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Impacts of energy subsidy reform on poverty and income inequality in Malaysia

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Abstract Malaysia pays a great share of its gross domestic product on energy subsidies. Payment of subsidies causes some failures in the economy, such as disrupting the price mechanism and destroying allocation of resources in the economy. Removing these subsidies has important implication for sustainable development through their effects on energy consumption, price system, resource allocation and emission. This study employs a computable general equilibrium model, which is a more comprehensive method than statistical and econometric methods, to identify the long-run impacts of energy subsidy reform in the Malaysian economy, especially on poverty and income inequality across four Malaysian ethnic groups, namely Malay, Chinese, Indian, Other in both rural and urban areas, and one noncitizen household. The results of this study indicate that urban households are set to lose most from energy subsidy reform compared to rural and noncitizen households due to increased expenditure. In addition, Malay households, particularly in urban areas, lose more significantly than other household groups. This policy leads to initial increases in the overall inequality in the economy, but the increase in inequality in urban areas is greater than rural areas.

Keywords Poverty · Malaysia · Inequality · Subsidy reform · Welfare · General equilibrium

1 Introduction

Governments are pursuing specific goals of subsidies on energy consumption. Saunders and Schneider (2000) believe that energy consumption subsidies are used to ensure that all consumers, especially poor households, have access to a minimum level of energy consumption. Energy subsidies also encourage industrial growth as they lead to low cost

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energy for firms. Razack et al. (2009) argued that production subsidies in a sector increase production of that sector, reduce unemployment, raise the wage rate in the sector, and increase the consumption among the rural and urban households.

On the other hand, payment of subsidies causes some failures in the economy. They disrupt the price mechanism and result in destroying allocation of resources in the economy (Fattouh and El-Katiri 2013; Morgan 2007). Subsidies also lead to inefficient use of energy in the economy. Arze del Granado et al. (2012) showed that the top income quintile captures six times more in subsidies than the bottom. Wastage of energy is another problem that arises from the subsidies.

If these subsidies were gradually reduced by 2020, the demand for primary energy would decrease at the global level of 5.8 % and the CO_2 emissions would reduce by 6.9 %, compared with a baseline in which subsidy rates remain unchanged (IEA, OPEC, OECD and World Bank Joint report IEA 2010). Many studies investigated the impacts of removing energy subsidies in China and found that this policy decreases final demand of different economic sectors and significantly reduce the consumption of coal, oil, natural gas and electricity (Hong et al. 2013; Jiang and Tan 2013; Wang and Lin 2014).

However, empirical studies showed that removal of energy subsidies would decrease the households' welfare and increases the level of poverty, especially in developing countries. For example, in Nigeria, Nwafor et al. (2006) and Siddig et al. (2014) found that removal of petroleum subsidies, without spending of the associated savings, would increase the national poverty level. This is due to the consequent rise in input costs, which is higher than the rise in selling prices of most firms and farms. In addition, by applying CGE models, many studies showed that energy subsidy removal will have significant adverse impacts on welfare, GDP and employment (Lin and Jiang 2011; Liu and Li 2011; Manzoor et al. 2012). Similarly, BuShehri and Wohlgenant (2012) by employing a micro-model showed that electricity subsidy reform leads to loss in consumers' welfare in Kuwait.

Further studies on subsidy reform in agricultural and food sectors reveal the impacts of reform on the poor. Many of these studies showed the positive effects of policy reform on poor households' welfare, such as Boccanfuso and Savard (2007) study because they benefit from the increase in cotton prices. On the other hand, in North Sulawesi, Indonesia, the removal of fertilizer subsidy increases the incidence of poverty and income inequality (Firdausy 1997). However, many empirical studies by applying CGE methods showed that food subsidy reforms lead to decrease in welfare of households, especially in low income households (Lofgren and El-Said 2001; Ramadan and Thomas 2011; Karami et al. 2011). Dartanto (2013) also by applying a CGE model found that complete removal of fuel subsidies and the reallocation of 50 % of them to government spending, transfers and other subsidies could decrease the incidence of poverty by 0.28 % in Indonesia.

As agreed by G-20 nations, members attempt to reduce fossil fuel subsidies while preventing adverse impact on the poorest (IEA, OPEC, OECD and World Bank Joint report 2010). Therefore, there are potential efforts in worldwide to reduce the energy subsidy in the economies. However, there is still a concern about the negative impacts of energy subsidy reform on poverty, especially in developing countries. Therefore, the current study by applying a computable general equilibrium attempts to identify the effects of energy subsidy reform on poverty level of 9 household groups in Malaysia, namely, rural Malay, rural Chinese, rural Indian, rural others and 4 urban households as well plus a noncitizen group of household.[1]

Malaysia is an interesting case study due the following reasons. First, this country pays a high level of subsidy on consumption of energy. Government expenditure on subsidy in 2010 comes to about 18.8 % of government operating expenditure which is about 4.1 % of total GDP (Economic Planning Unit-EPU 2012). Second, in 2010, the subsidy on consumption of fuel in Malaysia among the five ASEAN founding economies is the third highest about $5.67 billion, while its per capita subsidy would be the highest (about $200) followed by Thailand by $126.6 and Indonesia by $73 (Abdul Hamid and Abdul Rashid 2012). Third, in August 2008, the government raised the price of natural gas for power generation by 124 % in Peninsular Malaysia, and the average electricity tariff for all sectors of the economy by 24 % (from USD 0.075/kWh to USD 0.093/kWh). It also increased the prices of gas and petrol by 41 and diesel by 63 % in June 2008 (IEA 2009). Finally, this country still has faced with high levels of poverty, especially in rural and western Malaysia regions. Table 1 reports the poverty indices by states and stratum in Malaysia. It shows that Sabah region has the highest share of poor households followed by Sarawak.[2] That is, 32 % of rural households and 9.8 % of urban households in Sabah cannot access to the basic food and non-food needs.

