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Interdependency of Business Cycle between Turkey and the Selected Central Asian Countries*

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Abstract

The dynamic interdependency among seven countries or economies (Turkey, Kazakhstan, Azerbaijan, Russia, China, Iran, and EU) is examined through the use of a vector error correction model, directed acyclic graphs (DAGs) and monthly data of the industrial production index. Overall, the results show that the industrial production of Russia affects the EU and the industrial production of the EU affects Turkey in a contemporaneous time horizon, which implies that two Central Asian countries, such as Azerbaijan and Kazakhstan, have no linkage with either Russia or Turkey in terms of their industrial production for a contemporaneous time horizon. However, all industrial productions of the seven economies are tied together in the long run in one cointegration relationship.

Keywords

Interdependency, Turkey, Central Asia, International business cycle, directed acyclic graphs

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INTRODUCTION

The end of the Cold War and the demise of the Soviet Union drastically changed not only the international environment that affects Turkey's foreign and security policy but also provided an economic opportunity for Turkey. Since then, the Turkish government has undertaken great efforts to adapt the country's foreign and socio-economic relations to the new situation. From the point of view of many analysts, these efforts have been characterized by a greater assertiveness in Turkish foreign policy regarding various regional political constellations. Self-constraint and a low profile no longer seem to be the hallmark of Turkey's foreign relations (Kramer, 1996), and among Turkish officials, conviction that Turkey "has a special role to play in Caucasus and Central Asia has re-emerged (Karamyan, 2012).

Indeed, the unraveling of the Soviet Union has confronted Turkey and the Turks with a "new world" in Central Asia upon which they wanted to exert influence and from which they have been confronted with certain demands (ibid.). For the Turkish public and large parts of the country's elite, the discovery of the "new cousins" in what is regarded as the original Turkish homelands has been a very welcome development. Now, there are other sovereign states in addition to Turkey in which Turks have become the dominant political group within which a related language is officially spoken and the culture of which has much in common with that of Anatolia.

Furthermore, the low level of economic and political development of these new republics has conveyed to many Turks the general impression of their superiority and has offered the country an opportunity to become a leader and be a role model politically and socio-economically (Solak, 2003). Accordingly, the psychological pre-conditions have resulted in high expectations by the Turkish public concerning the importance, dimension and scope of Turkey's relations with the republics of Central Asia and Caucasus (Kramerr, 1996). Such expectations have been particularly nurtured by certain nationalistic and religious ideas. In such circles, there has been open talk of the development of a 'bloc' or 'union of Turkic nations' under Turkey's leadership that would eventually become a powerful and recognized political actor in forging a new international order. Thus, mainstream Turkish politicians have been quick to grasp the opportunity to paint a bright picture of a new Turkic world stretching from the Adriatic Sea to the Chinese borderlands, with Turkey at its centre. The late president Turgut Özal told his countrymen and the world that the 21st century would be the "Turkish century" (Cem, 2001).

Since then Turkey has been cited as an important actor in the region due to its strong historical, cultural, ethnic and linguistic ties with the newly independent states of Central Asia and the Caucasus. Thus, the various roles that Turkey might play in this region have been extensively discussed, not only within Turkey but also in the West, where people have a fear that radical Islam might fill the power vacuum that occurred in the region with the demise of the Soviet Union. The so-called 'Turkish Model' of a secular democracy combined with a liberal economy has been debated by commentators and academics. The new Turkish cooperation in the region is somehow intended to bring further Turkish involvement and development in Central Asia and the Caucasus.

In order to expand the political, economic and cultural ties with Central Asia and the Caucasus, Turkey has launched a series of initiatives, particularly to promote a variety of educational and cultural programs targeting economic cooperation. After the initial phase of euphoria, Turkey's foreign policy in the region has become characterized by a major emphasis on cultural and economic relations rather than on political ones. Therefore, it might be crucial to examine the actual interrelationships between Turkey and these regions. In other words, it is worth evaluating the extent to which Turkey and the Central Asian countries interdependent and integrated in terms of industry, rhetorically and in reality.

Turkey has gone through significant transformations over the last decade. In this period, ongoing economic and political changes in the domestic arena have been accompanied by a renewed Turkish activism on the foreign policy front. Throughout this period, economy and trade have become the "practical hand" of Turkey's peaceful foreign policy, particularly toward neighboring countries (MÜSİAD, 2013). The impact of this approach is noticeable, especially in terms of Turkey's relations with Middle Eastern and Central Asian states. Thus, neighboring states, especially those of the Central Asian countries, have become profitable trading partners for Turkish industry.

Although Turkey's outward Foreign Direct Investment (FDI) performance has still been relatively modest by international standards, For the first time in recent history, Turkish institutional investors have turned into "visible actors" in both Central Asian and Middle Eastern markets. Thus, by 2009, Turkey's outward direct investment stock had reached $11.2 billion of which $3.1 billion dollars were directed to Central Asia and the Middle East.

As mentioned earlier, after the fall of the Soviet Union in the early 1990s, Turkish officials declared grand objectives for Turkic Central Asian countries that were not met. The so-called "romantic" declaration made during that period was based on a shared national and cultural heritage, but it was hard to realize (Cem, 2001). However, since the mid-1990s, corrective measures have been progressively taken by Turkish policy makers, who have shifted toward a more pragmatic stance for foreign policy in the region. This new policy has defined the relationship between Turkey and the Central Asian Republics as first and foremost through shared economic interests.

In brief, Turkey is now more involved in neighboring regions, including Central Asia, than ever before, and it continues to pursue and improve this involvement through both bilateral and multilateral channels. Although Turkey was once only looking toward the West, the country is now heading in several directions, with the Middle East and Central Asia as major areas of interest. Yet, this does not necessarily mean that Turkey is turning its back on the West. The accession to the EU and European markets still remains the main axis of Turkey's foreign policy and economy. However, it is also clear that Turkey's foreign policy and economic paradigms are evolving to take a more dynamic and multidimensional form.

Considering the situation discussed above, this study will examine the dynamic structure of interdependence of industrial production for Turkey, the Central Asian countries and other major neighboring countries in order to study how Turkey and Central Asian countries are linked to these other economies and how Central Asian countries have experienced integration with other economies after gaining independence from the Soviet Union. To our knowledge, this is the first study that uses a vector error correction model and directed acyclic graphs (DAGs) in an attempt to investigate the dynamic interrelationships among Turkey, the Central Asian countries and other major neighboring countries. One contribution of our study is to combine a vector error correction model (VECM) and DAG to facilitate a more in-depth exploration of the structure of interdependence in international business cycles. In addition, although most researches provide just information on correlation relationships between business cycles, our study can suggest causal relationships among business cycles. Another contribution is to include the Central Asian countries in the analysis considering a growing importance of this region.

