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The relation between growth, energy imports, militarization and current account balance in China, Israel and South Korea

Melike Bildirici [a], Fazıl Kayıkçı [b, *]

[a] Yildiz Technical University, Faculty of Economics and Administrative Studies, Davutpaşa Campus, 34220, Esenler, İstanbul, Turkey
[b] Yildiz Technical University, Department of Economics, Davutpaşa Campus, 34220, Esenler, İstanbul, Turkey

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ABSTRACT

This paper tested the relation among macroeconomic variables such as economic growth, current account balance, energy imports and non-economic variable as militarization for the selected countries by employing Markov Switching-Bayesian Vector Auto Regressive approach for China, Israel and South Korea. These countries have high rate of export and import of weapons, the current account surplus, and higher rate of energy imports. The results showed that the relation between the selected variables differs in these countries with respect to their energy and weapon import levels. According to Markov-Switching Bayesian Granger Causality results, if the governments determine the polices in the context of the results of the traditional causality test, it will be impossible to obtain the estimated impacts from the policies. Results determined that Militarization, energy imports, economic growth and current account balance relate to each other for all countries. Energy imports increase in the effect of militarization races and economic growth. The current account of the selected countries are vulnerable to the negative energy shocks and militarization.

1. Introduction

Militarization races, energy consumption, economic growth and current account balance havecrucial impacts on each other's. Especially, imports of military equipment and energy have substantial impact on the current account balance by depending upon whether a country produces military equipment and whether they have ownership of energy resources. Countries that do not have enough energy resources or high rate of militarization have to import energy and military equipments. The countries that import energy and military equipments, have enormous burden on the current account balance by the effect of consuming foreign exchange reserve and increasing trade deficits.

The offensive and defensive arms and energy that are imported by using scarce foreign exchange reserves decrease available resources for the imports of intermediate and investment goods and distort the link between savings and investments since negative net exports decrease foreign savings and domestic investment. Moreover, macroeconomic equilibria of the countries are affected adversely from these conditions since distortion of the saving-investment balance creates deterioration in Gross Domestic Product, disposable income, collected taxes, government budget, demand for loanable funds, etc. Destructive effects on external accounts arise because of coercing the nations to exhaust their reserves and moreover the countries are forced to borrow from abroad which lead to the crowding out of the tradable sector. On the other hand, disarmament or a decline in military expenditure and decrease of external dependence for energy do not imply an equivalent rise in the investments, but energy shocks exhibit adverse effects on the volatility of the economic growth and current account [1].But, decreasing weapon imports can recover the conditions in terms of foreign reserve scarcity, because the prices of military equipment and energy shocks have a significant influence on net foreign asset positions. These countries can undergo a slowdown in the economic growth [2].

* Corresponding author.
E-mail addresses: melikebildirici@gmail.com (M. Bildirici), fkayikci@yildiz.edu.tr (F. Kayıkçı).

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Increase in imports of energy and military weapons can cause to long-run fluctuations in the current account balances of the countries. In this perspective, this paper aims to investigate the dynamic and causal relationship among militarization, current account balance, energy imports and economic growth in China, Israel and South Korea by using Markov Switching Bayesian Vector Auto Regressive (MSBVAR) and Markov Switching Bayesian Granger Causality (MSBGC) methods. These countries were selected since they have high level of imports of military weapons and energy (It was exhibited in Figs. 1 and 2 in the section 3). China, Israel and South Korea have high rate of export and import of weapons, the current account surplus, and higher rate of energy imports. South Korea has continuosly have problems with North Korea and similarly Israel has continuosly problems with Palestine. These countries are always on the brink of war. Imports of weapons and energy increases in these countries as a result of militarization. These countries are selected for two different reasons. The first one is to differentiate this study form existing literature since there are many papers analyzing the relation among energy consumption and economic growth but no one examine these countries as a sample. The second one is to isolate the sample for only these countries in which not only they have high level of import of energy and military equipments, but also they are always in danger of war or terrorist attacks. In this condition, having the information about the direction of causality among militarization, current account balance, energy imports, and economic growth became more important to determine the appropriate defense and energy policies for the economy.

In the selected countries, since the linear time series do not represent the real world's real economic situation especially in the existence of economic crises, battles and other geopolitical dangerous events, oligopolistic structure in refinery and redistribution, production lags, and the structure of market competition; the relationship among militarization, current account balance, energy imports and economic growth, do not exhibit linear time series behavior. Taking the logarithm of the variable, as used by many papers, may not eliminate structural breaks of the variables. The series may not be linear again. In the effect of the highlighted problems above, it must be taken into account the stage of the business cycle, otherwise the estimated parameters would be improper and misrepresentative. To overwhelm these problems, the estimated sample can be divided into subsamples by considering the structural breaks in the analyzed time period; so the date of these fluctuations is considered, the researcher must describe it endogenously by dependent upon the data. This way can cause to various problems such as incorrect parameter estimation. Markov Switching (MS) method provides the various improvement to solve these types of problems in many papers [3]. attracted the attentions with his pioneering paper analyzed the volatility of oil price by MS method, following [4–9], used MSVAR models to examine the relation between real GDPand/or the other products related with energy consumption. Moreover, the model permits to determine the direction of causality between the variables without apply causality test. Contributions of MSBVAR models can be given under four points. But in this paper, MSBVAR method provide both improvements highleted above and a general method for combining a researcher's beliefs with the evidence contained in the data. Because the Bayesian approach to econometrics provides a general method for combining a modeller's beliefs with the evidence contained in the data In contrast to the classical approach to estimating a set of parameters, Bayesian statistic presupposes a set of prior probabilities about the underlying parameters to be estimated. And so, the model permits us to categorize regimes as basing upon the parameter switches in the sample and, it is possible to notice changes in dynamic relations among the variables. Second, the suggested model permits for some possible changes in the dynamic interactions among the variables at unknown times. Third, it is possible to make probabilistic inference about the dates that a change in regime occurred and our model allows to both improvements and a general method for combining a researcher's beliefs with the evidence contained in the data. And fourth, this method will provide direction of the causality as mentioned above.

This paper can be accepted as harmonizer of the earlier empirical papers. However, it diverges from the current literature with simultaneous estimations of the relation among militarization, energy import, current account and economic growth which was analyzed by MS-BVAR and MS-BGC methods. There is no study to our knowledge undertaken to investigate the effect of the selected variables by employing a MS-BVAR and MS-BGC models.

