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The Impact of Increase in Domestic Petroleum Prices on Costs of Production

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ABSTRACT

The paper examines the impact of an increase in domestic petroleum price on costs of production in the Malaysian manufacturing sector. The paper has identified three component costs of production which comprise domestic materials, imported input and labour. By using the input-output model, the paper simulated different scenarios of the effect of petroleum price changes on sectoral costs of production. The simulation results indicate that aside from the petroleum products sector, the glass product, other manufacturing product, other chemical product, and also the oils and fats industries are the sectors most affected by an increase in domestic petroleum prices. These sectors are expected to experience huge impacts as a result of domestic petroleum price increases because these industries are heavy consumers of petroleum products as an intermediate input in their production process.

Keywords: Input-output, Costs of Production, Manufacturing Sector, Petroleum Price, Malaysia

INTRODUCTION

Malaysia's economy, similar to that of other developing countries, depends on the use of large amounts of energy in its production sector as an intermediate input. Expansion of the manufacturing and transport sectors increased the final consumption of energy which grew at an annual rate of 7.8 percent from l,167.1

petajoules [1] (PJ) in 2000 to 1,699.8 PJ in 2005, as shown in Table 1. Among the energy types, the petroleum products are the most intensively used by the production sector accounting for about 67 percent of total energy used in 2000.

Table 1 Final Commercial Energy Demand by Source, 1995-2005

Source	1995		2000		2005	
	PJ	%	PJ	%	PJ	%
Petroleum products	676.0	72.8	804.3	68.9	1,139.1	67.0
Natural gas	81.1	8.8	120.0	10.3	184.4	10.9
Electricity	141.3	15.2	205.0	17.6	320.0	18.8
Coal and coke	29.8	3.2	37.8	3.2	55.9	3.3
Total	928.2	100	1,167.1	100	1,699.8	100

Source: Economic Planning Unit (2001)

Petroleum products, are mainly consumed locally by the industrial, transport and household sectors which as a group absorb nearly half of the total production. The industrial sector was the largest energy consumer, accounting for 37.1 percent of the total final energy demand in 2000 and increasing to 38.2 in 2005. Industries that contributed to the increase in energy consumption included the rubber, wood, glass, cement and food processing industries.

Recently, the rise in petroleum products prices was among the most topical issue in Malaysia, even though it remains relatively low in comparison to its neighbours in the ASEAN region, with the exception of Brunei. During the last two years there has been a significant rise in the domestic petroleum prices in Malaysia. Petroleum product prices for retail petrol, diesel as well as liquefied petroleum gas (LPG) was increased six times by the government between October 2004 to March 2006. Within this period of time, the price of petrol and diesel increased about 40 percent from RM 1.37 to RM 1.92 per liter and

[1]Joule is the unit of energy to establish the equivalent physical heat content of each energy form. One metajoule = 10^6 joules, one gigajoule (GJ) = 10^9 joules and one petajoules (PJ) = 10^{15} joules and one PJ = 0.0239 million tones of oil equivalent (mtoe).

from RM 0.781 to RM 1.581 per liter, respectively, as shown in Figure 1**.** The major driving factor for this increase was due to the need to reduce government subsidies resulting from the increase in crude petroleum prices in the world market. By allowing some increment in the petroleum price, the government would save RM4.4 billion a year which would be spent on development projects, particularly those involving improvement of the public transportation system.

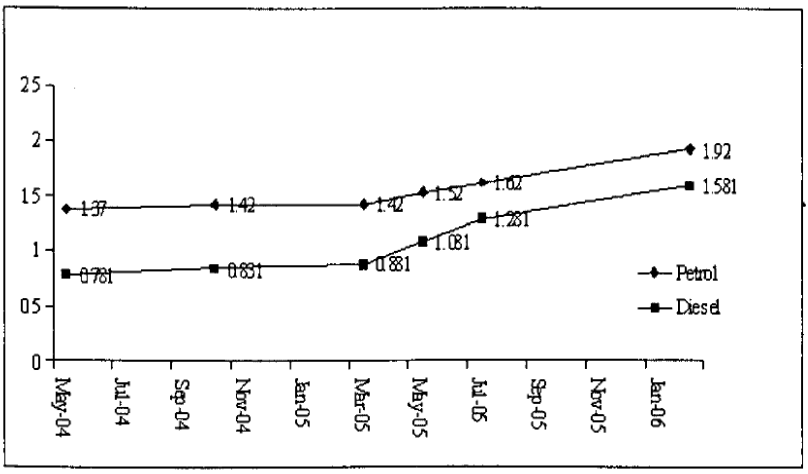

Figure 1 Increase in Petrol and Diesel Prices in Malaysia between May 2004 until February 2006

