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Gloria O. Pasadilla and Christine Marie M. Liao

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HAS LIBERALIZATION STRENGTHENED THE LINK BETWEEN SERVICES AND MANUFACTURING?

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Abstract

Globalization and pressure from increased competition have led to "splintering" of in-house services from formerly integrated manufacturing firms in developed economies and, at the same time, to an increase in "outsourcing" of these same services. These two trends have caused a stronger linkage in services and manufacturing in economic data because services which were previously lumped with manufacturing are now recorded separately and, in a sense, given identity. The study tries to shed some light on this linkage in the Philippine case. Contrary to experiences of other countries, the contribution of services to growth in manufacturing decreased from the 1980s to the 1990s. The manufacturing sector's usage of services also declined from the first to the second period. This result suggests that the Philippines has caught the "splintering" trend quite late and is, perhaps, only now catching on that the available 1990s data have not yet been able to capture.

Keywords: globalization, splintering, outsourcing, services-manufacturing link, growth accounting

1. INTRODUCTION

In recent years, services have become more and more significant to national economies. Part of this can be understood as going hand in hand with economic development. The theory is that as per capita income grows, the share of agriculture in total gross domestic product declines, manufacturing takes on a larger share of GDP and employment, until, eventually, the services sector takes over as the leading growth sector. A cross-country study conducted by Francois and Reinert (1996) empirically affirmed that the share of services in aggregate output and employment does indeed rise with the level of development.

Besides the growth in significance of services, there also takes place a shift in the industrial structure in many nations. Pilat and Wolfl (2005) document the growing trend towards the outsourcing of business-related services, such as research and development, financing or logistics instead of having these functions done in-house. Manufacturing firms hire specialized service providers or spin off segments of their company to create new firms that can then provide services at lower cost or higher quality. In the process, services have appeared to be more intricately intertwined with manufacturing, having been incorporated into the value chain as both links and individual components. The world over, the service sector's input to manufacturing has become more and more important as manufacturing firms fragment and grow more specialized.

Some economists believe that trade reforms and other shifts in economic policy have played a key role in the observed alteration of the industrial production structure. Liberalization has put pressure on firms to work towards operating at optimum efficiency in light of stronger competition. At the same time, globalization has changed the old picture of manufacturing factories into a globalized network of vertically integrated producers of various intermediate inputs. Liberalization and increased competition have made outsourcing service activities more necessary.

Growth of services' role in the economy is part of the evolutionary pattern of development and is positive. Yet, for developing countries, the strong role of services is faced with some trepidation. Some argue that growth in services alone cannot lead to sustained development. Manufacturing growth, they posit, is necessary, because services depend on manufacturing demand, and without concomitant growth in the latter, growth in services is simply not sustainable. However, with services becoming more and more important to the manufacturing efficiency and productivity, services growth itself can spur manufacturing growth. If this can be shown to empirically hold, it may be suggested that the two-way relationship between services and manufacturing will create a virtuous cycle that will allow both sectors to grow, and allay some fears regarding the sustainability of overall economic growth.

Over the past decade, the services sector in the Philippines has briskly expanded. In fact, it has done so to such an extent that services comprised 50% of the country's GNP and 53% of its GDP, as well as employ 47% of the total labor force, in 2005. In this, the nation's experience has paralleled those of other countries. The question, though, is whether liberalization in the country has, as it has in other countries, led to the shift in industrial

structure as well. What kind of linkage exists between services and manufacturing? Do services contribute significantly as an input to manufacturing in the country? Has the relative contribution of services to the growth in Philippine manufacturing increased as liberalization occurred? These are the questions that this study hopes to shed some light upon.

The rest of the paper is organized as follows: Section 2 provides a review of a few studies that examine the sources of growth and the role of services as an input to manufacturing, as well as studies that deal with observed structural changes in the manufacturing sector. Section 3 presents a sectoral discussion of how manufacturing makes use of specific services as part of its production process and gives a less abstract flavor of actual interaction between the two sectors. Section 4 discusses the methodology of the study, explaining the theory of the KLEMS (capital-labor-energy-materials-services) production function, which separately and explicitly recognizes the contribution of services to production. To complement the result of this growth accounting, an analysis of linkage and spillovers of services based on input-output tables for manufacturing are discussed in Section 5. Results from the examination of the 1985, 1988, 1994 and 2000 I-O tables are presented to assess changes in relative contribution of services to manufacturing. In order to give context to the changes that occurred, regression analysis is employed in Section 6. It examines whether any changes in the usage of services in manufacturing could be connected to liberalization and economic reforms. Section 7 concludes.

2. SERVICES, ECONOMIC GROWTH, AND STRUCTURAL CHANGES

Productivity studies in the Philippines have always used the traditional two-input framework of analysis, accounting only for labor and capital inputs in the production function. Using this standard model and employing a stochastic frontier production function approach to decompose output growth, Cororaton et al (1995) found that capital inputs showed increasing contribution to output growth in the manufacturing sector, while that of labor diminished. Using a different labor data and a slightly different methodology, Cororaton and Cuenca (2001), meanwhile, noted that while growth in the Philippine economy could generally be attributed to capital accumulation, the same could not be said of the manufacturing sector where capital growth did not *always* yield positive contributions.

In this two-input type of analysis, the role of services is difficult to recognize. Knowing the interplay among output, labor, and capital is not particularly helpful in determining the exact role that services play. To date, the matter has not been closely examined in the Philippine context although it has received attention in other parts of the world.

An Organization for Economic Co-operation and Development (OECD) study by Pilat and Wolfl (2005) focused on the linkage between services and manufacturing in a number of OECD member countries. They found that the value added from the services sector to manufacturing production has been increasing over time and reached up to a quarter of total output in certain OECD nations by the mid-1990s. They also discovered that a growing share of workers who officially belong to the manufacturing sector are engaged in service-related activities.

