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The relationships among the returns of investment instruments: a vector autoregressive approach for Turkey

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Abstract. *This paper that uses monthly data from 2003:M01 to 2016:M07 investigates the relationships among monthly real rates of return of stocks, USD, one-month deposits, and gold in Turkey by employing vector autoregressive (VAR) analysis. The findings of the paper indicate that while stocks seem to be a good investment instrument against USD and gold, USD is a good investment instrument against stocks and one-month deposits. Besides, gold is a plausible investment instrument against one-month deposits. Therefore, the paper yields that only stocks and USD are good investments instruments against each other in Turkey. In conclusion, the paper reveals that financial market participants in Turkey do not consider short-term fluctuations of returns of assets very much and that they may be interested in the long-run return of an asset.*

Keywords: Financial and non-financial assets, return of financial investment instruments, vector autoregressive analysis.

JEL Classification: C32, G11, G23.

1. Introduction

Financial markets experience a rapid change in today's world. Within this scope, financial markets and the variety of financial assets in these markets continuously develop. As is known, economic actors whose incomes are greater than expenditures invest in financial markets in order to make use of their savings. Investors in financial markets may invest in more than one investment instruments to utilize returns of different investment instruments and to decrease investment risks. In other words, they may diversify their portfolios. In developed countries, stocks take place on the top among these instruments as investors can invest in many firms' stocks from different sectors in stock markets (Yildiz, 2014). However, stock markets are considered as mixed and risky markets. Short and long-term interest rates on bank deposits present interest incomes to their investors. Investors who desire relatively safe return prefer deposits in financial markets. One of the basic investment instruments in financial markets is gold. Gold is seen as a safe harbor and is especially preferred by investors when there exist uncertainty and crises. Investors can also make money by investing in different currencies.

Movements in prices and yields of financial instruments affect both current incomes and future financial decisions of investors. Within this scope, an increase in interest rates may decrease investments in foreign exchanges and stock markets (Senturk and Ducan, 2014). Besides, some investors who want safety usually invest in bonds and/or deposits. On the other hand, some financial market participants invest in gold to decrease risk and to defence themselves against volatility in financial markets.

This paper aims at examining the relationships among monthly returns of stocks, USD, one-month deposits, and gold over the period 2003-2016 for Turkey. The remainder of the paper is structured as follows: Section 2 gives empirical literature. Data are introduced in Section 3. Section 4 presents estimation methodology. Estimation results are reported in Section 5. Section 6 concludes the paper.

2. Brief literature

When one examines the empirical literature on the returns of investment instruments, he/she will observe that many papers have been conducted so far. He/she will also observe that these papers have focused on the relationships among stocks, deposits, foreign exchange, and gold.

Najand and Noronha (1998), using data over the period 1977-1994 for Japan, examine the causal relationships among return of stocks, inflation, interest rates, and industrial production. They yield that inflation Granger causes return of stocks in Japan. Gjerde and Saettem (1994) examine the macroeconomic variables that affect return of stocks for the period 1974-1994 for Norway through a vector autoregressive (VAR) analysis. They find that return of stocks is negatively related to interest rates and is positively related to industrial production. Koch and Saporoschenko (2011) investigate the relationships among return of stocks, interest rates, and exchange rates over the period 1986-1992 for Japan by performing a generalized autoregressive conditional heteroscedasticity (GARCH) model. According to the findings of the paper, an increase in interest rates negatively affects return of stocks. Rapach et al. (2005) consider the predictability of return of stocks in 12 industrialised countries for the period 1970-1990 using some macroeconomic variables, such as interest rates, inflation rates, industrial production index, money stock, and unemployment rates. They yield that all these variables can be employed to forecast return of stocks. Abugri (2008) examines the effects of exchange rates, interest rates, industrial production, and money supply on return of stocks for the period 1986-2001 in four Latin American countries (Argentina, Brazil, Chile, and Mexico) by conducting VAR analysis. The findings of the paper reveal that all variables have effects on return of stocks.

