Effects of Volatility of Exports in the Philippines and Thailand

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Abstract:

There have been numerous studies on the relationship between volatility of exports and economic growth. Most of these studies have used cross-section data. Recently, some studies have used time series data to study the relationship. However, there have been no studies which have used the GARCH methodology to study export volatility. This paper fills the void. It uses quarterly data for the Philippines and Thailand to study the effects of export volatility. We find that for both countries, the shock to volatility of growth of exports is permanent. Also, past volatility is significant in predicting future volatility.

JEL codes: C22, F10

Introduction

Even though there are a number of studies about export volatility, there is no study which has used the GARCH methodology. This paper uses GARCH methodology to study volatility of exports using quarterly data from two ASEAN countries, namely, the Philippines and Thailand. A study of volatility of exports is important for these two countries because both countries have relied heavily on exports for economic growth.

Earlier Studies

The previous studies have focused on the relationship between export instability and economic growth. Most of these studies have used cross-section data. Yotopoulos and Nugent (1976) use cross-section data for 28 developing countries. Using a transitory index of export instability, they find that export instability tends to reduce consumption out of permanent income, thus leading to higher saving and economic growth. Thus, they find a positive relationship between export instability and economic growth. Some earlier studies like MacBean (1966) and Knudsen and Parnes (1975) also find a positive relationship between export instability and economic growth.

Gyimah-Brempong (1991) uses three different measures of export instability, namely, (a) the coefficient of variation of export earnings, (b) the mean of the absolute difference between actual export earnings and its trend value, normalized around the trend value of export earnings and (c) average of the squares of the ratio of actual export earnings to trend earnings. He uses average data for 1960-86 for 34 sub-Saharan African countries. He finds a negative relationship between export instability and economic growth using all three measures of export instability.

Sinha (1999) examines the relationship between export instability and economic growth for 9 Asian countries using time-series data. He uses a production function approach. The study finds a positive relationship between export instability and economic growth for India, Japan, Malaysia and the Philippines and a negative relationship for Myanmar, Pakistan, South Korea, Sri Lanka and Thailand. For India, Japan, Malaysia and the Philippines, the study finds a positive relationship between export instability and economic growth. For (South) Korea, Myanmar, Pakistan, Sri Lanka and Thailand, a negative relationship between the two variables is found.

Data and Methodology

Data are from the IMF (2006). For both the Philippines and Thailand, data are used from the first quarter of 1960 to the third quarter of 2005. All data are in billions of national currency (peso for the Philippines and baht for Thailand. Thus, we have 183 observations for each country. We deflate total nominal exports by the GDP deflator. Since quarterly export data are subject to seasonal fluctuations, we deseasonalize the data by using ratio-to-moving-average method. The seasonal indexes for the four quarters for the Philippines and Thailand are in Table 1. For the Philippines, the seasonal indexes are below 1 for the first and fourth quarters. The Philippines is a predominantly Christian country. Thus, a number of holidays may be an explanation for the lower indexes during the first and the fourth quarters. In contrast, the indexes are lower than 1 for the second and third quarters. This may be the effect of the monsoon period which falls during the second and third quarter months.

Before we proceed with the GARCH modeling, we have to ensure that the variable is stationary. In this paper, we use the Kwiatkowski-Phillips-Schmidt-Shin (1992) (KPSS hereinafter) for stationarity. In the Dickey-Fuller and Phillips-Perron tests, the null hypothesis is that the variable has a unit root. In contrast, the KPSS test takes trend or level stationarity as the null hypothesis. Consider the equation consisting of a deterministic trend, random walk and stationary error:

$$y_t = c_t + c_2 t + \nu_t \qquad (1)$$

where ν_t is a stationary process, t is the time trend and c_t follows the random walk $c_t = c_{t-1} + \mu_t$ with $\mu_t \sim iid(0, \sigma^2_\mu)$. The null hypothesis is: $\sigma^2_\mu = 0$ or c_t is a constant. For a non-trended variable, we can drop the trend term in (1).