On the other hand, the hard-core poor index, which measures the level of household income below the food poverty line, is high in the Sabah region in comparison with others.

The rest of the paper is as follows. The next section describes the methodology and model of the study. Section 3 assesses the effects of subsidy reform on Malaysian poverty and the economy. Section 4 discusses the results and Sect. 5 concludes the results.

2 Methodology

With the aim of analysing the effects of energy subsidy reform on poverty and welfare of households in Malaysia, this study employs a CGE model. There are a number of ways through which a policy or external shock influences an economy which policymakers are trying to capture such channels and effects. Computable general equilibrium (CGE) models provide a comprehensive framework to analyse the effects of a policy or external shock such as subsidy reform in the economy. They are also suitable tools to trace the effects of a policy on a specific sector or variable, such as welfare and poverty, in economy.

In order to estimate the economic and poverty impacts of energy subsidy reform, this study uses a static poverty focused CGE model for Malaysia. These models are suitable tools for capturing macro level, sectoral level and household level impacts of the

[1] *Malay* is an ethnic group of Austronesian people predominantly inhabiting the Malay Peninsula and coastal Sarawak and Sabah and other Malaysia's neighbour countries. *Chinese* is an ethnic group that most are the descendants of Chinese who immigrated to Malaysia between the early and the mid-twentieth centuries. *Indians* are Malaysians of Indian origin. Many are descendants from those who migrated from India during the British colonization of Malaya. *Noncitizen* households are non-Malaysian people who had stayed or intended to stay in Malaysia for 6 months or more (Department of Statistics 2009). *Other* is a group of Malaysian population that is not classified as Malay, Chinese, Indian and noncitizen such as Orang Asli.

[2] A household is considered poor if its income is less than its Poverty Line Index (Department of Statistics 2012).

Table 1 Distribution of poverty by region and stratum, Malaysia, 2009

Malaysia and regions	Incidence of poverty					
	Poor			Hard-core poor		
	Total	Urban	Rural	Total	Urban	Rural
Malaysia	3.8	1.7	8.5	0.7	0.2	1.8
Sabah	19.7	9.8	32.8	4.8	2	8.5
Sarawak	5.3	2.3	8.4	1	0.1	2
Peninsular Malaysia	2.7	1.7	4.2	0.4	0.2	0.8

Source Department of statistics (2009), Malaysia

energy subsidy reform on the Malaysian economy. The literature behind the applying CGE models to analyse policy issues in Malaysia is good (see Solaymani et al. Solaymani et al. 2015a, b; Ahluwalia and Lysy 1979; Ee 1982; Lundborg 1984; Yeah et al. 1994 for details). The theoretical structure of the core model of this study is an adoption of the Solaymani et al. (2014) and Solaymani and Kari (2013) model with an extension to incorporate the poverty and income modelling following Chala (2010).

2.1 Poverty calculation

The poverty line, Z_h, itself is determined endogenously by the CGE model. Hence, the food poverty line most be adjusted with the price change of food and non-food products. This study assumes that the composition of commodities in the poverty line does not change following the change in prices. This assumption follows the fact that the commodities in the poverty line are the basic need products which are price inelastic. Therefore, the new poverty line that changes following a variation in prices is known as the endogenous of the poverty line. The poverty line attempted to be as endogenous within the model. “As a general equilibrium framework permits one to endogenous prices, the change in the monetary poverty line during a simulation can be endogenous within the CGE model” (Naranpanawa and Bandara 2012, p. 106). The poverty line in the CGE model of the present study is an adopted framework which is introduced by Decaluwe et al. (2001, 2005) and applied by Dartanto (2013). It is determined as a basket of commodities (volume) which reflecting basic food and non-food commodities of households.

$$z_h = \sum_{fd=1}^{n} p_{fd}\cdot C\_\min_{fd,h}\left(1+\frac{dp_{fd}}{p_{fd}}\right) + \sum_{nfd=1}^{m} p_{nfd}\cdot C\_\min_{nfd,h}\left(1+\frac{dp_{nfd}}{p_{nfd}}\right) \quad (1)$$

where $\sum_{fd=1}^{n} p_{fd}\cdot C\_\min_{fd,h}$ is the food poverty line; $\sum_{nfd=1}^{m} p_{nfd}\cdot C\_\min_{nfd,h}$ is the non-food poverty line; P_{fd} is the food price, $fd = 1,\ldots,n$; $C\_\min_{fd,h}$ is the minimum consumption of food product by household h; dP_{fd} is the change in food price, $fd = 1,\ldots,n$; P_{nfd} is the non-food price, $nfd = 1,\ldots,m;$ $C\_\min_{nfd,h}$ is the minimum consumption of non-food product, $nfd = 1,\ldots,m$; dP_{nfd} is the change in non-food price-nfd, $nfd = 1,\ldots,m.$

The equations which have explained and formulated so far, used in the CGE model to make a model to analyse the impact of the shock on the economy and estimate the poverty lines of all household groups.

