Searching for Equitable Energy Price Reform for Indonesia

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Abstract

Indonesian government implemented a massive fuel price increase in 2005. While the benefit of the reform from efficiency ground had been widely acknowledged, whether or not such reform was equitable still open for debate. In this paper, this question is answered using a Computable General Equilibrium (CGE) model with disaggregated households that allows for rich and accurate distributional story. With this method, various counter-factual scenarios analysis of the recent energy price reform in Indonesia (October 2005 Package) is carried out. The simulations suggest that the reform could have been progresive if it only increases 'vehicle fuel' prices. However, if at the same time it also increase the price of domestic fuel (kerosene), it tends to increase inequality, especially in urban area. Proper and effective compensation matters in mitigating the distributional cost or poverty impact of the reform. Uniform cash transfers to poor households disregarding poor households' heterogenity tends to over compensate rural but undercompensate urban poor. Other results suggest that non-cash compensation, by subsidizing the poor's education and health spending may not be effective to mitigate the reform despite its desirability as longer-term poverty alleviation programs.

Keywords: Energy price reform, Distribution, CGE, Indonesia
JEL Classification: D30; D50

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1 Introduction

Global fuel subsidy could amount to between 250 and 300 billion dollar a year, which could "comfortably" pay off sub-Saharan Africa's entire international debt burden, leaving billions of dollars to spare (NEF 2004). Fuel subsidy creates distortion in the economy by disregarding the economic value of the fuel, creating excess consumption, and preventing energy substitution in the long-run. Since, Indonesia started to become a net oil importer since 2004, energy switch is very crucial in the future direction of the country's energy mix. Fuel subsidy has been a constraint to this important agenda.

Fossil fuel subsidy is also regarded as the main cause of environmental problems, which include not only pollution created by fossil fuel combustion by industry and vehicles, but also excessive traffic and the inconvenience it caused. Fuel subsidy also discourages the development of more traffic-free public transport infrastructure. In most big cities in Indonesia, this has already been a major public concern.

In addition to the above efficiency-related problem, fuel subsidy is often regarded as inequitable (although not necessary so). Vehicle owners benefit greatly from fuel subsidy, and fuel price reform had been widely advocated as the means of promoting efficiency as well as equity.

The biggest concern, in the Indonesian context, however, is the fiscal burden of the subsidy. Fuel subsidy has been the main portion of the central government budget. In the year 2000 for example (see table 1), fuel subsidy was amount to 40.9 trillion rupiahs, which was almost a third of the total government spending. Since government always has political constraint with regard to reducing this subsidy, government spending then had been heavily constrained by the fluctuation of the world oil price, especially after the year 2004 when Indonesia become net oil importer.

When world oil price started to rise rapidly since 2004, the government saw no option but to radically reform its fuel price policy. In October 2005 the government made a big adjustment in the fuel prices following rapid rise of the world crude oil price. At the end, it is not efficiency argument, or the voices from energy-price reformist, that urged the government to implement the reform, but international market.

For the last few years, actually, the reduction of fuel subsidy had been one of the main agenda of Indonesian government. Indonesian government had made gradual reform in its fuel policy as well as adjustment in the fuel prices since the year 1999 (see Box 1 and figure 1).

However, what made the reform went rather slowly was mainly strong opposition from the people and the parliament. Most of the opposition come from the concern that increase in fuel prices will translate into higher of other prices, reduce purchasing power, and exacerbate poverty. Those who are againts the fuel price reform had been concerned that the fuel price rise would create big chain reaction to other prices such as transportation and other important commodity, and finally will hurt the economy, and eventually will affect the least vulnerable such as the poor. Among many economists, however, the voices was almost unanimous that fuel price reform will not only be efficient but also equitable.

Table 1: Fuel Subsidy, Government Budget, and Oil Price, 1999 - 2006

	1999	2000	2001	2002	2003	2004	2005	2006
Fuel Subsidy (Rp Trillion)	40.9	53.8	68.4	31.2	30.0	59.2	89.2	62.7
Government Spending (Rp Trillion)	201.9	188.4	260.5	322.2	376.5	430.0	411.6	470.2
Percent	20.26	28.56	26.25	9.68	7.97	13.77	21.67	13.34
World crude oil price ($/barrel)	17.12	27.07	22.72	23.47	27.1	34.62	49.86	60.32

Source: Ministry of Finance, and U.S. IEA

Box 1. Timeline of Indonesian Fuel Pricing Policy

1 January 1999

Before 1999, all fuel prices were heavily subsidised. Since January 1999, GOI started to let aviation fuel price free according to market mechanism. At that time the price of Avtur was Rp. 1,700 and the price of Avgas was Rp. 1,080.

