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Agricultural exports and economic growth: Empirical evidence from the major rice exporting countries

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Abstract: This study investigates the evidence of the export-led growth in major rice exporting countries using the extended production model. In addition, a special attention is paid to sectoral exports, which are specified as non-agricultural, agricultural (excluding rice exports), and rice exports. The main finding of this study is that the rice exports are an important means of stimulating economic growth in major rice exporting countries.

Key words: export-led growth, rice exports, vector error correction model, Granger causality

The export-led growth (ELG) hypothesis, which states that export is an important determinant of economic growth, has been the subject of a number of empirical studies. Furthermore, its role in economic development is regarded as an important policy issue in many less developed countries (LDCs) (Dawson 2005). Numerous studies have investigated the relationship between exports and economic growth by examining the effects of the total exports on the gross domestic product (GDP) (Feder 1982; Marin 1992; Ghartey 1993; Kwan and Kwok 1995; Shan and Sun 1998). Although these previous studies typically utilized the ELG hypothesis, the results were mixed and did not provide any strong evidence either for or against the ELG hypothesis (Jin and Yu 1996).

Many countries, developing ones in particular, emphasize sectoral exports (for example, tourism service exports in Greece) in their economic development strategies (Thompson and Thompson 2010). In fact, Johnston and Mellor (1961) claim that the expansion of agricultural exports plays a key role in increasing incomes in developing countries, as the resource allocation of those countries may give them a comparative advantage in the agricultural sector. Compared to the previous studies, the relationship between agricultural exports (for that matter, sectoral exports) and economic growth has been neglected and only a very small study identifies the effect of agricultural exports on GDP (Dawson 2005; Sanjuan-Lopez and Dawson 2010; Duc and Tram 2011).

Unfortunately, not only is there a lack of research into the impacts of agricultural exportation, but there is also a dearth of information on the effects that the agricultural sector as a whole has on economic growth in developing countries. Furthermore, the lack interest in the effects of rice exportation on economic growth has caused difficulties for the policy makers who remain under the impression that the rice market is "thin."

This study investigates the effects of agricultural exports on GDP using the aggregate production function developed by Solow (1957) and Ram (1985). Furthermore, its main objective is to analyse the impacts of agricultural exports and rice exports on economic growth in developing countries (especially in the top four rice exporting countries). Moreover, this study analyses exports by dividing them into three subcategories; non-agricultural-exports, agricultural exports (excluding rice exports), and rice exports in major rice exporting countries. An extended production model based on the ELG hypothesis is constructed using the vector error correction model (VECM), which illustrates the dynamic relationships between the variables.

MODEL AND DATA

Following the work of Dawson (2005), this study focuses on the supply perspective in its investigation of the role of agricultural exports (in particular rice exports) in economic growth as supply has a comparative advantage in rice production. Initially, this study utilizes a theoretical framework developed by Solow (1957), Feder (1982), and Ram (1985) to develop the following model:

$$Y = \mathrm{f}(K, L, X) \tag{1}$$

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where Y is the aggregate real output (or GDP), K is capital, L is labour and X is exports, respectively. Equation 1 includes the conventional inputs (capital and labour) and the factors in the ELG hypothesis (export and GDP). In order to examine the contribution of agricultural sectors to economic growth, this study elects to divide the export input into three more strictly defined inputs; non-agricultural exports, agricultural exports (excluding rice exports), and rice exports. Therefore, the extended form of the model which captures the effect of sectoral exports on economic growth (Dawson 2005; Duc and Tram 2011; Serenis et al. 2011) is as follows:

$$Y = f(K, L, X^N, X^A, X^R) \quad (2)$$

where X^N is non-agricultural exports, X^A is agricultural exports (excluding rice exports), and X^R is rice exports. To derive the growth rate in Equation 2, we can take the total derivative and then divide by Y:

$$\frac{dY}{Y} = \frac{\partial Y/Y}{\partial K/K}\frac{dK}{K} + \frac{\partial Y/Y}{\partial L/L}\frac{dL}{L} + \frac{\partial Y/Y}{\partial X^N/X^N}\frac{dX^N}{X^N} + \\ + \frac{\partial Y/Y}{\partial X^A/X^A}\frac{dX^A}{X^A} + \frac{\partial Y/Y}{\partial X^R/X^R}\frac{dX^R}{X^R} \quad (3)$$

By simplifying Equation 3 and adding a constant term, α_0, and a random error term ε, the result becomes:

$$\dot{Y} = \alpha_0 + \alpha_1\dot{K} + \alpha_2\dot{L} + \alpha_3\dot{X^N} + \alpha_4\dot{X^A} + \alpha_5\dot{X^R} + \varepsilon \quad (4)$$

where the dots denote the growth rates and α_k is the marginal production elasticity of the k^{th} input (for k = 1, 2, 3, 4, 5).