After introduction, the second section of the study mentions about the literature. The third section discusses theoretically the link among economic growth, military expenditure, oil imports and current account balance. The fourth section presents the econometric theory while the fifth section comprises the empirical results. Finally, the last section includes conclusions and economic policy implications.

2. Literature

The literature focusing on the above-mentioned variables could be collected under two sub-sections. The first section focuses on the analysis of the relation among economic growth, energy usage, and current account balance. The second section covers the relationship among economic growth, military expenditure, and current account balance.

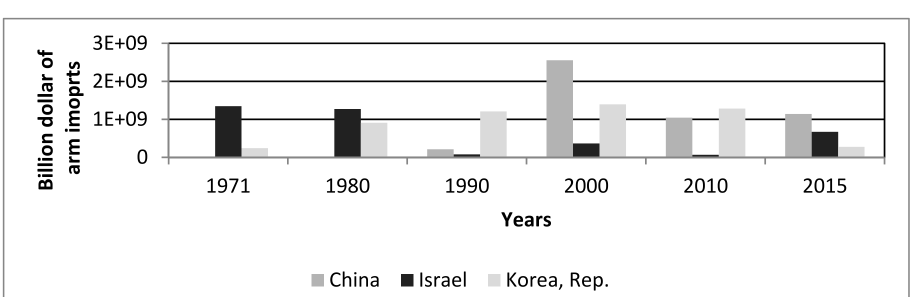

Fig. 1. Arms Imports by country, Sources [26].

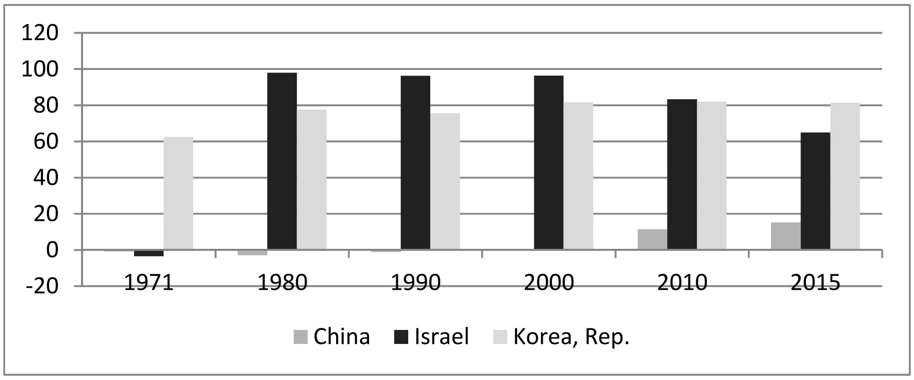

Fig. 2. Energy - imports (bbl/day) [27].

2.1. The literature of nexus among energy imports, economic growth, and current account balance

Some papers analyzed the impacts of changes in oil price on current account balance [10]. determined that oil price has a short-term effect on current accounts and a visible effect on the net foreign asset of the nations [11]. showed the variations in the trade balance will not have an effect on the current account of the nations [12]. examined the relation among U.S. current account deficits, real GDP growth and oil prices via MS-AR and the threshold vector error correction (TVEC) models [13]. analyzed the financial and trade interdependencies between 30 countries over the 1980–2011 period. They found that the major adjustment mechanism to volatility of oil price was dependent on the trade channel and that the valuation channel valid only on the short run [14]. examined the relationship among the oil price, inflation, the industrial production, trade balance and exchange rate. Their results determined co-movement between some macroeconomic variables and the oil price.

Some papers tested the relationship between energy consumption and current account balance [15]. tested the causal relation among electricity consumption, current account balance, and economic growth in the period of 1981–2013 for China, India, Singapour, South Korea, Turkey, and Taiwan [16]. analyzed the relation between crude oil trade and current account of a country for 91 countries during the 1984–2009 period and it was presented that oil exports are a significant reason of enlightening current account surpluses nonetheless that oil imports have not impact on current account deficits.

2.2. Literature of relationship among economic growth, military expenditure, and current account balance

[17,18] showed that military expenditure accelerates the economic growth. Following, this paper, many papers tested the relation between defense spending and real GDP [18,19] showed that the impacts of defense expenditures on economic growth are positive. They determined that, during the late 2002 and early 2003, military expenditures help to increase the economic growth. Moreover, 60% of the economic growth during this period was originated by military expenditures.

[20] examined the effect of military spending on current account balance and exchange rates for 125 countries and concluded that increasing the military spending of governments deteriorates the current account balance for both developing and developed countries.

Some of the other papers searched the nexus between economic growth and military expenditures. They determined the existence of positive or negative effects on each other's [21–25].

3. The military equipment imports and energy imports in the selected countries

The imports of military equipment and energy create a vast burden on the economy, because of using scarce foreign reserves, which cause to trade deficits. The financial burden of military equipment and energy imports grow over time via debt service. Militarization race accelerated after World War II and especially 2000, and it continues to increase. Fig. 1 exhibits arm imports of the selected countries.

[27] determined the twenty-five largest weapons exporters in period of 2013 and 2017. The size of international transfers of main weapons between 2013 and 2017 was 10% higher than during 2008 and 2012. China is the one of five largest exporters between 2013 and 2017. China is ranked as the fifth country within 20 largest exporters of major arms, while 8th country is Israel, 12th country is South Korea.

Increasing militarization brought an increase in energy consumption. Fig. 2 exhibits the energy import dependence of the selected countries. While the wealth of the countries shifted from weapon importing countries to weapon producer countries, on the other side, the increased oil price reallocate the wealth between oil importing and exporting countries, because the price elasticity of demand for gasoline and oil was found as inelastic in some papers [12]. Fig. 2 exhibits energy imports structure for analyzed countries.

In oil-importing countries, an exogenous rise in the price of imported energy creates negative effect on trade by leading to economic shock which has the effects on production decisions. The increasing oil prices decreases the economic growth, but there is some uncertainty about the size of this effect [28–30]. The economic growth of the selected countries is closely linked to the country's militarization and energy usage, and energy usage of the rest of the world. Since imported energy is an intermediate input in the internal production and a rise in energy prices causes direct increase in the input cost. On the other hand, import of weapons and energy leads to an overall negative trade balance.