The government's decision to increase the price of petroleum products will put pressure on consumers and manufacturers. This impact of higher oil prices on the economy can be traced through direct and indirect effects. Direct impacts are the increased expenses incurred for purchase of oil or oil based products by manufacturers. On the other hand, indirect impacts include the increase in prices of other products and services resulting from the higher fuel costs being passed on by increasing, product prices. Manufactures tend to increase prices of goods and services due to increased costs of production incurred resulting from the increase in petroleum inputs prices which puts pressure on their, profit margins. The increased prices of goods will ultimately lead to inflation in the economy. However, the effect of increase in petroleum price on sectoral costs of production is dependent upon the interdependencies of the industries in the economy. Industries which consume large amounts of petroleum energy as an input in its

production process can be expected to experience major increases in production costs.

In view of the above scenario, the purpose of this study is to analyse the effects of the price increase on the costs of production in various industries in the manufacturing sector. This paper limits its scope on the manufacturing sector due to availability of sectoral price data. In this paper, we do not seek to explain the reasons underlying the increase in petroleum prices. In addressing this issue, we shall examine the effects of different scenarios of changes in the domestic petroleum price on costs of production, by employing the general equilibrium of the input-output price model which will capture both direct and indirect effects.

This paper is structured as follows. Section 2 describes the background of the petroleum industry and its linkages to Malaysia's economy. Section 3 outlines the analytical framework of the input-output price model that we have used. Section 4 discusses the data coverage associated with the study. Section 5 presents the empirical findings of the price simulations. Concluding remarks follow in section 6.

PETROLEUM INDUSTRY AND ITS ECONOMIC LINKAGES

The Petroleum industry in Malaysia can be categorized into downstream and upstream activities. The extraction of crude petroleum and natural gas activities are categorized under the downstream phase whereas the upstream phase involves manufacture of coke oven, refined petroleum products and nuclear fuel. The economy's production of crude petroleum is mainly for export, which accounts for more than 65 percent of total production. The desirability of the export market is due to the fact that the country's crude which is of superior quality, with low sulphur content (i.e. sweet and light variety), fetches premium prices compared to the world crude. Furthermore, local refineries, which only have a total capacity of about 214, 800 b/d and a utilization rate of more than 80 percent, are insufficient to deal with total production. Local refineries are increasing their activities of refining local crude. For example, in 1991, 66 percent of refining activities used local crude whereas in 2000 the proportion

of local crude refined increased to more than 78 percent.

Oil development in Malaysia can be traced back to the early 1970s. During that time, local oil exploration was carried out by multinational oil companies such as Shell and Esso. The 1974 oil price hike resulted in the petroleum sector making substantial contributions to the Malaysian economy. As a result, petroleum exports which accounted only 4 percent in 1973 increased to 7.9 percent in 1975. Subsequently it lagged behind natural rubber, the traditional number one source of foreign exchange. However, in 1980, petroleum overtook natural rubber as Malaysia's chief foreign exchange earner and till today it still remains the leading export item commanding 13.9 percent of total exports in the economy in 1987.

As the petroleum industry became increasingly important to the development of the Malaysian economy in 1970s, the government introduced the Petroleum Development Act in 1974 to ensure that the development of the petroleum industry, including the arena of activities related to petroleum, is fully in line with national interests and objectives. Under this act, the government established PETRONAS which was to be responsible for all aspects of the petroleum sector, from exploration to final sales.

Today the petroleum industry contributes significantly to the Malaysian economy. The industrial economic linkages indices in the manufacturing sector reveals that the petroleum industry is one of the key industries in Malaysia's economy, as shown in Table 2. This industry recorded high indices (above I) for both backward and forward linkages; implying that it plays an important role in economic development by supporting as well as boosting other industries in the Malaysian economy.