1 April 2001

Fuel prices was set according to three categories. (a) Fuels consumed by general public were still subsidised; (b) Fuels for industry was set to be 50% of the market price (mean of Platts Singapore of the previous month plus 5 percent), and would be increased gradually; (3) Fuels for international business activities was 100% of market price.

16 June 2001

Another adjustment in the administered fuel prices with a statement that fuel prices for industry could be increased or decreased depending on the international prices.

6 January 2002

Gasoline price was adjusted to follow fully (100%) international price, kerosene price for general public was increased to Rp. 600. Other fuels (for industry) price were set to be 75% of the market prices. GOI also set price ceiling system (maximum and minimum retail price) depending on the international crude oil prices

1 March 2002

GOI delegated monthly retail prices to PERTAMINA (state-owned oil company) to be able to fluctuate according to average market prices. Fuel prices (except kerosene) started to fluctuate relatively more often during 2002 (see figure 1). Adjustment to fuel prices was made in April, May, June, July, August, September, October, November, and December 2002.

1 January 2003

Price of Kerosene was increased from Rp. 600 to Rp. 700. With usual adjustment in other fuel prices. Adjustment in the price of fuels (except kerosene) was made almost every month since then. GOI increased diesel price by 21.9% but then reduced it 6.5% due to public protest. Figure 1 shows a rare case where diesel price drop in February 2003.

1 October 2005

GOI release Presidential Decree (Perpres) no. 55/2005 declaring huge increase in the price of gasoline from Rp. 2400 to 4500 (87.5%), diesel from Rp. 2100 to Rp. 4300 (104.7%) and kerosene from Rp. 700 to Rp 2000 (185.7%).

By the time was perfect due to what happened in the world crude oil price market in the mid 2000's, the government made a big adjustment in the subsidised fuel prices. The reform package was announced in 1 October, 2005 consisting of increasing retail fuel prices for gasoline, kerosene, and diesel. The price of gasoline was increased by 87.5%, diesel by 104.7%, and surprisingly kerosene by 185.7%. The huge increase in kerosene price started to doubt many economists about the distributional direction of this reform[1] despite its compensation scheme.

[1]Among others are Azis (2006), Oktaviani et al. (2005), and many others comentators in media.

