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Social Capital and Adoption of Cassava Innovation among Rural Farmers in Abia State, Nigeria

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Abstract

Innovation is the practical implementation of ideas, thoughts and methodologies that results in the introduction of new and better ways of offering goods and services; while social capital incorporates the collective relationships that help people to get along with each other and act more effectively individually and within a group. Amidst the various technical, institutional and socio-economic constraints to Cassava production in Nigeria, adoption of innovative approaches within the farmers groups' is expected to improve the gross margin and profitability of Cassava production amongst rural Cassava farmers. The study analyzed the effect of social capital on adoption of Cassava innovation among rural Cassava farmers in Abia state, Nigeria. Data for the study was analyzed with descriptive statics, logistic regression and correlation matrix. Results from the analysis shows that adoption of Cassava innovation increases as the rural farmers grew older. Evaluation from the socio capital indices shows that the higher the number of days the Cassava farmers belonging to their respective social institutions/groups' claimed to have worked for their social institutions/group, the more the farmers adopt improved Cassava cultivation and processing methodologies. Result from the logistic regression model shows that Age of the rural farmers, Education level, Density of Membership Index, Decision Making Index and Meeting attendance Index were the significant variables influencing adoption of Cassava innovation among the rural Cassava farmers in the study area. High cost of innovation technologies, difficulty in operation and instability in government policies were the major constraints to the adoption of improved Cassava innovation among the rural farmers in Abia State, Nigeria. It is recommended that policies be directed to the development and improvement of various social institutions/cooperative societies in Nigeria; that would enhance rural farmer's access to productive farm resources, especially information, credit and labour resource, so as to achieve her farming objectives.

Keywords: Social Capital, Cassava Adoption, Rural Households, Abia State Nigeria

1. Introduction

Social capital encompasses communal/collective relationships that help people to get along with each other and act more effectively in groups and as isolated individuals. It is the ability of people to secure benefits by virtue of their membership in various social groups or organizations. It embodies the collective actions that members of a group/organization take to achieve their desired objectives (Okezie et al., 2020). It facilitates mutually beneficial collective action.

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Cassava (Manihot esculenta crantz) production has been acknowledged to be constrained by a wide range of technical, institutional and socio-economic factors. Olurotimi et al., (2018) observed that these constraints included pests and diseases problems, agronomic and climate change challenges, poor road networks and shortage of planting materials/inputs. Other constraints are poor processing facilities and lack of institutionalized form of social capital or cooperative groups to pull resources and knowledge together for collective efficiency. Social capital allows access to innovation aimed at improving the efficiency of cassava production among rural farmers.

Innovation is the practical implementation of ideas, thoughts and methodologies that result in the introduction of new and better ways of offering goods and services. Amidst the various technical, institutional and socio-economic constraints to cassava production in Nigeria, adoption of innovative approaches is likely to improve the gross margin and profitability of cassava production among rural farmers. Yet, the rural farmers in Nigeria find it very difficult to adapt improved cassava innovative approaches (Olurotimi et al., 2018). Problems arising from policy and lack of organizational structure hinder the rural farmers' in adapting innovative tactics to improve cassava production. Thus, social capital could create a synergy that would benefit all rural farmers in their respective farming activities.

It is worthy to note that cassava is an important source of dietary carbohydrate and provides food for over 61.1% of the people in Africa, used as raw material for the production of drugs, chemicals, starch, etc. The roots of cassava are processed into garri, fufu, tapioca, chips and cassava flour for human consumption as well as paper, pellets, adhesive and for pharmaceuticals and industrial usage. It is of great interest to note that Nigeria is the world's largest producer of cassava. Its current production was estimated in 2009 to be 36.8 million metric tonnes with a total cultivable land of 3.13 million hectares, which has an average of yield of 11.7 tonnes per hectares (Idrisa et al., 2010).

In spite of the importance of cassava as the largest cultivated crop in Nigeria; and the perceived impact of social capital in enabling the adoption of improved cassava innovation, there is no known empirical research in Abia State, Nigeria that has attempted to examine the role of social capital in facilitating the adoption of cassava innovation among rural farmers. As a result, there is little information on how social capital may influence adoption of cassava innovation for increased productivity and profitability. This scenario therefore created a gap that this study aims to bridge. Consequently, it is therefore necessary to study the role of social capital in expediting the adoption of improved cassava innovation among rural farmers in Abia State, Nigeria.

2. Methodology

2.1. Study Area

The study was carried out in Abia State, Nigeria. Abia State was created out of Imo State on August 27, 1991. It has a land mass of 700 square km with 17 local government areas. The state lies between coordinates 5°31'29.7" North and 7°29.677' East of the Greenwich meridian. Abia State is bounded on the east by Cross River and Akwa Ibom Sates, on the north by Ebonyi and Enugu States, on the West by Imo State and on the South by Rivers State. Abia State consists of three Agricultural Zones, namely; Aba, Umuahia and Ohafia. The annual rainfall in the State ranges from 200-250 mm while the temperature varies from 220c to 350c. Farming is done at a subsistence level with greater percentages in the rural areas. Cassava and yam is the most dominant crop cultivated in the State. The State is endowed with rich fertile soil that supports the growth of other crops such as cocoyam, melon, maize, oil palm, garden egg, cocoa, plantain, banana, cashew, rubber, coconut to mention but a few. Poultry, goat, pigs and sheep are the major livestock kept in the State. Livestock are kept mostly on a smallholder or subsistence basis (Nwaru, 2005).

2.2. Sampling Technique

A multi-stage sampling technique was employed, involving the three agricultural zones (Aba, Ohafia and Umuahia) in the State. In the first stage, two Local Government Areas (LGA) were selected at random from each agricultural zone (i.e. 2 LGAs from Aba, Ohafia and Umuahia Agric Zones respectively, making it 6 LGAs in total). In the second stage, one rural farming community was randomly selected from each of the designated LGAs, Stage three involved the random selection of 10 Cassava farming households in each community; bringing the sample size to 60 rural cassava farmers.

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2.3. Analytical Technique

Descriptive statistics was applied in examining the demographic variables of the rural cassava farmers. The use of tables and means was employed in identifying the available cassava innovation and its frequency of use by the rural cassava farmers in the State, as well as in determining the status of social capital among the rural cassava farmers in the study area. The 5 point rating scale was used to evaluate the constraints to the adoption of cassava innovation among the rural cassava farmers in Abia State, Nigeria.

The influence of social capital on adoption of cassava innovation among rural farmers was analyzed with the application of logistic regression model; while the casual relationship between social capital and adoption of cassava innovations among the rural household was analyzed with the correlation matrix.

2.4 Logistic Regression Model

Logistic regression (logit) analysis is a uni/multivariate technique which allows for estimating the probability that an event occurs or not, by predicting a binary dependent outcome from a set of independent variables. In this regard, adoption of cassava innovation as defined in this study could be either unconstrained or constrained. The dependent variable is adoption of cassava innovation and since probability ranges between 0 and 1, Cassava Farming Households with unconstrained adoption of cassava innovation were assigned 1 and the ones that were constrained have 0 assigned to them.

The linear probability model depicted it given as:

$P_i=E(Y=1X_i) = \beta_{n+} \beta_n X_n$,

where

X_i is the explanatory variable and Y=1 means that the CFH has unconstrained adoption of cassava innovation

Considering the following representation of access to credit:

$$P_i=E(Y=1|X_i)=\frac{1}{1+\exp[-(\beta 1+\beta 2Xi)]}=\frac{1}{1+\exp(-Zi)}$$

Where $Z_i= \beta_1+\beta_2X_i$

$L_i=\ln[P_i/(1-P_i)]=Z_i=\beta_1+\beta_2X_i$

That is, the log of the odds ratio is not only linear in X, but also linear in the parameter. L is called the Logit, and it is thus specified below,

$\text{Log } P/1-P = b_0+b_1X_1+b_2X_2+b_3X_3...+b_{17}X_{17}+\mu$

Y= adoption of cassava innovation by rural cassava farmers

An odds ratio equal to 1 suggests that the explanatory variable leaves the dependent variable unchanged. If the odds ratio is greater (less) than 1, it implies that the effect of explanatory variable is to increase (reduce) the dependent variable (Balogun et al., 2011; Adinya et al., 2008).

Y= Adoption of Cassava Innovation by Rural Cassava Farmers (Dependent variable)

The explanatory variables included in the Adoption of Cassava Innovation model were:

(A) Household Characteristics

X_1 = Age of Household's head (Years)
X_2 = Education Level of Household's head (Years)
X_3 = Gender of Household's head (1= male, 0 = female)
X_4 = Marital Status (1= married, 0 = otherwise)
X_5 = Household size (number)
X_6 = Farming Experience (Years)

(B) Social Capital Variable

X_7 = Density of Membership Index (%)
X_8 = Cash Contribution Index of Households (%)
X_9 = Labour Contribution Index of Household to Association (%)
X_{10} = Decision Making Index (%)
X_{11} = Meeting Attendance of Household to Association (%)

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X_{12} = Heterogeneity Index of Association (%)

The formulae for correlation matrix is represented as

$$.r_i = \frac{n\sum xy - \sum x \sum y}{\sqrt{(n\sum x^2 - (\sum x)^2) - (n\sum y^2 - (\sum y)^2)}}$$

Y = Adoption of cassava innovations.
X = Social capital variables
$\sum$ = summation sign.
r_i= correlation coefficient in period
n = number of respondents studied

3. Results and Discussion

3.1 Socio – Economic Characteristics of Respondents

Table 1: Summary of Socio economic Characteristics of the Respondents

		Frequency	Percentage (%)
Gender	Male	24	40.00
	Female	36	60.00
Total		**60**	**100**
Age	18-24	6	10.00
	25-34	10	16.67
	35-44	11	18.33
	45-54	17	28.33
	55-64	12	20.00
	65+	4	6.67
Total		**60**	**100**
Educational Background	Never attended	6	10.00
	Nursery	11	18.33
	Primary	16	26.67
	Secondary	20	33.33
Total	Tertiary	7	11.67
		60	**100**
Monthly Household Income (N'000)	<5	7	11.67
	6-15	10	16.67
	16-25	12	20.00
	26-35	14	23.33
	36-45	8	13.33
	46-55	6	10.00
Total	>56	3	5.00
		60	**100**
Family Size	1-3 persons	12	20.00
	4-6 persons	27	45.00
	7-10 persons	10	16.67
	>10 persons	11	18.33
		60	**100**

Source: Field Survey Data, 2017

Table 1 shows the socio economic characteristics of the rural cassava farmers. From the table, it was observed that a greater percentage of the respondents (60%) were females and only 40% were males. This implied that more females were engaged in farming than their male counterparts in the study area. A total of 28.33% of the respondents were within the age bracket of 45 -54 years, 20% of the respondents were within the age bracket of 55 – 64 years and 6.67%

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were within 65 years and above. This is an indication that most of the farmers were in their active and productive years (45 - 54 years) who can easily adopt new cassava innovations. Notwithstanding, majority of the youths in the study area (18 - 24 years and 25 - 34 years) recorded a low percentage of the rural cassava farmers. Unfortunately, the youths who are supposed to replace the elderly populace are either withdrawing from or reluctant to go into farming as a profession.

Farmers' level of education influences his/her ability to adopt modern agricultural innovations and make productive decisions on various aspects of farming. The results from table 1 shows that 10% of the farmers interviewed never attended to school, 18.33% had nursery education, 26.67% had primary education, while 33.33% had secondary education, only 11.67% had tertiary education. The result implied that majority of the respondents were relatively educated. Regarding rural cassava farmers household size, a total of 20% of the respondents had a household size of 1-3 persons, 45% had 4-6 persons living in the same household, while 16.67% had a household size of 7-10 members. Also, 18.33% have a household size greater than 10 people. Having a larger household size may provide most of the labour needed for Cassava farming. According to Kanu (2020), larger household size may result in reduction in the cost expanded in hiring farm labourers, thereby leading to increased productivity and income among the rural cassava farmers.

3.2 . Availability and Frequency of Usage of Cassava Innovations among the rural Cassava Farmers in Abia State, Nigeria

This sub-section identifies the various types of Cassava innovation available in the study area. The rate of utilization or usage of Cassava innovations was also ascertained. The various types of Cassava innovations available in the study area were rapid multiplication of Cassava Stems (by 2 – nodes stakes), mechanized peeler, mechanized Garri fryer, cabinet dryer, Cassava/Maize/Melon intercrop, slanting method of Cassava planting among others.

Table 2: Rate of Cassava Utilization (Do You Utilize Cassava Innovation in your Enterprise?)

Response	Frequency	Percentage (%)
Yes	53	88.33
No	7	11.67
Total	**60**	**100**

Source: Computed from Field Survey Data, 2017

Table 2 portrays the respondents view on the utilization of Cassava innovations in the study area. A total of 88.33% of the respondents have utilized Cassava innovations at one point in time in their enterprise; while the sum of 11.67% has not exploited Cassava innovations. This result infers that the farmers currently prefer improved varieties of Cassava because of the higher yields, early maturity, high suppression of weeds, greater resistance to diseases and pests. Hence, the high percentage of adopters.

Table 3: Cassava Innovation Availability and its Frequency of Use by Rural Cassava Farmers in Abia State, Nigeria

Variable	Frequency*	Percentage (%)
(A) Pre – Planting Operation		
(i) Rapid Multiplication of Cassava Stems (by 2 – nodes stakes)	51	85.00
(B) Planting Operation		
(ii) TMS 30572 (UMUCASS 36)	52	86.67
(iii) NR8082 (UMUCASS 37)	49	81.67
(iv) TMS 4 (2) 1425 (UMUCASS 38)	29	48.33
(C) Post - Planting Operation		

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(v) Harvesting Period (8-9 months)	54	90.00
(D) Processing Technology		
(vi) Mechanized Peeler	8	13.33
(vii) Cassava grater	26	43.33
(viii) Grinding machine	58	96.67
(ix) Fermentation tank	16	26.67
(x) Hydraulic press	48	80.00
(xi) Sifter	59	98.33
(xii) Cabinet dryer	34	56.67
(xiii) Mechanized Garri fryer	6	10.00
(D) Other Modern Innovations		
(xiii) Cassava/Maize/Melon intercrop	52	86.67
(xiii) Cassava/Maize/Cocoyam intercrop	51	85.00
(xiii) Cassava/Maize/Melon/Okra intercrop	46	76.67
(xiii) Slanting Method of Cassava Cuttings and Planting	44	73.33
Total Respondent*	**60**	**100**

* = Multiple Responses. *Source: Computed from field survey data, 2017*

Table 3 shows the availability of Cassava innovations and its frequency of use by rural farm households' in Abia State, Nigeria. At each level of production from the cultivation stage, harvesting, and processing; particular innovations were adopted to facilitate the production of the crop.

The TMS 30572 variety (86.67%) was the most planted improved Cassava variety in the study area followed by NR 8082 variety (81.67%), TMS 4 (2) 1425 variety have 48.33% adoption rate. The low adoption rate of TMS 4 (2) 1425 (48.33%) variety by the farmers in the area may possibly be due to unfamiliarity or lack of planting materials of the variety. This could suggest that TMS 4 (2) 1425 variety do not possess desirable characteristics or are relatively new in the study area.

In terms of frequency of use of processing innovation, 98.33% of the respondents opined that they employ Sifter in Cassava processing, 96.67% use grinding machine, 80% employ hydraulic press, 56.67% uses the cabinet dryer, while 43.33% of the respondents interviewed uses Cassava grater for processing. Only 13.33% of the respondents uses mechanized peeler while 10% uses mechanized Garri fryer. The implication of this result is that mainstream of the processing innovations adopted by the respondents in the study area were basically traditional or manual base.

A total of 86.67% of the rural farm households in the study area were involved in Cassava/Maize/Melon intercrop, 85% employs Cassava/Maize/Cocoyam intercrop, while 76.67% were involved in Cassava/Maize/Melon/Okra intercrop. The sum of 73.33% of the respondents uses Slanting Method of Cassava Cuttings and Planting.

3.3. Status of Social Capital among Rural Farm Households' in Abia State, Nigeria

The Social Capital variables that were considered in this analysis include: Density of Membership Index, Cash Contribution Index, Labour Contribution Index, Decision Making Index, Meeting Attendance Index and Heterogeneity Index. The measurement of these six social capital indices is as explained as follows:

Density of Membership Index: This is captured by the summation of the total number of associations to which each household belongs. In other words, membership of associations by individuals in the household was summed up.

Cash Contribution Index: This was obtained by the summation of the total cash contributed to the various associations which the household belong. The actual cash contribution for each household is rescaled by dividing this amount by the maximum fee and then multiplying the resultant fraction by 100 (or %).

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Labour Contribution Index: This is the number of days that household members belonging to their social institutions/group claimed to have worked for their institutions. This represents the total number of days worked by household members for their group. This is also rescaled to 100 using the same process as for cash contribution.

Decision Making Index: This was calculated by summation of the subjective responses of households on their rating in participation in decision making in their various social institutions. The responses were averaged across their various social institutions and multiplied by 100 for each household.

Heterogeneity Index: This is an aggregation of the responses of each household to the questions on the diversity of members of their various social institutions. Each household answered questions on whether members in their various social institutions live in same neighbourhood, are same kin group, belong to same occupation, are of same economic status or are of the same religion. Other include if they were of the same gender, age group or occupation. Hence, for each of the factors a 'yes' response is coded 0 while 'no' response is coded 1. A maximum score of 10 for each association represents the highest level of heterogeneity. The various 'no's are then multiplied by the total number of observations, in order to generate a heterogeneity index. This index is then multiplied by hundred. (A zero value represents complete homogeneity while 10 represent complete heterogeneity).

Table 4: Status of Social Capital among Rural Farm Households'

Social Capital	Mean (in %)	SD	Min (in %)	Max (in %)
Density of Membership Index	64.38	19.2	12	100
Cash Contribution Index	38.67	22.1	7	89
Labour Contribution Index	60.15	24.3	10	100
Decision Making Index	62.85	29.3	9	100
Meeting Attendance Index	57.45	21.6	7	78
Heterogeneity Index	49.67	31.5	4	72
Total	**100**		**100**	**100**

Source: Computed from field survey data, 2017

Table 4 shows the status of Social Capital among rural households in the study area. The mean is considered 50%. The mean density of Membership Index was marginally above average (64.38%). This implied that there were 64.38% of active household farmers in existing social association or organizations. Cash Contribution Index was generally below average (35.5%). The Cash Contribution Index implied that only 35.5% of the rural farm households were involved in payment of membership dues and other contributions. Lawal *et al.*, (2014) observed that the poor financial strength of groups or associations were a major constraint to group activities and development. They also noted that membership financial contributions have an overriding effect on group's sustenance and benefit.

The mean density of Labour Contribution Index was 60.15%. This inferred that there were 60.15% (>average) of the respondents who have contributed their labour skills in terms of productive work in their social organizations. This is measured by mandays.

Decision Making Index, Meeting Attendance Index and Heterogeneity Index have mean values of 62.85%, 57.45 and 49.67% respectively. The implication of these results is that 62.85% of the rural farm households (which is above the mean of 50%) follow a democratic pattern of decision making. Accordingly, about 57.45% are attendance at meetings schedule of their various social associations. A total of 49.67% of the respondents were heterogeneous. The criteria for heterogeneity was differences in neighbourhood, kin group, income group, religion, sex, age, level of education, belief and cultural practices, and trust.

3.4. Influence of Social Capital on Adoption of Cassava Innovation among Rural Farm Households' in Abia State, Nigeria

This objective was realized with the use of Logistic Regression Model or Logit. The Logistic Regression model is a multivariate technique which allows for estimating the probability that an event occurs or not, by predicting a binary dependent outcome from a set of independent variables. In this regard, adoption of Cassava innovation could be either unconstrained or constrained. The dependent variable is adoption of Cassava innovation and since probability ranges

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between 0 and 1, rural farm households in Abia State with unconstrained adoption were assigned 1 and the ones that were constrained have 0 assigned to them.

Table 5 Influence of Social Capital on Adoption of Cassava Innovation among Rural Cassava Farmers in Abia State, Nigeria

Variable	Odd Ratio	95% Confident Interval	P - Value
(X_1) Age of Households' Head	2.07*	0.73-1.03	0.0564
(X_2) Education Level of Households' head	0.79***	0.83 -1.12	0.003
(X_3) Gender of Households' head	0.84	0.42-5.12	0.722
(X_4) Marital Status	0.21	0.24-3.98	0.652
(X_5) Household size	1.03	0.76-1.05	0.942
(X_6) Farming Experience	1.87	0.95-1.06	0.756
(X_7) Density of Membership Index	1.07***	0.98-1.04	0.003
(X_8) Cash Index of Households	1.01	0.96-1.02	0.819
(X_9) Labour Contribution Index	1.63	0.98-1.04	0.535
(X_{10}) Decision Making Index	2.08***	0.95-1.01	0.002
(X_{11}) Meeting Attendance Index	2.03***	0.75-1.02	0.001
(X_{12}) Heterogeneity Index of Association	1.87	0.84-1.05	0.537
Chi square	36.89***		0.004

Legend: *** Significance at 1%, * Significance at 10%: ***Source: Field Survey Data, 2017***

The Influence of Social Capital on Adoption of Cassava Innovation among Rural Farmers in Abia State, Nigeria was presented in table 5 above. Iyanda et al., (2014) observed that when reporting the results of a logistic regression analysis, the estimated odds ratios for the regression coefficients, their confidence intervals and associated probability (P)-values should be presented. In addition, it is indispensable to give some statistics about the goodness of fit of the model to the data. The coefficient of likelihood ratio of Chi-square was estimated as 36.89, which is significant at 1% level; indicating a good fit for the estimated logistic model. The result shows that Age of Households' Head (X1), Education level of Household (X2), Density of Membership Index (X7), Decision Making Index (X10) and Meeting attendance Index (X11) were the significant variables influencing adoption of Cassava innovation among the rural farming households in the study area.

