

Impacts of Fuel Subsidy Rationalization on Sectoral Output and Employment in Malaysia

by Arief Anshory Yusuf

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Impacts of Fuel Subsidy Rationalization on Sectoral Output and Employment in Malaysia

NOORASIAH SULAIMAN, MUKARAMAH HARUN,
AND ARIEF ANSHORY YUSUF*

Large allocations for fuel subsidies have long put the Government of Malaysia's budget under great strain. Using a computable general equilibrium (CGE) model, this paper evaluates the impact of fuel subsidy rationalization on sectoral output and employment. Employment is classified into occupational categories and skill levels. Fuel subsidies were measured using the disaggregation of prices for petrol, diesel, and other fuel products. Findings show that removing fuel subsidies would hit economic performance through high input costs, specifically for industries closely attached to the petroleum refinery sector. The manufacturing sector has the largest reduction in output and employment. Nevertheless, high- and medium-skilled labor forces experience increased demand. To increase economic efficiency, the savings from the removal of fuel subsidies should be put toward policies such as sales tax reduction. This study provides useful information for policy makers in evaluating or updating current subsidy policies to reduce economic losses.

*Noorasiah Sulaiman (corresponding author): Center for Sustainable and Inclusive Development Studies, The National University of Malaysia. E-mail: rasiahs@ukm.edu.my; Mukaramah Harun: Universiti Utara Malaysia College of Business. E-mail: mukaramah@uum.edu.my; Arief Anshory Yusuf: Center for Sustainable Development Goals Studies, Padjadjaran University. E-mail: arief.yusuf@fe.unpad.ac.id. Research for this paper was supported by the Project of Economy and Environment Program for Southeast Asia (EEPSEA-2011). We thank the managing editor and the anonymous referees for helpful comments and suggestions. The Asian Development Bank recognizes "China" as the People's Republic of China.

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I. Introduction

The high level of uncertainty over future global oil prices, which are more influenced by international market conditions than domestic factors, places a domestic economy in a very precarious position. An increase in fuel prices affects government spending on fuel subsidies in many countries, including Malaysia. The latest data reveal that government spending on fossil fuel subsidies has cost Southeast Asia \$17 billion (International Energy Agency 2017). The fuel subsidy has been identified as the primary cause of Malaysia's ballooning fiscal deficit, which threatens to make the country's economic position unsustainable (Economic Planning Unit [EPU] 2010).

Besides straining the budget, as the fuel subsidy continually raises the issue of fiscal balance (Anand et al. 2013), the subsidy boosts the demand for fossil fuels and discourages energy efficiency (Liu and Li 2011), leading to negative environmental impacts (Li, Shi, and Bin 2017) and fuel smuggling (Asian Development Bank 2016). Also, the fuel subsidy, which was primarily created to help the poor, has benefited the wealthy population more. The poorest 20% of the population get only 7% of the subsidy's benefit, while the wealthiest 20% receive a disproportionate 43% (del Granado, Coady, and Gillingham 2012).

Rapid industrialization has led to the domination of fuel usage in the industrial sector, which has made Malaysia the third-largest energy consumer in Southeast Asia (International Energy Agency 2015). Therefore, when the managed-float mechanism for fuel prices comes into effect, fuel usage for all economic activities would be based on market rates, which means those economic activities would be exposed to high fluctuating costs. High-cost burdens those domestic sectors that are dependent upon fuel and other energy products in their production processes. Thus, sectors that are characterized by large shares of fuel-based inputs would be significantly affected. Subsequently, decision-making concerning production activities will be influenced too.

The impact of oil price hikes on commercial and industrial users includes increased production costs (Middle East Economic Survey 2016). For example, in Saudi Arabia, the Saudi Cement Company expected annual production costs to rise by \$18 million due to the removal of fuel subsidies (Trade Arabia 2015). Energy price increases caused by subsidy reforms highlight that cost increases occur both directly

and indirectly (Rentschler, Kornejew, and Bazilian 2017). Notably, energy-intensive manufacturing firms experience substantial changes to their cost structures, with adverse implications for profitability (Bazilian and Onyeji 2012).

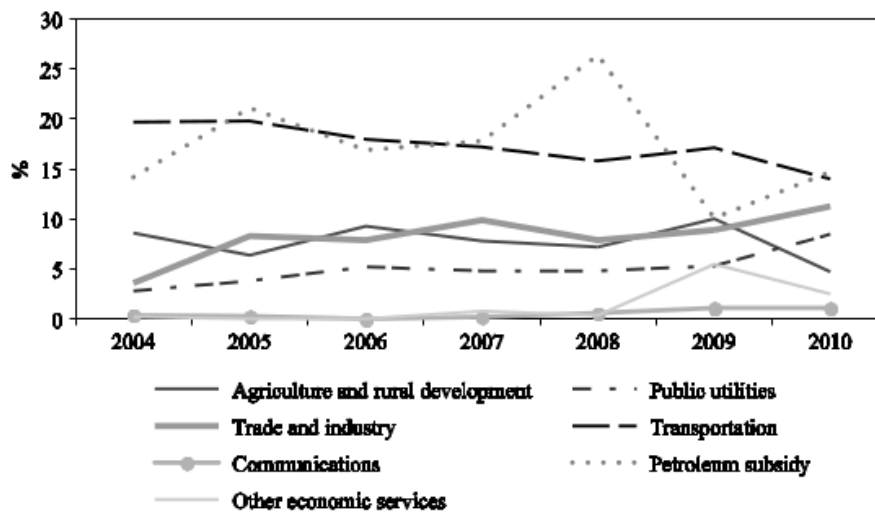
Such implications can have knock-on effects on economic activity, employment, and eventually on households (Kilian 2008). Although producers can pass on the cost to their consumers, the output is reduced due to increased production costs. Furthermore, employment decisions are impacted as high production costs lead to reduced desirability for producing more output, which lowers the demand for employment. Rentschler, Kornejew, and Bazilian (2017) highlight that cost increases (both direct and indirect) do not necessarily reflect competitiveness losses since firms have various ways to mitigate and pass on price shocks. Initially, high fuel prices are often associated with low output and, in turn, low employment. Moreover, the high costs of goods and services discourage spending by households and the government, leading to lower economic growth.

Malaysia's fiscal capacity runs at an unsustainable level as subsidies to maintain low fuel prices constitute a huge portion of the government's annual budget. The country must run a fiscal deficit when excessive spending on subsidies has to support rising fuel prices. When the crude oil price hovers between \$65 and \$85 per barrel under normal circumstances, the estimated fuel subsidy is between 9 billion ringgit (RM) and RM11 billion per annum (EPU 2008). When the crude oil price peaked in 2008 at more than \$100 per barrel, the Malaysian government's total fuel subsidy was RM15 billion (EPU 2008).

Figure 1 shows that the petroleum subsidy comprised a large percentage of public spending in Malaysia from 2004 to 2010, ranging from a low of 10.1% to a high of 26.4% in 2008. It is more than the combined total spending on agriculture and rural development, health, and housing, which are all critical to the country's development. The fiscal deficit, which was about 2.7% in 2007, climbed rapidly to 7.0% in 2009 as a result of the global oil price spike and its impact on the cost of fuel subsidies (EPU 2010). The large substitution effect of the petroleum subsidy can be seen by comparing it to other sectors. In other words, it indicates that a potentially high amount of savings from a cut in the petroleum subsidy can be utilized for other policy priorities that can have potentially more benefit for the Malaysian people.

Subsidy reforms and their impact have been thoroughly examined in developed and developing countries (Clements et al. 2014). These studies have emphasized welfare effects by looking at the distributional impact of fuel subsidy reform on households. These investigations have been conducted in developing countries (del Granado, Coady, and Gillingham 2012) such as Indonesia (Yusuf and

Figure 1. Petroleum Subsidy Expenditure as a Share of Total Government Spending in Malaysia



Source: Ministry of Finance, Government of Malaysia. 2011. *Malaysia Economic Reports 2004/05–2010/11*. Putrajaya.

Resosudarmo 2008) and Malaysia (Solaymani and Kari 2014; Li, Shi, and Bin 2017). Even though prior studies have investigated the potential adverse effects of fuel subsidy reform on households, research on the energy industry's impact is still required. Hence, this study aims to analyze the impact of fuel subsidy removal on the energy industry, specifically on sectoral output and employment (according to skill and occupation), by considering macroeconomic performance.

This study contributes to the current literature based on three perspectives. First, this study contributes via a comprehensive examination of the fuel subsidy removal's impact on the sectoral output and employment by classifying fuel into petrol (gasoline), diesel, and other fuels. Next, by extending the impact on labor into occupational categories and skill levels, this study also observes the impact of fuel subsidy removal on aggregate employment according to occupations and skills. The final aspect pertains to the model's contribution via incorporating a detailed description of the labor market's structure in the economy through nine occupational categories and three skill levels.

The remainder of this paper is structured as follows. Section II explains the database and labor classifications applied in the model. Section III describes the methodology, model validation, benchmark scenario, and simulations. Section IV presents the results and discussion, and Section V concludes.