The treadmill of destruction theory found that the energy usage is positively related with militarization scale [31,32]. [33] showed the nexus between military spending, energy usage, and real GDP [34]. tested nexus between economic growth, petroleum consumption and militarization in BRICTSM countries for the period 1987–2013 by using ARDL and causality approach. She found the evidence of bidirectional causal link among the variables [35]. found that military sector causes environmental degradation.

4. Data description and econometric methodology

4.1. Data description

The data was employed from 1972 to 2019 for all countries. The energy imports (C), militarization (ML), current account balance (CA) and real per Capita GDP (Y) data were used. All data were logged (ln) to minimize skewness. Energy imports (% of total energy use) data was taken from IEA energy statistics. The military import data (ML) is measured in constant 2005$ and obtained from SIPRI. Real GDP (constant 2010$) and Current account balance data (% of GDP) were obtained from World Bank. Data sets were exhibited between Figs. 3–6.

4.2. Econometric methodology

4.2.1. MS-Bayesian VAR analysis

The MSVAR and MSGC models were discussed by Refs. [6,36]to test the causal nexus between energy usage and economic growth which based on MSIA(.)-VAR(.) and MSIAH(.)-VAR(.) models. MS-BVAR method was used by Refs. [7,37]The MSIAH(.)-VAR(.) model is given as

$$y_t = \mu^{(s_t)} + \sum_{i=0}^{i} A_i^{(s_t)} \mathbf{x_t} + u_t^{(s_t)} \tag{1}$$

where $u_t / s_t \sim N(0,\ \delta^2(s_t))$ and A_i (.) show the coefficients of the laggedd values of the variable in different regimes. $\mathbf{x_t} = [\mathbf{x}_t']' = (y_{t-1}, \ldots, y_{t-p}, x_{t-1}, \ldots, x_{t-p})'$ in matrix form for $t = 1,2, \ldots, n$ define the input variables. $Pij = \Pr[s_t = j|\ s_{t-1} = i]$ is transition probabilities matrix.

$$u_t \sim i.i.d.\ N\left(0,\ \delta^2(s_t)\right) \text{ if } |\varphi|\ < 1 \tag{2}$$

s_t is governed by a Markov chain,

$$P_r\left[s_t \middle| \{s_{t-1}\}_{i=1}^{\infty}, \{y_{t-1}\}_{i=1}^{\infty}\right] = P_r\{s_t|s_{t-1}; \rho\}, \tag{3}$$

where p comprises the probability parameters. And it is defined as $P(y_t|Y_{t-1}, s_{t-1}) = P_r(y_t|Y_{t-1})$.

p_{ij} is characterized as

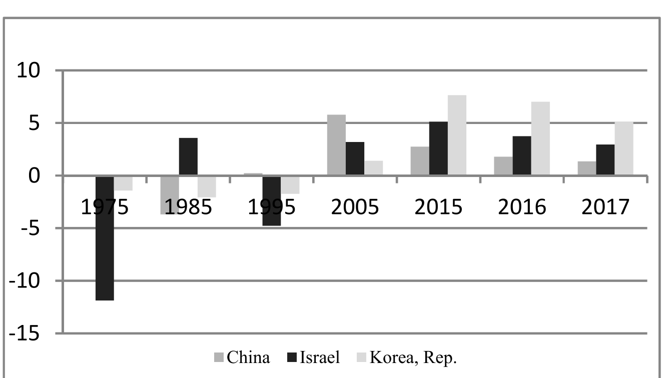

Fig. 3. Current account balance (% of GDP).

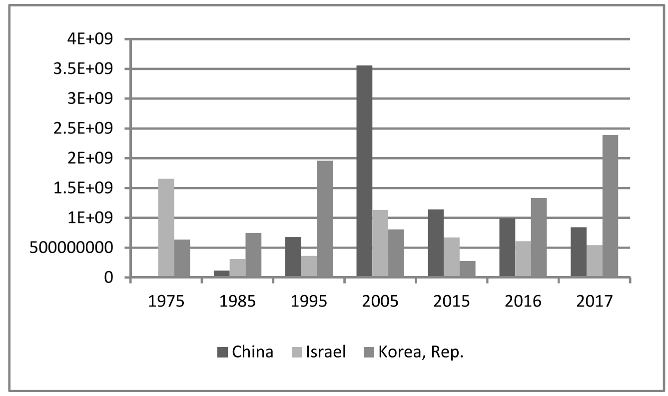

Fig. 4. Arm imports.

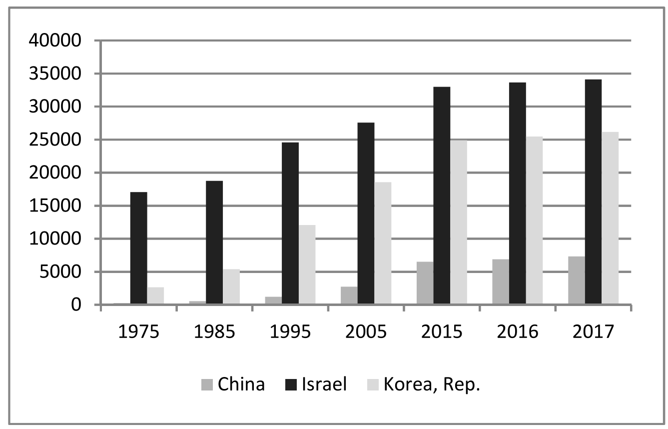

Fig. 5. GDP per capita (constant 2010 US$).

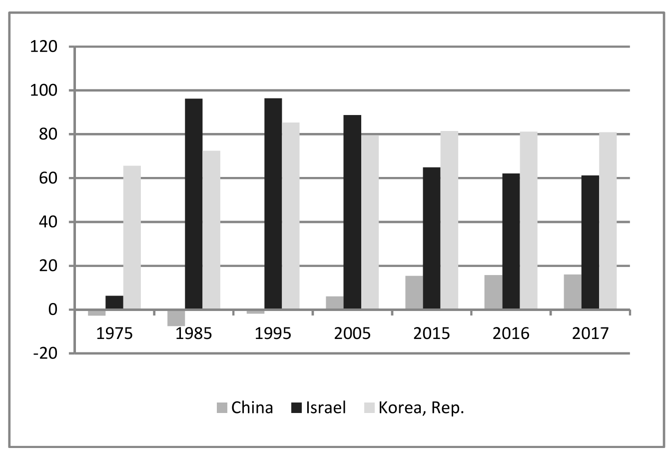

Fig. 6. Energy imports, net (% of energy use).

$$\Pr(s_t = j|s_{t-1} = i, s_{t-2} = k, \ldots, s_0 = h) = \Pr(s_t = j|s_{t-1} = i) = p_{ij}$$

and

$$\Pr(s_t = 1) = \frac{1 - p_{22}}{2 - p_{11} - p_{22}}, \Pr(s_t = 2) = \frac{1 - p_{11}}{2 - p_{11} - p_{22}} \tag{4}$$

As such, a structure may prevail for a random period of time, and will be replaced by another structure when switching takes place.