For India, Banga and Goldar (2004) studied panel data from three-digit level industries in India over a period of eighteen years in order to estimate a KLEMS (capital-labor-energy-materials-services) production function that would determine the sources of growth in the manufacturing sector. They found that the real value of services purchased by industrial units grew rapidly in the 1990s. In fact, the contribution of services input to manufacturing output increased from one percent in the early eighties to roughly twenty-five percent in the nineties. Industrial productivity was found to have a positive relationship with services input.

Hansda (2001) corroborated this strong relationship between services and manufacturing result in India. The study examined inter-sectoral linkages via the 1994 input-output tables and determined that industry was the most services-intensive sector in the country, with 70% of its activities directly so. It also found that services had the largest inducing effect on the economy, based on backward and forward linkages. Growth impulses in the Indian economy have been found to originate in services vis-à-vis manufacturing (and agriculture).

Bathla (2003), employing a Granger causality test on Indian GDP data from 1950 to 2001, found bidirectional causation between the manufacturing and services sectors. Services, the author maintained, may be stimulated by industrial expansion, but they also have the ability to induce industrial growth. Cointegration tests also find that services may even contribute to improving the linkages between agriculture and manufacturing.

For Korea, Kim and Kim (2000) posited that services liberalization could increase not only productivity in the services sector by technology transfers and economies of scale, but also productivity in other sectors, such as manufacturing, by increasing access to producer services and lowering the cost of inputs. Selecting manufacturing sectors for which output and factor data were available, the authors examined the total factor productivity (TFP) growth rates and the input coefficients of services to the chosen sectors in order to verify their hypothesis. Unfortunately, given that the liberalization in Korea occurred only in the mid-1990s, the results found were not definitive and the authors reported that it may be premature to claim that the liberalization of services has truly positively affected productivity. However, the authors did find evidence of enhanced competition in specific sectors that may, in the future, lead to increased productivity. Nam (1999) found that explicitly including intermediate inputs (which include services), other than capital and labor, in productivity models lead to smaller fluctuations and more consistency in manufacturing TFP growth rates in Korea. This is an indication of the significance of these inputs.

Using the same KLEMS production function for the United States, Strassner et al (2005) found that real demand for services input averaged the highest annual growth of all inputs used in the production of US output. A study conducted on Sub-Saharan Africa, Blunch and Verner (1999) also found significant evidence on the important role of the services sector. In modeling the relationship between agriculture and manufacturing, the authors found that services was present in the co-integrating relationship and was weakly exogenous to the system in all three economies under consideration, both in the long- and the short-run. The growth of the services sector was found to have dynamic effects on both agriculture and manufacturing.

Andersson (2004) likewise found producer services important for manufacturing industries in Sweden.

The above literature almost unanimously shows that, where services are explicitly taken into account in growth accounting, its increased role in economic growth and manufacturing has been evident. The other facet of the relevant literature tackles the structural change in manufacturing and highlights the greater service content of manufactured goods. Many of these papers attempt to correlate such a shift or structural change with trade reforms or liberalization.

For example, Banga and Goldar (2004) argue that the rapid growth of the use of services in manufacturing can be attributed to the trade reforms instituted in India. The growth in services input is corroborated by Gordon and Gupta (2003) who noted, by tracking changes in input-output coefficient, a 40% increase in the use of services sector input to industry from 1979 to 1994. Hansda (2001) also found that the intermediate use of services output has grown from 31.2 percent to 38.5 percent over the period 1968-1994 and that the number of industrial activities with above average services intensity has also been found to increase to 74 percent of industrial activities, while average service intensity has doubled to 30 percent of gross output.

In the United States, over as short a span as 1997 to 2003, services input rose from 22.5 percent of gross output to 25.1. This happened as materials and energy input dropped its share of production (Strassner et al, 2005). The high growth of intermediate inputs has also been noted as a particularly interesting feature of Canadian manufacturing growth (Gu and Ho, 2000).

Francois and Reinert (1996), studying national income data for 15 countries and examining upstream and downstream service linkages, found that the level of development measured by per capita income and the intensity of use of services in manufacturing are positively related. The demand for services as an intermediate input rises as changes take place within manufacturing industries. There is what they term a "fundamental change" in the production structure.

However, not all nations experience the same surge in the significance of services input in manufacturing as a result of policy changes. Ruben (2002), analysing sectoral dependency ratios based on Turkish national input-output tables for the years 1985, 1990 and 1996, found that the total intermediate input sales of the service sector to the manufacturing sector declined.

3. MANUFACTURING FRAGMENTATION: SECTORAL EXPERIENCES

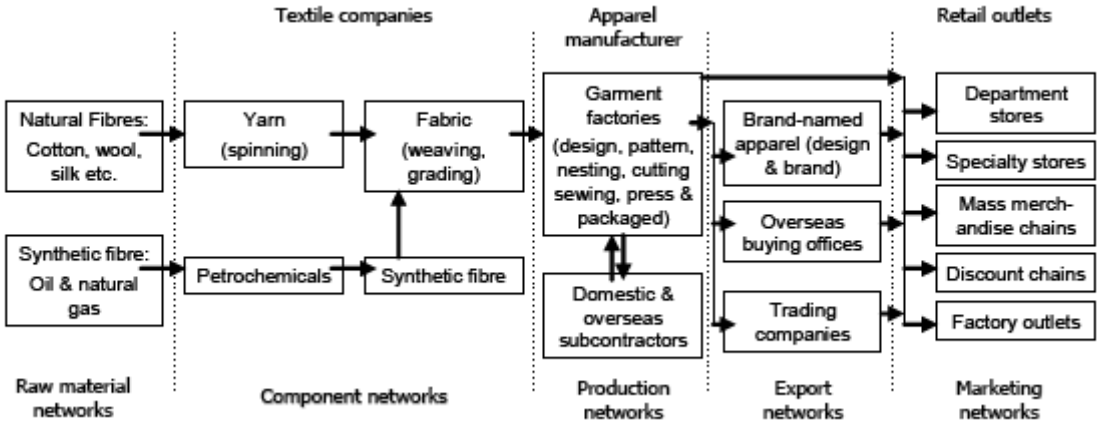
While most of the literature pointing to increased usage of services in manufacturing are based on model result or input-output analysis, Gage and Lesher (2005) provide a more descriptive study of the phenomenon of increasing fragmentation by manufacturing firms and the role that services play in this process. The study provides explorations of four specific industries, breaking down the value chains of apparel, automobiles, semiconductor chips and

wood furniture. We summarize their results as they are particularly illustrative of how services impact the manufacturing sector.