II. Data

This study uses the 2005 Malaysia Input–Output (IO) Table consisting of 120 industries and commodities (Department of Statistics Malaysia 2010). We disaggregated the subsector of petroleum refinery into three types of fuel commodities: petrol, diesel, and other fuel products (liquified petroleum gas, coke, and gas), thus bringing the total to 122 industries (see Table A1 of the Appendix). The disaggregation is based on the Malaysian Standard Industrial Classification (Department of Statistics Malaysia 2000), while the fuel share is based on the National Energy Balance (Energy Commission 2005). The disaggregation is in line with the subsidy provided according to fuel products,

Table 1. Database of the Computable General Equilibrium Model

	Extension	Matrix	Sector				
			Producer	Investor	Household	Export	Government
			1–122	1	1	1	1
Basic flows of intermediate inputs, domestic		122 × 122	V1dom	V2dom	V3dom	V4dom	V5dom
Basic flows of intermediate inputs, import		122 × 122	V1imp	V2imp	V3imp	V4imp	V5imp
Taxes		1 × 122	V1tax	V2tax	V3tax	V4tax	V5tax
Labor	Occupational category	9 × 122	V1lab				
	Skill levels	3 × 122					
Capital		1	V1cap				
Land		1	V1lnd				
Other costs		1	V1oct				

V1dom = domestic intermediate goods, V2dom = domestic investment, V3dom = household domestic consumption, V4dom = domestic production on export, V5dom = domestic government expenditure, V1imp = imported intermediate good, V2imp = investment on imported capital, V3imp = household consumption on import, V4imp = imported goods, V5imp = government expenditure on import, V1tax = taxes on producer, V2tax = taxes on investor, V3tax = taxes on household, V4tax = taxes on export, V5tax = taxes on government expenditure, V1lab = labor, V1cap = capital, V1lnd = land, and V1oct = other costs.

Source: Noorasiah Sulaiman and Mukaramah Harun. 2015. “Valuing the Impact of Rationalizing Malaysia’s Fuel Subsidies on its Macroeconomic Performance.” In *Economy-Wide Analysis of Climate Change in Southeast Asia: Impact, Mitigation and Trade-Off*, edited by A.A. Yusuf, Arvin Hemanto, A.R. Irlan, K. Ahmad, N. Sulaiman, and M. Harun, pp. 146–201. Los Banos: WorldFish and Economy and Environment Program for Southeast Asia.

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Table 2. Classification of Labor

Skill Level	Occupational Category	Job Description
High	1	Senior officials and managers
	2	Professionals
	3	Technicians and associate professionals
Medium	4	Clerical workers
	5	Service workers
	6	Skilled agriculture workers
	7	Craft workers
	8	Plant and machine operators
Low	9	Elementary workers

Source: Ministry of Human Resources, Government of Malaysia. 2008. *Malaysia Standard Classification of Occupations, 2nd Edition*. Putrajaya.

i.e., petrol for passenger vehicles, and diesel and other fuel products for non-passenger vehicles.

Table 1 presents the database that comprises production, primary factors, and final demand components, as well as detailed labor variables. The rows in the matrix represent the supply side. In particular, the table presents linkages among economic activities such as the relationships among production value, production cost, selling price, market clearing conditions for the commodity, primary inputs, other macro indicators, and the price index.

This study develops and includes an extension of the employment matrix, according to occupations and skills in the Malaysia IO Table, to analyze the impact of fuel subsidy removal on employment across subsectors. Employment data are obtained from the Labour Force Survey 2005 (Department of Statistics Malaysia 2006). As shown in Table 2, labor is classified into nine occupational categories and skill levels based on the Malaysian Standard Classifications of Occupation (Ministry of Human Resources 2008) and Sulaiman and Ismail (2019).

III. Methodology

The computable general equilibrium (CGE) model used in this study is based on the generic (ORANI-G) CGE model developed by Horridge (2006). The programming utilizes the General Equilibrium Modelling Package to analyze the impact of subsidy removal on sectoral output and employment according to occupation and skill. In this study, a static CGE model is developed, which includes the assumption that the

subsidy will be returned to the economy, so that aggregate employment remains constant. Thus, the analysis focuses on the structural implications of subsidy removal on sectoral output and employment growth.

The model is calibrated according to subsidy removal by fuel types, whereas employment is based on occupation and skill. The inclusion of occupation and skill into the Malaysia IO Table, and thus into the CGE model, allows the in-depth realization of the impact of fuel subsidy removal on output and employment growth. In analyzing the impact of the labor market in the CGE model, further assumptions are made (Meagher, Adams, and Horridge 2000). The demand side of the labor market assumes that labor by occupational type is demanded by industry according to constant elasticity of substitution (CES) functions. Meanwhile, the supply side assumes that labor is supplied according to the constant elasticity of transformation functions. Thus, both labor demand and supply are supposed to be in equilibrium. Similar labor skills are assumed substitutable among industries, and relative wage rates are assumed to adjust to clear labor markets by occupation.

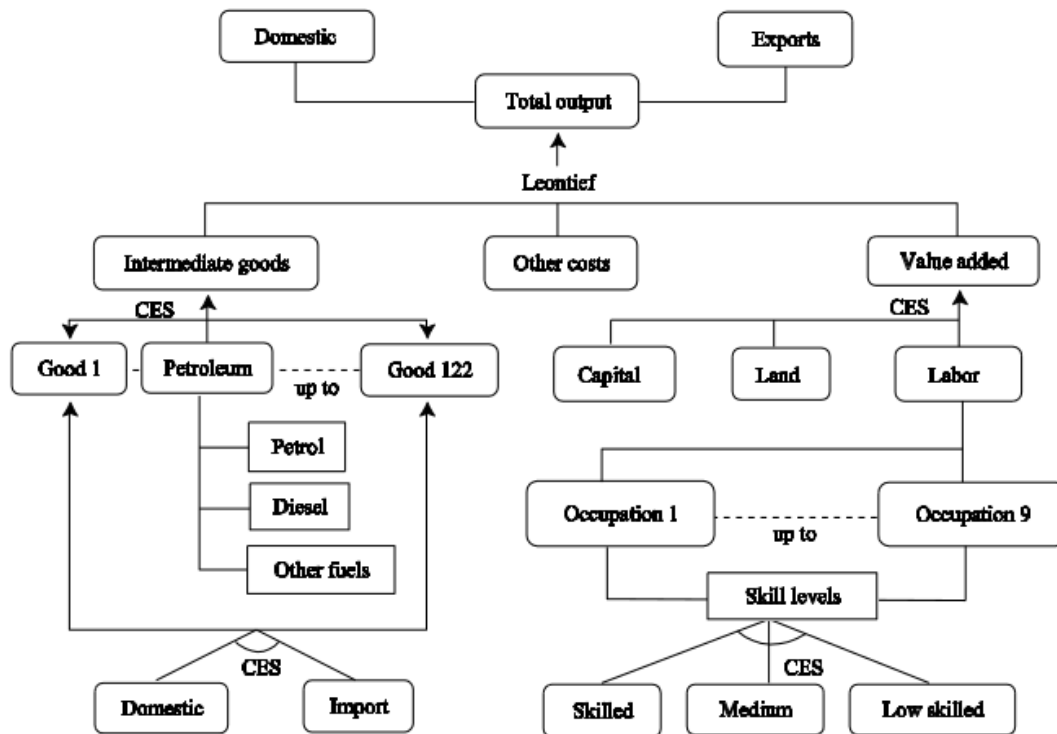
Since a fuel price increase is an endogenous variable, it would not directly affect output and employment among industries. The subsidy's removal would indirectly affect production. As this study analyzes subsidy removal on fuel commodities, removal of the subsidy would increase cost in terms of transportation due to diesel and other fuel products used for non-passenger vehicles. Output and employment would remain high in moderately competitive industries, with both falling in the least competitive ones.

The cost saving from subsidy removal is assumed as aggregate x revenue from all indirect taxes. The cost-saving return to households via cash transfer alleviates the increased cost of living, specifically among low-income households. Household spending would increase as a result of the cash transfer, resulting in higher aggregate demand.

Therefore, growth in aggregate demand would impact output and employment among subsectors of the economy. The price elasticities of demand are expected not to respond to fuel demand in the short run because the endogenous shock of the fuel price increase has a smaller impact on demand for fuel products from economic subsectors and households.

Nevertheless, demand for fuel can be elastic, as all inputs can be changed in the long run. In developing countries, cash transfer programs are now more prevalent, both as long-term poverty alleviation measures and to lessen the adverse effects of certain types of reforms that may impact the poor. It has been successful to use these transfers to reform fuel subsidies. Yusuf (2018) found that cash transfers funded by cost savings in fuel subsidies minimize disparity in Indonesia more than other approaches.

Figure 2. Nested Production Structure



CES = constant elasticity of substitution.
Source: Authors' illustration.

Figure 2 presents the production function of the model, based on a nested production system. With the assumption of the CES functions, industries are supposed to choose a mix of inputs that minimize production costs for their output level when different CES production technologies are assumed. The industry's output is classified into domestic and export. Both require intermediate goods, primary factors, and other costs in their production process.

Fuel subsidies are implemented into the model through net indirect taxes of fuel products (petrol, diesel, and other fuels). Removal of the subsidy would result in higher fuel prices that impact other sectors of the economy, especially those using fuel more extensively. For household consumption, the model adopts the linear expenditure system demand function derived from the maximization of a Klein–Rubin (1947) utility function, which distinguishes between necessary and luxury demand goods (Pollack and Wales 1992).

The next level of the primary-factor branch of the production nest consists of a CES combination of labor, capital, and land. At the lowest level, the industry- and occupation-specific labor demand are combined using a CES production technology to

obtain the occupation-aggregated labor input. Labor by occupational categories is represented by occupation 1 to occupation 9 and then classified into three skill levels.

The labor market extension in the CGE modeling techniques relies on the strength of its capacity to consider available information on the structural linkages between industries, occupations, and skills. Therefore, the model has a significant feature of disaggregated employment into occupational categories and skill levels to examine the impact of distributed labor demand and the output production across industries by three types of fuel products.

