Procyclical Productivity and Returns-to-Scale in Philippine Manufacturing*

Tatsufumi Yamagata

Bangladesh Institute of Development Studies and
The Institute of Developing Economies

The Philippines is regarded as a highly oligopolistic economy, and it is argued that this is a cause of the relative stagnation of the economy to neighbouring East Asian economies. This presumption might be associated with increasing returns to scale and market power, which are consistent with the procyclical total factor productivity that is observed in the Philippines and the United States. However, this study found no strong evidence supporting increasing returns for aggregate manufacturing and three-digit manufacturing industries during 1956–1980 in the Philippines, based on data constructed by Hooley (1985). Further, this study does not support the external effect discussed in Caballero and Lyons (1992).

I. Introduction

The Philippines is often used in comparative studies to highlight the excellent performance of neighbouring East Asian economies. The economy of the Philippines has not always lagged in this way. For example, the income level of the Philippines in the 1950s was as high as that of Korea; however, now the economic growth of the Philippines has fallen behind that of neighbouring economies, for example, the Republic of Korea and Thailand.[1] The current relative economic weakness of the Philippines is also reflected by the fact it was not listed as an ‘East Asian Miracle’ in a World Bank report (1993) even though the Philippines is in the middle of the East Asian region.

It is well known that big business groups have dominated the Philippine economy (de Dios, 1994; Koike, 1989, 1993a, 1993b; Fujimori, 1983). Lindsey

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1. Lucas (1993) compares Korea and the Philippines. Oshima (1987, chapter 7) and Ranis and Mahmood (1992, chapter 5) carry out comparative studies of Thailand and the Philippines.

(1976, 1979) showed that the three-establishment market concentration ratios for 1970 by three-digit level industry in the Philippines were high. Some casual analyses argue that the monopolistic nature of the economy has been detrimental to the post-war performance of the Philippine economy. In fact, market power, in principle, causes underproduction, so the monopolistic nature of the economy might be a reason for its poor performance.[2] Therefore, an empirical examination of whether the Philippine economy has been competitive or monopolistic (or oligopolistic) can help identify causes of the poor economic performance of the Philippines since World War II.

One way to investigate this issue is to estimate the returns to scale of the economy. When there is market equilibrium and production technology exhibits increasing returns, the market is not perfectly competitive; when all real factor prices are equal to the marginal productivity the cost exceeds the revenue. However, if the extra profits accruing from a firm's market power compensate for higher production costs, the firm is viable and the allocation where production technology exhibits increasing returns may be an equilibrium. Thus, increasing returns-to-scale are consistent with market power.[3] If estimation results indicate increasing returns, there will be an empirical support for market power.

Investigating returns-to-scale is also important in terms of short-run macroeconomic dynamics. It is known that macroeconomic models incorporating increasing returns exhibit peculiar dynamics (e.g., multiple equilibria, self-fulfilling prophecy and a strong multiplier effect caused by economic policies).[4] According to the literature, increasing returns tend to amplify the effects of policies. Therefore, if the Philippine economy demonstrates greatly increasing returns, it is likely that active macroeconomic policies are effective.

An empirical observation that is potentially consistent with increasing returns in the Philippines is the procyclical productivity that Yamagata (1998a) found for the Philippine macro economy. Increasing returns may cause procyclical total factor productivity because output increases more than proportionally when all inputs increase at a certain rate. Thus, it appears that the observed procyclical productivity in the Philippines is supporting evidence for increasing returns. However, not only increasing returns but also unobserved fluctuations in the utilization of factors of production can bring about the procyclical productivity. For example, capital may be used more intensively and workers may work

2. In the Schumpeterian growth model, for example Grossman and Helpman (1991) and Romer (1990), monopolistic rents are necessary for innovation and long-run economic growth. However, Aghion, Harris, Howitt and Vickers (1999) introduced a step-by-step innovation model, and showed that keen product market competition is likely to be growth-enhancing.

3. An externality is also consistent with increasing returns. Increasing returns reflecting a production externality need not be accompanied by market power.

4. See Benhabib and Gali (1995), Benhabib and Jovanovic (1991), Benhabib and Perli (1994), Benhabib and Rustichini (1994), Boldrin and Rustichini (1994), Farmer (1993), Farmer and Guo (1995) and Rotemberg and Woodford (1995, 1996). For the multiplier effect, see Bomfim and Diebold (1997).

harder during an economic boom. If capital and labour utilization are not taken into account as factors of production, unobserved and procyclical fluctuations in these factor utilizations result in procyclical total factor productivity even if the real returns-to-scale are constant. Therefore, it is necessary to take account of the factor utilization, when estimating the returns to scale.[5]

Taking account of capital utilization in the way explained in Section III, this study estimates the returns to scale of Philippine manufacturing industry. The results of the estimation suggest that Philippine manufacturing is characterized by constant returns to scale and no externality (or external diseconomy).

The organization of this paper is as follows. Section II contains a description of the empirical models. In Section III, there is an explanation of data used for analysis. Section IV contains the estimation results on returns to scale and Caballero-Lyons' externality of manufacturing industry for the Philippines. The final section summarizes the results.

II. Model

In this paper, two regression equations are used to estimate the degree of returns to scale. Both regression equations are based on the following production function.[6]

Suppose the technology of the *i*th manufacturing industry is expressed as the following homogeneous of degree γ production function.

$$Y_{it} = A_{it} F(L_{it}, K_{Sit}, M_{it}) \tag{1}$$

where Y_{it}, L_{it}, K_{Sit}, and M_{it} are gross real output, total effective labour, total capital service and real intermediate input, respectively. A_{it} stands for technology level. The log difference of A_{it} is assumed to be

$$\Delta \ln A_{it} = \lambda_i + \mu_{it} \tag{2}$$

5. For the US economy, Hall (1988, 1990) and Caballero and Lyons (1992) supported increasing returns, without taking account of unobserved factor utilization. However, once capital utilization is taken into account and appropriate instrumental variables are used, constant returns-to-scale is likely to be accepted. See Basu (1996), Basu and Fernald (1995), Basu and Kimball (1997), Bils and Klenow (1998), Burnside (1996), Burnside and Eichenbaum (1996) and Burnside, Eichenbaum and Rebelo (1993, 1995). For European and East Asian economies (Korea, Japan and Taiwan), increasing returns tend to be found, without taking account of factor utilization and endogeneity of input variables. See Beason and Weinstein (1996), Caballero and Lyons (1990), Chan, Chen and Cheung (1995), Kim and Lau (1994), Kwon (1986), Nadiri and Kim (1996), Nakajima, Nakamura and Yoshioka (1998), Oulton (1996) and Park and Kwon (1995). Using a proxy for capital utilization and appropriate instrumental variables, Burnside and Yamagata (1998) found constant or decreasing returns-to-scale for the Korean, Japanese and Taiwanese manufacturing industries.

6. I estimate the production function rather than the cost function, because input-output series for three-digit Philippine manufacturing industries are available in the data set, though factor prices, in particular hourly wage series, are not available for three-digit manufacturing industries.

where λ_i and μ_{it} are a rate of exogenous technological progress and technology shock, respectively. Δ denotes a one-year difference. μ_{it} is assumed to be white noise. Since μ_{it} is correlated with factors of production, instrumental variables are used to take into account the endogeneity problem. Further, Equation (1) is estimated in two ways.