The age of household head was significant at 10% level; with a positive odds ratio of 2.07. This implies that the adoption of Cassava innovation increases as the Cassava farmers grows older. This implies that if the age of the household head is increased by 1 year, adoption of Cassava innovation will increase by 2.07. This result suggests that increasing the magnitude of the Cassava farmers' age will boost their adoption rate. This is because the older the Cassava farmer the more experience he/she is in adopting innovation to enhance his farming skills. Age is therefore a major consideration in designing strategies to increase adoption of innovation. The significant of age among rural farmers could be attributed to increased maturity and experience; as the farmers are bound to make better cognizant decisions following increased life encounters over time.

The Logit result from the Influence of Social Capital on Adoption of Cassava Innovation among Rural Farmers in Abia State, Nigeria shows that the educational level of household head was significant at 99% level of confidence; with odds ratio of 0.79. This result implies that the adoption of Cassava innovation increases as the farmers' years of education rises. This means that if the level of education of the household head is increased by 1 year, adoption of Cassava innovation will increase by 0.79; all things being equal. Pradhan (2009) posited that the returns on investment in education translate to economic growth and of course extend to improvement in the quality of the society because education affect rural farmers' attitudes and assist them to grow up with social values that are more beneficial to themselves and the nation at large. Thus, a fundamental way of generating sustainable economic growth should focus solely on educational development. Therefore, education is the most important instrument to enhance rural farmers' capabilities and to achieve their desired objectives of agricultural, socio and economic development. To this end, education enables rural farming households to make informed choices and adopt improved Cassava innovation; amongst others.

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Membership Index is the summation of the total number of associations to which each rural farm household belongs. The density of membership index was found to influence rural farmers in their Cassava innovation adoption process. Density of membership index was significant at 1% level with an odd ratio of 1.07. This implies that, a unit increase in membership index among the rural farming households in their various social associations/group will increase the likelihood of them adopting Cassava innovation by 1.07. The result implies that, the more rural farmers belongs to associations/groups the higher their cassava innovation adoption process.

Decision making index with odds ratio of 2.08 was found to be positively significant at 1% level in the adoption of Cassava innovation among the rural Cassava farmers in Abia State. A unit increase in decision making among the respondents in their various social associations/group will increase the likelihood of adopting Cassava innovation by 2.08. Efficient decision making enables an individual to plan, implement and execute actions that leads to the realization of their set goals and objectives. Farmers involved in decision making are drivers, risk-takers and not laggards. Decision making in various social organizations increases the chances of rural farm households in adopting more improved innovation in their Cassava enterprise.

Meeting attendance index is the number of times rural farmers belonging to their various association/group actually met over a period of time. It is simply the summation of attendance of household members at meetings. Meeting attendance index with odds ratio of 2.03 was found to be positively significant at 1% level in the adoption of Cassava innovation among the rural Cassava farmers in Abia State. This implies that a unit increase in meeting attendance among the respondents in their various social associations/group will increase the likelihood of adopting Cassava innovation by 2.03. This result infers that the higher the meeting attendance of rural farming households, the higher their cassava innovation adoption. In veracity, the more a farm household attends to his cooperative/social meetings, the higher the probabilities of getting useful information that will enhance his farming operation.

3.5 . Relationship between Social Capital and Adoption of Cassava Innovations among Rural Household in the Study Area

Table 6: Correlation Matrix showing the Relationships between Social Capital and Adoption of Cassava Innovations in Abia State, Nigeria

	Y	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}
Y	1	0.531	0.640	0.627**	0.702	0.692**	-0.543***
X_7	0.531	1	-0.349	0.441	0.660	0.512	-0.434
X_8	0.640	0.349	1	0.211	0.495**	0.728	-0.143
X_9	0.627**	0.441	0.211	1	0.579	0.617	0.063
X_{10}	0.702	0.660	0.495**	0.579	1	0.405	0.288***
X_{11}	0.692**	0.512	0.728	0.617	0.405	1	-0.085
X_{12}	-0.543***	-0.434	-0.143	0.063	0.288***	-0.085	1

**Correlation is significant at the 0.01 level ***Correlation is significant at the 0.05 level *Source: Field Survey Data, 2017*

Table 6 is the Correlation Matrix showing the relationships between Social Capital and Adoption of Cassava Innovations by the respondents in Abia State, Nigeria. For the purpose of simplicity, 'Y' is the dependent variable, which is tagged 'Rate of Adoption of Improved Cassava Technology.' X_7 –X_{12} were the different Social Capital Variables. The Correlation matrix is bi – directional in response; that is, if Y influences X, therefore X influence Y.

The following variables were significant in the Correlation Matrix:

i. $Y – X_9$ or $X_9 – Y$ (r = 0.627**) at 1% level of significant,
ii. $Y – X_{11}$ or $X_{11} – Y$ (r = 0.692**) at 1% level of significant,
iii. $Y – X_{12}$ or $X_{12} – Y$ (r = -0.543***) at 5% level of significant,
iv. $X_8 – X_{10}$ or $X_{10} – X_8$ (r = -0.495**) at 1% level of significant,
v. $X_{12} – X_{10}$ or $X_{10} – X_{12}$ (r = -0.288***) at 5% level of significant.

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The analysis showed a high positive (r = 0.627**) relationship between Adoption of Cassava Innovations (Y) and Labour Contribution Index (X9) of the rural farmers. The result of the study implies that the higher the Adoption of Cassava Innovations, the greater the Labour Contribution Index. As a result, a 1% change/increase in adopting Cassava Innovations will result in 62.7% shift/upsurge in Labour Contribution. Hence, it could be concluded that adoption of Cassava innovations influence Labour Contribution Index of rural farmers.

The variables – adoption of Cassava innovations and meeting attendance index were positively correlated (r = 0.692**). There is a significant relationship between adoption of Cassava innovations and meeting attendance. The result of this analysis implies that the higher the acceptance of Cassava innovations, the greater the meeting attendance in the various social organizations. By implication, it can be deduced that a 1% shift/increase in adoption of Cassava innovations will result in 69.2% modification or increase in meeting attendance. Meeting attendance and adoption of Cassava innovations were found to be positively linked, thus reducing one entails the reduction of the other.

There is a negative (r = -0.543**) relationship between Adoption of Cassava Innovations and Heterogeneity index. The result of the analysis suggest that the higher the adoption of Cassava innovations, the lower the heterogeneity by the various social groups. By implication, it can be deduced that a 5% shift/increase in Adoption of Cassava Innovations will result in 54.3% shift/decrease in heterogeneity index.

Other result from the correlation matrix articulates a weak negative connection (r = -0.288***) between Decision Making Index and Heterogeneity Index at 5% level of significance. This denotes that a 5% upsurge in Decision Making Index will result in 28.8% decrease in Heterogeneity Index and vice versa.

3.6 Constraints to the Adoption of Cassava Innovation among Rural Farm Households' in Abia State

The constraints limiting the adoption of Cassava Innovation among rural farm households' in Abia State was analyzed with 5 point Likert scale. The following scales were **Very Serious** (VA), **Serious** (S), **Minor** (M), **Unserious** (U) and **Don't know** (DN).

The researcher considered the average mean score of 3.00 to be ***Accepted*** (A) while any item/score below 3.00 was *Rejected* (R). The score of ***3.00*** was calculated using the weightings attached to the response options of:

Very Serious	**(VS)**	= 5
Serious	**(S)**	= 4
Minor	**(M)**	= 3
Unserious	**(U)**	= 2
Don't know	**(DN).**	= 1

Hence, $\frac{5+4+3+2+1}{5} = \frac{15}{5} = 3.0$

Table 7: Distribution of Respondents by Constraints to the Adoption of Cassava Innovation in Abia State, Nigeria

S/N	Responses	V S	S	M	U	D N	Mean	Decision
1	Difficulty to Operate	90	64	36	18	5	3.55	Accepted
2	High Cost of Technologies	120	56	27	12	7	3.70	Accepted
3	Instability in Govt. Policies	65	64	27	28	8	3.20	Accepted
4	High Cost in Hiring Technology	65	48	33	30	9	3.09	Accepted
5	Lack of Knowledge	35	36	66	32	6	2.92	Rejected
6	Land tenure system	40	48	30	44	8	2.83	Rejected
7	Poor Extension Services	80	40	24	42	5	3.18	Accepted

Source: Field Survey Data, 2017

Table 7 is the distribution of rural farm households according to the Constraints limiting their adoption of innovation in Cassava farming. Any response with <3.0 mean value was rejected as a major constraint. High Cost of Technologies

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(mean = 3.7), Difficulty to Operate the technology (mean = 3.55), Instability in Government Policies (mean = 3.2), Poor extension services (mean = 3.18) and high cost in hiring the technology (3.09) were the accepted constraints to the adoption of Cassava innovation in the study area.

In regards to the High cost of Technologies, Isitor *et al*., (2014) observed that the availability of credit needed for the purchase and transfer of innovations is essential to the adoption rate. Agricultural production is capital intensive and farmers in developing countries like Nigeria need to inject money into it. Credit makes it easy for rural farmers to use modern improved technology in their farming operations. In the same way, instability in Government policies is a key constraint deterring the adoption of Cassava innovation in the study area. Attitude of the Nigerian government towards agriculture has been perceived to be scruffily poor since the discovery of petroleum in the country. The government has nose-dived to support agriculture reasonably. Such fiascoes include the non-enactment of favourable agricultural policies, poor funding of extension services, and poor development of infrastructure and so on.

Poor performance of the agricultural extension service is among the hindrances to the adoption of innovations by rural farmers in the study area. Limited budget experienced by educational institution is one of the contributory factors to the failure of extension service. This has led to poor research findings and implementation.

4. CONCLUSION AND POLICY RECOMMENDATIONS

- Mainstream of the rural Cassava farmers currently prefer improved varieties of Cassava because of the higher yields, early maturity, high suppression of weeds, greater resistance to diseases and pests. Hence, the high percentage of adopters;
- Greater percentage of the Cassava processing innovations adopted by the respondents in the study area were basically traditional and manual base;
- Adoption of Cassava innovation increases as the farmers grow older. Also, the higher the number of days that household members belonging to their social institutions/group claimed to have worked for their social organizations, the more the Cassava innovation adopted.
- The more Cassava innovations were adopted, the greater the labour contribution index of the rural farming households. Also, the greater the acceptance of Cassava innovations, the greater the meeting attendance of the various social organizations.
- High cost of innovation technologies, difficulty in operation and instability in Govt. policies were the major constraints to the adoption of improved Cassava innovation among the rural farmers in Abia State, Nigeria

The following recommendations are advised:

- Policies should be enacted that promote innovation in agriculture, because majority of the farmers currently prefer improved varieties of Cassava because of the higher yields, early maturity, high suppression of weeds among others;
- The ministry of agriculture and other research agencies should develop mechanical Cassava processing device, as a way of making work easier for the rural farmers;
- Rural farming households should be encouraged to participate actively in their various social organizations through regular meeting attendance and partaking in the decision making process of their group. This will increase their rate of innovation; through relevant discussion and brainstorming.
- Policies should be directed at the improvement in various social capital development/cooperative societies in Nigeria; that would enhance rural farmer's access to productive farm resources, especially credit and labour, so as to achieve farming objectives.

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Crypto Currencies in the Framework of Chaos Theory and the Relationship of Crypto Currency with Big Exchanges

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Abstract

Technological developments have had an impact on the currency as in every part of our lives. The money market has become more intangible with virtual currencies. Every state and person wants to keep their own money under control. Crypto money, which is the subject of the study, is a sub-type of virtual currency. It is not created by any institution. The discussions about crypto currencies, which have been mentioned frequently in recent years, bring the butterfly effect to our minds by looking at the state it has reached recently. "A butterfly flapping its wings in the Amazon Jungle could cause a storm to break out in the USA". It is a summary expression of the chaos theory expressed in the form and applied in various ways in almost all kinds of science. So, how will the crypto currencies, which emerged in 2009 and reached a solid place in the market today, will have an impact on the stock market and financial market?

In this study, within the framework of Chaos theory, the impact analysis between the large stock market volume and the Bitcoin volume in the 11-month period between 2019-2020 was examined, and then the relationship between them and the world uncertainty index was examined. Has been tried to be analyzed until it has changed.

Keywords: Chaos theory, Crypto currencies, Stock Market, Causality Relationship

1. Introduction

If we look at the history of crypto money, it was announced for the first time in 2009 by the institution or person named Satoshi Nakamoto, with a project called "Peer to Peer". Technologically, this century is called a new century, with tremendous progress being made in the 21st century. As a natural consequence of this discourse, crypto currencies can be assumed and accepted as part of this progress. Before moving on to the definition of crypto money, it is necessary to look at the concepts of digital money and virtual money. From the point of view of users, it is seen that these concepts are often confused. Therefore, it is useful to mention the difference between virtual money and digital money.

Virtual Currency; It is the digital equivalent of the value injected into the system by the developers, which can be audited and accepted among the members of the community. Digital Currency; It represents the currency issued by the authorities accepted by the system and supervised by the authorized authorities (Yüksel, 2015: 173). In this sense, virtual money can be said to be a subset of digital money. While the digital currency is controlled by the authorities, the virtual currency is under the supervision and control of the group to which it is affiliated.

In recent years, crypto currencies, which are a highly debated and researched subject, have gained widespread use in the market. Undoubtedly, it is a natural result of technological development, but the reasons such as not being published and controlled by a center cause it to be regarded with suspicion. Many types of crypto currencies can be considered as a personal system. However, as a result of the applications made in the market, it has become the focus of speculation. As its use has become widespread, its aspects that are curious by the market and society have also increased. For this reason, it is frequently brought into the subject of research by many researchers.

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In this study, Chaos Theory, Crypto Money and the markets affected by Crypto Money will be mentioned, the relationship of this newly existing money in the market with other markets will be examined within the framework of this theory and its relationship with other markets will be examined. In the first part of the study, the emergence of crypto money, which is a digital currency sub-unit, the factors affecting the price and the mechanism will be explained. In the second part, chaos theory will be explained and the relationship between theory and this concept will be discussed. In the third part of the study, the possible relationship with BIST 100, together with Nikkei 225, Dow Jones, Shanghai, SP 500, JP stock exchanges, which are accepted as 5 big stock markets, was tested with Granger Causality Analysis. As a result of our findings; a causal relationship was determined between BIST 100 and Nikkei, Dow Jones. A causal relationship was found between SP 500 and Nikkei 225, Dow Jones and Bitcoin market. No causality was found between Shanghai Stock Exchange and other stock exchanges. A causal relationship has been determined between the Bitcoin market and BIST 100 and Dow Jones.

2. Literature Review

Baek and Elbeck (2014) examined Bitcoin volatility with the S&P 500 Index in their study. In their study, they found that the S&P 500 Index has more volatility than Bitcoin. Regression Model was used to analyze the variables affecting Bitcoin returns. According to the results obtained from the study, they determined that the monthly change of the daily lowest and highest price difference is the only factor that affects Bitcoin prices.

Ciaian Pavel et al.; (2018) examined the formation of Bitcoin's price model between 2009 and 2015. Garch analysis was used in the study. In the analysis, they found a relationship between financial developments and speculations and the formation of Bitcoin prices.

Eyüboğlu (2018) examined Bitcoin and Litecoin Markets in the Day of the Week, Month of the Year Review in his study. In the study, data from 2013 to 2017 were used. According to the results obtained from the study, the effect of the concept of month or day for Bitcoin and Litecoin Market has been determined. According to the results obtained from the study, Monday, Tuesday and Friday create significant changes for Bitcoin. According to the result obtained from the study, it was determined that the highest return for Litecoin was achieved on Friday.

Kahyaoğlu (2012) analyzed investor behavior within the framework of chaos theory in his study. In the study, a correlation study was conducted between the trading volumes and market parameters of 68 investors trading in Borsa Istanbul, covering the 2009-2011 period data. In the results obtained, it was concluded that the number of negative correlations among investors increased in periods when market movements and stock prices decreased.

In his study, Kendirli (2006) talked about the definition and basic assumptions of Chaos Theory. He talked about the harmonization of the efficient markets hypothesis of the chaos theory, the regular markets hypothesis and the capital asset pricing model theories and the regular markets hypothesis. He mentioned the points where these theories are insufficient. In the study, he stated that the lack of market information will cause chaos. He concluded that getting out of these situations would be possible with competitive prices and full access to information.

In the study of Kesici (2006), within the framework of chaos theory, it has been tried to analyze the complex system in the economy and the difficulties encountered for the Nash Equilibrium. In his work, he investigated the existence of chaos on market dynamics. He found that chaos theory provides successful explanations in the Lorenz curve and the Henan Map. However, he concluded that the same success cannot be achieved in every theory.

In their study, Moore and Christin (2013) examined that after the 2008 crisis, Bitcoin offered an advantage to quantitative easing policies. In their study, they examined the relationship between Bitcoin's current risks and the stock market. They examined the risks experienced in the Bitcoin stock market and their relationship with the stock market volume and pointed out the danger situation proportionally.

In his study, Nakamoto (2008) put forward the idea that with Bitcoin, which was introduced with the idea of Crypto currency, Nakamoto distributed database could be a solution to the problem of multiple spending on virtual money.

Sümer (2016) stated in his study that chaos theory facilitates overcoming difficulties in establishing equilibrium in the market. In the study, the existence of chaos in the current market has been investigated. He made time series analysis for BIST, Gold and Foreign Exchange by making discrete variable and continuous variable analysis. According to the results obtained, it has been found that there is no chaos situation in these markets.

In his study, Şahin (2018) tried to perform Price Prediction of Crypto currency Bitcoin with ARIMA and Artificial Neural Networks. In his study, he made a price prediction with the factors affecting the price of Bitcoin, which is the currency of our period. According to the results obtained, the model gave successful results for 2017.

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In his study, Özbaş (2018) talked about the creation process of Bitcoin, its operation advantages and disadvantages. According to the results obtained from the study, he concluded that there is distrust towards Bitcoin in the world, although it is acceptable with the way it is processed.

In his study, Ünvana (2019) made causality analysis on the US, Japan, China and Turkey stock market indices of Bitcoin. In the study, data from 2016-2018 were used. According to the results obtained from the study, it has been determined that Bitcoin only affects BIST 100 unidirectionally. He concluded that there is a bidirectional relationship with Nikkei 225 and SSE 380 exchanges.

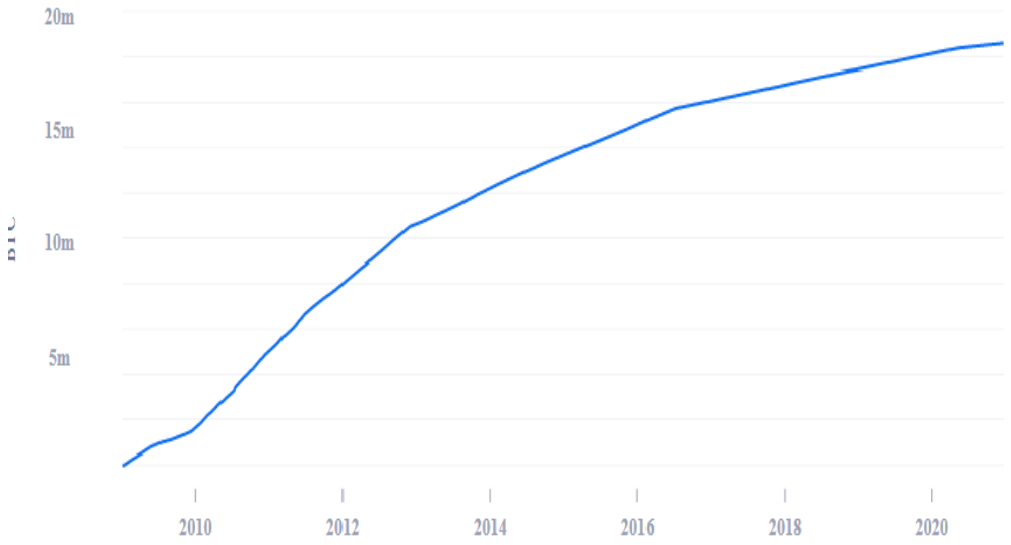
In the study by Yermack (2013), it was investigated whether Bitcoin is a currency or not. At the time of the research, almost zero correlation was observed between Bitcoin's daily exchange rates when compared to gold and commonly used currencies. That is, no relationship was detected between them.

3. Crypto currency

Cryptography from the Greek language means secrecy. The concept of crypto currency, which comes from the mystery, is virtual money that is produced on the basis of privacy in the virtual environment. The first type of crypto money that started to be produced in 2009 is Bitcoin (Çevik, 2016, p: 170).