A. Impacts of Fuel Subsidy Removal

The demand function is contingent on the impacts of energy disaggregated into diesel, petrol, and other fuel. Specified as follows, the elasticity of demand in a constant estimation with a range of parameters is

$$c = b^\varepsilon. \tag{1}$$

Therefore, we can express that as

$$\Delta c = \varepsilon(B_1 - B_0). \tag{2}$$

Meanwhile, the impact of household utilization is determined by the equation

$$\Delta c = C_1 - C_0, \tag{3}$$

where Δc is the change in energy consumption when the fuel price increases; ε is the long-run price elasticity of energy demand; B_0 and C_0 indicate the price of energy and its consumption before the subsidy removal policy, respectively. The B_1 and C_1 refer to the price of energy and its consumption after the subsidy removal policy.

B. Employment Impacts

It is assumed that all production factors are variable. Producers can rent capital and land in the agriculture sector. Intermediate inputs of capital and land are assumed fixed between industries. Production specifications for the model are nested. Demand for inputs for each industry (j) is determined by the cost-minimizing function subject to Leontief’s production function in equation (4). Inputs in the production structure are composite commodities (i) ($h + 1, s$), intermediate inputs, and other costs ($h + 2$).

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Therefore, the production function is

$$\text{Leontief} \left\{ \frac{I_{iy}^1}{T_{iy}^1} \right\} = T_j^1 A_j, \quad (4)$$

where

I_{iy}^1 is an effective input for good i for current production in industry j ,

A_j is the level of activity for industry j , and

T_y^1 and T_j^1 are the coefficients for technological change.

Based on equation (5), composite commodity I_{iy}^1 is used in every industry with a combination of export and import goods based on the CES technology. Primary input $I_{(h+1,x)j}^1$ also includes a combination of labor, capital, and land integrated based on the CES technology. The CES technology refers to the combination of exported and imported commodities, which explains that these two sources are imperfect substitutes for input demand that vary according to relative price changes:

$$I_{iy}^1 = \text{CES}_{\alpha=1,2,3} \left\{ \frac{I_{(h+1,x)j}^1}{T_{(h+1,x)j}^1} \right\} \quad \begin{array}{l} i = 1, \dots, h \text{ (} h \text{ is differential in production),} \\ j = 1, \dots, h \text{ (} h \text{ is differential in industries).} \end{array} \quad (5)$$

The CES specification allows for an inter-labor replacement for the primary factors' composite and intermediate inputs, depending on price changes relative to skill level. In the input demand function, the production of each industry's output level and the input price (excluding the composite labor demand) are exogenous factors. Consequently, minimizing costs can be solved with the input functions in the form of percentage change by choosing the following equation:

$$I_{ij}^1, I_{(ix)j}^1, I_{(h+1,x)j}^1, I_{(h+1,1,n)j}^1. \quad (6)$$

To minimize,

$$\begin{aligned} & \sum_{i=1}^h \sum_{x=1}^2 P_{(ix)j}^1 I_{(ix)j}^1 + \sum_{n=1}^n P_{(h+1,1,n)j}^1 I_{(h+1,1,n)j}^1 \\ & + \sum_{x=2}^3 P_{(h+1,1,x)j}^1 I_{(h+1,1,x)j}^1 + P_{h+2}^1 I_{h+2,j}^1. \end{aligned} \quad (7)$$

I_{ij}^1 is the demand for effective intermediaries and primary inputs for industry j ;

$I_{(ix)j}^1$ is the demand for intermediate inputs for import and export in industry j ;

$I_{(h+1,x)j}^1$ is the demand for primary factor input for industry j , including the capital, labor, and L ;

$I_{(h+1,1,n)j}^1$ is the demand for labor for types of skill levels for industry j ;

$P_{(ix)j}^1$ is the price for the intermediate input of import and export;
 $P_{(h+1,1,n)j}^1$ is the price for the primary factor s for industry j ; and
 P_{h+2}^1 is the price for other costs.

The function of demand for primary factors in equation (8) exhibits an increase in industry j , following the average cost of labor, capital, and land, and causing replacement factors:

$$I_{(h+1,s)j}^1 = y_j - \sigma_{(h+1,s)j}^1 \left(P_{(h+1,s)}^1 - \sum_x F_{(h+1,s)j}^1 P_{(h+1,s)j}^1 \right) + c_j^1 + c_{h+1,j}^1 + c_{(h+1,s)j}^1 - \sum_x F_{(h+1,s)}^1 c_{(h+1,s)j}^1 \tag{8}$$

$F_{(h+1,s)}^1$ is the share of labor, capital, and land for the payment of primary factor inputs in industry j .

Equation (9) is a demand function of labor according to skill level. It also includes changes in technical variables. In the absence of technological changes, an increase in labor price for specific skills relative to other skilled labor costs will increase the consumption of such labor more slowly than other labor:

$$I_{(h+1,1,r)j}^1 = x_{(h+1,1)j} - \delta_{(h+1,1,r)j}^1 \left(P_{(h+1,1,r)j}^1 - \sum_r F_{(h+1,1,r)j}^1 P_{(h+1,1,r)j}^1 \right) + c_{(h+1,1,r)j}^1 - \sigma_{(h+1,1)j}^1 \left(c_{(h+1,1,r)j}^1 - \sum_r F_{(h+1,1,r)j}^1 P_{(h+1,1,r)j}^1 \right), \tag{9}$$

$j = 1, \dots, h.$

$F_{(h+1,r)}^1$ is the share of costs for labor (at a skill or occupational level).

This can be explained as

$$F_{(h+1,1,r)j}^1 = \frac{P_{(h+1,1,r)j}^1 I_{(h+1,1,r)j}^1}{\sum_{r=1}^n P_{(h+1,1,r)j}^1 I_{(h+1,1,r)j}^1} \tag{10}$$

δ_{ij} denotes the elasticity of substitution between imported goods. Meanwhile, domestic goods are the input for the production in industry j . Therefore, this specifies that if the cost of any one source increases, it will cause a relative decrease in the input demand of that particular source.

C. The Closure

The conditions give the closure of the model on the (i) government balance and (ii) saving–investment balance. The government balance follows the condition that

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saving is endogenously determined as the difference between the government's disposable income and total expenditure. The saving–investment balance condition requires that investment is saving-driven, with gross fixed investment that derives from the sum of aggregate saving. The real exchange rate can be flexible, while gross saving and interest rates are fixed in nominal terms.

Government consumption and public transfers to households are fixed. Furthermore, investment, the nominal exchange rate, government saving, and real investment expenditure are also considered endogenous. Labor at three skill levels and nine occupational types are mobile across subsectors, and capital supply is exogenously fixed. Endogenous factor prices clear the corresponding labor and capital markets, so there is no unemployment model. The model results must be considered short term since the model is static with a fixed total factor supply.

D. Parameter and Model Validation

This study sets out the parameters of the model. The parameters are Armington elasticities between domestic and imported commodities for different CES functions for intermediate-use investment demand and household demand obtained from the *Global Trade Analysis Project* (2008). The parameters also include commodity-specific export elasticities, constant elasticity of transformation between domestic and export supply commodities from the ORANI-G model (Horridge 2006), and the elasticities of substitution between labor types by skill level utilized from the literature (Meagher, Adams, and Horridge 2000). Sensitivity analysis is done for each elasticity parameter, and the results show that the models are not sensitive to the value for different parameters.

The model's calibration is accomplished by a validation test to verify database construction, specifying the equations and closure of the model. The model establishes a validation test for the implementation of the CGE model (Horridge 2006). First, this study has performed the nominal and real homogeneity tests. The test considers the system of equations, and economic agents respond to the changes according to the relative prices, not the absolute price level. The results imply that if all exogenous nominal variables of the model change, then all endogenous nominal variables will also change, while real variables remain unchanged. Likewise, if all real exogenous variables of the model change, then all real endogenous variables will change, while nominal variables remain unchanged.

Second, the model should pass a conditional balance equal to gross domestic product (GDP) from the income and expenditure sides. Thus, the percentage changes

in GDP are uniform. Third, the zero-profit condition test is performed with the total cost of output equal to the total sale of commodities.

E. Benchmark Scenario and Simulations

The model simulation is outfitted with CES production and utility functions, with indirect taxation affecting inputs, and consumption as the subsidy is removed through the increase in prices. As an endogenous variable, the percentage change in prices can be used to simulate the impacts of different policy scenarios in the CGE model (Horridge 2006). Moreover, the endogenous variable of the price is used to determine a subsidy removal on the fuel commodities.

For efficiency in fuel consumption and real cost for the industry, this study developed a benchmark scenario used as a baseline for the model. The benchmark of the scenario is based on the price increase for petrol and diesel from the Means of Platts Singapore, which is a calculation of petrol prices done by a company based in Singapore called Platts. The retail prices of petrol and diesel in Malaysia are determined through the automatic price mechanism, ensuring that the difference between retail and actual prices is borne by subsidies and sales tax exemptions (EPU 2005).

In this study, we calculate the price changes in petrol and diesel as practiced in Malaysia. As shown in Table A2 of the Appendix, the price increases in petrol and diesel are considered as the base case and alternative scenarios. For petrol, the subsidized rate is RM1.62 per liter. Without the subsidy, the actual cost would be RM2.45 per liter. Hence, the government is bearing 83 sen: 59 sen in foregone taxes and 24 sen in subsidies.¹ On the other hand, the retail price is RM1.28 per liter for diesel, but the actual cost is RM2.07 per liter. Thus, the subsidy is 59 sen per liter with a foregone tax of 20 sen per liter. Besides, the unsubsidized price for other fuels (e.g., liquified petroleum gas) is higher (i.e., RM2.39 per kilogram), but the retail price is only RM1.45 per kilogram, and the subsidy is 94 sen (EPU 2005).