Table 2 Industrial Linkages Indices of the Manufacturing Sector, 2000

Industries	Linkages effects			
	Backward	Rank	Forward	Rank
1. Dairy Product	1.3046	2	0.7888	16
2. Vegetables and Fruit	1.2574	4	0.6604	26
3. Oil & Fats	1.5974		1.7925	
4. Grain Mill	1.1614	5	0.7116	21

5.	Baker Confectionery	1.0461	13	0.6932	24
6.	Other Foods	1.1371	8	0.7875	18
7.	Animal Feed	0.8889	26	1.0143	6
8.	Beverages	1.0626	11	0.6686	25
9.	Tobacco	0.8441	29	0.6376	30
10.	Textiles	0.9636	19	0.8540	10
11.	Wearing	0.9652	18	0.6524	28
12.	Sawmills	1.0744	10	0.7822	19
13.	Furniture & fixture	1.0396	14	0.6491	29
14.	Paper & printing	0.9580	20	1.1199	5
15.	Industrial chemicals	1.1611	6	1.3937	4
16.	Paints. Etc	1.1418	7	0.6603	27
17.	Other Chemical Product	0.9519	21	0.7925	15
18.	Petrol Product	1.0044	15	1.6124	2
19.	Rubber Process	1.2679	3	0.6146	31
20.	Rubber Product	0.9307	23	0.7093	23
21.	Plastic Product	0.8776	27	0.7931	14
22.	Glass Product	0.9686	17	0.7888	17
23.	Cement	1.0537	12	0.8875	9
24.	Non Metallic	1.1171	9	0.7103	22
25.	Basic Metal	0.9018	25	1.0129	7
26.	Other Metal	0.9088	24	0.9717	8
27.	Non Electric Machinery	0.7584	31	0.7516	20
28.	Electric machinery	0.8010	30	0.8336	11
29.	Motor vehicles	0.9426	22	0.8218	12
30.	Other Transport	1.0030	16	0.8162	13
31.	Other Manufacturing Product	0.8618	28	1.5140	3

Source: Input-output tables (2000)

A high backward linkage indicates that this industries' output will have a large impact on industries that supply inputs for its output. The electrical machinery, other chemical and other manufacturing products are among the industries which will get the most benefit from an increase in the petroleum industry output because they have strong connections with the petroleum industry as input suppliers. On the other hand, the forward linkages effects in the manufacturing sector reveal that the petroleum industry ranks number 2, after the oils and fats industry. This implies that it it is a significant contributor

of input for other industries' output. The oils and fats, glass, and other chemical products industries are among the industries which have been found to used substantial energy inputs from the petroleum sector in their production. Thus, based on the industrial linkages effects, the petroleum industry is shown to contribute significantly in the development of the Malaysian economy. The inter-industry linkages also point to the fact that the industry which has strong forward linkages with the petroleum industry can be expected to experience huge impacts from any increase in petroleum price because is makes intensive use of petroleum energy as an input in its production process.

INPUT-OUTPUT PRICE MODEL

The input-output price model developed by Leontief (1951) has been widely used both in developed and developing countries to analyse the nature of cost- price inter-relationships within a sectoral framework. This model is well documented in Miller and Blair (1985). Using the same approach, Han et al. (2004) investigated the potential impact of the rise in electricity rates on the Korean economy. Moreover, Valadkhani and Mitchell (2002) applied the input- output price model to assess the effects of petroleum price increases on inflation and household expenditures in Australia. While the previous studies fully applied the input-output price model, in this study we adopt the cost-based input-output model which was introduced by Mathur (1977) and later by Rashid (1989). In this model, we shall examine the impact of petroleum price on costs of production which comprises of costs of domestic materials, imported materials and labour.

Every process of production involves the use of a combinations of factors of production such as domestic materials, labour and capital. The costs of production are the value of inputs used and may be obtained by multiplying the amount of inputs used by their per unit prices (Rashid, 1989). In an input- output analysis, the input-output coefficients of a structural matrix describe the amount of inputs used per unit of output. These coefficients multiplied by the respective input prices, would give the cost of production per unit of output produced. In order to obtain per unit costs for each sector of the economy, we need as many prices as the number of sectors indicated by the tables.

