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A semiparametric assessment of export-led growth in the Philippines

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Abstract

The export-led growth (ELG) hypothesis for the Philippines is examined by adopting a semiparametric approach under two levels of temporal aggregation. To assess the impact of model specification on the ELG hypothesis, parametric and semiparametric error-correction models (ECMs) are estimated using Philippine annual and quarterly data on gross domestic product (GDP), exports, exchange rates, and gross fixed-capital formation, focusing on the role of exchange rates. The causal relationship between exports and economic growth is examined using the Granger-causality procedure. It can be concluded that for the Philippines, the ELG hypothesis is (a) sensitive to model specification and (b) affected by different levels of temporal aggregation and by the inclusion or exclusion of exchange rates. The general results on bidirectional causality between exports and economic growth suggest that the Philippines could enjoy economic prosperity by strengthening its trade and investment policy and gearing it toward opening up the economy.

JEL Classification: B41, C12, C13, C14, C32, F43
Keywords: export-led growth, semiparametric error-correction model, Granger causality

1. Introduction

The empirical testing of export-led growth (ELG) hypothesis has been the subject of much research interest. Advocates of this hypothesis argue that export-promotion strategies accelerate the pace of economic growth. This growth is the primary rationale, and efficient alternative, to import-substitution industrialization and inward-orientation strategies of development. Outward orientation is said to lead to elevated total-factor productivity leading to economic prosperity. Countries advocating this strategy consider export activity as a way to achieve economic development.

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However, the degree to which exports bring about growth in an economy has been debated in the literature. Some empirical studies have reported a significant and positive relationship between exports and growth (Arnade and Vasavada [1995]; Dutt and Ghosh [1994]; Xu [1996]); others documented growth-led exports (Ahmad, Harnhirun, and Yang [1997]; Ahmad and Harnhirun [1992]; Riezman, Summers, and Whiteman [1996]), and still others have given an account of no significant relationship between exports and economic growth (Ram [1987]; Ahmad and Harnhirun [1995]). In some works, a bidirectional causality between economic growth and openness is reported (Sharma and Dhakal [1994]; Anoruo and Ahmad [1999]).

Previous researchers have employed various statistical approaches to test the ELG hypothesis.[1] The early studies examined the simple correlation between export and economic growth. Others estimated regression equations explaining output growth based on the neoclassical growth-accounting techniques of production function analysis, including exports or export growth as an explanatory variable. Another group of studies emphasized the relationship between export growth and economic growth by employing Granger or Sims causality tests. More recent empirical estimations have applied cointegration techniques and error-correction models. However, empirical evidence based on these tests is mixed.

The Philippine government recently emphasized export promotion by enacting the Export Development Act of 1994, which is founded on the export-led growth hypothesis suggesting that exports contribute to economic growth and, therefore, can be an effective mechanism to expand output, employment, income, and foreign exchange earnings. In recent years, growth of the Philippine gross domestic product (GDP) has co-moved with the growth of exports. Real export of goods and services has followed an upward trend since 1981, with an average of Php 997.02 billion per year. The highest exports of goods and services were recorded in 2004, when the country exported a total of Php 2,024.00 billion in real terms. The lowest level of exports was in 1982 when, in real terms, we exported only Php 387.30 billion.

This study investigates the relationship between exports and economic growth based on the experience of the Philippines using parametric and semiparametric methods. The econometric evaluations address two important questions: (a) how exchange rates affect the ELG noncausality tests and the sensitivity of noncausality findings in the context of parametric and semiparametric models, and (b) how different levels of temporal aggregation affect the noncausality tests.

Given the ambiguity of results from previous studies, this research is justified based on its adoption of a semiparametric procedure under different levels of temporal aggregation. It also considers the impact of exchange rates on the ELG hypothesis tests. The use of these alternative methodologies may help identify sources of ambiguity in previous works. Finally, the result of this study is of major relevance to other low-income economies heavily dependent on international trade, including the Philippines.

The paper proceeds as follows. Section 2 provides the economic model. Section 3 contains a description of methodology for testing causality. Section 4 provides a survey of

[1] See Giles and Williams [2000] for a comprehensive survey of the empirical literature.

the time-series empirical literature dealing with the Philippine economy. Section 5 describes the data employed in this paper and presents the main findings. The conclusions and some policy implications are presented in section 6. The limitation of the study and suggestion for future research are provided in the last section.

2. Economic model

The principle of comparative advantage remains at the core of arguments for trade liberalization. Trade allows each country to specialize in the most efficient production of goods and services that could give it a comparative advantage in a global market. Trade barriers result in the production of fewer goods that can be efficiently produced by a country, and therefore more goods that can be produced efficiently elsewhere. By lowering barriers so that countries may exploit their own specializations, world output will increase and each country can raise its overall consumption and welfare.

The theory of comparative advantage gave rise to the so-called export-led growth hypothesis. Nevertheless, for a poor, less-developed country, an export-promotion strategy may not be beneficial since the effectiveness of export-promotion policies may depend on both the level of development and the structure of exports. A country must have efficient and competitive domestic industries for it to face globalization and participate in economic integration. Economic integration presupposes that participating economies have already attained a high level of competitiveness and their production structures are mature enough to be able to face regional and global competition [Onguglo and Cernat 2000]. Hence, export-promotion strategies may result in economic growth only if resources for exports production are allocated according to a country's comparative advantage. This is because when products are produced and exported based on comparative advantage, industries are better prepared to face global competition. Export-promotion strategies may provide a country with the opportunity to penetrate larger markets, thus expanding output in a manner consistent with economies of scale.

As a benchmark to this study, the macroeconomic variables considered important in the works of Keong, Yusop, and Khim-Sen [2003][2] and Al-Yousif [1999][3] on the ELG hypothesis for Malaysia are used to model the ELG hypothesis in the Philippines. Malaysia has also a small open economy that embraces export promotion as a means to increase employment and income. The static model shown as equation 1 conjectures that economic growth is a function of exports of goods and services, gross fixed capital formation, and real effective exchange rates.

$$GDP_t = f(\overset{+}{EXP_t}, \overset{+}{GFCF_t}, \overset{+}{RER_t}), \tag{1}$$

[2] Other variables accounted in their study included exchange rates, GFCF, labor, and imports.
[3] Other variables accounted in his study included labor, capital, and exchange rates.

where GDP is the real GDP growth, EXP represents real exports growth of goods and services, GFCF the real gross fixed capital formation, and RER the real effective exchange rates index. The expected relationship between each of the explanatory variable with the dependent variable is indicated by the signs above the variables.

