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The Impact of Macroeconomic Variables on the Money and Capital Markets using a Multilevel Model with a Future Studies and Multi-Criteria Decision-Making Approach

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ABSTRACT

Objective: the purpose of this study is to develop a multilevel model for the impact of macroeconomic variables on the money and capital markets with a future research and multi-criteria decision making (MCDM) approach.

Method: this is an applied research conducted based on a descriptive survey design and a mixed method approach.

The research was conducted in the course of 2020-2022 through two main phases using VIKO method and ISM technique. The statistical population included professors and PhD students of accounting, financial management, economics, and business administration in Iran. Using purposive (selective) sampling, 15 people were selected as the respondents to an online survey using a questionnaire, which took place in the winter of 2020.

Findings: applying VIKOR method, 18 macroeconomic variables were selected. Next, based on the obtained data from the questionnair, the components were ranked using ISM technique. This ranking took place at six levels of the endvariables.

Conclusion: The results of the interpretive structural modeling showed that the eighteen variables, identified in the VIKOR phase, could be ranked into six levels where government spending, active population, and investment were at the first level, and oil revenues, granted banking facilities, and GDP at the sixth level.

Keywords: Macroeconomics; Money and capital markets; Interpretive Structural Modeling (ISM), Mixed approach; Applied research

1. Introduction

The world economy has so far experienced many positive and negative shocks in crude oil prices and exchange rates, giving rise to sharp fluctuations in global inflation rate. The direct and mediated shocks to macroeconomic variables poses a serious challenge to the countries worldwide, causing them to think of various measures for protection against the negative consequences thereof. In fact, oil-exporting economies rely heavily on oil as the major source of their export earnings, and their growth is highly dependent on imports of intermediate and finished goods from the industrial countries. As a result, they have a more volatile business cycle and are more exposed to crisis relative to other smaller open economies [1].

Oil revenues are crucial for the Iran's economy and have a major impact on the country's macroeconomics. The oil sector, with its huge scale of activities is the chief source of the government's earnings and reserves in foreign currencies and its financing. Thus, given the Iran's economic dependence on the oil foreign sales, an oil price shock has a significant impact on its growth and welfare. The sudden rise of oil price in 1973 drastically changed Iran's economy and significantly increased the share of the oil sector relative to the non-oil sectors of the economy. A characteristic of the oil-exporting countries, like other single product economies, is their high dependence on oil (single product) revenues, which makes them vulnerable to the periods of inflation and recession in the world economy. In most oil-exporting countries, all or a major part of the oil revenues are received by the government who injects them into the national economy through implementation of monetary and financial policies. Thus, the effect of oil revenues on the economies of oil-exporting countries is reflected in the public financial policy which defines the structure and composition of the public budget. Part of the government's oil revenues is converted into national currency by the central bank and used in the government budget, and the rest is kept net of the foreign assets in the central bank, which serves to raise the monetary base. The increase of liquidity causes the total demand curve to move upwards and raises the general level of prices, leading to an increase in government spending to meet the development needs of the country. These factors together raise the inflation rate. As domestic production grows at a slower rate than the aggregate demand in these countries, an increase in oil revenues and the value of national currency is normally expected to increase import. With import of additional intermediate and capital goods, it is meant to boost production and improve the state of supply, and thereby, to maintain economic growth [2].

Today, financial markets, especially capital markets, play an increasingly important role in emerging economies. Financial markets by providing the possibility for securities trading, on the one hand, make funds available to financing firms and on the other hand, provide attractive returns for buyers of these securities [3]. Considering the price dynamics and relatively high stock price volatility, investors often seek to reduce stock-related risks [4]. Financial system includes a network of financial markets in which different institutions, commercial and manufacturing firms, households, and government participate and regulate its operation. Banks and monetary institutions, which are considered as the economic institutions present in the monetary and financial system, in the course economic activity, seek to attract as much liquidity as possible in the form of deposits, and the channel the deposited funds and direct them to active economic areas such as commercial, service and manufacturing activities [5]. One of the most important macroeconomic indicators is focused on cash resources and spendings, a large portion of which is provided by deposited funds. Hence, depositors' decisions on the type and amount of deposits can have a significant effect on the volume of deposits and quality of banking resources. Bank loan facilities are also among the spendings, and changes in the amount of loans and facilities granted by banks may cause significant changes in the level of investment and production that carry the real weight of the economy [6].

In analysis of macro issues and understanding of the macroeconomic model, effectiveness and efficiency of national trade policies is of special importance. Any change in the level of the country's imports has a significant impact on the domestic production, growth and development process. Thus, adopting the right import policies is crucial for the economy, and a right strategy accounts for the factors that significantly contribute to import. The stability of macroeconomic variables such as GDP growth rate and changes in inflation rate and exchange rate are among such factors that account for the country's

(expected) amount of imports [1]. Inflation, among others, is an indicator of economic stability, whose rising signals economic instability. Inflation rate also adjusts bank's incentives for the amount of liquidity to be held, as a rising inflation rate undermines the real value of assets (not just cash, but the real rate of return on all assets), as well as the bank's earnings and profitability from the source of lending. According to Gallup (1994), the inflation-induced uncertainty and instability have two economic main effects: one is the change in future decision making that makes people and investors engage in activities other than what (initially) intended, and another is the change in previously made decisions (e.g. leaving current projects unfinished or even altering them), if inflation rate varies (deviates) from the estimated one [7].

This study using a multilevel model seeks to explore the effect of major macroeconomic factors on the functioning of the country's money and capital markets and give more insight into the national economic policymaking, given the critical state of our economy that for decades has been experiencing international economic and financial sanctions.

The remainder of this paper is organized as follows. Section 2 gives an overview of the research literature and background. Section 3 describes the research methodology. Section 4 discusses the research findings in the VIKOR and ISM phases of analysis. The last section, discussion and conclusion, summarizes the results and their general implications and discusses the final output of the ISM analysis.