To accomplish this objective, a VECM for the industrial production of seven economies has been developed. Data on industrial production from seven economies, including Turkey, Kazakhstan, Azerbaijan, Russia, China, Iran, and the EU, have been used to examine the interrelationships among industrial business cycles. A VECM is a dynamic modeling methodology that takes into account both the long- and short-run effects. In an unrestricted vector, autoregressive model, which forms the basis of the VECM used here, the lags of all such series have been included in all equations. This creates an abnormally high number of estimated coefficients. As such, the dynamic structure is examined through impulse response functions and forecast error variance decompositions. The results of the DAGs present the contemporaneous causal structure among the variables and are used to find the causal relationship among the variables in VECM. The impulse response functions trace out the reaction of the entire system for a shock or an impulse in one of the series included in the model. Forecast error decompositions provide an indication of the amount of information that each series in the model contributes to the other series for different horizons.

The rest of paper is organized as follows. The next section reviews the related literature. Section three describes the data and methodology we have employed. The fourth section presents the main findings of our study. Finally, discussions and some concluding remarks are presented in the last section.

RELATED LITERATURE REVIEW

Regarding the theoretical background on co-movement or synchronization of international business cycles, Imbs (2004) provides good explanation pertaining to determinants of transmission channels of synchronization. According to Imbs (2004), Trade integration, financial integration and specialization can be variables that explain why some countries are more synchronized than others. In addition, other variables such as membership of a currency union or a trade agreement, distance between two countries, common border, common language, and so on could determine the degree of synchronization on business cycles.

With an increasing theoretical interest on synchronization of international business cycles, numerous empirical studies on co-movement or transmission of international business cycle between countries have been conducted. The literature on the transmission and synchronization of international business cycles can be divided into several groups (Erden and Ozkan, 2014). One line of studies examines the question of whether there exists a global business cycle using a dynamic factor analysis or factor structural VAR analysis. For example, Kose et al. (2003) finds the evidence of the presence of a global business cycle during 1990s. Another group of researches focuses on the transmission of business cycles. A VAR, a structural VAR, Markow-switching VAR or smooth transition VAR analysis in a bilateral basis are usually employed in this strand of researches. Sayek and Selover (2002), Osborn et al. (2005), Tastan and Yildirim (2008) and Chen (2009) are included in this strand. For example, Sayek and Selover (2002) explore the transmission channels between Turkish and European business cycles using a SVAR model. Another line of the studies investigates whether there exists a globalization of business cycle using a clustering algorithm in core-periphery framework (for instance, Crowley, 2008). Another group of the studies is to use panel regression or a system of simultaneous equations framework following the study by Frankel and Rose (1998). In this strand, a measure of synchronization is regressed on some transmission mechanisms of business cycles (for example, Imbs, 2004; Inklaar et al., 2008; Flood and Rose, 2010). Cross-country correlation coefficient is most widely used as a measure of synchronization in these studies. On the other hand, some researches try to figure out the interaction structure among economies to understand the mechanism of synchronization and estimate the network structure (Matesanz and Ortega, 2016; Gomez et al., 2012; Xi et al., 2014). For instance, Xi et al. (2014) analyze the business cycle synchronization of the G7 economic system based on a pairwise maximum entropy model.

Regarding business cycle synchronization or transmission of Turkish economy, most studies focus on investigating the issues on synchronization and transmission channels between Turkish and European business cycles (Berument et al., 2001; Akkoyunlu and Kholodilin, 2008; Gouveia, 2014; Akkoyun et al., 2014; Sayek and Selover, 2002, Erden and Ozkan, 2014). For example, Akkoyun et al (2014) analyze the business cycle synchronization of the Turkish economy with the euro zone and the United States using wavelet methodology. They find that the correlation of Turkish cycles with the cycles of the euro zone and the United States increased substantially after 2001. They also suggest that capital flows and financial conditions should be considered as determinants of international transmission of business cycles in addition to trade channels.

Erden and Ozkan(2014) investigate the channels through which international business cycles are transmitted to Turkish economy using a panel regression model in which the Longest Common Subsequence measure of synchronization is used as the dependent variable. They find that both trade and financial similarities are significant in the transmission of business cycle to Turkish economy and Turkish business cycles are closely linked with those of the members of European Custom Union.

Sayek and Selover (2002) examine the economic interdependence between Turkey and the European Union using correlations, a principal-component analysis and a structural vector auto-regression (SVAR) model which includes GDP, consumer prices, money supplies, interest rates, and the exchange rate for Turkey and Germany. They find that there is no Granger causality between Turkish and European business cycles from the results of Granger causality tests and regression analysis. Further, their SVAR analysis reveals a slightly significant effect of income transmission and modest effects of price transmission from Germany to Turkey.

To our knowledge, few studies examine the structure of transmission on business cycles among Turkish and Central Asian economies. Our study is not to investigate which transmission channels are operational on international business cycles, but to examine the structure of interdependency on business cycle at contemporaneous, short-run and long-run time horizon focusing on Turkish and Central Asian economies using VAR model and DAG analysis. DAG, a non-time sequence asymmetry in causal relations, was proposed by Spirtes et al., (2000) and Pearl (1995, 2000) as an alternative and more comprehensive approach for examining causal relationships among variables. DAG analysis is the powerful tool to provide data-based evidence on causal ordering in contemporaneous time. Further, DAG allows us to build the construction of the data-determined factorization on contemporaneous innovation covariance. Applications of DAG in finance and economics are not common yet. Recently, however, some researches applying DAG analysis have been conducted to find contemporaneous causal relationships (Bessler and Yang, 2003; Bessler and Loper, 2001; Bessler and Lee, 2002; Awokuse, 2006; Park et al., 2006; Park et al., 2008). To the best of our knowledge, our study is the first research employing the DAG analysis in order to examine the contemporaneous causal structure on business cycle.

METHODOLOGY

After Sims' (1980) seminal work, vector time series techniques have increased in popularity. Given the multitude of studies that use such techniques, only select studies that have applied vector auto-regression models (VAR) and VECM techniques to industrial business cycle have been reviewed here. We used a vector error correction model (VECM) as the basic tool for this analysis. Samuelson (1971) suggests that economic data is non-stationary, meaning that any particular price measured over time is not tied to its historical mean. Since the data series used in this analysis are non-stationary (see empirical results section), the analysis is conducted by using a VECM. The data generating process for Yt can be expressed as a VECM with k-1 lags (Hansen & Juselius, 1995):

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + e_t \quad (t = 1, \ldots, T) \qquad (1)$$

$$e_t \sim \text{N iid } (0,\Sigma)$$

where

- Yt denotes a vector that includes m non-stationary data series at time t,
- ΔYt represents the first differences ($Yt - Yt-1$),
- μ is a vector of constant terms,
- Π is a matrix of coefficients relating lagged levels of the series to current changes,
- Γi is a matrix of short-run coefficients relating lagged period *i* changes to current changes, and
- e_t is a vector of error terms.