Maddala and Kim (1998. pp. 120-122) point out that equation (1) is a special case of a test for parameter constancy against the alternative that parameters follow a random walk. This was first considered by Nabeya and Tanaka (1988). In Nebaya and Tanaka, the test statistic is as follows:

$$\text{LM} = \frac{\sum_{t=1}^{T} S_t^2}{\hat{\sigma}_e^2} \qquad (2)$$

In (2), e_t are the residuals from the regression of y_t on a constant and time trend. $\hat{\sigma}_e^2$ is the residual sum of squares divided by T (or residual variance) and $S_t = \sum_{i=1}^{T} e_i$ where t = 1,2,…..T. This is an upper tail test. When errors are not *iid*, the appropriate denominator of (2) is an estimator of σ^2 which KPSS call the "long run variance" rather than of $\hat{\sigma}_e^2$. σ^2 equals $\lim_{T\to\infty} T^{-1} E(S_T^2)$. A consistent estimator of σ^2 is given by

$$s^2(l) = T^{-1}\sum_{t=1}^{T} e_t^2 + 2T^{-1}\sum_{s=1}^{l} \omega(s,l) \sum_{t=s+1}^{T} e_t e_{t-s} \qquad (3)$$

$\omega(s,l)$ is an optional lag window that corresponds to the choice of a spectral window. KPSS use the Bartlett window (and we do the same in this paper), $\omega(s,l) = 1 - \frac{s}{l+1}$. This ensures the non-negativity of $s^2(l)$. The lag parameter l is set to correct for residual serial correlation. If the residuals are *iid*, then a lag of zero is appropriate.

The results of the unit root tests are in Table 2. REXP stands for real exports. LNREXP stands for the natural log of real exports. As we can see from Table 2, both REXP and LNREXP are non-stationary for the Philippines and Thailand. Thus, we cannot use the real exports or its natural log for GARCH modeling. So, we take the first difference of the natural log of real exports. It gives us the growth rate of real exports (GEXP). Table 2 shows that GEXP is stationary for both the Philippines and Thailand. Figures 1 and 2 show GEXP for the Philippines and Thailand respectively. For both countries, GEXP shows wide fluctuations.

GARCH Methodology

The autoregressive conditional heteroscedasticity (ARCH) methodology was introduced by Engle (1982). While in most models of regression we model the means of variables, in ARCH, we model the variance of a variable. Conventional wisdom associates the problem of heteroscedasticity with cross-section data and the problem of autocorrelation with time-series data. In forecasting time series, we often see that the forecast errors are sometimes small then large and small again. In such a case, the variance of the forecast errors is not constant. Thus, one of the assumptions of the classical linear regression model is violated. Behavior of forecast errors depends upon the behavior of errors of the regression. Thus, there may be autocorrelation in the errors of the regressions. Engle's ARCH model captures this idea. Bollerslev (1986) generalized the model by introducing what is known as the generalized ARCH or GARCH. The GARCH (1, 1) model can be expressed as follows:

$$y_t = \pi_0 + \sum_{i=1}^{k} \pi_i y_{t-i} + \varepsilon_t \tag{4}$$

$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-i}^2 + \beta\sigma^2_{t-1} \tag{5}$$

Equation (4) is the mean equation and equation (5) is the variance equation. σ_t^2 is the conditional variance because it is the one-period ahead forecast variance based on the past information. α which is the coefficient of the lag of the squared residuals from the mean equation is the ARCH term. This gives us the news about volatility from the last period. The volatility clustering is shown by the size and significance of α. β is the GARCH term. $\alpha + \beta$ measures the persistence of volatility. Any shock to volatility is permanent if $\alpha + \beta = 1$. The unconditional variance is infinite. Engle and Bollerslev (1986) call it the integrated GARCH or IGARCH process. In the IGARCH process, volatility persistence is permanent. Past volatility is significant in predicting future volatility. Volatility is explosive if $\alpha + \beta > 1$. A shock to volatility in one period will lead to even greater volatility in the next period.

