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The Diffusion Process of Business Cycles and Its Structural Change in the Philippines

Hiroki Nogami

Introduction

During the industrialization process of the past decade, the Philippine economy experienced various structural changes. The main forces which had driven its economic growth until the late 1970s were primary commodity exports and government expenditures. In the 1980s this growth structure changed. Manufactured goods came to occupy a dominant share in exports, replacing primary commodities, while the government could not, in the face of its huge budget deficit, expand its expenditures as it had in the 1970s.

Given such differences in the growth structure between the 1970s and 1980s, exports and government expenditures must have had differing impacts on the economy. This paper will try to identify the structural change in the diffusion process of business cycles over the last two decades. By using CIs of subsectors in the economy, the macroeconomic impact of exports, construction, and government expenditures will be studied. In particular, the diffusion process in the 1970s and that in the 1980s will be empirically compared. In the first section, the relationship of various economic variables will be examined, from which a summary of preliminary observations on the process of business cycle diffusion will be made. In the second section, the methodology of the empirical study and the compilation of the associated data will be presented. The third section clarifies the empirical results. The final section gives the concluding remarks.

Implications of the Fluctuations of the Macrovariables

The diffusion process of business cycles can be expressed as both the degree of linkage and lead-lag relationships between aggregate cycles of the whole economy and the specific cycles of subsectors which initially generate cycles. In order to discern such subsectors, the fluctuations of various macroeconomic variables will be compared in this section.

Annual growth rates of GDP, exports, government expenditures, and private construction are shown in Figure 8–1. Exports are divided into two groups: primary commodities and manufactured goods. Government expenditures include consumption expenditures and construction. The pattern of fluctuation in government expenditures clearly resembles that of GDP. For private construction the pattern of fluctuation also closely corresponds to that of GDP but with turning points lagging behind those of GDP by one or two years. The correspondence between fluctuations in exports and GDP is not so clear, though there are similar movements in the years around 1980 and in those years after 1985.

In the 1960s, as Table 8–1 shows, the shares for private construction and exports were large while the share for government expenditures was relatively small. In the 1970s the shares for private construction and for government expenditures increased, while in the 1980s only the share for exports increased. The impact of private construction and government expenditures was relatively large in the late 1970s, while in the 1980s the impact of exports was relatively large.

The continuous increase in the share of exports in GDP has been accompanied by a change in the commodity composition of exports. Table 8–1 clearly shows that the share for manufactured exports began to increase rapidly in the late 1970s and came to dominate exports in the early 1980s. Labor-intensive goods contributed the most to the increase in manufactured exports, as can be seen in Table 8–2. Here, textiles, wearing apparel, footwear, furniture and wood products, and electrical machinery constituted 47.8 per cent of total exports in 1985.

Two general conclusions can be drawn from the observations in this section. One is that primary commodity exports, labor-intensive manufactured goods, private construction, and government expenditures have been important factors influencing business cycles in the Philippines. The other is that the impact of primary commodity exports, construction, and government expenditures seems to have been large in the late 1970s, while that for exports of labor-intensive manufactured goods seems to have been large in the 1980s.