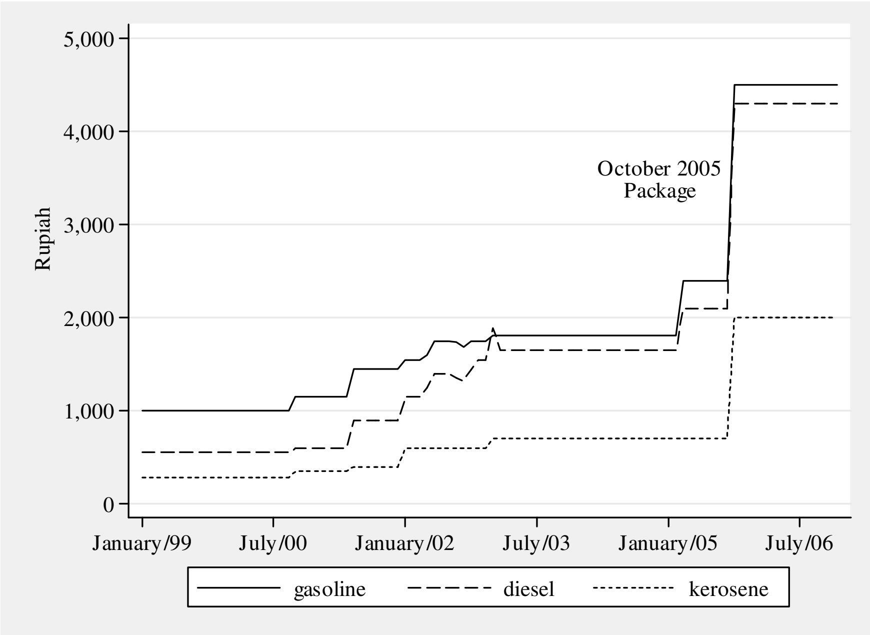

Figure 1: Price of gasoline, diesel, and kerosene, 1999 - 2006

In this case study, a CGE model will be used to simulate the economy-wide and distributional impact of the October 2005 package. The experiment will attempt to answer in greater detail whether or not the reform is progressive (or regressive), as well as its likely impact on poverty. It will also evaluate various scenarious of reform with different types of compensation scheme. This may provide lessons learned, and alternative better scenarios that might have been possible, for further reform in the future. This is still relevant because even after the last "shocking" fuel price increase in October 2005, currently the price of gasoline still 70% of the market price, and the price of kerosene is even still 31% of the market price. The government plans to totally remove this subsidy in the next one or two years. Hence, this is still a big issue that will remain in the near future, especially because kerosene is consumed more proportionally by the urban poor.

This paper is organised as follows. The next section discussed briefly the previous studies that analyse the impact of reducing fuel subsidy in Indonesia, followed by discussion on methodology in the next section. On the methodology, first the Social Accounting Matrix used as the data for the analysis is discussed. After that the structure of the CGE model will be discussed in greater detail which include production structure, household's demand, as well as the method on analyzing distributional impact, the important feature of the model. Later on scenarios, and discussion on the simulation results will be discussed before the final section concludes.

2 Previous studies

World Bank (2006) is the only available study that asses the distributional impact of October 2005 Package. However, other studies that analyse the impact of fuel subsidy reduction or fuel price rise for Indonesia do exist, although are not explicitly on this specific reform. They are Clements et al. (2003), Sugema et al. (2005), and Ikhsan et al. (2005), which were published before October 2005 package was implemented.

The method used by World Bank (2006) is a simulation using SUSENAS 2004 household survey data. It looks at the impact of the increase in various fuel prices on household expenditure, assuming no mitigating substitution effects. The total impact is disaggregated into the impacts of fuel prices; public transport prices (assuming 25 percent pass-through of the diesel price); and the general impact of residual inflation on the rest of the consumption bundle. The overall incremental inflation (due to the fuel price increase) assumption is based on time-series analysis of the overall elasticity of inflation to fuel price increases (0.06 percent for 10 percent increase in fuel prices). The residual (non-fuel; non-transport) incremental inflation rate is computed at about 1.9 percent for the October fuel price increases.

The result suggests that in the absence of any compensatory measures, it is estimated that the October 2005 package would have led to a 5.6 percentage point increase in the poverty incidence. Compensation in the form of unconditional cash transfer to poor and near-poor households, more than offset, on average, the negative impact of the fuel price increase for the poor. Hence, the impact of the combined effects of the fuel price increase and the compensation point to a net positive income gain, overall, for the poorest 20 percent of the population. Even with greater mistargeting of random cash benefit to bottom 60% still lead to positive net impact on the bottom 40%.[2]

It is not clear, however, how household behaviour in this study[3] is modelled. Although the mechanism from fuel prices to inflation seems to be based on historical data, other price transmission, such as transport price from diesel price seems to be ad-hoc. This simulation do not take into account economy-wide effect of the fuel price rises on the supply side, and their likely impact on households factor income through factor market. In this simulation, in seems that household income is assumed to be fixed, only changed by cash compensation.

With regards to distributional story, World Bank (2006) does not distinguish urban and rural households, it only distinguishes household by deciles. Urban and rural distinction may be important since urban poor is the biggest consumers of kerosene (not rural poor), hence poverty impact can not be separated. From SUSENAS 2002, it is calculated that 82.74% of the poorest 20% population are rural, under-represent what could happen to urban poverty.

Ikhsan et al. (2005) analyses the distributional impact of March 2005 fuel price adjustment. The fuel price adjustment are increase in the price of kerosene to industry by 22.22%, gasoline by 32.60%, diesel for transportation by 27.27%, diesel for industry by 33.33, diesel oil and fuel oil by 39.39%. In this price adjustment, kerosene for domestic household use was not increased.

The method used by Ikhsan et al. (2005) is a combination of a CGE model (INDOCEEM[4]) and household survey data simulation. Hence, it is more or less similar to World Bank (2006) but the price or inflation numbers are taken out from CGE model

[2]From Figure 6.1 of World Bank (2006)

[3]Since the description of the methodology is not explained in detail, only briefly at the footnote.