Similarly, the production statement for a particular sector would have the value of purchases from other sectors. When each of them is divided by the sector's value of output, the results will give the structure of inputs used in production. Its costs of production would, therefore, equal to the sum of the products of its input coefficients and the respective per unit prices. The costs of production can be represented by:

$${}_{j}a_{ij}P_j$$

Where a_{ij} and P_j are column vector of sector *j* inputs and coefficients and the producer prices of the respective input for the total of n sectors, *i* is the sector providing inputs to sector *j*.

Cost of Production

The model has identified three component of total costs, which are domestic materials, imported input and labour. Their respective input coeffiecient matrices, namely the structural and imported inputs matrices, represent the structure of each of the first two inputs. Since labour is not normally aggregated by sectors its labour coefficient vector represents the structure of labour used in production. Based on the above formulation, the total cost of production of sector *j* output can be expressed as:

$$\Sigma_j \mathrm{P}_j a_{ij} + \quad \Sigma_j w_j L_j \; + \; \Sigma_j \quad {}^{m}P_j \quad {}^{m}a_{ij}$$

Where, a_{ij} = domestic input coefficient

L_j = labour input coefficient

${}^{m}a_{ij}$ = imported input coefficient

P_j = price of domestic input

w_j = price of labour

${}^{m}P_j$ = price of imported input

Equation (2) represents the index of per unit cost of production in sector *j* in base year. In addition, due to some limitation in the way the producer prices were provided and the manner in which the model has been developed, all prices lf inputs have to be re-expressed in index form.

Cost of Domestic Materials

Let A be the Malaysian 2000 31st order square coefficient matrix whose elements a_{ij} represent the amounts of output from sector *i* used by sector *j* in order produce one unit of output. Let us further suppose that **P** is the column vector of producer price indices of domestic materials of which elements p_{ij} being the price index for domestic materials in base year in sector *j.*

The per unit cost of each sector of the economy can then be represented as:

$$\mathbf{PA} \tag{3}$$

The elements of PA matrix show the annual costs of production for each of the *n* sectors. By multiplying the column vector of P, we get the cost of sector *j* per unit of its output in base year, which is expressed as:

$$\Sigma_j \mathbf{P}_j \mathbf{a}_{ij} \tag{4}$$

Cost of Imported Inputs

The import coefficient $^{m}a_{ij}$ represents the amount of imported input from sector *i* purchased by sector *j* in order to produce one unit of output. When multiplied by the import price of sector *j* we get the value of imported output from sector *i* purchased by sector *j* for each unit of sector *j* output. Therefore the total cost of imported inputs in year *t* for producing one unit of *j* output is the column sum of all the values of imported inputs for each unit of sector *j* output.

$$\Sigma_j {}^{m}\mathbf{P}_j {}^{m}\mathbf{a}_{ij} \tag{5}$$

Cost of Labour

The costs of labour input is treated separately because the labour coefficient, unlike the other two cost items, is represented as a vector because labour cannot be distinguished by sectors. L is the labor coefficient representing the amount of salaries and wages paid to produce one unit of sector *j* output. The annual wage rate w. gives us the value of labour used in order to produce one unit of sector *j* output. When the sectoral wage rate is multiplied by the labour

coefficients, it will give the value of labour used in order to produce one unit of the sectoral output, or simply called labour cost.

$$w_j L_j \tag{6}$$

In matrix notation, the annual cost of labour for each of the *n* sector for the entire period is obtained by multiplying the column vector of the labor coefficient by the matrix of indices of wage rate, that is:

$$\mathbf{L.W} \tag{7}$$

Where L = column vector $[L_{ij}]$ and

$W = [w_{ij}]$

Price Simulations

In our model we have determined the total per unit cost of production of each sector using three constant coefficients and variables. All the input coefficients, which are domestic material, imported inputs and labour, are treated as constants, whereas the variables are the indices of prices of inputs. Since all . the three pairs of coefficients are constants, the total per unit costs of production after price shocks can be easily determined by substituting new price vectors into base year model of equation (2). In this paper we shall simulate different scenarios of petroleum price changes to ascertain the effects on sectoral costs of production. In addition, we analyse changes in price of domestic materials only by allowing changes in the petroleum products industry (industry 18) while the rest of the price components remain unchanged, which can be re-expressed via the following equation:

$$\Sigma_j \Delta P_j a_{ij} + \Sigma_j w_j L_j + \Sigma_j^m P_j^m a_{ij} \tag{8}$$