In the first published protocol of crypto money, it was stated that only 21 million units of one unit of crypto money would be produced. For this reason, considering the supply-demand balance, it is quite normal that the demand for virtual currencies has increased in recent years, taking into account the market conditions. In Chart 1, the price change of Bitcoin, which is the first money released to the market, over the years is given.

Chart 1: The Amount of Bitcoin Extracted by Data Mining over the Years (www.blockhain.com/erişim :23/12/2020)



The total supply of Bitcoin (BTC) is limited and is predefined in the Bitcoin protocol. According to this definition, a total of 21 million BTC can be mined and the mining reward (the method used to create Bitcoin) decreases over time. This chart shows how many Bitcoins have been mined or circulated over the years (Salhout, 2018:3).

The Bitcoin reward is divided by 2 every 210,000 blocks, or approximately every four years. Some Bitcoins in circulation are considered to be lost or unspendable forever, due to lost passwords, incorrect exit addresses, or errors in exit scripts. Crypto currencies have created a new stock market independent of economies, priced entirely according to supply and demand. There are 2,290 crypto currencies traded on various exchanges. Their total transaction volume is around 267 Billion Dollars.

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Crypto currencies have a decentralized and distributed structure, unlike centralized electronic money produced by central banks or banking systems. The control of this distributed order is carried out through databases called Block-Chain (Yıldırım, 2019: 75).

The smallest unit of Bitcoin, which can be divided up to 8 digits, is called Satoshi (from the name of its founder, Satoshi Nakamoto). In other words, 100 Million Satoshi is 1 BTC. So 0.00000001 Bitcoin is 1 Satoshi and it is possible to transfer it in the system. (Çakracıoğlu, 2016).

Bitcoin is used to obtain a Bitcoin wallet by downloading applications to electronic devices such as mobile phones and computers, or by opening an account on existing sites. This wallet is used for interpersonal transfers and keeping Bitcoin in the wallet. Transactions are carried out via the block chain. Block chain is the basic system that enables the generation, transfer and storage of crypto currencies without a centralized registration and control. Anyone who wishes can download this database, keep it, examine it, and check the accuracy and validity of the transactions. Records to this database are written by miners. In other words, the security of the Bitcoin network is provided by the miners. Blok-Chain is actually a distributed, open and reliable consensus system (Çakracıoğlu, 2016).

3.1. Block chain

It is the name given to the database where the transactions are recorded, which is the block chain in Turkish. Transactions are recorded here in order. Transactions are kept here in chronological order. It is a distributed database system that provides encrypted transaction tracking. In money transfers, each step creates a block. Since Nakamoto did not give us a centralized system, this system is a guarantee of money to us (Dyhrberg, 2015: 56).

3.2. Bitcoin mining

In the early days of Bitcoin, it was possible to produce large amounts of Bitcoin in a very short time due to the small number of miners. In the current situation, both the system getting harder and the number of miners multiply makes Bitcoin production difficult and costly. Bitcoin mining describes people who both verify and record transactions. Bitcoin production and the process of verifying transactions are done by miners. While miners ensure the security of the block chain system and the realization of crypto money transfers, their transactions are recorded in the distributed data ledger. Since Block chain technology is open account, all users can control their transactions. With the electrical energy they spend and the processing power they provide, the miners circulate the Bitcoin they produce in return for the system verification and registration service, and the Bitcoin that enters the circulation is transferred to the wallet accounts of the miners. Thus, Bitcoin miners can circulate Bitcoin in exchange for the energy they physically consume and the service they provide, while on the other hand, they can earn profits (Şimşek, 2019: 28).

3.3. Bitcoin chronology

• October 31, 2008-Technical document published by Nakamoto.

• January 3, 2009-First Bitcoin Block created

• January 12, 2009-First Transfer was made

• October 5, 2009-New Liberty Standard stock exchange published the first Bitcoin rate. Initial Bitcoin rate; $1 = 1,309.03 BTC. In February 2011, 1 dollar = 1 BTC.

• July 2010- The first BTC exchange was established. Name: MT.Gox. It was closed in 2014 due to technical problems.

March 28, 2013-BTC's market value exceeded $1 billion (Source: investing.com, accessed: 24/12/2020)

• Between 2013-2018, platforms such as the USA, China, Japan, Google and Facebook announced their Bitcoin decisions. The United States reported that it was perceived as a threat to the financial structure. Facebook and Google, on the other hand, went to ban advertising in general. The European Central Bank (ECB), on the other hand, announced that Bitcoin is seen as a balloon and compared to the tulip event. Japan announced that it does not look hot to Bitcoin, while China announced that they banned it. Iran agreed. In 2018, Dubai created its own crypto currency. NASDAQ has added Bitcoin and Etherium to its products. The Central Bank of the Republic of Turkey, on the other hand, stated that they want to issue their own digital currency according to the 11th Development Plan (Source: Bloomberght, Accessed: 24/12/2020).

The phases of Bitcoin are briefly mentioned. As of today, its value in dollar terms has reached the level of 46,931.40 USD (as of 26.08.2021). With the figure given at the beginning of the study, considering the value it reached on 26.08.2021,

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such a power of gaining value and influencing the market reminds us of the Chaos theory, which has recently been used for all branches of science. The flapping wing of the butterfly has caused a storm in the world stock markets in 11 years. This effect affected the transaction volumes in major stock exchanges and caused the functions of central banks to be questioned. The fact that it fluctuates frequently and is open to speculation, being open to cyber attacks, sometimes used for illegal purposes, as well as making money transfers at a lower cost and faster, has contributed to the increase of profits of these institutions thanks to the intermediation of these transfers by financial institutions (Şahin, 2007). 2018:80).

While its effect in financial markets was like this, BTC exchanges started to emerge in financial systems. Since personal information is given during registration to the exchanges, the famous secrecy of BTC is removed. In fact, we are seeing the understanding of crypto currencies in our time begin to evolve into what governments are planning to do.

4. Chaos theory

Chaos theory is not a structural theory of physics or mathematical induction, but a method that helps to explain the tendency of parts of physical reality as a whole (Kendirli, 2006:1). The main argument of chaos theory is that even the smallest of variables can result in big changes. If we think about it in terms of today's technology, it is more accurate to say big potential changes instead of big changes. In this study, the purpose of combining the subject we focused on with this theory, a project that spread exactly via an e-mail has entered the world stock markets today. It has led to the questioning of the functions of Central Banks. It can be said that this situation did not only affect the financial structure, but also started to change the cultural understanding and some habits (Kahyaoğlu, 2015: 39).

Financial structure affects investor behavior due to the functioning of the systems it contains (Mandelbort 2015, p: 11). Mandelbort made an observation on this subject by creating a computer simulation. In this study carried out in 2011, a computer environment was set up, 2 investors and a single environment were prepared. Over time, it has been seen that the two investors began to influence each other's decision. So the more investors, the more divergent views, the more similarities or differences, that is, the more behaviors and opinions. So, the butterfly effect of the Lorenz's chaos theory can also explain the Bitcoin effect in this way. Let's express the effects of Bitcoin on financial markets in a simpler way, away from complexity. An increase in the general level of prices causes individuals to buy the goods or services they buy more expensive. This situation increases the financial demand, causing an increase in interest rates and results in higher borrowing costs. This causes a decrease in investments. Indirectly, as it affects investments, which are an item of national income, it may cause a decrease in national income. This is an effect. A small change results in a big change. Although Simon de Laplace was one of the first mathematicians working on disorder, it is accepted that J. Henri Poincare provided the conceptual and theoretical contribution to chaos theory. But undoubtedly the most important contribution was made by Edward Lorenz (Kendirli, 2006: 172).

Lorenz is a meteorologist. He was entering data into his computer for the weather forecast, and graphing the value he found. He observed that small changes in temperature had an incredible effect on the temperature values of the universe, and realized that the graph he created reminded him of butterfly wings.

Chaos theory is a science that studies systems that cannot be predicted from the outside, which are carried out by mechanical and deterministic laws, contain order and chaos in such a way that they do not contradict each other. More simply, it tries to predict random and non-linear events. This was the point Lorenz was trying to get to. In other words, small and unpredictable changes can lead to big changes over time. The butterfly effect, on the other hand, was integrated with this theory and wanted to express that small changes, or events, can result in big changes.

The characteristics of chaos theory, which is used in many branches of science in the literature, can be listed as follows (Lale, 2018:480):

- ✓ Chaos theory helps us explain the nonlinear aspects of the universe.
- ✓ It is a bridge between Newton's reductionist approach and the randomness of quantum physics.
- ✓ -Small changes in the system can have big results in the end.
- ✓ It explains that the universe is an open system.
- ✓ Explains the human system, that is, the nature of the human body and weather events.

The basic propositions of the chaos theory are as follows (Kendirli, 2006: 173):

- ✓ Order creates disorder.
- ✓ There is order in disorder.
- ✓ Order arises from disorder.
- ✓ Compromise in the new order manifests itself after a change of commitment.
- ✓ The new order reached develops in an unpredictable direction through the self-organizing process.

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For this reason, we will of course have no difficulty in finding examples of chaos theory and especially the butterfly effect in social and financial life. When examining macroeconomic systems, the big consequences of small events are the best proof of this. The principle of nonlinearity in chaos theory involves events being independent of each other. We cannot mark the facts and events that prevail in the universe that they exist only from order. Gleick's; the phrase "complex systems have complex causes underlying" summarizes this situation.

Chaos theory examines the logic of classical science, while trying to explain the universe, searching for disorder in the whole, searching for order despite changing equilibrium conditions, giving place to predictions and using it in all branches of science are the integrative features of this theory (Yeşilorman, 2006: 84).

With crypto currencies, which are the main subject of this study, this is the purpose of our attempt to explain this theory. The value of crypto currencies, which were initially considered a crime by the governments, untrustworthy and frequently criticized, has come to affect the most important stock markets in the world today and create awareness with them.

5. Causality relationship between stock indices and Bitcoin

In this part of our study, the interactions between Bitcoin's Dow Jones, Nikkei 225, S&P 500, Bist100, Shanghai and NASDAQ stock indices and Bitcoin between the years 2019-2020 will be examined. The data used in the study were taken from the investing.com website.

Indices used in the study:

BIST 100: It is the name of the index in which the first 100 companies traded in the Turkish stock exchange and dominating the stock market (in terms of transaction volume and price) are listed.

S&P 500: One of the American stock exchanges.

Nikkei 225: Japanese stock exchange.

Shanghai: Shanghai stock exchange

Dow Jones: It is an index that includes the 30 largest companies in America.

In the first stage of the study, the extended Dickey Fuller Unit Test was applied to determine whether the series were stationary or not. Here, it is concluded that the data are stationary at the 1% significance level.

In the second stage, Granger Causality Analysis was performed. This test is a general approach in determining the existence of a causal relationship between two or more variables. According to this analysis, one variable can predict other variables. (Çil, 2018: 360).

Basic Assumptions of Granger Causality Analysis:

- The future cannot be the cause of the past.
- Causality can only be determined for a group of scotastic processes, causality cannot be known between two deterministic processes.

Granger (1969) developed a relatively simple test that identifies causality between variables. According to Granger, if the prediction of Y is more successful when the past values of X are used than when the past values of X are not used (other terms do not change); X is the Granger cause of Y. The Granger causality test with two variables such as yt and xt requires the first step of the estimation of the VAR model:

$$yt = \alpha 1 + \sum \beta ixt{-}i \; n \; i{=}1 + \sum \gamma jyt{-}j \; m \; j{=}1 + et1$$

$$xt = \alpha 2 + \sum \theta ixt{-}i \; n \; i{=}1 + \sum \delta jyt{-}j \; m \; j{=}1 + et2$$

The error terms eyt and ext are clean sequence processes with no relation between them.
In the model, there are four possible different situations below;
The lagged x values in the first equation are statistically different from zero by the group, and the lagged y values in the second equation are not statistically different from zero. In this case, it causes xt.
The lagged y values in the second equation are statistically different from zero by the group, and the lagged x values in the first equation are not statistically different from zero. In this case, it causes xt.
All sets of x and y values in both equations are statistically nonzero. In this case, there is bidirectional causality between xt and yt.
Not all sets of x and y values in both equations are statistically different from zero. In this case, xt and yt are independent of each other.

$H0 : \sum \beta i \; n \; i{=}1 = 0$ xt does not cause yt.

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$H1: \sum \beta i\ n\ i=1 \neq 0$ or xt cause yt.

While performing the analysis, the stationarity test was carried out and as a result of the test; the data were subjected to the stationarity test, which is the first condition for Granger causality analysis. After testing the series to be stationary, causality analysis was performed and the results were interpreted.

Table 1: VAR Granger Causality Test XU 100 (BIST 100) with Others

Dependent variable: XU100			
Examined	Chi-sq	df	Prob.
S&P 500	0.106624	2	0.9481
SHANGHAI	1.216403	2	0.5443
NIKKEI 225	22.37180	2	0.0000
DOW JONES	2.318175	2	0.3138
BTC	0.736267	2	0.6920
ALL	37.56962	10	0.0000

Considering the 0.05 significance level, no causality was found in the BIST 100 and SP 500, SHANGHAI with BITCOIN markets. There is causality in the NIKEEI 225 and DOW JONES markets.

Table 2: VAR Granger Causality Test S&P 500 with Others

Dependent variable: S&P 500			
Examined	Chi-sq	df	Prob.
XU100	4.856916	2	0.0882
SHANGHAI	0.623950	2	0.7320
NIKKEI 225	16.19686	2	0.0003
DOW JONES	8.521197	2	0.0141
BTC	7.422649	2	0.0244
ALL	48.15449	10	0.0000

For 0.05 significance level, causality was found between SP500 and NIKKEI 225, DOW JONES, BITCOIN

Table 3: VAR Granger Causality Test Shanghai with Others

Examined	Chi-sq	df	Prob.
XU100	1.731436	2	0.4207
S&P 500	1.164853	2	0.5585
NIKKEI225	1.249629	2	0.5354
DOWJ	0.604220	2	0.7393
BTC	0.361752	2	0.8345
ALL	6.477923	10	0.7736

When Shanghai stock market was analyzed for 0.05 significance level, no causality was found with other stock markets.

Table 4: VAR Granger Causality Test Nikkei 225 with Others

Dependent variable: NIKKEI 225			
Examined	Chi-sq	df	Prob.
XU 100	2.507369	2	0.2855

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SP 500	7.010920	2	0.0300
SHANGHAI	12.41891	2	0.0020
DOW JONES	4.978050	2	0.0830
BTC	0.416925	2	0.8118
ALL	16.35633	10	0.0899

When NIKKEI 225 was analyzed for 0.05 significance level, causality was found between SP 500 and SHANGHAI exchanges, but no causality was found with other exchanges.

Table 5: VAR Granger Causality Test Dow Jones with Others

Dependent variable :DOW JONES			
Examined	Chi-sq	df	Prob.
XU 100	6.227476	2	0.0444
SP 500	3.525147	2	0.1716
SHANGHAI	1.044996	2	0.5930
NIKKEI 225	18.80564	2	0.0001
BTC	10.97140	2	0.0041
ALL	56.86787	10	0.0000

When the causality relationship with the DOW JONES market is examined, causality has been determined between BIST 100 and NIKKEI 225.

Table 6: VAR Granger Causality Test BTC with Others

Dependent Variable: BTC			
Examined	Chi-sq	df	Prob.
XU 100	11.95513	2	0.0025
SP 500	5.445529	2	0.0657
SHANGHAI	1.900361	2	0.3867
NIKKEI 225	0.303122	2	0.8594
DOWJ	8.265594	2	0.0160
ALL	29.55808	10	0.0010

Causality Detected Between Bitcoin Exchange and Bist100 and Dow Jones

Interpretation of Results: For 0.05 significance level, there is a one-way causality relationship between Bist100 and Nikkei 225. There is a causal relationship between Dow Jones, BIST 100, Nikkei 225 and Bitcoin. There is causality between Nikkei 225, SP 500, and Shanghai Stock Exchange. A causal relationship has been found between Bitcoin and all stock markets. That is, according to our hypothesis, hypothesis H1 should be accepted. In Turkey, it is important for investors to be informed by following the Nikkei 225 and Bitcoin. When evaluated in the light of the results obtained, the plan of the Central Bank of the Republic of Turkey to create its own crypto money in the future is important and remarkable. Although, as a result of the fluctuations in the financial markets and crypto money markets, the Central Bank of the Republic of Turkey has suspended trading in crypto currencies, this perspective is important for the future.

Here, the relationship between the world uncertainty index and stock markets will be explained with the help of a graphic. The world uncertainty index is an index in which the records of 143 countries have been kept since 1996 (34 developed and highly developed economies since 1955). A graph was created between the data we used in the analysis and this index value. In the graph obtained, it was desired to monitor the change and fluctuation in order to see the effect of the crypto

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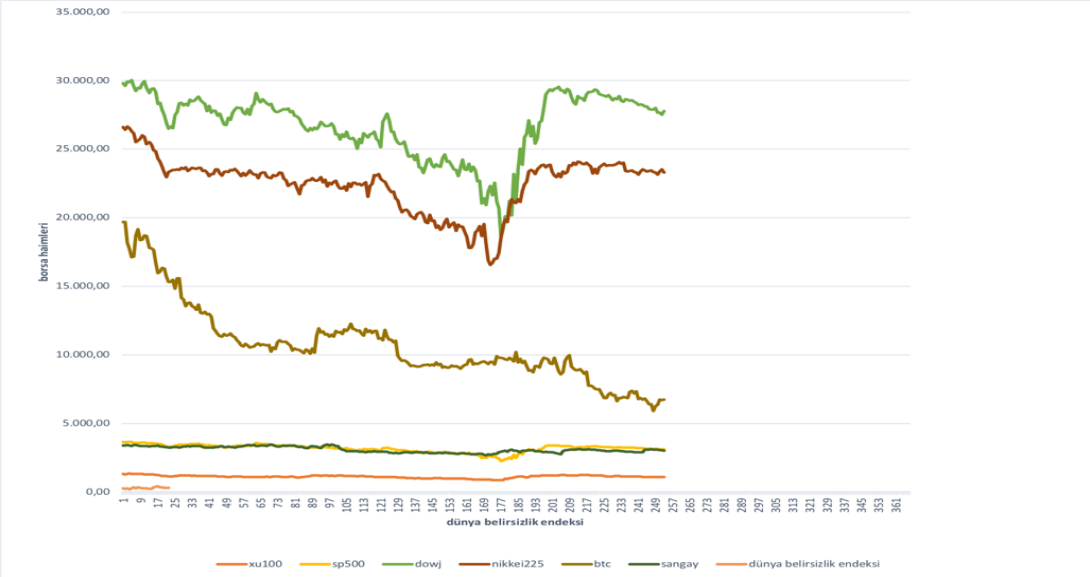
money value on a global scale. Data on the world uncertainty index were obtained from the web address https://www.policyuncertainty.com/financial_stress.html.

Chart 2: Stock Exchanges and World Uncertainty Index



As a result of the study, it has been determined that there is a bidirectional causality relationship between Bitcoin and the Dow Jones Index. It has been determined that there is a one-way causality relationship between Bitcoin and Nikkei 225. It has been concluded that there is a one-way causality relationship between Bist100 and Bitcoin.

6. Conclusion

The influence of crypto currencies increasing in popularity is increasing day by day. In order to see the effect of Bitcoin among the static data, daily data of 2019-2020 were used. When we examine the relationship with the stock markets with the causality test, the causality relationship between Bitcoin and all stock markets has been determined. It was determined that there is a bidirectional causality relationship with Dow Jones and XU100. In 13 years, the crypto money market, which has made great progress in this way, is on its way to becoming the currency of the future. Because, the opinions of many political powers in the world are positive regarding crypto currencies. From time to time (as in the case of Turkey), temporary measures are taken against crypto currencies after financial fluctuations and economic difficulties in countries. However, in this process where the world has evolved, it will not be possible to stay away from crypto currencies. Moreover, in established crypto money exchanges, the identity information of investors and players is requested absolutely. This, on the other hand, removes the veil of privacy and personality that crypto currencies bring.

Crypto currency markets and crypto currencies have attracted the demand of individuals and institutions due to the fact that traditional banking and brokerage transactions involve intense bureaucracy as well as the necessity of being based on trust. In addition to all these, the illegal use of crypto currencies and the fact that they are not dependent on authority make governments nervous. The currency with such a low volatility threshold drives away investors who do not want to take too much risk. Aside from its effects on the stock market, governments are not in a hurry to work on crypto currencies because it does not take up much space in the world's deposits at the moment.

Looking at the studies on this subject, it has been seen that there is an interaction between Bitcoin and stock markets. However, the general perception in Turkey is that it is not viewed as a long-term investment tool. This is because it is not created by the authority. Despite all this, it is a conclusion drawn from our results that countries should carry out more clear and well-structured studies regarding crypto currencies in the future.

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Annual Growth of Individual Pension Funds and Progressive Analysis of It's Development in Turkey

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Abstract

States have established various social security systems in order to eliminate the risks that their citizens will face at various times. Over time, the existing social security systems not meeting the expectations sufficiently and the search for new funding sources in order to meet the financing needs of the states gave birth to the private pension system. Thus, through these funds, individuals were directed to save and additional income was provided to individuals during their retirement. On the other hand, it contributed to the development of economic resources and capital markets needed by states and to channel savings to investment. Private pension funds, which are considered very important by developed and developing countries and are valuable in terms of providing economic resources, are a type of investment. The Private Pension System Law, which began de facto on October 27, 2003, entered into force on October 7, 2001. While in some countries access to the pension system is left to the choice of individuals, in some countries this is subject to a legal requirement. The aim of this study is; To examine the size of the private pension funds over the last ten years and the number of participants included in the system, using data from the Pension Monitoring Center.