Apparel

Apparel manufacturers view design, marketing and branding – all service components – as the source of competitive advantage, and have proceeded to disaggregate the entire manufacturing process into strategically pertinent components. A company like Benetton may now choose to focus on its core competence of design, cutting, quality inspections and distributions while outsourcing and off shoring the rest of the production activities to more cost-effective firms elsewhere, particularly in Asia. Aside from designing and marketing, an apparel company based in a developed country can oversee the provision of materials and the logistics of how, when and where manufacturing takes place (see Figure 1).

Figure 1. Apparel Value Chain



Source: Gage and Lesher (2005)

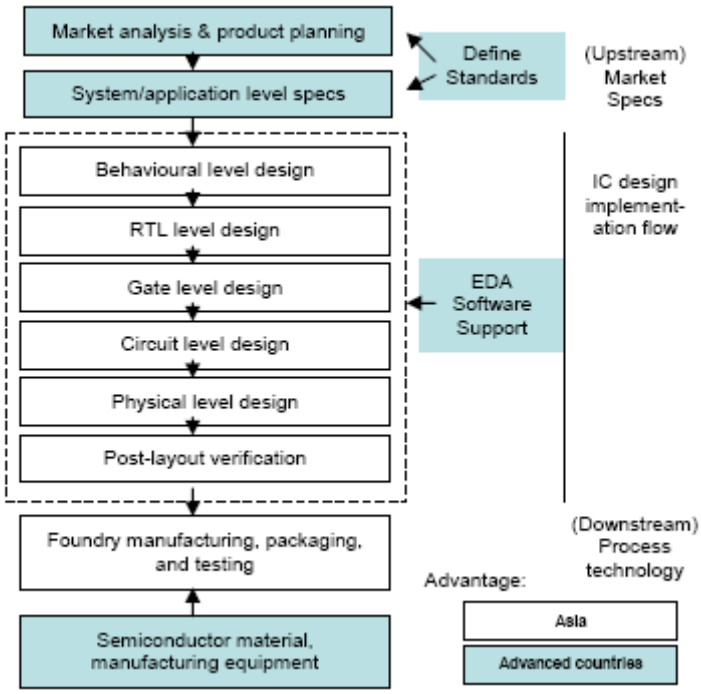
This type of fragmentation has been made possible by technology and changes in trade policy. With technology, firms are able to break up the digital aspects of production and turn these into a service that may be traded internationally. Too, bar coding allows for the faster and more accurate distribution of parcels and the ability to track their movements. Marketers are now able to reach consumers via the internet; companies may choose to hire internet specialists with more expertise and experience in promoting and advertising online. Computer-Aided Design encourages collaboration and facilitates the pattern-making, grading, and nesting and marking processes. These processes are transformed into digital services that may be transferred over the internet. In all of these, services that were formerly part of the in-house value of apparel manufacturing have been spun off and traded[1].

[1] Furthermore, the lower cost of transportation and the existence of economies of scale have led companies that used to be primarily garment factories to expand into the area of textiles and fibers. Due to developments in technology, trade in apparel-related services has become a stronger and stronger possibility for these firms.

Semiconductor Chips

Over the past two decades, the fabrication segment has diverged from the design segment, leading to the emergence of fabrication-less (fabless) firms. The latter focus on the design and marketing components and rely on contract manufacturers (foundries) to produce their designs. These fabless firms are founded primarily on intellectual capital, and their strength lies in their knowledge of their customers, their understanding of the capabilities of various suppliers, and their ability to identify appropriate designs. Their innovativeness and fast delivery times give them a high profile among rapidly growing industries (see Figure 2).

Figure 2. Semiconductor design value chain



Source: Gage and Lesher (2005).

Highly-trained engineers are at the forefront of the manufacturing process for semiconductor chips, creating designs using computer programs. Advances in Engineering Design Application (EDA) software have reduced the duration of the design stage of production and the complexity of the design process. Technological developments have also allowed for a two-way flow of the design, creating deeper relationships between the designers and the fabricators than merely arms-length contract manufacturing.

As in apparel industries, design services can be delivered via the internet, increasing efficiency and encouraging off-shoring of the segment. Firms have even delved into exploratory design services, hiring specialized firms or research institutions, primarily in Asia, to conduct activities such as behavioral-level design and post-layout verification as part of the research and development process. This fragmentation is particularly efficient, in that the Asian institutes have the speed, quality, flexibility and cost attributes ideal for exploratory design,

while the manufacturers in the developed countries are in prime position to conduct market analysis, product planning and system and application specification activities.

Other sectors

In other sectors like wood furniture, the relevant services inputs are distribution services as well as design, marketing, and after-sales services.

Distribution services play an important role, because flat pack shipping has revolutionized the industry by driving down costs. Likewise, design, branding, marketing and after-sales services, continue to be the preserve of multinationals even while outsourcing or outshoring the manufacturing segments. IKEA, for example, contracts out the manufacturing on 90% of its furniture products to roughly 2,300 suppliers in more than 60 countries. In some cases, it provides logistical support in terms on advice on the selection of equipment, raw materials and delivery options, as well as financial support.

In the automobile industry, car design is another spun-off services that allow the sector to concentrate on its core competency. The marketing and financing services are other aspects of the industry that are no less significant than the rest of the auto manufacturing process.

Gage and Lesher (2005) provide a clear picture of where services come into the picture in the entire manufacturing value chain. While there are no similar studies in developing countries, it may, perhaps, be conjectured that the same fragmentation trend may be also taking place in developing economies, albeit possibly at a delayed rate, since the IT revolution has also affected these economies. For example, it is conceivable that accounting services of some industries are already being devolved into a separate independent entity. Or, trucking and logistics services that used to be operated as part of the manufacturing company must have been spun-off and outsourced.