[4]INDOCEEM model is Indonesian CGE model based on ORANI-G developed initially by Monash University and Ministry of Energy.

simulation. In the literature this approach is in the class of top-down micro-simulation, where CGE model and distribution part are separate entity, starting from simulation in CGE and transferred the price result to micro-simulation data. The household survey data used was SUSENAS 2002 consumption module.

The policies examined are March 2005 fuel price rise with various compensation schemes i.e., subsidy to rice and education spending of poor (targeted) households which is the bottom 20%, with various assumption of effectiveness. The fuel price rises was simulated in INDOCEEM model and produce increase in all commodities prices with CPI increase by 0.9718%. The price rises then transferred to the SUSENAS simulation. The result suggests that without compensation poverty rises by 0.24%, whereas with compensation poverty falls by 2.6% if the compensation is 100% effective, and poverty fall by 1.89 if compensation is only 75% effective (table 9 in Ikhsan et al. (2005)).The policies simulated reduce inequality slightly.

The advantage of Ikhsan et al. (2005) is the use of INDOCEEM model where different various fuel commodity is distinguished hence the model allows for different shocks to different type of fuels[5]. However, in INDOCEEM model, there is only one single representative households, hence to see distributional impact it has to rely on other method and this is actually one of the methodological caveat of the approach. First, the use of CGE model to predict nominal price changes is questionable, since in nature CGE model is a real variable model. CGE model can not solve absolute price level, and there always have to be one price that hold fixed, where all price are relative to that numeraire. Changing numeraire. will not change the real solution. Usually in the class of ORANI-G model like INDOCEEM, when CPI is made endogenous, exchange rate is the numeraire, hence all nominal price change are relative to exchange rate. It often the case, that in the CGE model, the magnitude of the price increase is sensitive to changing numeraire. Many CGE modelers avoid direct interpretation of nominal variables results.

Secondly, when the price change is transferred to the SUSENAS-based micro-simulation model, the price change become exogenous, whereas in reality the structure of demand of various households determine new equilibrium prices. This price changes is only determined in single household CGE model in this top-down approach. Thirdly, there is no connection between factor market (which is actually represented in the CGE model) with the micro-simulation, hence households factor income is not affected by the simulation, because there is no direct link between supply side and household income.

In Clements et al. (2003), the CGE model used Social Accounting Matrix with multi households, hence households heterogeneity is integrated[6] directly into the CGE model. In the simulation, the scenario is increasing the price of petroleum product by 25%. This model however has only one type of aggregated fuel commodity, where for distributional story to be relevant, at least kerosene is better to be distinguished. The households however has only 10 categories, and grouped by socioeconomic class, not by income size, hence direct progressivity or regressivity as well as poverty incidence is not easy to be assessed.

Clements et al. (2003) study suggests that real household consumption fall from 2.1%

[5]Not many CGE models can do this because even with 175 sectors I-O table petroleum product sector is not disaggregated. INDOCEEM used specifically designed I-O table built with the help of Indonesian Statistics office (BPS).

[6]As opposed to top-down approach as in Ikhsan et al. (2005)

to 2.7%, where urban and high income suffer the most indicating the progressivity of fuel subsidy removal. It should be noted however that high income category indicated in SAM is not necessarily the highest income size, but based on socioeconomic characteristics which mainly household type of occupation. Clements et al. (2003) argues that high income groups suffer more because they are endowed with relatively more capital and the sectors where production declines most significantly are capital intensive. Higher-income groups also consume more petroleum products and utilities. The study also report increase in poverty but by assuming certain value of elasticity of poverty to mean consumption.

Another study is conducted by Sugema et al. (2005) where they analyse the impact of March 2005 fuel price rises. In this study, the poverty impact analysis is carried out using SUSENAS based simulation, and more macro-impact is carried out using ORANI-based CGE model. Both method is conducted separately or not related.

In the CGE approach, the model use 10 SAM households categories, where 29% increase in petroleum price is simulated. Since there is only one single petroleum product in this model, it is not really represent the March 2005 price adjustment because kerosene did not rise in the March package, the impact on households will be over-estimated. The result suggests that petroleum product consumption by households fall from 17.51% to 22.86%. Again, however, it should be noted, that especially in urban area household fuel consumption is mainly kerosene, where its price is not changing, hence this results is a very rough if not inaccurate approximation. The impact on welfare (measured by utility) fall from -0.09% to 1.48%, and not much different whether compensated or not. Aggregate household real consumption fall by -.99 (without compensation), and by -0.91 (with compensation).