The absence of a consistent causal pattern in ELG studies can be attributed to the omission of other important variables—imports, investment, government spending, exchange rates, and so on—which can influence the export-growth relationship [Islam 1998]. Knowing this importance, the influence of other important variables, such as gross fixed capital formation (proxy for investment) and exchange rates, is dealt with in this study. In the output model, labor and capital are included as the most likely variables to explain growth aside from exports [Sharma and Dhakal 1994]. Perturbations of these factors will register an appreciable effect in total output predicted by the neoclassical growth theory. Investment is a key factor to long-term growth. The higher the level of investments, the possibility of long-term sustained growth increases. As Islam [1998] pointed out, an increase in exports allows an increase in imported capital goods, which eventually raises the growth rate of capital formation and thus stimulates growth. Edwards [1993] reiterates that export industries are more susceptible to productivity improvements leading to increased investment, higher profits, and more rapid economic growth. Among other previous studies, Lee and Huang [2002], Sharma and Dhakal [1994], and Jin and Yu [1996] included gross fixed capital formation in testing the export-led growth hypothesis.

Henriques and Sadorsky [1996], in testing the ELG hypothesis for Canada, accounted for exchange rates to reflect price competitiveness in the international markets while Al-Yousif [1999] included this variable to reflect its indirect influence on economic performance via export channel. The author noted that of the three additional variables considered (exchange rate, labor, and capital), the exchange rate variable played an important role in determining both exports and real output in Malaysia. Cuaresma and Worz [2005], covering 45 countries including the Philippines, also included exchange rates. As viewed by the "new growth theory", exports in developing countries depend on world demand for exported goods. On the same note, world demand is dependent on the price of goods and the income of buyers. Hence, the exchange rate is significant in determining the relationship between exports and economic growth.

It is also important to note that causality may run from economic growth to export growth, in contrast to the export-led growth hypothesis. According to Lee and Huang [2002], when an economy is growing, some industries experience rapid learning and technical changes related to the accumulation of human capital, manufacturing experiences, and technology transfer from abroad through direct licensing or real capital accumulation arising from direct investment. These changes may have very little to do with the export-promotion policies of the government, and output will continue to grow even without such policies. The result is an unbalanced growth, i.e., the growth of domestic demand will lag behind the output growth of these booming industries, triggering producers to export their products. Hence, economic growth contributes to the growth of exports.

3. Empirical methodology

3.1. Econometric methods

The parametric and semiparametric approaches are employed in this study to investigate the ELG hypothesis in the Philippines. These are discussed briefly in the following sections.

3.1.1. Parametric

3.1.1.1. Granger-causality tests

Granger-causality tests have been the principal tool for the recent investigations of the export-led growth hypothesis. But prior to the estimation of any relationships between real GDP and its explanatory variables, the stationarity of each data series should be evaluated. In the case of stationary variables, the model can be estimated in levels and a standard Granger-causality test can be applied. If all the variables are nonstationary, I(1), in levels, and are nonstationary in first differences, I(0), then a cointegration test can be carried out to determine if a long-term relationship exists. Once cointegration is detected, causality tests have to be performed using an error correction model. If no cointegration has been detected, then the model has to be estimated in first differences and the standard Granger causality can be applied.

3.1.1.2. Stationarity and order of integration

The nonstationarity of the data is tested using the Phillips-Perron (PP) [1988] test. The tests are conducted by computing the following regression:

$$\Delta Y_t = a + cY_{t-1} + d_1\Delta Y_{t-1} + d_2\Delta Y_{t-2} + \ldots + d_{p-1}\Delta Y_{t-p+1} + \mu_t, \qquad (2)$$

where ΔY are the first differences of the variables of interest (GDP_t, EXP_t, $GFCF_t$, and RER_t); a, c, d_1, d_2; . . . ; dp_{-1} are parameters; t stands for time; and μ_t is a white-noise disturbance term. The null and alternative hypotheses are H_0: $c = 0$; H_1: $c < 0$. An important step is to specify the number of lagged first-difference terms in equation 2. The PP unit root test makes a nonparametric correction to the t-statistic of the c coefficient in order to control for the serial correlation in μ_t. The Newey-West [1987] correction is used to adjust for heteroscedasticity and serial correlation. For the PP unit root test the truncation lag p for the Newey-West correction is specified using the Akaike information criterion (AIC). The lag length that minimizes the AIC is considered the appropriate lag of the series under study. For the PP t-statistics, MacKinnon tables are used. If the coefficient c is not significant, we fail to reject the null hypothesis of nonstationarity and can conclude that the series is $I(1)$ process.

3.1.1.3. Lag order

The distribution of a test statistic is sensitive to the order of lags used. If the lag order used is less than the true lag, the regression estimates will be biased and the residuals will be serially correlated. If the order of lags used exceeds the true order, the power of the test is likely to be reduced. This problem is overcome by employing the Schwartz Bayesian criterion (SBC). The optimal lag length corresponds to the minimum SBC for selected lag

length values. This procedure removes arbitrariness in choosing the lag length in statistical tests of causality.

3.1.1.4. Cointegration and error-correction models

If the series are nonstationary, the next step is to test for cointegration. Cointegration can be tested using several procedures. A common method used in empirical research is the two-step ordinary least squares (OLS) approach of Engle and Granger. Examples of ECMs with one lag for each variable are given in the next equations.

$$\Delta GDP_t = \alpha + \alpha_1 \Delta GDP_{t-1} + \alpha_2 \Delta EXP_{t-1} + \alpha_3 \Delta RER_{t-1} + \alpha_4 \Delta GFCF_{t-1} - \rho_1 \varepsilon_{t-1} + \mu_{1t}, \tag{3}$$

$$\Delta EXP_t = \beta + \beta_1 \Delta GDP_{t-1} + \beta_2 \Delta EXP_{t-1} + \beta_3 \Delta RER_{t-1} + \beta_4 \Delta GFCF_{t-1} - \rho_2 \varepsilon_{t-1} + \mu_{2t}, \tag{4}$$

where ε_{t-1} is called the lagged error term obtained from the long-run cointegrating regression and ρ_1 or $\rho_2 \neq 0$. There are two possible sources of causation in the ECMs above. For instance, if EXP_t causes GDP_t, then this can be tested either through ε_{t-1} (which is a function of EXP_{t-1}) if $\rho_1 \neq 0$ or through lagged if $\alpha_2 \neq 0$.