2. Theoretical framework and research background

We divide financial markets into money and capital markets. Banks are among the major institutions in the money market. The money market is a market that mostly operates on short-term financial products such as money and certain types of credits, deposits, and loans. Domestic investments are made either in the stock exchange or in the field of activity by the company itself [8]. Probably, the most important issue in finance and investment is efficiency of the capital market in allocation of economic resources and handling of information. Other interrelated and overlapping topics in the financial theory, such as volatility, predictability, speculation, and anomalies, are as well relevant to the capital market performance. The empirical evidence from the countless testings of these topics by Pesaran and Wickens in 1999 are applied to support or discard the idea of capital market efficiency. The concept of capital market efficiency assumes that all available relevant information is reflected in the stock prices, making it impossible to consistently outperform the market [9]. The capital market whose chief function is allocation of financial resources [10] serves as a major investment venue to attract capital, where individual and institutional investors make a selection of their favorite equities, given their expected risk and returns. Thus, capital markets should provide the necessary efficiency in order to attract investors and adequate financial resources and thereby achieve optimal allocation of resources and realize greater returns [11]. In order for the capital market to achieve efficiency, it is necessary that fluctuations in the market are created in a logical way and based on the fundamental factors. According to the efficient market hypothesis (EMH), changes in fundamental value lead to fluctuations in asset prices. However, researchers have found that, significant changes in asset prices do not necessarily correspond to a (real) change in the fundamentals [12].

The growth and development of the capital market, as one of the chief constituents of a market economy, requires an efficient risk management system. In the competitive business environment of today, development of the capital market more than ever before necessitates presence of an integrated risk management system and risk-based analysis of investments that allows investors (both legal and real persons) to adopt right investment strategies and orientations by which they are distinguished from each other [13].

The complex and rapid developments in the world today present a serious challenge to a significant part of our capital market, underscoring sustainable competitive advantage and the capital market stability as two main concerns of the country. Achieving such a competitive advantage requires building new knowledge on risk-based management and establishing a risk management system in organizations or institutions operating in the capital market. Considering the large extent of the private sector in the country following the implementation of the policies conform to Article 44 of the Constitutional Law (promotion of ownership in the public domain to ensure social justice ...), the grasp of continuous risk

management is the key for individual investors and private enterprises who seek a sustainable competitive advantage. In addition, in presence of efficient financial systems, investors, by analyzing information on new investment opportunities, combining and equipping micro-savings, monitoring investments and managing risk in the capital market, as well as reducing transaction costs, can lead to optimal allocation of financial resources and eventually help the capital market reach high levels of efficiency and effectiveness [14].

An efficient capital market is vital and crucial for economic development. With an efficient capital market, financial resources are allocated economically. An efficient capital market also encourages individuals to invest in stocks and helps company managers maximize shareholder wealth [15]. Eugene F. Fama, in his 1970 major work, Efficient capital markets: A review of theory and empirical work, expounds the notion of efficient markets. Fama assumes that in the market, there is no opportunity for a single investor to outperform the market until when all available information are ex ante reflected in stock prices. Capital market efficiency has been one of the major research topics in the past decades, a trend which still persists. Capital market efficiency can be influenced by the capacity and ability of traders in collecting and disseminating information. More efficient capital markets will attract more investors, increasing market liquidity. Capital market efficiency is important for investors as their assets and wealth depend on stock price changes [16]. In general, capital market efficiency affects spending on consumption and investment and thereby, overall performance of the economy. Efficient market hypothesis suggests that price changes in the stock market follow a random walk pattern. This means that stock price are not predictable since the daily stock price reflects the real-time information announced on the same day. Put differently, since the news disseminated through the market is unpredictable, stock price that reflects such unpredictable news behaves randomly. It further assumes that current price reflects available information about the firm's future profitability (in terms of present value) [17]. When new information enters the market, stock prices are immediately adjusted to the information received and accordingly corrected. Therefore, market participants cannot use the available information to obtain abnormal excess return. Capital market efficiency, further, assumes a positive relationship between expected stock returns and their systematic risks.

Study of the relationship between macroeconomic variables, i.e. exchange rate, trade balance, inflation, liquidity, interest rates, tax rates, economic growth, GDP, oil prices, and investment, in money and capital markets settings, has been always of special importance in the literature.

3. Methodology

This is applied research with a mixed method approach conducted through a descriptive design in the course of 2020-2021. For qualitative and quantitative data analysis, interpretive structural modeling (ISM) was used.

The statistical population included the university professors and PhD students in accounting, financial management, economics, and business administration across the country. Of this population, using purposive sampling, 15 people were selected as the respondents to an online survey using a questionnaire (designed by the advising professor), which took place in the winter of 2020. The sample size of 15 is within the range of 10-25 normally applied in ISM analyses.

To begin with, through an extensive and systematic search in the extant literature, 23 macroeconomic variables were extracted as the most relevant.

The study was conducted in two phases. In the first phase, using VIKOR method, 18 of the 23 macroeconomic variables which had been derived from the literature were proposed as the most important and consequential.

In the second phase, using the interpretive structural modeling (ISM) technique, the model's components were rated based on the data provided by the sample respondents in a questionnaire developed for this purpose.

Findings

Part 1: VIKOR method

In this phase, VIKOR method was used to identify the most important macroeconomic variables. First of all, a decision matrix composed of 23 macroeconomic variables was set up. This matrix was then worked out through several mathematical steps as follows:

Step 1. descale the decision matrix
In this step, the criteria with different dimensions were converted into dimensionless criteria. The obtained matrix hereby, matrix F, is defined as follows:

$$F = [f_{11} \quad \cdots \quad f_{in} \quad \vdots \quad \cdots \quad \cdots \quad f_{m1} \quad \cdots \quad f_{mn} \quad]$$

In this matrix:

$$f_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} \quad x_{ij}^2}}$$

Step 2. Determine the weight vector of the criteria

In this step, given the coefficients assigned to different criteria in the decision matrix, the weight vector was defined as follows:

$$w = [w_1 , w_2 , \dots , w_n]$$

Step 3. Determine the best and worst values from among the exiting values for each criterion

The best (f_j^*) values for the positive and negative criteria are calculated from the following equations, respectively:

$$f_j^* = max_i \;\; f_{ij}$$
$$f_j^* = min_i \;\; f_{ij}$$

In these equations, f_j^* is the best value of the criterion j among all alternatives and f_j^- the worst value of the criterion j among all alternatives.

Step 4. Compute the value of utility (S) and the value of regret (R)

The values of S and R are computed by the following equations:

$$S_i = \sum_{j=1}^{n} \quad W_j \frac{f_j^* - f_{ij}}{f_j^* - f_j^-}$$

$$R_i = Max \left\{ W_j \frac{f_j^* - f_{ij}}{f_j^* - f_j^-} \right\}$$

In which W_j is the desired weight value for criterion j.