More detail distributional story in Sugema et al. (2005) is analysed using SUSENAS 2004 data. March 2005 fuel price is *assumed* to lead to inflation of 12.5%. Assumption on effectiveness of compensation is based on previous compensation scheme. With the assumption that fuel price rise of March 2005 will lead to inflation of 12.5%,poverty line will rise (with the assumption that elasticity is 1.3). As a result, poverty will rise by 1.95%. With petroleum price rice of only 29% this poverty impact is considered very big. This may be mainly due to the assumed high elasticity of inflation with respect to fuel price rise which is 0.43, as well as the elasticity of inflation with respect to poverty line (1.3). For comparison World Bank (2006), only assume that 0.06 percent inflation for 10 percent increase in fuel prices, which is based on historical data. Again this many assumption made are among the caveats of these studies.

3 Social Accounting Matrix (SAM)

The distributional impact of policies analyzed in the CGE modelling framework have been constrained in part by the absence of a Social Accounting Matrix (SAM) with disaggregated households. Since Indonesian official SAM does not distinguish households by income or expenditure size, it has prevented accurate assessment for the distributional impact, such as calculation of inequality or poverty incidence. The SAM used in this paper, is a specially-constructed SAM representing Indonesian economy for the year 2003, with 181 industries, 181 commodities, and 200 households (100 urban and 100 rural households grouped by expenditure per capita centiles) was constructed. The SAM (with the size of 768x768 accounts) constitutes the most disaggregated SAM for Indonesia at both the sectoral and household level.

The construction of the SAM is a lengthy process and consumed a lot of research resources, such as fieldwork and data collection, hence it will not covered in this paper. The nature of constructing specifically-designed SAM with distributional emphasis not only require large-scale household survey data but also involved reconciliation of various different data sources. Interested readers can refer to Yusuf (2006). The structure of the SAM can be seen from table 2.

Table 2: Structure of 768×768 Indonesian SAM

			Commodity		Factor									
		Activities 1⋯181	Domestic 1⋯181	Imported 1⋯181	labour 1⋯16	Capital	Ind. Tax	S-I	Households 1⋯200	Transfers	Enterprises	Gov't	ROW	TOTAL
Activities	1 ⋯ 181		MAKE Matrix											Industry Sales
Domestic Commodities	1 ⋯ 181	Domestic Intermediate Input						Domestic Investment	Domestic Hou. Consumption			Domestic Gov't Consumption	Export	Total Dom. Demand
Imported Commodities	1 ⋯ 181	Imported Intermediate Input						Imported Investment	Imported Hou. Consumption			Imported Gov't Consumption		Total Import
labour	1 ⋯ 16	Salary and Wages											labour used abroad	Total labour Demand
Capital		Non-labour											Cap. used abroad	Capital Demand
Ind. Tax		Tax/ Subsidy		Tariff										Ind. Tax Reven.
Urban HH	1 ⋯ 100				labour Income: Urban	Capital Income: Urban				Inter-Hous. Transfer			ROW transfer to HH	Total Hous. Income
Rural HH	1 ⋯ 100				labour Income: Rural	Capital Income: Rural				Inter-House. Transfer			ROW transfer to HH	Total Hous. Income
Transfer									Transfer to HH					Int. Hou. Transfer
S-I									Household Saving		Enterprise Saving	Gov't Saving		Total Saving
Government							Ind.Tax Revenue		Direct Tax		Ent. Trans. to Gov't	Inter G Transfer	ROW Tans. to Gov't	Govt Revenue
Enterprises						Enter-Capital					Inter Ent. Trans.		ROW Trans. to Enter.	Ente. Income
ROW				Import	Foreign labour	Foreign Capital			HH Transfer to abroad		Ent Trans. to abroad	G. Transfer to abroad		Forex Outflow
TOTAL		Industry Costs	Dom. Supply	Import Supply	labour Supply	Capital Supply	Ind. Tax Revenue	Total Invest.	Household Spending	Int. Hou. Transfer	Enter. Spending	Govern. Spending	Forex Inflow	

Table 2 shows the structure of the Social Accounting Matrix. It has 768 rows and 768 columns in all. It distinguishes industries from commodities to allow for industries producing multiple commodities. It distinguishes 181 sectoral classifications, and 200 households (100 urban and 100 rural classified by centile of expenditure per capita) classified by centile of expenditure per capita.