The level of price increase in fuel products affects government spending on subsidies. Based on this situation, the fuel subsidy will be markedly higher, especially when the fuel price per barrel has increased remarkably. The alternative scenario considers the largest price increase to reflect the highest percentage when the subsidy is removed. Table A2 of the Appendix shows that when the increase in fuel is larger than \$100 per barrel, the subsidized petrol and diesel are RM2.70 and RM2.58 per

¹The Malaysian ringgit is divided into 100 sen.

Table 3. Subsidy Removal Simulations for Petrol, Diesel, and Other Fuels

Simulation	Base Case Scenario	Description
SIM1	f0tax_s("C44aPetrol") is increased by 10%	25 sen per liter subsidy removal for all users of petrol
SIM2	f0tax_s("C44bDiesel") is increased by 10%	25 sen per liter subsidy removal for all users of diesel
SIM3	f0tax_s("C44cOthFuel") is increased by 10%	25 sen per liter subsidy removal for all users of other fuel products
Simulation	Alternative Scenario	Description
SIM1	f0tax_s("C44aPetrol") is increased by 30%	RM1.32 per liter subsidy removal for all users of petrol
SIM2	f0tax_s("C44bDiesel") is increased by 40%	RM1.70 per liter subsidy removal for all users of diesel
SIM3	f0tax_s("C44cOthFuel") is increased by 30%	RM1.32 per liter subsidy removal for all users of other fuel products

RM = Malaysian ringgit, SIM = simulation.

Source: Authors' calculations based on data from the Department of Statistics Malaysia, Government of Malaysia. 2010. *Malaysia Input-Output Tables 2005*. Putrajaya.

liter, respectively, representing 30% and 40% of the subsidy removal. Table 3 presents two scenarios that are examined in this study. In each scenario, three different simulations are designed (i.e., for petrol, diesel, and other fuels). In the base case scenario, the subsidy removal starts with a 10% increase in prices; the simulation of fuel products can be seen in SIM1 (petrol), SIM2 (diesel), and SIM3 (other fuels). The minimum 10% removal in subsidy per liter is chosen as the base model benchmark to observe the general impact. It is represented by a minimum subsidy removal of 25 sen per liter of fuel consumed for petrol, diesel, and other fuels.

Furthermore, it is crucial to examine the extent to which the policy instrument of subsidy is fully removed to ensure a competitive market. Without the subsidies, the prices for petrol and diesel are higher by 30% and 40%, respectively. Prices with those subsidies correspond to the largest amount that the government commits for subsidies.

IV. Results and Discussion

The results on the impact of demand for labor are analyzed in two stages. First, the macroeconomics scenario is discussed for the selection of macro variables. At the macro level, by conducting each simulation, employment growth is determined according to occupational categories and skill levels. At the sectoral level, labor is

aggregated into the employment rate to determine the impact of subsidy removal on employment growth. Similarly, at the subsector or industrial level, subsidy removal is analyzed based on the type of fuel product to examine the impact on employment and output growth. Price elasticities of demand for fuels at the sectoral level are also estimated.

A. Key Results

Table 4 presents the base case scenario and the alternative scenario of subsidy removal for selected macro variables and employment by occupation type and skill level. The impacts of each scenario can be seen in the aggregate employment level by occupational category and skill level. The base case scenario assumes a price increase of 10% for each fuel commodity. In contrast, the alternative scenario is based on fuel price increases of 30% (petrol) and 40% (diesel and other fuels). In both scenarios, the results for all simulations (SIM1: petrol, SIM2: diesel, SIM3: other fuel products) indicate that the price has increased for all users.

As the table shows, the fuel subsidy's reduction by 10% of the fuel price increase positively impacts macroeconomic variables for GDP, exports, and imports. GDP (in real terms) increases by 0.05% for SIM1 and SIM2, whereas for SIM3, it increases by 0.04%. Similar results are obtained for the alternative scenario, where the subsidy reductions are 30% (petrol) and 40% (diesel and other fuels) of the fuel price increase. GDP increases by 0.139% (SIM1), 0.185% (SIM2), and 0.119% (SIM3). Likewise, the increase in exports rises from 0.244% with a 10% fuel subsidy reduction to 0.721% with the fuel subsidy's full removal (SIM1), from 0.258% to 1.007% (SIM2), and from 0.205% to 0.608% (SIM3). The gain in imports also increases from 0.243% with a 10% fuel subsidy reduction to 0.73% with the fuel subsidy's full removal (SIM1), from 0.256% to 1.030% (SIM2), and from 0.204% to 0.613% (SIM3). A similar study by Solaymani and Kari (2014) also found that removing energy subsidies increases real GDP. However, total exports and imports decline, which is the opposite of the results obtained from this study.

On the other hand, household consumption and government expenditure are impacted negatively under the base case and the alternative scenarios. Household consumption under a 10% fuel subsidy reduction falls by 0.035%, 0.036%, and 0.043% for SIM1, SIM2, and SIM3, respectively. Similarly, government expenditure drops by 0.132%, 0.139%, and 0.111%, respectively. Nevertheless, both variables show a larger contraction for the alternative scenario (full subsidy removal). The larger decline in household consumption indicates that the cash transfer program does not fully compensate for a higher cost of living due to the rising prices of goods and services brought about by the increase in fuel prices.

Table 4. Key Results for Selected Macro Variables (%)

Macroeconomic Variable	Base Case Scenario			Alternative Scenario		
	SIM1	SIM2	SIM3	SIM1	SIM2	SIM3
GDP (real)	0.051	0.053	0.043	0.139	0.185	0.119
Household expenditure	-0.035	-0.036	-0.029	-0.103	-0.143	-0.088
Government expenditure	-0.132	-0.139	-0.111	-0.387	-0.537	-0.327
Exports	0.244	0.258	0.205	0.721	1.007	0.608
Imports	0.243	0.256	0.204	0.730	1.030	0.613
Skill Level	Employment by Occupation					
High						
	0.170	0.180	0.143	0.506	0.710	0.427
1. Senior officials and managers	0.164	0.173	0.138	0.487	0.682	0.410
2. Professionals	0.120	0.127	0.101	0.356	0.497	0.300
3. Technicians and associate professionals						
Total	0.454	0.480	0.382	1.349	1.889	1.134
Medium						
	0.158	0.167	0.133	0.469	0.657	0.396
4. Clerical workers	0.181	0.191	0.152	0.537	0.752	0.452
5. Service workers	0.152	0.161	0.128	0.453	0.634	0.381
6. Skilled agriculture workers	0.126	0.133	0.106	0.373	0.521	0.314
7. Craft workers	0.119	0.126	0.100	0.352	0.492	0.297
8. Plant and machine operators	0.736	0.778	0.619	2.184	3.056	1.526
Total	0.150	0.158	0.126	0.444	0.621	0.374
Low						
	0.150	0.158	0.126	0.444	0.621	0.374
9. Elementary workers						

GDP = gross domestic product, SIM = simulation.

Source: Authors' calculations based on data from the Department of Statistics Malaysia, Government of Malaysia. 2010. *Malaysia Input-Output Tables 2005*. Putrajaya.

All results rely upon the assumption of providing extra revenue to households through cash transfers to lower the cost of living. The results highlight that Malaysia's budget is distributing the cash transfers otherwise to other production factors. A positive sign for real GDP implies that the fuel subsidy's removal would reduce the government's budget and positively affect productive sectors. Specifically, the removal of the diesel subsidy has a larger impact, as shown by SIM2, compared to the removal of the subsidy for petrol (SIM1) and other fuels (SIM3).

Table 4 also shows that the aggregate demand for labor (the employment aspect) has recorded positive signs by occupational categories and skill levels. In the base case scenario, employment expansion for all types ranges from 0.100% to 0.191%; under the alternative scenario, it ranges from 0.297% to 0.752%. Specifically, diesel subsidy removal (SIM2) would significantly impact aggregate employment expansion for all skill levels and occupational categories. Furthermore, the service worker category experiences significant employment expansion.

