies Pareto optimality, no-envy, and consistency if and only if f = U and Ω satisfies the following:

(i) $\Omega \in \mathcal{V}^{[\text{short,long}]}$

(ii) Ω is consistent with respect to F.

Next, we add strong independence of trade volume to the list and we show in Theorem 2 that under strong independence of trade volume, the subclass of Uniform trade rules, $F = U \circ \Omega$ where $\Omega \in \mathcal{V}^{\{\text{short,long}\}}$ and Ω is consistent with respect to F uniquely satisfies Pareto optimality, no-envy and consistency.

Theorem 2. Let $\Omega \in \mathcal{V}$ satisfy strong independence of trade volume. A trade rule $F = f \circ \Omega$ satisfies Pareto optimality, no-envy, and consistency if and only if f = U and Ω satisfies the following:

(i) $\Omega \in \mathcal{V}^{\{\text{short,long}\}}$

(ii) Ω is consistent with respect to F.

IV. CONCLUSION

We analyze markets in open economies in which price is fixed and as a result the demand and the supply are possibly unequal and the population is variable. We characterize trade rules with respect to consistency property. We show that these rules either clear the short or the long side of the market.

In addition to consistency, there are other properties about population variation. Our next study will be the analysis of the other properties related to population variation, such as population monotonicity.

Another open question is the weakening of strong independence of trade volume. This property requires the trade volume rule to depend only on the total demand and total supply but not on their individual components and the agents' identities. One can study the implications of a weaker property which only relates two problems with the same set of agents.

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APPENDIX

To prove Theorem 1, we use the following two lemmas. The first one analyzes the relationship between the properties satisfied by a trade rule $F = f \circ \Omega$ and its component f. It shows that Pareto optimality, no-envy, and consistency satisfied by F passes on to f.

Lemma 2. If a trade rule $F = f \circ \Omega$ satisfies one of the following properties, then f also satisfies that property: Pareto optimality, no-envy, and consistency.

Proof. First, suppose for a contradiction $F = f \circ \Omega$ satisfies Pareto optimality whereas f does not. Then, there is $K \in (2^{\mathcal{B}} \cup 2^{\mathcal{S}}) \setminus \{\emptyset\}$, $R_K \in \mathcal{R}^K$, and $w \in \mathbb{R}_{++}$ such that $f(R_K, w)$ is not Pareto optimal with respect to (R_K, w). Then, there is $z \in \mathbb{R}_{++}^K$such that for each $k \in K$, $z_k \, R_k \, f_k(R_K, w)$, for some $l \in K$, $z_l \, P_l \, f_l(R_K, w)$, and $\sum_K z_k = w$. First, suppose $K \subseteq \mathcal{B}$. Then, consider $(R_K, T) \in \mathcal{M}_{\mathcal{B}}$ such that $T = w$. Note that $F(R_K, T) = f\big(R_K, \Omega_B(R_K, T)\big) = f(R_K, T) = f(R_K, w)$. Then z also Pareto dominates $F(R_K, T)$, a contradiction to F being Pareto optimal. If $K \subseteq \mathcal{S}$, then consider $(R_K, T) \in \mathcal{M}_S$ such that $T = -w$. Note that, $F(R_K, T) = f\big(R_K, \Omega_S(R_K, T)\big) = f(R_K, -T) = f(R_K, w)$. Then z also Pareto dominates $F(R_K, T)$, a contradiction to F being Pareto optimal. The other properties can be proved similarly.

The second lemma is by (Dagan, 1996) on the allocation rule f. Bilateral consistency is a weaker consistency property restricted to subsocieties containing exactly two agents. For its proof, see (Dagan, 1996).

Lemma 3. (Dagan, 1996) If the potential number of agents is at least 4 and if an economy consists of at least 2 agents, then f satisfies Pareto optimality, no-envy, and bilateral-consistency if and only if f = U.

Proof. (Theorem 1) The if part is straightforward and thus, omitted. The only if part is as follows. Since F satisfies Pareto optimality, no-envy, and consistency, by Lemma 2, f also satisfies those properties. Then, by Lemma 3, f = U. (For markets with only one buyer or one seller, all the allocation rules choose the same allocation.)

Now, let $N = (B \cup S) \in \mathcal{N}$, $(R_B, R_S, T) \in \mathcal{M}^N$ and $(B' \cup S') \in \mathcal{N}$ be such that $N' = (B' \cup S') \subseteq (B \cup S)$. Let $z \equiv F(R_B, R_S, T)$ and $z' \equiv F\left(r^z_{N'}(R_B, R_S, T)\right)$. Since F is consistent, for each $i \in N'$, $z'_i = z_i$. Then, by the definition of Ω, $\Omega\left(r^z_{N'}(R_B, R_S, T)\right) = \sum_{B'} z'_{b'} = \sum_{B'} z_{b'}$. Thus, Ω is consistent with respect to F.

To prove Theorem 2, in addition to lemmas 2 and 3, we need the following lemma. It shows that for Pareto optimal rules, a reduced market has the same short side as the original.

Lemma 4. Let F be a Pareto optimal trade rule. Then, for each $N = (B \cup S) \in \mathcal{N}$, $(R_B, R_S, T) \in \mathcal{M}^N$, and $N' = (B' \cup S') \subseteq N$, if $z \equiv F(R_B, R_S, T)$, then we have

$$h(r^z_{N'}(R_B, R_S, T)) = \begin{cases} B', & \text{if } h(R_B, R_S, T) = B \text{ and } B' \neq \emptyset, \\ S', & \text{if } h(R_B, R_S, T) = S \text{ and } S' \neq \emptyset. \end{cases}$$

Proof. **Let $N = (B \cup S) \in \mathcal{N}$, $(R_B, R_S, T) \in \mathcal{M}^N$, and $N' = (B' \cup S') \subseteq N$.** Let $z \equiv F(R_B, R_S, T)$. First, suppose $h(R_B, R_S, T) = B$ and $B' \neq \emptyset$. Since F is Pareto optimal, z is Pareto optimal with respect to (R_B, R_S, T). Then, by Lemma 1, for each $b \in B$, $p(R_b) \leq z_b$ and for each $s \in S$, $z_s \leq p(R_s)$. Then,

$$\begin{aligned} \sum_{B \setminus B'} z_b + \sum_{B'} p(R_{b'}) &\leq \sum_{B} z_b \\ &= \sum_{S} z_s + T \\ &\leq \sum_{S'} p(R_{s'}) + \sum_{S \setminus S'} z_s + T. \end{aligned}$$

That is, $\sum_{B'} p(R_{b'}) \leq \sum_{S'} p(R_{s'}) + T - \sum_{B \setminus B'} z_b + \sum_{S \setminus S'} z_s$. Note that $r^z_{N'}(R_B, R_S, T) = (R_{B'}, R_{S'}, T')$ for $T' = T - \sum_{B \setminus B'} z_b + \sum_{S \setminus S'} z_s$. Thus, $\sum_{B'} p(R_{b'}) \leq \sum_{S'} p(R_{s'}) + T'$. Therefore, $h(r^z_{N'}(R_B, R_S, T)) = B'$. The proof of the other case is similar.

Proof. (Theorem 2) The if part is straightforward and thus, omitted. The only if part is as follows. Since F satisfies Pareto optimality, no-envy, and consistency, by Theorem 1, $F = U \circ \Omega$ where $\Omega \in$

$\mathcal{V}^{[\text{short,long}]}$ and Ω is consistent with respect to F. Now, by using strong independence of trade volume, we will show that $\Omega \in \mathcal{V}^{\{\text{short,long}\}}$.

For this, let $N = (B \cup S) \in \mathcal{N}$, $(R_B, R_S, T) \in \mathcal{M}^N$. First, assume that $h(R_B, R_S, T) = S$. Let $a = \sum_B p(R_b)$, $d = \sum_S p(R_s) + T$ and $c = \Omega(R_B, R_S, T)$. Since $\Omega \in \mathcal{V}^{[\text{short,long}]}$, $c \in [d, a]$. Suppose for a contradiction $c \notin \{a, d\}$, that is $c \in (d, a)$. Let $\varepsilon \in \mathbb{R}_+$ be such that $\mathcal{E} < \min\left\{\frac{c}{n}, \frac{2(a-c)}{(n-2)}, \frac{2(n-1)(c-d)}{(m-1)(n-2)}\right\}$. Also, let $m, n \in \mathbb{N}$ be such that $n \geq 3$ and $m > \max\left\{3, \frac{c-T}{d-T}\right\}$.

Let $(R_{B'}, R_{S'}, T) \in \mathcal{M}^{B' \cup S'}$ be such that $|B'| = n$, $|S'| = m$ and

$$p\left(R_{b'_1}\right) = \frac{c}{n} - \varepsilon,\ p\left(R_{b'_2}\right) = \cdots = p\left(R_{b'_n}\right) = \frac{a}{n-1} - \frac{c}{n(n-1)} + \frac{\varepsilon}{n-1},$$

$$p\left(R_{s'_1}\right) = \frac{c}{m} - \frac{T}{m} + \frac{\varepsilon(m-1)(n-2)}{2(m-2)(n-1)},\ p\left(R_{s'_2}\right) = \frac{d}{m-1} - \frac{T}{m} - \frac{c}{m(m-1)} + \frac{\varepsilon(m-3)(n-2)}{2(m-2)(n-1)},$$

$$p\left(R_{s'_3}\right) = \cdots = p\left(R_{s'_m}\right) = \frac{d}{m-1} - \frac{T}{m} - \frac{c}{m(m-1)} - \frac{\varepsilon(n-2)}{(m-2)(n-1)}.$$

Also, let $(R'_{B'}, R'_{S'}, T) \in \mathcal{M}^{B' \cup S'}$ be such that

$$p\left(R'_{b'_1}\right) = \frac{c}{n} - \frac{\varepsilon}{2},\ p\left(R'_{b'_2}\right) = \frac{a}{n-1} - \frac{c}{n(n-1)} - \frac{\varepsilon(n-3)}{2(n-1)},$$

$$p\left(R'_{b'_3}\right) = \cdots = p\left(R'_{b'_n}\right) = \frac{a}{n-1} - \frac{c}{n(n-1)} + \frac{\varepsilon}{(n-1)},$$

$$p\left(R'_{s'_1}\right) = \frac{c}{m} - \frac{T}{m} + \frac{\varepsilon(m-1)(n-2)}{(m-2)(n-1)}$$

$$p\left(R'_{s'_2}\right) = \cdots = p\left(R'_{s'_m}\right) = \frac{d}{m-1} - \frac{T}{m} - \frac{c}{m(m-1)} - \frac{\varepsilon(n-2)}{(m-2)(n-1)}$$

Note that by the choice of ε and m, for each $k' \in (B' \cup S')$, $p(R_{k'}) \geq 0$ and $p(R'_{k'}) \geq 0$. Also, $\sum_{B'} p(R_{b'}) = \sum_{B'} p\left(R'_{b'}\right) = a$ and $\sum_{S'} p(R_{s'}) = \sum_{S'} p\left(R'_{s'}\right) = d - T$. Then, by independence of trade volume, $\Omega(R_{B'}, R_{S'}, T) = \Omega(R'_{B'}, R'_{S'}, T) = c$.

For each $K \in \{B', S'\}$, let $z_K \equiv F_K(R_{B'}, R_{S'}, T) = U(R_K, c)$ and $z'_K \equiv F_K\left(R'_{B'}, R'_{S'}, T\right) = U(R'_K, c)$. Since for each $i = 2, \cdots, n$, $p\left(R_{b'_1}\right) < \frac{c}{n} < p\left(R_{b'_i}\right)$, $p\left(R'_{b'_1}\right) < \frac{c}{n} < p\left(R'_{b'_i}\right)$, and $\frac{1}{(n-1)}(c - p\left(R'_{b'_1}\right)) < p\left(R'_{b'_i}\right)$, we have

$$z_{b'_1} = p\left(R_{b'_1}\right) = \frac{c}{n} - \varepsilon,\ z_{b'_i} = \frac{1}{(n-1)}(c - p\left(R_{b'_1}\right)) = \frac{c}{n} + \frac{\varepsilon}{n-1},$$

$z'_{b'_1} = p\left(R'_{b'_1}\right) = \frac{c}{n} - \frac{\varepsilon}{2}$, and $z'_{b'_i} = \frac{1}{(n-1)}\left(c - p\left(R'_{b'_1}\right)\right) = \frac{c}{n} + \frac{\varepsilon}{2(n-1)}$.

Since for each $= 2, \cdots, m$, $p\left(R_{s'_i}\right) < \frac{c-T}{m} < p\left(R_{b'_1}\right)$, $p\left(R'_{s'_i}\right) < \frac{c-T}{m} < p\left(R'_{s'_1}\right)$, and $\frac{1}{(m-1)}(c - T - p\left(R_{s'_1}\right)) > p\left(R'_{s'_i}\right)$, we have

$z_{s'_1} = p\left(R_{s'_1}\right) = \frac{c}{m} - \frac{T}{m} + \frac{\varepsilon(m-1)(n-2)}{2(m-2)(n-1)}$, $z_{s'_i} = \frac{1}{(m-1)}\left(c - T - p\left(R_{s'_1}\right)\right) = \frac{c}{m} - \frac{T}{m} - \frac{\varepsilon(n-2)}{2(m-2)(n-1)}$,

$z'_{s'_1} = p\left(R'_{s'_1}\right) = \frac{c}{m} - \frac{T}{m} + \frac{\varepsilon(m-1)(n-2)}{(m-2)(n-1)}$, $z'_{s'_i} = \frac{1}{(m-1)}\left(c - T - p\left(R'_{s'_1}\right)\right) = \frac{c}{m} - \frac{T}{m} - \frac{\varepsilon(n-2)}{(m-2)(n-1)}$.

Now, let $T' = \frac{2T}{m} + \frac{2(m-n)c}{mn} - \frac{3(n-2)\varepsilon}{2(n-1)}$ and consider the following two reduced problems:

(i) $r^{z}_{\{b'_1,b'_2,s'_1,s'_2\}}(R_{B'}, R_{S'}, T) = \left(R_{b'_1}, R_{b'_2}, R_{s'_1}, R_{s'_2}, T'\right)$

(ii) $r^{z'}_{\{b'_1,b'_2,s'_1,s'_2\}}(R'_{B'}, R'_{S'}, T) = \left(R'_{b'_1}, R'_{b'_2}, R'_{s'_1}, R'_{s'_2}, T'\right)$.