The data sources used in this SAM construction are (1) Official BPS SAM 2003 (102×102 accounts); (2) 181 sectors Input-Output table 2003; (3) SUSENAS Core Module 2003, with 894,427 individual observations; (4) SUSENAS Core Module 2002, with 862,210 individual observations; (5) SUSENAS Consumption Module 2002, with 64,441 household observations; and (6) SUSENAS Income Module 2002, with 64,441 households observations.

4 CGE Model

The CGE model is built based on ORANI-G model, an applied general equilibrium (AGE) model of the Australian economy. Its theoretical structure is typical of a static AGE model which consists of equations describing (1) producers' demands for produced inputs and primary factors; (2) producers' supplies of commodities; (3) demands for inputs to capital formation; (4) household's demand system; (5) export demands; (6) government demands; (7) the relationship of basic values to production costs and to purchasers' prices; (8) market-clearing conditions for commodities and primary factors; and (9) numerous macroeconomic variables and price indices (Horridge 2000).

Demand and supply equations for private-sector agents are derived from the solutions to the optimisation problems (cost minimisation, utility maximisation, etc.) which are assumed to underlie the behaviour of the agents in conventional neoclassical microeconomics. The agents are assumed to be price-takers, with producers operating in competitive markets with zero profit conditions.

To the standard ORANI-G model, the following modifications in the model structure[7] are carried out.

1. ORANI-G model treats energy commodity as among intermediate inputs under Leontief production function. Therefore, it does not allow price-induced energy substitution. The first modification is to allow substitution among energy commodities, and also between primary factors (capital, labor, and land) and energy. This modification is more or less similar to the modification in the INDOCEEM[8] model, another ORANI-G based model built by Monash University and Indonesian Ministry of Energy.

2. ORANI-G has only single household. Adding multi-household feature, then, is another important modification to the model. The multi-household feature is not only added to the expenditure or demand side of the model[9], but also from the

[7]To be distinguished from modification to the model's database.

[8]which stands for Indonesian Comprehensive Economy and Energy Model.

[9]Such as done for some of other ORANI-G version.

income side of the households[10].

3. ORANI-G model is almost purely based on Input-Output table, whereas for this research many information require information from Social Accounting Matrix. In a SAM, for example, corporate sector or enterprises own a great deal of undistributed earning, and the value of transfers among institution such as from government to households are recorded. Those important feature which is crucial for this model can not be captured form simply I-O based model. The model is then modified to incorporate transfers inter-institutions, most importantly from government to households.

4.1 Production Sectors

The structure of the nested production function for each industry is illustrated in figure 2. At the very bottom part, industry choose how many each type of labor demanded and determine the number of labor composite according to Constant Elasticity of Substitution aggregation function. More formally, every industry solve the following optimisation problem,

$$\min \sum_{o} w_o L_o \text{ s.t. } \tilde{L} = \text{ CES}\left(L_1, L_2, \ldots, L_O\right)$$

where w_o is wage of each of the occupational type, L_o is the number of labor for each occupation type, and $\tilde{L}$ is labor composite, and $o = 1, \ldots, O$. List of skill-type of labor can be seen in table 8 at the Appendix. In this model, the classification of the labor type is fairly detail and also represent the higher degree of dualistic nature of informality in the labor market, typical in developing countries. Therefore in this model, formal and informal labor, for example, are not perfect substitutes, and paid with different wages. This typical informality is often neglected in many others CGE model.

At the next stage, the optimisation problem for each of the industry is,

$$\min P^K K + P^N N + \tilde{w}\tilde{L} \text{ s.t. } V = \text{ CES}\left(K, N, \tilde{L}\right)$$

where K and P^K are capital and price of capital respectively, N and P^N are land and price of land respectively, and $\tilde{L}$ and $\tilde{w}$ are labor composite and its price respectively, whereas V is value added or primary factor composite.

At the other end, for every energy commodity, each industry optimise to choose the source of the commodity from either local or imported commodity, or

$$\min P_e^D E_e^D + P_e^M E_e^M \text{ s.t. } \tilde{E}_e = \text{ CES}\left(E_e^D, E_e^M\right)$$

where P_e^D and E_e^D are price of domestic energy e and quantity of domestic energy e respectively, where P_e^M and E_e^M are price of imported energy e and quantity of imported energy e respectively, whereas $\tilde{E}_e$ is domestic-imported composite of energy e.