In addition to these papers, several studies have been conducted in order to examine the relationships among returns of investment instruments in Turkey. The papers mentioned in the rest of this section have focused on Turkish financial markets. For instance, Karaca (2005), who uses data covering the period 1990-2005 and employs ARDL method, examines the relationships between interest rates and exchange rates and finds out that there is a weak and positive relationship between these variables only for the period 2001-2005. Kasman et al. (2011) explore the effects of interest rates and exchange rates on return of stocks of Turkish banks for the period 1999-2009 by employing ordinary least squares (OLS) and GARCH. They yield that return of stocks is negatively related to interest rates and exchange rates. Aksoy and Topcu (2013), using data over the period 2003-2011, analyse the relationships among return of stocks, government bonds, and gold and find out that return of stocks is negatively related to return of gold. Yildiz (2014) investigates the relationships among stock prices, interest rates, exchange rates, and gold prices using data over the period 2001-2013 by way of VAR analysis. They yield that stock prices are negatively related to interest rates and exchange rates. Senturk and Ducan (2014), who use data for the period 1997-2013 and perform VAR analysis and Granger causality test, examine the relationships among interest rates, exchange rates, and return of stocks. The findings of the paper indicate that i) return of stocks is negatively related to interest rates and exchange rates, ii) interest rates are negatively related to return of stocks and exchange rates, iii) exchange rates are negatively related to return of stocks and positively related to interest rates. The findings also show that there is unidirectional causality running from exchange rates to return of stocks and from interest rates to exchange rates. Oncu et al. (2015) examine the relationships among stock prices, gold prices, and exchange rates using data that covering the period 2002-2013. They yield that i) exchange rates Granger cause stock prices and ii) gold prices Granger cause stock prices and exchange rates.

3. Data

This paper performs a time series analysis for Turkey using monthly data from 2003:M01 to 2016:M07 in order to examine the relationships among monthly rates of return of some financial and non-financial assets (%). While financial assets are stocks, US Dollar, and one-month bank deposits, the non-financial asset is gold in this paper. BIST100, USD, DEPOSIT, and GOLD represent the monthly real rates of return of stocks, US Dollar, one-month deposits, and gold, respectively. Thereby all rates of return are adjusted for changes in consumer prices. All data are extracted from Turkish Statistical Institute.

Table 1. *Descriptive statistics and correlation matrix*

	BIST100	USD	DEPOSIT	GOLD
Descriptive statistics				
Mean	0.742	-0.247	0.604	0.346
Median	0.600	0.480	0.410	-0.170
Maximum	44.900	23.400	16.200	27.300
Minimum	-34.400	-20.200	-3.800	-12.090
Std. deviation	10.540	4.101	1.695	5.005
Observations	163	163	163	163
Correlation matrix				
BIST100	-	-0.312	0.035	-0.305
USD	-0.312	-	-0.205	0.601
DEPOSIT	0.035	-0.205	-	-0.019
GOLD	-0.305	0.601	-0.019	-

Table 1 reports descriptive statistics and correlation matrix for variables. One notes that all descriptive statistics of BIST100 except for minimum are greater than those of other variables. One notes, as well, BIST100 is negatively correlated to USD and GOLD and is positively correlated to DEPOSIT while USD is negatively correlated to DEPOSIT and is positively correlated to GOLD. Finally, he/she notes that DEPOSIT is negatively correlated to GOLD. Descriptive statistics and correlation matrix can provide one with some initial inspection, but one should consider some statistical methodologies to obtain more efficient estimations.

4. Methodology

4.1. Unit root tests

Specifying the order of integration of variables is the first step in time series analyses since one may experience spurious regression problem when analyses employ conventional ordinary least squares (OLS) estimations.

Unit root tests developed by Dickey and Fuller (1981, hereafter ADF) and Phillips and Perron (1988, hereafter PP) are commonly utilized in econometrics literature. The main shortcoming of these tests is that they do not take into account possible structural breaks in series. However, it should be considered that series may have structural breaks before a long-term relationship among variables is investigated.

