THE RELATIONSHIP BETWEEN ECONOMIC GROWTH AND EXPORTS IN MAINLAND CHINA: EVIDENCE FROM THE STRUCTURAL TIME SERIES MODEL

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ABSTRACT

This paper re-examines the nature of time series relationship between economic growth and exports using structural time series modelling approach based on the quarterly data of mainland China over the period 1979 to 2006. Empirical result indicates a feedback relationship between exports growth and economic growth which validates the joint hypotheses of 'export-led growth' and 'growth-led exports'.

Key words: Export-led growth hypothesis; Growth-led export; Structural time series model.

JEL classification: C32; F10; F14; O40.

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1. Introduction

There was a wide-spread perception among growth theorists, development economists, researchers and policy-makers since the mid-1960s onward that developing countries could create industrial bases and develop by exporting manufactured goods primarily to developed countries. Economists based on the experience of the spectacular economic growth of the high performance Asian economies dubbed this phenomenon as export-oriented industrialisation and growth. Given the wide ranging implications of 'export-led growth hypothesis', a large body of literature has accumulated over the past 40 years concerning the validity of the 'export-led growth hypothesis'.[1] Previous research aimed at testing the 'export-led growth hypothesis' yields mixed results with a number of studies that validate the hypothesis and others that reject the hypothesis (see, Jung and Marshall 1985, Alxentiou and Serletis 1991, Bahmani-Oskooee et al. 1991, Bahmani-Oskooee and Alse 1993).

The objective of this paper is to empirically re-assess the relationship between exports and economic growth using the time series

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[1] For example, see Afxentiou and Serletis (1991), Bahmani and Oskooee et al. (1991), Jung and Marshall (1985). For an exhaustive list of references, also see Shan and Sun (1998).

data of mainland China covering the period 1979Q1 to 2006Q4.[2] Mainland China offers an illuminating opportunity at the latest cross-road of high performance Asian economies as an interesting case study. Its unprecedented average annual growth of 8.8% and 9.5% during the decades of 1979-1990 and 1991-2001 pushed the economy to second position in global ranking measured in terms of PPP adjusted GDP and led many analysts to predict China as a major competitor of the US and Europe in its contribution to global trade and global ranking in the future (World Development Indicators 2008). China's exports increased from 21 billion Yuan in 1979 to 2003 billion Yuan in 2001 with export/GDP ratio rising to 23% and reached its peak to 40% by 2006.

Our study is different from previous studies in determining the export-growth relationship in the frequency of data and in the use of the methodology. Previous studies used annual data whereas we have used seasonally adjusted quarterly data. One distinctive feature of this research involves the application of the structural time series modelling approach of Harvey (1989) which examines the underlying time series properties and enable to test the nature of trend and cyclical relationship between exports and economic growth. The structural time series approach has hardly been used in this area of research.[3]

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[2] The global financial crisis and the ensuing recession exerted a significant negative impact on China's overall export receipts and macroeconomic climate. For a discussion, see Li et al. (2012), and Ping et al. (2009). Therefore, we have restricted the sample period up to 2006.

[3] Moosa and Choe (1998) employed the structural time series model to test the export-led growth hypothesis using the quarterly data of South Korea over the period 1970-1995.

The remainder of the paper is organized in the following manner. Section 2 describes the model and methodology employed in this paper with a discussion of the empirical results. The final sections contain concluding remarks.

2. Structural time series model: specification and estimation

The structural time series model of Harvey (1989) represents an observed time series in terms of its unobserved components, such as trend, seasonal, cyclical and irregular components:

$$y_t = \mu_t + \gamma_t + \psi_t + \varepsilon_t \qquad (1)$$

$$\varepsilon_t \sim \text{NID}\ (0,\ \sigma^2),\ \ t = 1, \ldots..T$$

Where y_t is observed value of the series. μ_t, γ_t, ψ_t, and ε_t signify trend, seasonal, cyclical and irregular components, respectively. The error term, ε_t is assumed to be normally identically and independently distributed with zero mean and a constant variance.

The stochastic trend captures the long-run secular movements in a series which may be expressed as:

$$\mu_t = \mu_{t-1} + \beta_{t-1} + \eta_t \qquad \mu_t \sim \text{NID}\ (0,\ \sigma_\eta^2) \qquad (2)$$

$$\beta_t = \beta_{t-1} + \xi_t \qquad \xi_t \sim \text{NID}\ (0, \sigma_\xi^2) \qquad (3)$$

The trend component is assumed to be a random walk with a drift factor, β_t. β_t is the slope of the trend which is assumed to follow a first order autoregressive process. The trend component reduces to a simple random walk with a drift if $\sigma_{\xi}^{2}=0$ and to a deterministic linear trend if $\sigma_{\eta}^{2}=0$ as well.

The idea of cyclical component emanates as a sinusoidal function which initially assumed to be generated as a linear stationary process:

$$\psi = a\cos\theta_T + b\sin\theta_T \qquad (4)$$

Where amplitude of the cycle is given by $\sqrt{(a^2+b^2)}$. Adding a disturbance term and a damping factor would make the cycle stochastic which is given by:

$$\begin{bmatrix}\psi_t \\ \psi_t^*\end{bmatrix} = \rho_\psi \begin{bmatrix}\cos\theta & \sin\theta \\ -\sin\theta & \cos\theta\end{bmatrix}\begin{bmatrix}\psi_{t-1} \\ \psi_{t-1}^*\end{bmatrix} + \begin{bmatrix}\upsilon_t \\ \upsilon_t^*\end{bmatrix} \qquad (5)$$

Where t = 1, 2, ..T; ρ_ψ is a damping factor which lies between $0 \le \rho_\psi \le 1$; θ is the frequency, in radian with the range $0 \le \theta \le \pi$; and υ_t and υ_t^* are two mutually uncorrelated disturbances with the assumptions υ_t ~ NID (0, σ_{υ}^{2}) and υ_t^* ~ NID (0, $\sigma_{\upsilon*}^{2}$).