Keywords: Social Security, Individual Pension, State Contribution, Individual Pension Funds

1. Introduction

All around the world, the precautions taken against the problems existing in the social security field have also created tremendous impression on our country. The situations have come into question which have emerged as complex and versatile in time, have induced crisis and hauled to crisis in our country (Ekin, Alper, Akgeyik, 1999:179). One of the required criteria within the range of industrialization and economic growth is the fact that investment growth depends on efficient, meritable and applicable financial funds. It is considered that the quantity of these funds to be transferred to investments has been substantially limited (Oktayer ve Oktayer, 2007:56). Our country has a young and dynamic population structure. In developed countries, demographic-oriented problems are usually at the heart of social security-related problems. In our country, the underlying reasons of the existing problems are usually the breakdown of the balance depending on insurance risks and statistics, institutional deficiencies and so forth (Teksöz, 2003).

States, through individual pension system, have been developing policies regarding social security and the service provision for individuals in required fields has been ensured in this respect. Individual pension system is based on the principal of saving. In this system, the purpose is saving some of the income earned during working life and using it during retirement period following the end of working life. Within this system including voluntary participation, pooled funds have also been utilized by specialized agencies in various investments.

Increasing the investments has been a significant factor in terms of industrialization and economic growth. Along with the financial liberalization occured in the '70s and '80s, some significant changes have originated, which are:

- Serious increase in the amount of funds in circulation
- Diversification of the instruments in the market
- Development of new financial markets

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- Ensuring low-cost transactions through the innovations in technology and communication fields

One of the encountered developments is private pension funds (Oktayer ve Oktayer, 2007:57).

The purpose of this study is to investigate the number of participants and the total asset value of funds regarding individual pension system for the last ten years. Number of participants in individual pension and growth in the total asset value of funds have been examined by years, through the digital data received from Pension Monitoring Center. In the second part, clafirications and definitions concerning social security, individual pension and individual pension funds have been provided. Besides, historical development of individual pension system has been briefly introduced. Information regarding the number of participants in individual pension and total asset value of funds by years has been provided through tables and graphics; the results have also been displayed in the third part.

2. Literature Review

In this section, the concepts regarding social security and individual pension systems have been clarified and their development in Turkey has been briefly introduced. The number of participants in individual pension and total asset value of funds by years and certain data about the system have been provided through tables and graphics.

2.1. Social Security

Social security is an assurance system aiming to protect individuals against threats and damages in terms of occupational, physiological and sociological risks (Zunluoğlu, 2014:7). Main objectives of social security system can be listed as follows:

- Taking economic precautions against lifetime risks and increasing life standards
- Participation into the system is not optional. All family members benefit from the system (mother, father, spouse and children)
- Social security is one of the fundamental human rights and ensuring the system is under the responsibility of the State.
- Utilization of healthcare services are provided for better health status and ensuring persons' acquisition of their own revenues.
- System supervision is ensured by State and system is financed by the employers and the State.
- There is no funds to valorise the pooled amount in this system. Return of premium is not applicable and there is no premium yield whatsoever.

Social security systems have simultaneously occured with Industrial Revolution and working class. In our country, Establishment of Social Insurance dated 1936 and Labour Law No.3008 on Social Insurance had been created firstly, these regulations were not enforced until 1945, because of World War II. Afterwards; Law No. 4772 Industrial Accidents, Occupational Diseases and Maternity Insurance dated 1945 have been the first law on social security field. Several related laws are introduced following this law (Gerek, 2004:75). In 2001, Draft Law of Individual Pension, Saving and Investment System have been reported to the Grand National Assembly and approved within the same year; aforementioned draft law has been designed to develop pension systems in a way to support and complete public social security system by enabling voluntary participation.

2.2. Individual Pension System

There are some notions coming to mind when the word of "pension" is mentioned. Pension is the post-work life satisfaction. Individual's position within life is significant and not only the actual possessions but also the deeds performed until that time have great importance (Çetinkaya, 2011: 18). According to Canatan (2008:107) pension is "not benefiting from or departing working life because of increased age. With reference to the idea of being unable to work because of increased age after sustaining the lifetime through working, pension is the planned termination of working life by providing individual with economical guarantee in this period. There are multiple factors affecting individuals' decisions in the pension system. One of the factors is economical condition. Reasons such as lack of employment, low income, high inflation rate and erosion of money have been affecting individuals' decisions in terms of pension (Canatan, 2007:71).

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In our country, as it is seen in the previous years; inefficient valorisation of investment funds and early retirement can be among the reasons of nonfunctionality and social security gaps, which negatively effect state budget and place burden to budget. This situation argues that social security system is non-functional and delinquent and individual pension system is essential and gives a new point of view to social security system and it can be considered as a replacement of social security system (Kaya and Kahya, 2017 as cited in Aslan vd. 2019:34). In the light of all this information, private pension system have become inevitable for eliminating individual's anxiety and economic problems at the end of working life and ensuring a more prosperous life.

In the Law No. 4632, the objective of individual pension system is speficied as ensuring a high income and prosperous environment in pension by providing additional incomes through the investment of individual pension-related savings. Besides, through long term funding, benefits for both employment and economic stability have been intended (Solmaz, 2016: 27). It is considered that the remarks for the objectives and scope of individual pension system have included similar approaches, as stated in the Law.

It is known that private pension system have first started in Chile in 1980 and subsequently, the system has been adopted by Peru after a decade. Afterwards, among the European countries, Poland has selected Chile and Peru models as baseline and has introduced private pension system. Even if private pension system regulation varies from country to country, the system has constantly been modernized in accordance with the necessities of the time (Elkatmış, 2012:82).

Individual pension system, which is a private pension system and includes voluntary participation; can be specified as using the pooled revenues in retirement period; Pooled revenues are created through converting regular savings into investments. Individuals make these regular savings during their working life. The objectives of individual pension can be listed as follows (www.egm.org.tr):

- Contributing to economic development
- Ensuring increase in employment
- Ensuring long term resources for the economy
- Using individuals' retirement savings as an investment instrument and valorising them and ensuring contribution to the individuals during pension period.

Apart from the abovementioned objectives, individual pension system have two major benefits: First, thanks to these savings, individuals can have a more prosperous life in their pension period. Second, a significant level of resource is ensured to national economy through long term retirement funds. This system is not obligatory. Individual pension system is based on voluntariness and has a supportive structure for social security system of the states. The features of ensuring economical resources and giving an opportunity to individuals to have a more prosperous life in pension period have been descriptive for the need to individual pension system. Belowmentioned examples can be provided regarding the opportunities of individual pension system and the duties and responsibilities of the system:

- Attributing more duties and responsibilities to private pension system within the social security system
- Expanding tax-related incentives and state subsidy in a way to increase participation level
- Organizing informative seminars for individuals and organizations on individual pension system and performing promotion and training activities
- Ensuring financial protection against ageing population
- Providing financial support in pension period
- Ensuring saving incentives
- Ensuring economic resources as a financial instrument

2.3. State Subsidy

The amounts regarding the contributions previously paid by the participants have been deducted from tax base. The system has been promoted in this way and been ended through law amendments; nonetheless, the application of state subsidy has been proceeding since 2013. According to the regulation, which was published in 2012 and put into practice in 2013; with the exception of contributions paid by employers, 25% of the contributions paid to participants' individual pension accounts have been registered to participant accounts by State (www.tsb.org.tr/). There is an upper limit for this contribution. This upper limit is the 25% of the annual amount of gross minimum wage. Gross minimum wage for 2020 is TRY 2.943; accordingly annual amount is TRY 35.316. %25 of this amount is equal to TRY 8.829, which represents the upper limit for state subsidy. State subsidy at the rate of %25 has been progressively sustained from the effective date of the system.

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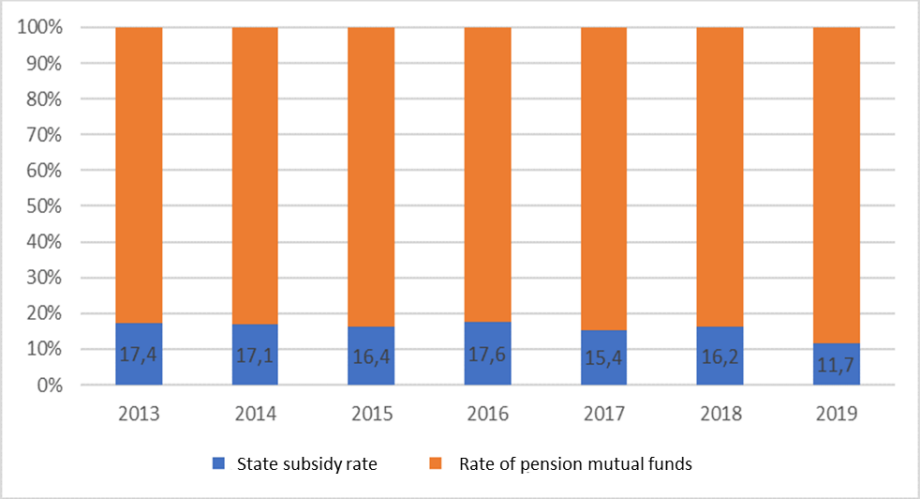
Proportional distribution of total amount of funds and state subsidy funds is provided in Graphic 1 (as of 31 December 2019) (www.egm.org.tr):

Graphic I. Total amount of pension mutual funds and the amount of State subsidy funds (%)



Source: www.egm.org.tr

Along with the introduction of state subsidy as of 1 January 2013, an increase has been observed in the system participation ratio. State has deposited TRY 25 for every TRY 100 of the contributions paid by system participants. State subsidy is granted for every citizen paying contributions within his/her individual or group pension contracts, within the limits specified in related law. New contract is not entailed for the utilization of state subsidy. State subsidy utilization is also applicable through existing contracts. State subsidy calculation is realized for contributions which are paid as of January 2013. Besides, independently of tax payer status, every individual can benefit from the system within lower and upper limits. Any auxiliary transaction, process or requirement is necessary for the utilization of state subsidy. Calculation regarding state subsidy is automatically realized over the paid contributions after the contribution payment process is completed. Any participant statement or notification is required and related calculations are realized by Pension Monitoring Center (PMC) by grounding on the data transmitted by related companies (www.egm.org.tr). Another issue is that the total amount, incuding state subsidy, has been paid to participant or his/her beneficiaries, if s/he is deceased; in case of leaving the system because of retirement, death or disability (www.spk.gov.tr).

2.4. Development in Turkey

As of 16 May 2000, development of a funded system through individual pension funds by Cabinet Council has been aimed. In this respect, as a successor and modifier of social security reform, which is the structural reform; “Draft Law on Individual Pension Savings and Investment System” has been submitted to Grand National Assembly of Turkey, which organizes the voluntary savings of people for voluntary pension with the aim of developing programs for pension system. Aforementioned Draft Law was accepted in 28 March 2001 and published on Official Gazette No. 24366. Opinions and suggestions are received from all related sectors such as Ministry of Finance, Ministry of Labour and Social Security, Undersecretariat for Treasury and Capital Markets Board of Turkey. Concurrently, Draft Law on Amendment of Certain Tax Laws was accepted by Grand National Assembly of Turkey in 28 June 2001. Along with this law, certain tax-related promotions are granted to intended participants and employers contributing on behalf of their employees in terms of directing the funds to investment and withdrawing the savings as lump sums and money. System has been introduced de facto along with the first authorized contract in 27 October 2003. Towards the efficient and reliable operation of the system, regulation procedures have been undertaken; administrative and legal scopes have been defined; some articles have been amended in 14 June 2007 and legal basis have been constituted along with the new provisions. In 29 June 2012, tax advantage has been abolished and state subsidy has been put into practice through Law on Individual Pension Savings

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and Investment System and Law on Amendment of Certain Laws and Decree Laws (Pension Monitoring Center Individual Pension System 2017 Progress Report).

2.5. Development in Turkey

Individual pension funds are financial instruments through which employees generate post-career income by gathering certain share of their income and converting these savings into contribution. Pension funds are economically needed due to the fact that they secure an efficient alternative for the provision of long term funds and above all, they have been mainstreamed via tax incentives (Tunay, 2001:104). Individual pension funds may include belowmentioned investment instruments (www.tsb.org.tr):

- Deposit and participation accounts,
- Debt instruments
- Repurchase and reverse repo transactions and partnership interest
- Precious metals and also assets on precious metals and real estates
- Derivative instruments and variants
- Takasbank money market transactions
- Investment fund shares and lease certificates
- Cash collaterals and premiums of derivative instrument transactions performed in stock market
- Other investment instruments specified with Capital Markets Board of Turkey

Following the end of working life, individuals need pension savings to improve their welfare and comfort level and to meet vital and other types of needs in their pension period. Individuals can make savings through deposits, stocks and shares, golden, life assurance and real estates as well as contributing to public and private pension plans. In a country, it is supposed to discuss pension system as public and private pension plans, joint and integral. Private pension systems have been considered as a supplementary to public pension systems and have substantial position and share in many countries in terms of pension system. In terms of private pension systems and ensuring a desired level of income for individuals; the role of public pension system reforms realized in the last years has great importance (Yazıcı, 2015:45-46).

2.6. Asset Value of Funds

Individual pension funds have constituted a fairly significant source in the name of financial innovations in capital merket and market modernization; asset value and importance of the funds have been improving (Türker, 2011). In the name of developing the pension savings, in the seventeen-year period, there has been a substantial increase in both number of participants and asset value of funds within the individual pension system which was de facto introduced in 2003. Summary data on individual pension system as of 26 November 2020 are displayed in Table 1 (www.egm.org.tr):

Table 1. Individual Pension System summary data (as of 26 November 2020)

Number of Participants (Million)	**6.8**
Total Asset Value of Funds (TRY Billion)	155.5

Source: www.egm.org.tr

Number of participants in individual pension system and total asset value of the fund for 2011-2020 are presented in Table 2 (www.egm.org.tr). (Stats for leaving the system have also been considered as of November 2020, also as of December in other years)

Table 2. Number of participants and total asset value of the fund in individual pension system in between 2011-2020

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Year	Number of Participants	Total Asset Value of Funds (TRY Billion)
2011	2.641.843	14.3
2012	3.128.130	20.3
2013	4.153.055	25.1
2014	5.092.871	34.7
2015	6.038.432	42.9
2016	6.627.025	53.4
2017	6.924.945	67.6
2018	6.878.224	76.9
2019	6.871.132	101.8
2020	6.889.489	155.5

Source: www.egm.org.tr

Along with the introduction of individual pension system in 2003; a progressive and rapid improvement has been observed in terms of participating into individual pension system, thanks to promotions and campaigns. In 2008, following the slight decrease after the rapid increase in the first years, rapid increase trend has been observed once again, along with state subsidy in 2013. In 2013, an approximate increase at a rate of 33% has been recorded in terms of number of participants compared to last year. It is seen that in terms of total asset value of funds, an approximate increase of 25% has been observed compared to last year. Besides, there has been critical proportional declines in the number of opt-outs as of 2013. In ten-year period, between 2011 and 2020, total asset value of the funds has grown approximately ten times, on the other side, number of participants has also increased 2,6 times. Together with COVID-19 pandemic, the number of participants has decreased by 21.000 in March-April period. Depending on the data received from Pension Monitoring Center for aforementioned period, it can be inferred that the decrease is not derived from the numbers of opt-out but the decrease in the number of new entrances to the system; as a matter of fact, system opt-outs are not increased but the number of new entrances has ceased. In this context, it has been observed that the number of participants has fallen to the level of 6.887.000 by 17 April 2020, which was 6.908.000 in 20 March 2020.

Nevertheless, if an evaluation is realized through Table 2, it can be witnessed that critical increase in the number of participants has been sustained from 2013 to 2016. Besides, it can be observed that in spite of the continuation of upward trend in 2017, there has been critical declines in increase rate and in 2018 and 2019, some sort of regression has taken place. As of November 2020, a respectively low level of increase has been recorded. On the other hand, it is possible to state that there has been a constant increase in terms of total asset value of funds in between 2011-2020. According to Table 2, an increase trend has been observed in each year, starting from 2012 up to 2019; with aproximate rates of 41%, 23.6%, 38.2%, 23.6%, 24.4%, 26.5%, 13.7% and 32.3% respectively and finally 52.7% in 2020. In the light of these data, it can be inferred that the greatest increase and performance in total asset value of funds have been recorded in 2020.

Remarkable data has come into existence when these data are tabularized: number of participants in the system and total asset value of funds; invested amounts, geographical and age distribution, the first ten provinces with the most participants, sex and the number of participants using pension right in the system. It is possible to analyze these tables under these criteria.

- Level of regional development
- Demographic structure
- Labour force participation ratio
- Number of employments
- Level of education
- Gender distribution
- Reputation of the system
- System reliability

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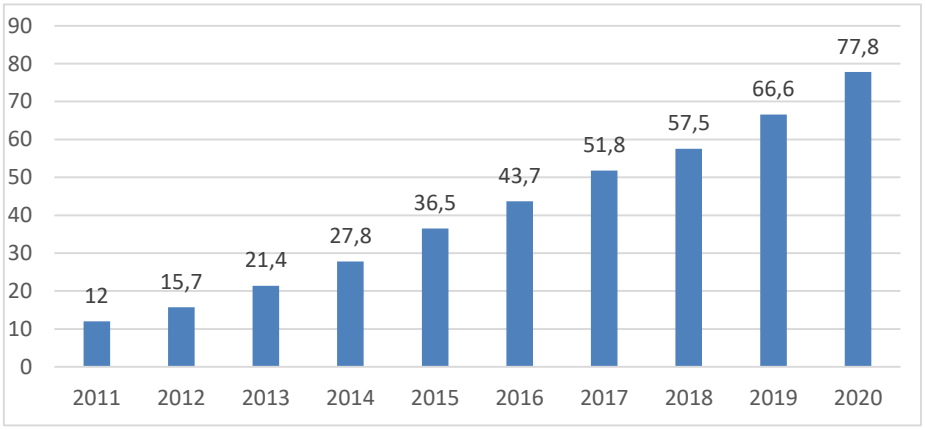
Invested individual pension system funds as from the last ten years (2011- October 2020) are displayed in Graphic 2:

Graphic 2. Invested amounts (TRY Billion)



Source: www.egm.org.tr

Geographical distribution of the number of participants in the system and total asset value of the funds are displayed in Table 3, as of 31 December 2019.

Following the analysis of the number of participants in the system and total asset value of the funds in terms of geographical distribution, it has been observed that Marmara Region has the highest ratio in this respect. Marmara Region is the prominent region in terms of development index, population density and labour force participation ratio and it is well-known that Marmara Region also has positive data in terms of education level and number of employments.

Table 3. Proportional distribution of contracts by regions (%) as of 31 December 2019

Region	Participant Ratio	Total Asset Value of Funds
Marmara	40,7	49,3
Central Anatolia	16,5	16,4
Aegean	15,4	14,3
Mediterranean	12,2	9,7
Black Sea	8,1	5,7
Southeastern	4,2	2,7
Eastern	3,0	1,8

Source: www.egm.org.tr

On the other hand, if Central Anatolia and Aegean regions data are analyzed, it can be inferred that there is a juxtaposition between these and Mediterranean region has lagged behind these two regions. Furthermore, Southeastern and Eastern regions have displayed relatively low results in terms of total asset value and the number of participants.

Age distribution data regarding system participants are provided in Graphic 3 as from 31 October 2020.