II.1 Specification 1

First, I assume a Cobb-Douglas production function[7] as follows:

$$Y_{it} = A_{it}[L_{it}^{\alpha_i} M_{it}^{\beta_i} K_{Sit}^{1-\alpha_i-\beta_i}]^{\gamma_i} \quad (3)$$

The effective labour is defined as a product of total employment (N) and hours per worker (workweek: H).

$$L_{it} = N_{it} H_{it} \quad (4)$$

Since there is no direct measure of capital service (K_{Sit}), a proxy is used. There are three proxies within the macroeconomics literature. The most direct proxy is hours of operation of machines. Unfortunately, this variable is available for only certain industries in specific countries.[8] The second proxy is electricity consumption, which was used by Jorgenson and Griliches (1967), Burnside, Eichenbaum and Rebelo (1995) and Burnside and Yamagata (1998). If electricity consumption is proportional to the hours of operation of machines, it is a good proxy for capital service. Time series for electricity consumption in manufacturing industries are available for the United States, Korea, Japan and Taiwan. However, the time series that suits the available data for the Philippines' manufacturing industries (described in Section III) is not available. The third proxy for capital utilization, that used by Bils and Cho (1994), is hours per worker. If the ratio of the number of workers to the number of machines is constant in the short-run, the hours per worker is proportional to the operation hours of machines. Then, hours per worker times the capital stock series is a good proxy for capital service. The hours per worker series of aggregate manufacturing are available in the Philippines. Therefore, the third proxy (hours per worker) is used. Total capital service is assumed as follows:

7. A Cobb-Douglas function suits this analysis on the following grounds. First, the logarithm of the right hand side of Equation (3) is the first-order Taylor expansion of Equation (1) with respect to the logarithms of L_{it}, K_{Sit}, and M_{it}. As shown in Appendix 2, the log-differences of input-output series are stationary. Then, both right- and left-hand sides of the regression equation (Equation (6)) are stationary. If I use a more general functional form, in particular, a transcendental logarithmic function, I have to use non-stationary variables (output level, capital stock level, etc.) for the regression. Moreover, a transcendental logarithmic function accompanies many explanatory variables. However, in order to deal with the endogeneity problem, the number of instrumental variables must exceed or equal the number of explanatory variables. It is extremely difficult to find many relevant instruments.

8. For example, the workweek of looms in the cotton-textile weaving industry is available in the United States. See Bils and Cho (1994).

$$K_{Sit} = K_{it} H_{it} \tag{5}$$

where K_{it} is real net capital stock.

Plugging Equations (4) and (5) into Equation (3), and taking log difference of Equation (3), results in the following regression equation:

$$\Delta y_{it} = \lambda_i + \gamma_i \alpha_i \Delta n_{it} + \gamma_i \beta_i \Delta m_{it} + \gamma_i (1 - \alpha_i - \beta_i) \Delta k_{it} + \gamma_i (1 - \beta_i) \Delta h_{it} + \mu_{it}. \tag{6}$$

A lower case letter denotes a logarithm of the original variable in upper case.

It is noticeable that the coefficient of Δh_{it} minus that of Δn_{it} is equal to the coefficient of Δk_{it}. In other words, one of the four coefficients attached to the factors of production is not free. Therefore, it is necessary to impose a restriction on the coefficients. Imposing this restriction, the growth rate of output is regressed on the growth rates of employment, real intermediate input, real capital stock and workweek to obtain an estimate of returns to scale for Philippine manufacturing.[9] λ_i captures the fixed effect when three-digit manufacturing industries are pooled.

II.2 Specification 2

Unfortunately, there is a weakness in Equation (6) on empirical grounds. There are four explanatory variables in Equation (6). Therefore, when the instrumental variable estimation method is applied to the Equation (6), at least four instrumental variables are needed. Moreover, those instrumental variables should not be highly correlated with one another; otherwise, there is a multicollinearity problem when the instrumental variable estimation is applied.[10] To avoid this problem, the number of explanatory variables should be as small as possible.

Caballero and Lyons (1992) showed that even if a production function of an industry (or a firm) exhibits increasing returns to scale (i.e., $\gamma > 1$) and there is some degree of market power, Equation (1) is equivalent to the following equation:

$$\Delta y_{it} = \lambda_i + \gamma_i \Delta x_{it} + \mu_{it} \tag{7}$$

where X_{it} is total costs so that Δx_{it} is the growth rate of total costs. That is, regression of output growth on the growth of total costs provides an estimate of returns to scale. The advantage of this method is that there is only one explanatory variable (i.e., total costs growth), so the required number of instrumental

9. The regression employing gross output as the dependent variable has an advantage over that of value-added. That is, if there is market power, a value-added is overestimated. A value-added is constructed by subtracting a product of revenue share of intermediate inputs ($p_M M/pY$: p_M, p are prices of intermediate inputs and output, respectively) and a quantity of intermediate inputs from gross output. If there are positive profits, the revenue share is smaller than the cost share ($p_M M/C$: C is total cost), which reflects real share of contribution of intermediate inputs to output. Thus, the value-added is overestimated. See Basu and Fernald (1995) for detail.

10. Shea (1997) pointed out this problem.

variables is small. However, as is noted below, the data source for the rate of return used to construct total costs series is different from the source of Hooley's main data. That is, a regression based on Equation (7) has the disadvantage that Δx_{it} is constructed with series from two different surveys. Since both specifications have merits and demerits, both Equations (6) and (7) are used to estimate returns-to-scale for manufacturing in the Philippines.

III. Data

III.1 Hooley data

In this study, the data set constructed in Hooley (1985) is used because it is a well-organized data set of three-digit Philippine manufacturing industries between 1956–1980 that contains real input-output variables, including real capital stock. Appendix 1 provides details of Hooley's data. Although the sample size (at most 24) is not large, this data set is a result of Hooley's extensive labour and cannot easily be brought up to date. Since the stagnation of the Philippine economy relative to neighbouring East Asian economies took place during this period, it is meaningful to use this data set to investigate the technological background to the stagnation to the Philippine economy.

Hooley constructed the data set from the data in the *Annual Survey of Manufactures* and the *Census of Manufactures*. The *Annual Survey* and the *Census* have different coverages of sample establishments. He adjusted the difference in the coverages and constructed a unified data set for establishments with 20 or more workers. Next, he estimated the real capital stock, producers' price index, and real intermediate inputs of 24 three-digit industries. All the data which he used in order to estimate Total Factor Productivity (TFP) were published in Hooley (1985).

In addition to the published data in Hooley (1985), I used unpublished series of the rate of return of capital (income tax is deducted), which were estimated by Hooley. The rate of return of capital was used to construct total costs series. The rate-of-return series are based on a survey of the 1,000 largest companies in the Philippines. Therefore, the coverage of this survey is different from that of Hooley's main data set. As a result, the rate-of-return series is not available for two industries, namely 'other chemicals' and 'glass products'.

III.2 Workweek

Raw data for the aggregate manufacturing workweek is obtained from various issues of the *Year Book of Labor Statistics*, published by the International Labour Office. This series is obtained from household surveys undertaken during some months of the year by the Department of Labor of the Philippines. Table 1 shows the months that surveys of workweeks were conducted (*Year Book of Labor Statistics*, various issues).

Table 1 Months in which the Surveys of Workweek were Undertaken

Year	1956–59	1960	1961	1962	1963–69	1970	1971–80
Month	May	October	May	October	May	N.A.	August

There are two problems with this raw data. First, the workweek series for 1970 are not available. Second, the months in which the surveys were undertaken are different, so that seasonal adjustments are needed. Fortunately, the workweeks for both May and October are available for 1965, 1966 and 1968 from the Department of Labor, Labor Statistics Service, the Philippines, *1977 Yearbook of Labor Statistics*, *1977*. Moreover, data for both May and August are available in 1971, 1972, 1973 and 1974 on the same statistics. As a result, it was possible to estimate the workweek series in May during 1956–1980 by comparing the average ratio of the workweek series in May to that in October during the three years of 1965, 1966 and 1968, and multiplying the ratio by the raw figure of the workweek in October 1960 and 1962. Next, estimates were obtained for workweeks for May 1960 and May 1962. The same adjustment method was applied to the raw workweek data during 1971–1980 with the average ratio of the workweek in May being compared to that of August for 1971, 1972, 1973 and 1974. Finally, the workweek in May 1970 was estimated as a simple average of workweeks in May 1969 and May 1971.