The paper proceeds next into the examination of whether the outsourcing of services and the increasing role of services observed in other countries have become a similarly significant pattern in the Philippines. In this, it will follow the same methodology as other studies that seek to discover such a trend from aggregate economic data.

4. CONTRIBUTION OF SERVICES TO MANUFACTURING OUTPUT GROWTH

The KLEMS Production Function

To measure the contribution of services in manufacturing output, we modify the standard two-factor (capital and labor) production function to include energy, material inputs, and more recently, services. This, therefore, gave rise to what is called in the literature as KLEMS model which stands for capital, labor, energy, materials, and services. These models recognize services as a separate input in production[2].

[2] In previous KLEM models, services are usually lumped with materials input.

In this analysis of the supply-side sources of growth, the production function may be viewed as

$$Q_{it} = f\,(K_{it}, L_{it}, E_{it}, M_{it}, S_{it}\,;\, A_{it}) = AK^{\alpha}L^{\beta}E^{\gamma}M^{\delta}S^{\xi}e^{\varepsilon}$$

where Q denotes gross output, K capital, L labor, E energy, M materials and S services. The subscripts i and t stand for industry and time (year), respectively. A_{it} represents technology, whereby inter-industrial and inter-temporal variations in total factor productivity are incorporated into the production function.

We estimate the model using panel data on 27 three-digit manufacturing industries[3] with complete information over the course of sixteen years, 1983 to 1998. As is common practice, a Cobb-Douglas functional form is applied[4].. After logarithmic transformation, the estimated equation is as follows:

$$\boxed{\ln(Q_{it}) = c_i + \lambda t + \alpha \ln(K_{it}) + \beta \ln(L_{it}) + \gamma \ln(E_{it}) + \delta \ln(M) + \xi \ln(S_{it}) + \varepsilon_{it}.}$$

ε here is a random error term and $\alpha,\beta,\gamma,\delta$, and ξ are, respectively, the output elasticities of capital, labor, energy, materials, and services. We discuss the data sources in one of the Appendices at the end of the paper.

Measurement of output and inputs

Output. For each of the 27 manufacturing industry group, real gross output was obtained by deflating the value of output by an implicit manufacturing price index[5].

Labor. Average employment for the year is considered to be the measure of labor input.

Capital. Net fixed capital stock at constant prices is taken as the measure of capital input. This series was derived via perpetual inventory method. The construction of the fixed capital series involved the following steps: (1) Data on Gross Domestic Capital Formation on Durable Equipment in current and constant prices over the period 1980[6] to 1998 was taken from the National Accounts of the Philippines. The implicit deflator is derived from this information, and the deflator series is constructed. As with all other data, the base year used is 1985. (2) The book value of fixed assets in 1983 was taken from the *Annual Survey of Establishments* (ASE) and deflated by the average value of the deflator for the previous four

[3] Food manufacturing, beverages manufacturing, tobacco manufacturing, textiles manufacturing, wearing apparel manufacturing, leather, wood and wood products, paper and paper products, printing and publishing, industrial chemicals, other chemicals, petroleum refineries, miscellaneous products of petroleum and coal, rubber products, plastic products, glass and glass products, cement, non-metallic mineral products, iron and steel, non-ferrous metal, fabricated metal products, machinery, electrical machinery, apparatus, appliances and supplies, transport equipment, professional, scientific, measuring and controlling equipment, furniture, and other manufacturing industries.

[4] A_{it} is specified as $\exp(c_i) + \exp(\lambda t)$

[5] The implicit manufacturing price index is constructed by dividing Gross Domestic Product (GDP) in manufacturing in current year prices by the GDP in manufacturing in constant 1985 prices

[6] The first year for which published data is available

years.[7] This is taken as the benchmark capital stock. (3) Gross investment in fixed capital for each succeeding year is found by subtracting the book value of fixed assets in the previous year by that in the current year and then adding the reported depreciation of fixed assets in the current year.[8] This series is deflated by the price series created in step one to obtain real gross investment in fixed assets. (4) To obtain real net investment in fixed assets, the depreciation of fixed capital, which is set at 5 percent per year, is subtracted from real gross investment in fixed assets. (5) The benchmark capital stock is taken, and real net investment in fixed assets is added to it for the succeeding years. What results is the net fixed capital stock series, which is used to represent capital input in the study.

Materials. The cost of materials and supplies purchased represents materials input. The implicit price index was obtained by dividing the annual values of GDP in all sectors save for services and electricity in current year prices by their counterparts in constant 1985 prices. This index was then used to deflate the values reported in the ASE.

Energy. The cost of fuels purchased and the cost of electricity purchased have been added together to reflect energy input. The implicit price index was obtained by dividing the values of GDP in electricity in current year prices by their counterparts in constant 1985 prices. This index was then used to deflate the values reported in the ASE.

Services. To obtain services input, we add the cost of industrial services[9] with the cost of non-industrial services[10] done by others. To correct for price changes, another deflator series was constructed. Taking the value of GDP in services in current prices and dividing it by the GDP in services in constant 1985 prices, the necessary index was built.

Estimation Results

We estimate the model using both the fixed effects and the random effects models for panel data estimates. The results are presented in Table 1.

[7] A longer time period for the deflator would have been advisable, since it can be posited that some of the assets existing in the base year would have been purchased prior to 1980. Unfortunately, no data prior to this year is available. Thus, there may be some understatement introduced in the benchmark estimate of capital stock. However, it must also be pointed out that assets acquired in the recent years would constitute a much larger part of the net book value of assets than those acquired from the fifth to the tenth years in the past, curtailing this downward bias.

[8] Book value of fixed assets reported in the ASE is the accounting value and is therefore net of depreciation.

[9] Industrial services are defined by the survey as those services related to manufacturing, mining and quarrying, electricity, gas and water, and construction. An example of this would be repair and maintenance work.

[10] Non-industrial services include rental expense, storage and warehousing, bank charges excluding interest, insurance expense, commission expense for non-regularly paid employees, communication expense, professional business and other service fees, transportation, representation and entertainment expenses, stevedoring, forwarding and other freight charges.