In the compromise planning method, if the parameter P is equal to ∞, the same value R_i is obtained:

$$L_\infty(A_i) = Max \left[W_j \left(\frac{f_j^* - f_{ij}}{f_j^* - f_j^-} \right) \right] = R_i$$

Step 5. Calculate the VIKOR index (Q value)

The value of Q is computed by the following equation:

$$Q_i = v \left[\frac{S_i - S^-}{S^* - S^-} \right] + (1 - V) \left[\frac{R_i - R^-}{R^* - R^-} \right]$$

$$S^- = Min\, S_i \qquad S^* = Max S_i \qquad R^-$$
$$= Min R_i \qquad R^*$$
$$= Max R_i$$

In this relation:
$\frac{S_i - S^-}{S^* - S^-}$ indicates the rate of difference from the ideal solution and $\frac{R_i - R^-}{R^* - R^-}$ the rate of difference from the counter-ideal solution and the parameter v is chosen according to the degree of compromise among the decision making group. In case of high compromise, its value is greater than 0.5, in case of compromise with the majority of votes, its value is equal to 0.5, and in case of low compromise, its value is less than 0.5. The value of Q is a function of S_i and R_i, themselves indicating the amount of distance from the ideal solution for P = 1 and P = ∞, respectively, in compromise planning.

Step 6. Sort the alternatives by the values of R, S and Q.
In this step, the alternatives are sorted into three groups according to the values R, S and Q, where they are ranked from smaller to bigger values. The alternative that is ranked best in all three groups of R, S, and Q is proposed as the best alternative.

It should be noted that in group Q the alternative is ranked best, if the following two conditions are satisfied:
Condition 1. If the alternatives A_1 and A_2 are the first and second best alternatives in the group and n is the number of alternatives, the following relation holds:

$$Q(A_2) - Q(A_1) \geq \frac{1}{n-1}$$

Condition 2. The alternative A_1 is ranked best in at least one of the groups R and S.
If the first condition does not hold, the following set of alternatives are proposed as the best alternatives:

Best alternatives = $A_1, A_2, \ldots, A_m$

The maximum value of m is calculated by the following relation:

$$Q(A_m) - Q(A_1) < \frac{1}{n-1}$$

When the second condition does not hold, the two alternatives A_1 and A_2 are proposed as the best alternatives.
According to the VIKOR results for identification and ranking of the macroeconomic variables (table 1), 18 variables were eventually selected as the most important factors.

Table 1. Ranking of the macroeconomic variables by VIKOR

Rank	Variable	Rank	Variable	Rank	Variable
1st	Exchange rate	7th	Oil revenues	13th	Investment
2nd	Inflation rate	8th	Government spending	14th	Price index of imported goods
3rd	Interest rate	9th	Tax revenues	15th	Budget deficit
4th	GDP	10th	Money supply	16th	Government debt to central bank
5th	Unemployment rate	11th	Active population	17th	Granted banking facilities
6th	Stock price index	12th	Expected inflation	18th	Savings

Part 2: Interpretive Structural Modeling (ISM)

In the next stage, the selected macroeconomic variables were level partitioned. The various stages that include the ISM technique are explained below [18]:

1. Formation of Structural Self-Interactive Matrix (SSIM)

In this step, the experts consider the criteria in pairs relative to each other and answer the pair comparisons. That is, in each comparison, the two criteria use the letters V, A, X, O defined as follows:
V: the element of row i helps achieve the element of column j; A: the element of column j helps achieve the element of row i;
X: the elements i and j help achieve each other;
O: there is no relationship between i and j.

2. Obtaining the initial reachability matrix

The SSIM is converted into a binary matrix called the initial reachability matrix by substituting symbols used to denote direction of relationship, i.e. V, A, X, O, by 1 and 0.

> If (i , j) entry in the SSIM is V, then, (i , j) entry in the reachability matrix becomes 1 and the (j , i) entry becomes 0
> If (i , j) entry in the SSIM is A, then, (i , j) entry in the reachability matrix becomes 0 and the (j , i) entry becomes 1
> If (i , j) entry in the SSIM is X, then, both (i , j) and (j , i) entries in the reachability matrix become 1.
> If (i , j) entry in the SSIM is O, then, both (i , j) and (j , i) entries in the reachability matrix become 0.

3. Checking the reachability matrix for transitivity

The initial reachability matrix is checked to see if i , j = 1; j , k = 1; then i , k = 1. Transitivity is the basic assumption in ISM, which states that if variable i is related to j and j is related to k, then i is necessarily related to k.

4. Level partitioning of reachability matrix

Partitioning of the reachability matrix into different levels on the basis of reachability and antecedents sets for each variable through iterations called level partitioning. Here, the variable has the highest level that its output (reachability) set is equal to its input (antecedent) set. Once identified, the row and column of the variable(s) are removed from the table and this operation is repeated for other variables.

5. Graphing the network of interactions

In this step, given the levels of variables (criteria) in ISM and the relationships between them, the interaction network is set up. Level one is selected as the most dependent and the last level as the strongest driving power.

ISM takes the following steps:

Step 1. Setting up structural self-interaction matrix

To obtain this matrix, a table, outlined as table 2, was presented to the experts and they were asked to indicate the type of the mutual relationship between the variables based on the the introduced symbols (O, X, A and V). The structural self-interaction matrix is made up of research variables which are compared using four modes of conceptual relationships. This matrix was completed by experts of the core process. The obtained information was summed up according to the ISM logic and the final structural self-interaction matrix (SSIM) was set up. The ISM logic acts in frequencies by a nonparametric and modular pattern. The symbols used in this method are presented in table 2.

Using the symbols in the table above, the pattern of causal relationships between variables was determined whereby the SSIM is formed (see tables 3 and 4).