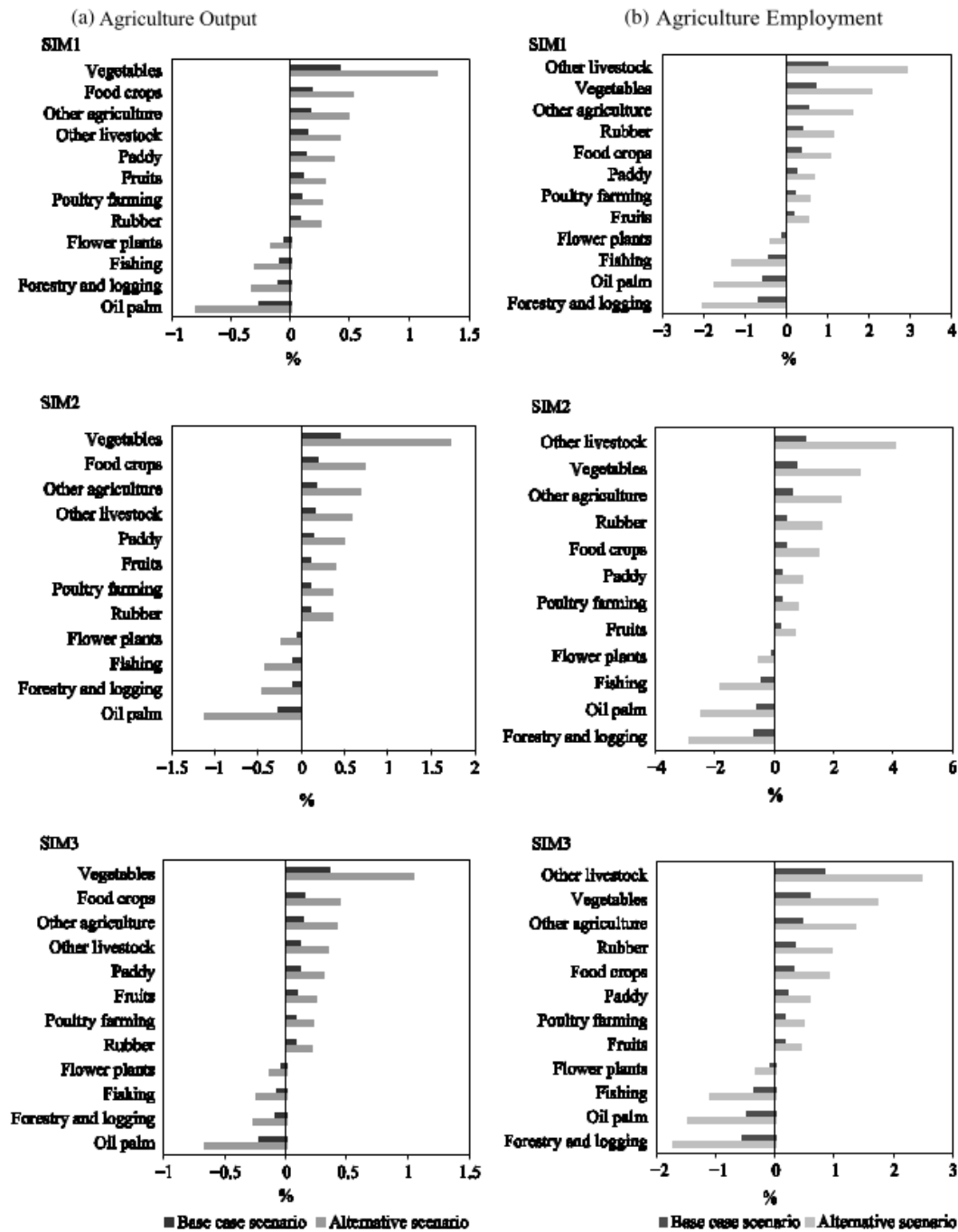
B. Output and Employment Effects

Rationalizing fuel subsidies would have a significant impact on industries. In the second stage of focusing on output and employment growth by type of industry, capital growth and technical change are constant when production costs increase. With a larger subsidy removal for fuel commodities, the additional cost to industry will directly affect output and labor usage. On the other hand, an industry with a relatively high rate of return will attract investment and enjoy a relatively high capital growth rate. As a result, a relatively low percentage of employment growth is achieved for a given rate of output growth. Also, for labor-intensive industries, employment expansion will increase labor productivity.

Since this study concentrates on the mitigation scenario to see the maximum impact of subsidy removal, the alternative scenario is given priority in the discussions. Hence, the relative growth (both positive and negative) in the base case scenario would always be a benchmark to examine the mitigation's impact in general. Thus, the relative growth rates in the alternative scenario are quite similar to those in the base case scenario. For all simulations, subsidy removal shows a contraction in output and employment for most of Malaysia's economic subsectors. The output and employment contractions range from 0.005% to 0.582% and from 0.011% to 3.951% for the base case scenario. Moreover, the alternative scenario registers larger contractions from 0.025% to 2.425% for output and from 0.051% to 14.484% for employment.

Figure 3 presents the output and employment effects for each scenario according to subsectors based on the findings for SIM1, SIM2, and SIM3. Within the agriculture

Figure 3. Agriculture Sector: Output and Employment



Source: Authors' calculations based on data from the Department of Statistics Malaysia, Government of Malaysia, 2010. *Malaysia Input-Output Tables 2005*. Putrajaya.

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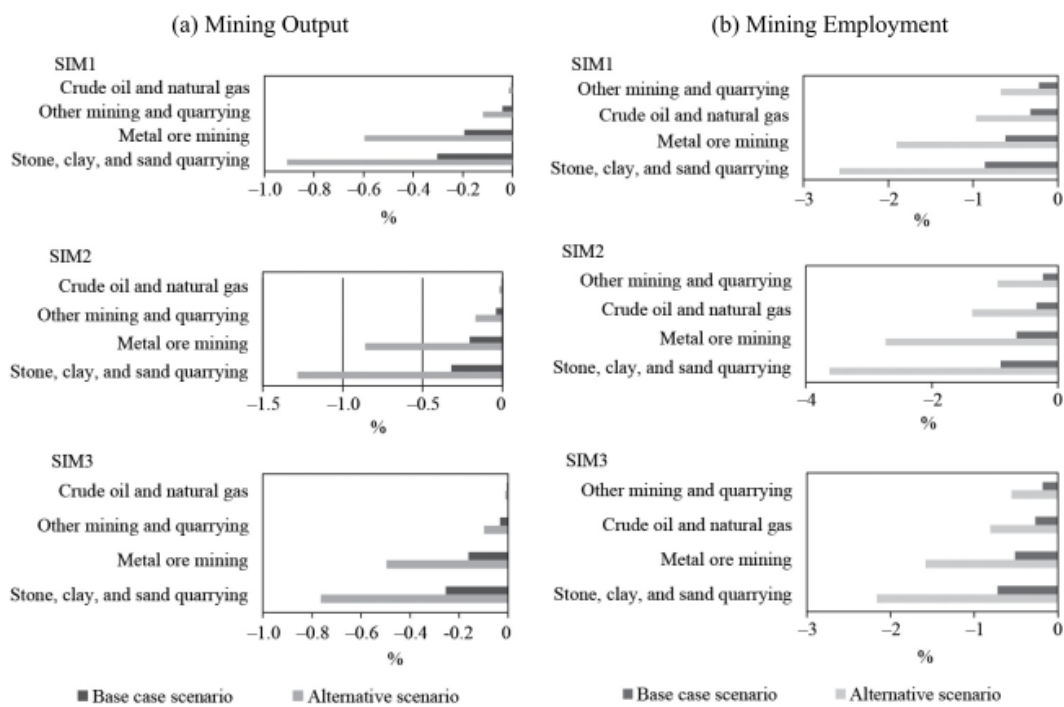
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sector, the oil palm subsector shows the largest contraction in output and a significant reduction in employment for all the simulations in the base case scenario. Similar results are obtained for the alternative scenario. All simulations have a larger impact on output and employment, with the largest contraction belonging to SIM2 (petrol). It shows a contraction of 1.141% for output and 2.505% for employment. However, the forestry and logging subsector have the largest contractions in employment at 0.678% (SIM1), 0.717% (SIM2), and 0.569% (SIM3). Thus, despite the adverse impact of subsidy removal, there are also some positive impacts on output and employment.

A positive impact on output and employment can be seen in subsectors such as vegetables, food crops, other agriculture, other livestock, paddy, fruits, poultry, and rubber. For all simulations in the alternative scenario, the growth in output ranges from 0.029% to 1.721%, while employment growth ranges from 0.430% to 4.062%. The findings indicate that employment growth is relatively larger than the output growth for all simulations in the alternative scenario.

In Figure 4, all subsectors of the mining sector suffer from the fuel subsidy's removal. It highlights the marginal impact on output and employment ranging from -0.635% to 0.617% and from -1.070% to 1.056%, respectively. The stone, clay, and

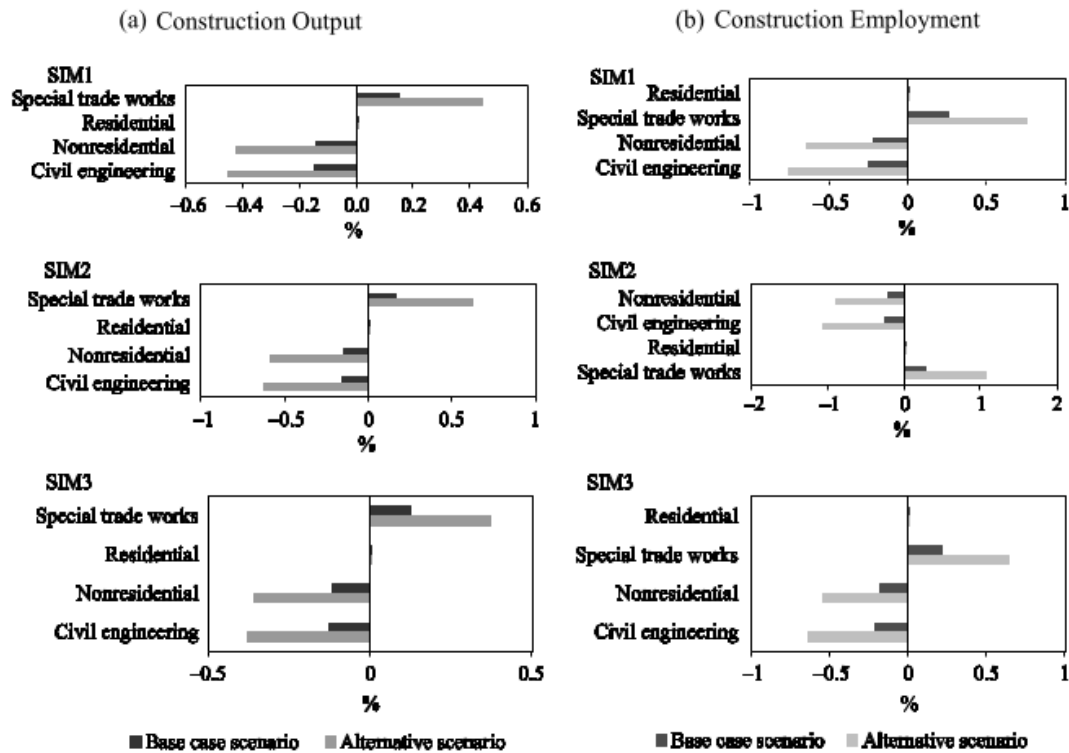
Figure 4. Mining Sector: Output and Employment



Source: Authors' calculations based on data from the Department of Statistics Malaysia, Government of Malaysia. 2010. *Malaysia Input-Output Tables 2005*. Putrajaya.