Note that, $p\left(R_{b'_1}\right) + p\left(R_{b'_2}\right) = p\left(R'_{b'_1}\right) + p\left(R'_{b'_2}\right)$ and $\left(R_{s'_1}\right) + p\left(R_{s'_2}\right) = p\left(R'_{s'_1}\right) + p\left(R'_{s'_2}\right)$. Then, by strong independence of trade volume, $\Omega\left(r^{z}_{\{b'_1,b'_2,s'_1,s'_2\}}(R_{B'}, R_{S'}, T)\right) = \Omega(r^{z'}_{\{b'_1,b'_2,s'_1,s'_2\}}(R'_{B'}, R'_{S'}, T))$. By consistency, for $i = 1,2$, $F_{b'_i}\left(r^{z}_{\{b'_1,b'_2,s'_1,s'_2\}}(R_{B'}, R_{S'}, T)\right) = z_{b'_i}$ and $F_{b'_i}\left(r^{z'}_{\{b'_1,b'_2,s'_1,s'_2\}}(R'_{B'}, R'_{S'}, T)\right) = z'_{b'_i}$.

Then, $\Omega\left(r^{z}_{\{b'_1,b'_2,s'_1,s'_2\}}(R_{B'}, R_{S'}, T)\right) = z_{b'_1} + z_{b'_2} = \frac{2c}{n} + \frac{\varepsilon(2-n)}{n-1}$ and $\Omega\left(r^{z'}_{\{b'_1,b'_2,s'_1,s'_2\}}(R'_{B'}, R'_{S'}, T)\right) = z'_{b'_1} + z'_{b'_2} = \frac{2c}{n} + \frac{\varepsilon(2-n)}{2(n-1)}$. Thus, $\Omega\left(r^{z}_{\{b'_1,b'_2,s'_1,s'_2\}}(R_{B'}, R_{S'}, T)\right) \neq \Omega\left(r^{z'}_{\{b'_1,b'_2,s'_1,s'_2\}}(R'_{B'}, R'_{S'}, T)\right)$, a contradiction. Thus, $\Omega(R_B, R_S, T) \in \{\sum_B p(R_b), \sum_S p(R_s) + T\}$.

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EFFECT OF SUPPLY CHAIN FINANCE ON VALUE OF FIRMS IN THE SUPPLY CHAIN*

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İsrafil ZOR***

Abstract

This study aims to determine the effect of supply chain finance on firm value of large buyers with high credit notes. For this purpose, a two-stage application was performed. Firstly, panel data analysis was applied with the data of 2.421 companies from 16 different countries among the G-20 members between 2009 and 2013 and the effect of variables which are affected theoretically by supply chain finance in large companies on firm value is examined. In the second stage of the application, 46 companies which started using supply chain finance between 2006 and 2013 have been identified. Wilcoxon signed-rank test was applied by using the data before and after year which the companies have been started to use supply chain finance and it is determined that whether the variables which is expected to be affected reveal a significant difference between these years. In conclusion, the effect of variables expected to be affected in large companies which make supply chain finance available for their suppliers on firm value differs for each market. Thus, it is concluded that supply chain finance will affect the firm value if the theoretical impacts are realized. However, the second part of the application shows that there is no significant difference in any of the variables before and after supply chain finance using. As a result, although theoretically it is expected that firm value of large companies located within the supply chain finance is affected, there is no effect on firm values in the markets.

Key Words: Trade Finance, Supply Chain Finance, Firm Value

JEL Code: G32, M21

* This study is based on PhD dissertation of Rıfat Karakuş titled "Supply Chain Finance and Its Effect on Firm Value of Firms in the Supply Chain".

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I. INTRODUCTION

The rapid development of globalization and technology has brought a climate of constantly increasing competition for businesses. Enterprises seeking to achieve their objectives within this competitive environment have tried to develop advantageous features that serve the ultimate purpose, such as increasing income, decreasing costs, improving customer satisfaction by providing coordination of internal functions. In order to achieve all these goals, beyond the internal functions, it has become necessary for enterprises to effectively coordinate with their stakeholders and the concept of supply chain has been shaped. Enterprises seeking competitive advantage have been involved in supply chains where the material, information and financial flows from first supplier to the last consumer have been coordinated.

In addition to material and information flows in the supply chain, a financial flow occurs from last customer to first supplier and management of this flow is described as financial supply chain management. One of the most important decisions to be made within the financial supply chain is to identify the financing methods to be used. Commercial financing methods such as commercial loans, factoring, letter of guarantee etc. have been used for a long time in the financing of the exchange of goods and services between the parties in the supply chain.

Especially after the 2008 global crisis, financial difficulties of financial institutions have affected credit markets. The activities of particularly small and medium-sized enterprises with low credit worthiness in the supply chains have come to a halt. Problems experienced in one or several of the stakeholders within the supply chain can affect the performance of the entire chain. For this reason, large enterprises with high credit ratings in the chain have concentrated on new financing methods to sustain the chain's efficiency. Supply chain finance has also gained popularity as a method based on a win-win principle in which large firms with high credit ratings provide low-cost credit to small firms in supply chains. The aim of efforts made by enterprises either individually or in coordination within the supply chains is to maximize the shareholder value. For this reason, the main factor in determining the financing methods used in the financial supply chain should contribute to the shareholder value. Supply chain finance is a method based on a win-win principle and a positive effect on firm value of suppliers, buyers and financial institutions included in the method is expected from supply chain finance. The purpose of this study is to determine the impact of supply chain finance on firm value of large buyers with a high credit rating which makes supply chain finance available for suppliers. In this study, which is aimed to achieve the stated purpose, firstly all aspects of supply chain

financing have been covered and then the effect of supply chain finance on firm value of large buyers with high credit worthiness has been analyzed by empirical implementation.

II. NEED FOR SUPPLY CHAIN FINANCE

Supply chain finance is a method aimed providing low-cost and easily accessible financing to small and medium-sized suppliers. The emergence of this method is based on the support of small and medium-sized enterprises (SMEs) for the sustainability of the supply chain by large buyers. For this reason, before disclosing the supply chain finance, revealing SMEs' priorities for the country's economies and their financial problems is beneficial.

In many developed and developing countries, SMEs are one of the most important actors in the economic system with employment creation, added value creation, investment and export shares (Torlak & Uçkan, 2005). For example, Turkey in 2012, 99.8% of the total number of initiatives, 75.8% of employment, 54.5% of wages and salaries, 63.3% of turnover, 54.2% of value added at factor cost and 53.2% of gross investment in property is created by SMEs (TUIK, 2014).

Although SMEs have importance for their country's economies with characteristics such as more production and products with less investment, encouraging individual savings, minimizing distortions in income distribution, easier adaptation to demand changes and diversity (Bayraktar & Köse, 2004), they face serious problems. Financial problems are one of the most fundamental problems which SMEs encounter in their operational processes. The main financial problems faced by SMEs are concentrated on access to financing and financing costs (Atay, 2012). In a survey conducted among the administrators, for 40% of SMEs in Cyprus, 32% in Greece, 23% in Spain and Croatia, 22% in Slovenia, 20% in Ireland, Italy and the Netherlands, , 9% in Poland, 8% in Germany and 7% in Austria, the most important problem is access to funding sources (Ipsos Mori, 2013). As seen in Figure I, SMEs' share of commercial loans provided by financial institutions is rather low for many countries.

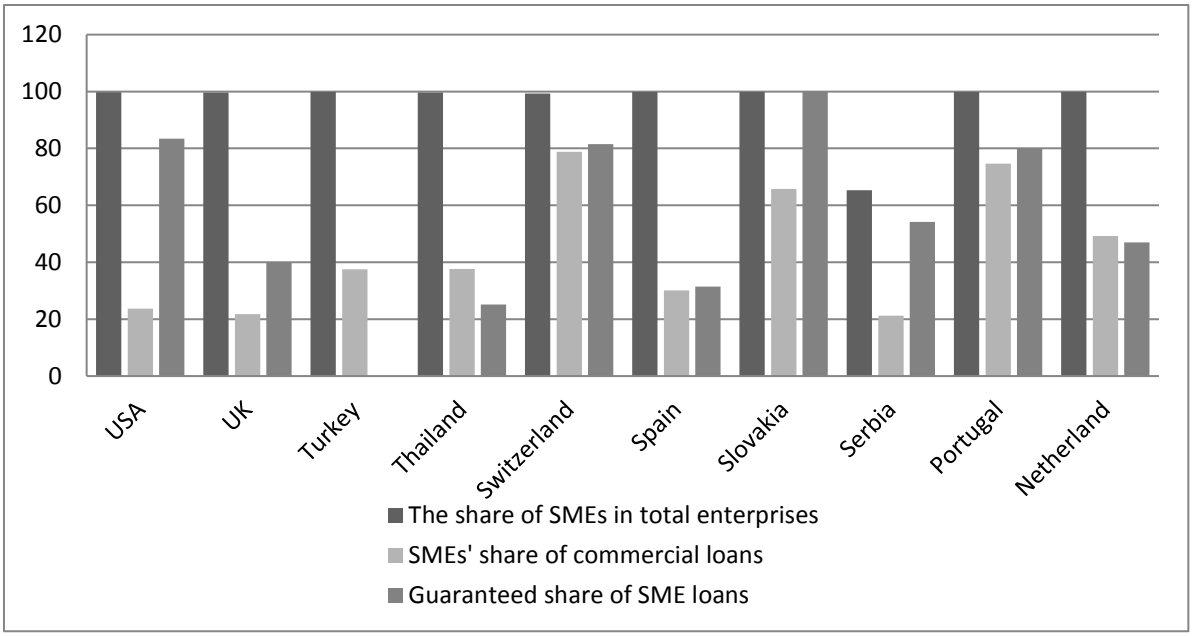

Figure I. SMEs' Share of Commercial Loans and Guarantees

Source: OECD (2014), ***Financing SMEs and Entrepreneurs 2014: An OECD Scoreboard***, Retrieved From http://www.keepeek.com/Digital-Asset-Management/oecd/industry-and-services/ financing-smes-and-entrepreneurs-2014_fin_sme_ent-2014-en#page1, 18.08.2014.

Another alternative fund source for SMEs is capital markets. However, it is seen that SMEs cannot provide sufficient funds from capital markets. The main reasons for this are as follows: SMEs are generally family companies and are worried about losing control, they do not want to bear the cost of opening up to the public and they are very small companies and have insufficient organizational structures, accounting systems and unrecorded transactions (Kutlu & Demirci, 2007).

In addition to the problem of access to finance in SMEs, the high costs of resources are another financial problem. It is inevitable that SMEs will have a higher cost of financing due to their generally higher risk than large enterprises. The investor expectation that expresses the equity cost for the company will be higher in SMEs. Similarly, financial institutions set higher interest rates for SMEs.

The difficulties of SMEs to access financing in terms of equity and foreign resources and the high cost of financing make trade finance more important. For this reason, the classical methods used in trade financing such as factoring, forfaiting, letter of credit and letter of guarantee constitute the alternatives that should be evaluated for SMEs. Although the mentioned methods offer advantages, they bring with them some disadvantages. As a result, supply chain finance as a new and innovative financing method is academically and practically gains importance.

III. SUPPLY CHAIN FINANCE

In traditional factoring transactions, the borrower that is the buyer and will make the payment at the maturity is not a party to the contract. The borrower does not provide any guarantee for the payment to the factor. The party that is the client of the factor is the supplier. For this reason, it is the supplier that determines obtaining of finance and the cost of the transaction. In the case of supply chain finance, which is also expressed as reverse factoring or supplier financing, the initiator of the method becomes the debtor company. Debtor companies agree with one or more financial institutions to discount their debt to suppliers. Bills that are requested by the supplier and approved by the company to be within a certain limit are discounted with the help of a technology platform (Tanrısever, 2015).

On the basis of the supply chain finance is the willingness of buyers with a high credit rating to make these capacities available to their suppliers. Large buyers with strong financial structure and high creditworthiness offer this method as an alternative to their suppliers in order to make it easier to finance them and obtain lower financing costs. The large buyer agrees with one or more financial institutions to discount their debts to suppliers. The supplier carries out the delivery of the goods or services to the big buyer and transmits the bill to the buyer through the technology platform shared by the buyer, supplier and financial institution. After the buyer confirms the invoice, the supplier selects the invoices to be discounted through the system and the financial institution discounts the invoice. The discounted amount is paid by the financial institution to the supplier, and at the maturity, the buyer, in other words the debtor pays the invoice amount to the financial institution (Vervoort, 2012). The process of supply chain finance is shown in Figure II.

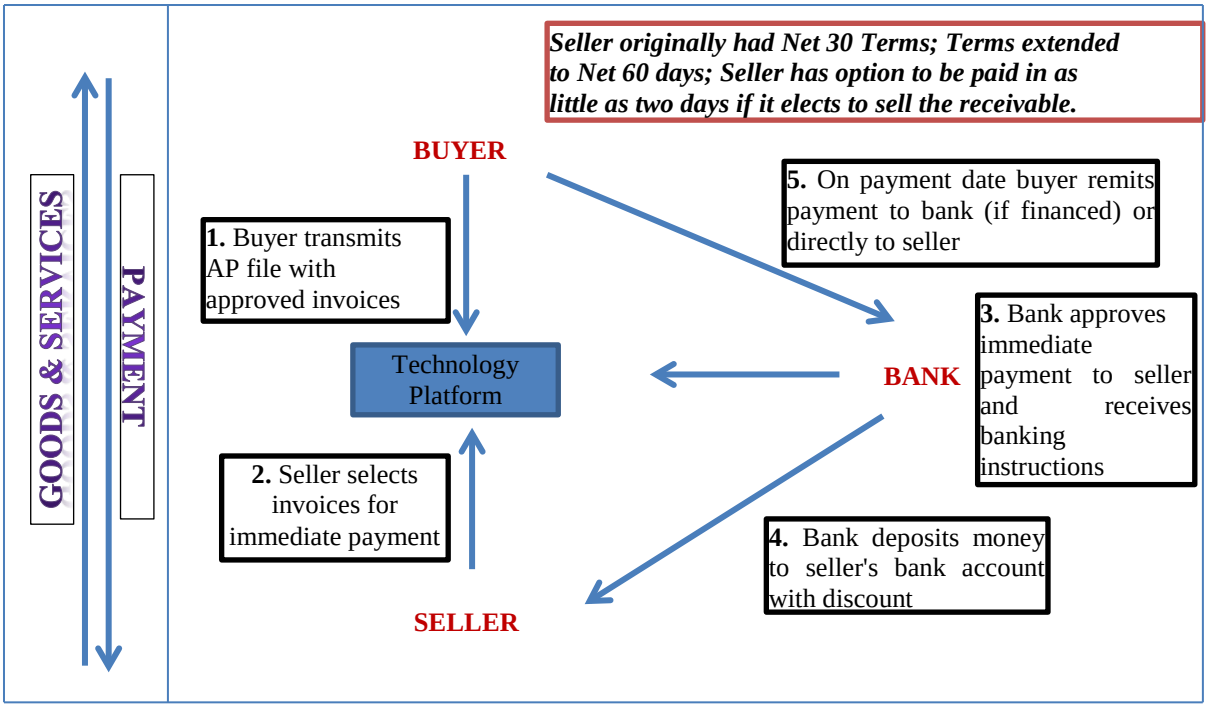

Figure II. The Process of Supply Chain Finance

Source: PwC (2009***), Demystifying supply chain finance***, Retrieved From http://www.pwc.com/us/en/issues/surviving-the-financial-downturn/assets/supply_chain_finance.pdf, 20.05.2015

In factoring, the receivable portfolio of a supplier to be paid by more than one buyer is discounted by a single factor. In fact, the factor is to discount the supplier's receivables from more than one customer in order to diversify the risk of collecting, so that if one does not pay the debts he wants to secure the receivables from other debts. However, this risk diversification requires the question of creditworthiness and the measurement of credit risk for more than one debtor. In supply chain finance, the factor is concentrated on a single borrower. Therefore, the identification of the credit risk becomes easier and more reliable. In addition collateralization is possible if necessary because of the fact that the factor is the creditor of the buyer. In the supply chain finance, the factor concentrates on the debt of a single company with a strong financial structure. Enterprises that are buyers in the supply chain finance are firms with high credit ratings and they give guaranty to the factor. Therefore factors are not willing to undertake any payments from suppliers that are at a higher risk group, namely an irreversible factoring process is carried out. In addition, when the borrower has a high credit rating, the cost of discounting become lower and suppliers with low credit ratings can provide financing at a lower cost by taking advantage of high credit ratings of customers (Klapper, 2006). Supply chain finance which is one of the buyer-centered financing methods and which is expressed in the form of inverse factoring or supplier financing; serve several advantages to suppliers, buyers and financial institutions. Advantages to buyers are discussed below in detail.