In the formulation of an ECM, the lag length of the changes in each variable must be identified. This is done by using the SBC similar to the unit root tests.

The causal relationship between economic growth and exports can now be examined using the Granger-causality procedure based on ECM. This test has been employed in the ELG work done by Zapata and Gil [1998]. Equations (3) and (4) can be expressed below, respectively, which include the error-correction term (ε_{t-1}):

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta GDP_{t-i} + \sum_{i-1}^{p} \alpha_{2i} \Delta EXP_{t-i} + \sum_{i=1}^{p} \alpha_{3i} \Delta GFCF_{t-i} + \sum_{i=1}^{p} \alpha_{4i} \Delta RER_{t-i} - \rho_1 \varepsilon_{t-1} + \mu_t \tag{5}$$

$$\Delta EXP_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta GDP_{t-i} + \sum_{i-1}^{p} \beta_{2i} \Delta EXP_{t-i} + \sum_{i=1}^{p} \beta_{3i} \Delta GFCF_{t-i} + \sum_{i=1}^{p} \beta_{4i} \Delta RER_{t-i} - \rho_2 \varepsilon_{t-1} + \mu_t \tag{6}$$

The estimated coefficients of ε_{t-1} (ρ_1, ρ_2) are expected to capture the adjustments of and ΔGDP_t and ΔEXP_t, respectively, toward long-run equilibrium. That is, these coefficients

determine whether there is an inherent mechanism that correct deviations in economic growth and export growth back to equilibrium very quickly. The parameters (β_1, β_2, ..., β_4, and α_1, α_2, ... α_4) are expected to capture the short-run dynamics of the model, i.e., the coefficients determine whether *GDP*, *EXP*, *GFCF*, and *RER* have a temporary or short-run relationship. The structure lag is determined by using the Schwartz Bayesian criterion. Wald test is used to examine the causality between predetermined and dependent variables.

3.1.1.5. Noncausality hypotheses

Six noncausality hypotheses are tested in this study as follows:

- *Exports do not cause economic growth.*

  This hypothesis means a test on the coefficients of exports in equation (5).

  $$H_o : \alpha_{21} = \alpha_{22} ... = \alpha_{2p} = \rho_1 = 0.$$

- *Economic growth does not cause exports.*

  This hypothesis means a test on the coefficients of GDP in equation (6). Economic growth is assumed to cause export growth if the joint test in the corresponding coefficients is significant.

  $$H_o : \beta_{11} = \beta_{12} ... = \beta_{1p} = \rho_2 = 0.$$

- *Exports do not cause long-run economic growth.*

  The cointegration between two or more variables is already sufficient to indicate the presence of causality at least in one direction [Granger 1988]. Hence, long-run noncausality shall be tested if cointegration is present. This hypothesis means that there is no significant cointegrating relation in equation (5).

  $$H_o : \rho_1 = 0.$$

- *Economic growth does not cause long-run exports.*

  This hypothesis means that ρ_2 in equation (6) does not have significant cointegrating relation, as follows:

  $$H_o : \rho_2 = 0.$$

- *Exports do not cause short-run economic growth.*

  This hypothesis means that coefficients of exports in equation (5) do not have a significant effect on GDP:

  $$H_o : \alpha_{21} = \alpha_{22} ... = \alpha_{2p} = 0.$$

- *Economic growth does not cause short-run exports.*

  This hypothesis means that the coefficients of GDP (b_{1i}) in equation (6) do not have a significant effect on exports (EXP):

  $$H_o : \beta_{11} = \beta_{12} \ldots = \beta_{1p} = 0.$$

3.1.2. Semiparametric

In this paper, the export-led growth hypothesis is also investigated using the same Philippine macroeconomic data used in the parametric method but by estimating a semiparametric ECM. This estimation procedure combines the benefits of parametric and nonparametric approaches. In semiparametric specification, efficiency is improved by specifying a parametric portion of the model for those characteristics whose effects on the dependent variable are expected to be linear, and a nonparametric portion for those expected to be nonlinear. The strength of this method lies in the fact that one need not specify a parametric form for the nonlinearity part. Thus, this method allows for the estimation of a regression function with flexible functional form, and is much easier to compute than most of nonlinear regression models [Bachmeier and Li 2002].

Studies have shown that there is a nonlinear relationship between exports and exchange rates and that the behavior of real exchange rates is nonlinear. In this study, the effects of exchange rates on GDP are modeled nonparametrically, whereas the effects of other variables (EXP, GFCF, error correction term) are modeled parametrically.

The same time-series properties (stationarity, lag length, etc.) previously determined for all parametric variables are used. For the nonparametric variable, however, the generalized cross-validation [Craven and Wahba 1979] is used to determine the number of lags to be included in the estimation of the semiparametric ECM.

Based on the model described by Robinson [1988], the parametric error-correction models written as equations (3) and (4) can be expressed, respectively, as semiparametric error correction models as follows:

$$\Delta GDP_t = \alpha + \alpha_1 \Delta GDP_{t-1} + \alpha_2 \Delta EXP_{t-1} + \alpha_4 \Delta GFCF_{t-1} - \rho_1 \varepsilon_{t-1} + f_1(RER) + \mu_{1t}, \quad (7)$$

$$\Delta GDP_t = \alpha + \alpha_1 \Delta GDP_{t-1} + \alpha_2 \Delta EXP_{t-1} + \alpha_4 \Delta GFCF_{t-1} - \rho_1 \varepsilon_{t-1} + f_1(RER) + \mu_{1t}, \quad (8)$$

3.1.3. Quarterly data analysis

To determine the effects of different levels of temporal aggregation, the parametric and semiparametric methods previously outlined in the methodology sections are followed using quarterly data. Quarterly data on real effective exchange rate index are the averages during the quarter while exports of goods and services, gross fixed capital formation, and GDP are the total values at the end of the quarter.