III.3 Instruments

The explanatory variables on the right hand side of the regression equations (Equations (6) and (7)) are endogenous variables. If a favourable technology shock takes place, the explanatory variables are likely to increase because of an increase in the marginal products with respect to factors of production. Thus, if OLS is used, the effect of technology shock on the change in output may be part of the effect of change on production factors. That is, the effects of change in technology and factors of production cannot be differentiated. By using appropriate instrumental variables that are not affected by technology shocks occurring in the Philippines, but which are highly correlated with explanatory variables, it is possible to identify the effects of change in technology and factors of production.

To do so, this study uses as instrument variables to deal with the endogeneity problem: (1) the log differences in petroleum price at Ras Tanura, Saudi Arabia; (2) the log differences in American and Japanese per capita GDP; (3) the log differences in American and Japanese import indices; and (4) the difference in Federal Funds Rate of the United States.[11]

11. Petroleum price from Saudi Arabia, US per capita GDP, US and Japanese import indices and the Federal Funds Rate were obtained from the International Monetary Fund, *International Financial Statistics*, November 1995, CD-ROM. Japanese per capita GDP is from Penn World Table (Mark 5.6).

Saudi Arabia is one of the largest petroleum exporting countries in the world, and also was the largest petroleum exporter to the Philippines during 1972–80. Even during the preceding 1962–1971 period, in terms of the level of petroleum exports to the Philippines, Saudi Arabia was ranked higher than or equal to the fourth largest petroleum exporter.[12] In contrast, the Philippines is not a major petroleum consumer in the world. Because petroleum is a major intermediate input for Philippine manufacturing, Saudi Arabian petroleum prices are a well-qualified instrument.

The American and Japanese economies greatly affect the Philippines. Colonization by the United States and the subsequent preferential treatment for the United States were part of a deep relationship between the Philippines and the United States that is still apparent even decades after the end of colonization. The import and export shares of US products as a percentage of total imports and exports of the Philippines in 1970 were 31.6% and 41.7%, respectively, according to UN and OECD trade data. The same shares of Japanese products were 39.4% and 39.8%, respectively. Although the shares of the United States and Japan decreased as a whole from 1970 to 1980, the figures were still fairly high. The import and export share of US products as a percentage of the total imports and exports of the Philippines in 1980 were 25.0% and 27.5%, respectively. The same shares of Japanese products were 21.3% and 26.6%, respectively. The shares of Philippine products as a percentage of the total imports and exports of the United States and Japan were all below 3% in both 1970 and 1980, which were negligible for the United States and Japan. Therefore, US and Japanese import indices are appropriate as instruments.

Similarly, American and Japanese per capita GDPs seem suitable as instruments. It is natural that American and Japanese GDP are not as responsive to business cycles in the Philippines, although the US and Japanese GDPs may have a major effect on the Philippine economy. While fluctuation in American and Japanese import indices represents a change in demand from abroad for the Philippines, US and Japanese per capita GDP may capture what their import indices do not (i.e., supply side factors of the US and Japanese economies).

It is highly likely that the US Federal Funds Rate is independent of changes in any economic variables that occurred in the Philippines. However, it affects world financial markets and ultimately influences the Philippine economy because the Philippines has had heavy financial debt through international financial markets. Therefore, the US Federal Funds Rate is surely a candidate as an instrument.

In general, instrumental variables should be correlated with explanatory variables and uncorrelated with the error term (in this case, technology shocks).

12. Indonesia, Iran and Kuwait were other major petroleum exporters for the Philippines during 1962–1980, according to a UN/OECD data base compiled by the Institute of Developing Economies. The data before 1962 are not available.

While correlation between instruments and the error term is checked with Hansen's (1982) *J*-test estimation by estimation, correlation between instruments and explanatory variables is examined below.

Shea (1997) and Staiger and Stock (1997) have argued that if the instrumental variables are not correlated with the explanatory variables, the degree of inconsistency in parameter estimates might be larger using 2SLS than using OLS, even if the instrumental variables seem exogenous. R^2, which results from the regression of an explanatory variable on instruments is helpful to check relevancy of the instrument set. However, Shea proposes a better measure, the 'partial R^2', which he denoted by R_p^2. This measure of fit is a 'partial' measure because it takes into account the correlation among the explanatory variables. When an explanatory variable is highly correlated with the instruments, the explanatory power may come from correlation with just a few of the instruments, and if this is true for other explanatory variables, the 2SLS procedure will suffer from multicollinearity problems. The R_p^2 measure allows us to determine whether our instruments are sufficiently relevant more adequately than does R^2.

Table 2 exhibits R^2, R_p^2, and $\bar{R}_p^2$, which is the degrees of freedom adjusted R_p^2 defined as follows:

$$\bar{R}_p^2 = 1 - [(T-1)/(T-n)](1 - R_p^2) \qquad (8)$$

T and n are the sample size and the number of instrumental variables, respectively. As shown in Table 2, even if R^2 is high, R_p^2 and $\bar{R}_p^2$ can be low or even negative. This result illustrates the difficulty in collecting relevant instrumental variables.[13] Since only one explanatory variable is needed for specification 2, the R_p^2 and $\bar{R}_p^2$ are not used for total costs. Instead, R^2 and $\bar{R}^2$ are shown for total costs in Table 2. It is noticeable that $\bar{R}^2$ for total costs is considerably higher than $\bar{R}_p^2$'s of explanatory variables for Equation (6). Taking account of the magnitude of both R_p^2 and $\bar{R}_p^2$, $Z1$ is used as the benchmark instrument set.

IV. Empirical Analysis of Returns to Scale

Based on the model introduced in Section II, returns to scale for Philippine manufacturing are estimated in this section, using the data described in the previous section. Before estimating returns to scale, the procyclicality of total factor productivity is demonstrated for manufacturing in the Philippines, and then the estimation is shown.

13. In general, it is very difficult to find good time-series instruments for the estimation of aggregate production function. According to Shea (1997 footnote 3), R_p^2 and $\bar{R}_p^2$ of Robert Hall's instruments for the US economy, which are widely recognized as a good instruments, are close to zero or even negative.

Table 2 Partial R^2 of Regression of Explanatory Variables on Instruments

	Employment			*Hours per Worker*			*Capital Stock*		
	R^2	R_p^2	$\bar{R}_p^2$	R^2	R_p^2	$\bar{R}_p^2$	R^2	R_p^2	$\bar{R}_p^2$
*Z*1	0.432	0.048	−0.232	0.240	0.029	−0.257	0.289	0.057	−0.220
*Z*2	0.216	0.003	−0.147	0.157	0.001	−0.148	0.258	0.005	−0.145
*Z*3	0.393	0.000	−0.150	0.148	0.000	−0.150	0.114	0.000	−0.150

	Intermediate Inputs			*Total Costs*	
	R^2	R_p^2	$\bar{R}_p^2$	R^2	$\bar{R}^2$
*Z*1	0.246	0.052	−0.227	0.217	−0.014
*Z*2	0.223	0.003	−0.147	0.189	0.009
*Z*3	0.028	0.000	−0.150	0.014	−0.206

Notes: R_p^2 and $\bar{R}_p^2$ are the partial R^2 and degree-of-freedom adjusted partial R^2, respectively. R^2 and $\bar{R}^2$ are usual R^2 and degree-of-freedom adjusted R^2, which result from a regression of an explanatory variable on an instrument set. Instruments for 2SLS estimations above are the following:

*Z*1: The benchmark instruments set: the difference in US Federal Funds Rate, the log difference in Saudi Arabian petroleum price, the log difference in US per capita GDP and import index, and the log difference in Japanese per capita GDP and import index.