Graphic 3. Age distribution of the participants (31 October 2020)

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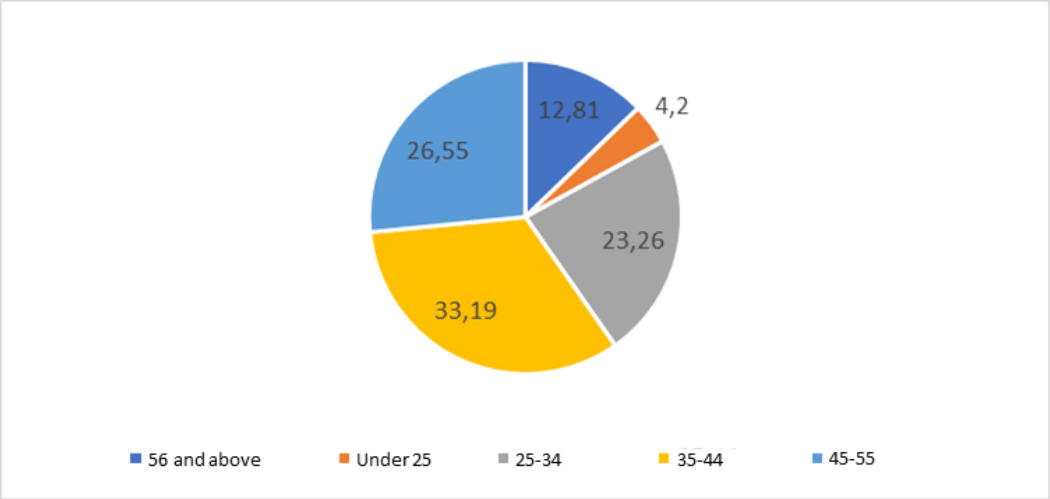
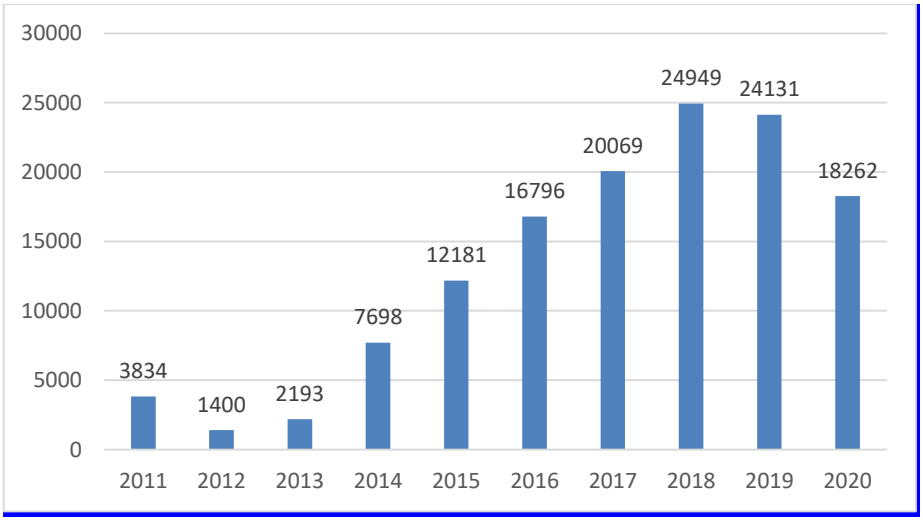


Source: www.egm.org.tr

Following the analysis of age distribution graphic, it can be stated that the low level of participation (4.20%) which was recorded among the people under 25 years old is directly correlated with the low level of labour force participation of the same age group. Besides, when examined, it can be seen that the age groups of 25-34 and 45-55 are proportionally juxtaposed. The highest ratio is recorded in 35-44 age group. Aforementioned ratio is observed as %12.81 among the people who are 56 years and above and this ratio cannot be clasified as low when the issue is considered in terms of retirement age.

According to September 2020 data, it is recorded that 131.250 individuals have retired through the system so far. Total number of retired individuals starting from the system introduction date up to 2011 has been provided cumulatively. Data for other years are considered on annual basis. Data regarding the participants who used their pension rights between 2011 and September 2020 are provided in Graphic 4 as follows:

Graphic 4. Number of participants using their pension right



Source: www.egm.org.tr

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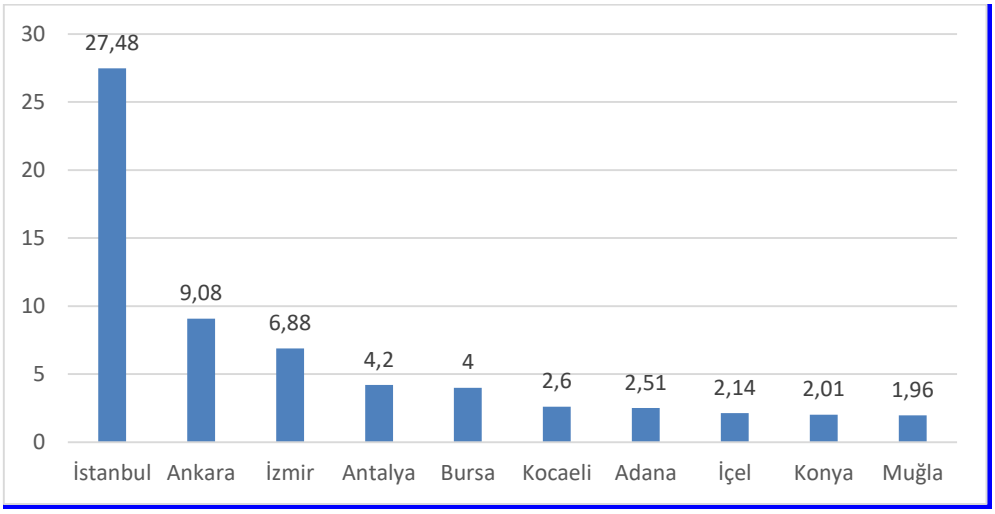
When 31 October 2020 data of Pension Monitoring Center are analyzed, the first ten provinces with the greatest number of participants can be revealed in Graphic 5 as follows:

Graphic 5. First ten provinces with the most participants (%) (as from 31 October 2020)



Source: www.egm.org.tr

It is visible that a significant amount of participants are in Istanbul; which is followed by Ankara, Izmir, Antalya and Bursa.

5. CONCLUSION and Evaluation

After making a general evaluation on the capital markets of Turkey, it can be stated that a critical increase has been realized in collected funds after 2010. Individual pension funds have a significant part and effect in this increase trend. Various empirical studies have been conducted regarding the effect of pension system funds on capital markets. Its supplementary features on individuals, economy, development and social security system have been addressed through distinctive studies.

Through the individual pension system, individuals can generate additional revenue in their post-work life and also this system avails economic recovery, canalization of this resources and finally, employment and development through ensuring long term funding. However, it is considered that these voluntary-based system requires more informative, promotive or encouraging innovations and regulations.

It is understood that individuals have regarded state guarantee as inadequate owing to the distress in pension period in terms of meeting the needs. This situation reveals the necessity level of individual pension system. The level of the need and the importance of the system can be better understood through the examination of funds which are created through the system and form a critical economic resource; and the benefit of the system in terms of driving people to making savings. In this context; modern structuring, required legislations and arrangements are obliged by taking cultural, economical, educational differences etc. and conditions into consideration in order to popularize individual pension system in every level of society. Different conditions may arise depending on different factors in the individual pension system and it is witnessed that these conditions affect the number of intended participants and total asset value of the fund. As a result, it is suggested that seperate research studies can be conducted on each imposing factor. There are numerous imposing factors affecting the growth of individual pension funds such as the increase in household consumption cost and lack of saving, high inflation rates, decrease in employment, poor economic conditions and economic crises, decline in the concern for future, lack of knowledge or ignorance about the system.

It can be seen that there are various systems and requirements for individual pension system applications all around the world, changing from country to country. In general terms, individual pension system have been utilized by developed

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countries as a voluntary system which is complementary to social security system. It is understood that obligatory applications which are deemed as a replacement of social security system are rather available in developing countries. In our country, the system is voluntary-based; funding amount has been growing in concurrence with the number of participants.

Through analyzing individual pension system-GDP ratio, it is considered that the system is open for development and improvement. According to 2019 data, total asset value of funds-GDP ratio is approximately 2.9%. A ratio of 3% is expected for 2020 and progressive structure of the fund reveals that total asset value will be much higher in the future. Individual pension system is executed in an effective, transparent and reliable way in Turkey. State subsidy incentives have obvious contributions to the development of individual pension system; however, new incentive regulations and arrangements are required to attract more participants and increase the total asset value of funds. Particularly, incentive factors and supports provided during the times of pandemic, natural disasters and economic crises will decline the opt-outs and restrain the decline of fund amount.

In terms of COVID-19 pandemic, current remarks have stated that common economic effects of the pandemic have forced individual pension systems but in Turkey, it is revealed that the number of participants has declined proportionately while total asset value of funds has greatly increased. Increase in life expenctancy and ageing population and ever-increasing meaning of health and welfare in pension period -as in every period- have spread progressive pressure on public funding. Individuals' concern about their pension period also gradually increases when economic effects of the pandemic are included into this situation. Considering the pandemic process only within the limits of healthcare is fallacious. Pandemic process affects industry, production, workforce, interest rates and returns of investment and increses individuals' concerns for the future. Furthermore, pandemic process is the reason of the increase in debt levels of countries. Therefore, affecting from those factors even in ensuring sustainable and sufficient pension revenues can be anticipated. Increase in national debts and restriction of pensions or any type of healthcare service are among the possibilities in the future. After all, governments aim to alleviate the inevitable effects of pandemic by adopting various applications.

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Relationship with Independent Audit Quality and Financial Performance

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Abstract

Although the scope of the independent audit is not clear that there are no undesirable situations such as fraud, error and corruption in the financial statements and data of the company that the auditor is auditing, it is obligatory to give a reasonable assurance within the framework of the audit evidence that can form a basis for the auditor's opinion. Taking into account the compliance of the financial statements and financial data with the generally accepted accounting principles and rules, it is evaluated that compliance with the legislation is ensured. Auditing financial statements includes accounting books, documents and accounting records. Financial statements are audited through these documents.

Keywords: Financial statements, independent audit, financial data, operational performance

Introduction

In order for an investor to be able to make the most accurate decision about the company he is related to, it is important that the financial statements have been audited independently and that the auditor has a positive or negative opinion about the company as a result of this audit. Independent auditing is the process of examining the reliability of data on economic assets and operating results of companies. This process is one of the elements of public disclosure in companies. Financial statements that have been independently audited are disclosed to the public both on the companies' website and on the Public Disclosure Platform (KAP) in line with the provisions of the lawmaker, as a requirement of public disclosure principles. Financial statement users can get an expert's opinion on the accuracy of the financial status of companies that have gone through this process and can determine their decisions accordingly.

1. Independent Audit

1.1. Independent Audit

Independent audit is a type that emerges when a distinction is made from audit types according to the status of the auditor. (Chen et.al, 2011). Although the work performed is essentially an audit, the status of the person has given a name to this type of audit. In this section, a more comprehensive definition and characteristics of independent auditing will be examined.

1.2.1. Definition and Characteristics of Independent Audit

Independent audit is the audit work performed by individuals who are self-employed or who are partners of an auditing company in order to determine the degree of compliance of the financial statements of enterprises with generally accepted accounting principles. Independent audit in Turkey Capital Markets Authority (SPK), Public Oversight, Accounting and Auditing Standards Authority (KGK), Banking Regulation and Supervision Agency (BDDK), Energy Market Regulatory

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Authority (EMRA). It can be done by institutions such as the Undersecretariat of Treasury in accordance with the relevant general and special legislation.

Independent audit according to KGK, Auditing the financial statements and other financial information on books, records and documents by applying the necessary independent audit techniques stipulated in the auditing standards in order to obtain sufficient and appropriate independent audit evidence that will provide reasonable assurance regarding the compliance and accuracy of financial reporting standards. and evaluated and reporting on it. Independent audit is the audit study conducted by individuals who work on their own behalf as self-employed or who are partners or authorized auditors of an auditing company, in order to determine the degree of compliance of the financial statements of the enterprises with the Turkish Commercial Code, the Capital Markets Law and the Tax Laws and the Generally Accepted Accounting Principles.

1.2.2. Objectives of Independent Audit

The main purpose of the independent audit is to investigate whether the financial statements reflect the real situation within the framework of generally accepted accounting principles, financial statements principles and legislation provisions. It reveals to the administrative units and the tax administration that the records in their financial statements are true, accurate and reliable. Transparency and public disclosure are of great importance in forming the audit opinion.

1.2.3. Purpose of Independent Audit

The purpose of the independent audit is to audit the compliance of the activities and financial situations of the enterprises with reality as a result of the examinations and evaluations of the assigned independent auditors and to inform the information users correctly. At the same time, it is aimed to examine the accuracy of the financial statements by fully addressing the operational status of the enterprises in the light of auditing standards and regulations, by evaluating their conformity with reality (Bayram, 2011).

The independent auditor aims to inform the public and information users accurately. It is of great importance that investors and shareholders are informed accurately. Independent audit activities have an important place in terms of sustainability of businesses. Ensuring continuity in businesses and informing the public transparently and accurately are the main objectives. Inspecting the activities of the business and informing the business environment accurately and transparently will bring an environment of trust.

For this reason, it is an important issue for the business and the business environment for the independent auditors to express the necessary and appropriate audit opinion by applying the audit activities in the light of the independent auditing standards, together with the ethical and moral rules. With the auditing standards developed and updated by the Public Oversight Authority, the auditor aims to reach sufficient and appropriate audit evidence to express his opinion, and aims to express a correct opinion in this direction. It is quite possible for an unaudited company to receive investment and to harm the sustainability of the company by adding to the legal negativities it may encounter. When legal problems and penal sanctions are added together with the financial problems that may be encountered, the continuity of the company will be disrupted and other companies, investors and information users will be adversely affected.

In order to prevent all these negativities, a need for independent audit activities arose. It is aimed to prevent these problems by using the inspection systems effectively by predicting the problems that may be experienced instead of evaluating the problems that may be experienced afterwards. It is aimed to ensure that other companies and institutions, including companies and institutions, are not harmed and the right to information is provided on the basis of transparency.

1.2.4. Scope of Independent Audit

Although the scope of the independent audit is not clear that there are no undesirable situations such as fraud, error and corruption in the financial statements and data of the company that the auditor is auditing, it is obligatory to give a reasonable assurance within the framework of the audit evidence that can form a basis for the auditor's opinion.

As stated in the independent auditing standards, the auditor is obliged to give reasonable assurance. This assurance does not imply an assurance that there is no such thing as error, fraud or corruption. Audit activities continue in line with the documents, information and findings obtained, and the audit activities end with the declaration of a reasonable opinion by the auditor. The auditor continues his audit activities by taking into account the ethical and moral rules, as well as the auditing standards. The absence of any friendships, partnerships and similar ties that may create intimacy is one of the main rules of the audit (Independent Auditing Standard 200).

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Considering the compliance of the financial statements and financial data with the generally accepted accounting principles and rules, the compliance with the legislation is evaluated. Financial statements are audited based on these documents (Çelik, 2005). Before the audit activity, the audit firm and the company to be audited should agree on a contract and the direction of the audit should be agreed. As stated in the new Turkish Commercial Code, in terms of the scope of the audit, the annual activity report prepared by the board of directors together with the financial statements is also within the scope of the audit. Thus, the scope and scope of the audit has been broadened to include all accounting systems.

2. Relationship With Independent Audit Quality And Financial Performance

Increasing trade with globalization has caused competition in the world to become more difficult and to increase gradually. The emerging competitive environment affects not only companies engaged in international trade, but also companies operating on a national basis. Because, thanks to the global markets and the great influence of technology, it has become possible for individuals or companies to easily obtain the products or services they need from national and international sectors. In the competitive environment we have mentioned, businesses need to keep up with these conditions and increase their competitive power in order to survive.

So much so that they should not compromise on quality in their products, services and processes in this competitive environment. But today, it would not be right to limit the competition conditions of enterprises to the products and services they offer. Especially after the industrial revolution, businesses that started to be established with multiple structures started to turn into an institutional structure by moving away from family companies. The multiplicity of the number of partners and the increasing complexity of the work have revealed the need for auditing and this process has been started to be carried out by the person or persons independent of the enterprises (Aziz, 2018).

The audit activity, which has increased its impact with globalization over time, has started to increase in the markets in the companies that perform this job, with the protection and making it compulsory by law. At this point, quality, which is defined as the ability to respond to the needs of people, has become a phenomenon among businesses and businesses that have independent audits have started to look for audit firms that perform this activity in a quality manner. The audit activity, which ends with the independent and reliable analysis of the client's opinion on the financial statements of the firm as a result of the audit carried out by the independent audit company, and presenting the audit report, actually heralds a new beginning for the client firm.

Because the presented audit report will be reviewed by internal and external users such as the client firm's relevant investors, creditors, business management and partners. The higher the quality of the independent audit activity, the higher the quality, correct and appropriate will be the decisions and practices of internal and external users who benefit from the reports resulting from the audit. As a result of a quality audit, the confidence of the enterprises in the market will increase and they will be able to receive full support from the investors and will not have financial problems in obtaining credit and acquiring partners with the transparency it offers. Therefore, there will be an increase in the financial performance of the enterprises and they will not have difficulty in maintaining their existence in this challenging and conditions-based competitive environment by increasing their financial performance, which is one of the most effective competition techniques today.

Performance, which is defined as the power of fulfilling, being able to accomplish any task, worshiping and applying as a word meaning, is defined as the qualitative or quantitative values obtained as a result of the planned effectiveness of the determined objectives as a business definition (Akal, 1996). In general, performance is an inference by comparing the predetermined values of the organization or people with the situation they are in. The purpose of performance appraisal is to determine whether the employees in the public or private sector fulfill the qualifications required by their employers and to evaluate whether the enterprise has reached the desired level of efficiency as a result of these determinations (Helvacı, 2002: 155-169; İplik, 2004: 195-205). Performance measurement in enterprises is the most important link of the control function, which is one of the functions of management. It is aimed to determine the performance targets, to compare the determined targets with the achieved performance values, and to evaluate the differences that arise with the control function (Sipahi, 2005: 23).

The benefits provided by the performance measurement and evaluation of the enterprises are stated below (Baki and Ustasüleyman, 2001: 71).

- It gives the opportunity to monitor how and how the company works
- Provides useful information to the company about the problems that may be encountered, successful and unsuccessful issues,
- It helps to identify possible performance gaps,

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- It shows the extent to which the predetermined resource usage is realized in line with the created plans,
- Rewarding and punishment is also effective.

Regardless of the area of the goods or services they produce, businesses are generally established to achieve a goal and achieve certain goals. One of the main purposes of business management is to ensure that the strategic goals and objectives of the organization are realized in the best way. Performance evaluations have an important place in achieving the stated strategic goals and objectives. In order for a performance appraisal to be successful, it must have the following features (Zerenler, 2003: 204-205).

Informativeness: Performance measurement in enterprises should provide information about both the internal and external environment of the organization.

Ensuring Development: The results of performance measurement should be shared not only with the relevant managers but also with the employees, and the current situation of the organization should be improved.

Understandability: In the performance measurement system, the information presented must be understandable and acceptable to everyone.

Timeliness: Performance measurement should provide the information needed by its users in a timely manner and should be in a continuous and regular structure.

Significance: Values based on performance measures should be in line with what is actually being measured.

Flexibility: The performance measurement system should be sensitive to changes in the internal and external environment, dynamic and flexible.

Compliance: Measurement systems should be applied in accordance with the mission and vision of the enterprises. Performance criteria in businesses can be handled in many different dimensions, but in this study, the financial performances of businesses were evaluated.

Financial performance in businesses deals with the financial dimension of business performance. This dimension is the determination of the financial continuity of the investments made by the enterprises, their profitability and the risks they have taken. Persons or organizations that make an appraisal of financial performance will evaluate the situation of the business based on the previous year's data and make their plans for the future in this direction (Şit, 2018: 23).

Financial performance measures the results of the activities and policies of the firms in monetary conditions. Thanks to these results, companies have information on many issues such as increase or decrease in profits, growth rates and company success. Businesses have developed certain techniques and ratios to measure their financial performance. Thanks to the data revealed by the accounting unit, the previous year or years and the current financial year are analyzed, and it guides the managers and business persons in the steps they need to take about the future.

So much so that the most frequently used method among these ratios is the ratio analysis method. Ratio analysis is the data obtained by mathematically dividing two values by each other. These results obtained from the financial data of the enterprise are interpreted by comparing them with the market accepted rates. It is tried to reach a conclusion about the financial, economic and profitability status of the enterprise by establishing mathematical relations between the financial data and accounts analyzed by the ratio method (Akdoğan and Tenker, 2003: 606).

2.1. The Relationship Between Independent Audit Quality and Financial Performance

The effects of the recent global financial crises on the world economy have once again revealed the importance of reliable and high quality financial reporting. Achieving quality financial reporting depends on the quality and professional examination of the financial statements of the client companies by the listed independent audit firms. Audit quality is an important part of public interest, regulatory and supervisory organizations. Internal and external users in the public sector direct their investments and profitability thanks to quality financial statements (Baker et al., 2015: 138).

Thanks to the audit report obtained as a result of quality independent audit activities, it causes the creditors of the enterprises to trust these financial statements and to eliminate their worries about giving loans. This situation enables businesses to obtain financial resources and to increase their financial performance by transforming this financial resource into investment or income. Independent audit quality opinion has a wide place in accounting studies. Businesses need auditing to support the quality of accounting information and to ensure the trust of financial statement users towards the business. However, businesses that want their financial statements to be more reliable can direct the auditor's opinion by deceiving or manipulating the auditors by putting pressure on the auditors. This situation leads to the emergence of

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information asymmetry problem between businesses and financial statement users in the future, and also reduces the trust in auditing.

In many studies in the literature, it is aimed to better understand audit quality. As a matter of fact, many of these studies were successful and evaluations were made to determine the relationships between audit quality and dependent variables (Ziaee, 2014: 36). The first study on audit quality was made by DeAngelo in 1981.

De Angelo examined the relationship between auditor size and audit quality in his study called Auditor Size and Audit Quality. Deloitte & Touch, Ernst & Young, KPMG and PriceWaterhouse, also known as Big4, four big audit companies and other audit companies as the basis of audit quality in the research, DeAngelo revealed that if the audit is performed by these four big companies, it is of good quality, otherwise a poor quality audit is performed.

In most of the studies conducted since the audit quality process that started with De Angelo, four large audit firms constitute the data of the audit size variable. There are many different studies in the literature on the relationship between audit quality and financial performance. When these studies are examined, it has been determined that the financial performance of the companies and the independent audit quality phenomena are examined separately from each other. Woodland and Reynolds (2003) examined the relationship between audit quality variables and the financial statements of companies in their study.