In order to calculate the effect of the energy subsidy reform on income inequality and poverty level of each Malaysian household, we use another method. It is a non-parametric method and can easily be calculated with the use of DAD software (Duclos and Araar 2002) specifically developed for poverty and inequality estimations.

The DAD software measures the poverty and welfare indices of all households in the model. For this calculation, first, we provide micro data of household income in the DAD software, which for this study includes 192 households' income data from each household group (totalling 1728 households' income data), then by introducing the percentage change in income and the poverty line, which are generated from the CGE model, into the DAD package we can calculate the poverty level and other indices introduced in the current study. One of the indices, which are calculated by this package, is the Foster, Greer and Thorbecke (FGT) index, of which its features are explained as follows.

The Foster, Greer and Thorbecke (FGT) indices are the most popular poverty indices in the literature. According to Foster et al. (1984), the FGT measure, Pα, can be mathematically defined as:

$$P_{\propto} = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z - y_i}{z}\right]^{\propto} \quad (2)$$

where z is the poverty line, as defined in Eq. (1), q denotes the number of poor households (having income no greater than z), n represents the total number of households and parameter α is a measure of poverty aversion which differentiates members within the distribution.

The incidence of poverty is measured based on the difference in the poverty aversion, α, parameter. When the value of $\alpha = 0$, $P\alpha$ becomes the standard head count ratio, which gives the proportion of poor households below the poverty line within each group. Since this measure cannot indicate how poor people below poverty line are becoming more or less poor, further measurement is introduced (Chala 2010). It will be captured by increasing the value of α. When $\alpha = 1$, $P\alpha$ becomes the income poverty gap which gives the relative proportion to all households below the poverty line within each group. In other words, it measures the average shortfall of income poor people from the poverty line. It also measures the amount of money which needs to transfer to poor households to bring their expenditure up to the poverty line.

However, the major limitation of this measure is, it does not reflect changes in inequality among the poor people under consideration. As mentioned by Naranpanawa and Bandara (2012), in calculating the income poverty gap, it gives the same weight to those who are just below and far below the poverty line.

In contrast, if the value of poverty aversion increases, it gives more weight to the very poor households, which measures the severity of poverty. Therefore, in order to measure the severity of poverty, the poverty aversion, α, in this study is set at 2 ($\alpha = 2$). The poverty severity index captures differences in income levels among the poor which basically calculates inequality among them. Contrary to the both previous indices (P_1 and P_2), which record the elimination effects of anti-poverty policies; the poverty severity index indicates the effects of these policies on poverty alleviation.

In order to examine the robustness of the poverty indicators, a range of other poverty measures Watts index, Sen index and Clark, Hemming and Ulph's (CHU) index were also computed in this study. Furthermore, we also estimated one of the most popular measures of welfare inequality, the Atkinson social welfare Index.

In addition to the above measures, two inequality indices are also computed for checking the situation of inequality in income of households due to the shock. The first index is Gini-coefficient. Second, in order to verify the inequality results from *Gini-coefficient*, the study uses the Atkinson index of inequality, which is an alternative to the *Gini-coefficient*. This study uses both $\varepsilon = 0.5$ and 0.75 to show different levels of the society's aversion to poverty.

2.2 Database and calibration

The model was calibrated for the year 2005 using a Social Accounting Matrix (SAM). The SAM has 19 sectors (see Appendix Table 7 for the list of these sectors). Households and labours are disaggregated into 9 categories according to their ethnic: Malay, Chinese, Indian and Other in both urban and rural areas plus a noncitizen household. The study used monthly household income data for 192 households for each household type which are from the 2004 Household Income and Expenditure Survey. In this study capital is include land.

The supply of labour and capital are exogenously fixed, but both are sectorally mobile. The associated labour and capital markets are cleared by endogenous factor prices; thus, there is no unemployment in the model. Since the capital is mobile and can adjust over time, the results of the model must be interpreted as long-run results. The experiment was carried out within a long-run macro closure. Furthermore, sectoral rates of interest, nominal exchange rate, government savings and real investment are also considered endogenous. The CGE model was solved using the GAMS (General Algebraic Modelling System) software.

The parameters of the functions in the model have been taken from literature on other CGE models. The exponents of Armington and CET functions, the shift parameters for the material aggregate production function and substitution elasticity parameter of the energy function have taken from Solaymani and Kari (2013) and Solaymani et al. (2014).

3 Results

The study simulates the long-run impacts of energy subsidy reform on macro variables, sectoral level variables and the household level absolute poverty.[3] This simulation was carried out to quantify the direction and the magnitude of the long-run impact of a cut in government energy subsidies. As mentioned above, the Malaysian government pays a high level of energy subsidies to diminishing energy poverty and improves economic development by enabling access to affordable modern energy services. Therefore, this simulation is justified under the administered price mechanism since the government is removing energy subsidies.