*Z*2: *Z*1 minus the log difference in US per capita GDP and import index.

*Z*3: *Z*1 minus the log difference in Japanese per capita GDP and import index.

IV.1 Procyclical Total Factor Productivity

Hooley (1985) estimated the total factor productivity (TFP) growth rate, using real gross output, total employment, real intermediate inputs and real capital stock. The TFP for aggregate manufacturing in the Philippines is highly procyclical and most TFPs for three-digit manufacturing are also highly procyclical (see Table 3). Only five of the twenty-four industries exhibit a negative correlation with real gross output. Factors of production do not necessarily correlate positively with TFP. The correlation coefficients of total employment and fixed capital are both –0.16; however, the sample medians of the 24 industries are slightly positive, 0.05 and 0.09, respectively. On the other hand, intermediate inputs tend to correlate positively with TFP. Figure 1 shows that the growth rate of TFP is correlated with the growth rates of gross output and intermediate inputs, even though the variance of the growth rate of TFP is a great deal smaller than those of output and intermediate inputs. As Basu (1996) noted, fluctuations in intermediate inputs may reflect unobservable utilization of labour and capital. Therefore, it is reasonable that Hooley's TFP is better correlated with intermediate inputs than with total employment and capital stock, which do not incorporate variable factor utilization.

Table 3 Correlation between Growth Rate of TFP and Input-Output Variables

	Gross Output	*Total Employment*	*Fixed Capital*	*Inventory*	*Intermediate Inputs*
3. All manufacturing	0.78	−0.16	−0.16	0.20	0.41
311–12. Food manufacturing	−0.02	−0.25	0.12	0.17	−0.12
313. Beverages	0.63	0.56	0.02	−0.63	0.36
314. Tobacco products	0.91	−0.17	−0.21	−0.10	0.76
321. Textiles	0.46	0.30	0.13	0.03	−0.11
322. Wearing apparel	0.44	0.42	0.14	−0.28	−0.60
323. Leather products	0.37	0.20	−0.30	0.23	0.11
324. Footwear	0.83	−0.20	0.10	0.34	0.70
331. Wood products	0.37	0.19	−0.08	0.15	0.35
332. Furniture and fixtures	−0.15	−0.18	0.09	0.27	−0.33
341. Paper and paper products	−0.24	−0.29	0.06	−0.05	−0.34
342. Printing and publishing	0.59	0.07	0.23	0.07	0.02
351. Industrial chemicals	0.17	0.02	−0.12	0.29	−0.22
352. Other chemicals	−0.35	−0.62	−0.44	−0.47	−0.54
353. Petroleum products	0.64	0.33	0.41	0.54	−0.02
355. Rubber products	0.38	0.19	0.10	0.10	0.19
356. Plastic products	0.75	0.09	0.15	−0.29	0.64
361, 63 & 69. Non-metallic products	0.55	0.33	0.06	0.38	0.44
362. Glass products	0.45	0.34	0.15	0.44	0.08
371. Iron and steel basic products	0.32	0.48	0.07	0.46	0.41
372. Non-ferrous basic products	−0.09	−0.08	−0.00	−0.19	−0.17
381. Fabricated metal products	0.45	−0.62	0.13	0.29	0.30
382. Machinery	0.57	−0.05	0.40	0.31	0.42
383. Electric machinery	0.34	−0.06	0.09	0.13	0.32
384. Transport equipment	0.32	−0.42	−0.03	0.39	0.22
Sample mean	0.36	0.02	0.05	0.11	0.12
Sample median	0.41	0.05	0.09	0.16	0.15

Note: The correlation coefficient between TFP growth and the growth rate of workweek for aggregate manufacturing is 0.10.

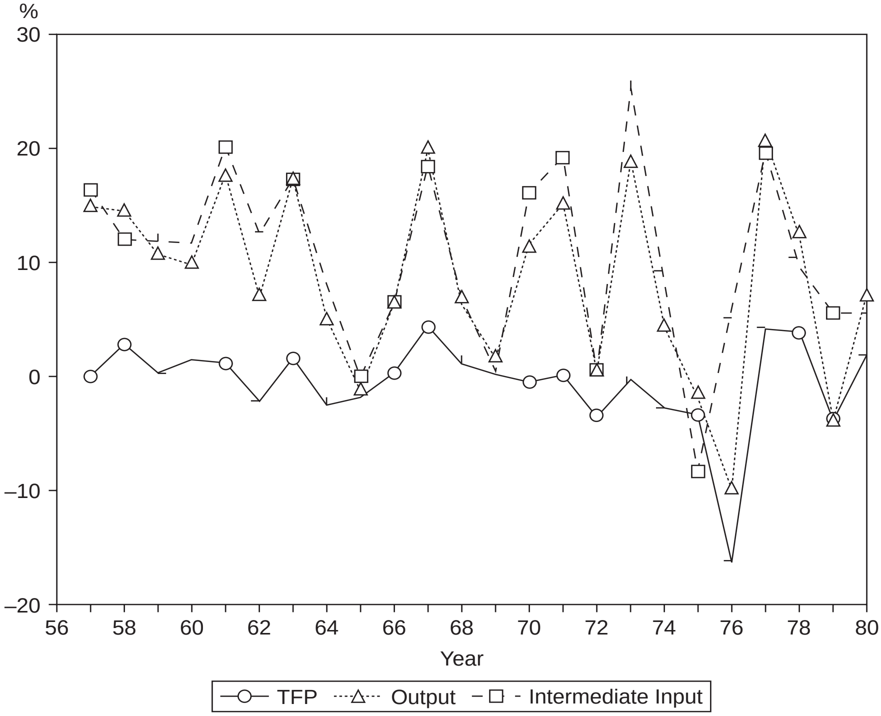
IV.2 Aggregate manufacturing

In this subsection, Equations (6) and (7) are estimated using the aggregate manufacturing data. The log differences in all the series are assumed to be stationary because most of them passed the augmented Dickey-Fuller test with the conventional level of significance, as shown in Appendix 2.

Table 4 shows the estimation results for aggregate manufacturing. OLS, 2SLS and Generalized Method of Moments (GMM) are applied.[14] Without using any instrumental variables, the OLS estimate of the elasticity of output with respect to capital services is negative, and the estimated elasticity with respect to intermediate inputs is close to one. The OLS estimation seems to be affected by

14. For GMM, see Ogaki (1993) and Greene (1997), among others.

Figure 1 Growth Rates of Output, Intermediate Input and TFP: Philippine Manufacturing



Source: Data from Hooley (1985).

simultaneity bias caused by the endogeneity of factors of production. A similar negative estimate for the elasticity with respect to capital is often obtained with US macro data, unless instrumental variables are used (Romer, 1987, p. 185; Benhabib and Jovanovic, 1991, p. 91). Once an instrument set, $Z1$, is used, the 2SLS and GMM estimates, shown in Table 4, look more reasonable. Most of the elasticity estimates fall in the range of 0 to 1; and the elasticity estimate for intermediate input is closer to the average share of intermediate input in gross output, 62.0%, than the OLS estimate. For all estimation, the intercepts are not significantly different from zero. That is, exogenous technological progress of the Philippine manufacturing does not seem to be rapid.[15]

All the estimated returns to scale (denoted as the sum of coefficients in Table 4) are less than one, although the constant-returns hypothesis is not rejected

15. This observation does not imply that there was no technological progress in the Philippine manufacturing. Innovation and technology adoption may be made by exploiting capital and labour. The contribution of factors of production to 'endogenous' technological progress is reflected by elasticity of production with respect to factors of production. Even without exogenous technological progress and increasing returns, per capita income can grow in the long-run See Rebelo (1991) for detail.