In the study, the variables of audit fees, the size of the audit firm, the tenure of the auditor, the expertise of the auditor, and the financial performance criteria as audit quality were analyzed with the help of regression analysis. As a result of the research, while significant positive effects of audit fees on the analysis of financial statements were determined, it was not mentioned that there was any positive effect on other variables (Ziaee, 2014).

Zureigat (2011) investigated the effect of audit quality on the financial structure of companies by examining the financial statements of 198 companies registered in Amman Stock Exchange (ASE) in his study in Jordan. Using logistic regression analysis in its research, Zureigat found a significant and positive relationship between the quality of independent auditing and the financial structures of national and international companies operating in the Amman stock exchange.

Chan et al. (2011) examined the effect of the change of auditors on firm performance in order to achieve financial savings. In the research, two financial performance variables, namely the stock variable and earnings performance, were taken into account. The variable of auditor changes is “1 if the audit of the company is transferred from the big four auditing firms Deloitte & Touch, Ernst & Young, KPMG and PriceWaterhouse to one of the four big auditing companies in this group, 0 otherwise”, “If the audit of the company is from the four big auditing companies, it is from the four big auditing companies. It was created with three different variables: 1 if the company's control was transferred to a different company that is not one of the big four auditing companies, 0 otherwise, and 1 if the company's audit was transferred to another company that is not one of the big four auditing companies, and 0 otherwise.

The authors, who made the study using 500-day data of 51 companies, determined that after the changes in the auditors, the earnings performance and the return on assets increased especially in the companies where the audit was performed by companies other than the four big auditing companies and then started to be done by the four big auditing companies.

Miettinen (2011) evaluated the relationship between auditor quality and financial performance of firms in his research. Miettinen, based on two variables, the frequency of audit committee meetings and the size of the audit firm, as the audit quality variables, determined that the size of the audit firm (audit quality) has a significant effect on the financial performance of the firms.

Fooladi and Shukor (2012) examined the relationship between the quality of independent auditing and the performance of companies in their study. Fooladi and Shukor, who carried out their studies on 400 companies registered in the Malaysia Stock Exchange in 2009, investigated the relationship between audit quality not only with financial performance, but also with the board of directors. The audit quality, which is considered as an independent variable in the research, is measured with the help of the dummy variable, with the data obtained by giving a value of 1, otherwise 0 if the audit is performed by four large audit firms, while for the dependent variable, financial performance, TobinQ ((Number of Unpaid Shares x Share Price) + (Total Liabilities) / (Book Value of Assets), return on assets (ROA), CEO duality, board independence and board size were analyzed using the multiple linear regression method with the help of data created. As a result of the analysis, it has been determined that there is a statistically significant and positive relationship between the quality of independent auditing and the financial performance of the companies.

Bouaziz (2012), in his study, measured the effect of the audit committee on financial performance by using the data of 26 companies registered in the Tunisian Stock Exchange between 2007 and 2010. The audit quality included in the

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research and determined as the independent variable; The size of the audit committee (the number of people on the audit committee), the knowledge and experience of the members of the committee, the frequency of meetings, and the independence of the audit committee (the proportion of independent directors on the committee) were measured. Financial performance, which was determined as the dependent variable, was measured with ROA (Return on Assets) and Roe (Return on Equity) ratios. The data obtained as a result of the research were tried to be explained by using the multiple linear regression analysis method. According to the data obtained as a result of the study, it has been determined that the independent variables determined on the audit committee have positive and positive effects on financial performance.

Moutinho et al. (2012) investigated the effect of audit fees on the financial performance of firms by using the data of 2881 publicly traded firms operating in the United States (USA) for the years 2000-2008. While audit fees are used as independent variable in the research, Return on Assets (ROA), Return on Equity (ROE), TobinQ and Earning Power (Earnings Before Interest and Taxes) variables are used for financial performance data used as independent variable. The data obtained as a result of the research were analyzed with the fixed data analysis (Panel data) method and according to the results of the analysis, it was concluded that the increase in audit fees reduces the financial performance of the enterprises.

Sulong et al. (2013), in their study, tried to determine the relationship between leverage, managerial ownership, audit quality and financial performance by using the three-year data of 82 companies traded in the Malaysian Stock Exchange between 2007 and 2009. In the study, managerial ownership (total percentage of shares currently held by managers), audit quality (total fees paid to auditors) and leverage ratio (total liabilities/total assets) were used as independent variables. In order to obtain the financial performance data, which is the dependent variable of the research, the value of TobinQ ((Market value of equity + Total liabilities)/Total assets) was used. The data obtained in the research were analyzed with the multiple linear regression model method and it was concluded that the quality of independent auditing had a negative but statistically significant effect on the financial performance of the firms.

Cheng et al. (2013) examined the relationship between auditor quality and auditor size and the financial performance of companies, using a total of 10,339 data obtained from the financial statements of publicly traded and publicly traded audit companies operating in the Taiwan Stock Exchange between 1989 and 2006.

In the study, four influential factors were taken as the independent variable, namely audit quality, "the level of education of the auditors, abilities, personal quality of the personnel and audit partners", while the "natural logarithm of the net profit of each audit firm" was taken for the dependent variable, financial performance. They analyzed the data obtained in the research with the path analysis method and revealed that there are statistically significant relationships between independent audit quality, audit size and financial performance.

Chen et al. (2013) examined the relationship between audit quality and audit size and the financial performance of firms. The data subject to the research were obtained from the Audit Companies Research Report published by Taiwan Financial Audit Commission between 1992-2006. In the study, three important factors called human capital, namely "professional experience of the auditor, education level and professional education" were taken into account as the independent variable, while the data were obtained by considering the net income of the audit firms for financial performance as the dependent variable. The authors, who interpreted the data obtained in the study with regression analysis, revealed that there is a statistically significant and positive relationship between audit quality and financial performance.

Hassan and Farouk (2014) examined the effect of independent audit quality on financial performance in their study.In the study, which was created by examining the financial statements of companies operating in the Nigerian cement sector between 2007 and 2011, the financial performance criterion was taken as the dependent variable, while the size of the independent audit (four big audit firms and others) was taken into account as the independent variable. Hassan and Farouk interpreted the data they obtained in their studies with multiple linear regression analysis and concluded that the independence of the auditor, and especially the size of the independent auditor, has a significant effect on the financial performance of the firms.

Jusoh and Ahmad (2014) examined the financial statements of 730 companies registered in 72 Malaysian Stock Exchange between 2007 and 2009 in their study in which they investigated the effect of independent audit quality and ownership structure on the financial performance of companies. Jusaoh and Ahmad, who dealt with the Return on Assets (ROA) and TobinQ values for financial performance, which are the dependent variables in their studies, considered the ownership structure as two stages, corporate ownership and managerial ownership, as independent variables. As a result of the analyzes made, it was revealed that the quality of the independent audit positively and positively affects both financial performance criteria, TobinQ and ROA.

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Ziaee (2014) examined the effect of independent audit quality on financial performance in his study. In the study on Iran Tehran Stock Exchange, financial statements of listed companies between 2008 and 2012 were used. The survey method was used in the study, and the experience of the audit firm, the reputation of the audit firm and the audit period were taken into account as independent variables. Ziaee, who determined that audit quality has an effect on financial performance according to the data obtained as a result of the research, emphasized that this determination is valid for all three variables.

Al Ani and Mohammed (2015) investigated the effect of audit quality on the financial performance of companies by examining the financial statements of 112 companies registered in the Muscat (Oman) Stock Exchange for the period 2009-2013. The authors, who obtained data such as audit quality as an independent variable, audit work done by four big audit firms and not by four big audit firms, and financial performance data as dependent variable, Return on Assets (ROA), Return on Equity (ROE), leverage ratio. and obtained in the form of market values of stocks. As a result of the regression analysis, they found that the audit quality had a statistically significant and positive effect on the return on equity (ROE) and stock market value of the big four and non-big four audit companies.

Aledvan et al. (2015) measured the effect of the independent audit quality on the financial performance of the companies by using the 2009-2013 data of 20 cement companies operating in Jordan in their study. While they used auditor size and auditor independence to measure audit quality as independent variables, they used Net Profit Margin for financial performance of firms as dependent variable. The authors, who analyzed the data with the multiple linear regression model, revealed that auditor independence and auditor size have a positive effect on financial performance.

Sayyar et al. (2015), in their research, used the financial data of 542 companies registered in the Malaysian Stock Exchange, covering the years 2003-2012, to examine the effect of independent audit quality on the financial performance of companies. While measuring the financial performance values as the dependent variable in the research with the Assets Profitability (ROA) and TobinQ variables, they determined the audit quality data, which was determined as the independent variable, with the rotation of the audit firm and the audit fee variables. The data obtained as a result of the research were analyzed with the regression analysis method and they revealed that the effect of the independent audit quality on the financial performance of the companies is positive and positive.

Eshitemi and Omwenga (2016) examined the effect of independent audit quality on financial performance in their study on certified public accountants operating in Kenya. In the research, 89 people were selected by simple random sampling method out of 826 certified public accountants who were operating continuously between 2009-2013 and a questionnaire was applied to the selected people. While the financial performance criteria determined as the dependent variable are Return on Assets (ROA) and Return on Equity (ROE), the auditor's experience, the size of the audit firm, the qualifications of the audit team and the independence of the auditor are taken into account for the audit quality, which is the independent variable.

Conclusion

Regulatory and supervisory organizations, which want to increase the confidence in financial statements today, have developed studies, laws, directives and standards that will increase the quality of independent auditing in order to provide and maintain this trust, and they will continue to develop them throughout the global economy. Independent auditing attracts the attention of internal and external users by increasing the reliability of financial statements. Therefore, the higher the quality and effectiveness of the independent audit activity, the more effective the trust of the users of the financial statements will be. When the studies on the effect of independent audit quality on financial performance are examined, it has been stated that large audit firms are more respected in the market in terms of performing better quality audits and they earn higher wages than small audit firms with the brand value created thanks to the reputation. The reason for this is that large audit firms employ employees with high experience and education, and have human capital and information and technology resources that can increase audit quality.

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Survey System Using Blockchain for Scientific Research

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Abstract

The survey is a list of questions prepared according to a specific plan for the resource people who constitute a universe or sample to understand specific people's feelings, thoughts, and experiences on a subject. However, there are many disadvantages such as lack of transparency, lack of participant privacy, and low level of security due to the centralized structure of existing survey systems. Blockchain is a Digital Trust Protocol that provides agentless, transparent, secure information transfer that protects user privacy with crypto encryption. In this study, we propose a blockchain-based, inter-university survey system to be used in scientific research to solve the problems encountered in existing survey systems. We also do a SWOT analysis of our proposed approach and centralized survey systems, utilize an algorithm in the literature to investigate whether blockchain is suitable for survey applications, compare the central survey systems with the design we propose in terms of transparency using the CNN transparency index. Moreover, we use the technology organization environment (TOE) theory to identify barriers that may arise in technology adoption and use the Fuzzy Decision-Making Trial and Laboratory Evaluation (Fuzzy Dematel) method to evaluate, analyze and prioritize the interactions of these barriers with each other.

Keywords: Blockchain, Survey System, Fuzzy Dematel, TOE

1. Introduction

Surveys are commonly used tools to collect relevant data for scientific research problems. Survey design aims to present an efficient survey system to reach robust conclusions by preserving data validity and reliability throughout the study. The design aims to provide an efficient questionnaire system to reach correct inferences by ensuring data validity and reliability, especially during the data collection phase of the study.

Blockchain is a technology, which emerged with the decentralized digital money transfer system Bitcoin, which was first produced against the central banking system (Mackey, Nayyar and Mackey, 2017a). Manipulation of recorded data is impossible in a blockchain system because the database is distributed over a peer-to-peer network and central authority is distributed to blockchain users without a central server or trusted third-party intermediaries. Therefore, with blockchain technology, organizations that need centralized architectures or trusted third parties can operate decentralized and securely (Casino, Dasaklis and Patsakis, 2019).

Researchers have recently become more interested in blockchain technologies, and prospective applications in a variety of industries are being discussed.

In this study, we present a blockchain-based survey system architecture used in academic studies, where the miners are universities. In this way, we aim to create a shared data repository for academics while providing transparency, user privacy, security, and reliability. In addition, we are investigating whether blockchain technology is suitable for surveys applied in scientific research, and we compare the system we propose with the existing survey systems using SWOT analysis and CNN transparency index.

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Even though there are studies on blockchain in many sectors, and it is promising in terms of being reliable by the public, there has not been any study on the blockchain-based survey system yet. In addition, there are some barriers to identifying technologies that can replace commonly used technologies. In this study, we also identified the obstacles to adopting the blockchain-based survey system using the TOE method. We examined and prioritized the interactions between these obstacles using the Dematel method.

The paper is organized as follows. A blockchain literature review is presented in the second part of the study. Information about the methods to be used is shown in the third part. Section four includes analyzing the suitability of blockchain for survey systems, the system's architectural design, CNN transparency analysis, Swot analysis, and the determination and prioritization of the obstacles encountered in adoption. The fifth chapter is the evaluation, and the sixth chapter is the conclusion.

2. Literature Review

Blockchain first emerged with bitcoin during the 2008 world economic crisis; unlike the existing banking system, it is decentralized, transparent, and provides user privacy with cryptography (Nakamoto, 2008). Since this date, many studies have been carried out on bitcoin and blockchain. We can divide the studies into four categories: blockchain studies concerning bitcoin, studies examining other cryptocurrencies and blockchain networks, studies investigating blockchain technology, presenting development and research proposals, and studies on various application areas of blockchain technology.

Firstly, after introducing the idea of Bitcoin, many studies were carried out that first investigated the pros and cons of blockchain technology and offered development suggestions. The majority of these studies are studies examining blockchain technology over bitcoin (Decker and Wattenhofert, 2013), (Eyal and Emin,2013), (Wang and Liu, 2015), (Heilman et al., 2015), (Baur et al., 2015), (Eyal et al., 2016), (Croman et al., 2016), (Li and Wang, 2017), (B et al., 2015), (Tschorsch and Scheuermann, 2016), (Kraft, 2016). These studies, in general, focused on new protocol proposals for scalability, reliability, and forking issues, bitcoin miner review, bitcoin financial value review, bitcoin exchanges, bitcoin, and blockchain potential.

Secondly, other cryptocurrencies and blockchain networks have been studied. Such studies have focused on another cryptocurrency, Etherium. Unlike Bitcoin, Ethereum has a smart contract feature (Luu et al., 2016), (Grishchenko, Maffei and B, 2018), .(Bhargavan et al., 2016), (Zhang et al., 2016), (Tuan et al., 2020), (Ulusoy and Çelik, 2019). These studies focus on the comparison of blockchain platforms and security of smart contracts.

On the other hand, many studies have been conducted stating that the blockchain is technology beyond bitcoin and cryptocurrencies, offering various development suggestions for the technology to be more useful and suggesting that it could investigate usability in different areas (Yli-Huumo et al., 2016a), (Trevor, 2015), (Pilkington, 2016), (Zheng et al., 2017), .(Xu et al., 2016), (Lemieux, 2016), (Xu et al., 2017), .(Kshetri, 2017), .(Androulaki e al., 2018), (Zheng, Xie and Dai, 2018a), (Casino, Dasaklis and Patsakis, 2019), (Fernando, Rozuar and Mergeresa, 2021), (Bruens and Moehrle, 2018), (Biswas and Gupta, 2019), (Kosba et al., 2016), (Luu and Gilbert, 2016), (Xiong et al., 2018), (Uygun, 2019).

Finally, when it was understood that blockchain is beyond bitcoin and can be used in different areas, many studies have been carried out on various application areas of this technology. Data management system ((Zyskind and Pentland, 2015), (Liang et al., 2017), .(Ma et al., 2018), .(De, Pandey and Pal, 2020)),(Öncü, 2019) internet of things and blockchain integration (Sharma, Chen and Park, 2018), (Christidis and Devetsikiotis, 2016a), (Huh, Cho and Kim, 2017), .(Ahmad and Salah, 2018), (Novo, 2018), .(Tahar, Hammi and Bellot, 2020), (E-textiles, 2018), (Sharma et al., 2017)), health service ((Azaria et al., 2016), (Yue et al., 2016), (Esposito et al., 2018), (Kuo, Kim and Ohno-machado, 2017), (Q. I. Xia et al., 2017), (Q. Xia et al., 2017)), cyber security ((Wang and Han, 2018), (Hassan, Rehmani and Chen, 2019)), E-commerce ((Zhang and Wen, 2015)), energy trading ((Munsing, Mather and Moura, 2017), (Mengelkamp et al., 2018), .(Aitzhan and Svetinovic, 2018), (Guan et al., 2018), (Andoni et al., 2019), (Kang et al., 2017), (Sikorski, Haughton and Kraft, 2017)), smart transportation ((Yuan and Wang, 2016), (Li et al., 2018), (Dorri et al., 2017), (Lei et al., 2017)), smart city (.(Sun and Yan, 2016), (Biswas and Technology, 2016)), sharing economy ((Huckle et al., 2016)), banking ((Guo and Liang, 2016)), process management ((Weber, Xu and Governatori, 2016), (Viriyasitavat et al., 2020)), education ((Sharples and Domingue, 2016), (Information, 2018)), public administration ((Janssen, 2017)), supply chain ((Toyoda, Mathiopoulos and Member, 2017), (Mackey, Nayyar and Mackey, 2017b), ("Kshetri, 2018), (Kim and Laskowski, 2018), (Galvez, Mejuto and Simal-gandara, 2018), (Kamble, Gunasekaran and Sharma, 2020), (Surendra et al., 2020)), e-vote ((Cryptography et al., 2017)), environmental impact assessment(.(Farooque et al., 2020)), artificial intelligence.(Salah, Member and Rehman, 2019) are examples of this category's topics.

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As a result of the literature review, we did not encounter a blockchain-based survey system, so we aim to fill the gap in the literature in this study. The mind map of the literature review is given in figure.2.1.

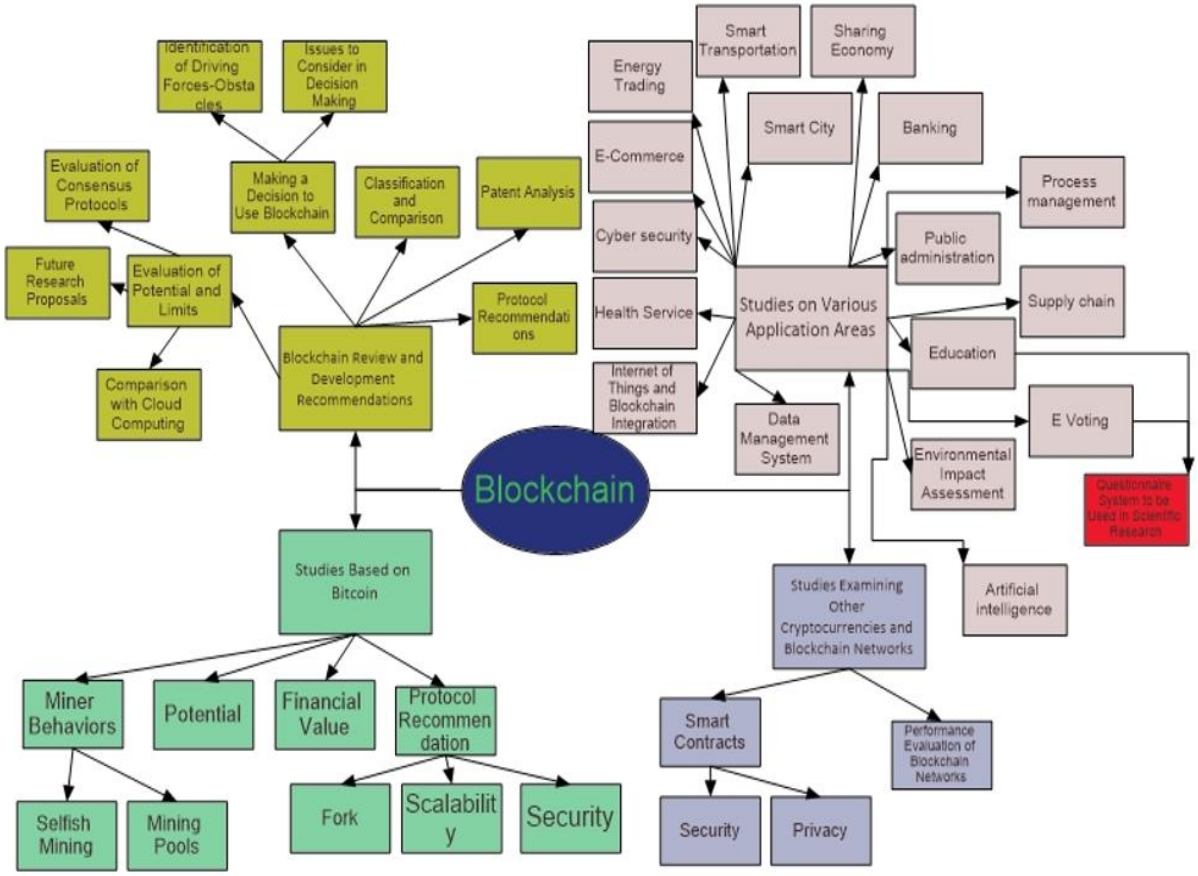

Figure 2.1 Mind Map of Examined Articles Related to Blockchain

3. Method

The methodology of this study which proves that the blockchain is suitable for the survey system, shows that it will be better than the central systems, identifies the obstacles to the implementation of the system, prioritizes these obstacles, is shown in figure 3.1.