The transition probability p_{ij} gives the probability that state i will be followed by state j. Thus, the transition probabilities satisfy

$$p_{i1} + p_{i2} + \dots\dots\dots + p_{iN} = 1 \quad (5)$$

It is assumed that s follows an irreducible ergodic M state Markov process with the transition matrix defined as,

$$\mathbf{P} = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1M} \\ p_{21} & p_{22} & \cdots & p_{2M} \\ \vdots & \vdots & \cdots & \vdots \\ p_{M1} & p_{MM} & \cdots & p_{MM} \end{bmatrix} \quad (6)$$

To estimate the MS models, there are different methods, such as the maximum likelihood estimate (MLE) and the expectation maximization (EM) suggested by Hamilton. The EM algorithm has been designed to estimate the parameters of a model where the observed time series depends on an unobserved or a hidden stochastic variable. To make inference, it was used the iterative method for t = 1, 2, T, while taking the previous value of this probability,

$$\xi_{it-1} = P_r[s_{t-1} = i | \Omega_{t-1}; \alpha] \quad \text{as input} \quad (7)$$

where i = 1,2; $\Omega_t$stands for information set and θ is the vector of parameters to be estimated.

The iterative estimation technique can be used to make inference as

$$\xi_{it-1} = P_r[s_{t-1} = i | \Omega_{t-1}; \alpha] \quad \text{for} \quad t = 1, 2, \dots, T \quad (8)$$

The conditional log likelihood can be given as

$$\log f\left(y_1, y_2, \dots, y_T \middle| y_0; \alpha\right) = \sum \log f(y_t | \Omega_{t-1}; \alpha) \quad (9)$$

The Bayesian inference that is dependent upon the posterior distribution is employed. The likelihood function is given as

$$p(\alpha) = \prod_{i=1}^{N} p(\alpha_i) p(P) \quad (10)$$

This state permits the possibility of prior knowledge of the state-specific parameters, α_{st}, individually for each regime.

The posterior distribution is demonstrated as

$$p(\alpha | y, S) \infty \prod_{i=1}^{N} p(\alpha_i | y, S) p(P | y, S) \quad (11)$$

And it can be decomposed into a posterior density of the transition probabilities matrix:

$$p\left(P \middle| S\right) \infty \prod_{i=1}^{N} p(s_0 | P) \prod_{i=1}^{N} \prod_{k=1}^{N} p_{ik}^{N_{ik}(s)} p\left(P\right) \quad (12)$$

The posterior density is demonstrated as follows

$$p\left(\alpha_i \middle| y, S\right) \infty \prod_{i=1}^{N} p(y_i | \alpha_i, y_{i-1}) p\left(\alpha_i\right) \quad (13)$$

In this paper, prior distribution suggested by Ref. [38] was employed. The posterior distribution of b is

$$p(b / y_t) = \pi(b_0) \pi(b_+ / b_0) \quad (14)$$

where y_t denotes the data matrix up to time T,

$$\pi\left(b_0\right) \infty \left|B_0\right|^T \exp\left(-\frac{1}{2} trace\left(B_0 S B_0\right)\right) \quad (15)$$

$$\pi(b_+ | b_0) = \lambda((I \otimes U) b_0; I \otimes V) \quad (16)$$

$\lambda(\mu; \sigma^2)$ means the normal density function with mean $\mu$and variance σ^2. S, U and V are matrix functions in equations [7].

4.2.2. MS-Granger causality analysis

[6,8,36] used MS-VAR Granger Causality method. And [37]used the MS-BVAR Granger causality methodology can be given as follows.

$$\begin{bmatrix} dy_t \\ dx_t \end{bmatrix} = \begin{bmatrix} n_{1,st} \\ n_{2,st} \end{bmatrix} + \sum_{k=1}^{q} \begin{bmatrix} \varphi_{11,st}^{(k)} & \varphi_{12,st}^{(k)} \\ \varphi_{21,st}^{(k)} & \varphi_{22,st}^{(k)} \end{bmatrix} \begin{bmatrix} dy_{t-k} \\ dx_{t-k} \end{bmatrix} + \begin{bmatrix} e_t \\ \varepsilon_t \end{bmatrix} \quad (17)$$

When any of the coefficients of $dy_{t-1}, \dots, dy_{t-q}$ in regimes is different from 0 in the equation for dx, it is accepted that dy is Granger cause of dx in that regime. Granger causality can be identified by testing H_0:$\varphi_{12}^{(k)}$= 0 and H_0: $\varphi_{21}^{(k)}$= 0. The approach needs the estimation of either MSIAH(.)BVAR(.) or MSIA(.)BVAR(.) model.

5. Empirical results

The results were obtained in the five stages:

1. Firstly, the unit root testsswere applied to decide if the variables were state of I(0), and/or I(1). Kapetanios, Shin and Shell (KSS) non-linear unit root test were employed to evaluate the stationarity of the variables. If the sample period has non-linear structure because the selected other tests can cause to the spurious results. In this state, KSS test must be used as complimentary. To determine non-linear structure, Tsay NL Test was applied.
2. In the secondsstep, Johansen test was used to determine the presence of cointegration. When the null hypothesis was not rejected by Johansen test, the coefficients which were determined by the MS-BVAR methods were used for MS-Bayesian Granger causality (MS-BGC) analysis.
3. Dating, that was determined by selected models, was compared with Economic Cycle Research Institute (ECRI) dating. If they are similar, the selected models will be considered as correct. In the third step, MS-BVAR models provided the coefficients of the variables, the regime durations and transition probabilities by employing innovations of the variables.
4. The coefficients determined by the MS-BVAR methods were used for MS-BGC analysis.
5. And lastly, the results of the MS-BGC test were used to compare with the results of the traditional causality method.

5.1. The unit root test

The first differences of *y*, *ml*, *c* and *ca* were found as stationary as it can be seen from Table 1. In the second step, Johansen test is employed to test the possibility of cointegration.