Of all the different types of GARCH models, GARCH (1, 1) is the most popular one. In the simplest GARCH (1, 1) model, there are no $\sum_{i=1}^{k} \pi_i y_{t-i}$ terms. Even though we report the results of the simplest GARCH (1, 1) model, we have tried other GARCH models but the results are the same. In estimating the GARCH (1, 1) model, we use the

Berndt-Hall-Hall-Hausman optimization algorithm and Bollerslev-Wooldridge heteroscedasticity-consistent covariance. The values of the coefficients of the mean and variance equations for the Philippines and Thailand are in Table 3. Remember that for the mean equation, only the value of π_0 is reported. The Jarque-Bera test does not show any evidence of non-normality of the standardized residuals. The ARCH LM test also shows there is no ARCH effect left in the standardized residuals.

For the Philippines, α is significant at 5% level, but β is not. The size of α is large implying that there is clustering of volatility of growth of exports. $\alpha + \beta$ is less than 1. However, the Wald test of the restriction of $\alpha + \beta = 1$ has the χ^2 statistic (with one degree of freedom) value of 0.0739 with a p-value of 0.7857. Thus, we cannot reject the null hypothesis of χ^2 statistic (with one degree of freedom). Thus, a shock to volatility of growth of exports is permanent. Also, the past volatility is significant for predicting future volatility. For Thailand, β is significant at the 5% level while α is not. Thus, there is no problem of clustering of volatility of growth of exports for Thailand. Just like for the Philippines, for Thailand, $\alpha + \beta$ is less than 1. However, we also conduct a Wald test of the restriction of $\alpha + \beta = 1$. χ^2 statistic (with one degree of freedom) is 0.8910 with a p-value of 0.3452 indicating that we cannot reject the null hypothesis of $\alpha + \beta = 1$. So, just like the Philippines, the shock to volatility of growth of exports is permanent for Thailand. Again, like the Philippines, past volatility is significant in explaining future volatility.

Conclusion

It is important to study the nature of the volatility of exports of a country. Both the Philippines and Thailand have relied heavily on exports for economic growth. We study the volatility of growth of exports of the Philippines and Thailand using the GARCH model. For both countries, we find that the shock to volatility is permanent and past volatility is significant in predicting future volatility.

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Table 1. Quarterly Seasonal Indexes for Real Exports for the Philippines and Thailand

	Philippines	Thailand
Quarter 1	0.9560	1.0631
Quarter 2	1.0298	0.9844
Quarter 3	1.0189	0.9507
Quarter 4	0.9970	1.0051

Table 2. KPSS Unit Root Tests

	Philippines	Thailand
REXP	0.3349	0.4318
LNREXP	0.1677	0.2974
GEXP	0.0691*	0.1889*

Note: An asterisk denotes that the variable has no trend. For all test statistics, an intercept is included. The critical value for the trended and the non-trended cases are 0.1460 and 0.4630 respectively.