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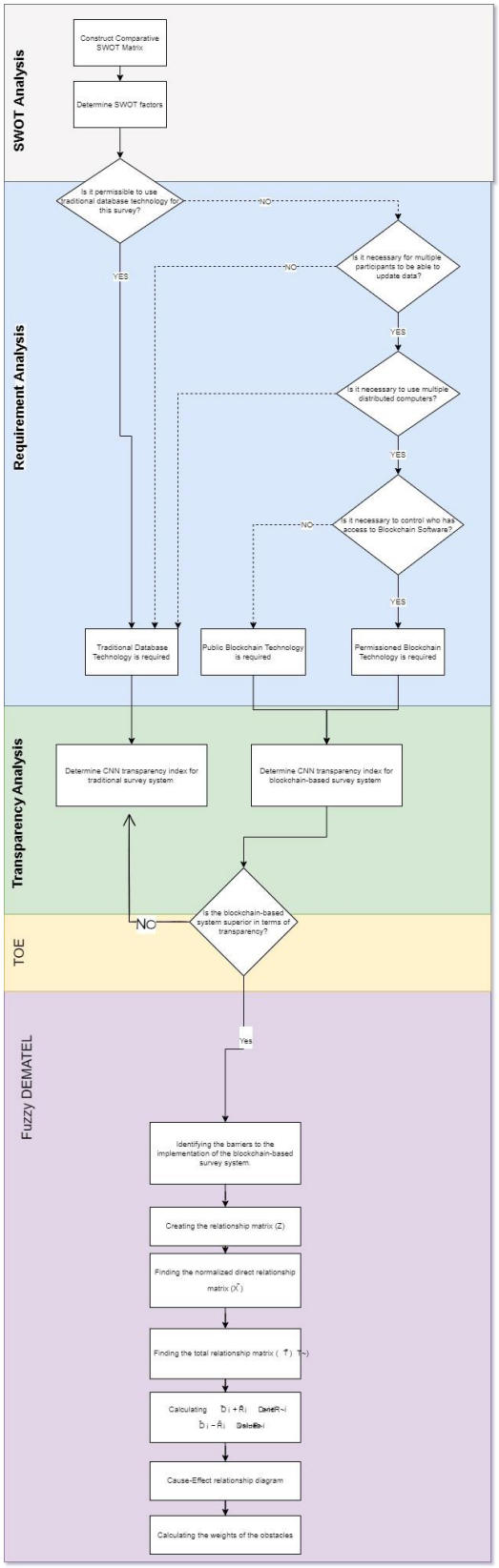

Figure 3.1 Methodology

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3.1. Blockchain

3.1.1. What is Blockchain?

Blocks are data lists with transaction records. Blockchain is a list of records created by blocks, linked to each other by cryptographic methods, and thus secured.

A blockchain can be thought of as a log whose records are grouped into time-stamped blocks. Each block is identified by its hash code. Each block references the hash code of the block before it. This establishes a link between blocks, thus creating a blockchain structure (Christidis and Devetsikiotis, 2016b). The first block without the main block is called a genesis block. The blockchain structure is represented as in Figure 3.2.

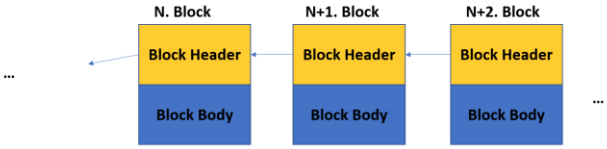

Figure 3.2 Representative Blockchain Structure

A block consists of a block header and a block body. The block header contains the following information; block version, which indicates which block validation rules to follow; parent block hash which shows the previous block's hash code, timestamp which shows current timestamp in seconds since 1970-01-01T00:00 UTC, nBits which shows current hashing target, nonce which indicates the value used to select the node to create the block, merkle tree root hash which shows hash value of all transactions in the block. The block body consists of a transaction counter and transactions. The block structure is shown in figure 3.3 (Zheng, Xie and Dai, 2018b).

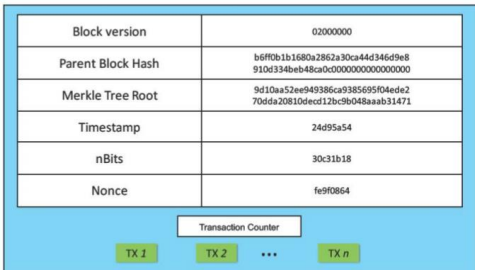

Figure 3.3 Block Structure

As seen in Figure 3.4, the hash codes of the transactions in the block are grouped in pairs for merkle tree roof hash. The obtained hash codes continue to be grouped until a single hash code is obtained.

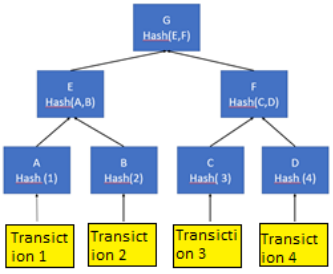

Figure 3.4 Merkle Tree Roof Hash

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3.1.2. Concensus Algorithm

Nodes perform the tasks of verifying online transaction requests and storing transaction records, as the center in central systems does , to create a distributed environment in blockchain technology. However, the problem is how to reach consensus among nodes in the distributed environment of blockchain technology. Also, there is no central node that ensures that the ledgers in distributed nodes are all the same. Some protocols are needed to ensure that the ledgers on different nodes are consistent (Zheng et al., 2017).

There are many different types of consensus protocols designed according to the blockchain type and objectives. According to the Proof of Work (PoW) algorithm used in Bitcoin, nodes find a byte string called nonce. Using nonce, it is aimed that the Hash code will consist of a certain number of leading zeros and ones. Since cryptographic hashes are one-way functions, finding such a nonce can only be done by calculating the hash of the block for all possible nonces until a valid solution is found. Therefore, finding an entry that produces a solution is difficult, but it is simple to verify (Decker and Wattenhofert, 2013). Thus, the nodes prove that they make an effort to create blocks for the system and spread them to other nodes. The nodes that solve the problem first get the right to create a block and share it with other nodes. In Bitcoin, it is aimed to create a block every 10 minutes. Therefore, the difficulty level of the question is increased or decreased by increasing or decreasing the nonce length to achieve the target of 10 minutes.

Although the PoW algorithm successfully chooses the node to create and share blocks, it has been criticized for its high energy requirement. Bitcoin daily energy consumption is determined as 1.5 million dollars/day (Yli-Huumo et al., 2016b). Therefore, various consensus algorithms are used for various blockchain networks such as Proof of Stake (PoS), Proof of Trust (PoT), Proof of Authority (PoA), Proof of Burn (PoB), etc.

3.1.3. Cryptology

Cryptography is the science of encryption. Cryptography provides user privacy and control of whether the data has been changed in the blockchain.

Hash is the method that converts a text to a fixed-length password. There are many algorithms to perform this operation. The SHA 256 algorithm is used in bitcoin, which came into our lives as the first application of the blockchain. According to the SHA 256 algorithm, extracting a summary text from a text is quite simple for computers, while reaching the text from the password is close to impossible with current technology. In addition, it is close to impossible to obtain a similar output from two different inputs.

In the blockchain, according to user information, each user has a unique hash code. Everybody can see transactions, but nobody knows who did this. In this way, user privacy and transparency are provided at the same time. When a block is created, all data in that block is passed through the SHA 256 algorithm. Each block created contains the hash code of the previous block. Thus, the chain structure is formed. If a cyber attack is made on one of the nodes and the information of a block in that node is changed, the hash code of the block whose data has changed will change. Since the hash codes in the parent block and the following block do not match, users will understand that the data in the following block has been changed and will not respect the data in this node. If an attacker wants to change the block's data in a blockchain, he must also change the data in the parent blocks of that block and perform this operation on at least 51% of the available nodes (Kroll, Davey and Felten, 2013). While even decoding a hash code is close to impossible with current technology, this provides data security in the blockchain.

3.1.4. Blockchain Classification

Because the majority of blockchain structures are cryptocurrencies, most researchers classify blockchain networks as financial and non-financial. Some classify it as blockchain 1.0, blockchain2.0, and blockchain3.0 based on the blockchain version. Applications that handle cryptocurrency transactions are Blockchain 1.0, applications extending beyond smart contracts, and cryptocurrency transactions blockchain 2.0. Applications that include applications in areas apart from the previous two versions such as government, health, science, and IoT are defined as Blockchain 3.0 (Casino, Dasaklis and Patsakis, 2019).

It can also be classified as public and private blockchains according to whether or not using the blockchain network is public.

A more detailed classification can be made according to the usage purposes of the blockchain network, such as e-commerce, health, management, education, supply chain applications etc.

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3.2. SWOT Analysis

Swot is one of the most effective evaluation methods to evaluate projects' strengths and weaknesses, opportunities, and threats. Thanks to this technique, we can determine the positive or negative internal and external factors to achieve the goal. Furthermore, our strengths and weaknesses enable us to evaluate internal factors, opportunities, threats allow us to evaluate external factors.

3.3. Technology-Organization-Environment (TOE) Framework

The TOE framework was created in 1990 by Tornatzky, Fleischer, and Chakrabarti. According to this framework, the technological, organizational, and environmental factors that affect the adoption of an innovation are discussed. It has been used in various studies investigating the adoption of blockchain technology (Wong et al., 2020).

The technological context describes the technology variables that influence adoption decisions, such as technical competence and compliance, the organizational context describes the variables of an organization such as firm size and top management support, and the environmental context describes the factors surrounding an organization such as competitive pressure (Fernando, Rozuar and Mergeresa, 2021).

3.4. Fuzzy Dematel

Examining the obstacles to forming a situation is a difficult problem to overcome; as the number of obstacles increases, there are complex relationships between them. For this reason, many multi-criteria decision-making methods have been developed. The analytical hierarchy process (AHP) and the interpretative structural model (ISM) are used by scientists in various applications. Often, researchers consider Ism and Dematel superior to Ahp when examining interdependent factors for both success and failure. In addition, the Dematel technique is considered superior to Ism since it can determine the total effect degree for each factor. Researchers prefer Dematel technique because it can classify factors as causal and receptive groups, establish dependency relationships between factors, and allow working with a limited number of experts (Biswas and Gupta, 2019).

Gabus, A., and Fontela first used the Dematel method at the Geneva Research Center in 1973 to solve global problems such as famine, environmental protection, and race. Since its first use, the field of research has expanded considerably (Yang, Lee and Chang, 2019).

The fuzzy Dematel approach has been developed by using fuzzy set theory to prevent human errors such as bias and uncertainty in decision making (Wu and Lee, 2007). The Fuzzy Dematel method has been used in many kinds of research, such as examining problems in supply chain management, choosing green suppliers, remanufacturing automotive parts, examining barriers to the development of coastal transport as a sustainable and efficient alternative to road transport in India (Farooque et al., 2020).

The following steps should be followed to apply the Fuzzy Dematel method;

Step 1: It is necessary to determine the criteria to create a pairwise comparison matrix.

Step 2: Creating the relationship matrix (Z). After the factors are determined, the relationship between the criteria should be evaluated by experts on a fuzzy scale. The scale is expressed in five linguistic terms: Very high influence, high influence, low influence, very low influence, and no influence. Triangular fuzzy numbers are used in linguistic terms. Linguistic expressions and the equivalent of these expressions as fuzzy triangular numbers are given in Table 3.1. Pairwise comparison matrix is created as much as the number of experts. $\tilde{Z}_{ij}^{k} = l_{ij}^{k}, n_{ij}^{k}, u_{ij}^{k}$ is a triangular fuzzy number and represents that kth researcher's answer for the level of effect of factor i on factor j.

$$\tilde{Z}^{(k)} = \begin{bmatrix} 0 & \cdots & \tilde{z}_{1n}^{(k)} \\ \vdots & \ddots & \vdots \\ \tilde{z}_{n1}^{(k)} & \cdots & 0 \end{bmatrix}; k = 1,2, \dots p \quad (1)$$

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Table 3.1 Linguistic Expression

Impact Score	Linguistic Expression	Triangular Fuzzy Equivalent of Linguistic Expression
0	No Influence	(0,0,0.25)
1	Very Low Influence	(0,0.25,0.5)
2	Low Influence	(0.25,0.5,0.75)
3	High Influence	(0.5,0.75,1.0)
4	Very High Influence	(0.75,1.0,1.0)

Step 3: Finding the normalized direct relationship matrix ($\tilde{X}$). The p pairwise comparison matrices in the fuzzy scale we have obtained are obtained using the following equations.

$$\tilde{X}^{(k)} = \begin{bmatrix} 0 & \cdots & \tilde{x}_{1n}^{(k)} \\ \vdots & \ddots & \vdots \\ \tilde{x}_{n1}^{(k)} & \cdots & 0 \end{bmatrix}; \mathrm{k} = 1,2, \ldots \mathrm{p} \quad (2)$$

$$\tilde{x}_{ij}^{(k)} = \frac{\tilde{z}_{ij}^{(k)}}{r^{(k)}} = \left(\frac{l_{ij}^{(k)}}{r^{(k)}}, \frac{n_{ij}^{(k)}}{r^{(k)}}, \frac{u_{ij}^{(k)}}{r^{(k)}}\right), r^{(k)} = \max_{1 \le i \le n}\left(\sum_{j=1}^{n} u_{ij}^{(k)}\right) \quad (3)$$

Here the assumption $\sum_{j=1}^{n} u_{ij}^{(k)} < r^{(k)}$ is valid.

A matrix is obtained by averaging the p units normalized direct relationship matrices obtained.

$$\tilde{X} = \frac{\left(\tilde{X}^{(1)} + \tilde{X}^{(2)} + \cdots \tilde{X}^{(p)}\right)}{p} \quad (4)$$

By using equation number 4, equation r 5 is obtained as $\tilde{x}_{ij} = \frac{\sum_{k=1}^{p} \tilde{x}_{ij}^{(k)}}{p}$

$$\tilde{X} = \begin{bmatrix} \tilde{x}_{11} & \cdots & \tilde{x}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{x}_{n1} & \cdots & \tilde{x}_{nn} \end{bmatrix} \quad (5)$$

Step 4: Finding the total relationship matrix ($\tilde{T}$). The convergence in equation 6 must be provided to carry out this operation.

$$\tilde{T} = \lim_{k \to \infty}\left(\tilde{X} + \tilde{X}^2 + \cdots \tilde{X}^k\right) = \tilde{X}(I - \tilde{X})^{-1} \quad (6)$$

In this case, the matrix in equation 7 can be created.

$$\tilde{T} = \begin{bmatrix} \tilde{t}_{11} & \cdots & \tilde{t}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{t}_{n1} & \cdots & \tilde{t}_{nn} \end{bmatrix} \quad (7)$$

The $\tilde{t}_{ij} = \left(l_{ij}'', n_{ij}'', u_{ij}''\right)$ in equation 7 is the indicator of the evaluation by all experts of the effect level of criterion i on criterion j. Depending on this, the following equations can be written.

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$$[l''_{ij}] = X_l x(I - X_l)^{-1}$$
$$[m'_{ij}] = X_m x(I - X_m)^{-1} \quad (8)$$
$$[u''_{ij}] = X_u x(I - X_u)^{-1}$$

Step 5: Calculating $\tilde{D}_i + \tilde{R}_i$ and $\tilde{D}_i - \tilde{R}_i$ values. $\tilde{D}_i$ is the sum of the row elements the matrix $\tilde{T}$., $\tilde{R}_i$ is the sum of the column elements of the matrix $\tilde{T}$. By using equation 9, $\tilde{D}_i + \tilde{R}_i$ and $\tilde{D}_i - \tilde{R}_i$ values obtained in fuzzy scale are clarified, and exact numbers are obtained.

$$\tilde{D}_i^{def} + \tilde{R}_i^{def} = \frac{1}{4}\left(x_{ij,l} + 2x_{ij,m} + x_{ij,u}\right), \tilde{D}_i^{def} - \tilde{R}_i^{def} = \frac{1}{4}\left(x_{ij,l} + 2x_{ij,n} + x_{ij,u}\right) \quad (9)$$

Criteria with a positive $\tilde{D}_i - \tilde{R}_i$ value are called senders and have a higher impact on other criteria. Therefore, it has priority. Criteria with a negative $\tilde{D}_i - \tilde{R}_i$ value are named recipients and are more affected by other criteria. That's why it has low priority. $\tilde{D}_i + \tilde{R}_i$ is the expression of the relationship of a criterion with other criteria. Being high means having a high degree in the relationship (Dematel, Makİne and Organ, 2013).

Step 6: The diagram with the horizontal axis $\tilde{D}_i + \tilde{R}_i$ and the vertical axis $\tilde{D}_i - \tilde{R}_i$ is created to obtain the Cause-Effect relationship diagram.

Step 7: The weights of the obstacles are obtained with the help of equations 10 and 11.

$$w_i = \left\{\left(\tilde{D}_i^{def} + \tilde{R}_i^{def}\right)^2 + \left(\tilde{D}_i^{def} - \tilde{R}_i^{def}\right)^2\right\}^{1/2} \quad (10)$$

$$\mathrm{W}_i = \frac{w_i}{\sum_{i=1}^{n} w_i} \quad (11)$$

4. Implementation

4.1. SWOT Analysis

When we propose a new technology instead of the commonly used methods, we need to analyze the advantages and disadvantages of the existing techniques and the technology we suggest very well, and research whether the technology we propose can eliminate the disadvantages of the current method. The two-dimensional swot analysis of existing survey systems, and the blockchain-based survey systems is shown in table 4.1.

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Table 4.1 The two-dimensional swot analysis of existing survey systems, and the blockchain-based survey systems

		●	▲	★
STRENGTHS (S)	Widespread usage at present		✓	
	Low Cost		✓	
	Extensible database	✓		
	Transparent			✓
	Trustworthy			✓
	Unable to change data			✓
	Resistance to data fabrication			✓
WEAKNESS (N)	Lack of transparency		✓	
	Vulnerable to security attacks		✓	
	Possibility of data being changed		✓	
	Inability to provide user privacy		✓	
	Scalability			✓
	Cost			✓
OPPORTUNITIES (O)	Easy to access people	✓		
	Data pool for researcher-Labour saver			✓
	High public confidence to research.			✓
	High rate of participation due to cryptology			✓
THREATS (T)	Modification or fabrication of data		✓	
	Decreased public trust in surveys.		✓	
	Data can be used against individuals due to a lack of user privacy.		✓	
	Resistance to new technology			✓
	Requirement of government policy.			✓

● COMMON IN BOTH SYSTEMS ▲ TRADITIONAL SYSTEMS

★ BLOCKCHAIN-BASED SYSTEMS

As seen in the SWOT analysis, blockchain-based survey systems have many advantages over existing centralized applications. The most important of these advantages are the transparent structure of blockchain technology, the collection of data in more than one center, user privacy and security being provided by cryptology.

4.2. Do You Need a Blockchain?

Although blockchain is seen as a revolutionary technology that will eliminate the disadvantages of existing centralized systems, before moving to blockchain technology in any field, we need to research whether we need blockchain for the system we propose, and what kind of blockchain architecture would be appropriate. For this purpose, we used the algorithm in figure 4.1, which is frequently used in the literature, which helps us understand whether the blockchain meets our needs (PECK, 2017) .

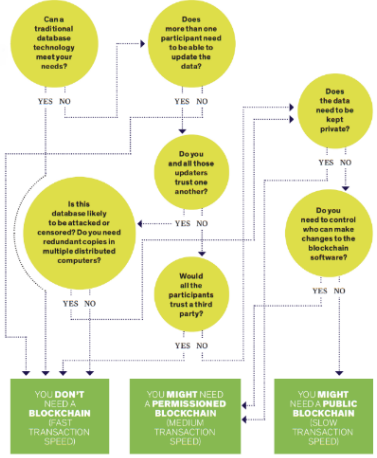

Figure 4.1 Do You Need a Blockchain

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Step 1: Can a traditional database technology meet your needs?: As mentioned in the previous section, it was noted that data abuses occur in some scientific studies, which raises the suspicion that there may be more abuses and that the trust in scientific studies has decreased. In addition there are many studies on scientific ethics on this subject. The Danish Committees on Scientific Dishonesty (DCSD) was established in 1993, the UK Committee on Publication Ethics (COPE) was established in 1997 to deal with violations in research and publication ethics, the United States government established the Office of Scientific Integrity (OSI) and the Scientific Integrity Review Office in 1989. (OSIR) founded (Claxton, 2005). However, the frequency with which scientists generate and falsify data or commit other forms of scientific misconduct is still a matter of debate. Estimates on this subject do not fully reflect reality (Fanelli, 2009).

Step 2: Does more than one participant need to be able to update the data?: We will have two types of users: people who participate in the survey and researchers who upload or solve surveys to the system.

Step 3: Do all participants trust each other?: As mentioned in Step 1, the main reason the traditional system cannot achieve its goals is the problem of trust.

Step 4: Do all participants trust a third party? While editors, communities, publishers, and organizations such as DCSD, COPE, OSI, have tried to protect science through the publication and enforcement of guidelines and rules, there are examples of data abuse, change. How much of this is true, is it just the tip of the iceberg is a matter of debate. Therefore, there is a need for a system where distrustful parties can create a reliable platform.