A single equation may include exogenous explanatory variables, lagged values of dependent variables as well as unobserved components such as trend and cycle. Therefore, the complete model of economic growth may be written as:

$$\Delta y_t = \mu_t + \psi_t + \sum_{i=1}^{n}\alpha_i\Delta y_{t-i} + \sum_{j=1}^{m}\beta_j\Delta e_{t-j} + \varphi EC_{t-1} + \varepsilon_t \qquad (6)$$

Where variables identified in Eq. (6) are: export receipts (e) and real output (y); EC denotes error correction term.[4] The evolution of the trend and cyclical components are determined by values of hyper parameters σ_{η}^{2} , σ_{ξ}^{2}, σ_{υ}^{2}, θ and ρ_{ψ} over time.[5] An export growth equation may also be specified in a similar spirit.

Harvey (1989), and Koopman et al. (2000) have suggested estimating the hyper parameters and state vectors of coefficients in equation (6) using maximum likelihood in the time or frequency domain after writing the model in state space form. The frequency domain estimation results of equation (6) are reported in Table 1. For the sake of brevity, the results include the estimated state variables, hyper parameters with their t statistics and some measures of diagnostic test statistics. The diagnostics are the modified coefficient of determination R_{D}^{2} (calculated for the first difference of the dependent variable), heteroscedasticity test and two measures of series correlation: the Durbin-Watson statistic and Ljung-Box Q statistics.

Both the estimates of level (μ) and slope (β) coefficients are insignificant with the values of σ_{η}^{2} is small and zero for σ_{ξ}^{2}. These results indicate that the trend component may be represented by a deterministic

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[4] The data on export receipts, GDP, market exchange rate, and GDP deflator were downloaded from the DATASTREAM.

[5] Numerical optimization are made amenable and easier by imposing the constraint σ_{υ}^{2} = $\sigma_{\upsilon*}^{2}$.

trend. The estimates of cyclical components are insignificant. The size of the lagged error correction term in the output growth equation is larger and indicates that nearly full amount of disequilibrium being eliminated within one period. The lagged independent variable has correct sign and its estimated effect is statistically significant in the output growth equation. Moosa and Choe (1998) contend that if exports variable can explain various components of output, then trend would become a constant and the seasonal and cyclical components become insignificant. Only then exports can explain significant fraction of movement in the output growth. A careful analysis of these results indicates that exports are the driving force underlying the movement of output growth in mainland China. Furthermore, the negative and statistically significant error correction terms in both equations again indicate a bi-directional relationship between export and output growth to validate the joint hypotheses of 'export-led growth' and 'growth-led export'. The evidence of bi-directional relationship is consistent with studies of Shan and Sun (1998), Liu *et al.* (2002), Mah (2005) and others.

3. Conclusion

This paper employs the structural time series modelling approach to re-examine the empirical validity of the 'export-led growth hypothesis' using the seasonally adjusted quarterly data of the mainland China. The frequency domain estimation results indicate that trend component of output is deterministic and the cyclical component is insignificant. On the whole, the structural time series models demonstrate a statistically significant and dominant effect of export growth on output growth. The findings also document the evidence of 'growth-led exports' in mainland China.

A number of studies reported a bidirectional relationship between exports and economic growth. An OECD report terms this scenario as 'growth-led export' as well as 'export-led growth'. The development strategies pursued in the high performance Asian economies led those fast-growing economies to build up national competitiveness which resulted in dynamic growth and then in an increased supply of exports. In this context it is more appropriate to dub the phenomenon as growth-led exports and not export-led growth. This idea of growth-led exports emanates from the recent developments of growth theory which emphasised the role of increasing returns to scale, technology, strategies, knowledge absorption process and investment in producing dynamic economic growth. Consequently, the economic growth resulted in the rapid growth of the export of manufactures.[6]

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[6] For a lucid discussion, see Mikic (1998).

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Table 1: Estimates of the structural time series model

Parameter: State variable	Dependent variable Δy_t	Dependent variable Δe_t
μ	0.0369	0.0592
	(0.7570)	(1.575)
β	-0.0002	-0.0002
	(-0.1213)	(-.2876)
ψ	0.00079	0.0182
	(0.14197)	(1.200)
ψ^*	0.0016	-0.0196
	(0.2955)	(-1.273)
Δy_{t-1}		0.0005
		(.0041)
Δe_{t-1}	0.5165***	-0.4017***
	(6.781)	(-3.326)
ΔEC_{t-1}	-0.976	-0.6308***
	(-8.417)	(-3.792)
σ_η^2	0.00039	0.00007
	(0.0264)	(0.0035)
σ_ξ^2	0.0000	0.0000
	(0.0000)	(0.0000)
σ_υ^2	0.0000007	0.0000
	(0.0000)	(0.0000)
σ_ε^2	0.0148	0.0199
	(1.000)	(1.000)
R_D^2	0.89	0.80
HS(36)	2.63	0.213
DW	2.02	2.12
Q (11, 6)	11.13	12.89

*** Significant at the 0.01-level.

[a] *t*-value in the bracket underneath the parameter; *q*-ratio in the bracket underneath the hyper parameter.

[b] *DW* and *Q* are the Durbin-Watson and Ljung-Box statistics, respectively for testing serial correlation and *HS* is the test statistic for heteroscedasticity.