Table 4 Returns to Scale: Aggregate Manufacturing: Specification 1

$$\Delta y_t = \lambda + \gamma\alpha\Delta n_t + \gamma\beta\Delta m_t + \gamma(1-\alpha-\beta)\Delta k_t + \gamma(1-\beta)\Delta h_t + \mu_t.$$

Method	*Sample Size*	*Intercept*	*Total Hours*	*Capital Stock*	*Intermediate Inputs*	R^2 *s*	*Sum of Coefficients*	*Overidentifying Restriction*
OLS	24	−0.012	0.126	−0.106	0.930	0.748	0.950	
		(0.021)	(0.093)	(0.126)	(0.122)	0.044	(0.189)	
2SLS:	24	0.002	−0.059	0.492	0.392	0.317	0.825	$J = 0.736$
*Z*1		(0.052)	(0.286)	(0.600)	(0.498)	0.073	(0.498)	[0.994]
GMM:	24	−0.009	0.021	0.412	0.502	0.449	0.936	$J = 1.039$
*Z*1		(0.036)	(0.184)	(0.384)	(0.307)	0.065	(0.322)	[0.984]
2SLS	24	0.015	−0.113	0.445	0.363	0.320	0.696	$J = 0.309$
*Z*2		(0.056)	(0.330)	(0.608)	(0.509)	0.072	(0.545)	[0.989]
2SLS	24	−0.140	−0.505	1.772	0.918	−2.672	2.184	$J = 0.004$
*Z*3		(0.450)	(1.847)	(4.167)	(3.575)	0.168	(4.328)	[1.000]

Notes: *s* is the standard error of regression. For Generalized Method of Moment estimation, Bartlett kernel and Newey-West fixed bandwidth are used without pre-Whitening. Even if quadratic kernel and/or other bandwidth (Andrews bandwidth and Newey-West variable bandwidth) are used with or without pre-Whitening, the results do not change very much. The figure in parentheses under each estimate is a standard error, while that in square brackets is a *p*-value. A test of the overidentifying restrictions is provided in the 8th column. For instrumental variable sets, refer to Table 2.

because of a large standard error. The only exception is when the Japanese per capita GDP and import index are dropped from the instrument set, which is represented as 2SLS with *Z*3 in Table 4. However, the standard error for the estimated returns to scale is also great and the constant-returns-to-scale hypothesis is not rejected.

For all estimation, the instrumental variable sets satisfy the over-identifying restriction (in other words, they pass Hansen's *J*-test on exogeneity of instruments) because the *p*-value of the over-identifying restrictions is high. It is worth noting that the estimated elasticity of output with respect to labour is very small. However, the standard errors of the coefficients are large.

Table 5 displays the estimation results for specification 2. For OLS, the estimated returns to scale slightly exceed one. However, the constant returns-to-scale hypothesis is not rejected. Moreover, all the 2SLS estimates are smaller than one. Results for specification 1 and specification 2 support the presumption of constant returns to scale for aggregate manufacturing.

IV.3 Three-digit manufacturing industries

The estimates for individual three-digit manufacturing industries by 2SLS for specification 1 are in Table 6. Though most of the elasticity estimates fall in the range of 0 and 1, there are some estimates that are smaller than zero or larger than unity. The estimate of returns to scale is above unity in fifteen industries out of twenty-four. However, none are significantly greater than one at a conventional level of significance. That is, for all three-digit manufacturing industries, the results support the constant-returns hypothesis.

Table 5 Returns to Scale: Aggregate Manufacturing: Specification 2, 1958–80

Method	*Sample Size*	*Intercept*	*Total Cost*	R^2	*s*	*Overidentifying Restriction*
OLS	23	−0.006 (0.017)	1.021 (0.154)	0.676	0.048	–
2SLS: Z1	23	0.024 (0.034)	0.683 (0.367)	0.602	0.053	$J = 2.59$ [0.858]
2SLS: Z2	23	0.018 (0.035)	0.745 (0.380)	0.627	0.052	$J = 1.41$ [0.843]
2SLS: Z3	23	0.062 (0.173)	0.254 (1.953)	0.294	0.071	$J = 1.26$ [0.868]

Notes: See Table 4.

The simple means of the estimated elasticity of output with respect to labour, capital and intermediate inputs of the 24 three-digit manufacturing industry are 0.270, 0.423 and 0.573, respectively (see Table 6). The medians are 0.287, 0.332 and 0.623, respectively. The mean and median of estimated elasticity with respect to labour are much higher than typical labour shares. Across the three-digit industries during the period between 1956 and 1980, the median and simple mean of labour share, are 0.116 and 0.124, respectively. On the other hand, the same median and simple mean of intermediate input shares are 0.617 and 0.624, respectively. These are as large as the mean and median (i.e., 0.573 and 0.623) of the estimated elasticity with respect to intermediate inputs of three-digit manufacturing industry. Incidentally, the hypothesis of orthogonality between the residuals and the instruments is accepted for all industries.

Table 7 contains the estimation results for specification 2. The estimates of returns to scale exceed unity for six out of twenty-two industries. However, none are statistically significant. The mean and median of the estimated returns to scale are 0.825 and 0.889, respectively. The over-identifying restriction is satisfied for all twenty-two industries with a 95% significance level. Here again, the constant returns to scale hypothesis is supported.

It is important to remember that the estimated returns to scale may have an upward bias caused by the workweek series used. The workweek series of aggregate manufacturing was a proxy for capital utilization in order to estimate the returns to scale of three-digit manufacturing industries. However, this aggregate workweek series does not reflect industry-specific fluctuations in the workweek. It is reasonable to assume that the true workweek for a three-digit industry is more correlated with other industry production factors than the workweek series of aggregate manufacturing. Since this idiosyncratic (industry-specific) part of fluctuations in the workweek is omitted from the regression, the estimates of the returns to scale of three-digit industries will be biased. Moreover, since the idiosyncratic part of the fluctuations in the workweek is likely to be positively correlated with other production factors, the estimated returns to scale will have an upward bias.

Table 6 Returns to Scale: 3-Digit Manufacturing Industries: Specification 1 (2SLS: Z1)

	Sample Size	*Intercept*	*Total Hours*	*Capital Stock*	*Intermediate Inputs*	R^2 *s*	*Sum of Elasticities*	*Overidentifying Restriction*
311–12. Food	24	0.029	−0.013	0.171	0.391	0.735	0.548	$J = 1.58$
manufacturing		(0.040)	(0.377)	(0.444)	(0.179)	0.070	(0.567)	[0.954]
313. Beverages	24	−0.026	0.910	0.182	0.551	0.838	1.643	$J = 2.43$
		(0.169)	(1.007)	(1.195)	(1.167)	0.126	(1.365)	[0.876]
314. Tobacco products	24	0.018	−0.351	0.146	0.929	0.768	0.724	$J = 1.32$
		(0.052)	(0.381)	(0.502)	(0.274)	0.125	(0.542)	[0.971]
321. Textiles	24	−0.008	0.352	−0.083	0.720	0.604	0.989	$J = 3.97$
		(0.038)	(0.266)	(0.233)	(0.399)	0.111	(0.255)	[0.680]
322. Wearing apparel	24	0.010	0.316	0.513	0.093	0.479	0.923	$J = 3.79$
		(0.040)	(0.274)	(0.488)	(0.253)	0.151	(0.436)	[0.705]
323. Leather products	24	−0.013	0.070	0.186	0.770	0.913	1.026	$J = 1.18$
		(0.035)	(0.330)	(0.426)	(0.172)	0.092	(0.433)	[0.978]
324. Footwear	23	−0.028	0.307	2.264	−0.127	−0.030	2.444	$J = 0.083$
		(0.088)	(1.094)	(2.399)	(1.523)	0.389	(2.082)	[1.000]
331. Wood products	24	−0.045	0.661	0.263	0.801	0.573	1.725	$J = 0.671$
		(0.090)	(0.984)	(1.589)	(0.632)	0.167	(0.839)	[0.995]
332. Furniture	24	0.003	0.430	0.389	0.284	0.675	1.103	$J = 1.82$
and fixtures		(0.102)	(0.647)	(1.040)	(0.436)	0.258	(0.993)	[0.936]
341. Paper and paper	24	0.002	−0.343	−0.017	1.102	0.797	0.742	$J = 1.18$
products		(0.071)	(0.565)	(0.462)	(0.310)	0.092	(0.683)	[0.978]
342. Printing and	24	0.013	−0.825	0.707	0.686	0.477	0.568	$J = 2.91$
publishing		(0.057)	(1.394)	(1.311)	(0.268)	0.147	(0.599)	[0.820]
351. Industrial chemicals	24	−0.256	2.722	0.375	0.499	−0.091	3.596	$J = 0.204$
		(0.322)	(3.323)	(2.254)	(0.989)	0.367	(2.692)	[1.000]
352. Other chemicals	22	0.042	−0.410	0.034	0.730	0.688	0.355	$J = 2.22$
		(0.035)	(0.449)	(0.545)	(0.288)	0.076	(0.390)	[0.898]