***Table 1*. Estimates of KLEMS Production Function, Philippine Manufacturing**

Dependent Variable: ln (Q)

Time Period: 1983-1998

Explanatory Variables	Fixed-Effects		Random-Effects	
	Coefficients	t-Statistics	Coefficients	t-Statistics
ln(K)	0.076*	2.08	0.154**	5.25
ln(L)	0.326**	9.19	0.117**	5.01
ln(E)	0.072**	3.62	0.079**	3.95
ln(M)	0.453**	20.05	0.539**	25.68
ln(S)	0.066**	3.39	0.094**	4.66
t (time)	0.011*	2.82	0.002	0.67
No. of observations	432		432	
Overall R2	0.8944		0.9601	
Hausman statistics	96.53			
Wald Chi2 (6)			5031.91	

Notation: Q = real value of output, K = capital input, L = labor input
E = energy input, M = materials, S=services input
** statistically significant at the five percent level*
*** statistically significant at the one percent level*

As can be seen from the t-statistics, the estimated coefficients for capital, labor, energy, materials and services are generally statistically significant at the one percent level. As expected, all of them are positive and less than one. This is consistent with the theory of producer behavior. The sum of the five coefficients in the fixed effects model is 0.993, while it is 0.984 in the random effects model. The assumption of constant returns to scale is not rejected by either result. The Hausman test has been run to determine which model (fixed effect or random) is preferred. Going by the p-values generated, the fixed effects model is more appropriate and will be used in the subsequent analysis.

Using the coefficients above, we take a closer look at the sources of output growth. To get a good idea of the big picture as well as to understand how things have changed over the years, the analysis is conducted for three different time periods. Results are shown for (1) the entire period from 1983 to 1998, (2) the subperiod 1983 to 1990, henceforth referred to as the eighties, and (3) the subperiod 1991 to 1998, the nineties in shorthand. The results of the previous regression have been used to decompose output growth. The estimates α, β, γ, δ and ξ in the equation above represent the elasticities of output with respect to their corresponding inputs, in this case α for capital, β for labor, γ for energy, δ for materials and ξ for services. In the fixed effect model, the elasticity of services is 0.066 which means that a one percent growth in services input leads to a 0.07 percent growth in output.

Contribution of Services in Output Growth

The actual contribution of each input to output growth is arrived at by multiplying the trend growth rate of each input by the elasticity of output with respect to each input.[11] The trend growth rate is found by applying an equation for exponential growth to the available time series on inputs and outputs.

$$\textbf{Trend growth rate} = [(V_e/V_b) \wedge (1/p)] - 1$$

Where V_e is the ending value, V_b is the beginning value and p is the number of time periods under consideration.

The relative contribution of services to output growth is found by dividing the contribution of services to input growth by total output growth. The results are shown in Table 2 below.

***Table 2*. Sources of Growth in Philippine Manufacturing, 1983 to 1998**

In percent per annum

	1983-1998	*1983-1990*	*1991-1998*
Trend growth rate of output	4.41	2.83	5.92
Trend growth rates of inputs			
Capital	10.61	10.23	9.58
Labor	3.18	3.55	2.66
Energy	0.98	-0.03	2.14
Materials	3.85	2.75	4.19
Services	5.83	7.53	4.13
Contribution of inputs			
Capital	0.80	0.78	0.73
Labor	1.04	1.16	0.87
Energy	0.07	0.00	0.15
Materials	1.74	1.24	1.90
Services	0.39	0.50	0.27
Trend growth rate of total input	6.42	5.48	6.48
Relative contribution of services to output growth (%)	8.75	17.59	4.61

Source: Based on coefficients from the fixed effects model (Table 1)

The real value of services used in manufacturing grew at a rate of 7.53 percent between 1983 and 1990 while the rate of growth is slower at 4.13 percent for the period 1991 to 1998. It can be seen that the contribution of services to manufacturing growth has decreased rather than

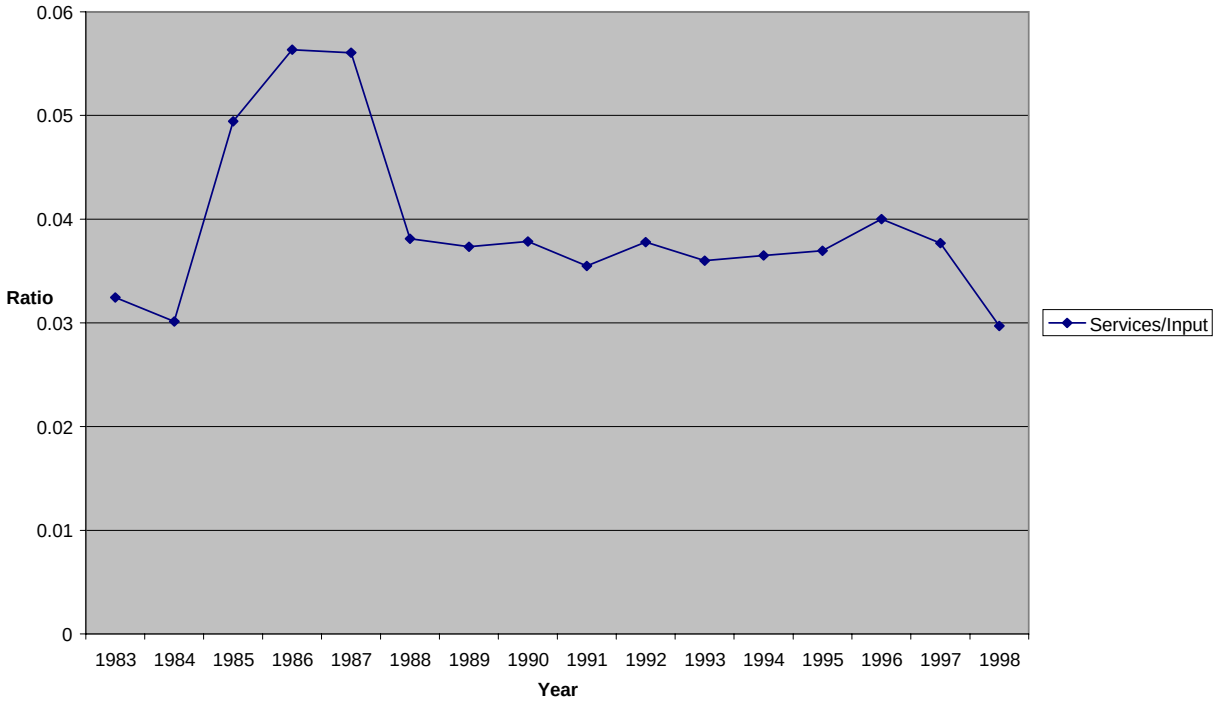
[11] As derived in Nicholson (2002), the growth in output attributable to a change in input is equal to the growth rate of the input per unit of time multiplied by the elasticity of output with respect to that input.