Narayan and Popp (2010) propound a unit root test with two structural breaks endogenously determined. They propose two models allowing for two structural breaks. The first model, namely M1, allows for two structural breaks in intercept while the second model, namely M2, allows for two structural breaks in intercept as well as trend.

The data-generating process of a time series $y_t = d_t + u_t$ that Narayan and Popp (2010) define has two components, a deterministic component (d_t) and a stochastic component (u_t) where u_t exhibits an AR (1) process. Models are demonstrated as follows:

$$d_t^{M1} = \alpha + \beta t + \Psi^*(L)\left(\theta_1 DU'_{1,t} + \theta_2 DU'_{2,t}\right) \quad (1)$$

$$d_t^{M2} = \alpha + \beta t + \Psi^*(L)\left(\theta_1 DU'_{1,t} + \theta_2 DU'_{2,t} + \gamma_1 DT'_{1,t} + \gamma_2 DT'_{2,t}\right) \quad (2)$$

where $DU'_{i,t} = 1\left(t > T'_{B,i}\right)$, $DT'_{i,t} = 1\left(t > T'_{B,i}\right)\left(t - T'_{B,i}\right)$, i=1,2.

Here, $T'_{B,i}$, i = 1,2 denotes the true break dates. The parameters θ_i and γ_i stand for the magnitude of the intercept and trend breaks, respectively. Narayan and Popp (2010) remark that the inclusion of $\Psi^*(L)$ allows breaks to happen slowly over time. Therefore, the proposed model is an innovative outlier class of models since it is based on the idea that the series responds to shocks to the trend function in a similar way as it responds to shocks to the innovation process, e_t.

The test regressions are the reduced forms of the corresponding structural model. They are showed as follows:

$$y_t^{M1} = \rho y_{t-1} + \alpha_1 + \beta^* t + \theta_1 D(T'_B)_{1,t} + \theta_2 D(T'_B)_{2,t} + \delta_1 DU'_{1,t-1} + \delta_2 DU'_{2,t-1} +$$
$$+ \sum_{j=1}^{k} \beta_j \Delta y_{t-j} + e_t \quad (3)$$

$$y_t^{M2} = \rho y_{t-1} + \alpha^* + \beta^* t + \Omega_1 D(T'_B)_{1,t} + \Omega_2 D(T'_B)_{2,t} + \delta_1^* DU'_{1,t-1} + \delta_2^* DU'_{2,t-1} +$$
$$+ \gamma_1^* DT'_{1,t-1} + \gamma_2^* DT'_{2,t-1} \sum_{j=1}^{k} \beta_j \Delta y_{t-j} + e_t \quad (4)$$

The break dates are determined using a sequential procedure (see Narayan and Popp (2010) for the details of this procedure). The null hypothesis of a unit root of $\rho = 1$ is tested against the alternative hypothesis of $\rho < 1$, and t-statistics of $\hat{\rho}$ in Equations 3 and 4 are used. Critical values are generated through Monte Carlo simulations and depicted in Table 3 in Narayan and Popp (2010). If calculated test statistics are greater than critical values, the null hypothesis of a unit root is rejected.

4.2. VAR analysis

VAR models suggested by Sims (1980) are commonly employed to forecast systems of interrelated time series and to analyse the dynamic impact of random disturbances on variables. Every endogenous variable in the system is a function of the lagged values of all endogenous variables.

A VAR model can be expressed in matrix notations as the following (Maddala, 1992):

$$y_t = A_1 y_{t-1} + \ldots + A_p y_{t-p} + m + \varepsilon_t \quad (5)$$

where y_t is a kx1 vector of endogenous variables, m is a kx1 vector of constants, $A_1, \ldots, A_p$ are k x k matrices of coefficients to be estimated, and ε_t is a kx1 vector of white noise process.

If it is assumed that k = 2 and p = 1, the VAR model is expressed as follows (Johnston and Dinardo, 1997):

$$y_t = \begin{bmatrix} y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} m_1 \\ m_2 \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} y_{1,t-1} \\ y_{2,t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} = m + A y_{t-1} + \varepsilon_t \quad (6)$$

This model can be expressed via equations as below:

$$y_{1t} = m_1 + a_{11} y_{1,t-1} + a_{12} y_{2,t-1} + \varepsilon_{1t} \quad (7)$$

$$y_{2t} = m_2 + a_{21} y_{1,t-1} + a_{22} y_{2,t-1} + \varepsilon_{2t} \quad (8)$$

Hence, in all VAR models, each variable is stated as a linear combination of lagged values of itself and of all other variables in the system.