Table 2. Used Symbols for SSIM

V	A	X	O
Variable i has an effect on variable j	Variable j has an effect on variable i	Two-way relationship between i and j	No relationship between i and j

Table 3. Identified codes for research variables

Rank	Variable	Rank	Variable	Rank	Variable
A	Exchange rate	G	Oil revenues	M	Investment
B	Inflation rate	H	Government spending	N	Price index of imported goods
C	Interest rate	I	Tax revenues	O	Budget deficit
D	GDP	J	Money volume	P	Government debt to central bank
E	Unemployment rate	K	Active population	Q	Granted banking facilities
F	Stock price index	L	Expected inflation	R	Savings

Table 4. Structural Self-Interactive Matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	-	V	V	O	V	O	A	X	O	A	O	O	V	O	V	A	O	X
2		-	A	O	O	A	O	O	A	O	O	A	O	O	X	O	O	V
3			-	O	V	A	O	V	V	V	O	A	O	O	A	O	A	A
4				-	O	O	V	O	V	O	V	O	V	V	V	O	O	X
5					-	O	O	A	O	O	O	O	V	O	O	X	O	O
6						-	V	O	O	X	V	V	O	V	V	O	X	A
7							-	O	O	X	O	X	O	X	O	O	V	V
8								-	V	V	A	A	O	X	X	A	O	O
9									-	O	O	X	O	V	V	O	O	O
10										-	X	A	O	V	V	V	A	A
11											-	A	A	A	A	O	V	O
12												-	A	A	O	X	O	O
13													-	A	O	A	A	A
14														-	O	O	O	X
15															-	O	O	V
16																-	X	O
17																	-	V
18																		-

Step 2. Setting up the initial reachability matrix

In the second step, the initial matrix is formed by transcribing the cells in the SSIM into zero and one. This is done according to the following rule:

> If the symbol of the cell ij is the letter V, the cell takes the value 1 and the corresponding cell the value 0.

> If the symbol of the cell ij is the letter A, the cell takes the value 0 and the corresponding cell the value 1.

> If the symbol of the cell ij is the letter X, both that cell and the corresponding cell take the value 1.

> If the symbol of the cell ij is the letter O, both that cell and the corresponding cell take the value 0.

Step 3: setting up the transitive initial reachability matrix

Once the initial reachability matrix has been obtained, its internal transitivity must be established. For example, if variable 1 leads to variable 2 and variable 2 to variable 3, then variable 1 must also lead to variable 3. If this condition does not exists in the reachability matrix, the matrix is modified to afford such relationships. This transitivity is added to the initial reachability matrix using secondary relationships that may not exist. In Table 6, the cells with 1 refer to the relationships that have been created in the transitive matrix.

Table 5. Initial reachability matrix

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
A	1	1	1	0	1	0	0	1	0	0	0	0	1	0	1	0	0	1
B	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
C	0	0	1	0	1	0	0	1	1	1	0	0	0	0	1	0	0	0
D	0	0	0	1	0	0	1	0	1	0	1	0	1	1	1	0	0	1
E	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0
F	0	1	1	0	0	1	1	0	0	1	1	1	0	1	1	0	1	0
G	1	0	0	0	0	0	1	0	0	1	0	1	0	1	0	0	1	1
H	1	0	0	0	1	0	0	1	1	1	0	0	0	1	1	0	0	0
I	0	1	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0	0
J	1	0	0	0	0	1	1	0	0	1	1	0	0	1	1	1	0	0
K	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	1	0
L	0	1	1	0	0	0	1	1	1	1	1	1	0	0	0	1	0	0
M	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0
N	0	0	0	0	0	0	1	1	0	0	1	1	1	1	0	0	0	1
O	0	1	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	1
P	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	1	1	0
Q	0	0	1	0	0	1	0	0	0	1	0	0	1	0	0	1	1	1
R	1	0	1	1	0	1	0	0	0	1	0	0	1	1	0	0	0	1

Table 6. Initial reachability matrix made transitive

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
A	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1
B	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	0	0	1
C	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1
D	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	0	1	1
E	1	0	0	0	1	0	0	1	0	0	1	1	1	0	0	1	1	0
F	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
G	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
H	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	0	1
I	0	1	1	0	0	0	1	1	1	1	1	1	1	1	1	1	0	1
J	1	1	1	0	1	1	1	1	0	1	1	1	1	1	1	1	1	1
K	1	0	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1
L	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
M	0	1	1	0	0	0	1	1	1	1	1	1	1	0	0	1	1	0
N	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
O	1	1	1	1	1	1	0	1	1	1	1	0	1	1	1	0	1	1
P	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Q	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
R	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Step 4: level partitioning of the factors

In this step, we compute the input (antecedents) and output (reachability) sets for each variable (criterion) and then specify the common factors. Here, the criterion has the highest level that its output (reachability) set is equal to its common set. Once identified, the row and column of the variable are removed from the tables and this operation is repeated for other variables. The inputs and outputs are extracted from the transitive initial matrix (Table 6) in which the number of ones in each row corresponds to the output and the number of ones in each column corresponds to the input. The results of the level partitioning are reported in table 7.

Part Three: MICMAC Analysis

MICMAC software comprises four main matrices: matrix of direct impact (MDI), matrix of potential direct impact (MPDI), matrix of indirect impact (MII), and matrix of potential indirect impact (MPII). In MICMAC, the matrices of direct impact and potential direct impact are considered as input elements, and the two matrices of indirect impact and potential indirect impact present the obtained results from the analyses (output) to be interpreted. The first output of this matrix, as presented in Table (8), concerns the general properties of the understudy matrix.

Table 7. Level partitioning of macroeconomic variables

Sign	Row	Level	Sign	Row	Level
A	Exchange rate	5th	J	Money supply	3rd
B	Inflation rate	3rd	K	Active population	1st
C	Interest rate	3rd	L	Expected inflation	4th
D	GDP	6th	M	Investment	1st
E	Unemployment rate	2nd	N	Price index import	3rd
F	Stock price index	5th	O	Budget deficit	3rd
G	Oil revenues	6th	P	Government debt to central bank	4th
H	Government spending	1st	Q	Granted banking facilities	6th
I	Tax revenues	4th	R	Savings	3rd

Table 8. General properties of the understudy matrix

Matrix size	18
Number of repetition	2
Number of zeros	167
Number of ones	59
Number of twos	69
Number of threes	29
Number of Ps	0
Total sum	157
Ratio of filled cells	48.45679%

In the following, the four main matrices, as the output of MICMAC, are analyzed.

