



RESEARCH ARTICLE

A RE-EXAMINATION OF THE RELATIONSHIP BETWEEN EXPORT INSTABILITY AND  
ECONOMIC GROWTH

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ABSTRACT

The theoretical and empirical macroeconomic literature has focused on three main questions about the relationship between export instability and economic growth for developed and developing countries. One of them implies that a higher degree of export instability negatively affects economic growth. Second one attracts attention if export instability is transmitted to the rest of economy, this would be reflected by a high degree of economic instability. According to the third one, export instability is detrimental per se to economic growth. In this context, the purpose of this study is to re-examine the relationship between export instability and economic growth for the period of 2003-2017 (quarterly) of Turkish economy. In this study, Kalman Filter Technique was applied to obtain export instability series. The econometric framework is explained as follows: Optimal Box-Jenkins model for export variable firstly was statistically estimated. Then, export instability series were obtained by using Kalman Filter Technique under optimal Box-Jenkins model. Finally, the probable relationships between export instability and economic growth were investigated by using Granger Causality Analysis. According to the results of this study, there are no relationship between export instability and economic growth for Turkish economy in short-term.

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INTRODUCTION

The theoretical and empirical macroeconomic literatures have concentrated on the relationship between export instability and economic growth. In the related literature, there are three main hypotheses about the effects of export instability on the economic growth of less developed countries. According to the first hypothesis, a higher degree of export instability causes economic growth as negative. However, second hypothesis indicates export instability leads to a high degree of economic instability. The third hypothesis explains economic instability is detrimental per se to economic growth. The effects of between export instability on economic growth have been researched in theoretical ground through different channels. McBean (1966) used the data of 45 poor and 18 rich countries and investigated their export instability structures. He found that the average export instability of the poor countries was not much larger than that of the rich countries. He did not reject the consensus that export instability retarded the economic growth of an average under-developed country. McBean (1966) found no systematic relationship between export instability and economic growth. Vartikar (1969) and Kenen and Voivodas (1972) criticized the works of

McBean (1966) in terms of his statistical analysis and findings. Vartikar (1969) expressed that Macbean had made many elementary mistakes in economic analysis. According to Vartikar (1969), his instability indices and regression analysis could not identify the problem about national and international measures. That is why, his regression analysis was wrong and it did not support the commonly accepted view that fluctuations in export earnings tend to create fluctuations in domestic investment and national income. Kenen and Voivodas (1972) asked three questions about the work of McBean: Had he measured the relevant variables appropriately? Were special factors at work in the period he studied (1950-58)? Was his sample of countries representative? They put forward that his work was not acceptable in terms of statistical analysis, data and periods. In 1978s, Lancieri tested the impacts of export instability on economics with a full statistical coverage of 149 countries. He had important findings such as higher export instability was shown by smaller countries, by countries having smaller exports, by less developed countries, by countries with slower economic growth. He found that there were the relationship between the degree of export instability and the rates of growth of exports and investments for developing countries. He expressed that export instability was an economic phenomenon affecting almost solely the developing countries and the instability was strongly and negatively correlated with

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economic growth. However, *Moran (1983)* discovered that export instability has no significant long-run impact on either domestic savings rate or economic growth rate. *Fosu (1992)* tested the effects of export instability on the economic growth for a sample of 35 African LDCs and the subsample of 30 sub-Saharan African LDCs. The empirical findings of *Fosu (1992)* indicated that the estimated effect of export instability on economic growth was negative but not statistically significant for African LDCs; in contrast, the estimated impact of the export instability for non-African LDCs was significantly negative. Recently, *Ajmi et al (2015)* investigated the dynamic causal link between exports and economic growth using linear and nonlinear Granger causality tests for South African data. According to *Ajmi et al. (2015)* the results of the linear Granger causality test showed there was no relationship between two variables. However, the results of the nonlinear Granger causality test there was a unidirectional causality between exports and economic growth. *Cariolle and Goujon (2015)* focused on measurements of instability in export revenue data for 134 countries from 1970 to 2005. They concern on economic instability is evidenced by a broad spectrum of indicators, based on the deviation of observed values of a given economic aggregate from its reference or trend value. They expressed that this assertion may be true for variance-based indicators, measuring the average magnitude of deviations from the trend. We can see that the related literature for Turkish economy is limited. Within this framework, the aim of this study is to investigate the causal relationship between export instability and economic growth for Turkish Economy. The data used in the study are quarterly and cover the period of 2003-2017. In this study, Kalman Filter Technique among various algorithmic approaches was used to get export instability. In this study, firstly, optimal Box-Jenkins model of export values was statistically estimated. Then, export instability was obtained by using Kalman Filter Technique under optimal Box-Jenkins model. Finally, the probable relationship between export instability and economic growth was tested by using VAR Granger Causality/Block Exogeneity Wald Tests. In this study, data and methodology, empirical findings, and conclusion are presented in Sections 2, 3, and 4 respectively.

