Income and Price Elasticities of Exports in Philippines

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Abstract

This paper examines the elasticities of export demand for Philippines using Johansen time series technique. The results from the study suggest that the income elasticity of exports is unity and the relative price elasticity is significant with expected sign. These long run income and relative price elasticities have important implications for export growth policies.

Keywords: Price and Income Elasticities, Export Growth Policy and Johansen Method.

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1. Introduction

The aim of this paper is to examine the long run income and price elasticities of export demand in Philippines with the Johansen Maximum Likelihood (JML) technique. The export demand is one of the heavily researched topics in macroeconomics because the income and relative price elasticities has implications for export growth policies. Exports are treated as an engine of growth for those countries where income elasticity of exports are high. However, some countries have high price elasticity implying that their exports are more competitive in the world market and a real devaluation will be effective in boosting export revenue. It is important to have high export earnings so that foreign exchange reserves are sufficient to finance imports and capital accumulation. Further, the long run elasticities of exports are vital to analyze the real exchange rate fluctuations on the trade balance.

There are limited empirical studies on export demand for Philippines.² The most influential work is Senhadji and Montenegro (1999). They used Phillip Hansen’s Fully Modified Ordinary Least Squares (FMOLS) method and found that the income and price elasticities of export demand for Philippines is 1.20 and -1.24, respectively, from 1960-1993. The major limitation in Senhadji and Montenegro (1999) is that exchange rate is excluded in the relative price variable. According to Rao and Singh (2007), the income and price elasticities would be over-estimated or under-estimated if exchange rate is excluded from the relative price variable. Barns (2003) estimated export and import services equations for Philippines from 1981-2000. He used Ordinary Least Squares (OLS) and obtained an income elasticity of 2.8. The income elasticity is over-estimated because he ignored the relative price variable in his estimation. In a recent study, Razmi and Blecker (2006) estimated export demand equations for developed and developing countries using Two Stage and Three Stage Least Squares methods. For Philippines, they

used data from 1983-2001 and obtained income elasticity around 1.5. The relative price estimate is not given for Philippines.

Our paper is organized as follows: Section 2 contains our specification of the export model. Sections 3 and 4 detail our empirical results and conclusions, respectively.

2. Specification

Following Rao and Singh (2007) we specify our export demand as follows:

\[
\ln X_t = \beta_0 + \beta_1 \ln Y_F - \beta_2 \ln \left(\frac{P_D}{E \times P_F}\right) + \epsilon_t \tag{1}
\]

where \(X\) is the total exports of goods and services deflated by export price index, \(P_D\) is domestic price of exports, \(P_F\) is price level of trading partners, \(E\) is exchange rate measured as the price of foreign currency in domestic currency and \(Y_F\) is income of trading partners. There are many studies on developing and developed countries which excluded \(E\) when estimating export functions. Rao and Singh (2007) showed this could result in an under-estimation of the price elasticity if devaluations dominate the sample. Alternatively, price elasticity will be over-estimated if appreciations dominate the sample.

Our prior expectations are that income and relative price elasticities are significant and their signs are positive and negative, respectively. We used Microfit 4.1 of Pesaran and Pesaran (1997) for all estimation. The sample period is 1974-2004. The definitions of variables and sources of data are in the Appendix.

3. Empirical Results: The JML Method

The time series properties of the variables are examined via, the Augmented Dicky-Fuller (ADF) and Elliot-Rothenberg-Stock (ERS) tests. The computed ADF and ERS test statistics for the levels and first differences of the variables are given below in Table 1.
Table 1: ADF and ERS Unit Root Tests

<table>
<thead>
<tr>
<th>Variable</th>
<th>L</th>
<th>ADF</th>
<th>ERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ln X</td>
<td>[0,1]</td>
<td>-3.268</td>
<td>16.57</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.587)</td>
<td>(4.73)</td>
</tr>
<tr>
<td>Δln X</td>
<td>[1,0]</td>
<td>-5.903</td>
<td>1.79</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.587)</td>
<td>(3.22)</td>
</tr>
<tr>
<td>ln YF</td>
<td>[1,2]</td>
<td>-3.134</td>
<td>28.54</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.587)</td>
<td>(2.23)</td>
</tr>
<tr>
<td>Δln YF</td>
<td>[0,1]</td>
<td>-3.690</td>
<td>3.12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.587)</td>
<td>(5.66)</td>
</tr>
<tr>
<td>ln (PD/(E × PF))</td>
<td>[0,1]</td>
<td>-3.051</td>
<td>34.90</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.587)</td>
<td>(5.67)</td>
</tr>
<tr>
<td>Δln (PD/(E × PF))</td>
<td>[0,0]</td>
<td>-6.093</td>
<td>1.86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(3.584)</td>
<td>(2.82)</td>
</tr>
</tbody>
</table>