Johnston and Dinardo (1997) explain impulse-response functions obtained through the estimation of the VAR models. Accordingly, a shock in ε_{1t} has an instant effect on y_{1t}, but no effect on y_{2t}. In period t+1, this shock in y_{1t} affects $y_{1,t+1}$ via the first equation and also affects $y_{2,t+1}$ via the second equation. These effects continue to period t+2, and so forth. Thus a shock in the VAR model starts a chain reaction over time in all variables in the VAR system. Hence these chain reactions are calculated by impulse-response functions.

5. Findings

Table 2 depicts the results of ADF and PP unit root tests. As is seen from the table, the null hypothesis of a unit root can be rejected for variables. In other words, all variables are stationary.

Table 2. *ADF and PP unit root tests*

Variable		ADF test statistic		PP test statistic	
		Intercept	Intercept and trend	Intercept	Intercept and trend
BIST100		-10.388*	-10.503*	-10.451*	-10.534*
USD		-8.697*	-9.088*	-9.097*	-9.163*
DEPOSIT		-10.211*	-12.113*	-10.685*	-12.102*
GOLD		-9.653*	-9.644*	-9.579*	-9.569*
Critical values	1%	-3.470	-4.015	-3.470	-4.015
	5%	-2.879	-3.437	-2.879	-3.437
	10%	-2.576	-3.143	-2.576	-3.143

Note: * indicates the rejection of the null hypothesis at 1% level of significance.

Table 3 presents Narayan and Popp (2010) unit root test's results. Accordingly, all variables are stationary with regard to both models of the test. Break dates obtained from Narayan and Popp (2010) unit root test correspond to some considerable periods for the Turkish economy. Accordingly, the financial turbulence in Turkey in May 2006 may account for the break in 2006. The global financial crisis in 2008-2009 may account for the breaks detected for 2008 and 2009. The sovereign debt crisis in Euro Area might account for the breaks detected for 2011.