III.I. Effect of Supply Chain Finance on Large Buyers with High Credit Worthiness

Supply chain finance is a system based on win-win principle. For this reason, it is expected that the financing-generating (large) and financing-enabled (small) enterprises in this financing process will be positively affected. Also, financial institutions that provide financing should also have positive effects that will enable them to participate in this process.

It is clear that supply chain financing will have a positive effect on the big buyer companies. Otherwise, these companies will not launch such a system. The first of the expected positive effects can be realized as an extension of payment periods. Large firms that work with suppliers with limited financing capabilities will need to make payments in a shorter period of time to meet their suppliers' expectations. However, it is possible that large firms that make supply chain finance available to their suppliers will be able to offer a longer maturity, as they enable suppliers to access finance soon. For this reason, large firms using supply chain finance can expect shortened cash cycle period due to the prolonged average commercial debt repayment period (Lamoureux & Evans, 2011).

The use of supply chain finance will increase the pay-out times of large firms, thus shortening the cash cycle period will limit the need for working capital. So it may be possible to reduce the working capital without increasing the risk of liquidity. Thus, liquidity ratios such as current ratio, acid-test ratio and cash rate can be decreased in these firms and by keeping net working capital at a smaller level net working capital turnover rate can be increased. In a study conducted with the participation of senior executives of 23 large firms using supply chain finance, it was observed that the use of this financing method resulted in an average reduction of 13% in working capital of large firms (Seifert & Seifert, 2009). Another reason why liquidity ratios are affected is the fact that firms' working capital decreases while their short-term debt rises due to the increase in the term. In addition, due to the increasing short-term borrowing, firms' capital structure will be different and short-term debts, which have cheaper cost, will reach a greater weight on the balance sheet.

The use of supply chain finance in payments to be made by large firms has resulted in a decrease in the financing costs of small firms as well as a similar profitability effect for large firms. For example, $ 1 million trade of a large company with a 45-day normal payout period with its supplier can be examined. Three different scenarios were created under the assumption that the financing cost of the large buyer with a 45 day normal payment period is LIBOR + 1% thanks to its higher credit rating, the supplier’s financing cost is LIBOR + 4%, the LIBOR is 0,65%, when the supply chain financing is applied, the supplier discount bills on the 10th day

with LIBOR +%2. In the 45-day payment system the supplier costs $ 5813 financing costs for this period and the bigger firm with a 75 days cash flow cycle bears to $ 1375 financing costs. The bigger company can reduce its own financing costs to $688 by increasing its payment period by 15 days to 60 days, but in this case the financing cost of the supplier increases to $7750. Therefore, it is inevitable that the excess cost of the supplier will be reflected to the bigger company. In the third scenario, when the maturity is extended by using supply chain financing, the cost of the large company will be reduced to 688 USD, also the financing cost of the supplier will be reduced to 4973 USD (Frohling, 2012). As it can be seen in this example, supply chain finance can decrease the financing cost of the large company, which can have a positive impact on profit before tax. In addition, a reduction in administrative expenses related to payments can support this result. Potential increase in profit before tax may lead to an increase in profitability measures such as return on equity and return on assets.

Another advantage of supply chain finance can be seen as a decrease in costs. Small firms using supply chain finance will be able to source with lower financing costs, so they will be able to offer cheaper prices for products or services they will sell (Revathi, 2013). In addition, providing fast and inexpensive access to financing for suppliers will make the firm an attractive market for uncomprehended suppliers and create a competitive environment among suppliers. These conditions will have a positive effect on the cost of sales of large firms and will increase the gross sales profitability.

Big firms working with suppliers with limited financing capabilities may not be able to use these suppliers more with their current maturity policies when they want to increase their operating volume. It may not be possible to increase their activity volumes for suppliers who have difficulty in accessing financing. For example, Caterpillar, the world's leading manufacturer of building equipment, faced that when it wanted to increase its production in 2010, the top 500 suppliers could not respond to this demand due to their financing difficulties (Steeman, 2014). Hence, in this case large firms will have to multiply additional costs to reach new suppliers or limit activity volume. Another alternative would be to provide fast and cheap financing to suppliers. One of the most suitable alternatives for this can be shown as supply chain finance. It is clear that the supply chain finance will help to increase the volume of activity in large firms for the mentioned reason. In addition, since payment periods can be increased when supply chain finance is used, it will be possible for firms to increase their sales volumes by extending their collecting terms (Wohlgeschaffen, 2010).

Large firms that offer supply chain finance to their suppliers will have created different positive effects beyond the financial impacts indicated. In addition to contributions such as a strong electronic payment system, increased transparency in the payment process, strengthening of relations with suppliers, support for small and medium-sized enterprises, which have an important place in the economy for many countries will be considered an important activity in terms of social responsibility. Supplier financing programs developed and supported by governments in the United States and the United Kingdom will illustrate the importance of this social responsibility (Clarissa, 2014).

IV. EMPIRICAL ANALYSIS AND RESULTS

IV.I. Data Set

This research which examines whether large firms that make supply chain finance available to their suppliers contribute to their value by using this method consists of two steps. Firstly, it will be investigated whether the financial indicators of large firms that are expected to be influenced by using supply chain finance have an effect on firm value. For this part of the survey, 16 countries that can be accessed data from 19 countries constituting the G20 countries were included in the data set and an index was selected from stock exchange in each country. When the indices were determined, the number of companies included in the indices became determinants, and the indices covering more companies were taken into the dataset. Companies which includes the relevant index and which can be accessed financial data for the 2009-2013 period and which is not financial companies constitutes the data set. Financial companies do not fall within the scope of the research because they are companies that provide supply chain finance. For this reason they are not included in the data set. Data were obtained from relevant stock exchanges and company official websites, and financial data provider databases. Table I shows the countries included in the study's dataset, selected indices for countries and the number of companies in the selected indices.

Table I. Number of Companies Included in the Data Set

Country	Selected Index	Number of Companies Including Index	Not Included Company Numbers Due to Being a Financial Company	Not Included Companies Number Due to Lacking of Data	Number of Companies Included in the Data Set
USA	S&P 500	505	84	43	378
UK	FTSE 350	353	97	45	211
France	CAC 40	40	5	3	32
İtaly	FTSE ITALIA ALL SHARE	224	47	29	148
Germany	CDAX	467	40	149	278
Japan	NIKKEI 225	225	21	11	193
Canada	S&P TSX COMPOSITE	250	48	36	166
Australia	S&P ASX 300	297	55	70	172
Turkey	XUTUM	346	98	84	164
Argentina	BOLSA GENERAL	66	7	16	43
India	CNX 200	200	46	23	131
South Korea	KRX 100	100	17	4	79
Mexico	IPC COMP MX	60	7	15	38
Russia	BROAD MARKET	100	7	35	58
Brazil	BOVESPA IBOV	71	10	21	40
China	SSE 380	380	0	90	290

In the study, the effect of financial variables which are expected to be influenced by using supply chain finance, on firm value of large buyers was tested at different markets. Later, it was examined whether these variables differed in practice in companies using this funding method. For second part of the study, large firms that started to supply chain finance were searched for 2006-2013, as 31 of them in the USA, 5 in the UK, 1 in France, 2 in Australia, 1 in Mexico, 1 in Singapore, 3 in Turkey, 1 in Taiwan and 1 in China, a total of 46 companies traded on the stock exchanges were identified. The independent variables used in the first part of the research for the relevant companies were calculated for the period prior to the start of supply chain finance (2009) and the following period (2011), and examined whether this method of financing brought about a difference in these variables.

IV. II. Variables

In this research which seeks to determine whether the value of large firms creating supply chain finance is influenced by this financing, the expected effects for the large firms are theoretically explained in Part III.I. In order to determine the expected theoretical effects, the variables which are indicative of these effects are defined. Thus, dependent and independent variables of panel data analysis are determined.

IV.II.I. Dependent Variable

The dependent variable is the annual stock return, which indicates the change in the value of the firm because in the study, it is tried to measure the level of influence on the value

of big companies. For all companies included in the data set, by using share prices, the number of share certificates received during the year, the number of bonus shares received and value of right of priority between the years 2008 and 2013, five-term stock returns between 2009-2013 were calculated. In the survey, annual returns of stocks are calculated as follows (BİST):

$$G_t = \frac{F_t * (BDL + BDZ + 1) - R * BDL + T - F_t - 1}{F_{t-1}}$$

G_t : Return of year "t"

F_t : The latest closing price for the year "t".

BDL : Number of rights issued during the year.

BDZ : Number of bonus share issued during the year.

R : The price of using right of priority

T : Net dividend paid to a share during the year.

F_{t-1} : Latest closing price of the previous year from "t"

IV.II. II. Independent Variables

Large businesses that make supply chain finance available to their suppliers are expected to be influenced by this financing. These effects are described in part III.I of the study. In large firms, by using supply chain finance working capital needs may decrease, short-term borrowing may increase, the average payment period can be extended, return on equity and return on assets may increase, gross margin may increase, financing costs may decrease and the activity volume may be increased. It is possible to monitor these effects with specific financial ratios. Decrease in working capital and increase in short-term borrowing results to decrease in current ratio, acid test ratio and cash ratio and increase in net working capital turnover rate. It is expected that extended payment period by supply chain finance provide longer average payment period and shorter cash conversion cycle for large buyer firms. Increase in activity volume thanks to supply chain finance results to increase in sales and assets. Expected decrease in financing costs and rise in profitability affect gross margin, return on equity, return on assets, earnings before tax and net income positively. Increase in short-term debt also results to change in debt ratios. So, these financial ratios of large firms using supply chain finance is expected to change prognosticatively. For this reason, effect of these financial ratios on firm value is important to predict the effect of supply chain finance on firm value of large firms. Table II shows the independent variables of the study, the way these variables are calculated, the symbol to be expressed in the continuation of the study, and which effect is used to explain. The independent

variables are included in the model by taking the change from the previous term in a similar way with dependent variable.

Table II. Independent Variables of the Study

Independent Variable	Calculation	Symbol	Influence Explained
Current Ratio	Current Assets / Short-term Liabilities	CAOR	● Working capital needs may decrease. ● Short-term borrowing may increase.
Acid Test Ratio	(Current Assets – Inventories) / Short-term Liabilities	ASTOR	
Cash Ratio	Cash and Marketable Securities / Short-term Liabilities	NAKOR	
Net Working Capital Turnover Rate	Net Sales_T / ((Current Assets_T –$\text{Short-term Liabilities}_T$ + $\text{Current Assets}_{T-1}$ – $\text{Short-term Liabilities}_{T-1}$) / 2)	NISDH	
Average payment period	Accounts Payable / Cost of Goods Sold *365	OOS	● The average payment period can be extended.
Cash Conversion Cycle	Inventory conversion period + Receivables conversion period - Payables conversion period	NDS	
Net Sales	Net Sales	NETSAT	● The activity volume may be increased.
Total Assets	Total Assets	AKTOP	
Gross Margin	Gross Profit / Net Sales	BSKAR	● Gross margin may increase.
Return on Equity	Net Income / Shareholders Equity	OZKAR	● Gross margin may increase. ● Financing costs may decrease. ● Return on equity and return on assets may increase.
Return on assets	Net Income / Total Assets	AKKAR	
Earnings Before Tax	Earnings Before Tax	VOK	
Net Income	Net Income	DNK	
Short-term Debt to Total Assets	Short-term Liabilities / Total Assets	KVBPT	● Short-term borrowing may increase.
Long-term Debt to Total Assets	Long-term Liabilities / Total Assets	UVBPT	
Debt Ratio	Total Liabilities / Total Assets	TBPT	

IV.III. Panel Unit Root Tests

As in the analysis of the whole-time series, panel data analysis, which involves both time and horizontal cross-sectional analysis, requires variables to be stationary in order to avoid false associations between variables (Korkmaz, Yıldız & Gökbulut, 2010). The use of non-stationary series may lead to unreliable and economically difficult results. For this reason, before examining the existence of the relationship between the variables in the regression

analyzes made by the time series, it is necessary to examine the time series characteristics of the variables used in the analysis (Altıntaş, 2009).

Panel unit root tests are used to determine whether the data to be used in the panel data analysis are stationary. If the data are not stable, and if the first differences are not still stable, the second difference is taken and the data become stable. In this study, Im, Pesaran and Shin W-stat and ADF-Fisher Chi-square tests which assessed the individual unit root process for each unit, i.e. each company, and Levin, Lin & Chu (LLC) test which investigated the common unit root process, were applied with fixed and fixed trend. According to any method, if the any series are non-stationary, first difference of the series is taken, if not enough, second difference of the series is taken and series become stationary for all series.

IV.IV. Methodology

Panel data analysis and Wilcoxon signed rank test were used in the research. Firstly panel data sets were created for each market separately and panel linear regression was applied to observe the effect of independent variables on firm value. Panel data analysis can be expressed as a combination of regression and time series analysis.

There are different models in analysis to be done with panel data. These are pooled least squares, fixed effects and random effects models (Greene, 2003). In the study, it is necessary to determine which model is more effective before the panel regression analysis is performed. The Breusch-Pagan LM Test which tests the null hypothesis that there is no random effect and F Test which tests the null hypothesis that there is no fixed effect are applied for each market as suggested by Park (2011) and results are summarized in Table III. If null hypotheses are rejected in both test results, Hausman test is applied and if null hypothesis is rejected, fixed effect model; if it cannot be rejected, the random effects model is selected as appropriate model.