Notes: ADF is the standard Augmented Dicky Fuller F test and ERS is the Elliot-Rothenberg-Stock test. L is the lag length of the first differences of the variables. For example [1,1] means that one lagged first difference is found to be adequate in the two test statistics, respectively. For both ADF and ERS, the 5% critical values are given below the test statistics in parentheses. In E-views, the null hypothesis of unit roots is rejected if the computed ERS test statistic is below the critical value. A time trend is included because it is significant in levels and first differences of the variables. ADF and ERS tests were conducted in Microfit 4.1 and E-views, respectively.

According to the ADF test statistics, the unit root null for the level variables cannot be rejected at 5% level. Alternatively, the null that their first differences have unit roots is undoubtedly rejected. Similarly the computed ERS test statistics are more than the 5% critical values, implying that all the levels of the variables are non-stationary. However, the test statistics are lower than critical values for the first difference of these variables and reject the unit root null at 5% level. Therefore, these variables are I(1) in levels and I(0) in their first differences.
In what follows we report our estimates of exports equation using the JML method. The variables \( \ln X_t, \ln Y_F \) and \( \ln (P_D/(E \times P_F)) \) are subjected to the JML together with an intercept and a trend term included as exogenous variables in a VAR(4) framework. The Akaike Information Criteria (AIC) and Schwartz Bayesian Criteria (SBC) criteria indicated lag length of 3 periods. The AIC and SBC reached a maximum of 87.416 and 79.431 for the third order, respectively. We selected the unrestricted intercept and no trend option because only this option gave us meaningful results. The maximal eigenvalue and trace test statistics for the null that there is no cointegration are 22.557 and 32.296, respectively. The 95% critical values are 21.120 and 31.540, respectively. The null that there is at least one long run equilibrium relationship, the corresponding computed values, with the critical values in the parentheses are 9.414 (14.880) and 9.739 (17.860), respectively. Therefore, both the eigenvalue and the trace test statistics reject the null of no cointegration, but indicate there exists at least one cointegrating vector. The implied cointegrating vector normalized on \( \ln X \) is given below.

\[
\ln X_t = 0.955 \ln Y_{Ft} - 1.395 \ln (P_D/(E \times P_F))_t \quad (2)
\]

\( (3.81)^* \quad (2.10)^* \)

The estimated income elasticity of real exports is unity and the implied price elasticity is around \(-1.4\). These important elasticities are significant and plausible.

In estimating the error correction model for the short run, we adopted the lag search procedure used in the General to Specific (GETS) approach in the second stage. We started with a very general specification in which \( \Delta \ln X_t \) is regressed on its lagged values, the current and lagged values of \( \Delta \ln Y_{Ft} \) and \( \ln (P_D/(E \times P_F))_t \) and the lagged error term of the corresponding cointegrating equation. We have used lags up to 4 periods on exports, income and relative price. \( ECM_{t-1} \) is the lagged residual from the cointegrating equation (2). By using the standard variable deletion tests, we arrived at the following parsimonious \( ECM \) equations\(^3\).

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\(^3\) Absolute \( t \)-ratios are below estimated coefficients. The significance at the 5% level is indicated by \(^*\).
\[
\Delta \ln X_t = 0.975 - 0.306 \, ECM_{t-1} - 0.308 \, \Delta \ln X_{t-2} - 0.366 \, \Delta \ln X_{t-3} - 0.395 \, \Delta \ln Y_{Fr-2} \\
(3.42)^* \quad (3.05)^* \quad (2.54)^* \quad (1.70) \quad (1.62)
\]

\[-0.597 \, \Delta \ln (P_D/(E \times P_F))_t - 0.337 \, \Delta \ln (P_D/(E \times P_F))_{t-3} \\
(3.74)^* \quad (1.66)
\]

\[\bar{R}^2 = 0.609, \quad SER = 0.084, \quad Period: 1977-2004\]

\[X^2_{sc1} = 0.680 (0.41), X^2_g = 0.001 (0.97),\]

\[X^2_n = 1.647 (0.44), X^2_{hs} = 1.091 (0.30) \quad (3)\]