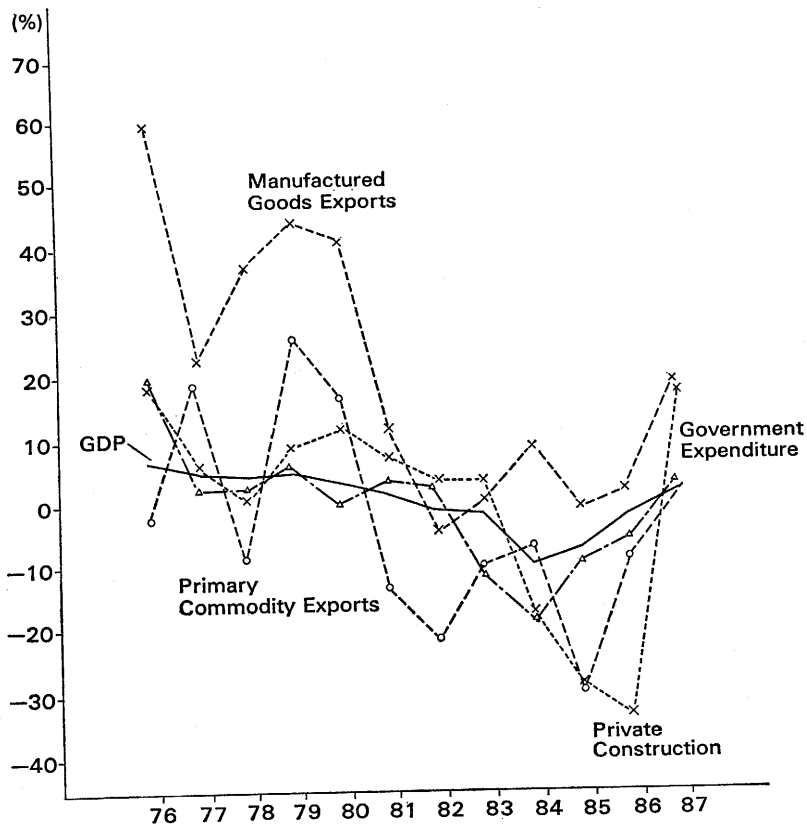

Fig. 8–1
Growth Rates of Philippine Economic Indicators

Source: National Economic and Development Authority, National Statistical Coordination Board, *Philippine Statistical Yearbook*, 1988.

Notes:
1. GDP, government expenditures, and private construction are at 1972 constant prices. Government expenditures are defined as a summation of government consumption expenditures and government construction.
2. Manufactured goods exports include chemicals, textiles, miscellaneous manufactured goods, and others. Primary commodity exports include copra, sugar, bananas, logs and lumber, desiccated coconut, coconut, coconut oil, canned pineapples, gold, abaca (unmanufactured), and copper concentrates. They are F.O.B. values in U.S. dollars.

Table 8-1
Structural Change of Main Economic Indicators

Year	Shares in Real GDP			Export Composition	
	Private Construction	Exports	Government Expenditures	Primary Commodities	Manufactured Goods
1960	5.4	16.6	9.4	89.2	3.6
1965	8.0	22.0	9.3	79.4	5.8
1970	5.1	17.1	9.3	76.0	10.9
1975	5.6	15.0	14.0	70.6	17.4
1980	6.8	19.2	14.2	45.5	40.1
1985	5.4	22.0	12.0	24.3	64.7
1986	3.7	26.3	11.5	22.1	65.3
1987	4.3	24.6	11.7	19.6	67.7

Sources: 1. National Economic and Development Authority, National Statistical Coordination Board, *Philippine Statistical Yearbook*, various years.
2. National Economic and Development Authority, National Statistical Coordination Board, *Philippine Statistical Yearbook*, 1988.

Notes: 1. Shares in real GDP are given at 1972 constant prices.
2. Government expenditures are summations of government consumption expenditures and government construction.
3. Export composition is based on F.O.B. values in U.S. dollars.
4. The coverage of primary commodities and manufactured goods are the same as those in Figure 8-1.
5. Total does not add up to 100 because minor primary commodities and fuel and lubricants are not included here.

Data and Method of Empirical Study

In preparation for statistical analyses, cyclical movements of the aggregated economy and those of the subsectors need to be represented by indicators. In this study one aggregate composite index (*ACI*) and four sectoral composite indices (*SCI*s) were compiled on a monthly basis, as follows.

1. Aggregate CI (CICOIN80)
2. Primary Commodity Export Prices CI (CIPRCOMO)
3. Manufactured Goods Export CI (CIEXLABO)
4. Construction CI (CICONST)
5. Public Sectoral CI (CIFISCAL)

The list of variables included in each CI is given in Appendix 8-1, and graphs of these CIs are presented in Appendix 8-2. The criterion for choosing the variables was basically the degree of their importance in each sector. Especially for the CIEXLABO, variables were selected from the five industries with low capital-labor ratios given in Table 8-2.