**MATERIALS AND METHODS**

The data used in this study cover export (EXP) and economic growth (GRW) series. The data are quarterly and cover the period of 2003-2017. Economic growth obtained from the first level difference of Logarithm Real Gross Domestic Product. All data were seasonally adjusted using Census X-12 process. In this study, firstly the appropriate Box-Jenkins model was determined for export series. Then, Box-Jenkins models decided under the fixed parameter assumption were again estimated by using Kalman Filter Technique. After, export instability (EXPINST) series were derived by using time varying coefficients. Finally, the possible dynamic relation between export instability and economic growth was tested by using Granger Causality Analysis. Why was used Kalman Filter Technique to get export instability series in this study? According to *Erdem and Yamak (2014)*, this question could be explained as follows:

“There are several different measures of instability series in the empirical literature. A common measure is to use standard deviations of variables. Most of approaches pay attention to time variation in the instability variables, implicitly,

restrictedly and indirectly. However, if there are specification errors such as omitted variables and linear approximation of nonlinear forms, these approaches will provide biased, inefficient, and inconsistent estimates. Instead, we suggest to use Kalman Filter Technique to get time varying instability series. This technique is not a substitution for the traditional econometric techniques, but it is complementary to them. This technique is chosen as the major analytical tool in this study because of many advantages. Kalman Filter Technique enables to provide time varying as the best and unbiased estimates”.

“In the Kalman Filter estimation technique, the first necessary step is to construct the state space form, which consists of measurement and transition equations (*Kalman, 1960*). Measurement equation is not different of standard OLS regression equation’s coefficient, which is added time factor. The following equation (1) is measurement equation.

$$Y_t = \alpha_t + \beta_t X_t + \varepsilon_t E(\varepsilon_t) = 0 \text{ and } V(\varepsilon_t) = V_t \dots\dots\dots (1)$$

The transition equation is the system of equation how changing parameters of measurement equation change depending over time. In this studying, it was assumed that variable parameters of measurement equation has AR(1) structure. According to (1) number equations, there are two transition equations.

$$\alpha_t = t_1 \alpha_{t-1} + \mu_{1t} \dots\dots\dots (2)$$

$$\beta_t = t_2 \beta_{t-1} + \mu_{2t} \dots\dots\dots (3)$$

To explain Kalman Filter process, it must be expressed (1), (2), (3) equations by matrix form. (4) and (5) equations are matrix form of (1), (2) and (3) equations.

$$y_t = x_t Z_t + \varepsilon_t \dots\dots\dots (4)$$

$$Z_t = \Phi Z_{t-1} + \mu_t \dots\dots\dots (5)$$

(4) Equation is expression as matrix of (1) measurement equation. While y represents Y, x does X (including the constant term). Z represent the vector of size 2x1 that has elements  $\alpha$  and  $\beta$ ,  $\Phi$  represent main diagonal.  $t_1, t_2$  represent the matrix of size 2x2 which is zero off-main diagonal and  $\mu_t$ , describe the vector of size 2x1 that has elements  $\mu_1, \mu_2$ .