Seven data series (m = 7, see data section) are included in the VECM as a system of equations in which all series have been considered endogenous, and the maximum likelihood is used to estimate the VECM (Johansen, 1992).

Exclusion and Weak Exogeneity

If Π is of a reduced rank, Π can be expressed as $\alpha\beta'$ where α and β are m x r matrices of full rank and r is the number of cointegrating vectors (Hansen & Juselius, 1995). The long-run structure of the seven series is identified by the cointegration space spanned by β and testing the hypotheses on β. Exclusivity tests determine whether one or more of the seven series are excluded from the long-run relationships. The null hypothesis is that a particular series is not in a cointegrating space, and the alternative is that the series is in the cointegrating space. Under the null, the likelihood ratio test is a distributed chi-squared test with degrees of freedom that are equal to the number of cointegrating vectors (Hansen & Juselius, 1995).

The short-run structure is identified through α and Γi (Juselius, 2006). The α matrix provides information for the short-run adjustments to perturbations in the long-run relationships. Weak exogeneity tests on α are used to determine whether the market is unresponsive to deviation from the long-run relationships (Johansen, 1991). The null hypothesis is that each market does not respond to perturbations in the cointegrating space, and as with the exclusivity tests, the likelihood ratio test is a distributed chi-squared test with degrees of freedom equal to the number of cointegrating vectors.

Dynamic Structure

Since the coefficients of the VECM are difficult, if not impossible, to interpret individually, one procedure involves examining the dynamic structure among the series by using innovation accounting procedures. One way to conduct innovation accounting procedures is to represent the VECM as the VAR levels. A VECM can be expressed as the following VAR levels:

$$Y_t = \mu + (1 + \Pi + \Gamma_1)Y_{t-1} - \sum_{i=1}^{k-2}(\Gamma_i - \Gamma_{i+1})Y_{t-i-1} - \Gamma_{k-1}Y_{t-k} + \Psi Z_t + e_t \qquad (2)$$

$$e_t \sim N\,iid\,(0,\Sigma).$$

Innovation accounting summarizes the dynamic interactions among the series. To conduct innovation accounting, the contemporaneous structure of the error terms must be independent (orthogonal), which is usually not the case for economic data. In order to provide structure, the innovations are written as a function of the more fundamental driving sources of variation,, that are orthogonal to other sources of variation:

$$e_t = A^{-1} \quad \varepsilon_t \qquad (3)$$

where A is the matrix representing how the non-orthogonal innovations, et, have been caused by the orthogonal variation in each equation (Bernanke, 1986). The usual innovation accounting procedures have been carried out on the VAR obtained by pre-multiplying equation (2) by A:

$$\begin{aligned} AP_t &= A\mu + A(I + \Pi + \Gamma_1)P_{t-1} \\ &- A\sum_{i=1}^{k-2}(\Gamma_i - \Gamma_{i+1})P_{t-i-1} - A\Gamma_{k-1}P_{t-k-1} + A\Psi Z_t + Ae_t \end{aligned} \quad (4)$$

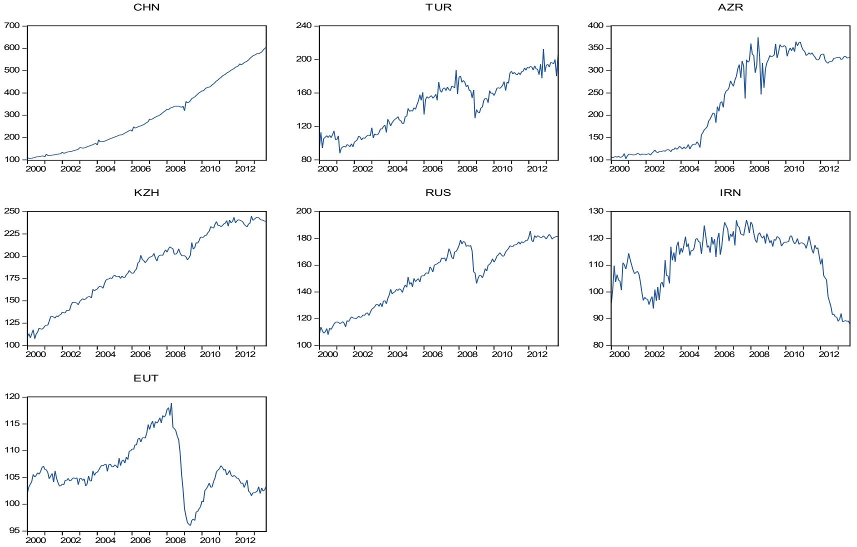
Swanson and Granger (1997) note that the relevant information for contemporaneous ordering is contained in the covariance matrix of the VECM error terms, and they suggest that a directed acyclic graphical representation can provide the Bernanke ordering. The consensus in the literature is that the use of causality modeling is an improvement over previous methodologies. As such, DAGs are used to obtain the Bernanke ordering (for further discussions, see Hoover, 2005; Park, Mjelde, & Bessler, 2008).

A directed acyclic graph is an illustration that is composed of arrows and vertices that represent the causal flow among a set of vertices. In this study, only directed acyclic graphs, which contain no directed cyclic paths, are considered. This represents the contemporaneous causal flow among the innovations from the VECM. In a DAG, arrows are used to represent causal flows where X → Y indicates that variable X causes variable Y. Two variables that are not connected by information flow are represented as two variables that do not have any arrow connecting them [for a detailed discussion of DAGs, see Pearl (2000), Spirtes et al., (2000)]. The GES algorithm within TETRAD IV (2004) is used to obtain the DAG from the variance / covariance matrix associated with the VECM innovations. The GES algorithm is a two-phase greedy search algorithm that looks over the equivalence classes[1]of the graphs starting from a graphical representation with no edges. A graph with no edges implies that all variables are independent of all other variables. The GES algorithm proceeds stepwise, searching over more complicated representations and scoring each using the Bayesian scoring criterion. Through the addition and deletion of single edge and through the reversal of the edge directions, GES scores each equivalence class for the DAGs of every state. After comparing the score, among all possible equivalence classes, the one equivalence class that increases the score the most is chosen for its next step. The greedy search means that the algorithm always moves in the direction that increases the score the most. This procedure is repeatedly conducted until no such replacement increases the score. The causal pattern that generates the maximum Bayesian score is searched over the equivalence classes by adding dependencies in the first phase. Once a local maximum has reached the first phase, the second phase begins by deleting a single edge and by comparing the scores of the DAG in equivalence classes repeatedly until a local maximum has been reached again. When the algorithm reaches a local maximum, it obtains an optimal solution (Chickering, 2003).