Table III. Panel Model Selection

Fixed effect (F test)	**Random effect Breusch-Pagan LM Test**	**Model Selection**
H_0 is not rejected (No fixed effect)	H_0 is not rejected (No random effect)	Pooled OLS
H_0 is rejected (fixed effect)	H_0 is not rejected (No random effect)	Fixed effect model
H_0 is not rejected (No fixed effect)	H_0 is rejected (random effect)	Random effect model
H0 is rejected (fixed effect)	H_0 is rejected (random effect)	Choose a fixed effect model if the null hypothesis of a Hausman test is rejected; otherwise, fit a random effect model

To determine the effective model, each test shown in Table III was applied to the 16 markets forming the data set of the research, and according to these results, the appropriate model for each market was determined and revealed in Table IV.

Table IV. Appropriate Panel Model for Each Market

	F Test		Breusch-Pagan LM Test		Hausman Test		
Country	**Statistic**	**Prob.**	**Statistic**	**Prob.**	**Statistic**	**Prob.**	**Model**
USA	195.415060	0.0000	2880.446	0.0000	46.78567	0.0000	Fixed Effect
UK	126.747134	0.0000	1586.113	0.0000	9.542332	0.0085	Fixed Effect
France	12.964812	0.9982	81.05366	0.0000			Random Effect
İtaly	164.341157	0.0000	2199.738	0.0000	7.968040	0.0928	Fixed Effect
Germany	164.125532	0.0000	2234.390	0.0000	15.21670	0.0551	Fixed Effect
Japan	171.823147	0.0000	1717.311	0.0000	22.78448	0.0190	Fixed Effect
Canada	103.919712	0.0000	826.3677	0.0000	1.943108	0.8570	Random Effect
Australia	30.455051	0.0000	0.388851	0.5329			Fixed Effect
Turkey	365.244782	0.0000	7468.696	0.0000	3.624220	0.3050	Random Effect
Argentina	61.002123	0.0000	281.4644	0.0000	1.368772	0.5044	Random Effect
India	390.259804	0.0000	8146.447	0.0000	4.782487	0.3104	Random Effect
South Korea	88.290303	0.0000	1.451742	0.2282			Fixed Effect
Mexico	12.886975	0.0049	8.741995	0.0031	6.229153	0.1827	Random Effect
Russia	43.591813	0.0000	0.341639	0.5589			Fixed Effect
Brazil	105.567045	0.0000	7.060145	0.0079	0.904369	0.8244	Random Effect
China	1096.792752	0.0000	55.37990	0.0000	1.765664	0.8805	Random Effect

In the first part of the analysis, the influence of expected effects on the firm value because of the involvement of supply chain finance were examined with panel regression analysis, then it will be tested whether these effects are seen in companies that practice this funding method in practice. For this, 46 large firms that provide supply chain finance for their suppliers and the start of this financing has been determined. The indicators that are expected to be affected are calculated separately for the period before and after the beginning of the supply chain finance. These indicators were tested with the Wilcoxon Signed Rank Test to determine whether there was a statistically significant difference. The nonparametric Wilcoxon Signed Rank Test was chosen as the appropriate method for the data set because it does not need the assumptions required for parametric tests. The Wilcoxon Signed Rank Test examines the null hypothesis that there is no difference between two samples.

IV.V. Autocorrelation and Heteroscedasticity

One of the important assumptions in the least squares analysis is that the error terms have a constant variance. In cases where the variance of error terms does not remain constant, the problem of heteroscedasticity is encountered. In the case of heteroscedasticity, the estimates obtained with least squares maintain neutrality and coherence but lose the property known as minimum variance or effectiveness. This can lead to unreliable statistical tests. So the partial t and general F tests of the least squares estimators lose reliability. Moreover, the predictions made with the developed model are not effective (Albayrak, 2008). In this study, heteroscedasticity was analyzed by Wald test for fixed effect models and LR test for random effect models. The common null hypothesis of both tests is that there is no heteroscedasticity.

Another assumption which is as important as the constant variance in the analysis by the least squares method is that there is no relation between the error terms, i.e. autocorrelation. In the case of autocorrelation between error terms, the least squares estimators of the parameters are not effective even though they are unbiased and consistent. In this case, the variance of the parameters will also be deviated because the variance of the error term will deviate. When positive autocorrelation is found, the deviation will be negative and variances will be undercounted. As a result, the t test statistic value will be larger than the actual value. Thus, an insignificant coefficient is likely to be significant and also R^2 will rise. Therefore, since the value of F is greater than it is, T and F tests will lose reliability and give misleading results (Yavuz, 2009). In this study, whether the error term is related or not, i.e. whether there is an autocorrelation problem in the analysis has been tested with the Wooldridge Autocorrelation Test and the null hypothesis that no autocorrelation exists between error terms was tested.

The LR Test or Wald Test results which are used to test heteroscedasticity and Wooldridge Test results which are used to test autocorrelation for each market are summarized in Table V. If the autocorrelation problem is present in the error terms according to the test results, White period standard errors and covariance is used (Sayılgan & Sayman, 2012). White diagonal correction for markets with only heteroscedasticity problems, white cross-section correction for markets with both heteroscedasticity and autocorrelation problem is used (Korkmaz & Karaca, 2014).

Table V. Autocorrelation and Heteroscedasticity Tests Results

	Wooldridge Test		Autocorrelation	LR Test / Wald Test		Heteroscedasticity	Robust Estimator
Country	**F**	**Prob.**		**chi²**	**Prob.**		
USA	15.554	0.0001	YES	3.1e+05	0.0000	YES	White cross-section
UK	4.753	0.0304	YES	2.6e+35	0.0000	YES	White cross-section
France	5.089	0.0313	YES	118.23	0.0000	YES	White cross-section
Italy	0.351	0.5543	NO	14413.98	0.0000	YES	White diagonal
Germany	20.412	0.0000	YES	2.2e+06	0.0000	YES	White cross-section
Japan	28.700	0.0000	YES	11949.71	0.0000	YES	White cross-section
Canada	105.604	0.0000	YES	1248.91	0.0000	YES	White cross-section
Australia	7.538	0.0067	YES	3.4e+05	0.0000	YES	White cross-section
Turkey	16.332	0.0001	YES	486.32	0.0000	YES	White cross-section
Argentina	24.742	0.0000	YES	164.54	0.0000	YES	White cross-section
India	325.440	0.0000	YES	425.47	0.0000	YES	White cross-section
South Korea	26.592	0.0000	YES	11264.80	0.0000	YES	White cross-section
Mexico	0.000	0.9983	NO	190.74	0.0000	YES	White diagonal
Russia	6.454	0.0138	YES	2.0e+05	0.0000	YES	White cross-section
Brazil	71.732	0.0000	YES	111.54	0.0000	YES	White cross-section
China	590.031	0.0000	YES	616.29	0.0000	YES	White cross-section

IV.VI. Results of Panel Data Analysis

Separate panel regression analyzes were conducted for 16 markets to examine the impact of the 16 financial indicators on firm value, which are expected to emerge in large firms by making supply chain finance available to their suppliers. 16 independent variables were searched for each market by a step-wise backward elimination method to create models that are effective in each market. It is seen in the analysis results that the established models are statistically significant for all markets. In addition, in the analysis results, the adjusted R-square which expresses explanatory power of the independent variables on the changes of dependent variable remained at low levels. It can be said that this is normal considering the fact that the factors that can affect the firm value are too much. The panel regression analysis results for each market are summarized in Table VI

Table VI. The Panel Regression Analysis Results for Each Market

	Australia	Turkey	Argentina	Germany	India	İtaly	South Korea	UK	Mexico	Russia	France	USA	Brazil	China	Japan	Canada
CAOR				0.03939 (0.0675)						-0.00887 (0.0246)					-1.01957 (0.0000)	-0.25403 (0.0000)
ASTOR	0.01007 (0.0361)						0.02718 (0.3254)	0.10212 (0.0986)	0.38012 (0.2674)			0.05082 (0.0278)		0.08584 (0.0900)	1.04302 (0.0000)	0.26245 (0.0000)
NAKOR					0.04364 (0.0009)	-0.01042 (0.0000)									-0.06578 (0.0032)	
NISDH										0.00015 (0.0000)						
OOS												-0.01294 (0.5026)			0.46949 (0.0011)	
NDS			0.00496 (0.0000)	8.46E-05 (0.2493)							-0.11906 (0.0000)					-0.07242 (0.0000)
NETSAT		-0.01946 (0.0523)		0.03570 (0.2268)							0.87985 (0.0354)		0.50039 (0.0281)		0.25672 (0.0806)	
AKTOP				0.30804 (0.0000)		-0.00032 (0.9983)	0.13390 (0.4235)	-0.19631 (0.2164)			-1.70194 (0.0007)	0.20069 (0.0000)	-0.13901 (0.0134)	0.07107 (0.0000)	0.17139 (0.0017)	0.12009 (0.0000)
BSKAR									-2.08891 (0.0982)	0.13810 (0.1167)		0.09120 (0.0000)				0.14765 (0.0324)
OZKAR				0.00287 (0.2976)	-0.02930 (0.2438)		0.00749 (0.1128)		0.06571 (0.0406)	-0.06447 (0.0512)						
AKKAR	0.00628 (0.6002)					-0.03654 (0.0048)	0.00349 (0.8952)			0.08381 (0.0018)	0.14495 (0.0003)				-0.02300 (0.0445)	
VOK	0.00372 (0.2679)	0.00205 (0.0451)								0.02840 (0.0005)		0.00220 (0.0103)	0.01005 (0.0050)	0.00593 (0.0072)	-3.86E-05 (0.8024)	
DNK	-0.01002 (0.5472)			-0.00524 (0.2001)	0.03551 (0.2215)	0.04261 (0.0067)	-0.0218 (0.4233)			-0.02729 (0.0000)	-0.17538 (0.0000)				0.02443 (0.0178)	
KVBPT				0.02400 (0.0005)										-0.19952 (0.2722)	-0.08488 (0.2357)	
UVBPT									-0.01434 (0.0001)	0.08251 (0.0000)						
TBPT		-0.17819 (0.0938)	-1.12748 (0.2123)	-0.28226 (0.0000)	-2.83E-05 (0.1463)		-0.0808 (0.4468)			-0.41413 (0.0000)	0.37892 (0.2449)	-0.27166 (0.0000)		0.19457 (0.4258)	-0.43704 (0.0000)	
C	21.8618 (0.0000)	37.7355 (0.0726)	5.62348 (0.8599)	22.0430 (0.0000)	38.5489 (0.0803)	3.61685 (0.0920)	26.9857 (0.0000)	-5.23651 (0.0000)	-11.2828 (0.0014)	7.15334 (0.0000)	0.95154 (0.9262)	22.5831 (0.0000)	22.2519 (0.2065)	24.1830 (0.2714)	12.6329 (0.0000)	26.2488 (0.0229)
F Statistic	4.69475*	5.9051*	3.043***	21.4625*	7.09719*	29.0661*	10.121*	29.7826*	10.6386*	8.97082*	5.72359*	36.7179*	6.08539*	8.55106*	26.9901*	12.1073*
Adjusted R-Square	0.042412	0.02155	0.03477	0.150501	0.035951	0.249489	0.18837	0.147768	0.203396	0.294625	0.182447	0.159513	0.071205	0.025497	0.287958	0.062857

"*" İndicates that the model is statistically significant at the significance level of 1%, and "***" İndicates that the model is statistically significant at level of 10%.

As can be seen in Table VI, the increases in the current ratio (CAOR) have an effect on firm value in 4 markets. The increase of current ratio in Russia, Japan and Canada reduces the firm value. In Germany, the increase in the current ratio has an increasing effect on firm value. When the acid-test ratio (ASTOR), which is another liquidity ratio, is examined, it is seen that the related ratio is used in the models formed for 8 markets. Although the relevant ratio is not statistically significant in 2 of these 8 markets, the coefficients for all markets are found to be positive. In other words, contrary to the current ratio, the increase in the acid-test ratio results increase in the firm value. It is observed that the cash ratios (NAKOR) which is another one of the liquidity ratios are included in the model established for 3 markets, increases in the corresponding variables results the increase in firm value in India market and decrease in Italy and Japan markets. The only market where all three liquidity ratios are included in the model is Japan. While the increases in the current ratio and the cash ratio for the Japanese market have reduced the firm value, there is a positive relationship between acid-test ratio and firm value. This leads to the conclusion that current assets other than stocks and cash and cash equivalents have an increasing effect on the firm value. The net working capital turnover rate (NISDH), which represents the level of activity of the net working capital, is used in the model for the Russian market and has a positive effect on the firm value.

It is seen that the average payout period (OOS) and cash conversion cycle (NDS), which are the most important indicators that are expected to be influenced for large firms that generate supply chain financing, are included in models for 2 and 4 markets, respectively. The result is that the average pay period is not statistically significant for the US market, only the effect on the firm value can be explained at a meaningful level for Japanese market. In this market, there is a positive relationship between average payment time and firm value. In other words, it has been seen that companies extending the payment period for their purchases have a positive effect on the firm value. A statistically significant relationship between cash conversion cycle and firm value is found for 3 markets, the relationship is positive for Argentina and negative for France and Canada. Therefore, the opinion that shortening the cash conversion cycle for French and Canadian markets increases the firm value has been supported.

It is seen that the change in net sales (NETSAT) included in the study's dataset to express the increase in activity volume is included in the model for 5 markets and the change in total assets (AKTOP) is included in the model for 10 markets. As expected, there is a positive relationship between changes in net sales and firm value for France, Brazil and Japan markets. In Turkey, on

the contrary to the expectations, there is a negative relation between net sales and firm value. The effect of change in total assets on firm value is found statistically significant for 7 markets. There is a negative effect for France and Brazil while it is observed that the increase in the total assets also increases the firm value for 5 markets (Germany, USA, China, Japan and Canada).

In order to express the profit expected to be influenced for large firms that generate supply chain finance, both the profitability ratios and the changes in profit amounts are included in the models and their effects on firm value are examined. Theoretically, the increase in profits is expected to increase the value of the company because it is expected to increase future cash flows. The most appropriate variable for this theoretically expected situation is the pre-tax profit (VOK) change. It has been shown that the related variable has a positive effect on the firm value for all of the 5 markets in which the variable is included the model. The same situation is not valid for other profit and profitability indicators. While the gross margin (BSKAR) has statistically significant and positive effect on firm value for the US and Canadian markets, there is an exact opposite situation for the Mexican market. Again, while the increase in the return on equity (OZKAR) has created an increase in firm value for Mexico, it has been seen that it reduces the value of the firm for the Russian market. The effect of return on assets (AKKAR) on firm value was found as statistically significant for 4 markets. There is a positive effect on the firm value for Russia and France markets, while for Italy and Japan markets it is found to be negative. A similar situation exists for change in the net profit (DNK). While accelerating the increase in net profits for the Italian and Japanese markets boosts firm value, there is an adverse effect for the Russian and French markets.