In the first step, by using the initial or unconditional estimates of Z and their variance-covariance matrix P, the conditional estimates of Z and their conditional variance-covariance matrix are obtained from the following equations (6) and (7).

$$Z_{t|t-1} = \Phi Z_{t-1} \dots\dots\dots (6)$$

$$P_{t|t-1} = \Phi P_{t-1} \Phi' + R \dots\dots\dots (7)$$

In the second step, the conditional y, the one step ahead prediction error H, and its conditional variance F, are estimated by using outputs of the first step and the following equations (8) - (10).

$$y_{t|t-1} = x_t Z_{t|t-1} \dots\dots\dots (8)$$

$$H_t = y_t - y_{t|t-1} \dots\dots\dots (9)$$

$$F_t = x_t P_{t|t-1} x_t' + V \dots\dots\dots(10)$$

In the final step, the unconditional Z and its variance-covariance matrix P, are obtained by utilizing the outputs of the previous steps and the following updating equations (11) and (12).

$$P_t = P_{t|t-1} - (P_{t|t-1} x_t' F_t^{-1} x_t P_{t|t-1}) \dots\dots\dots(11)$$

$$Z_t = Z_{t|t-1} + P_{t|t-1} x_t' F_t^{-1} H_t \dots\dots\dots(12)$$

Once the filter completes all three steps and provides unconditional P and Z, then the unconditional estimates enter into step 1, as being inputs and the filter again starts to work to complete all three steps for t+1 and continues until last time period, t-1. Therefore, the Kalman Filter is known to be a recursive estimation technique through time<sup>1</sup>.

**Empirical Findings**

Before we get series of export instability under the Kalman Filter techniques, firstly, we must determine the best ARIMA<sup>2</sup> model for export series. We computed the correlograms of export series to define which ARIMA model was best. We run various ARIMA models with different orders:

- ARIMA(1,1,1), ARIMA(1,1,2), ARIMA(1,1,3),
- ARIMA(2,1,1), ARIMA(2,1,2), ARIMA(2,1,3),
- ARIMA(3,1,1), ARIMA(3,1,2), ARIMA(3,1,3).

**Table 1. ARIMA (1,1,3) Model for Export Series**

	Coefficient	Std. Error	t-Statistics
Constant	0.010368***	0.002256	4.595260
AR(1)	0.749721***	0.097980	7.651775
MA(1)	-0.672773***	0.121689	-5.528614
MA(2)	0.332826**	0.135620	2.454112
MA(3)	-0.659615***	0.116526	-5.660677
Breusch-Godfrey Serial Correlation LM Test:			
Obs*R-squared	1.752947	Prob. Chi-Square(1)	0.1855
Heteroskedasticity Test: ARCH			
Obs*R-squared	0.042448	Prob. Chi-Square(1)	0.8368

**Table 2. Unit Root Test Results for GRW**

	ADF	PP
Intercept	-7.8397***	-7.8341***
Trend and Intercept	-7.7920***	-7.7877***
None	-5.9087***	-6.1651***

Note:\*\*\* %1 level test critical values.

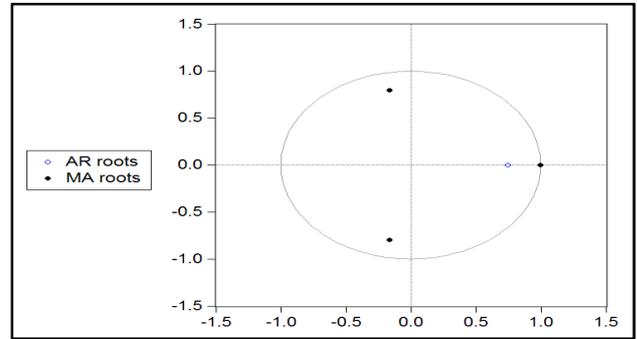
**Table 3. Unit Root Test Results for EXPINST**

	ADF	PP
Intercept	-3.4058**	-40.225***
Trend and Intercept	-22.167***	-41.792***
None	-0.0661	-37.161***

Note:\*\*\* %1 level test critical values.