Since we are only concerned with domestic petroleum products price effects, in all simulations, we assume that prices of the imports and labour wage rates are constant, *ceteris paribus.* In this framework, we shall simulate the impact of 30 percent, 60 percent and 90 percent increases in domestic petroleum prices on costs of production.

DATA SOURCES

In this study, we collected published data from the 2000 input-output (I-O) tables which is the latest published for Malaysia. Although the original 2000 I-O table was compiled with 92 industries, for simplicity the aggregated version of 31 industries is employed in this study. This table was compiled using new industrial classification of the Malaysian Standard Industrial Classification (MSIC) on the basis of the 1993 System of National Accounts (SNA) which is the latest international standard or compiling (I-O) proposed by the United Nations.

We also collected published data from annual issues of the Industrial Surveys as well as unpublished annual data on producer price indices for year 2000, from the Department of Statistics, Malaysia (DOS). By using the Malaysia Standard Industrial Classification (MSIC), we have reclassified the published producer price indices at two-digit level for the domestic production price while import prices are classified by the Standard Industrial Trade Classification (SITC). In cases where more than one price index (SITC) corresponds to a particular sector in the input-output table, a simple average of them represents that industry's index. They represent the input prices of production.

In estimating the wage rates for various industries, we would prefer to use the earnings figure to represent wage rates. However, due to the unavailability of such information, price of labour is now defined as the ratio of compensation of employee to the number of employees in an establishment. These prices are given in value terms which have to be converted to indices before it can be applied to the model. Further, employee compensation figures have been obtained from the published figures for year 2000 throught the survey conducted by DOS.

RESULTAND DISCUSSIONS

Petroleum is an important source of energy which is essentially used as intermediate goods. An understanding of the impact of higher energy prices requires careful consideration of its relationship with the production costs structure. It is important that the analytical framework be that of general rather than partial equilibrium. By using the expressions for calculating the costs of

production described above, Table 3 shows the result of the manufacturing indices of total costs. These indices represent the costs of production for a unit of output produced by the manufacturing sector.

Table 3 Index of Costs of Production of the Manufacturing Sector

Industries		Components of costs of production			Total costs
		Dom. materials	Imports	Labour	
1.	Dairy Product	0.1716	0.1085	0.0008	0.2809
2.	Vegetables and Fruit	0.1433	0.2692	0.0012	0.4137
3.	Oil & Fats	0.0182	0.0023	0.0001	0.0206
4.	Grain Mill	0.0672	0.0253	0.0103	0.1028
5.	Baker Confectionery	0.1714	0.2132	0.0298	0.4144
6.	Other Foods	0.1384	0.0568	0.0032	0.1985
7.	Animal feeds	0.1154	0.1960	0.0023	0.3137
8.	Beverages	0.3042	0.1359	0.0068	0.4469
9.	Tobacco	0.1211	0.2981	0.0017	0.4209
10.	Textiles	0.0481	0.0600	0.0017	0.1098
11.	Wearing	0.0598	0.0673	0.0081	0.1351
12.	Sawmills	0.0149	0.0112	0.0011	0.0273
13.	Furniture & fixture	0.0849	0.0610	0.0077	0.1536
14.	Paper & printing	0.0431	0.0457	0.0010	0.0898
15.	Industrial chemicals	0.0313	0.0245	0.0003	0.0561
16.	Paints. Etc	0.3925	0.2650	0.0060	0.6635
17.	Other Chemical Product	0.0469	0.0406	0.0015	0.0890
18.	Petroleum Product	0.0059	0.0064	0.0000	0.0124
19.	Rubber Process	0.0298	0.0337	0.0015	0.0649
20.	Rubber Product	0.0504	0.0604	0.0043	0.1151
21.	Plastic Product	0.0323	0.0733	0.0020	0.1076
22.	Glass Product	0.0917	0.0515	0.0030	0.1462
23.	Cement	0.2521	0.1793	0.0030	0.4345
24.	Non Metallic	0.1910	0.1032	0.0057	0.3000
25.	Basic Metal	0.0179	0.0348	0.0011	0.0538
26.	Other Metal	0.0474	0.0685	0.0014	0.1172
27.	Non Electric Machinery	0.0014	0.0119	0.0000	0.0133
28.	Electric machinery	0.0016	0.0059	0.0001	0.0076
29.	Motor vehicles	0.0316	0.0406	0.0006	0.0728
30.	Other Transport	0.1423	0.0609	0.0028	0.2060
31.	Other Manufacturing Product	0.0107	0.0118	0.0004	0.0228
	Total	2.8785	2.6225	0.1096	5.6106