Finally, the effect of financial structure on firm value is examined. It is seen that the short-term debt to total assets (KVBPT) is statistically significant only for the German market and positively affects firm value. It is found that long-term debt to total assets (UVBPT) is significant in 2 markets, a positive relationship for the Russian market and a negative relationship for the Mexican market is valid. The debt ratio (TBPT) affects the firm value negatively for the 5 markets in which it is included the model. In other words as the borrowing rate increases, the value of the firm decreases.

IV.VII. Results of Wilcoxon Signed Rank Test

The effect of the variables expected to be theoretically influenced for large buyers using supply chain finance on firm value is analyzed for each market by panel data analysis. As a result of the analysis it is observed that different variables for each market have an effect on firm value. In the next phase of the study, Wilcoxon Marked Rank Test is applied to test whether the expected effects actually exist. It is examined whether there are any significant differences between previous and the following period data from starting to use this method in 16 variables predicted to be influenced by this financing method and the results are shown in Table VII. With the analysis applied to all 46 firms, the analysis is repeated for only 31 companies operating in the United States and 15 companies operating outside the United States.

Table VII. Wilcoxon Signed Rank Test Results

	For all 46 companies		For 31 companies operating in the United States		For 15 companies operating outside the United States	
Variables	Z value	Probability	Z value	Probability	Z value	Probability
CAOR	-0.410	0.6820	-0.431	0.6664	0.000	1.0000
ASTOR	-0.464	0.6424	-0.568	0.5698	-0.170	0.8647
NAKOR	-1.469	0.1417	-1.862	0.0626	0.057	0.9547
NISDH	-0.879	0.3791	0.000	1.0000	-1.533	0.1252
OOS	-1.273	0.2031	-1.881	0.0599	0.511	0.6092
NDS	1.060	0.2892	1.068	0.2855	0.341	0.7333
NETSAT	0.672	0.5016	0.607	0.5435	0.625	0.5321
AKTOP	1.284	0.1992	1.137	0.2557	0.454	0.6496
BSKAR	0.978	0.3282	1.019	0.3082	0.341	0.7333
OZKAR	0.191	0.8484	0.372	0.7096	-0.057	0.9547
AKKAR	-0.235	0.8143	0.235	0.8141	-0.795	0.4265
VOK	-0.279	0.7806	0.196	0.8446	-0.682	0.4955
DNK	0.093	0.9260	0.333	0.7390	-0.170	0.8647
KVBPT	0.147	0.8827	0.353	0.7243	-0.057	0.9547
UVBPT	0.169	0.8655	-0.216	0.8293	0.795	0.4265
TBPT	0.432	0.6661	-0.118	0.9064	1.079	0.2805

For companies traded in the US and for companies traded in non-US countries as well as for all firms all 16 variables do not vary depending on whether supply chain finance is used or not. Probability values greater than 0.05 as a result of the Wilcoxon Signed Rank Test applied to all variables in all three groups indicate that the variables do not show any significant change.

These results show that the financial variables expected to be influenced for large firms using supply chain finance do not show theoretically expected changes. From this point of view,

it can be argued that supply chain finance has no effect on firm value. In order to strengthen this argument, it is important to examine the non-financial variables related to companies such as "development of supplier relations" which is influenced by supply chain finance in a separate study. In this study, it is tried to foresee that only whether the financial variables differentiate and affect the firm value. As a result, it is observed that such an effect does not exist. However, only financial variables do not affect firm value. For this reason, the consideration of non-financial variables in different studies will provide important contributions to the literature.

V. CONCLUSION

Since the primary financial objective of the business is to maximize the shareholder value, the key factor in determining the financing methods should serve the same purpose. It is expected that all parties participating in the method of supply chain finance, which is claimed to be based on win-win principle, will have a positive impact on the firm value. The purpose of this study is to find out whether supply chain finance shows the expected effect on large firms with high credit ratings.

For the aim of the study, firstly financial indicators that are expected to be influenced for large buyers using supply chain finance were examined by panel data analysis to see whether they had an impact on firm value. The key point reached by panel data analysis is that the effect of the variables on the firm value shows significant differences for the 16 markets involved in the analysis. For example, the increase in the current ratio have a decreasing effect on firm value in Russia, Japan and Canada markets as expected, while there is an increasing effect on the German market. Similarly, effect of changes in net profit growth on firm value is positive for the Italian and Japanese markets, while negative for the French and Russian markets. At the same time, despite the presence in the analysis models for Australian, German, Indian and Korean markets, the corresponding variable did not seem to have any significant effect on the value of the firms in these markets. The results show that it is not possible to mention a common model that affects firm value for all markets. In this case, developing a strategy by evaluating the variables influencing the firm value for the markets will contribute to increase the firm value when companies will use the supply chain finance. For example, a large buyer who will use supply chain financing in Turkey may increase the firm value by using this method to increase profit before tax; on the other hand

large enterprises that will use this method in France and Canada should concentrate on the shortening of the cash conversion cycle.

With the Wilcoxon Signed Rank Test conducted during the second phase of the study, it is analyzed whether the financial variables of large firms are differentiated by using supply chain finance. According to analysis results, for companies traded in the US and for companies traded in non-US countries as well as for all firms, all 16 variables do not vary depending on whether supply chain finance is used or not. The reason for such a consequence may be that the method cannot be used effectively by the suppliers or the use is limited. This can be explained by the fact that small suppliers are lacking in financial information, method is too new, and factors such as hosting technology requirements result lack of interest from suppliers.

In this study, the effect of supply chain financing on firm value of large buyers is evaluated by using financial variables and it is concluded that there is no effect. However, in order to be able to pinpoint that supply chain financing has no effect on firm value, the effect of other non-financial variables (supplier relationships, etc.) besides financial variables needs to be analyzed. For this reason, the consideration of non-financial variables in different studies will provide important contributions to the literature. Also, the studies to be performed by using different financial variables will be important in terms of determining the effect of supply chain finance on firm value. It will also be a significant contribution to the literature with studies focused on determining how supply chain finance affects the value of small suppliers and financial institutions.

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SOSYAL GÜVENLİK POLİTİKALARI AÇISINDAN BÜTÇE TRANSFERLERİNİN MAKROEKONOMİK ETKİLERİ: TÜRKİYE DENEYİMİ

Utku ALTUNÖZ*

Özet

Türkiye 1990'lardan beri sosyal güvenlik sistemindeki bütçe açıkları ile mücadele etmektedir. Söz konusu açık 2000'li yıllara gelindiğinde içinden çıkılamaz boyutlara ulaşmıştır. Bu nedenle Türkiye'nin sosyal güvenlik sisteminde yapılan yapısal reformların ana hedefi, mali açıdan süreklilik arz eden bir yapıya kavuşmak olmuştur. Bu çalışmada, sistemin mali yapısı, sistemin önemli bir kalemlerinden bütçe transferleri ve bütçe transferlerinin diğer ekonomik kalemlere etkisi ekonometrik olarak analiz edilmektedir. Elde edilen sonuçlara göre bütçe transferleri kamu giderlerini artırmakta, bütçe dengesini olumsuz etkilemekte, kamu yatırımlarını hem olumlu hem de olumsuz etkilemekte, iç ve dış borç stokunu artırmaktadır.

Anahtar Kelimeler: Bütçe Transferleri, Birim Kök, Eş Bütünleşme, Nedensellik

Jel Sınıflaması: H45, H49, H51

IN TERMS OF SOCIAL SECURITY POLICIES, THE MACROECONOMIC IMPACTS OF BUDGET TRANSFERS: TURKEY EXPERIENCE

Abstract

Turkey has been struggling with budget deficit in social security system since 1990s. Mentioned problem reached the serious extents in 2000s. One of the most important target of the reforms of social security system in Turkey was to reach constitute a sustainable construction fiscally. For this purpose, the fiscal structure of system, budget transfer which was transmitted to the system and economic reflections of budget transfers are examined. According to obtained results, budget transfers boosts the expenditures, effect budget balance negatively and effect the public investments both negatively and positively. And also increases domestic and external debt stock.

Keywords: Budget Transfers, Unit Root, Cointegration, Causality

Jel Classification: H45, H49, H5

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I. GİRİŞ

Bireylerin sosyal güvenlik ihtiyaçlarının karşılanması, diğer bir ifade ile sosyal güvenliğinin sağlanması devletlerin en öncelikli görevlerinden biridir. Devletler, söz konusu ihtiyaçların karşılanmasında gerekli olan finansmanın eksikliğinde merkezi yönetim bütçesinden yaptıkları transferlerle kendilerine finansman kaynağı yaratırlar.

Türkiye'de sosyal güvenlik sistemindeki yapısal sorunlar ve çözümüne yönelik uygulanan politikalar bütçe transferlerini devamlı gündemde tutmaktadır. Literatürde Türkiye'nin sosyal güvenlik sistemindeki gerçekleşen bütçe transferleri ile ilgili olarak birçok çalışmaya rastlamamız mümkündür. Bununla birlikte söz konusu transferlerin ekonomiye etkileri birçok çalışmada görmezden gelinmiştir. Çalışmada, Türkiye'nin sosyal güvenlik sisteminin mali yapısı ve sisteme yapılan bütçe transferlerinin sisteme ve sistemle ilgili makroekonomik göstergelere nasıl bir etkide bulunduğu analiz edilmektedir. Böylelikle söz konusu çalışmalardaki boşluğun da doldurulması hedeflenmektedir.

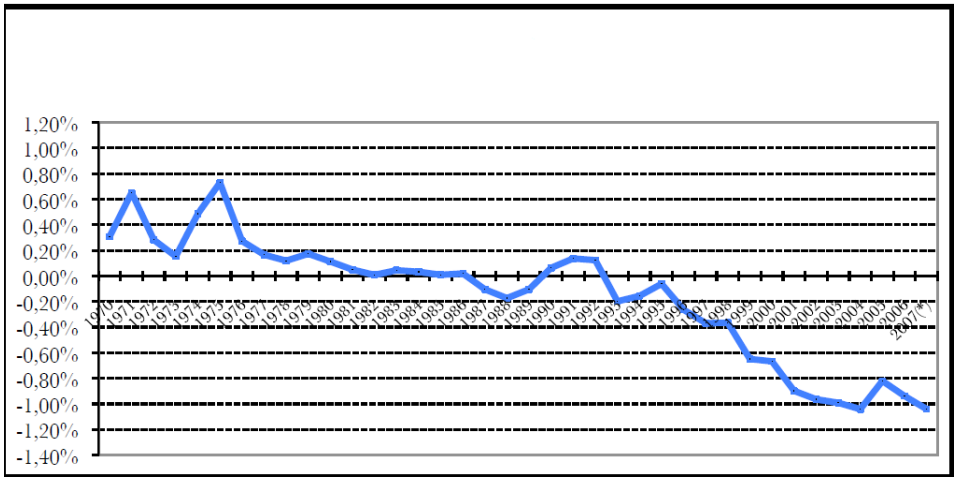
Çalışmada öncelikle Türkiye'nin sosyal güvenlik sistemine kısaca değinilecek, daha sonra sistemin aksaklıkları irdelenecektir. Literatür taramasının ardından bütçe transferlerinin kamu borç stoku, dış borçlanma, bütçe açığı ve yatırımlar ile ilişkili olup olmadığının araştırılması amacıyla eş bütünleşme ve nedensellik testleri yapılacaktır.

I.I. Türkiye'nin Sosyal Güvenlik Sistemine Kısa Bir Bakış

2006 yılına kadar Türkiye'de sosyal güvenlik sistemi Emekli Sandığı, Esnaf ve Sanatkârlar ve Diğer Bağımsız Çalışanlar Sosyal Sigortalar Kurumu (BAĞ-KUR) ve Soyal Güvenlik Kurumu (SSK) olmak üzere üç yapılı siteme dayanmaktaydı ve bunun yanında bir primsiz sağlık yardımından oluşmaktaydı. Bu üç kurumun temel görevi kurum mensuplarına ve kurum mensuplarının ilk derece yakınlarına emeklilik maaşı ve sağlık sigortası hizmeti sağlamaktı. Söz konusu sistemin istihdam temelli sosyal güvenlik yapısının tüm topluma sağlık güvencesi ve yaşlılıkta gelir güvencesi sağlayamadığının anlaşılması, sisteme olan eleştirileri de beraberinde getirdi (Yılmaz ve Yentürk, 2015:2).

Sosyal güvenlik sisteminde işçi ve işverenlerin ödedikleri primler SSK'nın gelirlerini oluştururken çiftçiler ve esnafların (kendi hesabına çalışanların) primleri BAĞ-KUR gelirlerini oluşturmaktaydı. Emekli sandığında durum biraz daha fark arz ederken, kurumun bütçesi kamu bütçesinden doğrudan transferler yoluyla gerçekleşmekteydi. Sosyal güvenlik harcamalarının

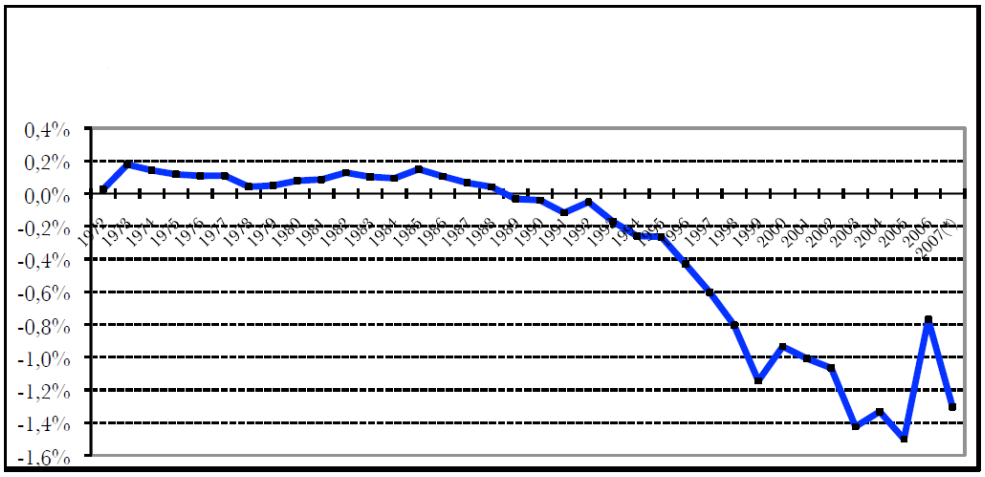
seyri ve yapısı, yine problemli bir alan olarak karşımıza çıkmaktadır. Temel hedefin gelir gider dengesi olduğu sosyal güvenlik kurumlarından Emekli sandığı, ilk açık veren kurum olarak karşımıza çıkmaktadır (Yılmaz ve Yentürk,2015:6).