The following subsections analyse the impacts of the removal of energy subsidies, which allocated to those sectors use subsidy, on macroeconomic variables, prices, income distribution, and poverty.

[3] Absolute poverty measures the poverty level of households living below minimum, socially acceptable living conditions, usually established based on nutritional requirements and other necessary goods. However, relative poverty compares the lowest groups of a population with upper group (Freguja 2013).

3.1 Macroeconomics and sectoral effects

This sub-section focuses on a discussion of the findings captured from the CGE model. The results of the impact of energy subsidy reform on macroeconomic variables are reported in Table 2. This government policy leads to an initial rise in real and nominal GDP by 0.58 and 0.44 %, respectively, whereas the effect on real GDP is greater. This is happened due to a 1.68 % increase in real investment in the economy.

The energy subsidy removal leads to an appreciation in the exchange rate by 0.24 %, which means a decrease in the value of the local currency against foreign currencies. Total real exports decrease initially by 0.03 %, whereas total imports drop with the bigger magnitude of 0.07 %. Total real investment increase significantly by 1.68 % due to the policy shock. However, investment in the majority of sectors increases significantly, although decreases in those sectors which already have used energy subsidies. Therefore, this policy raises incentive to invest in the economy because it leads to reallocation of resources and competitive conditions. The increase in the consumer price index (CPI) (about 0.04 %) shows that this policy reform leads to initial inflation, which decreases the purchasing power of the households.

The consumption of all household groups decreases significantly (Table 3). The rural households experienced greater falls in their income and consumption than urban households, of which the rural Chinese and Indian households experienced the highest decreases in their income and consumption among all household types. On the other hand, the urban Indian households experienced the highest decrease in their income and consumption among all urban households.

A decrease in incomes of all household types decreases their income taxes and saving consequently.

One of the advantages of CGE modelling is providing a possibility for researchers to trace the impacts of a shock on sectoral variables. Therefore, it is necessary to analyse the impacts of energy subsidy reform on them. Table 4 reports the effects of subsidy removal on selected sectoral variables. As observed, the employment in those sectors which already used energy subsidies (before removing energy subsidies) such as food processing and industrial sectors as well as transport sector, decreased due to a decrease in their outputs. Therefore, it can be concluded that these sectors, especially textiles, cement, iron and steel and transport, affected more by this policy shock. Where, any reduction in energy subsidies would lead to a decline in sectoral output and shift labour to other sectors, especially energy sectors. On the other hand, services sectors, like trade works and services, also experience increases in their employment and output.

We conclude that energy subsidy reform encourages investment in the economy, especially in oil producing sectors such as crude oil, natural gas, and petroleum refinery. In addition, reallocation of resources, especially in the domestic energy market leads to greater efficiency in the economy.

3.2 Household level effects

In general, the findings on the effects of energy subsidy reform on variables reported so far are captured from the CGE simulations, but the impact on poverty can be captured from the income distribution module and the DAD distribution analysis package.

In order to estimate the poverty impact of the energy subsidy reform, FGT poverty measures have been estimated for 9 household types. These households are Malay,

Table 2 The impacts of energy subsidy reform on selected macro variables

Variables	Percentage changes from base-run	Variables	Percentage changes from base-run
Real GDP	0.58	Total real investment	1.68
Consumer price index (CPI)	0.04	Agricultural	19.89
Total real exports	−0.03	Crude oil	13.04
Total real imports	−0.07	Textiles	−31.80
Exchange rate	0.24	Iron and steel industry	−1.35
Government revenue	9.21	Transport	13.38
Government saving	48.35	Communication	13.41

Source Simulation results

Table 3 The impacts of energy subsidy reform on households' characteristics

Variables	% changes from base-run	Variables	% changes from base-run
Household consumption		Poverty line	
Rural		Rural	
Malay	−1.77	Malay	0.46
Chinese	−3.31	Chinese	0.55
Indian	−2.84	Indian	0.63
Other	−1.53	Other	0.28
Urban		Urban	
Malay	−1.75	Malay	0.52
Chinese	−1.82	Chinese	0.40
Indian	−2.17	Indian	0.55
Other	−1.51	Other	0.26
Noncitizen	−1.68	Noncitizen	0.17
Real households' income (Agg.)	−2.52	Households tax	−2.17
Real households' consumption (Agg.)	−2.41	Households saving	−2.25

Source Simulation results

Chinese, Indian, Other in both urban and rural areas plus a noncitizen household. Figure 1 reports the percentage changes of the FGT indicators from the base-run situation. Thus, a positive change in the FGT index denotes an increase in absolute poverty. Furthermore, three types of FGT indices capturing the *headcount ratio*, *poverty gap* and *poverty severity* are estimated.

In the rural areas, the *head count* poverty index increased for all rural households, except Other households. The rural Malay households among all rural households experienced the highest increase in the *headcount index* by 4.17 % and other household the lowest by 0.0 %. This index implies that 4.17 % of the rural Malay, 4.0 % of the Chinese and 1.74 % of Indian households have fallen below the poverty line due to the energy subsidy reform. On the other hand, in urban areas, the *headcount ratio* increased in all household types. In this area, the Malay households also experienced the highest rises in their *headcount ratio* by 11.87 % and the other households the lowest by 0.88 % (Fig. 1).