4. Previous empirical evidence from the Philippines

Empirical evidence on export-led growth hypothesis for the Philippines is mixed, i.e., cases of export-led growth, growth-led export, bidirectional causality, and noncausality were reported by previous studies. However, the Philippines is often cited by some literature as an instance of success in export-promotion strategies. Previous studies with emphasis on the Philippines are reviewed here.

Ram [1987], following an OLS approach and using annual data on population growth, real investment as share of output, and dummy variable for the 1973 oil crisis within the period 1960-1982, failed to find evidence of causality between exports and economic growth in the case of the Philippines. Ahmad and Harnhirun [1995], using a bivariate Granger-causality test, also reported no support for the ELG hypothesis test for the Philippines using annual data from 1966 to 1990.

Among other works, empirical evidence of export-led growth hypothesis for the Philippines can be found in the works of Arnade and Vasavada [1995], Dutt and Ghosh [1994] and Xu [1996]. Arnade and Vasavada [1995] employed a trivariate Granger-causality tests with terms of trade as the other variable included in the model, while Dutt and Ghosh [1994] used a bivariate Granger-causality test to examine ELG hypothesis using annual data from 1953 to 1991. Xu [1996] also employed a bivariate Granger-causality test but using Philippine data from 1951 to 1990.

On the other hand, empirical works that reported causality running from economic growth to exports growth can be seen in the study conducted by Ahmad, Harnhirun, and Yang [1997]. The author examined cointegration and causality between exports and economic growth of the five members of the ASEAN (Association of Southeast Asian Nations) from 1987 to 1993. Other works that reported the same can be found in the studies of Ahmad and Harnhirun [1992] and Riezman, Summers, and Whiteman [1996].

Analyses of Sharma and Dhakal [1994] and Anoruo and Ahmad [1999] both reported bidirectional causality between exports and economic growth, though they accounted for different variables that may influence the relationship between exports and output. Imports were accounted by Anoruo and Ahmad [1999] while Sharma and Dhakal [1994] accounted for more and different variables: population, world output, exchange rate, and gross fixed capital formation. Both studies employed multivariate Granger-causality test. Sharma and Dhakal [1994] used the unit root test developed by Phillips and Perron [1988] while Anoruo and Ahmad [1999] employed an Augmented Dickey-Fuller test. Ekayanake [1999] and Anoruo and Ahmad [1999] used the same time period (1960-1997), with bivariate and multivariate analysis, respectively. The former used cointegration and error-correction models in testing an export-led growth hypothesis in eight Asian developing countries[4] while the latter, who used the same method, tested this hypothesis in selected ASEAN countries.[5] Anoruo and Ahmad's [1999] analysis further accounted for imports. But even given these differences, both reported bidirectional causality for the Philippines.

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[4] Included India, Indonesia, Korea, Pakistan, Philippines, Sri Lanka and Thailand.

[5] Included Indonesia, Malaysia, Philippines, Singapore and Thailand.

Different methods seemed to have different effects on the tests of the ELG hypothesis. For instance, the study of Riezman, Summers, and Whiteman [1996], which selected variables such as GDP, export growth, real import growth, primary school enrollment (as percentage of primary school-age children), and the ratio of total investment over output for 126 countries for the period 1965-1999, revealed that for the five-variable conditional linear feedback, the Philippines had evidence of noncausality between the export variable and the economic growth variable. The same study reported evidence of growth-led export for the Philippines using a bivariate Granger method. Pomponio [1996] reported noncausality for bivariate analysis but found evidence of growth-led exports for a trivariate case when accounting the role of investment in determining the relationship between exports and economic growth.

This study differs from previous literature in that the effect of different levels of temporal aggregation on tests of the ELG hypothesis in the Philippines is examined. In addition, no other study has employed semiparametric procedures to test the export-led growth hypothesis.

5. Data and empirical findings

5.1. Data and definitions of variables

This study used time-series data on real GDP, real exports of good and services, real effective exchange rate index, and gross-fixed capital formation to test the export-led growth hypothesis in the Philippines. Real effective exchange rate is the nominal effective exchange rate[6] divided by a price deflator or index of costs. The sample period chosen for this study was from 1981 to 2004 and 1981:1 to 2004:4 for annual and quarterly analysis, respectively. The logs of the variables are taken so that the differences can be easily interpreted as growth rates.

Data were obtained online from the International Financial Statistics website of the International Monetary Fund. Data on real effective exchange rates are expressed as an index and represent the averages during the period (i.e., quarterly or annual average). Exports of goods and services, GDP, and gross fixed capital formation are measured in terms of billions of Philippine pesos. Real values were calculated using consumer price index, 2000=100.

5.2. Descriptive analysis

The Philippine macroeconomic variables used in this paper from 1981 to 2004 are reflected in Figures 1 and 2 for annual and quarterly data, respectively. It can be seen that real GDP and exports has co-moved upward, reaching a record high in 2004 (Php 3,929.64 billion and Php 2,024.00 billion, respectively). Real effective exchange rates had a downward trend over the last two decades. Annual GFCF from 1981 to 2004 has an average of Php 539.98 billion, with a maximum value of Php 713.09 billion in 1997, and the lowest value of Php 297.03 billion in 1985. This variable followed a fluctuating trend during the period of analysis as shown in graph (d), Figure 1.

