

Does Openness Increase Productivity? Evidence from an Emerging Economy: Turkey

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Abstract

This study analyzes one of the main postulates of Endogenous Growth Theory, which suggests that international trade openness may speed up growth by favorably affecting productivity. Cointegration and vector error correction model (VECM) procedures are applied on quarterly data set covering the period 2000Q1-2011Q4. The main finding of the paper is that, for the Turkish economy, openness to international trade and manufacturing sector partial productivity are cointegrated and, thus, they cannot drift too far apart. However, we find that -in the Granger sense- causality is unidirectional and runs from productivity to openness, but not vice versa.

Key Words: Endogenous Growth, Openness, Productivity, Cointegration, VECM

JEL Codes: C32, F41

1. Introduction

As trade shakes national boundaries and goes-global, the relationship between openness to trade and economic growth has been of continuing interest both in theoretical and empirical grounds. In this mode, after the fall of the Neo-Classical Theory, the Endogenous Growth Theory, primarily attributed to Romer (1986; 1990), Lucas (1988) and Grossman and Helpman (1991), has gained popularity. The endogenous growth theory, in fact, does not argue that trade increases economic growth *per se*, rather it suggests trade may open up several channels thorough which productive agents become more capable, consequently, increasing growth rate. Therefore, in order to an economy achieve higher growth rates by trading; these channels should be working favorably on behalf of the country's productive means. Considering openness to trade, as Cameron et al. (1998) discuss, major possible channels may be: a) due to 'see-how'¹ transfers, the stimulation of the adaptation of new foreign technological advances, b) the acceleration of specialization and efficacy and, thus, spurring international competition, and c) the generation of larger economies of scale in production, which in turn encourages research and development (R&D) activities.

As in Frankel and Romer (1999) and Barro (2001), for instance, the empirical literature on trade and productivity or growth mostly uses the basic measure of openness, which is exports plus imports divided by GDP. The methodological orientation of the literature, however, varies greatly. Mentioning some, Sachs and Warner (1995) and Edwards (1998) employ cross-section analysis, Miller and Upadhyay (2000) and Yanikkaya (2003) use panel-data regressions, and Jonsson and Subramanian (2001) and Tsen (2006) utilize time series techniques. These studies and many others find a positive and statistically significant relationship between openness to trade and growth or productivity. For example, Barro (2001) using data for about 100 countries finds that on average, calculated for a 10-year period, openness increases the growth rate of real per capita GDP by 13 percent. In a similar study, Yanikkaya (2003) estimates it being about 2 percent for a year.

¹ Unlike 'know-how', or technical skill, 'see-how' can be considered as conceptual skill.

As it is mentioned in Herzer (2005), however, many of the cross-country specifications suffer from methodological problems such as heterogeneity, error autocorrelation, and simultaneity bias. Therefore, the robustness of specific results of many of these types of studies, which constitute vast majority of the related literature, is dubious. Based on this doubt, Rodriguez and Rodrik (1999) had argued that the empirical research did not provide convincing evidence, considering positive openness-growth nexus. The methodological issues present in many of the studies estimating the relationship indicate that the lack of convincing evidence still continues today. In order to avoid most of the methodological setbacks mentioned above, in this study we use cointegration and vector error correction model (VECM) procedures to determine the possible relationship between openness to trade and labor productivity. Especially compared to cross-country applications, these procedures provide superior statistical outcome and also do not suffer from the issue of regression being spurious. The analysis covers Turkey's case. In the following, section two introduces the data. Section three describes the methods of analysis and displays the estimated results. Finally, section four concludes the paper.

II. Data

Our quarterly data for openness to trade (OP) and partial productivity (PR), output per worker, start from 2000Q1 and ends in 2011Q4. The openness variable used in this study is, in real values, the sum of exports and imports of goods and services measured as a share of gross domestic product (GDP), multiplied by 100. The productivity variable we use is the indexed values (2005=100) of manufacturing industry real production. The data for both variables were obtained from Turkish Central Bank's electronic database (TCMB).

The Figure 1 below shows the behaviors of productivity in manufacturing industry total production and openness to trade variables for Turkey, covering the period 2000Q1-2011Q4. Both variables are presented in raw forms, as described above.