Table 4 The impacts of energy subsidy reform on selected sectoral variables

Sectors	Percentage changes from base-run					
	Total employment	Gross output	Exports	Imports	Labour income	Capital demand
Agricultural	−0.75	−0.47	0.75	−1.94	−2.39	−0.31
Food processing	−1.75	−1.36	−1.67	−0.42	−3.31	−1.24
Textiles	−32.0	−31.81	−35.17	−9.20	−33.08	−31.65
Petroleum products	1.18	1.64	3.06	−1.51	−0.42	1.71
Chemical products	−0.68	−0.29	−0.19	−0.67	−2.25	−0.16
Cement industry	−2.66	−2.43	−5.87	4.44	−4.20	−2.15
Iron and steel	−3.97	−3.63	−4.80	−0.12	−5.49	−3.47
Manufacturing	−0.54	−0.16	−0.16	−0.04	−2.11	−0.02
Trade works	1.47	1.86	2.28	1.31	−0.06	2.08
Transport	−1.85	−1.56	−6.04	4.22	−3.43	−1.36
Communication	−0.50	−0.09	0.84	−1.09	−2.10	−0.01
Services	−0.01	0.23	0.97	−0.85	−1.64	0.46

Source Simulation results

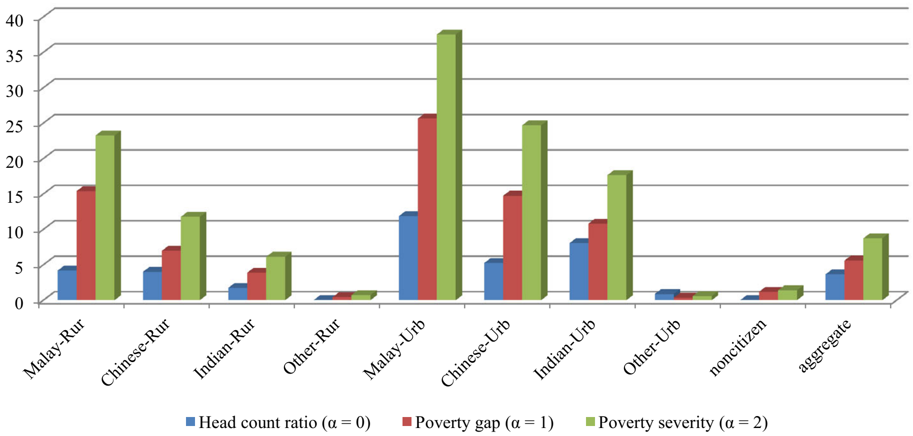

Fig. 1 Impacts of energy subsidies reform on rural (Rur) and urban (Urb) poverty indices (FGT). *The poverty line of all households (aggregate) is an average of all poverty lines for all groups. *Source* Estimated results

Since the *headcount poverty index* is a fairly weak measure of poverty, it is necessary to measure other FGT indices. The extent of poverty compared to the poverty line was also measured with a *poverty gap index*. The simulation results showed that the urban households' income gap, especially for Malay households, increased more significantly than rural and noncitizen households from the poverty line. This indicates that poorer households in the urban areas would significantly affect by energy subsidy reform as compare to other groups. The extent of poverty among households was further evaluated by a *poverty severity index*. Based on the simulation results, the vulnerability of 37.5 % of urban Malay households to severe poverty risk was maximized while this index for rural Malay households is only 23.3 % followed by Chinese and Indian households in both urban and rural areas.

The FGE indices are sensitive to the choice of the poverty line. Therefore, it is necessary to check the stability of the results with a wide range of the poverty line. The difference in the before and after simulation FGE indices are presented in Fig. 2 for a wide range of the poverty line. This figure shows that for a full range of the poverty line and for all household groups, the poverty has risen slightly after the simulation. Same results have also found for poverty severity and the poverty gap indices.

In order to evaluate the robustness of the FGT poverty measures, a range of popular poverty indices (Watts index, Sen index and CHU index) is computed, based on the changes in nominal monthly income distributions and poverty lines generated from the CGE model (Fig. 3). Interestingly, these poverty measures are consistent with the FGT poverty indicators, thus indicating that urban households are the group most adversely affected by the removal of energy subsidies, followed by rural households.

The results of Gini-coefficient are reported in Table 5. The fully mobility of capital between sectors means that the general reduced activity in the industrial sectors falls the interest rate of return on all capital. As reported in Table 3, the incomes from industrial sectors decreased more significantly than agricultural and services sectors. Therefore, it is expected that the decrease in household incomes in the urban areas will be greater than the rural areas. Indeed, the inequality indices show rises in inequality. Thus, with free mobility, energy subsidy reform would tend to increase inequality through income losses for the urban households of the society as seen in Table 5.

The results of the Atkinson index in Table 6 show that inequality has increased more in urban areas than rural. The inequality in the urban areas has increased, especially in three main groups of Malaysian population (namely Malay, Chinese and Indian households).