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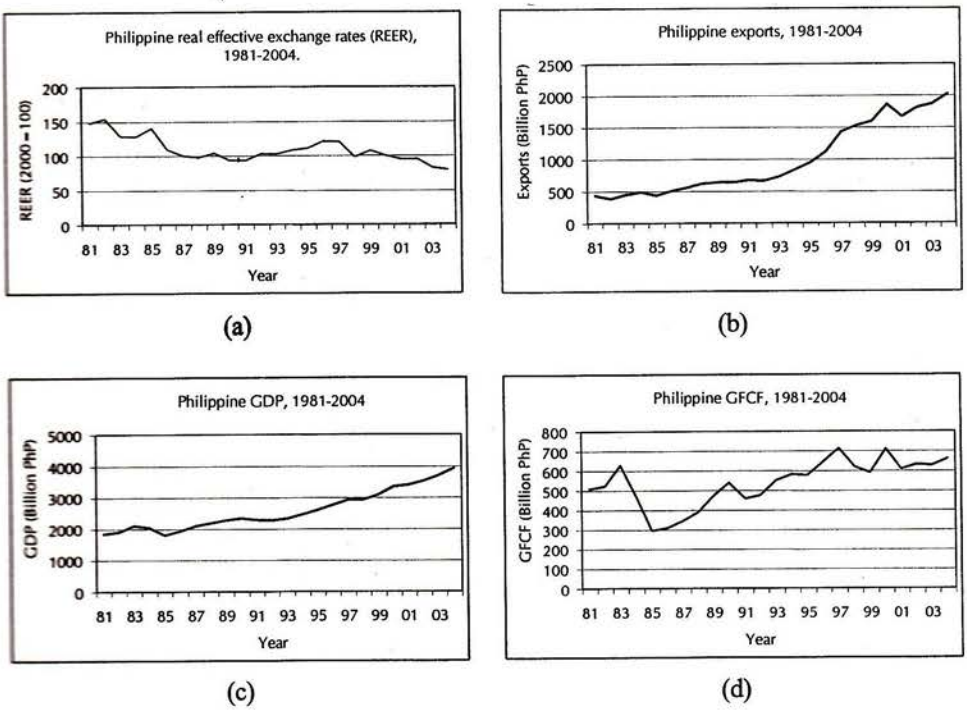
[6]Against the US dollar, the Japanese yen, the euro, and the British pound.

Figure 1. Philippine annual exchange rates, exports, GDP and GFCF, 1981-2004



5.3. Contribution of Philippine exports to GDP

The contribution of exports to GDP is presented in Figure 3 as a percentage to GDP with an annual mean of 31.91 percent from 1981 to 2004. It contributed the most in the year 2000 (55.40 percent) and the least in 1982 (with only 20.33 percent). The contribution generally followed an upward trend.

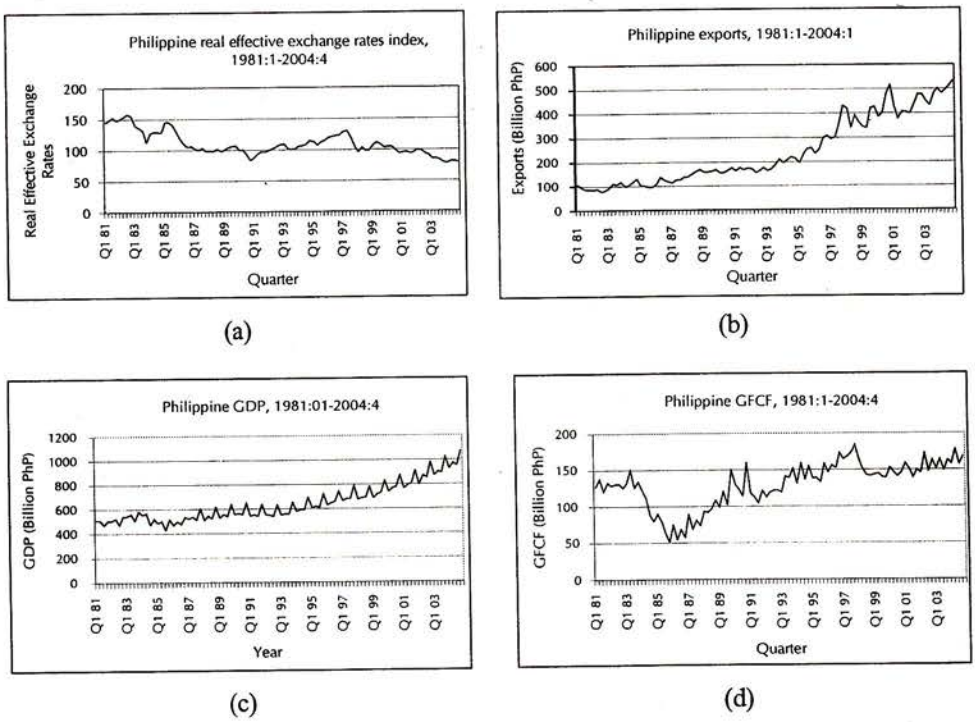
5.4. Long-run equilibrium relationship estimation

For annual data analysis, equation 9 provides parameter estimates (cointegrating vector) that represent long-run elasticities, together with their respective p-values in parentheses. This is presented as equation 10 for quarterly data.

$$GDP = \underset{(0.00)}{5.68} + \underset{(0.00)}{0.33}EXP + \underset{(0.01)}{0.15}GFCF - \underset{(0.01)}{0.21}RER \quad (p\text{-}values) \tag{9}$$

$$GDP = \underset{(0.00)}{4.80} + \underset{(0.00)}{0.29}EXP + \underset{(0.00)}{0.12}GFCF - \underset{(0.15)}{0.08}RER - \underset{(0.00)}{0.10}D_1 - \underset{(0.00)}{0.08}D_2 - \underset{(0.00)}{0.12}D_3 \quad (p\text{-}values) \tag{10}$$

Figure 2. Philippine quarterly exchange rates, exports, GDP and GFCF, 1981:1-2004:4

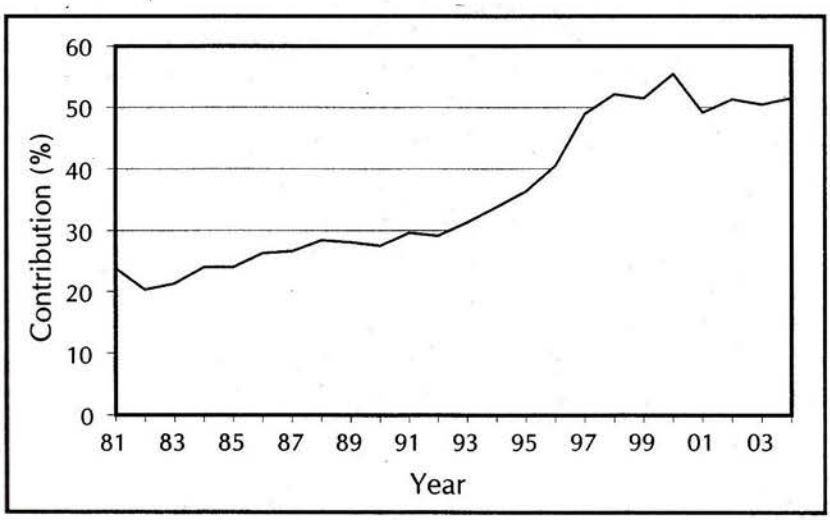


The preceding equations indicate that the variables such as exports and gross fixed capital formation are positively correlated with economic growth. These results are as expected from economic theory, i.e., as exports increase, GDP increases. Investment (proxied by GFCF) can determine long-term growth, so the higher the level of investments, the higher the prospect of economic growth.