Data

The data in this study consists of seven industrial production indexes from each economy. All the data were obtained from Global Insight. Monthly data from January 2000 to September 2013 was used, providing 165 observations. The selected countries or economies are Turkey (TUR), Kazakhstan (KZH), Azerbaijan (AZR), Russia (RUS), China (CHN), Iran (IRN), and the total for the EU (EUT). According to Global Insight, "the ***Industrial Production Index*** typically measures the physical output that is produced by the domestic manufacturing, mining, and utilities sectors. For some countries, the industrial production index can also include activity in the construction sector." Hence, the industrial production index can be said to represent the physical business cycle of each economy.

FIGURE 1. *Industrial production indexes for seven economies (January 2000 to September 2013).*



EMPIRICAL RESULTS

Stationarity

Several transformations were conducted on the data to address this modeling issue before the estimation. Seasonality was removed from the industrial production index by using the corresponding procedure within E-views, and all subsequent estimations have performed on logarithmically transformed data, VECM estimation, and the subsequent model testing and analyses were conducted using RATS and CATS Version 6.2 (Dennis, 2006).

The logarithmically transformed data is used to conduct augmented Dickey-Fuller (ADF) tests (Fuller, 1976) (Table 1). The ADF tests indicate that all seven series are non-stationary at both the 5% and 10% level of significance. The tests for stationarity on the first differences indicate that all first differences are stationary at both the 5% and 10% level of significance. All series are non-stationary, indicating that the VECM is valid for hypotheses testing.

TABLE 1. *Augmented Dickey-Fuller (ADF) Tests*

Variable	Test statistic	Lag Lengthb	Probabilityc
Levels			
China- CHN	4.81	1	1.00
Turkey- TUR	-0.57	2	0.87
Azerbaijan- AZR	-0.89	2	0.78
Kazakhstan- KZH	-1.62	1	0.46
Russia- RUS	-1.34	0	0.60
Iran- IRN	-0.82	1	0.80
EU total- EUT	-2.85	3	0.05
First Differences			
China- CHN	-20.53	0	0.00
Turkey- TUR	-13.92	1	0.00
Azerbaijan- AZR	-15.21	1	0.00
Kazakhstan- KZH	-15.81	0	0.00
Russia- RUS	-15.20	0	0.00
Iran- IRN	-18.20	0	0.00
EU total- EUT	-3.86	2	0.00

[a] ADF test statistics are the t-statistics of the estimated coefficient on the lagged variable. The null hypothesis for the ADF test is that the variables are on-stationary.

[b] Length is determined based on SIC automatically, and the maximum lag length is 10.

[c] Mackinnon (1996) one–sided p-values.

Model Specification

The optimal lag length and the cointegrating rank were searched according to the loss measures, as Wang and Bessler (2005) suggested. The results suggest that there is one cointegrating vector or long-run relationship between the seven variables, with the constant excluded from the cointegrating space. The Schwartz loss measure is minimized at one cointegrating vector without a constant in the cointegrating space. Hence, the model specification used in the remainder of this study is that of one cointegrating vector without a constant.

TABLE 2. *Schwartz loss metric on 1-5 lags and 1-7 rank on VECM with and without constanta*

	Cointegration rank	Number of lags 1	2	3	4	5
With Constant	r = 1	-51.439	-51.359	-50.752	-50.100	-49.178
	r = 2	-51.388	-51.331	-50.756	-49.983	-49.094
	r = 3	-51.361	-51.266	-50.601	-49.807	-48.943
	r = 4	-51.243	-51.092	-50.440	-49.653	-48.806
	r = 5	-51.131	-50.961	-50.322	-49.555	-48.700
	r = 6	-51.037	-50.872	-50.242	-49.498	-48.638
	r = 7	-50.994	-50.832	-50.202	-49.461	-48.607
Without constant	r = 1	-51.518*	-51.481	-50.916	-50.125	-49.225
	r = 2	-51.490	-51.385	-50.731	-49.926	-49.044
	r = 3	-51.346	-51.185	-50.546	-49.762	-48.881
	r = 4	-51.203	-51.035	-50.405	-49.633	-48.756
	r = 5	-51.088	-50.924	-50.296	-49.549	-48.679
	r = 6	-51.020	-50.853	-50.225	-49.483	-48.619
	r = 7	-50.994	-50.832	-50.202	-49.461	-48.607

a r indicates the number of cointegrating vectors. “*” indicates the minimum value of Schwartz loss.

Tests of Exclusion and Weak Exogeneity

The null hypotheses for the exclusivity tests have been rejected for all seven series at a significance level of 5% or less, implying these seven series are in the cointegration space (Table 3). This result means that all seven series are part of one long-run relationship. The weak exogeneity null hypotheses were rejected for China, Azerbaijan, and Kazakhstan (Table 3) at a significance level of 5% or less. Accordingly, these three variables do not respond to perturbations in one cointegrating vector.

TABLE 3. *Exclusion Tests for Nine Variables from the Cointegration Space[a] and Weak Exogeneity Tests on Seven Variables assuming one cointegrating vector[b]*

Variables	Tests of exclusion		Tests on weak exogeneity	
	Chi-squared test	p-value	Chi-squared test	p-value
CHN	23.46	0.00	3.62	0.06
TUR	52.77	0.00	33.07	0.00
AZR	10.16	0.00	1.26	0.26
KZH	15.68	0.00	2.59	0.11
RUS	3.96	0.04	6.07	0.01
IRN	6.73	0.00	5.43	0.02
EUT	6.42	0.01	19.3	0.00
constant	14.47	0.00	-	-

a The null hypothesis of this test is that a series is not in the cointegration space.

b The null hypothesis of this test is that a series is weakly exogenous with respect to perturbations in the cointegrating vectors.