Grafik I: Emekli Sandığı Gelir Gider Dengesi / GSMH (1970-2007)

Kaynak: Kalkınma Bakanlığı

Grafik 1'den izlenebileceği gibi Emekli Sandığı'nda denge 1986 yılına kadar açık vermemiştir. Bununla birlikte 1975'te en yüksek seviyesine ulaşan Emekli Sandığı Gelir Gider Dengesi / GSMH oranının bu tarihten sonra düşüş trendine girdiği ve 1986 yılında açık verdiği anlaşılmaktadır. 1986 yılından sonra çeşitli reform çabalarıyla yeniden açık kapansa da 1993 yılında açık kaçınılmaz olmuş ve sistemin birleştirildiği 2006 yılında Emekli Sandığı'ndaki gelir dengesizliği GSMH'nin %1'ine ulaşmıştır. Gelir gider dengesi performansında BAĞ-KUR'un Emekli sandığına göre daha iyi performans sergilediğini söyleyebiliriz. Özellikle Gelir Gider Dengesi / GSMH oranının Emekli sandığına göre daha ileriki yıllarda sıfırın altına düşmesi, bu yorumu yapmamıza olanak sağlamaktadır. Ayrıca BAĞ-KUR'un gelir gider dengesi /GSMH açığı, Emekli sandığına göre daha derin ve daha uzun süreli olmuştur. Grafik 2'de BAĞ-KUR'un Gelir Gider Dengesi / GSMH (1972-2007) performansı izlenebilmektedir.

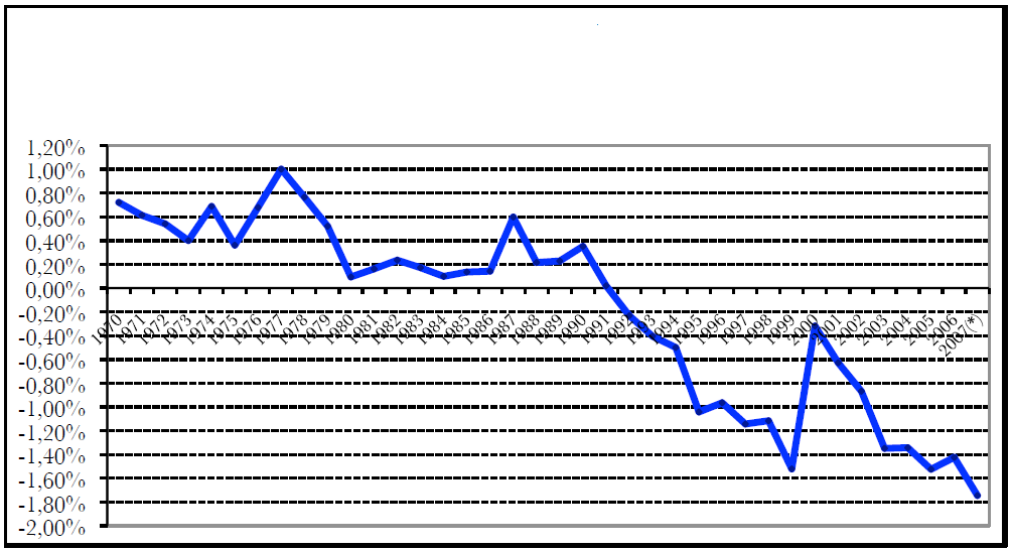


Grafik II: BAĞ-KUR Gelir Gider Dengesi / GSMH (1972-2007)

Kaynak: Kalkınma Bakanlığı

Grafik 2'ye göre gelir gider dengesi performansında 1989'a kadar açık verilmediği ve yatay bir trend izlendiği görülmektedir. Bununla birlikte 1989 yılından itibaren açık verilen kurumda 1994 yılından sonra açık oldukça sert bir şekilde devam etmiş ve 2006 yılı sosyal güvelik kurumu birleşiminden bir yıl önce BAĞ-KUR'un gelir gider dengesi / GSMH oranı %1.5'e kadar ulaşmıştır.

SSK'da durum BAĞ-KUR'dan çokta farklı değildir. 1991 yılı sonuna kadar açık vermemeyi başaran kurum, bu tarihten sonra önemli problemlerle uğraşmak zorunda kalmıştır.



Grafik III: SSK Gelir Gider Dengesi / GSMH (1970-2007)

Kaynak: Kalkınma Bakanlığı

Grafik 3'teki SSK Gelir gider dengesi / GSMH eğilimine bakıldığında BAĞ-KUR'a benzer bir durum karşımıza çıkmaktadır. 1992'de eksiye düşen oran 2007 yılına kadar pozitif değerlere ulaşamamıştır.

Sosyal Güvenlik açıklarının Hazine tarafından gerçekleştirilen bütçe transferleri ile finanse edildiği Türkiye'de söz konusu transferlerin devlet katkısı, açık finansmanı, ek ödeme, faturalı ödemeler, teşvikler, ödeme gücü bulunmayanların genel sağlık sigorta primleri olmak altı transfer alt kalemi bulunmaktadır.

Çalışma ve Sosyal Güvenlik Bakanlığı istatistiklerine göre 2002 yılında 9.684.000 TL olan bütçe transferleri devamlı bir artış trendi ile 2005 yılında 23.322.000 TL'ye, 2009 yılında 52.600.000 TL'ye, 2013 yılında 71.264. 000TL'ye ve 2014 yılında 80.950.000 TL'ye ulaşmıştır. Bütçe transferleri kaleminin alt kalemlerine bakıldığında açık finansman kalemi en büyük kalemi oluşturmaktadır. En küçük kalem de ödeme gücü olmayanların genel sağlık sigorta ödemeleri kalemidir.

Açık finansman kalemi 2007 yılına kadar pasif şekilde kalırken 2007 yılında 25.820.000 TL 2010 yılında 27.069.000 TL, 2013 yılında 20.348.000 TL'ye ve 2014 yılında 22.680.000 TL'ye ulaşmıştır. Ödeme gücü olmayanların genel sağlık sigorta ödemeleri kalemi ise 2010 yılına kadar pasifken 2011yılında 403.000 TL, 2012 yılında 3.469.000 TL, 2013yılında 6.929.000 TL ve 2014 yılında 6.651.000 TL olarak gerçekleşmiştir.

2016 istatistiklerine göre 2016 yılı toplam gelirinin 581 milyar 927 milyon TL olması öngörülmüş olup söz konusu toplam gelirin yüzde 84"ünü ise 489 milyar TL ile vergi gelirleri oluşturacak. Gelir vergisinin en büyük dilimini ise 137 milyar TL ile gelir vergisi ve 213 milyar TL ile Katma Değer Vergisi oluşturmaktadır.

I.II. Türkiye'de Sosyal Güvenlik Sistemi'nin Temel Problemleri ve Açıklarının Boyutu

Türkiye'de sosyal güvenlik sisteminin genel problemleri arasında en temel sorun, sistemin tüm toplumu kapsamamasıdır (Egeli ve Özen, 2009:7). Sistem, nüfusun büyük çoğunluğunu güvence altına almanın oldukça uzağındadır. (Buğra ve Keyder 2006:212). Hâlbuki sosyal güvenlik sistemlerinin temel amacı, vatandaşlarının bugününü ve geleceğini güvence altına almaktır (Talas,1997: 398).

Türkiye'de sosyal güvenlik sistemi tutarlı ve sağlıklı bir devlet politikasına sahip değildir. Sistemdeki kaynak sorunu, sistemin diğer bir problemli ayağını oluşturmaktadır. Türkiye'de sosyal güvenlik sistemine ayrılan kaynak oranı, gelişmiş ülkelerle karşılaştırıldığında oldukça düşük kalmaktadır. Bu durumun kaçınılmaz sonucu olarak sistemin finansman açığı büyümektedir. 1995 yılında GSYİH'nın %1,8'ine karşılık gelen BAĞ-KUR,

Emekli Sandığı ve SSK'nın toplamının finansman açığı, 1998 yılında %2,79'a, 1999'da %3,76'ya, 2000'de %2,57'ye, 2001'de %3,08'e ve 2002 yılında ise %3,40'a ulaşmıştır. SGK'nın 2015 yılındaki zararı ise 11 milyar 444 milyon lira olarak gerçekleşerek %4 oranına ulaşmıştır.

Ancak, açıkların GSYİH' ya oranının 2020 yılında %4,3'e ve 2050 yılında %10,1'e çıkacağı öngörülmektedir (SGK raporlarından derlenmiştir). Yoksulluğun devam ediyor olması bu durumun en somut kanıtıdır. Sistemdeki diğer bir problem erken emekliliktir. Genç emeklilik sayısının fazlalığı, uzun bir emeklilik ve kısa süreli prim geliri elde ederken daha uzun süreli emekli aylığı ödemesi yapma anlamına gelmektedir. Tablo 1'de 1950-1999 yılları arasında Türkiye'deki emeklilik yaşları gösterilmektedir.

Tablo I**:** Türkiye'nin 1950-1999 Yılları Arası Emeklilik Yaş İstatistikleri

Yıl	Kadın	Erkek
1950	60	60
1965	55	60
1969	38	43
1986	55	60
1992	38	43
1999	58	60

Kaynak: Çalışma ve Sosyal Güvenlik Bakanlığı

Yukardaki tablo 1'den görüleceği gibi Türkiye'deki emeklilik yaşının 38'li yaşlara kadar indiği dönemler olmuş ve sistemin olmazsa olmazı olan yaşlılık aylığı bağlanmasında esas olan kişinin çalışma verimini düşürecek kadar yaşlanmasıdır kuralı uygulanamamıştır.

Devlet katkısının yetersizliği sistemdeki diğer bir aksaklıktır. Her ne kadar bireysel emeklilik sistemine katılımın sağlanması için devletin katkı payı ödemesi uygulaması hayata geçirilmiş olsa da sistemin güçlenmesi için yeterli katkı payına hala ulaşılamamıştır. Hâlbuki birçok gelişmiş ülkede devletin sisteme katkısı ciddi denecek boyutlara ulaşmıştır. Tablo 2'de OECD'ye üye ülkelerin sosyal güvenlik sistemine finansman katılım oranları gösterilmektedir.

Tablo II**:** OECD Ülkelerinde Devletin SGK Finansmanına Katılım Oranları (2010)

Ülkeler	Devlet katkısı (%)	Ülkeler	Devlet katkısı (%)
A.B.D.	29.48	**İrlanda**	61.43
Avustralya	25.66	**İsveç**	49.25
Avusturya	17.41	**İsviçre**	26.30
Belçika	31.11	**İzlanda**	88.36
Danimarka	85.70	**Japonya**	22.78
Finlandiya	44.66	**Kanada**	61.17
Fransa	19.63	**Lüksemburg**	32.45
Hollanda	14.95	**Norveç**	55.55
İngiltere	55.06	**Portekiz**	15.44
Yunanistan	12.41	**Yeni Zelanda**	92.47

Kaynak: TÜSİAD (2010)

Tablo 2'ye göre devletin SGK finansmanına katılım oranları en az %12.41 ile Yunanistan'a aitken İskandinav ülkelerinde bu oran %50 bandındadır. Yeni Zelanda'da oranın %92'ye yükseldiği görülmektedir. Prim tahsilatının yetersizliği ve prim oranlarının yüksekliği, sistemin diğer bir problemli yanını oluşturmaktadır. Diğer bir ifadeyle Türkiye'de ücretin hemen hemen yarısı işçiye verilirken yarısı da SGK primi ve vergi olarak devlete aktarılmaktadır. SGK'ya aktarılan fonların etkin olarak kullanılamaması, sistemdeki diğer bir aksaklıktır. Sosyal sigorta kurumlarının kabul ettiği temel prensip fon biriktirme esasıdır. Biriktirilen fonlar, etkin ve verimli alanlarda değerlendirilmeli ve sağlanacak ek gelirle sigortalıların daha iyi hizmet alması sağlanmalıdır. Oysaki Türkiye'de siyasi iradenin de sistem üzerindeki müdahaleleri sonucunda fonlar verimsiz ve düşük getirili alanlara yönlendirilmiştir.

Kayıt dışı uygulamalarla kayıt dışı istihdam, Türkiye'nin SGK'nın gelişimindeki önemli bir engeli teşkil etmektedir. Bu sorun sigortalı olarak çalıştırılan işçilerin yanında bir o kadar da sigortasız çalıştırılan işçiler olarak karşımıza çıkmaktadır. SGK'nın kayıt dış istihdamla mücadele portalı verilerine göre kayıt dışı çalışma üç şekilde karşımıza çıkmaktadır. Bunlar;

- Çalışanların işverenlerce Sosyal Güvenlik Kurumu'na bildirilmemeleri,
- Çalışma gün sayılarının olandan düşük bildirilmesi,
- Sigorta primine esas kazanç tutarlarının olduğundan düşük bildirilmesidir.

Aktif-Pasif sigortalı dengesinin bozulması, erken emekliliğin bir sorun olarak karşımıza çıkmaktadır. Erken emekliliğin neden olduğu mali yapıdaki bozulmalar, aktif sigortalı sayısının

pasif sigortalı sayısına oranla oldukça düşük seviyelerde kalmasından kaynaklanmaktadır (Erol, 2014:49).

Norm ve standart birliğinin olmaması sistemin diğer problemli alanlarıdır. (Erol, 2014:40) Türkiye'de sosyal güvenlik sistemi, uygulanan çeşitli finansman yöntemlerine rağmen grafik 1, grafik 2 ve grafik 3'te bahsedildiği gibi açık vermiş ve bu durum üç farklı kurumun birleştirildiği 2006 yılından sonra da devam etmiştir. Kurumun en önemli gelir kaynağını sigorta primleri en önemli giderini ise emekli aylık ödemeleri oluşturmaktadır**.**

Tablo III: Sosyal Güvenlik Kurum'nun Gelir-Gider Dengesi (2003-2015)

YILLAR	GELİRLER	Artış Oranı (%)	Giderler	Artış Oranı (%)	Açık	Gelirlerin Giderleri Karşılama Oranı
2003	27916539	39,5	41336077	47,7	-13419538	67,5
2004	34689248	24,3	50621622	22,5	-15932374	68,5
2005	41249438	18,9	59941373	18,4	-18691935	68,8
2006	53830886	30,5	71867475	19,9	-18036589	74,9
2007	56874830	5,7	81915401	14,0	-25040571	69,4
2008	67257484	18,3	93159462	13,7	-25901978	72,2
2009	78072788	16,1	106775443	14,6	-28702655	73,1
2010	95273183	22,0	121997301	14,3	-26724118	78,1
2011	124479836	30,7	140714602	15,3	-16234766	88,5
2012	142928505	14,8	160223453	13,9	-17294948	89,2
2013	163013555	14,1	182688916	14,0	-19675361	89,2
2014	184328932	13,1	204400437	11,9	-20071505	90,2
2015	71861708		75632755		-3771047	92,7

Kaynak: SGK İstatistik Bülteni, 2015

Tablo 3'te 2003-2015 yıllarındaki gelir gider gerçekleşmelerine bakıldığında devamlı açık verildiği izlenebilmektedir. Bununla birlikte olumlu bir gösterge olan gelirlerin giderleri karşılama oranı son beş yılda artarak 2015 yılında %92,7'ye kadar yükselmiştir. SGK istatistiklerine göre 2011 yılında izlenen %3'ık artışın nedeni, Cumhuriyet tarihinin en kapsamlı affının yapılmış olmasındandır (Demir ve Canbay, 2013: 453). 6111 sayılı af yasası kapsamında yapılandırılan prim ile 'geçici' bir prim artışı kaydedilmiştir.