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Figure 5. Construction Sector: Output and Employment



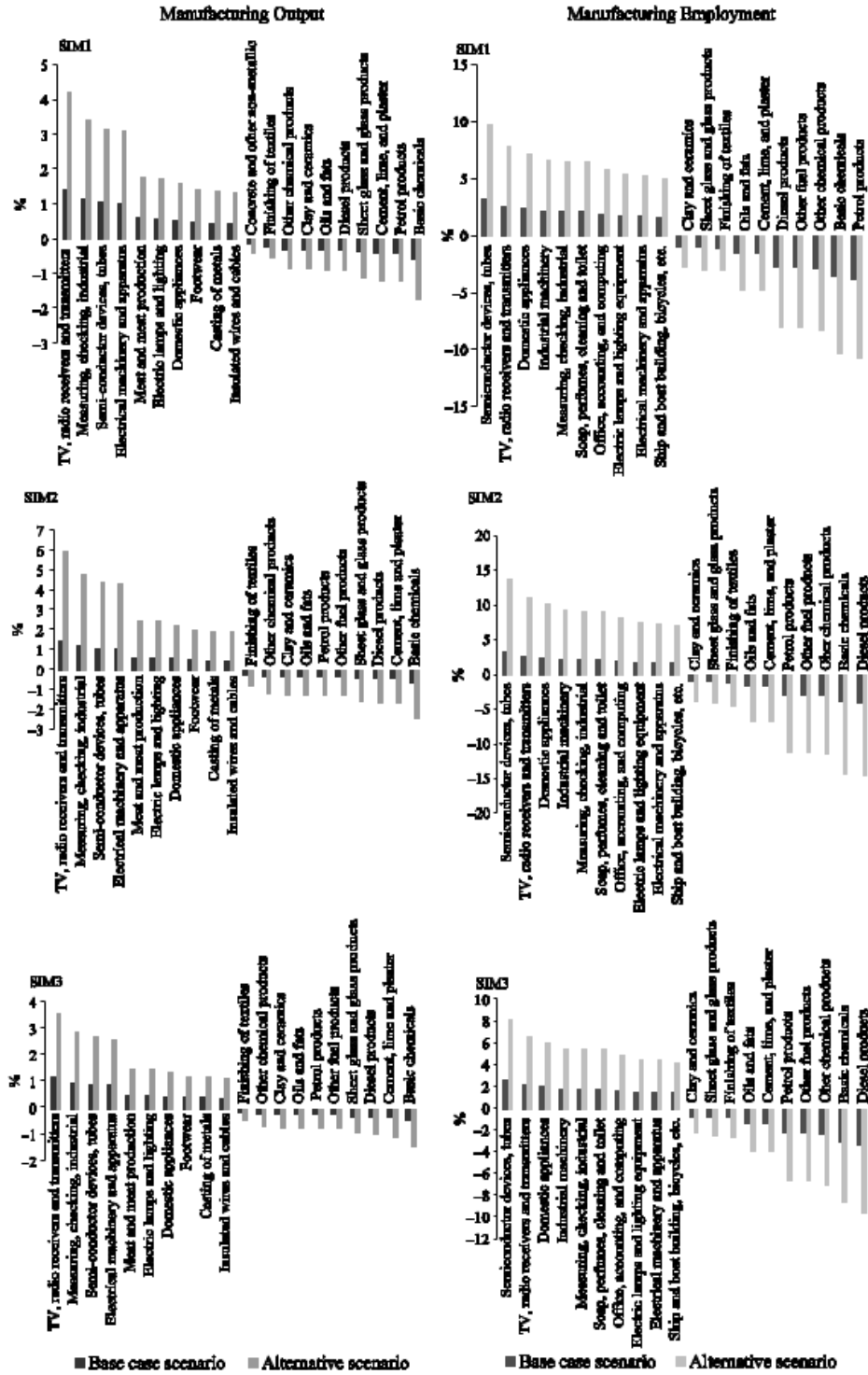
Source: Authors' calculations based on data from the Department of Statistics Malaysia, Government of Malaysia, 2010. *Malaysia Input-Output Tables 2005*. Putrajaya.

sand quarrying subsector is the most affected, followed by the metal ore and other mining and quarrying subsectors. The alternative scenario shows a reduction in output and employment from 0.012% to 1.282% and from 0.555% to 3.620%, respectively.

The construction sector's residential and special trade work subsectors experienced a smaller expansion in output and employment (Figure 5). In contrast, the nonresidential and civil engineering subsector experienced a contraction in output and employment, even though it was relatively small.

Figure 6 exhibits the impacts on output and employment among subsectors of the manufacturing sector. For the alternative scenario, SIM1 shows output and employment contractions of 1.732% and 10.721%, respectively. For SIM2, the contractions are 2.425% and 14.484%, respectively; while for SIM3, they are 1.459% and 9.501%, respectively. Under SIM1, the basic chemicals products; cement, lime, and plaster; and sheet glass and glass products subsectors each have a reduction in output ranging from 1.070% to 1.730%. SIM2 generates relatively larger output contractions in these subsectors ranging from 1.144% to 2.425%, while SIM3's

Figure 6. Manufacturing Sector: Output and Employment



Source: Authors' calculations based on data from the Department of Statistics Malaysia, Government of Malaysia. 2010. *Malaysia Input-Output Tables 2005*. Putrajaya.

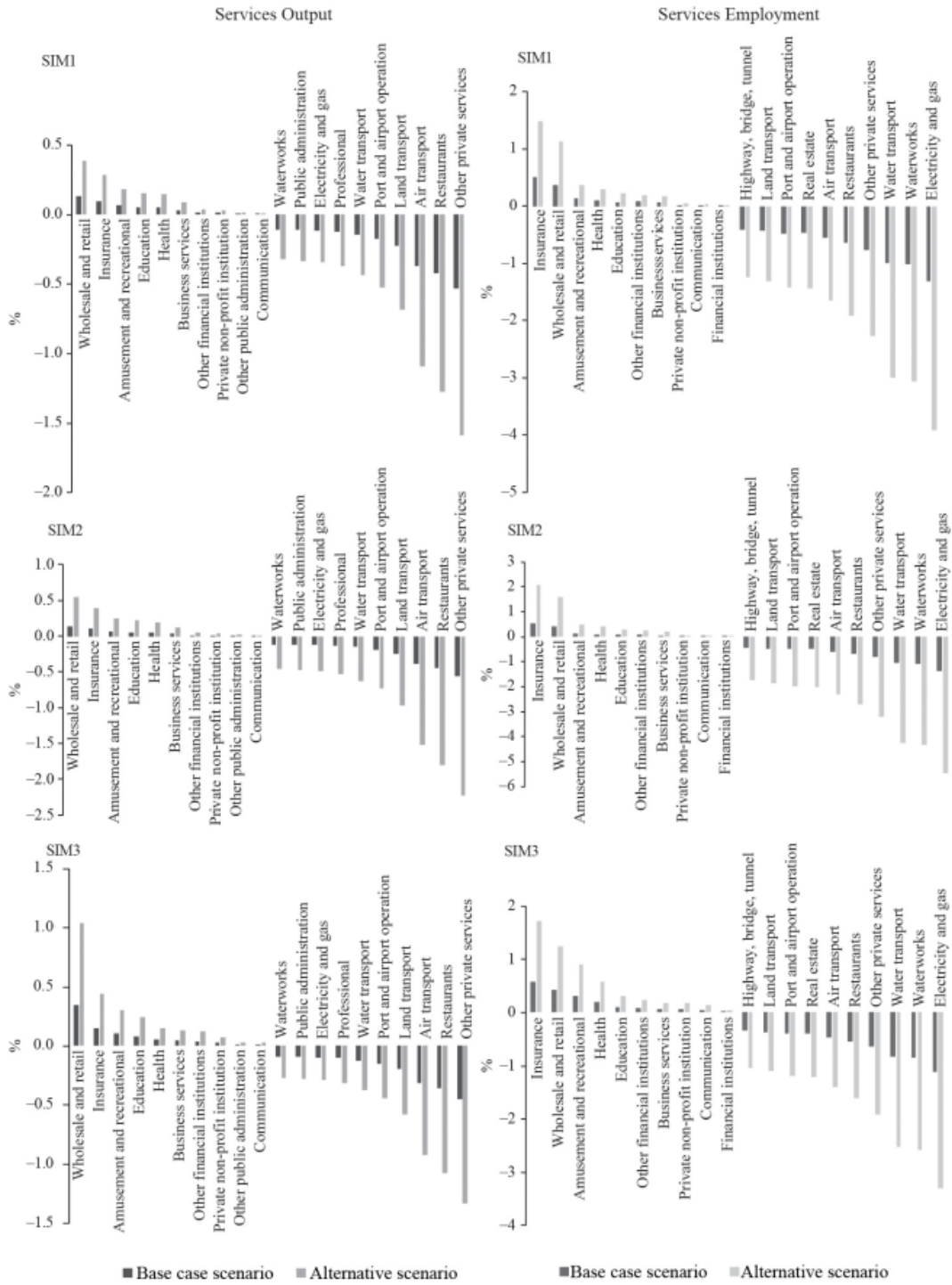
contractions range from 1.040% to 1.459%. In terms of employment, the contractions range from 2.596% to 10.721% (SIM1), from 3.647% to 14.484% (SIM2), and from 2.184% to 9.501% (SIM3).