To analyse the dynamic relationships among the variables, the vector auto-regression (VAR) model can be adopted as follows:

$$X_t = \mu + \beta_0 + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \cdots + \beta_k X_{t-k} + \mu_t \quad (5)$$

where X indicates the estimated variables and μ is an error term. If all of the variables are non-stationary and there are co-integrated vectors, we may consider the vector error correction model (VECM) (see Johansen 1998). Under these conditions, Equation (4) can be adapted into a VECM like so:

$$\Delta\dot{Y}_t = \gamma_0 + \sum_{k=1}^{n}\gamma_k\Delta\dot{Y}_{t-k} + \sum_{k=0}^{n}\theta_k\Delta\dot{L}_{t-k} + \sum_{k=0}^{n}\pi_k\Delta\dot{X}_{t-k} + \\ + \sum_{k=0}^{n}\rho_k\Delta\dot{X}^A_{t-k} + \sum_{k=0}^{n}\sigma_k\Delta\dot{X}^R_{t-k} + \sum_{k=0}^{n}\delta_k\varepsilon_{t-k} + \mu_t \quad (6)$$

When we utilize the time-series data in the regression analysis, the non-stationary series can yield spurious regression results (Granger and Newbold 1974). For this reason, we use the Augmented Dickey Fuller (ADF) test to identify the stationary of the series. Furthermore, this study utilizes the co-integration analysis and the Granger causality based on the VECM to analyse the relationships between sectoral exports and GDP.

To estimate Equation (4), this paper utilizes the GDP, capital, labour, and trade values (including the total exports, agricultural exports, and rice exports) of major rice exporting countries from 1980 to 2010. According to the FAO rice market monitor (2012), the major rice exporting countries[1] are Thailand,

Table 1. Descriptive statistics of variables

Variables (Million US $)	Thailand		Vietnam		India		Pakistan	
	mean	std. dev	mean	std. dev	mean	std. dev	mean	std. dev
Y	1.26E+05	7.71E+04	4.03E+04	2.95E+04	6.53E+05	4.08E+05	8.72E+04	4.27E+04
K	3.79E+04	2.29E+04	1.61E+04	1.36E+04	2.03E+05	1.67E+05	1.64E+04	8.80E+03
L	3.24E+01	4.90E+00	4.15E+01	5.94E+00	4.12E+02	4.98E+01	4.39E+01	9.11E+00
X^N	5.71E+04	5.09E+04	2.04E+04	2.03E+04	9.39E+04	9.25E+01	6.35E+03	1.50E+03
X^A	7.03E+03	6.39E+03	1.02E+04	9.65E+03	1.69E+04	1.49E+04	6.68E+03	3.99E+03
X^R	1.99E+00	1.32E+00	1.08E+00	8.54E-01	1.20E+00	7.80E-01	7.53E-01	5.46E-01

Source: FAOSTAT (faostat.fao.org) and World Bank (World Development Indicators)

[1]In 2010, the market share of rice exports in the world market was Thailand (27.23%), Vietnam (16.68%), India (11.79%), and Pakistan (11.06%). The ratios of agricultural values to GDP were for Thailand (12.39%), Vietnam (20.58%), India (17.74%), and Pakistan (21.18%). The ratios of rice export values to GDP were for Thailand (1.66%), Vietnam (3.05%), India (0.14%), and Pakistan (1.22%).

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Vietnam, India, and Pakistan. Real GDP, capital, labour, and total export values are from the World Development Indicators (WDI). Agricultural and rice export values are from the FAOSTAT. Table 1 presents the summary of descriptive statistics.