II. LİTERATÜR

Yazgan (1974) sosyal güvenlik sisteminin finansmanı konusundaki çalışmasında ülke için ekonomik ve sosyal koşullara uygun finansman yönteminin kullanılması durumunda sistemin vergilerden sonra gelir dağılımını belirleyen en önemli araç olacağı sonucuna ulaşmıştır.

Akgeyik ve diğerleri, (2007) sosyal güvenlik açıkları ve reform tartışmalarının sosyo-ekonomik yansımalarını analiz ettikleri çalışmalarında sistemde meydana gelen borçlanma gereğindeki artışın iç ve dış borçlanmayla finanse edilmeye çalışıldığını, bu durumun sonucu olarak borç faiz ödemelerinde sorunlar meydana geldiğini belirlemişlerdir.

Arısoy ve diğerleri (2010) sosyal güvenlik sistemi bağlamında 1960-2005 yılları için Türkiye ekonomisinde sosyal harcama düzeyi ile iktisadi büyüme ilişkisini incelemişlerdir. Çalışmada sosyal harcamaların ve sosyal harcamaların alt bileşenleri olan sosyal koruma ve eğitim harcamalarının ekonomik büyümeyi olumlu etkilediği sonucuna ulaşmışlardır.

Sarısoy ve Koç (2010) sosyal kamu harcamaları ile yoksulluk arasındaki ilişkiyi sosyal güvenlik sistemi paralelinde irdeledikleri çalışmalarında yoksulluğun yok edilebilmesi veya azaltılması için gerekli olan politikaların eksikliğine vurgu yapmaktadırlar. Ayrıca çalışmada yaptıkları ekonometrik analizde sosyal kamu harcamalarının yoksulluk oranlarını azalttığı sonucuna ulaşmışlardır. Türkiye İşveren Sendikaları Konfederasyonu (2012) aylık bülteninde yer alan çalışmaya göre Türkiye'de sosyal güvenlik transferlerinin bütçe dengesini bozduğu sonucuna ulaşılmıştır.

Akalın (2013) yapmış olduğu çalışmada sosyal güvenlik sistemine yapılacak finansman katkılarının gelir dağılımındaki bozukluğu düzeltici bir etkiye sahip olmayacağını dile getirmektedir. Akalın'a göre, sisteme yapılan finansman katkıları, emek gelirinin GSMH içindeki payını arttırmamakla birlikte emek gelirinin iç dağılımını eşitlik yönünde düzeltebilecektir.

Yılmaz (2014) çalışmasında sosyal güvenlik sistemine aktarılan transferlerin kayda değer rakamlara ulaşması sonucunda kamu finansmanını olumsuz yönde etkileyeceğini dile getirmektedir.

Yılmaz, sosyal güvenlik sistemine aktarılan transferlerin kamu borçlanma gereğini ve bütçe açığını arttırdığı sonucuna ulaşmıştır. Bu durum da genel ekonomiyi olumsuz etkilemektedir.

Cural (2016), Türkiye'de sosyal güvenlik sisteminin yapısal sorunlarını ve bütçe transferlerinin sistem üzerindeki etkilerini irdelediği ekonometrik çalışmada bütçe transferlerinin kamu giderlerini ve iç borç stokunu arttırdığı, bütçeyi olumsuz etkilediği ve kamu sabit sermaye yatırımlarını hem olumlu hem de olumsuz etkilediği sonucuna ulaşmıştır.

III. TÜRKİYE'NİN SOSYAL GÜVENLİK SİSTEMİ'NE YAPILAN BÜTÇE TRANSFERLERİNİN MAKROEKONOMİK ANALİZİ

III. I. Veri ve Yöntem

Çalışmanın ekonometrik analizinde Sosyal Güvenlik Sistemi'ndeki açıkların finansmanı amacıyla gerçekleştirilen bütçe transferlerinin kamu borç stoku, dış borçlanma, bütçe açığı ve yatırımlar ile ilişkili olup olmadığının araştırılması amaçlanmaktadır. Literatürde SGK için gerçekleştirilen bütçe transferlerinin yatırımları azalttığı, bütçe açıklarını ve kamu borç stokunu arttırdığı yönünde birçok görüş bulunmaktadır. 1990-2015 yılları arası yıllık verilerle incelenen analizde Cural'ın (2015) yaptığı analizden yararlanılmıştır.

Tablo IV: Değişkenler, Kısaltmaları ve Elde Edilen Kaynak

DEĞİŞKENLER	KISALTMALARI	ELDE EDİLEN KAYNAK
Bütçe Transferleri	BT	Kalkınma Bakanlığı
İç Borç Stoku	İBS	Hazine Müsteşarlığı
Dış Borç Stoku	DBS	Hazine Müsteşarlığı
Kamu Yatırımları	KY	Kalkınma Bakanlığı
Bütçe Giderleri	BG	OECD ve SGK
Ham Bütçe Giderleri	HBG	OECD ve SGK

Not: HBG, SGK'ya yapılan bütçe transferleri hariç bütçe giderlerini ifade etmektedir

Analize konu olacak olan tüm zaman serilere ait tanımlayıcı istatistikler tablo 5'de sunulmuştur.

Tablo V: Tanımlayıcı İstatistikler

	BT	İBS	DBS	KY	BG	HBG
Ortalama	15.12	16.11	16.21	14.11	15.90	16.01
Medyan	15.11	15.11	16.20	15.20	16.11	16.10
En Çok	17.09	16.40	15.78	15.71	15.01	15.80
En Az	14.90	17.80	17.11	15.80	15.10	15.86
Standart Sapma	0.065	0.60	0.98	0.58	16.90	16.11
Çarpıklık	0.28	-0.31	-0.17	-0.18	-0.15	-0.30
Basıklık	0.12	2.35	1.40	1.32	1.20	1.27
Jarque Bera	1.90	3.23	5.21	1.11	1.10	1.10
Olasılık	0.39	0.18	0.20	1.19	0.29	0.26
Gözlem	25	25	25	25	25	25

Tablo 5'deki tanımlayıcı istatistiklere göre incelenen dönemde zaman serilerinin normal bir dağılım göstermediği çarpıklık ve basıklık değerlerinden anlaşılmaktadır. Normal dağılımında çarpıklık değerinin 0, basıklık değerinin de 3 olması beklenmektedir. Basıklık değeri 3'ün üzerinde olduğunda mevcut dağılımın normal dağılıma göre sivri tepeli olduğu anlaşılmaktadır. Bu durum, dağılımın aşırı değerler içerebileceği şeklinde yorumlanmaktadır. Tablo 5 sonuçlarına göre, elde edilen basıklık değerlerinin tümü 3'ten küçük çıkmıştır. Bu durum ince kuyruk özelliği gösterdikleri anlamına gelmektedir. Bir tanesi hariç diğer tüm serilerin çarpıklık değerinin negatif olması serilerin sola çarpık olduğu anlamına gelmektedir. Zaman serlerinin normal dağılıma sahip olup olmadığı Jarque-Bera (JB) test istatistiği ile analiz edilmiştir. Elde edilen sonuçlara göre elde edilen test istatistiklerinin $\chi 2$ tablosu değerlerinden büyük ve istatistikî olarak anlamlı olması nedeniyle zaman serileri normal bir dağılıma sahip olduğu sıfır hipotezi reddedilmiş ve hiçbir zaman serisinin normal dağılım göstermediği anlaşılmıştır.

III. II. Uygun Gecikme Uzunluğu ve Birim Kök Testleri

Birinci farkları alındığında durağan hale gelen zaman serilerinde ileride yapılacak analizler için uygun gecikme uzunluğunun belirlenmesi gerekmektedir.

Tablo VI: Gecikme Uzunluğunun Tespiti

Gecikme Uzunluğu	LR	AIC	SC	HQ
0	6.111	65.111	66.132	68.113
1	115.130	65.210	67.230	66.110
2	18.123	64.111	61.119	59.109
3	11.908*	61.131*	60.312*	59.011*
4	4.312	64.098	60.999	59.789
5	1.231	66.213	68.710	60.189

Tablo 6'da LR (Likelihood), AIC (Akaike Information Criterion), SC (Shwarz Information Criterion), HQ (Hannan-Quinn Information Criterion) bilgi kriterlerinden istifade edilerek en uygun gecikme uzunluğu saptanmıştır. En uygun gecikme uzunluğu üç olarak kabul edilmiş olup tüm analizlerde gecikme uzunluğu üç olarak kullanılacaktır.

Zaman serileri analiz edilirken çoğu makroekonomik zaman serisinin durağan olmadığı, diğer bir ifade ile birim kök içerdiği göz önünde tutulmalıdır. Birim kök, serilerde ana karakteristik köklerinin mutlak değerlerinin 1'e eşit olması anlamına gelmektedir. Bu durumun sağlanmadığı, birim kök içeren serilerden ulaşılacak sonuçlarda regresyon tahminleri sağlıklı ve güvenilir olamamakta, sahte ve yanıltıcı tahminlere neden olmaktadır. (Gujarati, 2004:792).

Bu durumu ortadan kaldırmanın yolu zaman serilerine birim kök testi uygulamaktır. Birim kök testleri için Y_{it} serisinden meydana getirilen birinci derece otoregresif süreci içine alan basitleştirilmiş model denklem (1) deki gibidir.

$$y_{it} = PY_{it-1} + \varepsilon_{it} \qquad -1 \leq p \leq 1 \tag{1}$$

Eşitlik 1'de p, birim kök testinin otoregresif katsayısını ifade etmekte olup p mutlak değer değeri 1'den küçük ise birim kökün içermediği sonucuna ulaşılmaktadır. Bununla birlikte mutlak değer p değeri 1'e eşit ise seri durağan değildir ve birim kök taşımaktadır sonucuna ulaşılmaktadır (Maddala, 1992:581-582). Çalışmada kullanılacak iki birim kök testinden biri Dickey ve Fuller (1981) tarafından geliştirilen Augmented Dickey-Fuller (ADF) testidir.

$$\Delta Y_t = PY_{t-1} + \sum_{i=1}^{k} \beta_i \Delta Y_{t-i} + \varepsilon_t \tag{2}$$

$$\Delta Y_t = \alpha + PY_{t-1} + \sum_{i=1}^{k} \beta_i \Delta Y_{t-1} + \varepsilon_t \tag{3}$$

$$\Delta Y_t = \alpha + \delta t + PY_{t-1} + \sum_{i=1}^{k} \beta_i \Delta Y_{t-1} + \varepsilon_t \tag{4}$$

(3), (4) ve (5) numaralı denklemlerdeki ΔY_tanalize konu olan değişkenin birinci farkını ifade etmektedir. Denklemlerdeki k gecikme uzunluğunu, t zaman trendini, ΔY_{t-i} bir dönem gecikmeli fark terimini, ε_t ise hata terimini ifade etmektedir. ADF testlerinde $H_0 \, ve \, H_1$ olmak üzere iki hipotez kurulmakta olup boş hipotez, serinin birim kök içerdiğini iddia etmektedir. Sonuçta boş hipotezin ret edilememesi birim kökün varlığı sonucunu doğuracaktır. Tablo 4'de ADF birim kök testleri izlenebilmektedir.

Tablo VII: ADF Birim Kök Test Sonuçları

	Seviyede		**Birinci Farkta**	
	Sabit	**Sabit ve Trendli**	**Sabit**	**Sabit ve Trendli**
BT	-0.86	-3.21	-5.12**	-3.62**
İBS	-0.88	-1.33	-7.76**	-8.54**
DBS	-1.31	-1.65	-3.56*	-4.31*
KY	-1.41	-2.56	-6.23*	-4.43*
BH	-1.33	-1.11	-5.34*	-5.34*
HBG	-0.87	-1.70	-6.12**	-6.23*

Not: *,** sırasıyla %1 ve %5 anlamlılık düzeyini ifade etmektedir

Tablo 7'deki sonuçlara göre gerek sabit gerekse sabit ve trendli hiçbir değişken seviyede durağan değilken birinci farkları alındığında durağan hale gelmiştir.

Çalışmada kullanılacak diğer birim kök testi olan Yapısal Kırılmalı Lee ve Strazicich testidir. Bu testte yapısal değişimler içssel olarak belirlenmektedir. (Lee ve Strazicich,2003:1088).

Lee ve Strazicich birim kök testi 2 farklı modelle tahmin edilmektedir. A modeli yapısal kırılma, C modeli sabit ve trenddeki kırılma olmak üzere analize dâhil edilmektedir.

$$Y_t = \vartheta' Z_t + \varepsilon_t \;\; ve \; \varepsilon_{t=}\beta\varepsilon_{t-1} + e_t \quad (5)$$

Eşitlik (5) te Z_t içsel değişken vektörü ve ε_t hata terimini temsil etmektedir. Bir kırılmaya izin veren A modeli için;

$D_t, t \geq T_B + 1$ Olduğunda 1, farklı durumlar için 0 değerini alan kukla (dummy) değişkenini temsil etmek üzere (5) no'lu denklem için;

$Z_t = (1, t, D_{1t})$ Şeklini almaktadır. T_B Kırılma zamanını temsil etmektedir.

Ortalamada iki kırılmaya imkân kılan durağanlık testi için Model AA, $D_{jt} = 1; j = 1,2$ olduğu durumda

$D_t, t \geq T_{BJ} + 1$ iken 1, bu durumun dışındaki durumlarda 0 değerini alan dummy değişkeni gösteren (5) no'lu denklemde

$Z_t = (1, t, D_{1t}, DT_t)$ olmaktadır.

Hem sabit terimde hem de trendde iki kırılmaya olanak sağlayan CC modeline ulaşmak için j=1, 2 olacak şekilde (Arısoy ve Ünlükaptan, 2010:449). $DT_{tj}, t \geq T_{Bj} + 1$ iken t-T_{BJ} farklı şartlarda 0 değerini alan dummy değişkeni ifade etmek suretiyle Z_t yerine $Z_t = (1, t, D_{1t}, D_{2t}, DT_{1t}, DT_{2t}$ konulmaktadır.