Expansions in output for all simulations of the alternative scenario were registered for the following subsectors: semiconductor devices, tubes, and circuit boards; TVs, radio receivers, transmitters, and associated goods; domestic appliances; industrial machinery, measuring, checking, and industrial process equipment; soap, perfumes, cleaning, and toilet preparations; office, accounting, and computing machinery; electric lamps and lighting equipment; electrical machinery and apparatus; and ship, boat building, and bicycles. These industries are all associated with multinational companies and/or foreign direct investment. The output expansion was largest for SIM2, ranging from 1.918% to 5.973%, followed by SIM1 (from 1.363% to 4.231%) and SIM3 (from 1.146% to 3.551%). The employment growth was largest for SIM1, ranging from 5.024% to 9.827%, followed by SIM2 (from 7.034% to 13.906%) and SIM3 (from 4.232% to 8.242%).

Fuel products show a significant contraction, both in output and employment, particularly in the full subsidy removal (i.e., alternative) scenario. For both the base case and full subsidy removal scenarios, the subsectors of petrol, diesel, and other fuel products suffer large contractions in output and employment in each simulation. Observing the full subsidy removal scenario, for SIM1, these industries experience output reductions ranging from 0.856% to 1.177%, while for employment, the decline ranges from 7.857% to 10.721%. SIM2 shows the largest effects, with contractions ranging from 1.208% to 1.604% for output and from 11.002% to 14.484% for employment. A similar result is obtained for SIM3, with output and employment reductions ranging from 0.719% to 1.040% and from 6.618% to 9.501%, respectively. Overall, these results imply that subsidy removal increases the price of fuels so that the cost of production increases, indicating a decline in output and employment in fuel product industries and among manufacturing subsectors.

Finally, for the service sector, subsectors closely related to petroleum refining exhibit a larger impact on output and employment for all simulations in the alternative scenario (Figure 7). The subsectors include other private services, restaurants, air transport, land transport, port and airport operation, water transport, electricity and gas, and waterworks. For those subsectors, output and employment decline under SIM1 from 0.323% to 1.585%, from 0.457% to 2.228% (SIM2), and from 0.271% to 1.333% (SIM3). Large declines are recorded in the output of other private services, with contractions of 1.585% (SIM1), 2.228% (SIM2), and 1.333% (SIM3). Similarly, for restaurants, the reductions in output are 1.277% (SIM1), 1.799% (SIM2), and

Figure 7. Service Sector: Output and Employment (%)



Source: Authors' calculations based on data from the Department of Statistics Malaysia, Government of Malaysia. 2010. *Malaysia Input-Output Tables 2005*. Putrajaya.

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1.333% (SIM3). Among the transportation sector, air transport and land transport are the most affected subsectors in output reduction for all alternative scenarios in this study.

Furthermore, all simulation results register even larger contractions in employment. The subsectors of electricity and gas and waterworks register the largest reductions in employment. For electricity and gas, the declines are 3.910% (SIM1), 5.472% (SIM2), and 3.297% (SIM3); while for waterworks, the reductions are 3.065% (SIM1), 4.323% (SIM2), and 2.576% (SIM3) (Figure 7). The results are similar for the subsectors of water transport, other public services, restaurant, air transport, real estate, port and airport operation services, land transport and highways, and bridge and tunnel operations, with each subsector experiencing a significant contraction in employment for all simulations.

From the results obtained, a few inferences are formed. Based on the scenario analysis, first, the findings reveal that SIM2 (diesel) has a larger impact on the output and employment contraction than SIM1 and SIM3 for both the base case and alternative scenarios. It is supported by the fact that the government-borne subsidy for diesel is substantially larger than for petrol and other fuels. Specific subsectors, especially those under the manufacturing sector, are affected the most when the subsidy is removed. Notwithstanding, fuel subsidy reforms significantly influenced sectoral output through increased production costs due to an increase in the prices of intermediate inputs (Rentschler, Kornejew, and Bazilian 2017). Furthermore, the larger contribution in both domestic and imported inputs shows that intermediate input is the major component of total factor productivity growth for the manufacturing sector (Sulaiman 2012). Also, the manufacturing sector is supported by upstreaming (as consumers) and down-streaming industry (as suppliers) linkages (Sulaiman and Fauzi 2017), implying that those manufacturing subsectors deal with the transportation of intermediate inputs and finished products from the supplier to the consumers.

Second, in general, both scenarios (base and alternative) indicated that all sectors experience either a contraction or expansion in output and employment, particularly both are larger for the manufacturing sector. A contraction in output usually reduces the need for employment, and vice versa in the case of output and employment expansion. The subsectors most influenced by multinational firms' production experience an increase in output and employment. As mentioned, the semiconductor devices; tubes, circuit boards, TVs, radio receivers, and transmitters associated goods; and measuring, checking, and industrial process equipment subsectors all have substantial ties to foreign producers (i.e., multinational corporations). On the other hand, output and employment contractions are experienced by local producers. Oil and

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fats; clay and ceramics; sheet glass and glass products; basic chemicals; and cement, lime, and plaster are examples of locally produced goods. These findings are corroborated by Sulaiman, Rashid, and Hamid (2012), who revealed that multinational corporations are more efficient in utilizing both domestic and imported inputs than local manufacturers.

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Third, this study found a larger contraction in output for subsectors closely related to the fuel sector, both in the manufacturing and service sectors. The findings are comparable to that of an Indonesian study that reached the same conclusion (Yusuf and Resosudarmo 2008). Furthermore, the study observed that fuel subsidy removal tends to increase the price of industrial outputs that are highly dependent on fuel such as in the transportation, energy, fishery, and industrial sectors. Increased production costs result from rising oil prices for commercial and industrial customers (Middle East Economic Survey 2016). Increases in energy prices from subsidy reforms result in direct and indirect cost increases (Rentschler et al. 2017). Thus, subsectors that used more energy, in particular, would have a significant impact on their cost structures (Bazilian and Onyeji 2012).

Fourth, the alternative scenario shows the contraction in the employment rate is greater than that in output. This finding is rational because firms will react by not hiring new workers rather than reducing their production units. Thus, to cover the cost of a price increase due to a subsidy removal, firms would prefer to minimize labor compared to reducing the output produced, implying that the decline in the labor used would adversely impact the output. Similarly, expansion in employment growth is larger than the output growth even though it is not as big as the contraction, resulting in a moderate impact on the distribution of employment across industries. Such consequences may have repercussions for economic activity, jobs, and, ultimately, households (Kilian 2008). Even though producers can pass on the cost to their customers, the industry's output is being reduced as production costs rise (Harun et al. 2018). Therefore, employment decisions must be carefully considered because high production costs reduce the desire to produce more output, depressing the employment rate. According to Rentschler, Kornejew, and Bazilian (2017), cost increases (both direct and indirect) may not indicate competitiveness losses because firms have a variety of techniques to manage and pass on price shocks. Initially, high fuel prices are often associated with lower output and, as a result, lower employment. Furthermore, high prices for goods and services deter household and government spending, resulting in slower economic growth.

Finally, based on the analysis presented, it is notable that when the revenues from subsidy removal policies are channeled back into the economy via payments to

households, the resulting increase in demand will stimulate the economy. In Malaysia, studies such as [Solaymani and Kari \(2014\)](#) and [Loo and Harun \(2020\)](#) identified the harmful effects that would come from the implementation of the fuel subsidy reform and urged for mitigating measures. The study found that the integration of a transfer of government income to rural households would increase pro-poor growth and reduce the negative impacts on all households' real incomes with a slight improvement. Specifically, [Loo and Harun \(2020\)](#) emphasized that (i) cash transfers are needed to cope with the underlying high price resulting from the high fuel consumption price, and (ii) the vulnerable—primarily low-income households and the poor—are the ones hit hardest. Cash transfers are particularly preferable in the short term, where extended time is needed for behavioral change, while developmental investments have long-term benefits.

C. Sensitivity Analysis

Table 5 shows the price elasticity effects on fuel consumption estimates for the whole economy, in which the elasticities range from -0.14 to -0.94 . The ranges in demand elasticity in key sectors are as follows: agriculture sector (-0.14 to -0.49), mining sector (-0.43 to -0.44), manufacturing sector (-0.14 to -0.49), construction sector (-0.46 to -0.63), and service sector (-0.35 to -0.94). It is not surprising that demand in the agriculture and manufacturing sectors is relatively inelastic because price elasticities could have been lower even for the long-run period, as revealed by [Bohi and Zimmerman \(1994\)](#) and [Graham and Glaister \(2002\)](#).

Table 5. Elasticities of Demand for Fuel and Household Consumption

Sector	Price Elasticities of Demand for Fuels		Expenditure Elasticities of Household Consumption	
	Range	Mean Value	Range	Mean Value
Agriculture	-0.14 to -0.49	-0.27	0.32 to 1.15	0.63
Mining	-0.43 to -0.44	-0.44	1.01 to 1.04	1.03
Construction	-0.46 to -0.63	-0.58	0.28 to 0.63	1.34
Manufacturing	-0.14 to -0.49	-0.32	0.28 to 1.01	0.74
Services	-0.35 to -0.94	-0.56	0.47 to 0.87	1.28
Total mean		-0.40		0.89

Source: Authors' calculations (using the Klein–Rubin utility function) based on data from the [Department of Statistics Malaysia](#), Government of Malaysia. 2010. *Malaysia Input–Output Tables 2005*. Putrajaya.

However, prior studies found that long-run price elasticities tend to be much higher than in the short run due to the three crucial conclusions on the sensitivity of price changes on fuel demand in the long run (Graham and Glaister 2002, Plante 2014). First, behavioral responses to cost changes occur over time, implying demand has a larger impact than short-run elasticity. Second, the range of responses included changes by vehicle type and location decisions. Third, policy options are more comprehensive in the long run.