From the viewpoint of the classical model, the coefficient of the exchange rates is not consistent with the a priori assumption. The classical model suggests that the devaluation of the real exchange rate has expansionary effects on output if the Marshall-Lerner[7] condition is satisfied. This result suggested that the depreciation of the Philippine peso slows down the growth of GDP. The Philippine government has devaluated its currency to improve competitiveness of exported goods in the international markets. Such policy may not have worked after the 1997 Asian financial crisis as most of the currencies in East Asia had already been devaluated, which may well have induced a contagion effect in efforts to improve international competitiveness [Keong, Yusop, and Khim-Sen 2003].

[7] The condition that some of the elasticities of demand for exports and imports exceed one (in absolute value); that is, $\eta_X + \eta_M > 1$, where η_X, η_M are the demand elasticities for a country's exports and imports, respectively, both defined to be positive for downward sloping demands. Under certain assumptions, this is the condition for a depreciation to improve the trade balance, for the exchange market to be stable, and for international barter exchange to be stable.

Figure 3. Contribution of Philippine exports to GDP, 1981-2004 (%)



5.5. The effect of excluding the exchange-rate variable

This study also determines the effect of exchange rates on the ELG hypothesis tests since exchange rate seem to have an impact on economic growth. This might address the omitted-variable problem cited in previous ELG works. This is done by estimating a regression in which the exchange-rate variable is not considered opposed to what had been done in the previous section and testing the ELG hypothesis using this regression. The long-run equilibrium relationships are reported as equations 11 and 12 for annual and quarterly analysis, respectively, with the p-values reported in parentheses below coefficient estimates.

$$GDP = \underset{(0.00)}{4.69} + \underset{(0.00)}{0.39}EXP + \underset{(0.11)}{0.09}GFCF \quad (p\text{-}values) \tag{11}$$

$$GDP = \underset{(0.00)}{4.39} + \underset{(0.00)}{0.31}EXP + \underset{(0.00)}{0.10}GFCF - \underset{(0.00)}{0.10}D_1 - \underset{(0.00)}{0.08}D_2 - \underset{(0.00)}{0.12}D_3 \quad (p\text{-}values) \tag{12}$$

The signs of the coefficient of exports and gross fixed capital formation are consistent with economic theory, which is also true when estimating a regression with the exchange-rate variables. In terms of the significance of each coefficient, they are significant at 10 percent level just like the estimated regression with the exchange-rate variable except for the coefficient estimates of annual GFCF, which is not significant here as shown in equation 11. While the exchange-rate variable appears to have an important effect on annual GDP (equation 9), there is little effect on the size of the exports coefficients (equations 11 and 12); the significance is unaffected by the exclusion of the exchange-rate variable (please refer to equations 9 and 10 for comparison).

5.6. Test results for unit root

Using annual data, the result of the unit root test shows that the t-test statistic for all series from PP tests are statistically not significant to reject the null hypothesis of nonstationarity at 0.10 significance level (Table 1). This indicates that the series are nonstationary at their level forms. Therefore, these variables contain a unit root process or they share a common stochastic movement.

Table 1. Results of the PP unit root tests for the variables in the ELG hypothesis test for the Philippines, annual data

Equation	Null Hypothesis H_o	Null Hypothesis H_o	Variable							
			GDP		Exports		GFCF		Exchange rate	
			Test-Stat	Conclusion	Test-Stat	Conclusion	Test-Stat	Conclusion	Test-Stat	Conclusion
(14)	$\delta_1=0$	-3.13	-1.978	I(1)	-2.579	I(1)	-2.430	I(1)	-2.018	I(1)
(14)	$\delta_1=\delta_2=0$	5.34	2.524	I(0)	3.676	I(0)	3.111	I(0)	2.021	I(0)
(13)	$\delta_1=0$	-2.57	0.501	I(1)	0.285	I(1)	-1.572	I(1)	-1.425	I(1)

Notes: The unit root test used in this study is the Phillips-Perron test. The regression equations are

$$\Delta Y_t = \delta_0 + \delta_1 Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \mu_t , \tag{13}$$

$$\Delta Y_t = \delta_0 + \delta_1 Y_{t-1} + \delta_2 t + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \mu_t , \tag{14}$$

where μ_t is the white noise. The additional lagged terms, m, are included to ensure that the errors are uncorrelated. Equation (13) is a model with constant and no trend and (14) is one with-constant and a trend.

Column 1 indicates the regression equations used in testing the null hypothesis in column 2. The null hypotheses are as follows: (a) null hypothesis of a unit root ($\delta_1 = 0$), and (b) null hypothesis that the trend term is equal to zero given the presence of a unit root ($\delta_1=\delta_2= 0$). Column 3 is the critical value at 10 percent level of significance. The last major column is the variable under investigation. The test-statistic subcolumn is the computed statistics, and it is compared with the critical value column to arrive to a conclusion that is indicated in the conclusion subcolumn.

Using quarterly data, results show that the GDP and exports series are stationary in their level forms but the GFCF and exchange rates are not (Table 2). When the unit root test is conducted at first difference of each variable using annual and quarterly data, the null hypothesis of nonstationarity is rejected at 0.10 significance level for all the variables examined (Table 3). This is consistent with some previous studies that demonstrated that most of the macroeconomics and financial series are expected to contain unit root and thus are integrated at order one, I(1). Thus it can be concluded that the series are integrated at order one, and a higher order of differencing is not required.