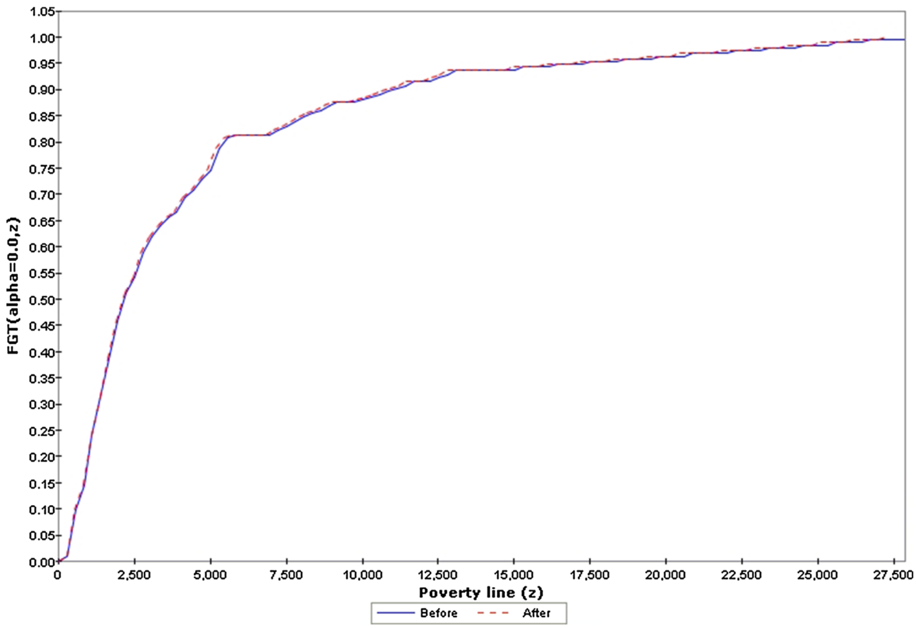

Fig. 2 Headcount ratio curves for total household income (FGT with $\alpha = 0$)

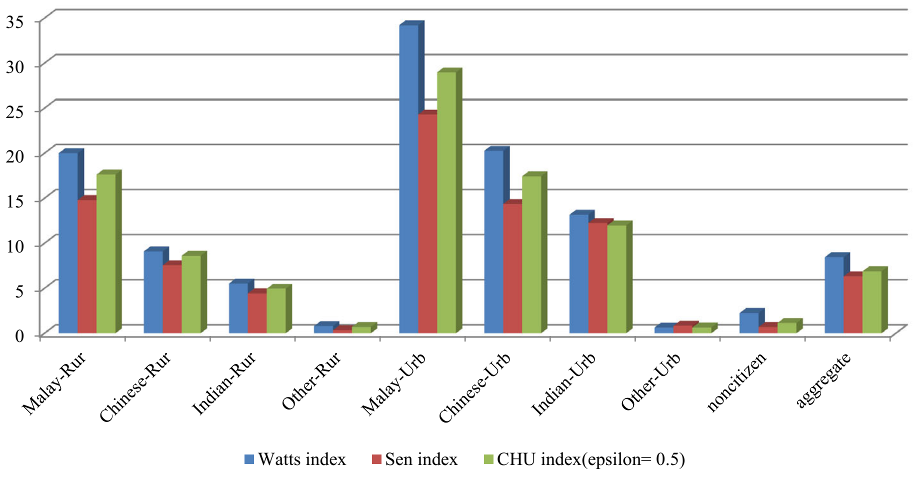

Fig. 3 Impacts of energy subsidy reform on poverty indices (other than FGT). *Source* Simulation results

Table 5 Gini index of inequality

Households	Before simulation	After simulation	percentage change
Rural households			
Malay	0.499 (*0.014*)	0.506 (*0.014*)	1.40
Chinese	0.532 (*0.014*)	0.534 (*0.014*)	0.38
Indian	0.483 (*0.014*)	0.485 (*0.014*)	0.41
Other	0.356 (*0.015*)	0.356 (*0.015*)	0.00
Urban households			
Malay	0.543 (*0.015*)	0.553 (*0.016*)	1.84
Chinese	0.513 (*0.014*)	0.524 (*0.014*)	2.14
Indian	0.518 (*0.014*)	0.523 (*0.014*)	0.97
Other	0.538 (*0.016*)	0.538 (*0.016*)	0.00
Non-citizen households	0.527 (*0.017*)	0.529 (*0.017*)	0.38
All household incomes	0.558 (*0.020*)	0.563 (*0.020*)	0.90

Note The figures in parentheses are the standard deviations. *Source* Simulation results

The Malay households also experienced greatest falls in their income and inequality among other rural households. This inequality result is most likely driven by the factor market closure rule.

The Lorenz curves in Fig. 4 for the whole population confirm the above results by showing that there is an initial difference in distribution before and after the simulation.