Table 6 (*cont'd*)

	Sample Size	*Intercept*	*Total Hours*	*Capital Stock*	*Intermediate Inputs*	R^2 *s*	*Sum of Elasticities*	*Overidentifying Restriction*
353. Petroleum products	19	−0.025	0.611	0.033	0.875	−0.990	1.519	$J = 1.24$
		(0.137)	(0.512)	(1.248)	(0.949)	0.195	(1.691)	[0.975]
355. Rubber products	24	−0.033	0.781	0.485	0.277	0.833	1.544	$J = 2.70$
		(0.044)	(0.492)	(0.542)	(0.458)	0.127	(0.486)	[0.845]
356. Plastic products	23	0.037	0.266	−0.226	0.670	0.894	0.710	$J = 3.44$
		(0.158)	(0.392)	(1.021)	(0.367)	0.090	(1.058)	[0.752]
361, 63 & 69.	24	0.000	0.483	0.229	0.397	0.790	1.109	$J = 5.81$
Non-metallic products		(0.057)	(0.466)	(0.368)	(0.185)	0.162	(0.304)	[0.445]
362. Glass products	24	−0.061	0.144	0.539	0.724	0.846	1.408	$J = 3.01$
		(0.049)	(0.215)	(0.295)	(0.295)	0.124	(0.332)	[0.807]
371. Iron and steel basic	21	0.017	−0.946	0.660	0.936	0.592	0.650	$J = 0.213$
products		(0.084)	(0.733)	(0.516)	(0.257)	0.267	(0.603)	[1.000]
372. Non-ferrous basic	21	−0.065	0.589	0.321	0.268	0.799	1.178	$J = 1.04$
products		(0.151)	(0.315)	(0.408)	(0.287)	0.493	(0.368)	[0.984]
381. Fabricated metal	24	−0.032	0.224	0.342	0.700	0.739	1.235	$J = 6.54$
products		(0.052)	(0.296)	(0.561)	(0.196)	0.112	(0.740)	[0.366]
382. Machinery	24	−0.047	0.490	1.118	0.333	0.730	1.942	$J = 1.53$
		(0.071)	(0.538)	(0.955)	(0.149)	0.256	(0.717)	[0.957]
383. Electric machinery	24	−0.030	−0.200	0.829	0.559	0.904	1.189	$J = 4.77$
		(0.038)	(0.283)	(0.409)	(0.163)	0.082	(0.224)	[0.574]
384. Transport	24	−0.077	0.222	0.699	0.576	0.712	1.497	$J = 0.258$
equipment		(0.052)	(0.586)	(0.592)	(0.238)	0.095	(0.499)	[1.000]
Mean			0.270	0.423	0.573		1.265	
Median			0.287	0.332	0.623		1.144	
Standard Deviation			0.705	0.502	0.290		0.699	

Notes: The standard error is in parentheses. The *p*-value is in square brackets.

Table 7 Returns to Scale: 3-Digit Manufacturing Industries: Specification 2 (2SLS: Z1)

	Sample Size	*Intercept*	*Total Cost*	R^2	*s*	*Overidentifying Restriction*
311–12. Food manufacturing	23	0.056	0.365	0.653	0.077	$J = 1.46$
		(0.018)	(0.209)			[0.962]
313. Beverages	23	0.016	1.232	0.812	0.133	$J = 3.38$
		(0.030)	(0.203)			[0.760]
314. Tobacco products	23	0.052	0.995	0.803	0.112	$J = 0.981$
		(0.027)	(0.249)			[0.986]
321. Textiles	23	0.008	0.896	0.267	0.119	$J = 3.12$
		(0.054)	(0.544)			[0.794]
322. Wearing apparel	23	0.058	0.249	–0.068	0.211	$J = 3.73$
		(0.047)	(0.397)			[0.714]
323. Leather products	23	0.043	0.914	0.822	0.126	$J = 2.60$
		(0.026)	(0.130)			[0.858]
324. Footwear	22	0.048	0.873	0.882	0.128	$J = 3.77$
		(0.031)	(0.270)			[0.708]
331. Wood products	23	0.018	0.930	0.749	0.123	$J = 3.11$
		(0.030)	(0.289)			[0.795]
332. Furniture and fixtures	24	0.098	0.501	0.572	0.282	$J = 1.83$
		(0.058)	(0.283)			[0.934]
341. Paper and paper products	23	0.023	0.897	0.828	0.082	$J = 6.21$
		(0.020)	(0.113)			[0.399]
342. Printing and publishing	23	0.050	0.464	0.580	0.124	$J = 3.91$
		(0.026)	(0.138)			[0.688]
351. Industrial chemicals	23	0.121	0.540	0.747	0.172	$J = 11.29$
		(0.036)	(0.139)			[0.080]
352. Other chemicals	–	–	–	–	–	–
353. Petroleum products	19	0.048	0.413	0.042	0.127	$J = 9.09$
		(0.054)	(0.567)			[0.169]
355. Rubber products	24	–0.001	1.192	0.913	0.088	$J = 6.32$
		(0.023)	(0.133)			[0.388]
356. Plastic products	23	–0.019	1.239	0.905	0.081	$J = 3.71$
		(0.038)	(0.224)			[0.715]
361, 63 & 69. Non-metallic products	24	–0.011	1.016	0.667	0.195	$J = 4.36$
		(0.053)	(0.211)			[0.628]
362. Glass products	–	–	–	–	–	–
371. Iron and steel basic products	21	0.077	1.083	0.765	0.192	$J = 6.69$
		(0.043)	(0.215)			[0.351]
372. Non-ferrous basic products	21	0.093	1.391	0.857	0.374	$J = 0.44$
		(0.108)	(0.357)			[0.998]
381. Fabricated metal products	24	0.023	0.680	0.774	0.099	$J = 5.29$
		(0.021)	(0.124)			[0.508]
382. Machinery	24	0.041	0.882	0.697	0.258	$J = 1.92$
		(0.055)	(0.237)			[0.927]
383. Electric machinery	23	0.042	0.875	0.831	0.104	$J = 4.42$
		(0.026)	(0.145)			[0.620]
384. Transport equipment	24	0.036	0.528	0.566	0.112	$J = 3.67$
		(0.031)	(0.254)			[0.721]

Notes: The sample mean, median and standard deviation of the estimated returns to scale of the 3-digit level manufacturing industries are 0.825, 0.889 and 0.316, respectively. The standard error is in parentheses. The *p*-value is in square brackets.