EMPIRICAL RESULTS

Table 2 shows the results of unit root tests using the ADF with respect to the estimated variables. As this study uses the time-series data, the unit root tests are required to check for the non-stationarity as the linear model can produce invalid results when the non-stationary series are included. As shown in Table 2, the null hypothesis of non-stationarity cannot be rejected at the 10% level for any of variables, therefore, we conclude that GDP, capital, labour, and exports in the four countries are non-stationary.

Table 3 illustrates the results of the Johansen co-integration procedure which determine the number of the co-integrating relationship among the six variables in each of the four countries. The results indicate that the null hypotheses from no co-integration through three co-integrating relationships (r = 0, 1, 2, 3) can be rejected at the 5% level, but the null of four co-integrating relationships (r = 4) cannot be rejected for any of the countries.

Tables 4 and 5 present the estimated results of short- and long-run relationships among the variables. Table 4 shows that three of the four countries (Vietnam excluded) fail to demonstrate a positive relationship between economic growth and either agricultural exports or rice exports in the short-run. However, the estimated coefficients on are significant at the 10% level for all four countries, and this implies the existences of long-run relationships. As seen in Table 5, the coefficients on non-agricultural exports range from 0.2929 to 0.3068 and are significant at least on the 5% level (excepting Pakistan), but the coefficients of agricultural exports (excluding rice exports) are not significant. The rice export coefficients range from 0.1429 to 0.2468 and are significant at least the 10% level.

Finally, Table 6 represents the results of the Granger causality test, and the results imply that three countries (Thailand, Vietnam, and Pakistan) demonstrate the Granger causality between non-agricultural exports and economic growth; one country (Thailand) exhibits the Granger causality between agricultural exports and economic growth; and all four countries indicate the Granger causality between rice exports and economic growth.

Table 2. Results of the unit root test

Variables	ADF in levels in lag(1)	ADF first differences in lag(1)	ADF in levels in lag(1)	ADF first differences i n lag(1)
	Thailand		Vietnam	
ln (Y)	–0.019 (0.539)	–0.674 (0.004)***	–0.020 (0.508)	–0.375 (0.024)**
ln (K)	–0.085 (0.210)	–0.822 (0.003)***	–0.081 (0.469)	–0.560 (0.005)***
ln (L)	–0.047 (0.384)	–0.766 (0.003)***	–0.004 (0.144)	–0.176 (0.074)*
ln (X^N)	–0.019 (0.314)	–0.605 (0.017)**	–0.026 (0.568)	–1.582 (0.000)***
ln (X^A)	–0.009 (0.779)	–0.870 (0.004)***	–0.039 (0.472)	–1.814 (0.000)***
ln (X^R)	–0.012 (0.898)	–1.358 (0.000)***	–0.069 (0.524)	–1.137 (0.008)***
	India		Pakistan	
ln (Y)	–0.070 (0.561)	–0.758 (0.035)**	–0.023 (0.502)	–0.991 (0.013)**
ln (K)	–0.059 (0.300)	–0.932 (0.021)**	–0.057 (0.446)	–0.721 (0.065)*
ln (L)	–0.022 (0.235)	–0.132 (0.045)**	–0.005 (0.668)	–0.890 (0.019)**
ln (X^N)	–0.052 (0.206)	–1.130 (0.010)***	–0.127 (0.473)	–1.564 (0.003)***
ln (X^A)	–0.092 (0.332)	–1.101 (0.000)***	–0.037 (0.582)	–1.342 (0.003)***
ln (X^R)	–0.217 (0.164)	–1.831 (0.001)***	–0.03 (0.791)	–1.455 (0.001)***

The p-values are in parentheses; *** indicates significance at the 1% level, **significance at the 5% level, *significance at the 10% level; the lag order of the ADF test is selected by the Schwert criterion (SC)

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Table 3. Results of the Johansen co-integration rank tests