4 Discussion

Reforming energy subsidies have different impacts on the economic sectors. It leads to an initial rise in real and nominal GDP. This is happened due to an increase in real investment in the economy. As discussed by Breisinger et al. (2012), if fuel subsidies are reduced,

Table 6 Atkinson index of inequality

Households	ε = 0.5			ε = 0.75		
	Before	After	% change	Before	After	% change
Rural households						
Malay	0.201 (*0.011*)	0.208 (*0.012*)	3.48	0.294 (*0.015*)	0.305 (*0.016*)	3.74
Chinese	0.230 (*0.012*)	0.232 (*0.012*)	0.87	0.333 (*0.016*)	0.336 (*0.017*)	0.90
Indian	0.186 (*0.011*)	0.188 (*0.011*)	1.08	0.273 (*0.015*)	0.275 (*0.015*)	0.73
Other	0.106 (*0.008*)	0.106 (*0.008*)	0.00	0.161 (*0.012*)	0.161 (*0.012*)	0.00
Urban households						
Malay	0.239 (*0.013*)	0.250 (*0.014*)	4.60	0.346 (*0.018*)	0.363 (*0.019*)	4.91
Chinese	0.210 (*0.011*)	0.221 (*0.012*)	5.24	0.304 (*0.015*)	0.320 (*0.016*)	5.26
Indian	0.214 (*0.012*)	0.219 (*0.012*)	2.34	0.309 (*0.016*)	0.317 (*0.016*)	2.60
Other	0.230 (*0.015*)	0.231 (*0.015*)	0.44	0.329 (*0.019*)	0.329 (*0.020*)	0.00
Non-citizen households	0.221 (*0.015*)	0.223 (*0.015*)	0.91	0.315 (*0.020*)	0.318 (*0.020*)	0.95
All household incomes	0.250 (*0.018*)	0.255 (*0.018*)	2.00	0.353 (*0.023*)	0.361 (*0.024*)	2.27

Note The figures in parentheses are the standard deviations. *Source* Simulation results

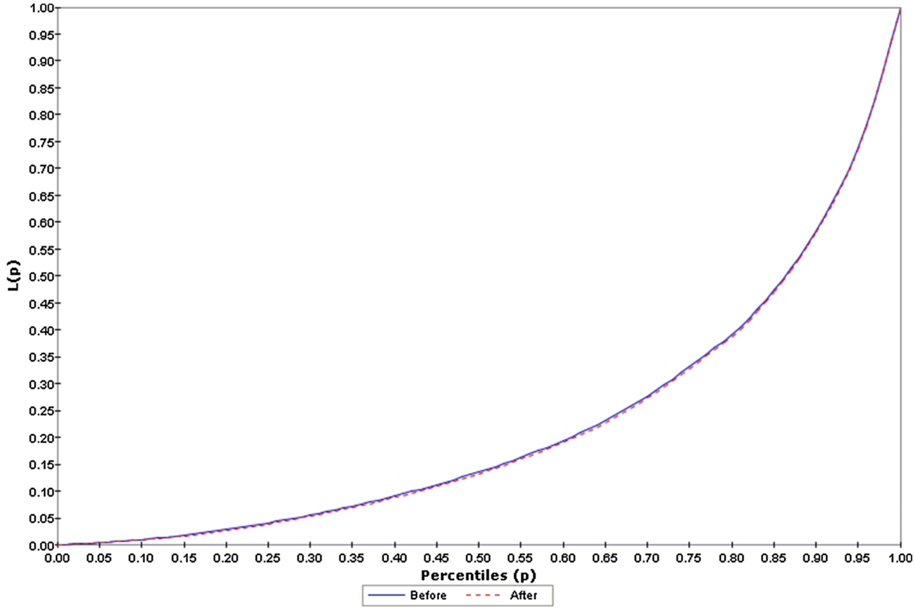

Fig. 4 Lorenz curves

government savings increase, which leads to an overall increase of savings in the economy, and thus to higher investment. Similarly, energy subsidy reform will increase funds available for upstream companies to invest in exploration and production activities while downstream companies will be encouraged to invest in producing better and cleaner grades of automotive fuels. It also leads to a more competitive in the fuel market (IISD 2012). Solaymani and Kari (2014) also found that energy subsidy reform in Malaysia leads to an increase in real GDP and investment and a decrease in energy demand and CO_2 emission in the economy.

Because of an appreciation in the exchange rate, (means a decrease in the value of the local currency against foreign currencies) total exports decrease and total imports drop. The policy also raises incentive to invest in the economy because it leads to reallocation of resources and competitive conditions. Energy subsidy reform decreases the purchasing power of the households. These findings are similar to Boccanfuso and Savard (2007) and Clements et al. (2007) results.

In terms of a decline in household income and consumption, the rural Chinese and the urban and rural Indian households are the main losers of energy subsidy reform in Malaysia. This is consistent with their poverty lines because the percentage increases in the poverty line of these households are greatest among others. The poverty line of all household groups increased, whereas, both the rural Chinese and Indian households experienced the highest rises in their poverty lines (about 0.55 and 0.63 % respectively). A change in prices of basic needs and incremental changes in the poverty lines for rural, urban and noncitizen households adversely affect poor households.

Energy subsidy removal leads to an increase in the prices of commodities which formerly received subsidy such as the energy-incentive sectors. Therefore, subsidy removal leads to an increase in the overall level of prices in the economy. The rise in prices of already subsidized commodities leads to a fall in both domestic output and demand. However, the exports of these sectors not only increased, but also decreased due to significant decreases in their demand for intermediate goods. In contrast, the imports of these commodities fall due to the decrease in their domestic demand and also an appreciation in the exchange rate. These results are corresponding to the findings from other similar studies like Abdul Hamid and Abdul Rashid (2012).