Thus, the estimated returns to scale of three-digit manufacturing industries are likely to have an upward bias. However, the estimates supporting constant returns to scale with the data of three-digit industries were obtained. This observation suggests that the hypothesis of increasing returns to scale is less likely to hold for three-digit industries.

IV.4 Pooled data

Next, variables were pooled for the twenty-four, three-digit manufacturing industries, and the degree of returns to scale was estimated, imposing cross-industry restrictions such that the elasticity of output with respect to each factor of production is common across three-digit manufacturing industries. The fixed effects are captured by industry dummies, i.e., λ_i of Equation (2). Estimated coefficients obtained with this pooled data set are also likely to have an upward bias because of the specification error problem mentioned in the previous subsection. This problem must be remembered during the exploration of the data.

Table 8 shows the results of OLS, iterative SUR, and 3SLS with the pooled data for specification 1. The estimated returns to scale obtained by OLS, iterative SUR and 3SLS are significantly larger than unity. However, the cross-industry

Table 8 Returns to Scale: Pooled Data: Specification 1

$$\Delta y_{it} = \lambda_i + \phi_N \Delta n_{it} + \phi_M \Delta m_{it} + \phi_K \Delta k_{it} + (\phi_N + \phi_K)\Delta h_{it} + \mu_{it}$$

	OLS	*SUR*	*3SLS: Z1*
Total hours	0.419	0.386	0.344
	(0.035)	(0.007)	(0.017)
Capital stock	0.261	0.241	0.356
	(0.045)	(0.009)	(0.022)
Intermediate inputs	0.531	0.523	0.471
	(0.021)	(0.004)	(0.010)
Returns to scale	1.212	1.147	1.171
	(0.045)	(0.011)	(0.024)
$\phi_{Ni} = \phi_{Nj}$ for all $i \neq j$	70.64	–	184.77
	[0.000]		[0.000]
$\phi_{Ki} = \phi_{Kj}$ for all $i \neq j$	44.75	–	133.43
	[0.004]		[0.000]
$\phi_{Mi} = \phi_{Mj}$ for all $i \neq j$	128.46	–	400.92
	[0.000]		[0.000]
$\phi_{Ni} = \phi_{Nj}$, $\phi_{Ki} = \phi_{Kj}$, $\phi_{Mi} = \phi_{Mj}$ for all $i \neq j$	241.92	–	6791.4
	[0.000]		[0.000]

Notes: The figures in the fifth to eighth rows are χ^2 statistics and their p-values (in square brackets). Since estimates by unrestricted SUR estimation do not converge because of the near singularity of the variance-covariance matrix of the residuals, the test for the restrictions can not be executed.

Table 9 Returns to Scale: Pooled Data: Specification 2

	OLS	*3SLS: Z1*
Returns to Scale	0.921 (0.029)	1.217 (0.015)
Cross-Industry Restriction (χ^2 statistics [*p*-value])	164.87 [0.000]	–

Notes: The figure in parentheses is the standard error. The figure in square brackets is the *p*-value. Convergence is not achieved after 100 iterations for 3SLS without the cross-industry restriction. However, the χ^2 test statistic at the 100th iteration is 606.64 and the *p*-value is 0.000.

restrictions are strongly rejected with OLS and 3SLS. Although it is not shown in Table 8, even if different instrument sets are used, the cross-industry restrictions tend to be rejected. In the case of US manufacturing, the cross-industry restrictions on returns to scale tend to be strongly rejected, and Burnside (1996) argued that imposing the restrictions could be highly misleading.

Estimation of returns to scale for specification 2 provides the same results as those of specification 1 (Table 9). That is, the 3SLS estimate of returns to scale exhibits statistically significant increasing returns. However, the cross-industry restriction is rejected for OLS, and the coefficients of the estimation without the cross-industry restrictions do not converge for 3SLS.[16]

Based on the upward bias of an estimate of returns to scale due to industry-specific fluctuations in the workweek and the rejections of the cross-industry restrictions, it is apparent that the evidence supporting increasing returns is less than convincing.

IV.5 Caballero-Lyons' externality

Caballero and Lyons (1992) estimated the effect of a change in the output of aggregate manufacturing based on a change in the output of two-digit manufacturing as an external effect for US manufacturing. Following Caballero and Lyons, this study estimates the same effect for Philippine manufacturing. The regression equation corresponding to specification 1 (namely, Equation (6)) is as follows:

$$\Delta y_{it} = \lambda_i + \phi_N \Delta n_{it} + \phi_M \Delta m_{it} + \phi_K \Delta k_{it} + (\phi_N + \phi_K)\Delta h_{it} + \phi_Y \Delta \bar{y}_t + \mu_{it} \tag{9}$$

where $\bar{y}_t$ is a logarithm of real gross output of aggregate manufacturing. Assuming $\Delta y_{it} = \Delta \bar{y}_t$ for all three-digit manufacturing industries, the degree of overall returns to scale at the aggregate level is $(\phi_N + \phi_M + \phi_K)/(1 - \phi_Y)$.

For specification 2, the corresponding regression equation is as follows:

16. For the 3SLS estimation, convergence is not achieved after 100 iterations without the cross-industry restriction so that the restriction cannot be tested. However, the χ^2 test statistic at the 100th iteration is as great as 606.64 and the *p*-value is 0.000.

$$\Delta y_{it} = \lambda_i + \phi_X \Delta x_{it} + \phi_Y \Delta \bar{y}_t + \mu_{it} \tag{10}$$

The overall returns to scale for this specification is $\phi_X/(1 - \phi_Y)$.

Tables 10 and 11 show the estimation results. A striking finding is that the coefficient on the externality term (ϕ_Y) is significantly negative for 3SLS and SUR. This may denote that an external diseconomy occurs as a result of activity by aggregate manufacturing to three-digit individual manufacturing. Due to this ‘external diseconomy’, the degree of overall returns to scale tends to be smaller than one. Moreover, all the 3SLS estimates of both internal and overall returns to scale were significantly smaller than one, regardless of which specification was used. While the economic logic behind the external diseconomy is not clear, there is little evidence to support Caballero-Lyons’ (positive) externality in Philippine manufacturing.

Table 10 Caballero-Lyons’ Externality: Specification 1

$$\Delta y_{it} = \lambda_i + \phi_N \Delta n_{it} + \phi_M \Delta m_{it} + \phi_K \Delta k_{it} + (\phi_N + \phi_K)\Delta h_{it} + \phi_Y \Delta \bar{y}_t + \mu_{it}$$

	OLS	*SUR*	*3SLS: Z1*
Total hours	0.419	0.362	0.179
	(0.035)	(0.007)	(0.020)
Capital stock	0.247	0.253	0.090
	(0.045)	(0.009)	(0.024)
Intermediate inputs	0.521	0.519	0.568
	(0.021)	(0.004)	(0.013)
Externality	0.247	−0.214)	−1.334
	(0.092)	(0.020)	(0.176)
Internal returns to scale: $\phi_N + \phi_K + \phi_M$	1.188	1.134	0.837
	(0.046)	(0.010)	(0.029)
Overall returns to scale: $\frac{\phi_N + \phi_K + \phi_M}{1 - \phi_Y}$	1.578	0.934	0.359
	(0.192)	(0.018)	(0.033)

Notes: The figure in parentheses is the standard error.

Table 11 Caballero-Lyons’ Externality: Specification 2

$$\Delta y_{it} = \lambda_i + \phi_X \Delta x_{it} + \phi_Y \Delta \bar{y}_t + \mu_{it}$$

	OLS	*3SLS: Z1*
Externality: ϕ_Y	0.145 (0.108)	−0.378 (0.132)
Internal Returns to Scale: ϕ_X	0.911 (0.041)	0.797 (0.018)
Overall Returns to Scale: $\phi_X/(1 - \phi_Y)$	1.065 (0.130)	0.578 (0.055)

Notes: The figures in parentheses are standard errors.