Null Hypothesis	Eigenvalue	Trace statistics	Eigenvalue	Trace statistics
	Thailand		Vietnam	
H_0: $r = 0$	0.979	158.98 [94.15]	0.901	174.41 [94.15]
H_0: $r \leq 1$	0.835	106.67 [68.52]	0.886	93.07 [68.52]
H_0: $r \leq 2$	0.729	68.77 [47.21]	0.880	52.52 [47.21]
H_0: $r \leq 3$	0.649	38.35 [29.68]	0.777	29.68 [23.99]
H_0: $r \leq 4$	0.509	**15.41 [17.69]**	0.610	**6.05 [15.41]**
H_0: $r \leq 5$	0.349	**3.76 [5.23]**	0.229	**1.11 [3.76]**
H_0: $r \leq 6$	0.165	**2.05 [3.59]**	0.056	**1.07 [3.73]**
	India		Pakistan	
H_0: $r = 0$	0.950	153.43 [93.15]	0.9117	119.51 [94.15]
H_0: $r \leq 1$	0.942	99.15 [68.52]	0.743	73.39 [68.52]
H_0: $r \leq 2$	0.864	61.22 [47.21]	0.710	47.55 [47.21]
H_0: $r \leq 3$	0.771	33.14 [29.68]	0.554	32.19 [29.68]
H_0: $r \leq 4$	0.628	**14.32 [15.41]**	0.528	**15.41 [17.90]**
H_0: $r \leq 5$	0.519	**0.410 [3.76]**	0.433	**3.76 [7.11]**
H_0: $r \leq 6$	0.020	**0.402 [3.21]**	0.312	**0.51 [5.20]**

Parentheses indicate 5% critical values

According to the above results, exports do not significantly affect the economic growth of the major rice exporting countries in the short-run. However, in the long-run, rice exports are shown to Granger-cause the economic growth, even though there is a lack of the theoretical framework linking agricultural

Table 4. Results of the short-run relationship on the VECM

Variables	Thailand	Vietnam	India	Pakistan
	coefficients	coefficients	coefficients	coefficients
$\Delta\ln(Y_{t-1})$	1.2156 (0.010)***	0.0896 (0.597)	0.6807 (0.246)	0.6374 (0.240)
$\Delta\ln(K_{t-1})$	−0.0470 (0.791)	0.4168 (0.000)***	0.3722 (0.285)	0.0170 (0.942)
$\Delta\ln(L_{t-1})$	1.1181 (0.049)**	0.4162 (0.537)	0.7686 (0.396)	0.7747 (0.125)
$\Delta\ln(X^N_{t-1})$	0.4107 (0.051)*	0.2353 (0.046)**	0.4259 (0.038)*	0.2395 (0.083)*
$\Delta\ln(X^A_{t-1})$	0.3009 (0.135)	0.0795 (0.602)	−0.3204 (0.166)	0.0476 (0.685)
$\Delta\ln(X^R_{t-1})$	0.1803 (0.241)	0.2303 (0.073)*	0.1699 (0.342)	0.0233 (0.807)
δ	−0.7001 (0.090)*	−0.0723 (0.065)*	−0.2758 (0.084)*	−0.2771 (0.091)*
Constant	−1.7738 (0.037)**	1.7276 (0.777)	1.8939 (0.241)	−1.8677 (0.009)***
$F(7, 22)$	168.41	644.67	162.08	134.52
R^2	0.9817	0.9973	0.9895	0.9874

The p-values are in parentheses; *** indicates significance at the 1% level, **significance at the 5% level, *significance at the 10% level; the optimal lag order length (all countries are $p = 1$) is selected by the Akaike Information Criterion (AIC) and the Schwartz Information Criterion (SC)

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Table 5. Results of the long-run relationship on Equation (4)

Variables	Thailand	Vietnam	India	Pakistan
	coefficients	coefficients	coefficients	coefficients
ln (K)	0.3850 (0.000)***	0.3068 (0.030)**	0.4317 (0.001)***	0.3259 (0.000)***
ln (L)	0.1179 (0.078)*	0.1279 (0.915)	0.1687 (0.015)**	0.7687 (0.000)***
ln (X^N)	0.0302 (0.000)***	0.3068 (0.040)**	0.2929 (0.011)**	0.0850 (0.293)
ln (X^A)	–0.0134 (0.895)	0.0218 (0.927)	0.1572 (0.189)	0.0712 (0.302)
ln (X^R)	0.1523 (0.045)**	0.2468 (0.084)*	0.1587 (0.083)*	0.1429 (0.010)***
Constant	4.8123 (0.234)	9.3179 (0.589)	6.7506 (0.411)	1.4745 (0.432)
$F(5, 25)$	942.66	346.43	654.57	497.95
R^2	0.9947	0.9914	0.9939	0.9940

The p-values are in parentheses; ***indicates significance at the 1% level, **significance at the 5% level, *significance at the 10% level; procedures are adopted by the ordinary least square (OLS)

exports and economic growth. This implies that, in the major rice exporting countries, rice exports can serve as a catalyst for the aggregate growth in the long-run.