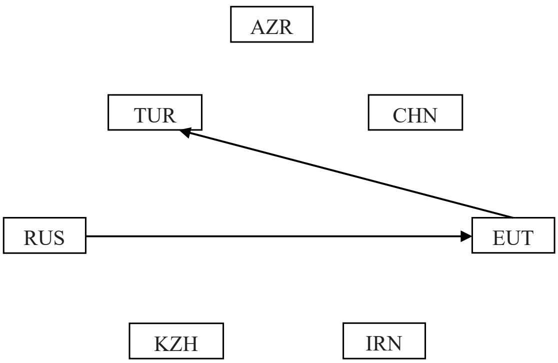
Identifying Contemporaneous Structure

The lower triangular elements of the contemporaneous innovation correlation matrix from the estimated VECM are:

$$
VCV = \begin{array}{ccccccc}
CHN & TUR & AZR & KZH & RUS & IRN & EUT \\
1.00 & & & & & & \\
0.220 & 1.00 & & & & & \\
0.104 & 0.039 & 1.00 & & & & \\
0.079 & 0.140 & 0.017 & 1.00 & & & \\
0.166 & 0.316 & -0.062 & 0.095 & 1.00 & & \\
-0.043 & 0.018 & 0.058 & 0.099 & -0.056 & 1.00 & \\
0.049 & 0.332 & 0.042 & 0.259 & 0.414 & 0.013 & 1.00
\end{array} \quad (5)
$$

Innovations from the three economies (Russia, Turkey and EU) show relatively strong correlations with each other with relatively weaker correlations with the remaining economies. The correlations from Equation (5) are used in the directed graph analysis to identify the Bernanke ordering structure. Based on this correlation matrix, the contemporaneous causal flows suggested by the GES algorithm are given in Figure 4. These flows give the Bernanke ordering for use in the innovative accounting measures, and these DAGs clearly show flows between the variables. Among the seven variables, the contemporaneous causal flows of only three variables, such as Russia, EU, and Turkey, were found to be linked. In a contemporaneous time period, Russia causes EU total and EU total causes Turkey.

FIGURE 2. *Directed Acyclic Graphs Showing Contemporaneous Relationships*

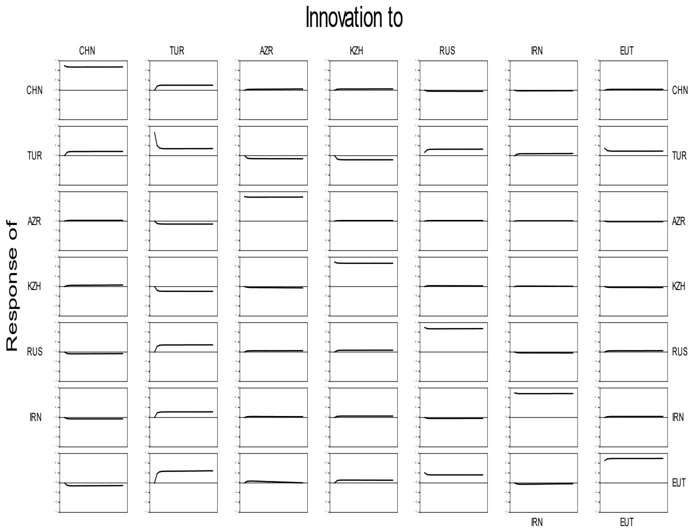


Impulse Response Functions

The impulse response functions are presented as a matrix of graphs with each element of the matrix corresponding to the response of one series to a one-time-only shock in another series (Figure 3). The horizontal axes on the sub-graphs represent the time horizon or the number of months after the shock. The vertical axes indicate the normalized response of the industrial production to the one-time-shock in each economy labeled at the top of each column of graphs. Normalization allows for comparisons of the relative responses across the variables, and the objective in presenting impulse response functions is not to provide the precise impact, but rather to show the direction and the relative magnitude of how the industrial production response to a shock in the industrial production of other economies. The horizon for the shock patterns is of twenty-four months. It should be noted, however, that impulse responses give the response to shocks in the error terms. Therefore, in the impulse response functions, the long- and short-run effects have been removed.

The response of Turkey to a shock in the China shows weak but long-lasting positive impulses. Shocks in China have a very small influence on Azerbaijan and Kazakhstan. The responses of Russia, Iran and EU to a shock in China show very weak but negative impulses. A shock in Turkey has no immediate influence but has a long-lasting positive influence on China, Russia, Iran and EU and a long-lasting negative influence on Azerbaijan and Kazakhstan. These negative responses suggest that Turkey may have a making-up relationship in these two economies. A shock in Azerbaijan, Kazakhstan and Iran has a very small influence on the other economies. The responses of Turkey and the EU to a shock in Russia show weak but long-lasting positive impulses while the other economies respond with small impulses to a shock in Russia. A shock in the EU has an immediate but long-lasting and weak influence on Turkey but no influence on the other economies.

FIGURE 3. *Standardized Responses of the industrial production to a Shock in industrial production for the Various Countries with One Cointegrating Vector.*



Forecast Error Variance Decomposition

The forecast error variance decompositions are given in Table 4. The decompositions provide the percentage of industrial production in each market at time t+k that is due to the innovation in each economy (including itself) at time t. Listed here are the results at horizons of zero (contemporaneous time), 5 months, 10 months and 20 months ahead.

TABLE 4. *Forecast Error Variance Decompositions[a] for Industrial production indexes for Various Months (Steps) Ahead*

	step	CHN	TUR	AZR	KZH	RUS	IRN	EUT
CHN	0	100.00	0.00	0.00	0.00	0.00	0.00	0.00
	5	95.96	3.48	0.12	0.21	0.12	0.04	0.10
	10	95.34	3.91	0.15	0.25	0.15	0.05	0.12
	20	94.97	4.19	0.19	0.27	0.17	0.04	0.13
TUR	0	0.00	88.97	0.00	0.00	1.88	0.00	9.13
	5	5.57	59.08	2.76	5.23	14.58	1.26	11.48
	10	7.54	49.11	3.77	7.06	18.72	1.75	12.02
	20	9.02	41.60	4.57	8.39	21.80	2.17	12.42
AZR	0	0.00	0.00	100.00	0.00	0.00	0.00	0.00
	5	0.07	1.07	98.69	0.06	0.04	0.01	0.03
	10	0.08	1.22	98.50	0.07	0.04	0.01	0.03
	20	0.09	1.31	98.40	0.08	0.05	0.02	0.04
KZH	0	0.00	0.00	0.00	100.00	0.00	0.00	0.00
	5	0.21	2.95	0.11	96.49	0.09	0.03	0.09
	10	0.26	3.39	0.14	95.93	0.10	0.03	0.11
	20	0.32	3.66	0.18	95.56	0.10	0.03	0.12
RUS	0	0.00	0.00	0.00	0.00	100.00	0.00	0.00
	5	0.40	6.32	0.21	0.40	92.34	0.09	0.20
	10	0.45	7.25	0.24	0.47	91.23	0.11	0.23
	20	0.45	7.80	0.26	0.51	90.56	0.12	0.26
IRN	0	0.00	0.00	0.00	0.00	0.00	100.00	0.00
	5	0.25	3.85	0.11	0.24	0.13	95.27	0.12
	10	0.29	4.41	0.12	0.28	0.14	94.59	0.13
	20	0.31	4.76	0.12	0.30	0.15	94.20	0.14
EUT	0	0.00	0.00	0.00	0.00	17.14	0.00	82.86
	5	0.85	13.34	0.32	0.81	9.35	0.17	75.12
	10	0.92	14.99	0.28	0.89	8.61	0.17	74.10
	20	0.92	16.15	0.18	0.90	8.13	0.14	73.37

a Forecast Error Variance Decompositions are partitions based on innovations observed from the estimated vector error correction model. The entries sum to one hundred (within rounding error) for any particular row. The interpretation of each row is as follows. Looking ahead at the horizon given in the far left-hand column (0, 5, 10, or 20 months), the percentage of uncertainty for the variable is attributable to a variation in each series in the column.