Table 2. Results of PP unit root tests for the variables in the ELG hypothesis test for the Philippines, quarterly data

Equation	Null Hypothesis H_o	Critical Value at 10% level	Variable							
			GDP		Exports		GFCF		Exchange rate	
			Test-Stat	Conclusion	Test-Stat	Conclusion	Test-Stat	Conclusion	Test-Stat	Conclusion
(14)	$\delta_1=0$	-3.13	-6.382	I(0)	-4.676	I(0)	-2.858	I(1)	-2.181	I(1)
(14)	$\delta_1=\delta_2=0$	5.34	20.539	I(1)	11.126	I(1)	4.106	I(0)	2.389	I(0)
(13)	$\delta_1=0$	-2.57	0.731	I(1)	-0.328	I(1)	-1.738	I(1)	-1.523	I(1)

Table 3. Results of the unit root tests on the first differences of the variables for Philippine ELG hypothesis test

Variable	Annual		Quarterly	
	Tau Statistics	Pr < Tau	Tau Statistics	Pr < Tau
GDP	-1.78	0.07	-2.90	0.00
Exports	-3.19	0.00	-4.48	<.00
Exchange Rates	-3.65	0.00	-4.53	<.00
GFCF	-4.28	0.00	-3.72	0.00

Note: H_o: The series is nonstationary in first differences

5.6.1. Correcting for seasonal unit roots

The seasonality of the nonstationary series is treated by estimating a regression equation with quarterly seasonal dummy variables (quarters 1, 2, and 3). Results of stationarity tests indicate that the linear combination is stationary in first differences when seasonal dummy variables are included in the model. Hence, quarterly data are analysed with seasonal dummies.[8]

5.7. Test results for cointegration

Having confirmed the existence of unit roots for the data series, the next step involves applying Engle-Granger two-step cointegration procedure.

Results showed that using any one of the four equilibrium relations, at 10 percent level of significance, the variables are cointegrated at order (1,1) for both annual and quarterly data (Table 4). Based on this test, the economic growth and its macroeconomic determinants exhibit a long-run relationship. This means that real GDP, exports of goods and services, gross fixed capital formation, and real effective exchange rates tend to move together over the entire period of analysis (annual and quarterly data).

[8] A formal test of the unit roots at various frequencies using the test proposed by Hylleberg, Engle, Granger, and Yoo (HEGY) [1990] were conducted. Results revealed that seasonal dummy variables capture seasonality well.

Table 4. Results of the cointegration tests for four Philippine macroeconomic variables, 1981-2004

Regressand	*Annual*		*Quarterly*	
	α_1	*p-value*	α_1	*p-value*
GDP	0.329	.075	0.197	0.003
Exports	0.385	.053	0.158	0.008
Exchange Rates	0.508	.011	0.114	0.017
GFCF	0.499	.013	0.069	0.000

5.8. Adequacy of the selected econometric model

5.8.1. Portmanteau test

According to Lutkepohl [1993], the selection of the lag order may be interpreted as a method for determining a filter that transforms data into a white-noise series. The sequence of residuals is a white-noise process if each value in the sequence has a mean of zero, a constant variance, and is serially uncorrelated. As long as the residuals of a given model are close enough to white noise, that model can be regarded as appropriately specified. The result of the Portmanteau test for residual autocorrelation is reported in Table 5.

Table 5. Portmanteau test for residual autocorrelation of the selected model for ELG hypothesis test of the Philippines, 1981-2004

Annual		
To Lag	Chi-Square	P-value
3	45.12	0.0001
4	64.94	0.0005
Quarterly		
6	205.99	<0.0001
12	264.51	<0.0001
18	266.51	<0.0001

Note: H_o: There is no remaining residual autocorrelation at lags 1 to specified lag length.

The presence of correlation in the estimated model usually means that the lag lengths are too short. The Portmanteau test checks the null hypothesis that there is no remaining residual autocorrelation at lags 1 to specified lag length against the alternative that at least one of the autocorrelations is nonzero. It can be noticed that the null hypothesis of no residual autocorrelation is rejected both at lags 1 to 3 and at lags 1 to 4 for annual data. For quarterly data, the null hypothesis that there is no remaining residual autocorrelation at lags 1 to 6, 1 to 12, and 1 to 18 can be rejected.

5.8.2. Normality

The hypothesis tests and interval estimates for the coefficients are based on the assumption that the errors, and hence the dependent variable, are normally distributed. The normality of the errors for the model selected is tested using Jarque-Bera test. The rejection of normality may indicate that there are some outlying observations or that the error process is not homoskedastic. Based on the results presented in Table 6, it can be observed that the residuals are normally distributed at 10 percent level of significance, i.e., p-values > 0.10.

Table 6. Normality tests for the residuals of the selected model for ELG hypothesis test of the Philippines, 1981-2004

Annual		
Variable	*Jarque-Bera Chi-Square*	*P-value*
GDP	2.74	0.2544
Export	1.12	0.5723
Exchange Rates	0.22	0.8958
GFCF	1.23	0.5405
Quarterly		
GDP	3.67	0.1588
Export	2.60	0.2729
Exchange Rates	2.77	0.2506
GFCF	5.64	0.0596

5.9. Test results on Granger causality

The Granger-causality tests between exports and economic growth for the Philippines is summarized in Table 7.

5.9.1. Parametric analysis of annual and quarterly data

As shown in Table 7, results of the parametric procedure show that the tests on the export-led hypothesis vary depending on the frequency of the data, i.e., different levels of temporal aggregation have different effects on the ELG hypothesis test. Based on the result

Table 7. Results of the granger causality tests between exports and economic growth for the Philippines, 1981-2004

Restriction	*Annual*		*Quarterly*	
	Parametric	*Semiparametric*	*Parametric*	*Semiparametric*
Short-run	Export-led growth	Bidirectional	Bidirectional	Bidirectional
Long-run	No causality	No causality	Bidirectional	Growth-led exports
Total	Export-led growth	Bidirectional	Bidirectional	Bidirectional

of this study, the annual data analysis supports the export-led growth theory in the Philippines but only in the short run. It can be noticed that although there is total causality running from export growth to economic growth, there is no evidence of long-run causality. Hence, over the longer run, this positive impact of exports on economic growth tends to die down.