increased over the time periods. From 0.50 percent in the 1980s, it was almost halved to 0.27 percent in the 1990s. From a relative contribution of 17.59 percent, it dropped to only 4.61 percent in the next decade. It was energy and materials input whose role in the production process increased. This experience is the exact opposite of the one documented for the United States in Strassner, et.al (2005).

Given the overall growth of the services sector and the experiences of other nations, this decreased contribution of services to industrial growth in the Philippines was not the intuitively expected result of the regression. However, a quick examination of actual values reported by firms on their input costs, deflated by the appropriate price indices, support the conclusion.

Services input as a percentage of total input was at its lowest in 1998, and on average, it was higher in the 1980s. From 1983 to 1990, the average expenditures of manufacturing firms on services was 4.22 percent. From 1991 to 1998, it fell to 3.63 percent (Figure 3).

Figure 3. Services as a Percentage of Input



Another notable finding is that total input growth does outstrip total output growth for the manufacturing sector. While the trend growth rate of output in manufacturing more than doubled in the nineties from its eighties value, moving to 5.92 from 2.83, the single percentage point increase in input growth was still enough to keep the input growth higher than output growth in both periods and overall. On average, the growth rate of output from 1983 to 1998 under study is 4.41 percent, while that of input is 6.42 percent. This corroborates the findings of Cororaton and others, which found negative total factor productivity growth for the

manufacturing sector as a whole. The gap between the growth of total input and the growth of total output represents the growth of TFP. In this case, that is -2.02 percent.

5. LINKAGE AND SPILLOVERS

To validate the results of the growth analysis that the role of services in manufacturing output has declined in the 1990s, as well as to gain a better understanding of the historical roles of manufacturing and services in the overall economy, we use the input-output tables of the Philippine economy for the years 1985, 1988, 1994, and 2000.

Sectoral Dependency Ratio

Focusing specifically on the interrelationship between manufacturing and services, we construct the sectoral dependency ratios for each of the years under study. Employing the USE tables of the Philippine input-output table, we can determine the sector's purchase of input from a particular sector as a percentage of its total intermediate input purchases of each industry. Below, we examine the dependence of manufacturing on services intermediatete inputs over the years.

Table 3. Sectoral Dependency Ratio of Manufacturing

	1985	1988	1994	2000
Agriculture	0.4912	0.3803	0.3264	0.2630
Mfg	0.3799	0.4439	0.4993	0.5346
Services[12]	**0.1217**	**0.1410**	**0.1390**	**0.1678**

Source: Authors' computations based on Input-Output tables.

Table 3 shows that slightly more than one-tenth of the total intermediate input in manufacturing is purchased from the services sectors. What is significant to note in the table is that, while it validates the similar conclusion from the model namely, that services' contribution to growth in manufacturing declined from the 1980s to the 1990s, there is increase in the use of services inputs in 2000, a period not covered by the estimation in Section 4 above. This can imply that the splintering trend in the Philippines must have caught on late in the 1990s or even already in 2000, unlike in developed countries where the trend started earlier in the 1990s. Additionally, the ratios above confirm the KLEMS model finding that manufacturing firms remain highly dependent on materials inputs from other manufacturing firms.

Other Linkage Analysis

We also compute the direct and indirect forward and backward linkages of various sectors. Although this is not directly related to the question of changed linkage between services and manufacturing, we find the index computation insightful with respect to relative importance of sectors in the economy. In the case of forward linkages, we note how important services sector is as a supplier of inputs to other sectors. We compute forward linkage using

[12] Excludes construction, electricity and steam, and water.

the Leontief inverse matrix [$(I-A)^{-1}$] by summing the row values and dividing each of them by the average sum using the formula below:

$$\textbf{Rasmussen FL} = \frac{\sum_{i=1 \text{ to } n} r_{ij}}{(1/n) \sum_{j=1 \text{ to } n} \sum_{i=1 \text{ to } n} r_{ij}}$$

In the case of backward linkages, we note how important services sector is as a purchaser of inputs from other sectors. That is, it indicates the increase in output of all the industries whose products are used by services in response to a unit change in the demand of services. The computation sums up the column values of the inverse matrix and divides them by the average sum as shown below. For both backward and forward linkage, an index greater than one implies a greater than average linkage. The result of the computations are shown in Table 4.

$$\textbf{Rasmussen BL} = \frac{\sum_{j=1 \text{ to } n} r_{ij}}{(1/n) \sum_{i=1 \text{ to } n} \sum_{j=1 \text{ to } n} r_{ij}}$$

Table 4. Rasmussen Forward and Backward Linkages

Forward Linkages				
	1985	1988	1994	2000
Agriculture	1.0470	1.0952	0.8461	0.9026
Manufacturing	1.6504	2.2419	1.8011	1.7249
Services	**1.1129**	**1.3315**	**1.1313**	**1.1191**
Backward Linkages				
	1985	1988	1994	2000
Agriculture	0.9751	1.1631	0.9778	0.9441
Manufacturing	1.6349	2.0953	1.6867	1.5762
Services	**1.1792**	**1.4223**	**1.1461**	**1.2408**

Source: Authors' computations based on I-O tables.