Under the linear expenditure (Klein–Rubin) system, the elasticity of marginal utility of income is estimated, which shows that the long-run household expenditure elasticities for the whole economy are relatively larger, ranging from 0.28 to 1.15. In contrast, the mean value ranges from 0.63 to 1.34. This result is in line with prior studies that have reported income elasticity of fuel consumption in the range of 0.6–1.6 (Graham and Glaister 2002).

The subsidy removal minimizes deadweight losses in the economy by incorporating an efficient fiscal policy to give a complete result (Plante 2014). Remarkably, the Government of Malaysia has distributed the savings from rationalizing fuel subsidies in the form of a direct cash assistance program to low-income groups to mitigate fuel price increase (e-BR1M 2018). The program provides RM500 (\$159) in cash aid to households with a monthly income of RM3,000 (\$953) or below. Even though the cash transfer program is not a popular practice, it can save about 70% of the government's current expenses on fuel subsidies and benefit low-income groups, while the benefits of fuel subsidies are biased toward high-income groups.

V. Conclusions

The simulations investigate the impact of fuel price increases on macroeconomic variables, sectoral outputs, and employment. In addition, the disaggregation of fuel commodities into petrol, diesel, and other fuel products has enabled examining the impact of price increases for these fuel commodities separately according to industry.

The subsidy removal and subsequent increase in fuel prices will reduce selected sectors' activities in the Malaysian economy. Still, a reduction in the general sales tax has an expansionary impact on the broader segments of the economy. This effect will more than compensate for the contractionary impact, resulting in a positive net gain for the overall economy. On the other hand, removing fuel subsidies can have immediate negative effects on macroeconomic indicators like GDP through an increase in the cost

of production, a rise in the consumer price index, and a reduction in employment. Nevertheless, the net macroeconomic impact is positive when revenue from the subsidy removal is given back to the economy through cuts in the general sales tax. It indicates that the pre-reform fuel pricing policy has distorted resource allocation. Therefore, a departure from such a policy reform would be the right move toward having a more efficient economy.

The contraction in output is larger in the manufacturing sector due to increased diesel prices versus petrol and other fuels. It is not surprising because a larger proportion of the government's fuel subsidy expenditure goes to diesel rather than petrol and other fuels. However, negative impacts, such as increased production costs due to higher fuel prices, would be more than offset by the positive impacts of government revenue reallocation. Most subsectors exhibit a drop in output due to an increase in the cost borne by all users. Some producers have no choice concerning the consumption of petroleum products; they will not reduce their use and thus, their cost of production will increase, resulting in contractions in industry output. Nonetheless, some industries experience a positive impact on output and employment.

Furthermore, the distributional impacts across different types of labor vary and are much larger than impacts on output. Hence, the results show that the effect of subsidy removal would be felt much more by unskilled labor, such as service workers and elementary workers, compared to skilled labor. On the other hand, the most uniform impact across workers implies that the distributional impact of the reform would be neutral. Under the subsidy rationalization program, the Government of Malaysia has planned for a gradual subsidy removal for other subsidized items, primarily food (e.g., wheat flour, cooking oil, sugar, and rice). This is because it accounts for a sizable portion of the operating expenditure in Malaysia's national budget.

An estimated RM25 billion worth of subsidies is allocated in the budget annually, depending on price changes. The sugar subsidy was eliminated on 26 October 2013, and the rice subsidy was completely removed on 1 November 2015. On 1 November 2016, the government announced that the cooking oil subsidy would be phased out (Ministry of Finance Malaysia 2018). All of these actions are part of the subsidy rationalization program, necessitating further analysis and future research.

This study, therefore, suggests that the design of subsidy removal has to include mitigating measures that address the well-being of the Malaysian people, especially from the perspective of employment. A well-designed subsidy rationalization program would not only increase the acceptance level of the reform but underpin sustainable economic development. Regarding the fuel subsidy rationalization that has been

focused on in this study, the integration of a cash transfer program would strengthen economic performance by increasing real GDP growth, aggregate output, and employment, and by improving the trade balance.

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Appendix

Table A1. Subsectors of the Malaysian Economy

No.	Sector and Subsector	No.	Sector and Subsector	No.	Sector and Subsector
Agriculture					
1	Paddy	29	Other food processing	60	Rubber products
2	Food crops	30	Animal feed	61	Plastic products
3	Vegetables	31	Wine and spirits	62	Sheet glass and glass products
4	Fruits	32	Soft drinks	63	Clay and ceramics
5	Rubber	33	Tobacco products	64	Cement, lime, and plaster
6	Oil palm	34	Yarn and cloth	65	Concrete and other non-metallic minerals
7	Flower plants	35	Finishing of textiles	66	Iron and steel products
8	Other agriculture	36	Other textiles	67	Basic precious and non-ferrous metals
9	Poultry farming	37	Wearing apparel	68	Casting of metals
10	Other livestock	38	Leather industries	69	Structural metal products
11	Forestry and logging	39	Footwear	70	Other fabricated metal products
12	Fishing	40	Sawmilling and planing of wood	71	Industrial machinery
Mining					
13	Crude oil and natural gas	41	Veneer sheets, plywood, etc.	72	General-purpose machinery
14	Metal ore mining	42	Builders' carpentry and joinery	73	Special purpose machinery
15	Stone, clay, and sand quarrying	43	Wooden and cane containers	74	Domestic appliances
16	Other mining and quarrying	44	Other wood products	75	Office, accounting, computing machinery
Construction					
17	Residential	45	Paper, paper products, and furniture	76	Electrical machinery and apparatus
18	Non-residential	46	Publishing	77	Other electrical machinery
19	Civil engineering	47	Printing	78	Insulated wires and cables
20	Special trade works	48	Petrol products	79	Electric lamps and lighting equipment
Manufacturing					
21	Meat and meat production	49	Diesel products	80	Semi-conductor devices, circuit boards, etc.
22	Preservation of seafood	50	Other fuel products	81	TV, radio receivers, transmitters, etc.
23	Preservation of fruits and vegetables	51	Basic chemicals	82	Medical, surgical & orthopedic appliances
		52	Fertilizers	83	Measuring, checking, etc.
		53	Paints and varnishes	84	Optical instruments, etc.
		54	Pharmaceutical, chemical, etc.	85	Watches and clocks

Continued.

Table A1. *Continued.*

No.	Sector and Subsector		
24	Dairy production	55	Soap, perfumes, cleaning, etc.
25	Oils and fats	56	Other chemical products
26	Grain mills	57	Tires
27	Bakery products	58	Rubber processing
28	Confectionery	59	Rubber gloves
91	Recycling	101	Port and airport operation services
	Service	102	Highway, bridge, and tunnel operation
92	Electricity and gas	103	Communication
93	Waterworks	104	Banks
94	Wholesale and retail trade	105	Financial institutions
95	Accommodation	106	Insurance
96	Restaurants	107	Other financial institutions
97	Land transport	108	Real estate
98	Water transport	109	Ownership of dwellings
99	Air transport	110	Rental and leasing
100	Rental and leasing	111	Computer services
		86	Motor vehicles
		87	Motorcycles
		88	Ship and boat building, bicycles, etc.
		89	Other transport equipment
		90	Other manufacturing
		112	Research and development
		113	Professional
		114	Business services
		115	Public administration
		116	Education
		117	Health
		118	Defense and public order
		119	Other public administration
		120	Private non-profit institution
		121	Amusement and recreational
		122	Other private services

Source: Department of Statistics Malaysia, Government of Malaysia, 2010. *Malaysia Input-Output Tables 2005*. Putrajaya.

Table A2. The Benchmark Scenario

No.	Item	Price Per Liter (RM)			
		July 2005		June 2008	
		Petrol	Diesel	Petrol	Diesel
1	Product cost	2.13	2.10	4.28	4.25
2	Other costs	0.32	0.23	0.32	0.23
	(i) + <i>Alpha</i>	0.05	0.04	0.05	0.04
	(ii) + <i>Operational cost</i>	0.10	0.10	0.10	0.10
	(iii) + <i>Oil company's margin</i>	0.05	0.02	0.05	0.02
	(iv) + <i>Fuel retailer's margin</i>	0.12	0.07	0.12	0.07
3	Actual price	2.45	2.33	4.60	4.48
4	Retail price	1.62	1.28	2.70	2.58
5	Tax + subsidy	(0.83)	(1.05)	(1.90)	(1.90)
	<i>Sales tax foregone</i>	0.58	0.20	0.59	0.20
	<i>Subsidy</i>	0.25	0.85	1.32	1.70
6	Price increase (%)	10.20	36.50	28.70	38.00
	Base case scenario	0.25 ~ 10%	0.25 ~ 10%		
	Alternative scenario			1.32 ~ 30%	1.70 ~ 40%

RM = Malaysian ringgit.

Notes:

- Product cost is based on average current Means of Platts Singapore + alpha (a constant: 5 sen for petrol and 4 sen for diesel).
- Other costs are the summation of i, ii, iii, and iv, which are fixed elements.
- Actual price is obtained from product cost and other costs (a + b).
- Retail price is obtained from actual price – (tax + subsidy).
- Sales tax is obtained from actual price – subsidy.
- Subsidy per liter of petrol and diesel obtained in July 2005 and June 2008, respectively.
- Price increase is obtained from subsidy divided by actual price (a proportion of subsidy removed from the actual price).

Source: Authors' calculations based on data from the Department of Statistics Malaysia, Government of Malaysia. 2010. *Malaysia Input–Output Tables 2005*. Putrajaya.

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