The first step of MICMAC analysis: the matrix of direct impact (MDI)

This matrix includes the structural variables of the system (model) that fill the columns and rows of the respective table. This matrix describes the direct relationships that exist between the variables in a system (model). Another output of MICMAC software in this section is the matrix sum table in which to each variable two values are assigned: one pertains to the column sum and another to the row sum. The row sum gives the variable's degree of influence and the column sum the variable's degree of dependence. Table 9 presents the matrix sum of the direct impact of the variables.

In this table, the variable money supply is ranked first in terms of the degree of impact and dependence, given its degree of impact (20) and its degree of dependence (25). Other rankings within the MDI

involving impact and dependency are presented in table 10.

Another MICMAC output for the MDI step is system (model) stability. Here, the standard number of rotations to achieve system stability is two. In the first rotation, the system's degree of impact was 88% and the system's degree of dependence was 95%. In the second rotation, both its degree of impact and dependence%equally amounted to 105%. The results hereof are summarized in Table 11.

Table 9. The matrix sum of the direct impact

Row	Research variables	Row sum of variables	Column sum of variables
1	Exchange rate	19	20
2	Inflation rate	12	12
3	Interest rate	16	16
4	GDP	15	0
5	Unemployment rate	11	18
6	Stock price index	18	19
7	Oil revenues	18	16
8	Government spending	19	21
9	Tax revenues	19	12
10	Money volume	20	25
11	Active population	18	13
12	Expected inflation	14	19
13	Investment	15	10
14	Price index import	15	24
15	Budget deficit	13	15
16	Government debt to central bank	13	8
17	Granted banking facilities	10	15
18	Savings	19	21

Table 10. Ranking of impact and dependence in MDI

Row	Research variables	Impact	Dependence
1	Exchange rate	Second	Fourth
2	Inflation rate	Eighth	Tenth
3	Interest rate	Fourth	Seventh
4	GDP	Fifth	Thirteenth
5	Unemployment rate	Ninth	Sixth
6	Stock price index	Third	Fifth
7	Oil revenues	Third	Seventh
8	Government spending	Second	Third
9	Tax revenues	Second	Tenth
10	Money supply	First	First
11	Active population	Third	Ninth
12	Expected inflation	Sixth	Fifth
13	Investment	Fifth	Eleventh
14	Price index import	Fifth	Second
15	Budget deficit	Seventh	Eighth
16	Government debt to central bank	Seventh	Twelfth
17	Granted banking facilities	Tenth	Eighth
18	Savings	Second	Third

Table 11. System stability in MDI

Row	Rotation	Impact	Dependence
1	First	88 percent	95 percent
2	Second	105 percent	105 percent

The MICMAC chart involves four variables: influential variables, dichotomous variables, dependent variables, and independent variables. The first section includes influential variables which are characterized as follows:

> These variables are with a more and less driving power;

> These variables are displayed in the northwest section of the chart;

> Influential variables are the most critical components of the system;

> These variables are considered as system input variables;

> Environmental variables are generally found among these variables; and

> These variables are generally not controllable by the system.

The second section includes dichotomous variables with the following properties:

> These variables simultaneously act as both highly dependent and highly influential;

> These variables are displayed in the northeast section of the chart;

> The nature of these variables is mixed with instability; and

> These variables are divided into two categories of risk variables and criterion variables.

The third section includes dependent variables with the following properties:

> The dependent variables find themselves in the southeast section of the graph;

> They have a low degree of influence and very high degree of dependence;

> They are very sensitive to the evolvement of influential and dichotomous variables; and

> They serve as the system output.

Section 4 contains independent or exceptional variables with the following attributes:

> They neither are affected by other system variables nor affect them;

> They are located in the southern part of the graph and have a very little relationship with the system;

> They do not stop a main variable, nor they cause a variable to evolve and progress in the system; and

> They are of two categories: discontinuous and regulatory variables.

The analysis of the graph's four sections indicated the dichotomous variables as the key strategic variables. These variables can be manipulated and can affect the system's dynamics and changes. These variables exert a high influence and are not controllable.

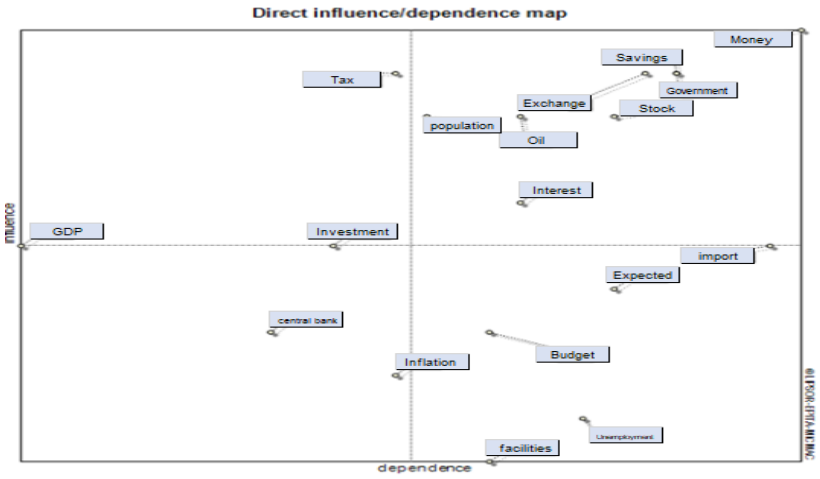

Figure 1. The degree of influence and dependence on MDI map

According to the results of the MICMAC chart analysis, the direct impact of the variable government debt to central bank was located in the section of independent variables. The variables tax revenues, GDP and investment were located in the section of influential variables. The variables inflation rate, granted banking facilities, unemployment rate, budget deficit, expected inflation and price index of imported goods were located in the section of dependent variables. Finally, the variables exchange rate, interest rate, stock price index, oil revenues, government spending, money supply, active population and savings were identified as dichotomous variables.