Source: Computed from equation (2)

The table also demonstrates the cost structure for the different industries in the manufacturing sector. Overall, the domestic material inputs represent the largest amount of input used in the production for each ringgit worth of output produced. However, looking at individual sectors, half of the manufacturing sector required more imported inputs whereas the rest of the sector required high domestic material inputs. In addition, labour costs do not represent the largest proportion of the manufactures' total costs. Among the industries which incur a large proportion of domestic costs are the dairy product, oils and fats, grain mill, other foods and beverages industries. On the other hand, the vegetables and fruit, bakery confectionery, animal feeds, tobacco and textiles industries are among the industries which incure a large proportion of import costs. Since this study concerns the impact of domestic petroleum price increase, the industry which is largely dependent on domestic material inputs is expected to experience higher incidences of increase in the costs of production.

The variations in input prices are expected to show corresponding movements in the costs of production through the input-output relationship where the coefficients are fixed. Under the assumption that increases in petroleum prices do not affect labour or import prices, Table 4 displays the results of changes in cost of production resulting from domestic price level changes. The total impact on the cost of production in this table is obtained from three different price shock simulations. In the first simulation, the study allows a 30 percent increase in petroleum price, then increases of 60 percent and 90 percent for the second and third simulations, respectively.

Table 4 Changes in Index of Costs of Production Due to Changes in Domestic Petroleum Price

	Industries	Simulations					
		Simulation I[1]		Simulation II		Simulation III	
		Cost	Changes	Cost	Changes	Cost	Changes
1.	Dairy Product	0.2820	0.39 %	0.2831	0.78 %	0.2842	1.17 %
2.	Vegetables and Fruit	0.4158	0.51 %	0.4179	1.01 %	0.4200	1.52 %
3.	Oil & Fats	0.0213	3.35 %	0.0220	6.70 %	0.0227	10.05 %
4.	Grain Mill	0.1058	2.90 %	0.1088	5.79 %	0.1117	8.69 %
5.	Baker Confectionery	0.4161	0.40 %	0.4177	0.80 %	0.4194	1.20 %
6.	Other Foods	0.2008	1.16 %	0.2031	2.33 %	0.2054	3.49 %
7.	Animal feeds	0.3149	0.39 %	0.3161	0.77 %	0.3174	1.16 %
8.	Beverages	0.4482	0.28 %	0.4494	0.55 %	0.4506	0.83 %
9.	Tobacco	0.4222	0.31 %	0.4235	0.62 %	0.4249	0.94 %
10.	Textiles	0.1104	0.59 %	**0.1111**	1.18 %	0.1117	1.77 %
11.	Wearing	0.1352	0.09 %	0.1353	0.17 %	0.1355	0.26 %
12.	Sawmills	0.0280	2.53 %	0.0287	5.07 %	0.0293	7.60 %
13.	Furniture & fixture	0.1540	0.27 %	0.1544	0.55 %	0.1548	0.82 %
14.	Paper & printing	0.0908	1.07 %	0.0917	2.14 %	0.0927	3.22 %
15.	Industrial chemicals	0.0578	3.20 %	0.0596	6.40 %	0.0614	9.59 %
16.	Paints. Etc	0.6658	0.34 %	0.6681	0.68 %	0.6703	1.02 %
17.	Other Chemical Product	0.0929	4.42 %	0.0968	8.85 %	0.1008	13.27 %
18.	Petroleum Product	0.0136	10.09 %	0.0149	20.18 %	0.0161	30.27 %
19.	Rubber Process	0.0665	2.42 %	0.0681	4.85 %	0.0696	7.27 %
20.	Rubber Product	0.1177	2.26 %	0.1203	4.52 %	0.1229	6.79 %
21.	Plastic Product	0.1079	0.28 %	0.1083	0.57 %	0.1086	0.85 %
22.	Glass Product	0.1541	5.41 %	0.1620	10.82 %	0.1699	16.23 %
23.	Cement	0.4472	2.94 %	0.4600	5.87 %	0.4727	8.81 %
24.	Non Metallic	0.3027	0.91 %	0.3054	1.82 %	0.3082	2.73 %
25.	Basic Metal	0.0540	0.44 %	0.0543	0.87 %	0.0545	1.31 %
26.	Other Metal	0.1177	0.40 %	0.1182	0.79 %	0.1186	1.19 %
27.	Non Electric Machinery	0.0133	0.09 %	0.0133	0.18 %	0.0133	0.27 %
28.	Electric machinery	0.0076	0.08 %	0.0076	0.17 %	0.0076	0.25 %
29.	Motor vehicles	0.0729	0.13 %	0.0730	0.25 %	0.0731	0.38 %
30.	Other Transport	0.2066	0.30 %	0.2072	0.60 %	0.2078	0.89 %
31.	Other Manufacturing Product	0.0239	4.57 %	0.0249	9.14 %	0.0260	13.71 %
	Total	5.6676	52.52 %	5.7246	105.03%	5.7816	157.55%