The relationship between aggregate economy and the sectoral cycles is

Table 8-2
Capital-Labor Ratios and Export Share of Manufacturing Industries in the Philippines

Industry	SITC Code	Capital-Labor Ratio	Export Share (%)				
			1965	1970	1975	1980	1985
Wearing apparel (clothing)	(84)	9.53	0.1	0.0	1.4	4.8	5.7
Footwear	(85)	18.61	0.0	0.1	0.1	1.2	0.8
Furniture, wood products	(82, 63)	36.23	4.2	4.2	2.8	4.6	4.2
Textiles	(65)	66.26	0.6	0.5	1.0	1.3	0.8
Electrical machinery	(72, 931)	73.86	0.1	0.1	5.9	17.2	36.3
Manufacturing average		118.50					

Notes: 1. Capital-labor ratios in 1986. Original data are from the National Statistical Coordination Board, *Philippine Statistical Yearbook*, 1988.
2. Export data are from AID-XT (IDE trade data retrieval system).
3. A large part of Philippine electrical machinery was exported on a consignment basis, and main product lines under this category are classified in Philippine trade as SITC 931. Therefore, in this table, I assumed that SITC 931 were exports of electrical machinery. Figures for export shares in this table are a summation of SITC 72 and 931. For Philippine manufactured exports on a consignment basis, see Nohara (1987).

analyzed by estimating the polynomial distributed lags (PDL) between the *ACI* and *SCI*s. In this study I examined the estimated lag structure from two directions. First, I tested to see if each *SCI* was a significant factor for causing aggregate business cycles. *SCI*s with significant lag coefficients that are all positive are regarded as a factor causing business cycles. Second, I checked to see if there was any change in the lag structure during the three subperiods by looking at the mean lag. In this way I was able to estimate the PDL for the whole period (late 1970s and 1980s) and for the following three subperiods:

1. Period I (up to December 1979)
2. Period II (from January 1980 to December 1982)
3. Period III (after January 1986).

I excluded the period of political instability between 1983 and 1985. Also, the initial period is different depending on the data availability of each variable.

Estimation of distributed lags was done by using the following formula, Almon's polynomial distributed lags:

$$ACI(t) = a + \sum_{i=0}^{n} b_i \cdot SCI(t-i) + u(t). \qquad (1)$$

Each coefficient b_i can be approximated by a second-degree polynomial of the i, the length of the lag. Hence, b_i can be expressed as

$$b_i = c_0 + c_1 \cdot i + c_2 \cdot i^2. \qquad (2)$$

The parameters in equation (2) are specified as follows:

1. length of lag (i): 6 and 12,
2. degree of polynomial: 2,
3. end point restriction: coefficients of the lagged variables after the 6th or 12th are zero.

Since the coefficients are interpreted to follow the probability distribution, there are restrictions on the coefficients. First, coefficients should be positive. Second, coefficients should add up to unity. In mathematical terms, these restrictions could be expressed by

$$Q(L) = C_0 + C_1(L) + C_2(L)^2 + \cdots + C_n(L)^n,$$

where L is a lag operator,[1] $C_i > 0$ for all i, and $\sum_{i=1}^{n} C = 1$. Hence the mean lag is given by

$$C_0 + (0) + C_1 \cdot (1) + \cdots + C_n \cdot (n) = \sum_{i=0}^{n} C \cdot (i).$$

The mean lag can be interpreted to show the average leading period of an explanatory variable over the dependent variable. This mean lag will be used in order to compare the leading period of an *SCI* over *ACI* in the different subperiods and also to compare the leading periods among the different *SCI*s.

Empirical Results

The intensity of relationships and the lead-lag relationship between the *ACI* and each of the *SCI*s was estimated according to equation (1) for the whole sample period and for period I, period II, and period III. The OLS method was first applied to equation (1), but negative autocorrelation existed among the disturbance terms; therefore the autoregressive least squares (ALS) method, which is equal to GLS with first-order autocorrelation,[2] was applied.

The statistical causality relationships between the aggregate business cycle and each sectoral cycle during the three periods will be examined first. Table 8–3 summarizes only the statistically significant coefficients for the lengths of lag being six and twelve.