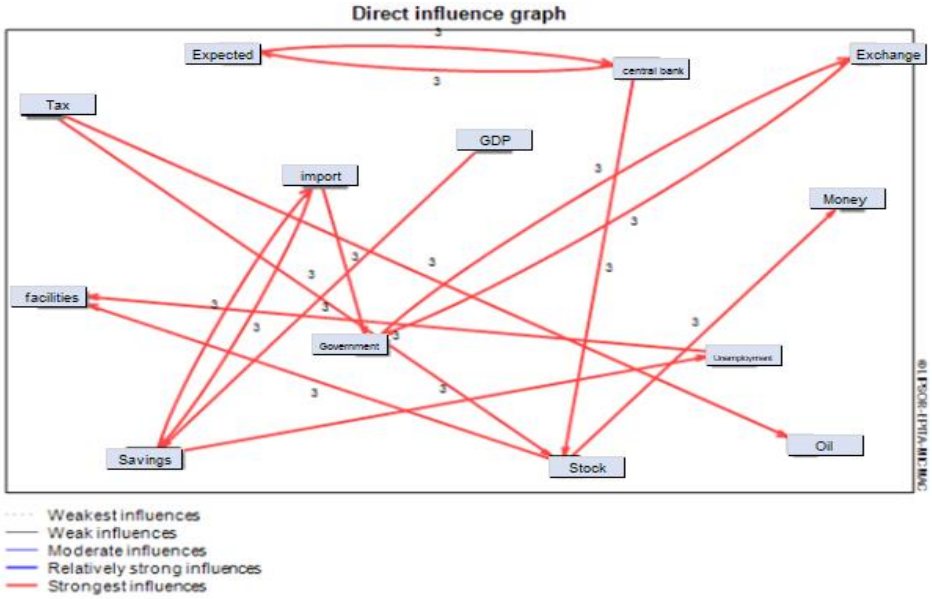

Figure 2. The degree of direct influence and dependence in MDI chart

MICMAC Analysis Step 2: matrix of indirect impact (MII)

The matrix of indirect impact corresponds to the matrix of direct impact which is strengthened through successive iterations. A researcher in any research work can define a number of iterations and consider them for maximum stability of the system. If the researcher does not consider a specific number of iterations, MICMAC software will show by default the number of iterations required to achieve stability. The latent variables are detected from multiplying the applied matrix by the indirect classification. In this section of the MICMAC output, the matrix multiplication table is in the classification where for each variable two values are provided: one is the column sum and another the row sum. The row sum gives the degree of the indirect impact of the variables and the column sum the degree of indirect dependence of the related variables. The output of this stage of MICMAC analysis is presented in table 12.

According to the results in the above table, the money supply variable is ranked first in terms of the degree of influence and dependence, with an impact degree of 5266 and a dependence degree of 6204. Other rankings of influence and dependence are presented in Table (13).

According to the obtained results from this part of the MII analysis, the variables government debt to the central bank and investment are located in the section of independent variables, GDP in the section of influence variables, inflation rate, banking facilities, unemployment rate, budget deficit, and expected inflation in the section of dependent variables, and finally, the variables tax revenues, interest rates, price index of imported goods, active population, oil revenues, savings, exchange rate, government spending, stock price index, and money supply in the section of dichotomous variables.

Table 12. Matrix sum of the indirect influence

Row	Research variables	Influence (%)	Dependence (%)
1	Exchange rate	4786	5516
2	Inflation rate	3165	3763
3	Interest rate	4170	4713
4	GDP	4122	0
5	Unemployment rate	2679	4612
6	Stock price index	4606	4026
7	Oil revenues	4530	3787
8	Government spending	5069	5693
9	Tax revenues	4802	3620
10	Money supply	5266	6204
11	Active participation	4515	3779
12	Expected inflation	3572	4127
13	Investment	3782	2295
14	Price index import	4150	5999
15	Budget deficit	3698	4390
16	Government debt to central bank	3566	2356
17	Granted banking facilities	2797	3967
18	Savings	4588	5016

Table 13. Ranking of influence and dependence in MII matrix

Row	Research variables	Rank of Influence	Rank of dependence
1	Exchange rate	4th	4th
2	Inflation rate	16th	14th
3	Interest rate	9th	6th
4	GDP	12th	18th
5	Unemployment rate	18th	7th
6	Stock price index	5th	10th
7	Oil revenues	7th	12th
8	Government spending	2nd	3rd
9	Tax revenues	3rd	15th
10	Money supply	1st	1st
11	Active participation	8th	13th
12	Expected inflation	14th	9th
13	Investment	12th	17th
14	Price index import	10th	2nd
15	Budget deficit	13th	8th
16	Government debt to central bank	15th	16th
17	Granted banking facilities	17th	11th
18	Savings	6th	5th