Especially, we often consider 'rice' as a 'strategic commodity' in Asia because rice is a major food staple and a mainstay for the rural population (FAO Rice in World Trade 2002). In addition, developing countries are the main players in the world rice trade, producing 83% of all rice exports and consuming 85% of imports (FAO Rice Market Monitor 2012). Figure 1 illustrates the relationship between rice exports and economic growth; one can see that the top four rice exporting countries lie above the 45 degree line. That is, this would seem to indicate that all major rice exporting countries increase the economic growth in their rice exports. Therefore, rice exports can be regarded as an important factor in the economic growth of Thailand, Vietnam, India, and Pakistan.

Table 6. Results of the Granger causality

Null hypothesis	Wald test	Conclusion	Wald test	Conclusion
	Thailand		Vietnam	
I	12.704 (0.005)***	reject	58.347 (0.000)***	reject
II	3.194 (0.368)	**accept**	43.304 (0.000)***	reject
III	6.842 (0.077)*	reject	93.06 (0.000)***	reject
IV	11.831 (0.008)***	reject	1.457 (0.483)	**accept**
V	7.117 (0.068)*	reject	21.023 (0.000)***	reject
	India		Pakistan	
I	11.450 (0.008)***	reject	8.786 (0.012)**	reject
II	11.172 (0.004)***	reject	9.120 (0.010)***	reject
III	2.7178 (0.257)	**accept**	6.599 (0.037)**	reject
IV	2.7258 (0.256)	**accept**	0.782 (0.676)	**accept**
V	5.9694 (0.047)**	reject	8.742 (0.011)**	reject

I = Capital does not Granger cause GDP, II = Labour does not Granger cause GDP, III = Non-agricultural exports do not Granger cause GDP, IV = Agricultural exports (excluding rice exports) do not Granger cause GDP, V = Rice exports do not Granger cause GDP

The p-values are in parentheses; ***significance at the 1% level; **significance at the 5% level; *significance at the 10% level

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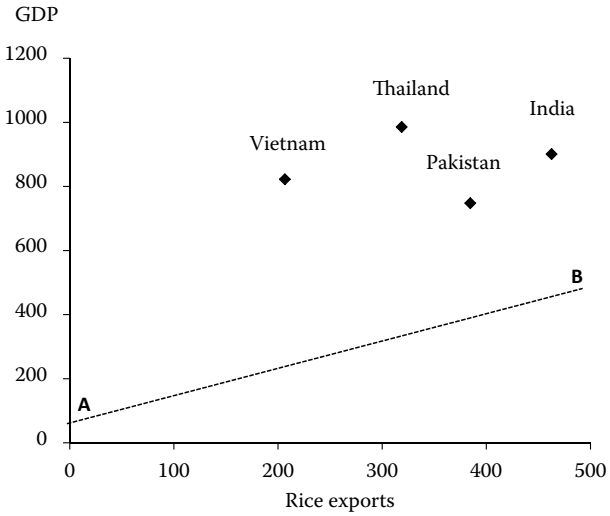

Figure 1. Ratio of Rice Exports and GDP in 2010 to 1980 (1980 = 100)

The line of AB indicates the 45 degree line

CONCLUSION

This study attempts to investigate the role of agricultural exports in the economic growth. Based on the ELG hypothesis, this study adopts the extended production model. Furthermore, the short-and long-run relationships between the variables are analysed with a VECM, and the Granger causality procedures are conducted to determine the presence of the causal relationship. Unlike the previous studies, this study focuses on sectoral exports, specifically agricultural exports and rice exports, in major rice exporting countries. The main conclusion of this analysis is that there is evidence that rice exports affect the economic growth in Thailand, Vietnam, India, and Pakistan.