The uncertainty associated with contemporaneous industrial production in China can be explained in itself by contemporaneous period shocks, CHN(100%). The variation in CHN is explained by the innovations from its own industrial production, CHN(94.97%) and TUR(4.19%) at the 20-month horizon. In contemporaneous time, the variation in TUR is explained by TUR(88.9%), RUS(1.88%) and EUT(9.13%). However, at a 20-month horizon, CHN(9.02%), TUR(41.60%), AZR(4.57%), KZH(8.39%), RUS(21.80%), IRN(2.17%) and EUT(12.42%) account for the variation in TUR. CHN, AZR, KZH, RUS and IRN are exogenous in contemporaneous time, but are less exogenous at a longer horizon. In contemporaneous time, the variation in EUT is explained by EUT(82.86%) and RUS(17.14%). At a 20-month horizon, however, the variation in EUT is explained by TUR(16.15%), RUS(8.13%) and EUT(73.37%). These results imply TUR, RUS and EUT have more influence on each other than on the other economies and have more influence in long run than in the short run.

DISCUSSION AND CONCLUSIONS

The short- and long-run linkages between the seven economies have been investigated in depth. While the DAG analysis provides contemporaneous linkages between the physical business cycle of the seven economies, the innovation accounting, forecast error variance decomposition and impulse response functions allow examining the dynamic effects. This study found that seven industrial productions, physical business cycles, have a unit root, indicating that the series of industrial production are non-stationary and are tied together with one long-run cointegration relationship. The results of the exclusion and exogeneity tests show that all of the industrial production for the seven economies exhibits long-run cointegration and that the economies, except China, Azerbaijan and Kazakhstan, respond to a perturbation in one long-run relationship.

According to the DAG results, only three economies, Turkey, Russia and EU are linked together in terms of their industrial production in contemporaneous time. The contemporaneous causal pattern suggests that Russia appears to be a driving force for the other two economies. In contemporaneous time, Russia causes EU and EU causes Turkey. The other four economies, China, Iran, Azerbaijan and Kazakhstan, are not in the contemporaneous casual flows. Unlike our expectations, two former members of the Soviet Union, Azerbaijan and Kazakhstan, are not linked to Russia in contemporaneous time. It would be difficult to find the factors that cause co-movements in industrial production of the seven economies because many economic factors may be related. These may include the volume of international trade and foreign direct investment, the interdependency of industry through intra- or inter- industrial trade, the degree of specialization of industry, the sensitivity to major exporting markets and so on. However, a plausible explanation of this result may be due to the specialized industrial production structure to the energy sector of two countries, unlike Russia. The physical business cycle of Iran and China appears to be unrelated with that of the EU economies.

The forecast error variance decompositions and the impulse response functions provide an analysis of the dynamic information flows over time. The influence of China in Turkey appears in the long-run, but it is small. The impulse response functions also show the innovations in China have a small but positive influence on Turkey. The fact that the influence of Turkey in Azerbaijan and Kazakhstan is a little greater than that of Russia is interesting. This may indicate that Turkey has a greater influence in Azerbaijan and Kazakhstan than Russia in terms of industrial production in the long run. In addition, Turkey accounts for a relatively larger amount of forecast error variance in the long run in Iran than other economies do. The forecast error variance of the EU is explained by itself and Russia in contemporaneous time, but Turkey accounts for a greater amount of the forecast error variance of the EU in the long run. A similar pattern is found in the case of the forecast error variance of Russia, and turkey accounts for more of the forecast error variance of Russia than the EU in the long run. This implies that Turkey may play an important role in the information flows of industrial production in the seven economies. The combined results for DAG, the forecast error variance decompositions, and the impulse response functions, physical business cycles of Azerbaijan and Kazakhstan do not move together in the short run, but move together in the long run. This result, however, differs from that of Jenish (2012) that finds business cycles of Kazakhstan and Russia are synchronized. This may be due to different variables such as Industrial production and GDP considered in two analyses. As for the interdependence of business cycles between Turkey and EU, our findings that Turkish business cycle is influenced by EU, as a whole, are consistent with those of previous studies (Akkoyunlu and Kholodilin, 2008; Gouveia, 2014; Akkoyun et al., 2014; Sayek and Selover, 2002, Erden and Ozkan, 2014) except that by Berument et al (2001).

This study has some limitations. First, the industrial production data were used for the analysis instead of GDP due to the issues related to the degrees of freedom. Further, only two of Central Asian countries were included in the analysis due to data availability. In addition, this study does not explicitly explain the causes that bring about the interdependency structure in the short run and in the long run. Finding the cause thereof is a possible research topic for a future study.

Endnotes

1 Two DAGs are said to be equivalent if these two DAGs are both distributional and independence equivalent. Two DAGs are distributional equivalent when two corresponding Bayesian networks(a graphical model for probabilistic relationships among a set of variables; Heckerman, 1996) have the same probability distribution. Two DAGs are independence equivalent if the independence constraints in the two DAGs are identical (Chickering, 2003)

References

Ahat, Andican. (2013). "Bağımsızlıktan Günümüze Kırgızistan-Türkiye İlişkileri ve Geleceğe İlişkin Düşünceler", in (ed.) Stratejik Düşünce Enstitüsü, *Kırgızistan - Türkiye İlişkilerinin Geleceği*, pp.3-9.

Akkoyun, H.C., Sen-Dogan, B., & Gunay, M. (2014). "Business cycle synchronization of Turkey with the Eurozone and the United States: What has changed since 2001?" *Emerging Markets Finance & Trade, 50(4)*, pp. 26-41.

Akkoyunlu, S., & Kholodilin, K.A. (2008). "A link between workers'remittances and business cycles in Germany and Turkey " *Emerging Markets Finance & Trade*, 44(5), pp. 23–40.

Aslan, Rıza. (2000). "Türkiye-Avrupa Birliği: Sancılı Gelişen İlişki." *Ankara Üniversitesi SBF Dergisi*, vol.55, no.3, pp.9-28.

Awokuse, T.O. (2006). "Export-led growth and the Japanese economy: evidence from VAR and directed acyclic graphs", *Applied Economics*, 38, pp. 593-602.

Aybet, Gülnur. (2006). "Turkey and the EU After the First Year of Negotiations: Reconciling Internal and External Policy Challenges." *Security Dialogue*, vol.37, no.4, December, pp.529-549.

Aydın, Zülküf. (2012). “ Global crisis, Turkey and the regulation of economic crisis.” *Capital & Class*, vol. 37, no.1, pp.95 –109.