5.2. Johansen test results

The Johansen test results were exhibited at Table 2. The variables were accepted as stationary. In this condition, the innovations of the variables, d*y*, *dml*, *dc* and d*ca*, can be employed for MSBGC test.

And then, whether the series were exhibited the structures of linear or non-linear were determined by the Tsay NL test. The

Table 1
Unit root test results for the analyzed countries.

	MZ_a	MZ_t	MSB	MPT	Elliott-Rothenberg-Stock Test Statistic [39]	KSS
Israel						
y_t	−1.14	−0.42	0.52	19.22	7.55	−0.25
dy_t	−6.75	−4.51	0.13	0.96	0.51	−3.89
ml_t	−0.15	−1.37	0.41	6.65	5.22	−1.15
dml_t	−5.88	−4.61	0.12	1.13	0.18	−5.67
c_t	−0.20	−0.18	2.39	12.09	13.43	−0.08
dc_t	−15.11	−4.19	0.15	1.33	0.91	−4.93
ca	−0.12	−0.29	1.21	22.19	7.11	−1.22
dca	−7.76	−3.95	0.13	0.29	0.224	−5.38
South Korea						
y_t	−1.65	−1.12	0.82	19.88	5.88	−1.36
dy_t	−9.61	−3.58	0.21	1.18	0.225	−5.63
ml_t	−1.55	−0.22	0.94	13.19	8.19	−0.29
dml_t	−15.18	−3.88	0.21	1.27	1.69	−4.33
c_t	−0.26	−0.56	1.86	8.86	3.31	−0.88
dc_t	−7.61	−3.66	0.19	0.82	0.31	−5.18
ca	−0.178	−0.26	1.88	8.95	4.88	−0.24
dca	−10.71	−5.29	0.16	0.96	1.07	−4.86
China						
y_t	−2.28	−1.62	0.79	4.57	4.88	−0.79
dy_t	−6.66	−4.77	0.11	1.11	1.18	−6.07
ml_t	−1.15	−1.22	0.97	5.83	5.99	−0.68
dml_t	−8.33	−5.87	0.11	1.03	0.95	−5.16
c_t	−0.72	−1.75	0.87	6.89	4.96	−1.18
dc_t	−5.11	−6.85	0.19	1.11	0.94	−5.09
ca	−1.13	−1.33	0.89	8.92	6.19	−0.76
dca	−7.85	−4.99	0.10	1.04	0.92	−4.99

Table 2
Nonlinearity test results.

	Lag	ly	lml	lc	lca		Lag	ly	lml	lc	lca
Tsay NL Test	Israel					South Korea					
	1	2.24 (0.00)	2.27 (0.00)	2.21 (0.00)	2.123 (0.00)	Tsay NL Test	1	2.44 (0.04)	4.661 (0.00)	3.99 (0.00)	4.61 (0.00)
	2	4.35 (0.00)	5.39 (0.00)	4.33 (0.00)	5.31 (0.00)		2	5.87 (0.002)	7.81 (0.00)	4.88 (0.00)	4.86 (0.00)
	3	3.48 (0.00)	4.45 (0.00)	3.46 (0.00)	3.36 (0.00)		3	4.95 (0.00)	5.94 (0.00)	4.091 (0.00)	4.19 (0.00)
	4	2.58 (0.00)	3.59 (0.00)	2.57(0.00)	2.42 (0.00)		4	3.98 (0.00)	4.84 (0.00)	3.96 (0.00)	4.01 (0.00)
	5	1.58 (0.00)	1.539 (0.00)	1.54 (0.00)	1.47 (0.00)		5	3.68 (0.00)	4.014 (0.00)	2.78 (0.08)	3.05 (0.09)
Tsay NL Test	6	1.08 (0.00)	1.01 (0.00)	1.14 (0.00)	1.12 (0.00)		6	2.33 (0.00)	3.55 (0.00)	1.93 (0.01)	1.14 (0.42)
	China										
	1	3.02 (0.00)	4. 794 (0.00)	1. 672 (0.49)	2.1854 (0.32)						
	2	5.17 (0.00)	6.174 (0.00)	3. 984 (0.00)	4.69 (0.00)						
	3	3.31 (0.00)	5.66 (0.00)	3.12 (0.00)	3.22 (0.00)						
	4	3.29 (0.00)	3.16 (0.00)	2.93 (0.00)	2.85 (0.00)						
	5	3.023 (0.042)	2.502 (0.00)	2. 001 (0.00)	1.026 (0.63)						
	6	2.99 (0.01)	1.989 (0.00)	1.056 (0.13)	0.972 (0.00)						

probability values in parenthesis.

results showed in Table 1b showed non-linear structure. The results of Tsay NL Test exhibited that the series have non-linear dependent on all dimensions.

In the second step, the presence of cointegration among$ly_{t,}$ lml_t, lc_t, lca_t variables was explored by Johansen's procedure. According to Table 3, the innovation or first differences of d$ly_{t,}$ dlml_t, dlc_t, and dlca_t, can be explored for MScBGC.

Table 3
Johansen test results for the analyzed countries.

	Israel	China	South Korea	Critical Values
$r = 0$	39.4	42.19	41.38	47.85
$r \leq 1$	24.39	26.16	28.36	29.797
$r \leq 2$	11.66	12.02	10.38	15.494
$r \leq 3$	1.35	2.07	1.92	3.841

5.3. MSBVAR models and dating

In third stage, the selected models are MSIA(3)BVAR(2) for Israel and MSIA(3)BVAR(1) for China, and Korea Republic. The selection of models was based on the Akaike InformationnCriteria (AIC), Log-likelihood, LR test statistics. To determine the number of regimes, BVAR model was examined against MSBVAR model with two regimes. All models were chosen by depending upon the results of the diagnostic tests.

After selection of the models, business cycle dating of the selected models were compared with ECRI's business cycle datings. If these dates are similar ECRI dating, it will be accepted the proof of the accuracy of the model. The business cycle dating determined by the selected models and ECRI were given in Table 4.

Regime 3 represents high growth regime and/or low volatility regime, regime 2 represents moderate volatility and/or growth regime and regime 1 represents the crisis regime and/or high volatility regime. The selected models detected the important recession years as the first enery crisis in 1974, second enery crisis

Table 4
Dating analysis (year: month).