V. Concluding Remarks

Procyclical TFP growth was observed in the Hooley data set on Philippine manufacturing industries for 1956–80. Although such observations are not inconsistent with increasing returns, there was little support for this.

The estimation results are as follows. For aggregate manufacturing, the constant returns to scale hypothesis is supported. While some 2SLS estimates of returns to scale were larger than one for individual three-digit manufacturing industries, none were statistically significant. On the other hand, some estimation results with pooled data showed significant increasing returns. However, an upward bias was suggested, and the restrictions for common parameters across industry were rejected. The external effect discussed in Caballero and Lyons (1992) was not observed in the pooled data.

As a whole, the estimation results suggest that constant returns are probably more plausible than increasing returns for Philippine manufacturing during 1956–1980. As a result, the peculiar dynamics caused by increasing returns (e.g., self-fulfilling prophecy, multiple equilibria, a strong multiplier effect, etc.) are unlikely to occur in the Philippine economy. On the other hand, although a high concentration of business to a small number of large firms was stated in related literature (e.g., Lindsey, 1976, 1979; Koike, 1989, 1993a,b; Fujimori, 1983; Lee, 1984), it is suggested that the Philippine manufacturing industry from the 1950s to 1970s was more competitive than it seems, contrary to the notion that it is dominated by big business groups.[17] The relative stagnation of Philippine economy since World War II does not appear to stem from underproduction due to market power. However, the real reason of the stagnation was not ascertained in this paper.[18]

Finally, it should be noted that, because annual variables are used in this paper, dynamic increasing returns that required more than a year (e.g. learning-by-doing with a long digestion period) might not be captured by the analyses in this paper. That is, such long-run dynamic increasing returns are not inconsistent with the results obtained in this paper.

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17. A working paper version of this paper analyses markup ratio of Philippine manufacturing industry and found that it was not high. See Yamagata (1997) for detail.

18. The poor performance of the Philippine textile industry in comparison with the Thai textile industry is analysed by Yamagata (1998b). He concludes that since the Philippines was not as open to foreign direct investment by synthetic fibre producing companies as Thailand was, the Philippine textile industry could not grow as fast as the Thai textile industry did.

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Appendix 1: The Hooley Data

Time series data of 3 digit manufacturing industries have been published since the mid-1950s by the Philippine government. However, there is a serious problem in the data that the samples of establishments covered are different between the census years (1961, 1967, 1972, 1975, and so on) and the other years. To address the problem, Hooley (1985) constructed a consistent data set covering establishments with 20 or more workers in manufacturing industry from 1956 to 1980, based on the original data series with different coverage. By limiting coverage to establishments with 20 or more workers, the data set sacrificed 98.5% of establishments in Food, Apparel and Wood products industries and 88% of those in the other manufacturing industries. However, 92% of the value of gross output is estimated to be kept in the data set.

Moreover, Hooley (1985) estimated: (1) producers' price indices; (2) real capital stocks, and (3) effective protection rates for 1956–80 to investigate productivity of manufacturing industries.

The producers' price indices for 24 manufacturing industries were constructed from price data on around 300 commodities as Laspeyres indices with 1972 as the base year. The original price data were obtained from the Central Bank of the Philippines.

The capital stock data of 24 manufacturing industries were constructed by the perpetual inventory method. Since the original investment data apparently excluded investment carried out by new firms, trends of investment expenditure were interpolated between each pair of census years to estimate true investment expenditure data. The estimated investment expenditures were deflated with an investment price index and summed over the depreciable life of assets to obtain gross capital stock. The depreciable life of assets were based on actual duration of depreciation of assets in each industry for 1975, which appeared in the *1975 Census of Manufactures*. Then, he extrapolated them backward to 1956 and forward to 1980 to adjust the composition of assets. With the depreciable life, the capital stock net of depreciation expressed at replacement cost in 1972 prices were obtained. Finally, total net capital stock for each industry was obtained by adding inventory deflated by the weighted average of prices of finished goods for the industry and the general price index of processed inputs to the net capital stock, with the net fixed capital.

The Effective Protection Rates (EPR) were estimated to adjust differences between prices of gross output and those of intermediate inputs and value added. Intermediate inputs for a manufacturing industry are often deflated with the price index of gross output of the industry. In most developing countries, however, tariff structure has a ‘cascading’ character that means high tariff on final goods and low tariff on intermediate inputs. Therefore, deflation of intermediate inputs with prices of gross output tends to result in downward bias in the real value of intermediate inputs and upward bias in the real value added. To fix this bias, the EPR was calculated as a ratio of value added in terms of domestic prices to that in terms of international prices. The international prices are supposed to be domestic prices divided by one plus the tariff rate (see Krueger (1984) for the detail). Hooley and Erlinda Medalla took three points of time when EPR was available, and interpolated those for the remaining years.

Appendix 2

Stationarity in Growth Rate of Variables: Augmented Dickey-Fuller Test Statistics

	Gross Output	*Total Employment*	*Fixed Capital*	*Inventory*	*Intermediate Inputs*	*TFP*
3. All manufacturing	–4.85	–3.03	–3.90	–4.85	–5.27	–3.60
311–12. Food manufacturing	–4.50	–3.21	–1.69	–3.71	–4.69	–2.22
313. Beverages	–4.93	–5.04	–1.36	–4.03	–4.34	–3.32
314. Tobacco products	–4.79	–2.47	–3.79	–3.29	–4.56	–4.22
321. Textiles	–4.77	–3.55	–2.76	–5.19	–4.72	–3.47
322. Wearing apparel	–3.20	–2.57	–2.60	–2.75	–4.15	–4.04
323. Leather products	–4.38	–4.11	–7.50	–3.22	–4.33	–3.94
324. Footwear	–3.07	–2.24	–1.71	–2.03	–3.98	–3.08
331. Wood products	–3.68	–7.14	–2.68	–4.13	–3.11	–3.24
332. Furniture and fixtures	–3.86	–3.96	–4.58	–3.34	–4.32	–3.95
341. Paper and paper products	–3.14	–3.27	–3.06	–2.63	–3.74	–3.30
342. Printing and publishing	–4.42	–2.94	–2.27	–3.76	–5.58	–4.91

Continued

	Gross Output	*Total Employment*	*Fixed Capital*	*Inventory*	*Intermediate Inputs*	*TFP*
351. Industrial chemicals	−4.60	−4.29	−3.73	−6.74	−5.04	−3.80
352. Other chemicals	−4.10	−3.69	−3.29	−5.07	−5.37	−3.28
353. Petroleum products	−2.86	−4.88	−2.58	−3.87	−5.75	−2.33
355. Rubber products	−4.72	−2.41	−4.87	−4.02	−3.67	−4.03
356. Plastic products	−3.91	−3.29	−2.80	−5.42	−3.91	−3.73
361, 63 & 69. Non-metallic products	−4.82	−3.38	−2.69	−4.46	−5.16	−2.95
362. Glass products	−3.42	−2.86	−2.88	−3.15	−3.95	−4.70
371. Iron and steel basic products	−7.00	−3.19	−3.85	−5.50	−8.19	−4.58
372. Non-ferrous basic products	−3.77	−3.73	−5.37	−4.46	−3.19	−2.55
381. Fabricated metal products	−3.71	−6.21	−1.00	−2.79	−3.18	−3.76
382. Machinery	−4.12	−3.97	−2.24	−5.68	−5.06	−4.81
383. Electric machinery	−3.00	−1.70	−1.54	−2.46	−2.25	−4.28
384. Transport equipment	−4.28	−2.35	−2.32	−3.56	−4.96	−4.86

Notes: The number of lags for this test is one. MacKinnon's critical values for rejection of the hypothesis of a unit root are as follows: 1%: −3.7667, 5%: −3.0038, 10%: −2.6417.