Table 8-3
Significant Coefficients of Lags

(1) Length of Lag 6

Periods	I (-79.12)	II (80.01-82.12)	III (86.01-)	Total
CIPRCOMO	—	—	0-6 (+)	1-6 (+)
CIEXLABO	1 (−)	—	0-3 (−)	2 (+)
CICONST	1 (−)	—	—	—
CIFISCAL	—	—	—	—

(2) Length of Lag 12

Periods	I (-79.12)	II (80.01-82.12)	III (86.01-)	Total
CIPRCOMO	0-2 (+) 5-12 (−)	—	0-12 (+)	0-6 (+)
CIEXLABO	7-12 (−)	—	1-5 (+)	0-4 (+)
CICONST	5-12 (+)	—	—	—
CIFISCAL	—	—	—	—

Note: Figures indicate the number of lags, and their signs are in parentheses. The level of significance is 10 per cent.

Period I (-1979)

For primary commodity exports (CIPRCOMO), the coefficients from zero to two lags were significant and positive, and those from five to twelve lags were significant but negative if the length of lag is assumed to be twelve. If the length of lag is six, all coefficients were positive but insignificant. Therefore, commodity export prices could not be regarded as a cause of business cycles. For manufactured goods exports (CIEXLABO), estimated coefficients were negative in both cases and thus will not be considered as a cause of business cycles. For construction (CICONST), when the length of lag is twelve, the coefficients were positive and significant. This means that construction activity was the most influential factor affecting business cycles in the late 1970s.

Period II (1980-82)

No significant results were obtained for this period. In other words, the aggregate cycles were influenced by other factors.

Period III (1986-88)

Significant and positive coefficients were obtained only for the two external

*SCI*s, namely the CIEXLABO and CIPRCOMO. Primary commodity export prices and exports of labor intensive manufactured goods were identified as causes of business cycles in the late 1980s.

In summary, Table 8–3 indicates that construction was the cause of business cycles in the late 1970s, and external factors such as exports of primary commodities and exports of manufactured goods were the causes of business cycles in the late 1980s. Exports of primary commodities continued to play an important role in Philippine business cycles, but the emergence of manufactured goods exports as a significant factor for cycles reflects the development of the labor-intensive manufacturing sector.

The lead-lag relationships between the aggregate CI and sectoral CIs will be measured next.

Table 8–4 gives the mean lag of the sectoral CIs. When the lag coefficients include negative figures, the mean lag is not calculated. For a lag of six months, mean lags are calculated for all sectoral CIs for the whole period covering the 1970s and 1980s. The order of the mean lags between the different *SCI*s is

$$\underset{(1.427)}{\text{CICONST}} < \underset{(1.785)}{\text{CIEXLABO}} < \underset{(2.812)}{\text{CIPRCOMO}} < \underset{(3.146)}{\text{CIFISCAL}}.$$

The figures in parentheses show the months of mean lag, or the average leading period of SCIs against the aggregate CIs. The average leading period of construction (CICONST) is 1.427 because the coefficient is largest when the lag is zero. The same applies to exports of manufactured goods

Table 8–4
Mean Lags of Sectoral CIs

(1) Length of Lag 6

Periods	I (-79.12)	II (80.01-82.12)	III (86.01-)	Total
CIPRCOMO	2.403	—	2.809	2.812
CIEXLABO	—	—	2.068	1.785
CICONST	—	—	—	1.427
CIFISCAL	—	—	—	3.146

(2) Length of Lag 12

Periods	I (-79.12)	II (80.01-82.12)	III (86.01-)	Total
CIPRCOMO	—	6.711	4.439	3.225
CIEXLABO	—	4.788	4.288	—
CICONST	—	—	—	5.671
CIFISCAL	—	—	—	—

(CIEXLABO). The CIs for primary commodity exports (CIPRCOMO) and government expenditures (CIFISCAL) have longer leading periods due to relatively larger figures for the coefficients of the lagged variables.