Israel	China	South Korea
1997–1999	1973–1974	1979–1980
2001–2003	1988–1989	1997–1998
2007–2009		2002–2003
2012–2012		2008–2012
OECD [40]	**ECRI** [41]	**ECRI** [41]
1996:12–1999:1	1988:8–1989:12	1979:3–1980:10
2000:9–2003:9		1997:08–1998:07
2007:11–2009:5		2002:12–2003:09
2011:8–2012:8		2008:7–2012:08
2015:9–2016:10		

in 1979, and the 2008 crisis as a whole.

In the selected MSBVAR models, the period of crisis regime, regime 1 has shorter time duration than the periods of economic growth, as regime 2. So the asymmetric behavior between economic growth and crisis periods was verified by depending upon the differences in length of time. According to these results, the transition probabilityymatrixxis ergodic and cannot be irreducible.

According to the results, it is determined that the 2-regime MS-BVAR model is appropriate for the analyses in the selected countries. By using the Akaike Information Criterion (AIC), the delay lengths are selected and it is decided that MSIA(2)-BVAR(1) model for China and South Korea, and MSIA(2)-BVAR(2) for Israel are determined as appropriate for these variables. Also MSIA(2)-BVAR models were selected from among the various models according to the posteriors.

In Table 5, for China, LR test is made in order to determine the number of regimes of the models, which is the first stage of model selection. According to the results, it is determined that the 2-regime MS-BVAR model is appropriate for the analyses. By using the Akaike Information Criterion (AIC), the delay lengths are selected and it is decided that MSIA(2)-BVAR(1) model is appropriate for the variables. Also MSIA(2)-BVAR(1) model was selected from among the various models according to the posteriors. The results of MSIA(2)BVAR(1) model were exhibited. Crisis regime approximates with ECRI recessions dates. $\text{Prob}(s_t = 1|s_{t-1} = 1) = 0.57$, $\text{Prob}(s_t = 2|s_{t-1} = 2) = 0.89$ show the persistence of regimes. This state defines the existence of important asymmetries. It was determined log posterior and posterior estimates as 68.88 and 399.45, and 888.18 and 3274.65 for regime 1, 2, respectively.

The results of MSIA(2)BVAR(2) model was chosen for Israel that were exhibited in Table 6. Sims and Zha (1998) test determined posterior estimates as 943.24 and 4210.15 for regime 1 and 2, respectively. Crisis regime approximates with ECRI recessions dates. $\text{Prob}(s_t = 1|s_{t-1} = 1) = 0.68$, $\text{Prob}(s_t = 2|s_{t-1} = 2) = 0.85$ show the persistence of regimes.According to ergodic probabilities, dominant regime was determined as the second one. This state defines the evidence of significant asymmetries.

The results for Korea are given in Table 7. The posterior estimates were estimated as 941.14 4214.63 for regime 1, 2, respectively. $\text{Prob}(s_t = 1|s_{t-1} = 1) = 0.59$, $\text{Prob}(s_t = 2|s_{t-1} = 2) = 0.76$ give the persistence of regimes.

5.4. Causality results

For analyzed countries, causality results determined by any regime were summarised in the Table 8.

According to the results of MSIA(3)BVAR(2) model for Israel, in all regimes, the variables of militarization, energy imports and real GDP are Granger causes of the current account. There is the existence of bidirectional Bayesian causal nexus between real GDP and energy imports, between real GDP and militarization, between current account and economic growth in all regimes, and between militarization and energy imports in regime 1. From militarization to the current account in all regimes and from energy imports to current account in all regimes were found as an evidence of one-way causal nexus. However, traditional Granger causality results found no causality between the current account and militarization, between militarization and energy imports, and between real GDP and energy imports. The MSIA(3)BVAR(1) model is determined for China, in regime 1, there is bi-directional Bayesian causality between variables of militarization and current account but there is the evidence of none causality in regime 2. In regime 2, it was found bi-directionall Bayesian causality between current account and energy imports, but in the other regime, it was found the evidence of uni-directional causality from current account to energy imports. The evidence of feedback relation between energy imports and real GDP in regime 2 was determined, but in regime 1, none-causality. So the two-way Bayesian causality between energy imports and real GDP was determined in regime 2. However, traditional causality results found one way causality from energy imports to real GDP. For Korea, energy imports is Bayesian Granger cause of the current account in all regimes. In the first and second regimes, there is the evidence of bidirectional causal link between militarization and current account balance. There isone-way causality from energy imports to current account balance in regime 1 and 2. The current account is Bayesian Granger cause of real GDP in regime 2.

5.5. Traditional linear Granger causality test results

The causality results are very important to determine the economic policies since they can produce wrong economic policies if

Table 5
China, MSIA(2)-VAR(1) model (Estimation sample: 1972–2019).

	Regime 1				Regime 2			
	dca_t	dc_t	dml_t	dy_t	dca_t	dc_t	dml_t	dy_t
c	0.75 (1.3)	1.28 (3.14)	2.17 (3.11)	0.52 (1.37)	0.14 (0.18)	0.62 (1.89)	1.63 (3.12)	0.64 (2.15)
dca_{t-1}	−1.19 (2.8)	−1.2 (−2.1)	−2.3 (−2.11)	0.88 (2.2)	−0.2 (−2.07)	−0.61 (−2.1)	0.15 (0.8)	0.49 (3.8)
dc_{t-1}	−0.63 (−1.4)	0.41 (2.3)	−0.16 (−2.11)	0.12 (0.76)	0.58 (2.11)	−0.33 (−0.18)	0.11 (0.88)	−0.45 (−3.28)
dml_{t-1}	3.39 (2.15)	2.22 (3.8)	0.52 (2.18)	0.22 (−1.6)	1.62 (0.66)	0.35 (2.28)	−0.44 (−2.77)	−0.27 (−2.57)
dy_{t-1}	−0.91 (−0.44)	0.37 (1.91)	0.47 (0.41)	−0.29 (−2.77)	−1.46 (−2.16)	1.33 (2.28)	0.91 (0.79)	0.32 (0.65)

	Log posterior	***Posterior estimate***	***Trans.Prob.***	
Regime 1	68.88	888.18	$\mathbf{P_{11}}$	0.57
Regime 2	399.45	3724.65	$\mathbf{P_{22}}$	0.89

Notes: t-statistics are given in ( ) parentheses. Log-likelihood: 130.40; LR test: 246.28.
linear system:63.4123; LR linearity test: 133.98; Chi(40) = [0.0000] Chi(46) = [0.0000] DAVIES = [0.0000].
H_0: Linear VAR(1) H_1: MSIA(2) BVAR(1).