The tables show that the manufacturing sector, which induces a 158 percent change in supplying sectors (Rasmussen BL) and a 172 percent change in using sectors (Rasmussen FL), has truly consistently provided the greatest stimulus in the economy. While the services sector has always remained second to the manufacturing sector in terms of producing externalities. While its linkage value exceeding one indicates that it is a key sector in the economy, both results support the idea that the significance of the service's sector contribution fell in the 1990s. As a purchaser from other sectors, services importance improved in 2000, but as supplier, its decline continued in 2000. The result of the various linkages implies that, while services growth needs to be supported, the manufacturing industries remain most important for inducing growth across the sectors.

6. ROLE OF POLICY REFORMS

Trade reforms in the Philippines began in the early 1980s, with the country's leadership slowly opening the economy to the outside world. Since then, the nation has continued to pursue liberalization, with ever lowering tariffs leading to increasing competition for local firms. These are part of the country's development strategy, a movement toward greater economic growth and industrialization.

Reforms in economic policy are expected to affect the production structure of firms. Liberalization increases pressure for firms to become efficient and, consequently, to outsource some of the service inputs, instead of producing them in-house. Hence, with liberalization policy, manufacturing grows to rely more and more on services as an input to the production process. Results in the previous section, however, indicate that this has not been the case in the Philippines given the available data up to 1998.

This section further attempts to examine the link between policy and experience. Perhaps, the growth in services may not be due necessarily to splintering but to some other factors, like liberalization that remove the previous constraints on the service sector. We, therefore, regress use of services in manufacturing (service use intensity, S/Q) against several other explanatory variables with Dummy Variables reflecting the policy shift. The regression equation is stated below:

$$\ln(S/Q)_{it} = \theta_0 + \theta_1 \ln(W/P)_{it} + \theta_2 TRF + \theta_4 DUM + \zeta_{it} \quad ....(5)$$

In this regression analysis, services use intensity (*S/Q*), the value of services input as a percentage of total manufacturing output, is the dependent variable. *W/P* is the ratio of the nominal wage rate to the price index of services derived in the previous section. This is a price variable for demand for services and hence the expected sign is negative. TRF is the tariff rate in manufacturing adjusted by the real effective exchange rate. The adjustment is done to ensure that any offsetting of the effects of lowering the tariff by a depreciation of the real effective exchange rate will be accounted for. It is expected that this is negatively related to service use intensity since the more protected manufacturing sector is, the less the incentive to outsource services. A dummy variable has been set for the 1990s to capture the effects of the policy changes in the period that may have affected the industrial production process and market structure. One significant enactment in the area came in 1991, with the issuance of Executive Order 470, which represented the most significant tariff reform initiative since the tariff reform program in 1985. As a whole, the 1990s were a period of economic growth and development in the country, and it is for this reason that a dummy has been applied to 1991 and the subsequent years.

Since most of the data in this section is available only in highly aggregated terms, the results of an ordinary least squares regression[13] on a time series encompassing sixteen years can be seen below:

Table 5. Determinants of Service Use Intensity
Dependent Variable: ln (S/Q)
Time Period: 1983-1997

	Coefficients	T-statistics
Ln (Nominal wage/price index of services)	-2.13786*	-2.8
Tariff rate adjusted for REER	1.628316*	2.43
Dummy for 1991 onwards (EO470)	0.148999	1.07
Constant	-4.56626	-7.83
No. of observations	16	
R2	0.4614	

** significant at the 5% level*

The results show that the wage variable is negative as expected. It is, however, worth noting that while in other countries, disproportionately increasing wage rates might motivate firms to outsource services rather than hire or retain employees and should thus lead to a higher service use intensity, in the Philippines, an increase in wages leads to lower use of services. In addition, due to restrictive labor practices in the Philippines, an increase in the wage rate, instead of leading firms to decrease employment, would instead prompt them to reduce costs in other areas, i.e., decreasing the use of other inputs, including services. What is, actually, unexpected is the fact that more protection via a higher tariff rate corresponds to an increased use of services instead of a negative relationship as we hypothesized. Upon closer glance, however, this still boils down to an issue of efficiency. Greater protection leads to less efficiency overall, and firms are tempted to increase the use of all inputs, including services.

While the dummy for the nineties has a positive if small coefficient, it is not statistically significant. This result can be taken to support our findings in Section 4, indicating that trade reforms in the 1990s have not yet shown themselves to have sufficiently and positively altered the structure of the manufacturing sector nor made conditions more conducive to the increased use of services in manufacturing production.

7. IMPLICATIONS AND CONCLUSIONS

This study sought to determine the contribution of services to the growth of the manufacturing sector and understand the effect of liberalization on the link between services and manufacturing. In order to do this, we first estimated a KLEMS (capital, labor, energy, materials and services) production function using data from twenty-seven industries from 1983 to 1998.

[13] A panel data estimation using disaggregated values for the dependent variable and duplicated values for the independent variables resulted in practically equal coefficients.

The results show that, contrary to the hope and the expectation based on the experiences of other nations, the use of services in manufacturing production markedly decreased, rather than increased, from the 1980s to the 1990s. As a result, its contribution to manufacturing growth also fell from the first period to the second, and its overall relative role in the growth of manufacturing output was less than ten percent.

On some level, this result is understandable. For one, 99% of firms in the country are small and medium-scale enterprises. Given their limited scales of operations, it is expected that such firms would be less likely to feel an urge to outsource. They can continue to do it all on their own, and they might have chosen to do so. Likewise, this result may indicate that the splintering effect might not have yet been captured in the 1990s data as there is an indication, based on manufacturing dependency from the 2000 I-O table, that there is an increased reliance by manufacturing on services.

Simple regression of service use intensity also implies that the economic reforms instituted in the Philippines have not (yet) made a significant contribution to transforming the manufacturing sector in the sense of increased outsourcing of services. The policy changes made in the early nineties were insufficient for industrialization. Both manufacturing and services firms did not splinter to such a degree that a marked reliance by manufacturing on explicitly service-oriented activities was created, as happened in other countries.