On the other hand, quarterly data analysis reveals that there is a feedback relationship, i.e., that output growth causes export growth and vice versa. This analysis suggests that using quarterly data, the Philippines followed the path of export-led growth, while suggesting that domestic market conditions had a significant impact on the growth process, with exports playing a reactive role.

5.9.2. Semiparametric analysis of annual and quarterly data

Findings of the semiparametric analysis of annual data provide evidence of bidirectional causality between exports and economic growth in the short run and total Granger-causality tests in the Philippine context. However, in the longer run, no causal relationship can be found.

It is interesting to note that quarterly data analysis also shows evidence to support bidirectional causality between exports and economic growth in the Philippines in the short run and in the total Granger-causality tests. While annual data analysis reported no causal relationship between exports and economic growth, quarterly data analysis revealed that in the long run, economic growth causes growth in exports.

5.9.3. Parametric versus semiparametric

5.9.3.1. Annual data

It is shown that in testing the export-led growth hypothesis, results of parametric analysis vary from the semiparametric approach in annual data. That is, in this study, the parametric procedure supported the export-led growth hypothesis in the short run and in total causality tests, but the semiparametric reported bidirectional causality given the same restrictions. In the long-run causality tests, however, parametric and semiparametric procedures reported the same results, i.e., there is no causality between exports and output.

5.9.3.2. Quarterly data

The parametric procedure of the study provides evidence of bidirectional causality between exports and economic growth when quarterly data are used. The semiparametric procedure also reported bidirectional causality except in the long run in which there is evidence running from economic growth to exports growth.

It is interesting to note that although differences are evident between the results of parametric and semiparamateric procedures and in different levels of temporal aggregation, the conclusions are generally not contradictory. For instance, annual analysis following a parametric procedure supports ELG hypothesis in the short run and total-causality tests while semiparametric model provides evidence to support bidirectional causality between exports and economic growth in both restrictions. Hence, aside from causality running from GDP to exports, there is also causality running from exports to GDP, which supports the conclusion of the parametric procedure. Both procedures support bidirectional causality

using the same restrictions in the quarterly data analysis. In the long-run analysis, there is no causality based on the result of both procedures using annual data. Quarterly data analysis, however, reports bidirectional causality and growth-led exports for parametric and semiparametric procedures, respectively. Hence, the result of semiparametric procedure in this case supports the parametric procedure that reports causality running from exports to GDP and vice versa, though just in one direction.

5.10. Granger-causality tests on the effect of excluding the exchange-rate variable

To determine whether exchange rates affect ELG noncausality tests, Granger-causality tests were also done with the model that excludes this variable, and results were compared with the model that considers this variable. A comparison of the Granger-causality results between the two regressions is presented in Table 8.

Table 8. The effect of exchange rates on ELG hypothesis test in the Philippines, 1981-2004

Restriction	*Annual*		*Quarterly*	
	A	*B*	*A*	*B*
Short-run	Export-led growth	Export-led growth	Bidirectional	Bidirectional
Long-run	No causality	No causality	Bidirectional	Bidirectional
Total	Export-led growth	No causality	Bidirectional	Bidirectional

Note: ***A*** represents the regression with the exchange rates variable. ***B*** represents the regression without the exchange rates variable.

Based on the results presented in Table 8, the exchange-rate variable affects the result of the ELG hypothesis tests only when testing for total Granger causality, i.e., total Granger causality following an estimation of a regression with exchange-rate variable reported evidence of export-led growth while estimation without the exchange-rate variable reported no causal relation between exports and economic growth. But all other causality tests reported the same results for both regressions using either annual or quarterly data.

6. Conclusions and policy implications

Based on the Philippine macroeconomic data, it can be concluded that the ELG hypothesis is (a) sensitive to model specification and (b) affected by different levels of temporal aggregation and by the inclusion or exclusion of exchange rates.

Under short-run and total-causality tests, parametric and semiparametric analyses using annual data support export-led growth and bidirectional causality, respectively, and no causality between exports and output in the long run. Quarterly data analysis revealed that, in the long run, parametric and semiparametric procedures support bidirectional causality and growth-led exports, respectively, and that there is bidirectional causality between exports and economic growth for short-run and total causality tests.

Using annual data, total causality tests support export-led growth and no causality, with the inclusion and exclusion of exchange rates, respectively. No changes in results are evident for short-run and long-run causality tests. Using quarterly data, no changes in results are shown in all Granger-causality tests.

It can be implied that the general results of analysis using quarterly data (i.e., bidirectional causality) can be a better representation of the Philippine economy than the analysis using annual data. The justifications behind this implication are as follows: (a) the quarterly data can capture well the seasonality of exports and the volatility of the exchange rates, and (b) quarterly data provide more observations and will likely better capture the variations of the time-series data.

The general evidence of bidirectional causality suggests that the Philippines followed the path of export-led growth, while suggesting that domestic market conditions had a significant impact on the growth process, with exports playing a reactive role. It can, therefore, be inferred that the unilateral liberalization pursued by the Philippines in order to foster efficiency and competitiveness is warranted and supported by the empirical results of this study. Results further suggest that the Philippines could enjoy economic prosperity by strengthening its trade and investment policy and gearing it toward opening up the economy.

Previous studies have argued that differences in outcomes of the ELG hypothesis tests may be due to different levels of temporal aggregation, methodologies, model misspecification, and omitted variables. This analysis introduces empirical evidence on these issues. It can also be argued that the export-led growth hypothesis may be consistently supported by empirical works that define exports variable as the exports of goods and services produced based on the theory of comparative advantage and exported at a time when an appropriate exchange-rate policy is implemented to complement export-promotion policy.

7. Limitation and suggestion for future research

As a semiparametric assessment, this study provided no assumption about the functional form of the exchange-rate variable. The work of Akram, Eithreim, and Sarno [2005] reported that the real exchange-rate variable has a nonlinear relationship with output. Of particular interest to future research may be to test the ELG hypothesis in a model where the relationship between the exchange rates and GDP is known, such as in a Monte Carlo framework. By specifying the true data-generation process, the relative merits of various econometric methods, under temporal aggregation, can be more robustly assessed.

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