Table 3. *Narayan and Popp (2010) unit root test*

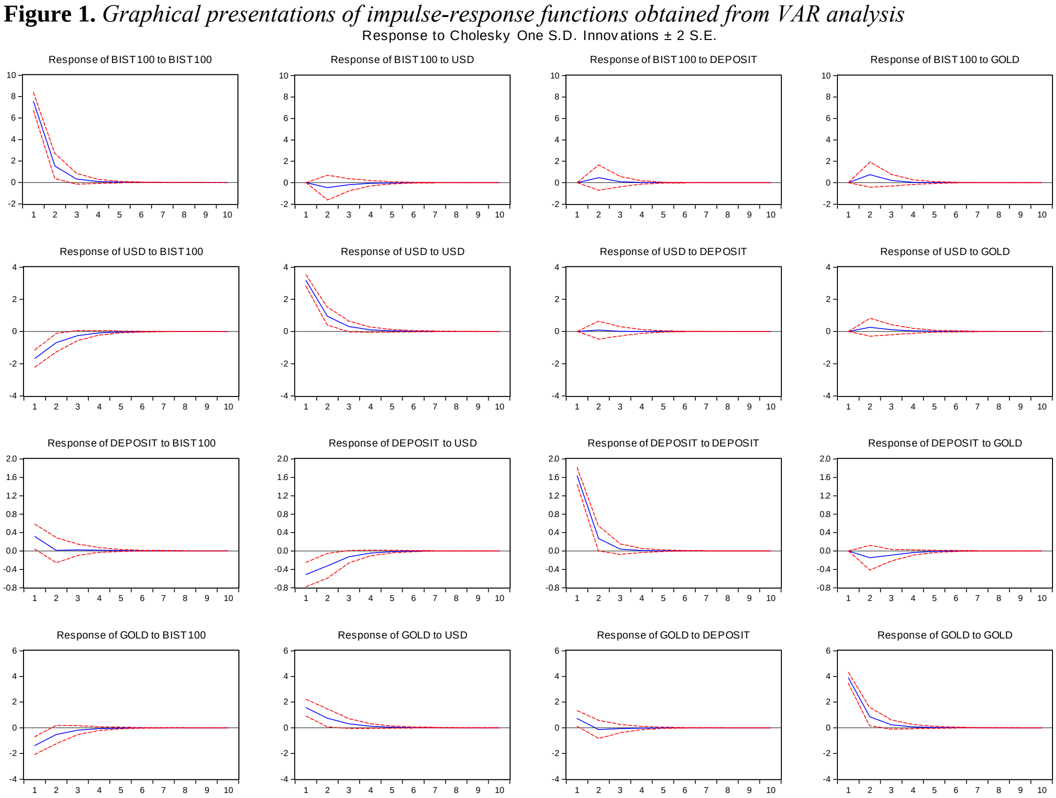
Variable		Test statistics and break dates	
		M1	M2
BIST100		-6.656* (Sep. 2008, Mar. 2009)	-6.846* (Sep. 2008, Mart. 2009)
USD		-10.760* (May 2006, Sep. 2008)	-10.520* (May 2006, Sep. 2008)
DEPOSIT		-12.720* (Sep. 2009, Sep. 2011)	-12.560* (May 2011, Sep. 2011)
GOLD		-9.962* (Sep. 2008, Jun. 2011)	-10.800* (Jul. 2008, Jul. 2011)
Critical values	1%	-4.958	-5.576
	5%	-4.316	-4.937
	10%	-3.980	-4.596

Notes: Break dates are showed in parentheses. Critical values are received from Narayan and Popp (2010).
* indicates the rejection of the null hypothesis at 1% level of significance.

Figure 2 shows the graphical presentations of impulse-response functions. First, a one-unit standard deviation shock to BIST100 leads to a decrease in USD and GOLD while it induces an increase in DEPOSIT. Hence one may argue that BIST100 is a good investment instrument against USD and GOLD. Second, a one-unit standard deviation shock to USD causes a decrease in BIST100 and DEPOSIT while it leads to an increase in GOLD. Thereby USD seems to be a good investment instrument BIST100 and

DEPOSIT. Third, a one-unit standard deviation shock to DEPOSIT induces an increase in BIST100 and GOLD while it does not have significant effects on USD. Fourth, a one-unit standard deviation shock to GOLD leads to an increase in BIST100 and USD while it induces a decrease in DEPOSIT. For this reason, GOLD appears to be a plausible investment instrument against DEPOSIT. These findings indicate that that BIST100 and USD are good investment instruments against each other in Turkey.

Figure 1. *Graphical presentations of impulse-response functions obtained from VAR analysis*



Notes: The optimal lag length is 1 with regard to Akaike Information Criterion, and there are not serial correlation and heteroskedasticity problems for this lag length.

6. Conclusion

This paper examines the relationships among monthly real rates of return of stocks, USD, one-month deposits, and gold in Turkey by utilizing monthly data covering the period 2003:M01-2016:M07. After conducting unit root tests and determining all variables are stationary, the paper conducts VAR analysis and impulse-response functions. According to the findings, (i) stocks appear to be a good investment instrument against USD and gold, (ii) USD is a good investment instrument against stocks and one-month deposits, and (iii) gold is a plausible investment instrument against one-month deposits. Based on these findings, the paper explores that only stocks and USD are good investment instruments against each other in Turkey.

One may expect that financial market participants invest in an asset when the return of this asset increases. As a result of this behaviour, other assets' prices and returns may decrease.

The findings of the paper do not support this event since we yield that an increase in the return of an asset leads to an increase in returns of other assets in most of the impulse response functions. Hence the findings of the paper indicate that financial market participants in Turkey do not consider short-term fluctuations of returns of assets very much. Thereby the paper explores that they may be interested in the long-run return of an asset.

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