Of course, it may be suggested that since most of the splintering that may have been brought about by economic reforms likely occurred after a lag, in the mid- to late 1990s, the structure of the economy would not yet have changed over the period studied. We allow that data from succeeding years, had they been available, would have provided more illumination on the medium-term effects of such reforms.

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Appendix 1

Details on Data Employed

Variable	Description	Source	Period
Output	Real gross output	Derived	1983-1998
Value of Output	Total value of products sold, receipts from contract work and industrial services done for others, receipts from goods bought and sold in same condition, fixed assets produced on own account and change in inventories	ASE	1983-1998
GDP in manufacturing in current prices	Value of all goods and services produced domestically in the manufacturing sector	National Accounts	1983-1998
GDP in manufacturing in constant prices	Value of all goods and services produced domestically in the manufacturing sector, exclusive of the influence of price changes since the base year of 1985.	National Accounts	1983-1998
Labor	Average employment for the year	ASE	1983-1998
Capital	Net fixed capital stock at constant prices, constructed via the perpetual inventory method	Derived	1983-1998
Gross Domestic Capital Formation in Durable Equipment in current prices	Outlays on durable equipment, plus changes in stocks	National Accounts	1980-1998
Gross Domestic Capital Formation in Durable Equipment in constant prices	Outlays on durable equipment, plus changes in stocks, exclusive of the influence of price changes since the base year of 1985.	National Accounts	1980-1998
Book value of fixed assets	Initial value or acquisition cost of fixed assets less the accumulated depreciation charges	ASE	1983-1998
Depreciation of fixed assets	Total amount set aside for the year to cover the decrease in value of physical assets owned by the establishment because of unforeseen obsolescence, wear and tear as a result of	ASE	1983-1998

	operation, and normal amount of accidental damage		
Depreciation of fixed capital		Set at 5%	1983-1998
Materials input	Cost of materials and supplies purchased	ASE	1983-1998
GDP in agriculture, fishery and forestry in current prices	Value of all goods and services produced domestically in the the agricultural, fishery and forestry sectors	National Accounts	1983-1998
GDP in agriculture, fishery and forestry in constant prices	Value of all goods and services produced domestically in the the agricultural, fishery and forestry sectors, exclusive of the influence of price changes since the base year of 1985.	National Accounts	1983-1998
GDP in mining and quarrying in current prices	Value of all goods and services produced domestically in the mining and quarrying sectors	National Accounts	1983-1998
GDP in mining and quarrying in constant prices	Value of all goods and services produced domestically in the mining and quarrying sectors, exclusive of the influence of price changes since the base year of 1985.	National Accounts	1983-1998
GDP in construction in current prices	Value of all goods and services produced domestically in the construction sector	National Accounts	1983-1998
GDP in construction in constant prices	Value of all goods and services produced domestically in the construction sector, exclusive of the influence of price changes since the base year of 1985.	National Accounts	1983-1998
Energy inputs	Cost of electricity purchased plus cost of fuels purchased	ASE	1983-1998
GDP in electricity in current prices	Value of all electricity, steam and water produced domestically	National Accounts	1983-1998
GDP in electricity in constant prices	Value of all electricity, steam and water produced domestically, exclusive of the influence of price changes since the base year of 1985.	National Accounts	1983-1998
Services input	Cost of industrial services purchased plus cost of non-	ASE	1983-1998

	industrial services purchased		
GDP in services in current prices	Value of all goods and services produced domestically in the transportation, communication and storage; trade; finance; ownership of dwellings and real estate; private services; and government services sectors	National Accounts	1983-1998
GDP in services in constant prices	Value of all goods and services produced domestically in the transportation, communication and storage; trade; finance; ownership of dwellings and real estate; private services; and government services sectors, exclusive of the influence of price changes since the base year of 1985.	National Accounts	1983-1998

Appendix 2

Data Transformation

Data representing the outputs and inputs of 27 major manufacturing industries in the Philippines[14] was derived primarily from the *Annual Survey of Establishments (Manufacturing),* a compilation of survey-based statistical information published by the National Statistics Office (NSO), from the year 1983 to 1998.[15]

In order to deflate outputs and inputs, sector-specific implicit price indices were found using disaggregated data on Gross Domestic Product and Gross Domestic Capital Formation. These were published by the National Statistical Coordination Board (NSCB) in the *National Accounts of the Philippines* from 1980 to 1998.

The 1985, 1988, 1994 and 2000[16], 59x59 input-output tables used for the second section of the production analysis were provided by the NSCB upon request. These years were chosen because they are the most recent and most appropriate benchmark years available.

The manufacturing tariff rates from 1983 to 1998 inputted in the regression in Chapter Five were supplied upon special request by the Tariff Commission. Real effective exchange rates from the same period were those reported by the Bangko Sentral ng Pilipinas (BSP, Central Bank of the Philippines) and published in the *Philippine Statistical Yearbook*. The nominal wage rate is an average of the non-agricultural nominal wage rates in the National Capital Region (NCR) and the regions outside NCR. These were also reported by the BSP.

[14] Industry groups with complete and corresponding data from 1983 to 1998 are as follows: Food manufacturing, beverages manufacturing, tobacco manufacturing, textiles manufacturing, wearing apparel manufacturing, leather, wood and wood products, paper and paper products, printing and publishing, industrial chemicals, other chemicals, petroleum refineries, miscellaneous products of petroleum and coal, rubber products, plastic products, glass and glass products, cement, non-metallic mineral products, iron and steel, non-ferrous metal, fabricated metal products, machinery, electrical machinery, apparatus, appliances and supplies, transport equipment, professional, scientific, measuring and controlling equipment, furniture, and other manufacturing industries.

[15] Due to the lack of funding, the NSO was unable to regularly conduct and publish results from the survey after 1998. 1983 is the first year included because prior to this, there was a different set of respondents for the survey, and therefore, earlier data could not be synchronized with later data. It is for the reason that the study is limited to the intervening years.

[16] As of the time of writing, 2000 is still the most recent edition of the input-output tables.