Batmaz, Nihat,. (2004). “Türkiye-Kazakistan Arasındaki Ticari-Ekonomik İlişkiler, Türk Müteşebbislerinin Bu Ülkede Yaptıkları Yatırımların Boyutu ve Karşılaştıkları Sorunlar.” *Bilig*, no.29, pp.83-104.

Batur, Erdi,. (1997). “Türkiye Avrasya İlişkileri.” *Amme İdaresi Dergisi*, vol.30, no.1, pp 109-127. Bernanke, B.S., 1986. Alternative explanations of the money-income correlation. *Carnegie-Rochester Conference Series on Public Policy,* 25, pp. 49-99.

Berument, M.H., Malatyali, N.K., & Neyapti, B. (2001). “Turkey’s full membership to the European Union.” *Russian and East European Finance and Trade, 37(4)*, pp. 50-60.

Bessler, D.A., & Lee, S. (2002). “Money and Prices: U.S. Data 1869-1914 (A study with directed graphs). “ *Empirical Economics*, vol.27, pp. 427–446.

Bessler, D.A., & Loper, N. (2001). “Economic Development: Evidence from directed acyclic graphs. “ *The Manchester School*, 69(4), pp. 457–476.

Bessler, D.A., & Yang, J. (2003). “The structure of interdependence in international stock markets. “ *Journal of International Money and Finance*, vol.22, pp. 261–287.

Cem, Ismail. (2001). Turkey in the New Century, Rustem Publishing.

Chen, Chien-Fu. (2009). “Is the international transmission of business cycle fluctuation asymmetric? Evidence from a regime-dependent impluse response function.” *International Research Journal of Finance and Economics*, 26, pp.134-143.

Chickering, D.M.(2003) “Optimal Structure Identification with Greedy Search.” Journal of Machine Learning Research 3, pp.507-554.

Crowley, P.M. (2008). “One money, several cycles? Evaluation of European business cycles using model-based cluster analysis.” Bank of Finland Research Discussion Paper 3/ Bank of Filand, Helsinki.

Dennis, G.J. (2006). *CATS in RATS: Cointegration Analysis of Time Series.* Version 2. Evanston, IL: Estima.

Dickey, D.A., Hasza, D.P, & Fuller, W.A.. (1984). Testing for unit roots in seasonal time series. *Journal of the American Statistical Association,* 79(386), pp.355-367.

Emerson, Michael. (2014). “Toward a Greater Eurasia: Who, Why, What, and How?” *Global Journal of Emerging Market Economies*, vol.6, no.1, pp. 35–68.

Erden, Lutfi., & Ozkan, I. (2014). “Determinants of international transmission of business cycles to Turkish economy” *Economic Modelling*, vol.36, pp. 383–390.

Erten, Behzat (2013). “Kırgızistan-Türkiye Ticari ve Ekonomik İlişkileri”, in (ed.) Stratejik Düşünce Enstitüsü, *Kırgızistan - Türkiye İlişkilerinin Geleceği*, pp. 24-34.

Flood, R.P., & Rose, A. (2010). “Inflation targeting and business cycle synchronization “ *Jounal of International Money and Finance*, 29(4), pp. 704–727.

Frankel, J.A., & Rose, A.K. (1998). “The endogeneity of the optimum currency area criteria.” *The Economic Journal*, 108(449), pp.1009-1025.

Fuller, W. (1976). *Introduction to Statistical Time Series*. New York, NY: John Wiley and Sons.

Gomez, D.M., Ortega, G., & Torgler, B.(2012). “Synchronization and diversity in business cycles. A network approach applied to the European union” QUT school of Economics and Finance, working Paper 277.

Gouveia, Sofia. (2014). “Business cycle correlation between the Euro area and the Balkan countries.” *International Journal of Economic Sciences and Applied Research*, 7(1), pp.33-49.

Habibi, Nader, May. (2012). “Turkey and Iran: Growing Economic Relations Despite Western Sanctions.” *Middle East Brief*, no.62.

Hansen, H., & Juselius, K.. (1995). *CATS in RATS: Cointegration Analysis of Time Series.* Evanston, IL: Estima.

Heckerman, D. (1996). “A Tutorial on Learning Bayesian Networks.” Redmond, WA: Microsoft Research, Technical Report MSR-TR-95-06.

Hoover, K.D. (2005). Automatic inference of the contemporaneous causal order of a system of equations. *Econometric Theory,* 21(1), pp.69-77.

Imbs, J. (2004). “Trade, Finance, Specialization, and Synchronization” The Review of Economics and Statistics, 86(3), pp. 723–734.

Inklaar, R., Jong-A-Pin, R. & de Hann, J. (2008). “Trade and business cycle synchronization in OECD countries-A re-examination” *European Economic Review, 52*(2), pp. 646-666.

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models. *Econometrica,* 59(6), pp.1551-1580.

Johansen, S.. (1992). Determination of cointegration rank in the presence of a linear trend. *Oxford Bulletin of Economics and Statistics,* 54(3), pp.383-397.

Juselius, K.. (2006). *The Cointegrated VAR Model*. Oxford: Oxford University Press.

Karamyan, Aram, Tilak Ishtiaq and Rizwan Naseer, May (2012). “Turkish Growing Influence in Central Asian Countires in Post-Cold War Era.” *Berkeley Journal of Social Sciences*, vol.2, issue 5.

Kaya, Ahmet. (2013). “ Türkiye - Kırgızistan Ekonomi - Ticaret İlişkileri”, in (ed.) Stratejik Düşünce Enstitüsü, *Kırgızistan - Türkiye İlişkilerinin Geleceği*, pp. 10-16.

Kazak, Metin. (2010). “Türkiye ile Ticari ve Ekonomik iliskiler”, *AP Uluslararası Ticaret Komitesi Session Document*.

Kose, M.A., Prasad, E.S. & Terrones, M.(2003). “How does globalization affect the synchronization of business cycle?” *American Economic Review, 93*(2), pp. 57-62.

Kramer, Heinz, March-May. (1996). “Will Central Asia Become Turkey’s Sphere of Influence.” *Perceptions*, vol.1.

Li, G., Song, H., & Witt, S.F. (2005). Recent developments in econometric modeling and forecasting. *Journal of Travel Research*, 44(1), pp.82-99.

Mackinnon, J.G. (1996). Numerical distribution functions for unit root and cointegration tests. *Journal of Applied Econometrics,* 11, pp.601-618.

Matesanz, D., & Ortega, G. J. (2016). “On business cycles synchronization in Europe: A note on network analysis “ *Physica A*, 462, pp. 287–296.

Morozov, Viatcheslav and Bahar Rumelili. (2011). “The External Constitution of European Identity: Russia and Turkey as Europe-makers.” *Cooperation and Conflict*, vol.47, no.1, pp. 28 –48.