[10] More or less similar modification to ORANI-G model has been made to the very popular WAYANG model, an ORANI-G based Indonesian CGE model.

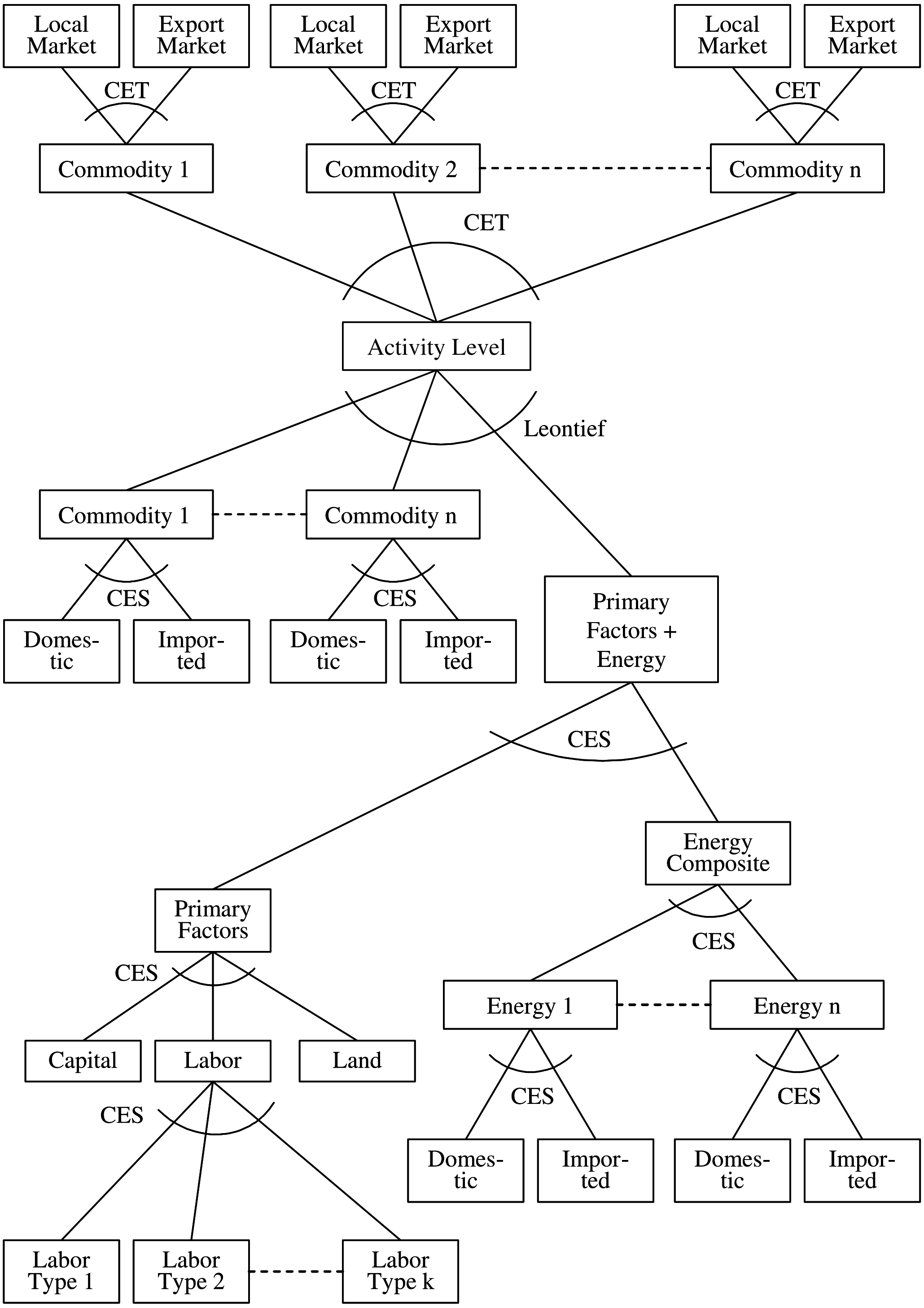

Figure 2: Structure of Production

The industry, then, choose the composition of energy type for every energy composite that they need,

$$\min \sum_{e} \tilde{P}_e \tilde{E}_e \text{ s.t. } E^C = \text{ CES} \left(\tilde{E}_1, \tilde{E}_2, \ldots, \tilde{E}_E \right)$$

where $\tilde{P}_e$ and $\tilde{X}_e$ are price and quantity of domestic-imported composite energy e, respectively, while E^C is the energy composite.