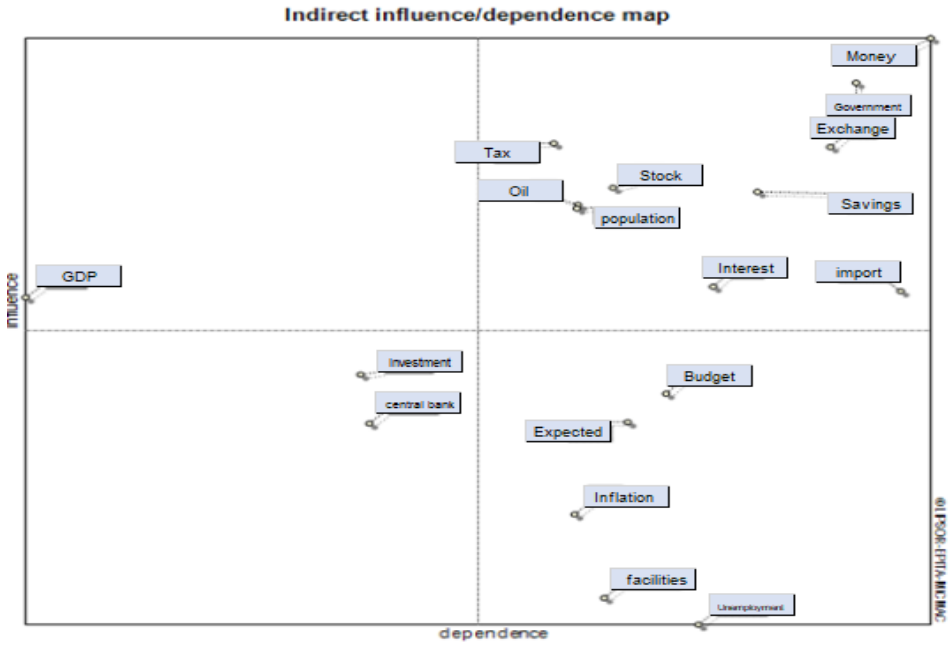

Figure 3. The degree of influence and dependence in MII map

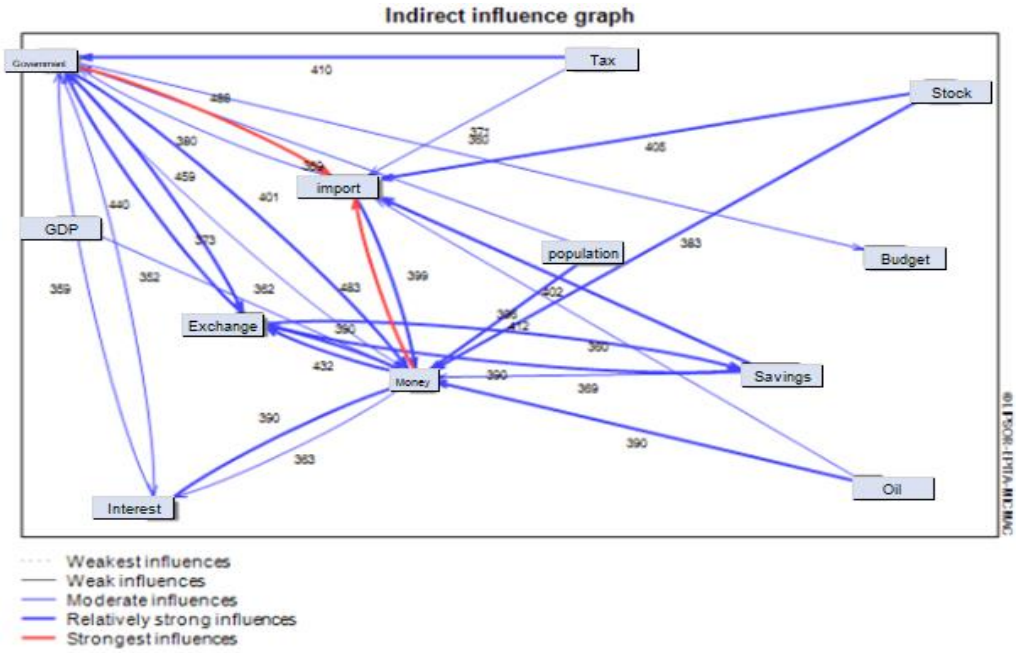

Figure 4. Influence and dependence relationships in MII map

Discussion and conclusion

In order to achieve its economic goals, each country adopts a special program in the framework of economic policies according to the specific economic-political and social conditions.

Macroeconomic studies involve Indicators such as GDP, unemployment rate and price indices and inflation rate. Using these indicators, one can understand how the economy works as a whole. They also develop models to explain and predict behavior of these factors in macro contexts. These models examine the relationships between such factors as income, spendings, consumption, unemployment, inflation, savings, investment, government expenditure, and international trade balance. These variables and factors generally form a class known as the set of macroeconomic indices. These indicators are divided into three categories: ahead of, lagging behind, and coinciding with the predicted capacity. By combining two or more of these factors, economists arrive at an analysis of economic orientations. Obviously, macroeconomics is focused on economic situation in general, while microeconomics studies the economic situation in terms of price and sales and production of goods and services at the the enterprise level. Both micro- and macroeconomic studies involve general theories that analyze events in the business and assess the buyer and market reactions and the trends in the money and capital markets.

Based on the final analysis and the evaluation of the ranking of the variables by MicMac, the variable money supply, the ranking of which is found to be the highest relative to other components as the most important macroeconomic component that affects the money and capital market. Considering that the most important role of the central bank is to maintain the value of the national currency, the effective implementation of which in all developed countries is ensured by ratification of the law of central bank independence from the government. Therefore, if the government can access the financial resources of the banks, especially in societies where there is no proper governance law, the country's economy will experience all sorts of crises, which may take several decades to correct. On the other hand, the central bank's tool of governance through monetary policy helps the growth and development of the country by maintaining the value of the national currency. Of course, in the growth and prosperity of the country, the government can also help in this matter by adopting financial policies along with the central bank.

Another factor of special importance, ranked second in this study, is government spending. The possible influence of government spending on economic growth is one of the well-known topics in the economic literature according to which the public sector is considered to play a major role in the process and flow of the country's economic cycle. Therefore, the use of such tools as government spending can be significant for attaining economic growth. From the microeconomic perspective, the government's actions and activities through legislation and administrative decisions as the governing instruments have an impact on the daily life and behavior of every individual in the society. Further, from the macroeconomic perspective, the government's economic policies are linked to issues such as resource allocation, economic stability, and distribution of income and wealth. Political measures of economic stabilization by the government can reduce the gap between the path of potential output and realized output and keep the realized output close to its potential level. In this regard, if the government spends a lot, it slows down the process of economic growth and faces problems. In other words, government spending imposes a net tax on the society, which is more than the corresponding benefits derived from it. Conversely, some government investment costs, especially investment in infrastructure, have a positive effect on growth. This is partly because these costs increase the return on private investments.

Tax revenues, ranked third in this study, are another factor. Different countries have different tax structures in the monetary and tax systems. In the tax system, this structure is different because of the difference in social preferences for public goods over private goods. Therefore, governments that seek to implement redistributive policies should apply a progressive personal income tax. On the other hand, other governments may apply less progressive taxes and look for proportional taxes such as consumption tax, sales tax or value added tax. Therefore, an efficient tax system can play an important role in the proper functioning of the economic system by influencing work motivation, consumption behavior, savings and investment. Therefore, in recent years, many debates have been raised about reforming the tax system based on the adopted structure and rates and its effect on the economy.

The exchange rate, ranked fourth, is also an important factor. There are serious and challenging issues regarding the effect of exchange rate fluctuations on the level of economic activities and other key economic variables. According to the theoretical framework and opinions of Keynesian economists, a decrease in the value of the national currency through a net increase in exports and an increase in total demand causes an increase in production. But this is only a necessary, and not sufficient, expansionary condition for reducing the (purchasing) power of the national currency. For example, a reduction in the value of the national currency has the effect of making imported inputs more expensive and can lead to a contraction of the supply curve of the entire economy. It can also reduce investment as an important part of total demand.