Although the Malay households are the main loser of the policy in both rural and urban areas, the three main households of Malaysia, namely Malay, Chinese and Indian, experienced significant increases in their poverty levels. However, a greater percentage of urban households compared to rural and noncitizen households have fallen below poverty due to the energy subsidy reform.

In general, in terms of FGT indices, the simulation results show that the *headcount ratio*, the *poverty gap* and the *poverty severity* are expected to increase among all household types, which indicate energy subsidy removal would exacerbate poverty among all household groups in Malaysia. Among all household groups, urban Malay households would experience a comparatively high incidence of poverty as a result of the energy subsidy reform where their *headcount ratio, poverty gap* and *poverty severity* increased by 11.9, 25.4 and 37.5 %, respectively. This condition also happened for all urban household groups. According to the 2009–2010 Household Income and Expenditure Survey, urban households spend more on energy than rural households (Department of statistics 2011). Furthermore, as urban households are predominantly employed in the industrial and services sectors which are negatively affected by the policy adjustment, a decline in factor income plays a crucial role in pushing them below the poverty line. These results are consistent with a recent study conducted by Gharibnavaz and Waschik (2012) on the impact of the food and energy subsidy reform in Iran. They showed that all income households in urban areas adversely affected by the reform. Mirshojaeian and Kaneko (2012) also argued that, although, energy subsidy reform impresses rural households more by an increase in consumption prices, urban households lose more real income due to their more expenditure.

On the other hand, the *headcount ratio*, *poverty gap* and *poverty severity* for rural Malay households, those are predominantly employed in the agricultural sectors, increased by 4.2, 15.4 and 23.3 %, respectively. However, in both urban and rural household groups, both *poverty gap* and *poverty severity* indices experienced significant increases as compared to the *headcount ratio*. They indicate that extremely poor households would severely affect in each area.

Therefore, in the long run, energy subsidy reform is harm income distribution and could not even improve it. However, overall inequality has not increased significantly. It increased around 0.9 %.

The Lorenz curves for the whole population confirm the above results by showing that there is an initial difference in distribution before and after the simulation. The theoretical argument is that in a country where the export industries are intensive in unskilled labour, energy subsidy reform is predicted to increase poverty in the long run. According to the Department of Statistics (2012), "In 2011, those with secondary education recorded the highest increase of the labour force participation rate by 1.2 % points to 64.7 %, followed by those with primary and no formal education by 0.7 % points to 65.7 and 54.1 %, respectively."

5 Conclusion and policy implications

This paper used a poverty focused CGE model to study the long-run impact of energy subsidy reform on poverty and inequality in Malaysia. The model is static in nature and of the neoclassical type. It contains 19 sectors, 9 factors of production and 192 household income data for each household type. The data are from 2005 SAM, constructed by authors.

The complete removal of energy subsidies is beneficial for energy sectors such as crude oil, natural gas, petroleum products and stimulates the exports of them. The policy also leads to gains in the economy by an increase in investment and real GDP. The policy lead to the reallocation of resources where both labour and capital shift to energy sectors and benefit from this policy. Most of the manufacturing sectors shrink, leading to a fall in demand for labour and capital. Therefore, these factors see a reduction in their remuneration. Overall consumer prices and consumption expenditure rise in the economy.

The policy increases overall poverty in the Malaysian economy and urban areas are more affected than rural areas. Among all household groups, the Malaya households, especially in urban areas, are the main losers of the energy subsidy reform policy. This is because a high percentage of low income households are concentrated in these areas. On closer inspection, it can notice that poverty increases more in the urban areas than rural areas because in urban areas expenditures on energy are greater than rural areas.

In addition, since the shock leads to fall in the income of all household groups, their consumption decrease significantly and both urban and rural households experience the highest fall in their consumption and poverty level. In terms of social welfare, the noncitizen households are most affected in comparison with other groups. In terms of income distribution, it can be seen that there is an initial increase in inequality, but a slight tendency towards a more equitable distribution. This is not too surprising given that, in general, urban households lose more than rural households. Although the magnitude of the impacts is relatively high, it is possible to gain valuable insights into the direction of change in poverty due to subsidy reform in Malaysia.

The results of the current study are helpful for the policy maker to understand the prospective impacts of energy subsidy reform on poverty and income inequality across households in Malaysia.

Appendix

See Table 7.

Table 7 Aggregated and disaggregated sectors in the model

	Aggregated sectors	Sectors in 2005 input–output table
1	Agricultural	1–10 and 12
2	Forestry and logging	11
3	Crude oil[a]	13
4	Natural gas[a]	13
5	Mining	14–16
6	Food processing, beverage and tobacco products	17–29
7	Textiles, wood and paper products	30–43
8	Petroleum refinery	44
9	Chemical products, Rubber and plastic	45–55
10	Cement and non-metallic mineral products	56–59
11	Iron and steel products	60–64
12	Manufacturing	65–85
13	Electricity[a]	86
14	Gas[a]	86
15	Trade works, wholesale and retail trade, hotel and restaurant	87–94
16	Transport	95–100
17	Communication	101
18	Financial institution	102–105
19	Other services	106–120

[a] These sectors have disaggregated from their original sectors using a disaggregation method presentd by United Nations, 1999. Department for Economic and Social Affairs Statistics Division, pp. 217–222

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