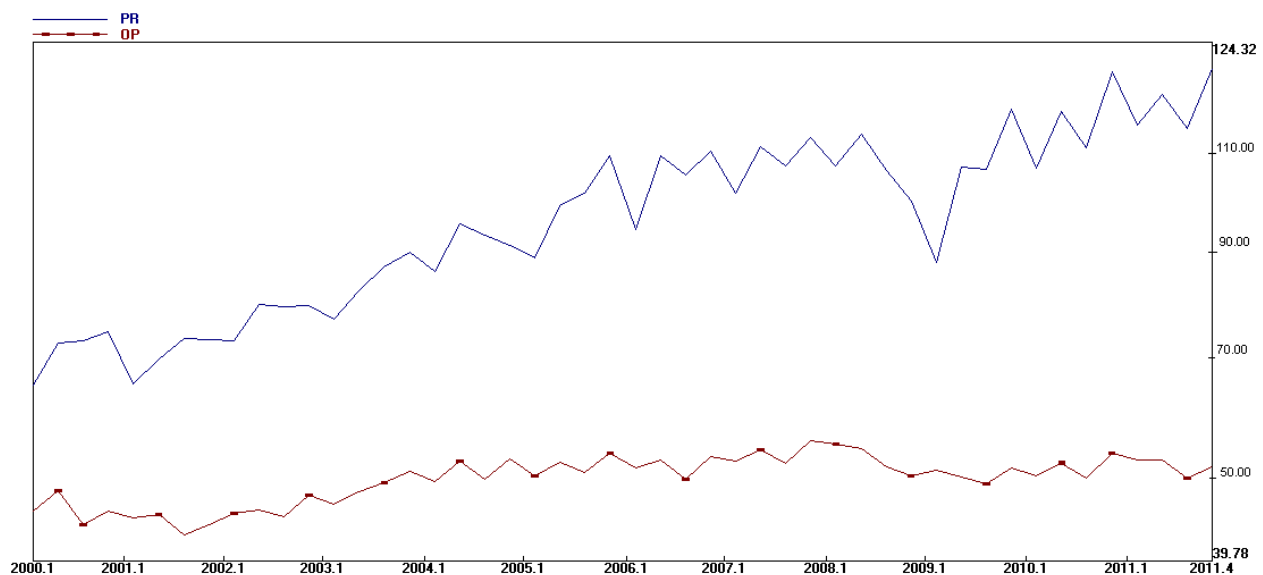


Figure 1: Partial productivity and openness values for Turkey

Figure 1 shows that Turkey's international trade pattern is quite stable in the long run and was the highest in the first two quarters of 2008. If we consider trade values measured as a share of GDP, multiplied by 100, Turkey's openness was 44.8%, 56.9% and 52.4% in 2000Q1, 2008Q1 and 2011Q4, respectively. In 2001Q3 it was lowest, being 40.1%. From the figure, it can be seen that within the last decade the partial productivity growth in manufacturing industrial production had an upward trend, in general.

III. Methodology and Estimation

Whether two or more time-series variables share a common stochastic trend can be examined by using cointegration procedure².

² Model descriptions used in this section to some extent rely on (Gunes, 2007). Also for all computations in the section, Shazam econometrics software were used.

Using such cointegration procedure, this paper investigates the long run relationship between openness to trade and manufacturing sector partial productivity. Let's assume that we have the following two time series related in the form of;

$$PR_t = \alpha_0 + \alpha_1 OP_t + v_t \tag{1}$$

Where PR_t and OP_t are productivity and openness, respectively, in period t , v_t is the error term and α_0, α_1 are parameters. The series PR_t and OP_t can be called 'cointegrated' if they are each $I(1)$ but there exists a linear combination of them, $v_t = PR_t - \alpha_0 - \alpha_1 OP_t$, that is $I(0)$. Consequently, α_1 is cointegrating parameter and equation (1) is the cointegrating regression. When PR_t and OP_t are cointegrated, the ordinary least squares (OLS) estimation of equation (1) gives a super consistent estimator of α_1 . This shows presence of long run, steady-state equilibrium relationship between PR_t and OP_t (Griffits et al., 1993: 701). We see that both variables must be nonstationary in their levels and must have same integration order; otherwise the OLS regression in equation (1) breaks down.

Since many macroeconomic series appear to be nonstationary, in the first step we check for the stationarity of the series. We apply Augmented Dickey-Fuller (ADF) (1981) testing procedure which is one of the most widely used unit-root test in the literature. The ADF is based on the ordinary least squares regression and Davidson and MacKinnon (1993) finite sample critical values are used to determine statistical significances for ADF tests³. The results of the ADF unit root tests for levels and first-differences are presented in Table 1.