As to the stock price index which is ranked next, according to the results, the claim that economic variables such as inflation, liquidity, exchange rate, etc. are the driving force behind stock price changes has been acknowledged in theory. However, in the last decade, efforts have been made to empirically investigate and measure the assumed effects of these economic forces. Hence, the dynamic relationship between macroeconomic variables and stock returns has been subjected to extensive research. This research which was based on the theory that stock prices reflect the current value of the future cash flows of that stock indicated that economic variables affect both future cash flows and expected returns, and thereby the stock prices.

The variable savings, being ranked next in this study, is also found of high importance. According to the endogenous and exogenous growth models, the savings rate is considered an important factor in explaining the phenomenon of domestic economic growth, though not successful enough in explaining the income differences between countries. In endogenous growth models, the growth rate of per capita production is found to be a function of the knowledge production growth rate, and the knowledge production growth rate, in turn, a function of the amount of capital and labor used in research and development and the initial level of technology. Therefore, the level of savings needs to be increased in order to achieve continuous economic growth, and household savings by providing the necessary financial resources for investment make building of new capacities possible.

Oil revenues and its price fluctuation is another factor that ranks high. Fluctuations in oil prices directly affect the government's budget and expenditures. To investigate the effect of oil price on economic growth through this channel, it is necessary to examine the effect of public spending on economic growth. According to economists, public spending can have a positive or negative effect on economic growth. If government spending increases the productivity of the private sector, then under the conditions that the social benefit of this issue is greater than the opportunity cost of reducing the resources available to the private sector, it can be said that government spending has a positive effect on economic growth. But if the public sector expenditures are only in the form of consumption and non-productive expenditures, then due to the lower efficiency of the public sector compared to the private sector, it can be said that the production level will also decrease. In other words, the more public spending complements private sector spending, the higher the economic growth will be, and the more public spending replaces private sector spending, the less the economic growth will be.

Lastly, the variables from active population (ranked 8th) to unemployment rate (ranked 18th) are found to be of lesser importance, and therefore, not further discussed here.

In this study, the most important variables affecting the money and capital markets were identified. Based on the results of the ISM analysis in the 4th step, the multilevel model of the impact of macroeconomic factors on the money and financial markets was set up (see figure 5). This model was developed at six levels. Government spending, active population and investment at the first level are identified as the most influential variables, and oil revenues, banking system facilities, and GDP at the sixth level as the most influential variables.

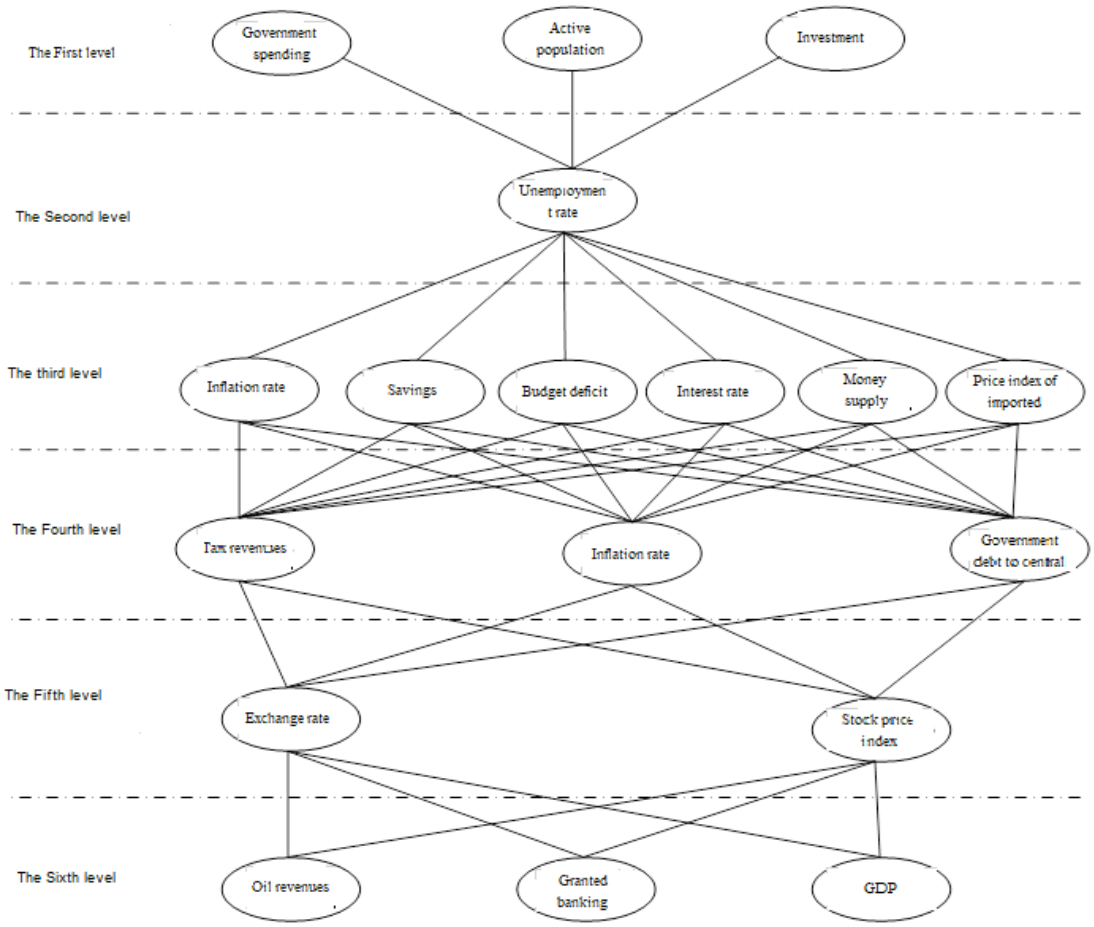

Figure 5. The multilevel model of the effect of macroeconomic variables on money and capital markets

Research limitations

This study, like any research, has its own limitations. As a compensation for the limitations of this study, we call for more studies hereon in the future by other complementary and alternative methods.

In this study, macroeconomic variables were identified using the VIKOR method. In future works, other multivariate decision-making methods such as ARAS and SORA can be used for identification of (other) macroeconomic variables and the results thereof can be compared with the findings of this study.

In this research, ISM technique was used in soft operations. In future work, this study can be reproduced, using methods such as fuzzy mapping and system dynamics, to provide further empirical support for the findings in this study.

Finally, since a large part of this research was carried out during the Corona pandemic, there was a lack of easy access to library resources and coordination with experts which caused the research to take time.

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