MÜSİAD. (2013). *Batı Sonrası Dünya Doğru Türk Dış Politikası*, Istanbul.

Mutlu, Gülay. (2014). “Çin’in İpek Yolu Politikası ve Orta Asya’ya Etkisi”, Eko Avrasya, no.26.

Öniş, Ziya. (2008). “Turkey-EU Relations: Beyond the Current Stalemate.” *Insight Turkey*, vol.10, no.4, pp. 35-50.

Osborn, D.R., Perez, P.J., & Sensier, M.(2005). “Business cycle linkages for the G7 countries: does the US lead the world?” Centre for Growth and Business Cycle Research, University of Manchester Discussion Paper 050.

Park, H., Mjelde, J.W., & Bessler, D.A.(2006). “Price dynamics among U.S. electricity spot markets.” *Energy Economics, 28*, pp. 81-101.

Park, H., Mjelde, J.W., & Bessler, D.A.(2008). “Price interactions and discovery among natural gas spot markets in North America.” *Energy Policy,* 36(1), pp. 290-320.

Pearl, J. (1995). “Causal diagrams for empirical research.” *Biometrika, 82*, pp. 669-710.

Pearl, J. (2000). *Causality Models, Reasoning, and Inference*. Cambridge, Massachusetts: Cambridge Press.

Samuelson, P.A., 1971. Stochastic speculative price. *Proceedings of the National Academy of Sciences,* 68(2), pp. 335-337.

Sayek, S., & Selover, D.D. (2002). “International interdependence and business cycle transmission between Turkey and the European Union.” *Southern Economic Journal*, 69(2), pp.206-238.

Selçuk Esenbel & Altay Atlı, September 30. (2013). "Turkey's Changing Foreign Policy Stance: Getting Closer to Asia?", Middle East Institute.

Sims, C.(1980). Macroeconomics and reality. *Econometrica,* 48(1), pp. 1-48.

Solak, Fahri. (2003). "Türkiye-Orta Asya Cumhuriyetleri Dış Ticaret İlişkilerinin Gelişimi." *T.C. Marmara Üniversitesi İ.İ.B.F. Dergisi*, vol.18, no.1, pp.69-96.

Spirtes, P., Glymour, C., & Scheines, R.(2000). *Causation, prediction, and search*. Cambridge, Massachusetts: MIT Press.

Swanson, N.R., & Granger, C.W.J.(1997). Impulse response functions based on a causal approach to residual orthogonalization in vector autoregressions. *Journal of the American Statistical Association,* 92(437), pp.357-367.

Taşağıl, Ahmet. (2010). "Türkiye'nin Orta Asya Türk Cumhuriyetleri ile ilişkilerinin Dünü, Bugünü ve Yarini", Mimar Sinan Üniversitesi, Fen-Edebiyat Fakültesi, Tarih Bölümü.

Tastan, H., & Yildirim, N. (2008). "Business cycle asymmetrics in Turkey: an application of Markow-switching autoregressions." *International Economics Journal*, 22, pp.315-333.

TC Ekonomik İşler Genel Müdürlüğü, TC Dışişleri Bakanlığı,. (2015). "Türkiye'nin Dış Ekonomik İlişkileri". http://www.mfa.gov.tr/turkiye_nin-dis-ekonomik-i-liskileri.tr.mfa

TETRAD IV Manual. (2004). Available at http://www.phil.cmu.edu/projects/tetrad/tetrad4.html. Accessed January 2015.

Tiao, G. & Box, G.(1981). Modeling Multiple time series with applications. *Journal of the American Statistical Association*, 76(376), pp.802-816.

Wang, Z., & Bessler, D.A.(2005). A Monte Carlo study on the selection of cointegrating rank using information criteria. *Econometric Theory,* 21(3), pp.593-620.

Xi, N., Muneepeerakul, R., Azaele, S., & Wang, Y. (2014). "Maximum entropy model for business cycle synchronization." *Physica A, 413*, pp. 189-194.

Yardımcıoğlu, Mahmut, Hilal Kocamaz and Gamze Şerbetçi, 1-2 Ekim. (2012). "Türkiye'de Dış Ticaret ve Ticari İlişkiler." *II.Bölgesel Sorunlar ve Türkiye Sempozyumu*, pp.339-346.

Zhussipbek, Galym, August. (2013). "What Defines Turkey and Central Asia Relations", The Washington Review of Turkish & Eurasian Affairs. http://www.thewashingtonreview.org/articles/what-defines-turkey-and-central-asia-relations.html

Türkiye ve Orta Asya Ülkelerinin Endüstriyel İş Döngüsündeki Karşılıklı Bağımlılığı*

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Öz

Yedi ülke ya da ekonomi (Türkiye, Kazakistan, Azerbaycan, Rusya, Çin, İran ve AB) arasındaki dinamik Karşılıklı bağımlılık vektör hata düzeltme modeli ve endüstriyel üretim indeksi aylık verileri kullanılarak ölçülmüştür. Genel olarak, sonuçlar eş zaman olarak dilimi içinde Rusya'nın endüstriyel üretiminin AB'yi, AB'nin endüstriyel üretiminin ise Türkiye'yi etkilediğini göstermektedir. Bu durum örneğin Azerbaycan ve Kazakistan gibi iki Orta Asya ülkesinin endüstriyel üretim açısından Rusya ya da Türkiye'yle bağlantısı olmadığı anlamına gelmektedir. Buna rağmen, yedi ekonominin tüm endüstriyel üretimi uzun vadede tek bir eşbütünleşme ilişkisiyle birbirine bağlıdır.

Anahtar Kelimeler

Karşılıklı bağımlılık , Türkiye, Orta Asya Ülkeleri, konjonktür dalgaları, asiklik yönlü

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Взаимозависимость экономического цикла между Турцией и отдельными странами Центральной Азии*

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Аннотация

Динамическая взаимозависимость между семью странами или экономиками (Турция, Казахстан, Азербайджан, Россия, Китай, Иран и ЕС) рассматривается с использованием модели векторной коррекции ошибок, направленного ациклического графа (DAG) и ежемесячных данных индекса промышленного производства. В целом, результаты показывают, что промышленное производство России влияет на ЕС и промышленное производство ЕС влияет на Турцию в данном временном горизонте, что означает, что две страны Центральной Азии, такие как Азербайджан и Казахстан, не имеют связи с Россией или Турцией с точки зрения их промышленного производства для данного временного горизонта. Тем не менее, все промышленные производства семи экономик связаны между собой в долгосрочном периоде в одном коинтеграционном отношении.

Ключевые слова

Взаимозависимость, Турция, Центральная Азия, международный экономический цикл, направленный ациклический граф

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