Table 1: ADF Unit Root Test Results

LnPR [I(0)]		LnOP [I(0)]	
No trend	Trend	No trend	Trend
-1.9073	-1.7410	-1.9574	-1.7050
LnPR [I(1)]		LnOP [I(1)]	
No trend	Trend	No trend	Trend
-3.8437**	-3.9335**	-2.6508***	-2.9188**

The significance levels are shown d by two (5%), and three (10%) asterisks. The optimal lag lengths are determined by Shazam default.

In Table 1 the ADF unit root test results show that the series are non-stationary in levels. On the contrary, the null hypothesis is rejected when the series are differenced once, i.e. $I(1)$, which shows that PR and OP are stationary in their first differences.

Since we have confirmed the existence of unit roots for the series, in the next step we can test for cointegration to detect possible long-run equilibrium relationship. In testing for cointegration we apply the Johansen-Juselius (JJ) procedure, which allows testing and estimating multiple cointegration vectors in a single step⁴⁴. The JJ testing procedure uses two test statistics to determine the number of cointegrating vectors. These are called as trace and maximum eigenvalue test statistics.

³ The ADF tests are based on the following specification:

$$\Delta y_t = \alpha + \gamma t + \pi y_{t-1} + \sum_{i=1}^k \gamma_i \Delta y_{t-i} + v_t$$

where y_t is the individual series of interest, Δ is the first difference operator, t is a linear time trend and k is determined by Akaike's information criterion (AIC) to determine that v_t is white noise. Detailed discussions can be found in most of the econometrics textbooks.

⁴ This approach is based on the following unrestricted vector autoregression:

$$\Delta \Gamma_t = \eta + \sum_{i=1}^{k-1} \psi_i \Delta \Gamma_{t-i} + \Theta \Gamma_{t-k} + v_t$$

where Γ is an $m \times 1$ vector of $I(1)$ series, Θ is an $m \times m$ matrix of unknown parameters. For more information see Enders (2004, p. 351).

When we use $\lambda_{trace} = T \sum_{j=r+1,n} \ln(1-\lambda_j)$ relationship, the trace test statistic for the null hypothesis that there are at most r number of cointegrating vectors. In the equation T represents the number of observations in the series, and λ_j s show the estimated values of the characteristic roots, in assuming that the series are $I(1)$. Then, the use of $\lambda_{max} = -T \ln(1-\lambda_{r+1})$ equation provides the maximum eigenvalue test statistic, for which the null hypothesis is there are at most r number of cointegrating vectors, and the alternative hypothesis is there are $r+1$ cointegrating vectors.

Cointegration test results obtained from the Johansen-Juselius procedure for the series are given in Table 2 below. For the test statistics special critical values are obtained from Johansen and Juselius (1990).

Table 2: The JJ cointegration test results

Country	Lag	Tests	r = 0	r <=1
Turkey	4	λ_{trace}	18.780**(5%)	3.309
		λ_{max}	15.471**(5%)	3.309

Lag lengths are selected according to the AIC and SC criterias. No restrictions on the constant term are imposed.

Results presented in Table 2 illustrate that there is a cointegration vector indicating that the PR and OP series are cointegrated. This finding shows that there is a long-run relationship between productivity and openness. Since we have found that the series are cointegrated, we can now proceed in order to find the essence of the association and also the short-run properties of the series, using a vector error correction model.

In their fundamental research, Engle and Granger (Granger, 1983; Engle and Granger, 1987) illustrated that the cointegrating series must have an error correction model (ECM) representation. Furthermore, if the variables are cointegrated, then the possibility of the estimated regression being spurious due to, for example, omitted variable bias is ruled out. This is in fact an important property as it allows researchers do robust estimates in cases of data shortages, which is a common problem especially in developing countries. The essence of long run equilibrium and the short-run association between the variables can be estimated utilizing the following vector error correction model (VECM):

$$\Delta \ln PR_t = \gamma + \sum \theta(i) \Delta \ln OP_{t-i} + \sum \Phi(i) \Delta \ln PR_{t-i} + \psi E_{t-1} + v_{1t} \tag{2}$$

$$\Delta \ln OP_t = \alpha + \sum \delta(i) \Delta \ln PR_{t-i} + \sum \mathcal{B}(i) \Delta \ln OP_{t-i} + \varphi E_{t-1} + v_{2t} \tag{3}$$

Introducing equations (2) and (3) above, Δ is called first-difference operator, v_{1t} , v_{2t} are white noise residuals, and γ , θ , Φ , ψ , α , δ , \mathcal{B} , and φ are parameters to be estimated. If we let \mathcal{A} represent θ , Φ , δ , and \mathcal{B} then $\mathcal{A}_{m,i}$ shows the effect of the i^{th} lagged value of variable n on the current value of variable m . E_{t-1} represents error correction term. This term gives residuals from cointegration regression $\ln PR_{t-1} - \beta_1 - \beta_2 \ln OP_{t-1}$. In the VECM model, the coefficients of E_{t-1} , ψ and φ , possess the adjustments of $\Delta \ln PR_t$ and $\Delta \ln OP_t$ towards long run equilibrium, and $\mathcal{A}_{m,i}$ capture the short run dynamics of the given model.