We decided the best model as ARIMA (1,1,3). Table 1 shows that optimal ARIMA model for export value. \*\*\* denotes significance at the 1% level. As seen from the table, all estimated coefficients are statistically significant at least 5% level. The results of diagnostic tests on the residuals for serial

correlation and heteroscedasticity are given in Table 1. There is no any model suffering from any autocorrelation problem. The calculated  $\chi^2$  is not greater than the critical value. Therefore, the null hypothesis that indicates non-existence of autocorrelation cannot be rejected at any significant level, and the heteroscedasticity does not appear to be a diagnostic problem on residuals. In Graph 1 indicates inverse roots of AR/MA polynomial(s).



**Graph 1. Inverse Roots of AR/MA Polynomial(s)**

AR Roots <|1 and MA Roots <|1 for the model. These mean that estimated AR processes are stationary and estimated MA processes are invertible. In addition, the estimated coefficients are statistically significant at %10 level for both models. After best Box-Jenkins model is estimated for the export variable, the Kalman Filter Techniques is run and export instability series are derived. As a final step, we investigate the relationship between economic growth and export instability variables. For this aim, we must summarize results of unit root tests (ADF and PP)<sup>3</sup> of economic growth and export instability in Tables 2 and 3, respectively. According to the results, both variables are stationary in the level differences. We can say that export instability and economic growth are co-integrated. They have long-term relationships.

**Table 4. VAR Lag Order Selection Criteria**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	490.4144	NA	1.12e-11	-19.53658	-19.46009	-19.50745
1	635.1128	272.0330	4.04e-14	-25.16451	-24.93507	-25.07714
2	670.3533	63.43298	1.16e-14	-26.41413	-26.03173	-26.26851
3	673.1309	4.777378	1.22e-14	-26.36524	-25.82987	-26.16136
4	807.6912	220.6789	6.61e-17	-31.58765	-30.89932	-31.32553
5	836.4340	44.83883	2.47e-17	-32.57736	-31.73607	-32.25699
6	901.3136	96.02171	2.19e-18	-35.01254	-34.01829	-34.63393
7	966.2715	90.94116	1.94e-19	-37.45086	-36.30365	-37.01400
8	1012.375	60.85627*	3.66e-20*	39.13499*	37.83482*	38.63988*

**Table 5. VAR Granger Causality/Block Exogeneity Wald Tests**

Dependent variable: GRW- Equation 1			
Excluded	Chi-sq	df	Prob.
EXPINST	4.932509	8	0.7648
All	4.932509	8	0.7648
Dependent variable: EXPINST- Equation 2			
Excluded	Chi-sq	df	Prob.
GRW	2.033447	8	0.9800
All	2.033447	8	0.9800

Table 4 shows the optimal lag to apply Granger Causality. According to the all lag criteria, the optimal lag is eight. Table 5 presents the results of Granger causality test. The null

<sup>1</sup>Erdem and Yamak (2014).

<sup>2</sup> For more information about ARMA models: Box, G.E.P. and G.M.Jenkins (1976, 575).

<sup>3</sup> Formore information: Dickey and Fuller (1979),Phillips, P and Peron, P (1988).

hypothesis in Equation (1) is that the lags of export instability are not significant as a whole, that is to say, export instability does not cause economic growth. Likewise, the null hypothesis in Equation (2) is that the lags of economic growth have no statistical significance in explaining export instability, which also means that economic growth does not cause export instability. In other words, we find that export instability does not cause economic growth and economic growth does not cause export instability. There are no two-sided relation between economic growth and export instability in Turkish economy in short-term.

### Conclusion

Turkey has had much political, economically and financial instabilities problems. Recent events have posed challenges for policymakers and have motivated to re-examine the relationship between export instability and economic growth in Turkish economy. This paper addresses two questions: Does export instability cause economic growth, or does economic growth leads to export instability? For this aim, in this paper, the relationship between export instability and economic growth were investigated in terms of short-term. In this study, export instability series were obtained by using Kalman Filter analysis, and the relationship between export instability and economic growth were tested by using Granger Causality. The findings of this study show that economic growth and export instability are co-integrated in long-term. However, there are no relationship between economic growth and export instability in Turkish economy in short-term.

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