Tablo VIII: Lee ve Strazicich Birim Kök Testi Sonuçlar

Değişkenler	**Model C**	**Model CC**	**Model A**	**Model AA**
BT	-2.64(1998)	-3.11(1980-1994)	-2.76(1998)	-2.17(1998-2009)
İBS	-3.75(1981)	-3.34(1980-1988)	-1.58(2000)	-3-01(1998-2001)
DBS	-2.42(1999)	-6.19(1998-2007)	-2.00(2007)	-2.98(1994-2000)
KY	-2.10(2000)	-2.60(1988-2002)	-1.88(2008)	-2.12(1997-2001)
BH	-5.10(200)	-3.90(1988-2002)	-1.90(2008)	-2.40(1998-2002)
HBG	-3.90(2001)	-1.90(1988-2001)	-1.87(2008)	-1.82(1998-2001)

Lee ve Strazicich testi sonuçları kritik değer tablosuyla kıyaslandığında meydana gelen yapısal kırılmalar dikkate alındığı durumda bile zaman serilerinin seviyede birim kök taşıdığına işaret etmektedir. Tablo 8'de izlenen kırılma tarihleri de Türkiye ekonomisi için anlamlı tarihlerdir.

1980 yılı liberal politikaların Türkiye'de hayata geçirildiği yıl olarak kabul edilmektedir. 1994, 1999 ve 2001 yılları Türkiye'nin kriz yılları olarak kayıtlara geçmiştir.

2007 yılı ise küresel krizin bir yıl öncesi olarak düşünülebilmektedir. Sonuç ADF birim kök testiyle aynı olup seviyede durağanlık söz konusu değildir.

III. III. Johansen-Juselius Eş Bütünleşme Analizi

Bulgular zaman serilerinin. ADF birim kök testi sonuçları dikkate alındığında I(1) olduğu sonucuna varılmıştır. Bu nedenle zaman serilerinin eş bütünleşme analizi için uygun olduğuna karar verilmiştir. Eş bütünleşme ilişkisinin tespiti için denklem (6) ve denklem (7) den yararlanılmaktadır.

$$Y_t = \alpha + \beta X_t + \varepsilon_t \quad (6)$$

$$X_t = \alpha + \beta Y_t + u_t \quad (7)$$

Denklem (6) ve (7) de Y_t t zamanındaki Y değişkenini X_t ise t zamanındaki X değişkenini temsil etmektedir. A ve β, parametreleri temsil ederken ε_t ve u_t hata terimlerini temsil etmektedir. Eş bütünleşme teorisinde eğer analize konu olan serler seride durağan olmamalarına karşın birinci farkta durağan oluyorlarsa aralarında eş bütünleşme ilişkisi söz konusu olabilmektedir. Çalışmadaki seriler birinci seviyede durağan oldukları için Johansen-Juselius (1990) tarafından geliştirilen eş bütünleşme analizine geçilmektedir.

Johansen-Juselius (1990) yönteminin çıkış noktası, aşağıdaki gibi p gecikmeli bir Vektör oto regresyon denklemine dayanır**:**

$$Y_t = \mu + A_1 Y_{t-1} + \cdots + A_p Y_{t-p} + \varepsilon_t \quad (8)$$

Denklem (8)'de Y_t seviyede durağan olmayıp birinci farkı alındığında durağanlaşan değişkenin nx1 değişkenler vektörünü, ε_t ise nx1 şoklar vektörünü temsil etmektedir (Çetin, 2012: 221). VAR modeli denklem (9) daki gibi ifade edilmektedir.

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \quad (9)$$

Johansen ve Juselius (1990), eş bütünleşme vektörlerinin sayısını ve anlamlılıklarını analiz etmek için iz ve maksimum öz değer olmak üzere iki ana test istatistiği geliştirmişlerdir. Söz konusu testler;

$$J_{iz} = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i) \quad (10)$$

$$J_{max} = -T \ln(1 - \lambda_{r+1}) \quad (11)$$

Tablo IX: Johansen Eş bütünleşme Testi Sonuçları

Değişkenler: BT, İBS, DBS, KY, BH, HBG; Gecikme Uzunluğu 3							
İz (Trace) İstatistiği				Maksimum Öz değer İstatistiği			
H_0	H_1	Test İstatistiği	Kritik Değer (%5)	H_0	H_1	Test İstatistiği	Kritik Değer (%5)
r=0	r≥1	81.118**	69.221	r=0	r≥1	45.132**	33.672
r≤1	r≥2	40.121	46.901	r≤1	r≥2	22.512	25.132
r≤2	r≥3	15.121	29.190	r≤2	r≥3	7.421	20.312
r≤3	r≥4	6.113	15198	r≤3	r≥4	5.312	14.123
r≤4	r≥5	1.812	3.110	r≤4	r≥5	1.453	3.454
r≤5	r≥6	1.212	3.210	r≤5	r≥6	1.213	2.798

Not: r eş bütünleik vektör sayısını ifade etmektedir. **, % 10 seviyesinde H0 ın ret edildiği anlamına gelmektedir.

Tablo 9'daki eş bütünleşme sonuçlarına göre hesaplanan iz testi ve maksimum öz değer istatistikleri, kritik değerlerle karşılaştırıldığında %5 anlam düzeyinde 1 adet eş bütünleşme vektörünün bulunduğunu görülmektedir. Diğer bir ifade ile bütçe transferleri ile ekonometrik analize konu olan değişkenler arasında herhangi bir eş bütünleşme vektörün bulunmadığını H0, iz ve maksimum öz değer testleri tarafından reddedilmektedir.

III. IV. Asimetrik Nedensellik Ve Granger Nedensellik

Bu aşamada uzun dönemli ilişkilerin birbirleri ile olan nedenselliğini araştırmak amacıyla nedensellik testi yapılmalıdır. Ayrıca hata düzeltme modeli ile eş bütünleşme ilişkisinin kısa ve uzun dönemli ayrıntıları irdelenmelidir. Bu amaçla çalışmada asimetrik nedensellik testinin yanı sıra geliştirilmiş granger nedensellik testi kullanılarak değişkenler arası nedensellik durumu analiz edilecektir.

Geleneksel Granger (1969) nedensellik testinde sınanan herhangi bir değişkenin geleceğe yönelik tahmin edilmesinde ikinci bir değişkenin faydalı bilgi sağlayıp sağlamadığıdır. Bu testin üzerine literatürde farklı testler geliştirilmiştir (Hacker, Hatemi, 2006:1499). Söz konusu testler pozitif şoklarla negatif şokların etkisini farksız kabul etmektedir.

Hatemi-J (2012) geliştirdiği asimetrik nedensellik testinde zaman serilerinin dinamiğini anlamaya yardımcı olacak ve muhtemel geleceğe yönelik tahminleri geliştirmeye imkân verecek saklı yapıyı bulmak amaçlanmaktadır.

Tablo X: Birinci farkı alınarak durağan hale getirilen değişkenlere ait nedensellik test sonuçları Asimetrik Nedensellik Testi Sonuçları

Nedensellik Yönü	**Bütçe Transferleri**			
	Pozitif		**Negatif**	
	Ki Kare	**P Değeri**	**Ki Kare**	**P Değeri**
İBS	2.81(3)	0.44**	8.12(3)	0.01
DBS	3.89(3)	0.38	11.12(3)	0.01
KY	10.98(3)	0.00	7.70(3)	0.07
BG	2.17(3)	0.72	7.11(3)	0.07
HBG	18.8(3)	0.00	1.32(3)	0.65

Tablo 10'da parantez içindeki değerler gecikme uzunluğunu ifade etmektedir. Tablo 10 sonuçlarına göre, %5 anlamlılık seviyesinde bütçe transferleri değişkeninin toplam bütçe giderlerini olumsuz etkilediği izlenmektedir. Bu sonuçta göz önünde tutulması gereken önemli bir husus, bütçe giderleri içinde bütçe transferlerinin de bulunmasıdır. Bu nedenle toplam bütçe giderlerindeki artışın belli bir kısmı bütçe transferlerinden dolayı olmaktadır. Nedensellik analizinden çıkan diğer bir sonuç ise bütçe transferlerinin kamu yatırımlarını sonuca göre hem olumlu hem olumsuz etkilediği görülmüş olup söz konusu sonuç Cural'ın (2015) çalışması ile paralellik göstermektedir. Bu durum bütçe transferlerinin kamu yatırımlarını üzerinde olumlu etki sağladığı fakat kamu harcamalarının neden olacağı özel kesimi dışlama etkisi ve faizlerin artışı ile durumun negatife dönebileceği olarak yorumlanabilir. Bu durumu diğer bir sonuç olan bütçe transferlerinin iç borç stokunu arttırmasından anlayabilmekteyiz. Artan iç borç stoğu faizlerin artışına neden olabilmektedir. Ayrıca bütçe transferlerinin dış borç stokunu olumsuz etkilediği, bu etkinin %1 anlamlılık düzeyinde sıfırdan farklı olduğu sonucuna ulaşılmıştır. Hata düzeltme modeli ile geliştirilmiş granger nedensellik testi sonuçlarında bütçe transferleri ile diğer değişkenlerin nedensellik ilişkileri tablo 11'de sunulmuştur.

Tablo XI: Hata Düzeltme Modeli İle Geliştirilmiş Granger Nedensellik Testi Sonuçları

	Geckme Sayısı	F İstatistiği	ECM_{t-1} İçin t istatistiği
ΔBT ⟹ ΔİBS	m=1 n=1	66.120*	-8.31*
ΔBT ⟹ ΔDBS	m=2 n=2	122.121*	-20.42*
ΔBT ⟺ ΔKY	m=2 n=2	3.312*	-0.43*
ΔBT ⟸ ΔBG	m=2 n=2	99.134*	15.43*
ΔBT ⟸ ΔHBG	m=2 n=2	4.331*	0.45*

*%5 A.S'de anlamlı olduğunu göstermektedir. m bağımlı n bağımsız değişken için Schwarz bilgi kriterine göre belirlenmiş optimal gecikme uzunluğunu göstermektedir.

Tablo 11'e göre granger nedensellikler için f değerlerinin tümü anlamlıdır. Bütçe transferlerinden iç borç stokuna bir nedensellik söz konusudur. İç borç stokuna paralel olarak

dış borçla da aynı yönde ilişki söz konusudur. Diğer bir sonuç ise bütçe transferleri ile kamu yatırımları birbirinin karşılıklı nedeni olmasıdır. Ayrıca bütçe giderleri ve ham bütçe giderlerinin, bütçe transferinin nedeni olduğu izlenebilmektedir.

IV. SONUÇ

1982 Anayasası'nın 60. maddesi sosyal güvenlik hakkını temel bir "sosyal hak" olarak herkese tanımış, bu temel hakkın sağlanmasında gerekli tedbirlerin alınmasını ve teşkilatların kurulmasını devletin başlıca görevleri arasında belirlemiştir. Tüm bireyler için anayasal hak olan sosyal güvenlik hakkı, birçok yapısal sorun nedeni ile istenilen verimlilik ve etkinliğe ulaşamamıştır.

Uzun yıllardır sosyal güvenlik sistemindeki sorunlarla ve bu sorunları çözme konusunda verdiği mücadele ile bilinen Türkiye'de sosyal güvenlik sisteminin oluşturduğu giderler ve finansman açıkları, 1990'lı yıllarla beraber hızlı ve keskin bir artış kaydetmiştir. Bu bağlamda 1999 yılında gerçekleştirilen sosyal güvenlik sistemi reformuyla gelir arttırıcı ve gider azaltıcı bir politika benimsenmiştir. Bununla birlikte istenilen başarı seviyelerine günümüzde dâhil ulaşılamamıştır. Özellikle sosyal güvenlik harcamalarının merkezi yönetim giderlerinin en hızlı artan kalemini oluşturması, sosyal güvenlik sistemine yapılan bütçe transferlerinin de sorgulanmasını beraberinde getirmiştir.

Bu çalışmada SGK'ya yapılan bütçe transferlerinin GSYİH'ya oranındaki artış trendi ve söz konusu bütçe transferlerinin kamu borç stoku, dış borçlanma, bütçe açığı ve yatırımlar ile ilişkisi ve bu değişkenler üzerindeki etkisi analiz edilmektedir. Türkiye'de 1990-2015 yılları için yıllık verilerle yapılan analizde çalışmanın daha anlamlı olması amacıyla geleneksel ADF birim kök testinin yanında kırılmalara izin veren Lee ve Strazicich birim kök testinden de yararlanılmıştır. Bu sayede birçok ekonomik gelişmeyi bünyesinde barındıran Türkiye ekonomisinde kırılmalar da dikkate alınmıştır. Benzer mantıkla çalışmada iki farklı nedensellik testi uygulanmış olup analiz sonuçlarına göre sosyal güvenlik sistemine yapılan bütçe transferleri, bütçe giderlerini arttırmaktadır. Bu noktada ilgi çekici detay, söz konusu bütçe giderlerinin içine bütçe transferlerinin de dâhil edilmiş olmasıdır. Yine çalışmada bütçe transferlerinin SGK'ya aktarılan bölümünün çıkarılarak analize dâhil edilen ham bütçe giderleri kalemi de bütçe transferleri sonucu artış göstermektedir. Çalışmadaki ekonomik analize toplu olarak bakıldığında bütçe transferleri değişkeninin toplam bütçe giderlerini olumsuz etkilediği izlenmektedir. Analizden çıkan diğer bir sonuç ise bütçe transferlerinin kamu yatırımlarını hem

olumlu hem olumsuz etkilediğidir. Bu durum bütçe transferlerinin kamu yatırımlarını üzerinde olumlu etki sağladığı fakat kamu harcamalarının neden olacağı özel kesimi dışlama etkisi ve faizlerin artışı ile durumun negatife dönebileceği olarak yorumlanabilir. Ayrıca artan iç borç stoku faizlerin artışına neden olabilmekte ve bütçe transferlerinin dış borç stokunu olumsuz etkilemektedir. Nedenselliğin yönüyle ilgili analiz sonuçlarına göre bütçe transferlerinden iç borç stokuna tek taraflı bir nedensellik söz konusudur. İç borç stokuna paralel olarak dış borçla da aynı yönde nedensellik ilişkisi mevcuttur. Bütçe transferleri ile kamu yatırımları birbirinin karşılıklı nedenidir. Bütçe giderleri ile ham bütçe giderleri, bütçe transferinin nedenidir

Bu çalışma sonucunda henüz istenilen başarının sağlanamadığı sosyal güvenlik sistemine yapılan bütçe transferleri, sistemle ilişkili makroekonomik kalemleri olumsuz etkilemektedir. Bu nedenle çalışmada belirtilen;

- Sistemdeki genç emeklilik sayısının fazlalığı,
- Yoksulluk,
- Devlet katkısının yetersizliği,
- Yeterli katkı payına hala ulaşılamamış olması,
- Prim tahsilatındaki yetersizlik,
- Kayıt dışı uygulamalar,
- Aktif - pasif sigortalı dengesinin bozulması,
- Fonların verimli ve etkin değerlendirilememesi,
- Norm ve standart birliğinin olmaması

gibi yapısal sorunların minimize edilmesi, sisteme aktarılan bütçe transferlerini azaltabilecek, bütçe transferlerinin neden olduğu iç ve dış borç stokları azalacak, yatırımların artması ve daha verimli yönetilmesi sağlanabilecek ve sosyal güvenlik sistemi daha etkin ve verimli bir hale gelebilecektir.

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