In particular, Sachchamarga and Williams (2004) mentioned that rice exports play a key role in the Thailand's economy and serve as its second largest source of the foreign exchange income. In Vietnam, the *doi moi* (1986 economic reform) policy, the implemented in the agricultural sector stimulated rice exports, encouraged savings, and opened the country to foreign investment. Consequently, the success of this reform in the rice sector had transformed Vietnam from a chronic rice importer to one of the top four rice exporting countries in the world (Minot and Goletti 2000).

Furthermore, this study points out that the rice policy makers should take note of the influence of rice exports on the economic growth and support a continued investment in the industrial rice fields. However, some previous studies (Tiffin and Irz 2006; Faridi 2012; Awokuse and Xie 2014) have argued that the empirical evidences supporting the agriculture-led growth (ALG) hypothesis is inconclusive and varies greatly depending on the stage of the economic growth. Hence, a further research ideally conducted with a large cross-sectional data set is needed to expand the ALG hypothesis.

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REFERENCES

Awokuse T.O., Xie R. (2014): Does agricultural really matter for economic growth in developing countries? Canadian Journal of Agricultural Economics, 63: 77–99.

Dawson P.J. (2005): Agricultural exports and economic growth in less developed Countries. Agricultural Economics, 33: 145–152.

Duc N.M., Tram N.A. (2011): Relationship between sectoral exports and economic growth: A time series econometric analysis for Vietnam fishery sector 1999–2008. Journal of Science. HCM Open University: 1–12.

FAO Rice in World Trade (2002): Available at http://www.fao.org/docrep/006/y4751e/y4751e03.htm

FAO Rice Market Monitor (2012): Available at http://www.fao.org/docrep/016/ap288e/ap288e.pdf

Faridi M.Z. (2012): Contribution of agricultural exports to economic growth in Pakistan. Pakistan Journal of Commerce & Social Sciences, 32: 133–146.

Feder G. (1982): On exports and economic growth. Journal of Development Economics, 12: 59–73.

Ghartey E.E. (1993): Causal relationship between exports and economic growth: Some empirical evidence in Taiwan, Japan, and the US. Applied Economics, 25: 1145–1152.

Granger C.W.J., Newbold P. (1974): Spurious regression in econometrics. Journal of Econometrics, 2: 111–120.

Jin J.C., Yu E.S.H. (1996): Export-led growth and the US economy: Another look. Applied Economics, 3: 341–344.

Johansen S. (1998): Statistical analysis of cointegrating vectors. Journal of Economic Dynamic and Control, 12: 231–254.

Johnston B.F., Mellor J.W. (1961): The role of agriculture in economic development. American Economic Review, 51: 566–593.

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Kwan A.C.C., Kwok B. (1995): Exogeneity and the export-led growth hypothesis: The case of China. Southern Economic Journal, 61: 1158–1166.

Marin D. (1992): Is the export-led growth hypothesis valid for industrialized countries? The Review of Economics and Statistics, 74: 678–688.

Minot N., Goletti F. (2000): Rice Market Liberalization and Poverty in Viet Nam. IFPRI Research Report No. 114. Washington, D.C.

Ram R. (1985): Exports and economic growth: Some additional evidence. Economic Development and Cultural Change, *33*: 415–425.

Sachchamarga K., Williams G.W. (2004): Economic factors affecting rice production in Thailand, TAMRC International Research Report No. IM-03-04.

Sanjuan-Lopez A., Dawson P.J. (2010): Agricultural exports and economic growth in developing countries: A panel cointegration approach. Journal of Agricultural Economics, 61: 565–683.

Serenis D., Tsounis N., Serenis P. (2011): Exchange rate volatility and sectoral exports: is there a relationship? New evidence from the E.U. Proceedings of the International Conference on Applied Economics (ICOAE'11): 579–588.

Shan J., Sun F. (1998): On the export-led growth hypothesis: The econometric evidence from China. Applied Economics, 30: 1055–1065.

Solow R.M. (1957): Technical change and the aggregate production function. The Review of Economics and Statistics, 39: 312–320.

Thompson A., Thompson H. (2010): The exchange rate, Euro switch, and tourism revenue in Greece. Tourism Economics, 16: 773–780.

Tiffin R., Irz X. (2006): Is agriculture the engine of growth? Agricultural Economics, 35: 79–89.

World Bank, World Development Indicators. Available at (http://databank.worldbank.org/data/views/variableSelection/selectvariables.aspx?source=world-development-indicators)

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