Step 5: Does data need to be kept private?: Researchers conducting surveys should be able to upload new surveys to the system, participate in existing surveys and see the results of other surveys. However, other users can only view and answer existing surveys.

Step 6: Do you need to control who can make changes to the blockchain software?: To not lose trust in the system, possible changes in the blockchain software should be made by the cooperation of universities.

When all the algorithm steps are followed, a private blockchain system design will be appropriate for the survey system, in which some users can access all the data, and some users can only view and respond to surveys.

4.3. System Architecture

4.3.1. System Users

As a result of the algorithm we followed in section 4.1 of the study, it was concluded that a private blockchain system design would be appropriate. Some users could access all data. On the other hand, some users could only view and respond to surveys. We defined two types of users in this direction: researchers administering surveys and participants solving survey questions. Researchers can upload new surveys to the system, see the results of other surveys, answer the questions of active surveys, or share the results of their analysis using the completed survey data. Participants who solve the survey questions can view the active surveys and answer the questions or see the analysis results.

4.3.2. Participating Organizations

University's responsibilities are approving, publishing, and storing data. Researchers register to the system with their institutional e-mail addresses. In this way, non-academic people cannot open an account as a researcher.

The survey participants' properties must be known, such as age, education level, etc., to properly evaluate the surveys' results. Therefore, integrating the system with E-Government is essential for the evaluation of the questionnaires. This integration will also prevent certain groups from opening different user accounts and sabotaging the survey by participating more than once. Users and institutions included in the system are shown in Figure 4.2.

4.3.3. Consensus

Since it is a public blockchain, we do not need algorithms such as PoW, which requires high energy consumption, or PoS, which can lead to injustice. Since we have a limited number of nodes, we can send transaction requests to all nodes. We use the Practical Byzantine Fault Tolerance principle so that all nodes can reach a consensus. The PBFT algorithm states that for normal execution of a consensus process, there must be at least (2N+1)/3 normal nodes for each consensus calculation among all nodes in the system (Zhu et al., 2021). When this number is reached, the transaction is confirmed, and the block is created.

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4.3.4. Workflow Design

A user who logs into the system as an academic can create a survey or fill other surveys. On the other hand, other participants can log in and fill created questionaries. The online transaction requests are sent to all nodes, according to a consensus algorithm we adopted to approve this transaction, and if at least (2N+1)/3 nodes approve the transaction, the transaction will take place. After the request is approved, a block is created and sent to all nodes. Thus, anyone who enters the system can see this survey, ensuring data security since there is no central server. The proposed system architecture is presented in Figure 4.3.

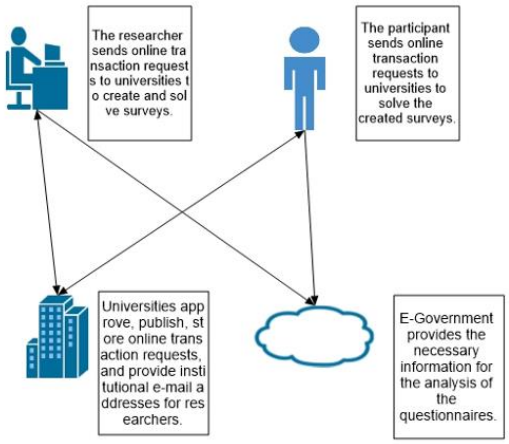

Figure 4.2 System Users and Institutions

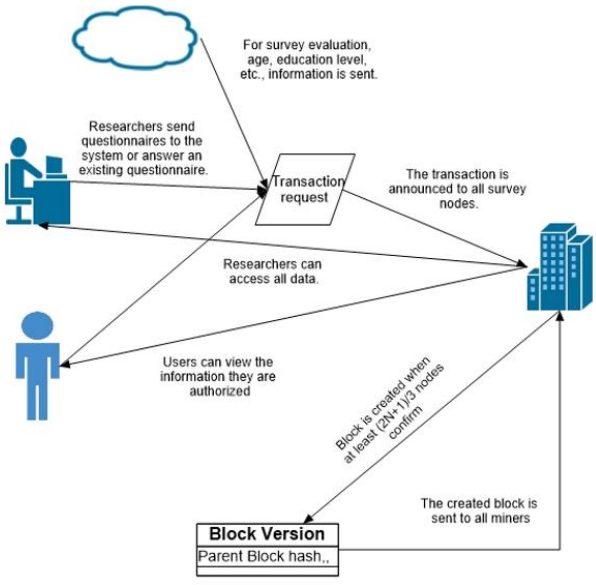

Figure 4.3 Structure of the Proposed System and Workflow Design

4.4. CNN Transparency Index

CNN has released a transparency index that includes a series of questions that need to be answered before releasing the opinion poll to the public. In this study, we compare the system we proposed with the existing systems according to transparency by using the data of a study that was published as a master's thesis in 2020, that used the adaptation of the

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CNN Transparency Index for Turkey to investigate the transparency of the pre-election surveys in Turkey (AYDAŞ, 2020). CNN transparency index categories and scores list is shown in attachment A.

Based on the data shared in the study (AYDAŞ, 2020), we calculated each criterion's average score for election questionnaires between 2011-2019. Table 4.2 shows the information. Unfortunately, no data could be obtained to calculate the average value of criteria 1,2, and 7. Since criteria 1 and 2 are not related to the blockchain, they will not affect the calculation result. However, since the survey time is clearly determined in the system we propose, we will receive 3 points. Therefore, we will use intervals when comparing.

Table 4.2 Evaluation of Pre-Election Polls in Turkey

CRITERION\ELECTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Ortalama
2011 GENERAL	x	1,5	1,9	x	1	1,9	x	0,2	1,1	0	0	1	1	0,2	0,2	1	13,46
2014 ANKARA	x	1,4	1,7	x	1	1,5	x	0	0,9	0,1	0	1	1	0,1	0,1	1	12,16
2014 ISTANBUL	x	1,4	1,4	x	1	1,6	x	0	1	0,1	0	1	1	0,1	0	1	12,3
2014 PRESIDENTIAL	x	1,5	1,7	x	1	1,9	x	0,2	1,1	0,2	0	1	1	0,4	0,1	1	15
2015 GENERAL (JUNE)	x	1,5	1,8	x	1	2,2	x	0,1	1	0,1	0	1	1	0,5	0,1	1	15,28
2015 GENERAL (NOVEMBER)	x	1,3	1,8	x	1	1,8	x	0,1	1	0,2	0	1	1	0,6	0,1	1	15,61
2018 GENERAL	x	1,1	1,4	x	1	1,9	x	0,1	1	0,3	0	1	1	0,8	0,2	1	14,07
2018 PRESIDENTIAL	x	1,2	1,4	x	1	1,9	x	0,1	1	0,3	0	1	1	0,9	0,2	1	14,76
2019 ANKARA	x	1,1	1,2	x	1	1,6	x	0	1	0,3	0	1	1	0,2	0,1	1	11,24
2019 ISTANBUL	x	1,1	1,4	x	1	1,6	x	0	1	0,2	0	1	1	0,2	0,2	1	11,88
2019 ISTANBUL REPEATED	x	1,3	1,7	x	1	1,8	x	0,1	1	0,2	0	1	1	0,4	0,1	1	14,04

The system we propose will receive 2 or 3 points from criterion 6, 3 points from criterion 7, 1 or 3 points from criterion 8, 2 or 3 points from criterion 9, and 1,2 or 3 points from criterion 10, 14, and 15.

Considering this situation, if the pre-election surveys in Turkey were conducted with the blockchain-based survey system, the transparency scores would be as in table 4.3.

Table 4.3 Possible Minimum and Maximum Changes of Election Polls in Turkey if Blockchain Based Survey System were Used

ELECTION	Average Scores of Surveys	Min. Average of Blockchain	Min. % Change	Max.Average of Blockchain	Max. % Change
2011 GENERAL	13,46	18,42	36,87	27,84	106,87
2014 ANKARA	12,16	18,11	48,89	27,58	126,82
2014 İSTANBUL	12,3	17,78	44,57	27,52	123,72
2014 PRESİDENTIAL	15	19,06	27,08	29,06	93,75
2015 GENERAL(JUNE)	15,28	19,36	26,72	29,16	90,85
2015 GENERAL(NOVEMBER)	15,61	19,73	26,41	29,73	90,47
2018 GENERAL	14,07	17,81	26,57	27,81	97,65
2018 PRESİDENTIAL	14,76	18,36	24,36	28,36	92,11
2019 ANKARA	11,24	17,36	54,45	26,12	132,38
2019 İSTANBUL	11,88	17,52	47,47	26,72	124,92
2019 İSTANBUL REPEATED	14,04	18,34	30,60	28,34	101,83

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4.5. TOE and DEMATEL

The list of barriers to the realization of our proposal, created within the framework of the Technology-Organization-Environment theory, is shown in table 4.4.

Table 4.4 Barriers to Implementation of the Proposed System

Barrier Group		Barriers
TECHNOLOGY	T1	Speed and scalability
	T2	Anonymity issue
	T3	Irrevocability of Transaction
	T4	High initial cost
	T5	Inefficient in terms of energy
ORGANIZATION	O1	Difficulties in integrating all universities into the system
	O2	Difficulties in accessing the participant to be surveyed
	O3	Researchers may not want to use the system
	O4	Integration Issues
ENVIRONMENT	Ç1	Negative public perception
	Ç2	The need for government policy support
	Ç3	Hesitation to use new systems

The Dematel method was used to identify and prioritize the relationship between barriers. We sent the matrix we wanted to be filled to 36 experts who had researched blockchain before, and we received feedback from 4 experts. The answers sent to us by the experts are shown in Attachment B.

The D+R and D-R values obtained by following the steps of the Dematel method are shown in table 4.5, and the weights of the factors are shown in table 4.6. The relationships between the elements are shown in figure 4.4.

Table 4.5 D+R and D-R Values

	D+R	D-R
T1	3,400243	-0,07079
T2	4,256155	-0,00023
T3	3,938849	-0,00092
T4	3,855695	0,065331
T5	3,192577	0,002136
O1	5,304758	0,000162
O2	4,632394	-0,00077
O3	5,010914	-0,00048
O4	4,841088	-4,6E-05
Ç1	5,06584	0,001617
Ç2	4,451729	0,001218
Ç3	5,660461	0,002766

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Table 4.6 Weightness of Factors

	w_i	W_i
T1	3,400979	0,063437
T2	4,256155	0,079388
T3	3,938849	0,07347
T4	3,856249	0,071929
T5	3,192578	0,05955
O1	5,304758	0,098947
O2	4,632394	0,086406
O3	5,010914	0,093466
O4	4,841088	0,090299
Ç1	5,06584	0,094491
Ç2	4,451729	0,083036
Ç3	5,660462	0,105582

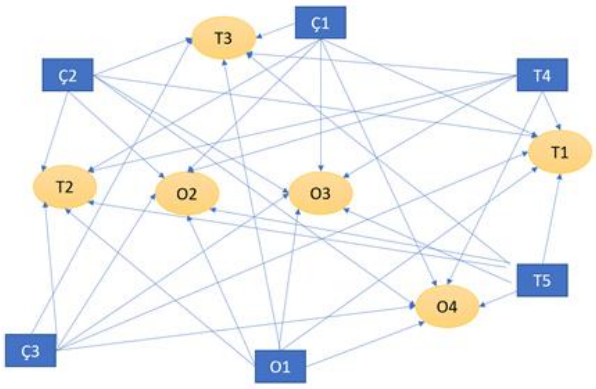

Figure 4.4 Relationships Between Factors

5. Evaluation

Since the user information is encrypted with cryptography in the proposed system, all users can see that a person has answered a survey, but they cannot know who this person is. Furthermore, since all these data are located on the servers of all universities, they cannot be changed, thus increasing the trust in research and a more secure structure against cyber-attacks compared to central systems. In addition, since there will be a shared database between universities, academicians who conduct similar research can use an existing questionnaire in the system; each of them can transform the data into information by using their methods.

According to the results of the CNN transparency index, if the blockchain-based survey system was used in the election surveys in Turkey between the years 2011-2019, the transparency scores of the surveys would increase between 24.36% and 132.38%.

According to the TOE framework, 12 obstacles to the implementation of the system were determined and then these obstacles were evaluated with the Dematel method. According to calculation results, the high initial cost and energy inefficiency of blockchain technology, the necessity of including all universities in the system, the negative public perception about the technology, the need for government support, and the hesitation problems people experience in transitioning to the new system are the factors affecting others. If we can solve these problems, this will impact the

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technology's speed, scalability, anonymity, non-recovery of transactions, reach to the survey person, encouraging researchers to use the system, and integration issues. The order of the weightiness of the factors is as Ç3>O1>Ç1>O3>O4>O2>Ç2>T2>T3>T4>T1>T5.

6. Conclusion

Survey applications are methods that are frequently used in scientific research. Today, there are many options for performing survey applications, such as internet, telephone, face to face, etc. However, no matter the survey's technique, the data obtained are collected in a center; the researcher or research groups in that center transform the data into information and share the result with the public. Due to this centralized structure, data is open to security threats and data abuse. Because of that, the confidence reduces in the research done.

In this study, we investigated blockchain technology, which has been researched in various application areas since the day it emerged, for survey systems. Firstly, we compared blockchain-based survey systems and central survey systems by using swot analysis. Then we researched what kind of blockchain system would be suitable for surveys. After that, we presented a blockchain-based survey architecture, and we compared the questionnaires made with the traditional methods in terms of transparency with the questionnaire system we proposed in the case study. Finally, we investigated and prioritized the obstacles to the implementation of this system.

As a result of the swot analysis, it was understood that blockchain-based survey systems are advantageous over central designs in terms of user privacy, transparency, and security. Following, we used an algorithm frequently used in the literature to investigate whether blockchain technology is suitable for survey systems and what kind of blockchain system would be suitable. We concluded that a private blockchain architecture would be ideal for survey systems, in which some users have access to all data, and some have access to limited data.

After concluding that blockchain technology would suit survey systems, we proposed a blockchain-based system architecture to be used in scientific research, in which universities assume the role of miners. In this system, we suggest, besides providing user privacy, transparency, security, and reliability, a shared database is also created for academics.

We used the CNN transparency index to prove the effectiveness of the proposed architecture in terms of transparency. Based on the study evaluating the pre-election surveys conducted in Turkey between 2011-2019, we sought an answer to how the transparency of the research would change if these surveys were conducted with a blockchain-based system. As a result, we showed that the transparency scores of the surveys increased between 24.36% and 132.38% if they were conducted via a blockchain-based survey system.

We identified the obstacles to realizing this proposed system through a literature review within the framework of the technology-organization-environment theorem. We identified twelve barriers, five technological, four organizational, and three environmental.

Then, using the Fuzzy Dematel method, we showed the relationship between these barriers and their weightiness. As a result of the evaluation of the relationship matrices, which were formed according to the evaluation of four experts in the field, it was determined that the biggest problem to be overcome was the hesitation in transitioning to new systems. In addition, it was understood that six obstacles were influencing factors, and their resolution would affect the other six factors.

We aim to carry out studies to implement this system we propose in the future and then expand the scope of the study to create a national blockchain-based e-voting system.

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8. Attachments

8.1 CNN Transparency Index Categories and Scoring

Category	Score	Criterion
1. The company that made the survey	0	10 years or less experience
	1	More than 10 years of experience
	0	Not a member of a transparency initiative
	1	Member of a transparency initiative
	0	Previous performance is not within top 20
	1	Previous performance is within top 20
2. Survey Mode	0	CATI, mixed, web survey
	1	Unreported
	2	Face-to-face
	3	Face-to-face in households
3. Sponsor	0	Political party, candidate
	1	Unreported
	2	Other sources (newspapers etc.)
	3	Pollster's own financial sources
4. Sample Size	0	1000 or less
	1	1000-1500, or unreported
	2	1500-2400
	3	2400 or more
5. Language	1	Unreported
6. Survey Questions	0	Unusual wording (e.g., will you vote for party X?)
	1	Unreported
	2	Intended vote
	3	Multiple questions
7.Survey Date	0	Unreported
	1	Without sufficient detail (e.g., in June)
	2	Without sufficient detail (e.g., end of June)
	3	Sufficiently detailed (e.g., between June 3, 2019 and June 6, 2019)
8. Sampling Method & Frame	0	Non-probabilistic or unreported
	1	Defined sampling frame, no sampling method
	2	Probabilistic, no information on the sampling frame
	3	Probabilistic, defined sampling frame
9. Quota Variables	0	0Quota sampling
	1	Unreported
	2	s used in within household selection of respondents, addresses selected ranc
	3	Probabilistic sample
10. Target Population and Representation	0	Unreported
	1	TP missing, defined source (missing mode) or TP is defined (non-F2F)
	2	TP missing, defined source (F2F) or both defined (missing mode)
	3	Defined TP and sampling source (F2F)
11. Cellphone Rate	0	Unreported
	1	Only rates or numbers of mobile and landline phones
	2	Rates or numbers from multiple operators and landline phones
	3	Rates or numbers from all operators and landline phones
12. Callbacks	1	Unreported
13. Verification	1	Unreported
14. Survey Error	0	Misused
	1	Reported, missing sampling method
	2	Probabilistic, margin of error is more than 2 points
	3	Probabilistic, margin of error is less than or equal to 2 points
15. Weighting	0	Unreported
	1	Weighted without explanation
	2	Weighted with insufficient detail (e.g., demographic variables are used)
	3	Weighted with sufficient detail
16. Minimum Subset Size	1	Unreported

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8.2 Pairwise comparison matrix sent by experts

	T1	T2	T3	T4	T5	O1	O2	O3	O4	Ç1	Ç2	Ç3
T1	0	1	3	0	0	2	2	4	4	4	4	4
T2	1	0	4	0	0	4	4	4	3	4	0	4
T3	3	4	0	0	0	3	4	4	3	3	2	3
T4	0	0	0	0	4	2	0	2	2	4	4	4
T5	0	0	0	4	0	4	0	2	3	4	4	4
O1	2	4	3	2	4	0	4	4	4	3	4	4
O2	2	4	4	0	0	4	0	4	2	4	2	4
O3	4	4	4	2	2	4	4	0	4	2	3	4
O4	4	3	3	2	3	4	2	4	0	0	3	3
Ç1	4	4	3	4	4	3	4	2	0	0	4	4
Ç2	4	0	2	4	4	4	2	3	3	4	0	4
Ç3	4	4	3	4	4	4	4	4	3	4	4	0

	T1	T2	T3	T4	T5	O1	O2	O3	O4	Ç1	Ç2	Ç3
T1	0	0	0	1	0	3	1	0	1	1	1	0
T2	0	0	4	0	0	3	3	3	2	3	2	3
T3	0	4	0	0	0	2	3	3	2	2	0	3
T4	1	0	0	0	1	1	0	0	0	0	0	2
T5	0	0	0	1	0	2	0	1	0	4	2	2
O1	3	3	2	1	2	0	4	3	3	1	1	2
O2	1	3	3	0	0	4	0	3	3	3	1	3
O3	0	3	3	0	1	3	3	0	3	3	1	4
O4	1	2	2	0	0	3	3	3	0	1	3	4
Ç1	1	3	2	0	4	1	3	3	1	0	2	4
Ç2	1	2	0	0	2	1	1	1	3	2	0	3
Ç3	0	3	3	2	2	2	3	4	4	4	3	0

	T1	T2	T3	T4	T5	O1	O2	O3	O4	Ç1	Ç2	Ç3
T1	0	2	0	0	3	2	0	0	1	0	0	0
T2	2	0	4	0	0	0	1	1	3	0	0	1
T3	0	4	0	0	0	0	0	1	1	1	0	2
T4	4	0	0	0	1	4	3	2	3	2	2	3
T5	3	0	0	1	0	0	0	0	1	1	0	1
O1	2	0	0	4	0	0	1	3	3	4	2	3
O2	0	1	0	3	0	1	0	3	3	4	2	4
O3	0	1	1	2	0	3	3	0	1	4	2	4
O4	1	3	1	3	1	3	3	1	0	0	1	0
Ç1	0	0	1	2	1	4	4	4	0	0	1	4
Ç2	0	0	0	2	0	2	2	2	1	1	0	3
Ç3	0	1	2	3	1	3	4	4	0	4	3	0

	T1	T2	T3	T4	T5	O1	O2	O3	O4	Ç1	Ç2	Ç3
T1	0	1	1	4	0	3	4	4	4	1	2	2
T2	1	0	1	4	0	4	1	4	4	4	4	4
T3	1	1	0	1	0	4	0	4	4	4	4	4
T4	4	4	1	0	4	4	0	1	4	4	4	4
T5	0	0	0	4	0	4	0	0	3	4	2	4
O1	3	4	4	4	4	0	4	3	4	4	4	4
O2	4	1	0	0	0	4	0	1	4	4	4	4
O3	4	4	4	1	0	3	1	0	4	4	4	4
O4	4	4	4	4	3	4	4	4	0	4	4	4
Ç1	1	4	4	4	4	4	4	4	4	0	4	4
Ç2	2	4	4	4	2	4	4	4	4	4	0	3
Ç3	2	4	4	4	4	4	4	4	4	4	3	0