Figure 1. Growth Rate of Real Exports of the Philippines

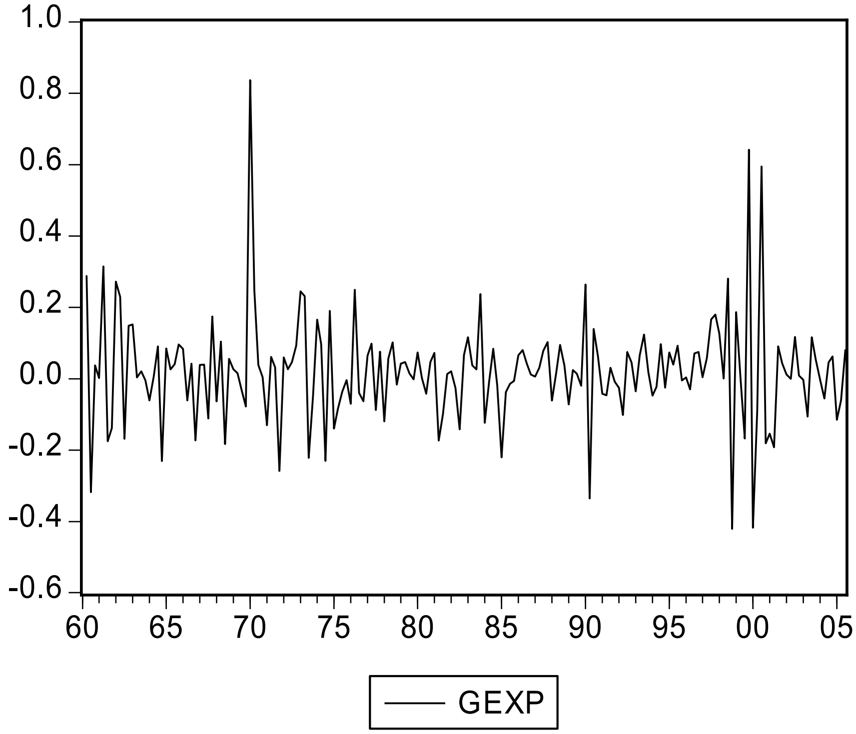

Figure 2. Growth Rate of Real Exports of Thailand

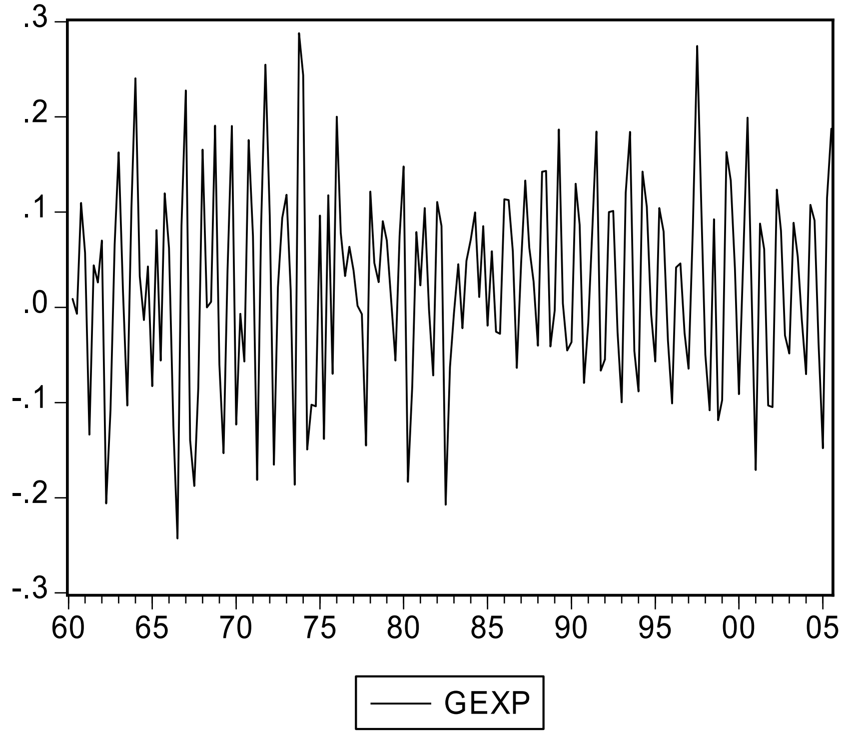

Table 3. The Coefficients of the Simplest GARCH (1, 1) Model for the Philippines and Thailand

	Philippines	Thailand
π_0	0.031 (0.014) (0.026)	0.024 (0.008) (0.002)
ω	0.009 (0.004) (0.010)	0.002 (0.002) (0.339)
α	0.842 (0.412) (0.041)	0.072 (0.049) (0.138)
β	0.059 (0.177) (0.739)	0.798 (0.164) (0.000)

Note: The numbers below the coefficients give the standard errors and p-values respectively.