Table 6
Israel, MSIA(2)-VAR(2) model (Estimation sample: 1972–2019).

	Regime 1				Regime 2			
	dca_t	dc_t	dml_t	dy_t	dca_t	dc_t	dml_t	dy_t
c	−1.41 (1.71)	2.05 (0.711)	1.37 (2.07)	0.83 (0.11)	−2. 34 (−2.25)	0.44 (2.31)	0.64 (2.66)	0.22 (3.39)
dca_{t-1}	−0.51 (−2.28)	0.218 (1.33)	0.344 (0.81)	−0.43 (−0.63)	0.33 (1.98)	0.21 (0.65)	0.31 (0.84)	−0.58 (−1.88)
dca_{t-2}	0.58 (2.41)	−0. 09 (−0.56)	0.29 (1.54)	0.31 (0.18)	0.14 (0.66)	0.37 (0.81)	−0.22 (−0.43)	−0.46 (−2.55)
dc_{t-1}	−2.56 (−2.77)	0.61 (0.85)	2.36 (3.4)	−0.55 (−2.38)	0.156 (0.55)	0.164 (1.86)	1.94 (3.4)	0.18 (2.6)
dc_{t-2}	−1.4 (−1.5)	−0.34 (−0.41)	2.14 (2.25)	−0.21 (−2.3)	1.26 (2.58)	−0.39 (1.95)	0.68 (4.14)	0.23 (3.5)
dml_{t-1}	−0.24 (−3.1)	−0.36 (−0.2)	−0.53 (−3.65)	−0.23 (−3.63)	0.18 (4.21)	−0.51 (2.43)	−0. 55 (−0.8)	−0.15 (−2.3)
dml_{t-2}	−2.55 (−3.14)	−0.18 (−2.66)	−0.68 (−2.56)	−0.39 (−2.56)	0.23 (2.73)	−0.28 (2.41)	−0.22 (2.4)	−0.02 (−0.65)
dy_{t-1}	2.42 (3.64)	−1.37 (−2.43)	−1.24 (−1.82)	1.83 (3.31)	2.19 (4.32)	1.39 (2.15)	−1.27 (−3.19)	0.22 (3.52)
dy_{t-2}	−1.85 (−2.11)	1.23 (1.86)	−2.53 (−2.24)	−0.43 (−0.16)	−2.26 (2.11)	−4.12 (0.52)	1.41 (5.11)	−0.11 (−0.21)

	Log posterior	***Posterior estimate***	***Trans.Prob.***	
Regime 1	72.83	943.24	P_{11}	0.68
Regime 2	426.91	4210.15	P_{22}	0.85

Notes: t-statistics are given in parentheses. LL(log-likelihood):85.3348 LR(linear system): 51.3748; AIC criterion: 1.72.
linear system: 4.32; LR linearity test:273.41 Chi (72) = [0.0000] Chi(78) = [0.0000] DAVIES = [0.0000]. LR Test: 201.34.
H_0: Linear VAR(2) H_1: MSIA(2) BVAR(2).

Table 7
South Korea, MSIA(2)-VAR(1) model (Estimation sample: 1972–2019).

	Regime 1				Regime 2			
	dca_t	dc_t	dml_t	dy_t	dca_t	dc_t	dml_t	dy_t
c	−0.33 (2.36)	0.21 (1.5)	0.17 (1.07)	−0.11 (0.22)	0.31 (−0.2)	0.56 (−0.67)	−0.21 (0.44)	0.17 (2.25)
dca_{t-1}	0.33 (0.11)	−0.11 (−1.42)	−0.21 (−4.33)	−0.44 (−2.38)	−0.26 (−0.22)	0.21 (−0.82)	0.21 (1.97)	0.23 (3.4)
dc_{t-1}	2.44 (2.21)	−0.63 (1.42)	−0.22 (1.86)	−0.76 (−2.5)	0.31 (−2.77)	−0.19 (1.99)	0.22 (0.61)	1.14 (2.18)
dml_{t-1}	2.32 (3.2)	−0.11 (−2.76)	0.34 (3.2)	3.22 (0.86)	1.12 (1.98)	0.63 (1.97)	0.61 (1.98)	0.33 (1.89)
dy_{t-1}	−0.27 (−0.34)	0.12 (2.6)	0.01 (1.1)	−0.49 (−1.07)	0.13 (0.89)	−0.36 (−1.89)	0.15 (1.93)	0.62 (0.41)

	Log posterior	***Posterior estimate***	***Trans.Prob.***	
Regime 1	70.82	941.14	P_{11}	0.59
Regime 2	426.91	4214.14	P_{22}	0.76

Notes: t-statistics are given in parentheses. log-likelihood:376.47; linear system:293.97; AIC: 22.25.
linear system: 19.56; LR linearity test: 164.97 Chi(40) = [0.00]; Chi(46) = [0.00]; DAVIES = [0.00].
LR Test: 255.33 H_0: Linear VAR(1) H_1: MSIA(2) BVAR(1).

Table 8
Summary of the Granger causality test results.

ISRAEL		CHINA		KOREA	
Regime1	Regime2	Regime1	Regime2	Regime1	Regime2
$ml \leftrightarrow c$	$ml \rightarrow c$	$ml \leftrightarrow c$	$ml \rightarrow c$	$c \rightarrow ml$	$ml \neq c$
$ml \leftrightarrow y$	$ml \leftrightarrow y$	$ml \neq y$	$ml \rightarrow y$	$ml \neq y$	$ml \leftrightarrow y$
$ml \rightarrow ca$	$ml \rightarrow ca$	$ml \leftrightarrow ca$	ml≠ca	$ml \leftrightarrow ca$	$ml \leftrightarrow ca$
$ca \leftrightarrow y$	$ca \leftrightarrow y$	$ca \rightarrow y$	$ca \leftrightarrow y$	$ca \rightarrow y$	$ca \rightarrow y$
$c \rightarrow ca$	$c \rightarrow ca$	$ca \rightarrow c$	$c \leftrightarrow ca$	$c \rightarrow ca$	$c \rightarrow ca$
$y \leftrightarrow c$	$y \leftrightarrow c$	c≠y	$y \leftrightarrow c$	$y \leftrightarrow c$	$c \rightarrow y$

the stages of business cycle are disregarded. The results obtained by traditional method will be compared with the MSBGC test.