Source: Computed from equation (8)

Note: [1]30 percent, [2]60 percent and [3]90 percent increases in domestic petroleum prices, respectively.

In total the manufacturers incurred 53 percent, 105 percent and 158percent increases from current cost of production level as a result of the 30 percent, 60 percent and 90 percent increases in domestic petroleum price. This implies that the cost of production in the manufacturing sector was highly affected by domestic petroleum price shocks. Looking at individual industries, the simulation results indicate that the petroleum, glass, other manufacturing, other chemical, and oils and fats products are among the top five industries which are most affected due to increase in the domestic petroleum price, in that order. If the price of petroleum increases by 90 percent more than current price levels, the cost of production of these sectors will increase up to 30 percent: petroleum (30 percent); glass (16 percent); other manufacturing (14 percent); other chemical (13 percent); and oils and fats (10 percent). The increase in the cost of production in these sectors is mainly due to interdependencies among the industries. These industries use significant proportions of petroleum as an intermediate input which has to be bought from the petroleum product industry resulting in a higher proportion of total intermediate cost. Since these industries are relatively more reliant on petroleum products, therefore an increase in petroleum price immediately impacts their production costs.

On the other hand, the results in Table 4 reveal that a major portion of the manufacturing sector is less affected by an increase in the domestic petroleum price. For example, the cost of production of the electric machinery industry only increases about 0.25 percent as a result of a 90 percent (simulation III) increase in domestic petroleum price. These industries are not much affected by the price increases because they use relatively less domestic petroleum products as an intermediate input in their production process. Indeed, these industries rely more on imported inputs rather than domestic materials as shown in the production cost structure in Table 3.

CONCLUSIONS

The paper analyses the impact of increase in domestic petroleum prices on the costs of production in the manufacturing sector. Since it employs the. input-output model as its basic framework, the study takes into account the inter-industry relationships in calculating the sectoral costs of production. Without

government interventions, the simulation results indicate that aside from its own petroleum sector, glass, other manufacturing, other chemical, and oils and fats industries will be most affected by an increase in domestic petroleum price. These sectors are most affected because, these sectors are relatively more reliant on petroleum products as an intermediate input in their production process.

The paper also found that despite half of the industries in the manufacturing sector incurring a high proportion of import cost, costs of domestic materials still represent the largest component of the manufactures' total costs. Therefore, the industry which is highly dependent on the domestic material inputs in the production cost structure will be most affected as petroleum prices increase. In addition, this study can also provide policy makers or the government information to help identify the industries which have been hit hardest by domestic petroleum price increases.

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