There is possibility to reduce further the number of estimated coefficients to raise the degrees of freedom. The coefficients of \(\Delta \ln X_{t-3}, \Delta \ln Y_{Fr-2}\) and \(\Delta \ln (P_D/(E \times P_F))_{t-3}\) are close and when this restriction is tested, the Wald test computed \(X^2(1)\) test statistic with \(p\)-value in the parenthesis is 2.492(0.114) is insignificant and therefore the constraint is accepted. The following final parsimonious equation is based on this restriction.

\[
\Delta \ln X_t = 0.939 - 0.294 \, ECM_{t-1} - 0.380 \, \Delta \ln X_{t-2} - 0.600 \, \Delta \ln (P_D/(E \times P_F))_t \\
(3.77)^* \quad (3.34)^* \quad (3.13)^* \quad (3.99)^* \\
- 0.342 \, (\Delta \ln X_{t-3} + \Delta \ln Y_{Fr-2} + \Delta \ln (P_D/(E \times P_F))_{t-3}) \\
(2.07)^*
\]

\[\bar{R}^2 = 0.640, \quad SER = 0.081, \quad Period: 1977-2004\]

\[X^2_{sc1} = 0.681 (0.41), X^2_g = 0.051 (0.82),\]

\[X^2_n = 1.768 (0.41), X^2_{hs} = 0.834 (0.36) \quad (4)\]

All the estimated coefficients are significant. The summary statistics of this equation are marginally improved. The coefficient of the lagged error term \(ECM_{t-1}\) have correct sign and are significant at the conventional level. This serves as negative feedback mechanism in the equation. The \(X^2\) statistics indicate that there is no serial correlation \(X^2_{sc1}\), functional form misspecification \(X^2_g\), non-normality \(X^2_n\) and heteroscedasticity \(X^2_{hs}\)
in the residuals. The identification and endogeneity tests were also conducted for real exports and found to be satisfactorily.\textsuperscript{4}

We also tested for the stability of export demand for Philippines. Our preferred equation (4) was subjected to \textit{CUSUM} and \textit{CUSUMSQ} stability tests. Both the \textit{CUSUM} and the \textit{CUSUM SQUARES} showed that export demand function is stable in Philippines. The plot of \textit{CUSUM} and \textit{CUSUM SQUARES} test is given by Figure 1 and 2, respectively.

\textsuperscript{4} For detailed discussion on conducting identification and endogeneity tests, see Rao (2006).
**Figure 1.** CUSUM Test for Equation (4)

Plot of Cumulative Sum of Recursive Residuals

The straight lines represent critical bounds at 5% significance level.

**Figure 2.** CUSUMSQ Test for Equation (4)

Plot of Cumulative Sum of Squares of Recursive Residuals

The straight lines represent critical bounds at 5% significance level.
4. Conclusion

This paper uses Johansen Maximum Likelihood technique to estimate the export demand function for Philippines. We also support Rao and Singh (2007) findings that income elasticities are substantially over-estimated in existing empirical works that exclude exchange rate in the relative prices. We have found that the long run income and relative price elasticities for exports are significant and plausible. The unit income elasticity implies that exports is an engine of growth for Philippines. The relative price elasticity is around -1.4 and implies that Philippines exports are competitive in the world market. Such a price elasticity also imply that Philippines has the option to devalue the currency to promote export earnings. However, to further improve the export of goods and services in Philippines, more trade promotion and export-driven growth policies needs to be developed. We hope that our work is useful for further work on Philippines.
**Data Appendix**

$X_t$ is Philippines export of goods and services (FOB) deflated by the export price index. Data are derived from International Financial Statistics (IFS-2005) and Asian Development Bank Database (ADB-2005).

$Y_F$ is the trade weighted average real income of Philippines major trading partners US, Japan, Netherlands, China and Singapore. Trade weights are computed as the share of trade to each of these countries relative to Philippines’s total trade. Data from (IFS-2005) and (ADB-2005).

$P_D$ is the price of Philippine’s export of goods, computed as the weighted average of Philippine’s unit value index of major domestic index of major domestic exports. Data from (IFS-2005) and (ADB-2005).

$E_t$ is the weighted average exchange rate and is the price of a unit of foreign currency in domestic currency. Data from (IFS-2005) and (ADB-2005).

$P_F$ is the import weighted average of major trading partner’s export price indices. Import weights are computed as the share of respective imports to total imports. Data from (IFS-2005) and (ADB-2005).
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