The vector error correction model (VECM) estimation results obtained from equations (2) and (3) are given in Table 3 below:

Table 3: The Output for the Error Correction Models

Equation (2): Dep. Var. : $\Delta \ln PR_t$		Equation (3): Dep. Var. : $\Delta \ln OP_t$	
Variable	Coefficient	Variable	Coefficient
E_{t-1}	-0.12715	E_{t-1}	-1.1098*
$\Delta \ln PR_{t-1}$	-0.68918*	$\Delta \ln OP_{t-1}$	0.24633***
$\Delta \ln OP_{t-1}$	0.00446	$\Delta \ln PR_{t-1}$	-0.98135**
$\Delta \ln PR_{t-2}$	-0.03276**	Constant	0.04637
$\Delta \ln OP_{t-2}$	0.00419	Eq.(2): $R^2:0.5286$, D.W.: 1.92	
Constant	0.00605	Eq.(3): $R^2:0.5563$, D.W.: 2.02	

Significance levels are shown as one asterisk (1%), two asterisks (5%), and three asterisks (10%).

Two lags for equation (2) and one lag for equation (3) were the best fitting specifications according to AIC (1974) and Hannan and Quinn (1979) criteria. From Table 3 we can see that there is a unidirectional Granger-causality in the model, because only ϕ is significant and the other long run impact parameter ψ is not. The causality runs from productivity to openness, but not vice versa. This means that productivity affects openness both in the short run and in the long run. More specifically, the negative value of ECT parameter ϕ (-1.1098) indicates that a wrong-way move of $\ln OP_t$ is completely corrected by the cause of other variable $\ln PR_t$ within the next period. In other words, a deviation of the variable openness from its long run equilibrium value in one period is corrected in the next period by the size of ϕ , which is around 110 percent according to our estimates. In Table 3, the other statistically significant coefficients should be interpreted as short-run responses.

IV. Conclusion

Our analysis shows that the variables productivity and openness are cointegrated. This means that there is a long run relationship between the two variables. Nonetheless, in the Granger-sense, causality between the series is unidirectional, running from productivity to openness to trade. The short-run relation appears to be related to one period back only, implying a quick settlement. The estimated results have shown that Turkey's openness to trade is strictly related to productivity. The more productive Turkish manufacturing sector leads to more open economy.

On the other hand, unlike our expectations, the results indicate that openness does not Granger-cause productivity, as the estimated coefficient of the error correction term in Equation 2 is insignificant. That is to say, manufacturing sector productivity is related to other factors, other than openness to trade in Turkey. According to our findings, one of the main implications of the endogenous growth theory could not be supported, that is, international trade does not open up the necessary channels through which productive agents would become more capable in manufacturing sector in Turkey. Further research is encouraged in this area of interest.

Notes

1. Unlike 'know-how', or technical skill, 'see-how' can be considered as conceptual skill.
2. Model descriptions used in this section to some extent rely on (Gunes, 2007). Also for all computations in the section, Shazam econometrics software were used.
3. The ADF tests are based on the following specification:

$$\Delta y_t = \alpha + \gamma t + \pi y_{t-1} + \sum_{i=1}^k \gamma_i \Delta y_{t-i} + v_t$$

where y_t is the individual series of interest, Δ is the first difference operator, t is a linear time trend and k is determined by Akaike's information criterion (AIC) to determine that v_t is white noise. Detailed discussions can be found in most of the econometrics textbooks.

4. This approach is based on the following unrestricted vector autoregression:

$$\Delta \Gamma_t = \eta + \sum_{i=1}^{k-1} \psi_i \Delta \Gamma_{t-i} + \Theta \Gamma_{t-k} + v_t$$

where Γ is an $m \times 1$ vector of $I(1)$ series, Θ is an $m \times m$ matrix of unknown parameters. For more information see Enders (2004, p. 351).

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