The important differences between methods were found in Table 9. For China, traditional test determined one-way causal nexus from ml to real GDP as similar to the results of regime 2, and bi-directional causality between ml and c as the results of regime 1. But findings of relations between energy imports and real GDP, and Current account and energy imports showed different results. In Korea, traditional Granger causality results found the evidence of no causality between militarization and real GDP, between militarization and current account, between energy imports and militarization and between energy imports and real GDP.

6. Conclusion and policy implications

This paper aims at analyzing the relationship among current account balance, military imports, economic growth, and energy imports in the diverse regimes of the economies in the selected the countries. For this aim, MS-BVAR and MS-BGC methods allow to determine this relation in the diverse stages of the economy as growth and crisis stages for the selected countries. It is the first paper analyzed the relationship among current account balance, militarization, economic growth, and energy imports for the countries by using MS-BVAR and MS-BGC methods to appraise this relation. This study diverges from the current literature with simultaneous estimations of the relation among militarization, energy import, current account and economic growth which was analyzed by MS-BVAR and MS-BGC methods.

Table 9
Traditional Granger causality test results.

Countries	Causality Direction		Causality Decision	
ISRAEL	$\Delta lml \rightarrow \Delta ly$	0.93	No	y→ml
	$\Delta ly \rightarrow \Delta lml$	**2.88**	**Yes**	
	$\Delta lca \rightarrow \Delta ly$	0.76	No	y→ca
	$\Delta ly \rightarrow \Delta lca$	**2.85**	**Yes**	
	$\Delta lml \rightarrow \Delta lca$	0.44	No	ml≠ca
	$\Delta lca \rightarrow \Delta lml$	0.686	No	
	$\Delta lml \rightarrow \Delta lc$	1.343	No	ml≠c
	$\Delta lc \rightarrow \Delta lml$	1.227	No	
	$\Delta lc \rightarrow \Delta ly$	1.12	No	c≠y
	$\Delta ly \rightarrow \Delta lc$	0.142	No	
CHINA	$\Delta lml \rightarrow \Delta ly$	3.69	Yes	ml→y
	$\Delta ly \rightarrow \Delta lml$	0.44	No	
	$\Delta lca \rightarrow \Delta ly$	1.86	No	y→ca
	$\Delta ly \rightarrow \Delta lca$	5.85	Yes	
	$\Delta lml \rightarrow \Delta lca$	0.222	No	ml≠ca
	$\Delta lca \rightarrow \Delta lml$	0.446	No	
	$\Delta lml \rightarrow \Delta lc$	2.886	Yes	ml↔c
	$\Delta lc \rightarrow \Delta lml$	3.19	Yes	
	$\Delta lc \rightarrow \Delta ly$	3.57	Yes	c→y
	$\Delta ly \rightarrow \Delta lc$	0.172	No	
	$\Delta lca \rightarrow \Delta lc$	1.369	No	ca≠c
	$\Delta lc \rightarrow \Delta lca$	0.221	No	
SOUTH KOREA	$\Delta lml \rightarrow \Delta ly$	0.786	No	ml≠y
	$\Delta ly \rightarrow \Delta lml$	0.142	No	
	$\Delta lca \rightarrow \Delta ly$	4.56	Yes	ca→y
	$\Delta ly \rightarrow \Delta lca$	0.912	No	
	$\Delta lml \rightarrow \Delta lca$	0.566	No	ml≠ca
	$\Delta lca \rightarrow \Delta lml$	0.872	No	
	$\Delta lml \rightarrow \Delta lc$	0.945	No	ml≠c
	$\Delta lc \rightarrow \Delta lml$	0.046	No	
	$\Delta lc \rightarrow \Delta ly$	0.044	No	c≠y
	$\Delta ly \rightarrow \Delta lc$	0.058	No	
	$\Delta lc \rightarrow \Delta lca$	7.016	Yes	c→ca
	$\Delta lca \rightarrow \Delta lc$	0.009	No	

According to MSBGC results, there is inter-relation between the variables. Policies that reduce energy imports and military expenditure improves the current account balance, however, these policies have adverse effects on GDP of the countries because of a causal relation between GDP and militarization. Militarization, energy imports, economic growth and current account balance relate to each other's. Energy imports increase in the effect of militarization races and economic growth since militarization leads to consumption of huge amounts of petroleum in planes, ships, and tanks. Since roughly three-quarters of the oil through the world are consumed by the military forces. In addition, the energy imports of the military was increased by the industries producing the equipment for the military forces.

Military expenditure and energy imports effect economic growth and current account balance. According to Keynesians, the military expenditure is important as a fiscal policy tool. The differences between employment as the primary and secondary policy tool of military expenditure in the context of fiscal policy is very important [42]. Their different usage area is distinguished by different application strategy in the countries. Military expenditure as a Keynesian policy toll in European countries [43] is not as important as the US example. [44] showed that energy imports increase in effect of militarization races and economic growth. In a general manner, the energy imports and military expenditure as fiscal policy have effect on current account balance and economic growth. While the countries exporting the products of defense industry have benefited from multiplier effects, the importing countries are charged with the costs. The prices of energy and weapons have economic impacts for both importer and exporter countries. For an energy-importing nations, an exogenous rise in the price of imported energy is frequently viewed as a negative trade shock over their special impacts on production decisions. The prices of imported weapons negatively affect the current account of balance.

The current account balance of the selected countries are vulnerable to the negative energy shocks and militarization. The economic growth will be forced to decrease since it is based deeply on imported raw-materials and intermediary goods, especially in the selected countries except Israel. The inflationary effects will become much more apparent during the shocks. The increased import prices bring on the load on the balance of the current account. As the countries reduce their dependency on energy and weapons imports, their trade or current account balancesscan improve while their sensitivity to sudden oil price shocks can decrease.

For energy-importing nationals, an exogenous sudden rise in the oil price has a negative effects on production decisions since imported oil is used as an intermediate input in the internal production. An iincrease in oil prices causes a direct rise in the input cost of the production. The imports of weapons and energy lead to the negative trade balance. And, militarization can be used in more productive areas. As countries decrease their dependence on the imports of energy and weapons, this may reduce their current account imbalances, they can decrease their sensitivity to sudden energy price changes.

Credit author statement

Melike Bildirici: Conceptualization, Methodology, Software, Data curation, Writing – original draft preparation. Fazıl Kayıkçı; : Visualization, Investigation, Supervision, Software, Validation.- Writing- Reviewing and Editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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