When the maximum lag is assumed to be twelve months that is, each sectoral cycle is assumed to have its impact on the aggregate economy for a period of twelve months, the mean lags of the CIPRCOMO and CICONST are

CIPRCOMO < CICONST.
(3.225) (5.671)

The lag distribution of the CIPRCOMO has relatively large coefficients with lags from zero to six months; the lag coefficients decrease rapidly after seven months. The CICONST's lag distribution has relatively large lag coefficients after seven months. This result shows that commodity export prices have effects mainly within six months, while construction causes effects mainly after seven months.

Mean lags for the three subperiods will now be examined in order to see the structural changes that take place in the diffusion process.

In the three subperiods, the mean lags can be calculated only for the two external sectoral CIs (CIPRCOMO and CIEXLABO). When the lag length is six, the order of the mean lags in periods I and III is

(CIEXLABO in III) < (CIPRCOMO in I) < (CIPRCOMO in III).
(2.068) (2.403) (2.809)

When the lag length is twelve, the order in period II and III is

(CIEXLABO in III) < (CIPRCOMO in III) < (CIEXLABO in II) <
(4.288) (4.439) (4.788)
(CIPRCOMO in II).
(6.711)

The figures suggest that with the progress of industrialization the leading periods of both the CIPRCOMO and CIEXLABO over the aggregate business cycle have shortened.

As for the effects of the public sector (CIFISCAL), only poor results were obtained. For the time covering periods I and II, the mean lag was 3.15 months, which is longer than any other sector. However, since the significance of estimated coefficients is low, the hypothesis that government expenditures cause business cycles cannot be empirically supported.

Concluding Remarks

This chapter has clarified two points regarding the diffusion process of business cycles in the Philippines. One is that, in the late 1970s, construction activity was identified as a primary cause of business cycles. The other point is that, after the mid-1980s, primary commodity exports and exports of labor-intensive manufactured goods were identified as causes of business cycles. At the same time only poor results were obtained regarding the effects of the public sector. This might be improved by changing the component variables of the public sectoral CI.

Notes

1 For an explanation of the mean lag, see Kuh and Schmalensee (1973), Chapter 4, appendix.
2 See SAS Institute Inc. (1984), Chapter 15.

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Appendix 8–1
Component Variables of Sectoral CIs

(1) Aggregate CI (CICOIN80)
MCGPWP (Import of Pulp and Waste Paper)
MCGMFL (Import of Minerals, Fuels, and Lubricants)
MCGEM (Import of Electorical Machinery)
MCGCHEM (Import of Chemical Products)
MCGTE (Import of Transport Equipment)
ELCCSCOM (Electricity Consumption of Commerce)
IEMPMA72 (Employment Index of Manufacturing, 1972=100)
ELCCSIND (Electricity Consumption of Industry)
ELCCSRES (Electricity Consumption of Residential Areas)

(2) Primary Commodity Export Price CI (CIPRCOMO)
PLYWODWP (Wholesale Price of Plywood (Tokyo Market))
COCWPPRC (Wholesale Price of Coconut Oil, New York)
SUGARUNV (Export Unit Value of Sugar, New York)
UNITCOP (Export Unit Value of Copper)

(3) Manufactured Goods Export CI (CIEXLABO)
ENFF (Export Value of Furniture and Fixtures)
EVCLOTH (Export of Clothing)
EVFO (Export of Footwear)
ENTYD (Export of Textiles, Yarns, and Fabrics)
EVEC (Export of Electrical Machinery)

(4) Construction CI (CICONST)
CEMENT (Cement Production)
RCPCONRES (Private Residential Construction, deflated with WPI)
RCPCONNRS (Nonresidential Construction, deflated with WPI)
RCPIHR (Relative Price of Housing=CPI of Housing/CPI)

(5) Public Sectoral CI (CIFISCAL)
RGOVEXOP (Government Expenditures, deflated with WPI)
REXDBPSO (External Public Debt in Pesos, deflated with WPI=a proxy variable of assistance from the external sector)
DBTINDX (Ratio of the Government Expenditures to Tax Revenue total= an index of expansion in fiscal policy)

Note: In compilation, the standard term is the period from January to December 1980, and all indices are standardized at January 1980=100.

Appendix 8–2
Aggregate and Sectoral CIs