Industries are allowed to substitute between energy and primary factors, so they are solving the following optimization problem

$$\min P^E E^C + P^V V \text{ s.t. } VE = \text{ CES} \left(V, E^C \right)$$

where P^E is the price of energy composite, and P^V is the price of primary factor composite, while VE is value-added and energy composite.

At the top of the production nest, each industry minimises cost of purchasing intermediate costs and primary-factor-energy composite to produce output of the activity level using Leontief production function, or

$$\min \sum_{c} P_c X_c + P^{VE} VE \text{ s.t. } A = \min \left(X_1, X_2, \ldots, X_C, VE \right).$$

where P_c and X_c are price and quantity of intermediate commodity c respectively, where A is activity level or total output of industry.

In this model, each industry is allowed to produce multiple commodities[11], such that

$$\max \sum_{c} P_c X_c \text{ s.t. } A = \text{ CET} \left(X_1, X_2, \ldots, X_C \right)$$

where CET refer to Constant Elasticity of Transformation function. And finally, industry can choose to sell either in local or export market such that the optimisation problem is

$$\max \sum P_c^D X_c^D + P_c^E X_c^D \text{ s.t. } X_c = \text{ CET} \left(X_c^D, X_c^E \right)$$

where P_c^D and X_c^D are price and quantity of commodity sold to local/domestic market, whereas where P_c^E and X_c^E are price and quantity of commodity supplied to export market.

The model has 38 number of sectors and 43 number of commodities. All industry producing single commodity except petroleum refinery sector where it produces 6 type of commodities i.e., gasoline, kerosene, automotive diesel oil, industrial diesel oil, other fuels, and LPG. This is the aggregation from 181 sectors/commodities in the Social Accounting Matrix, as discussed in the earlier section. Since fuel commodities is disaggregated in detail, it can capture accurately how the October 2005 package was implemented, because the rise in the fuel prices are different across fuel commodities.

[11] Although in the model, it will only applies to a single refinery industry that allow to produce multiple type of fuels.

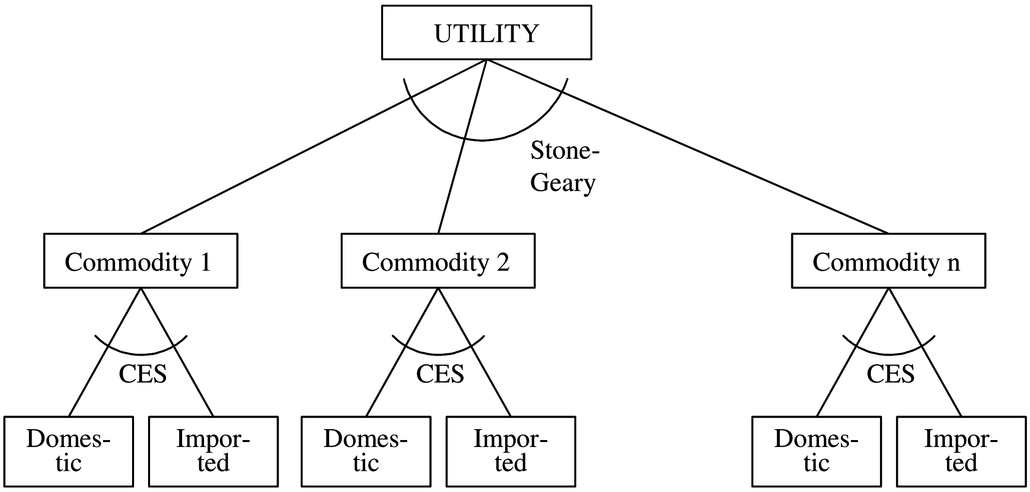

Figure 3: Structure of Household's Demand

4.2 Households

Household optimisation problem is illustrated in figure 3, where each household maximize Stone-Geary Utility function (in log form),

$$U = \sum_i \beta_i \log(x_i - \gamma_i)$$

where x_i is consumption of good i, γ_i is subsistence consumption of good i, $x_i > \gamma_i$, $0 \leq \beta_i \leq 1$, and $\sum_i \beta_i = 1$,

subject to

$$y = \sum_i p_i x_i.$$

This will yield the following demand system in expenditure form, which is called Linear Expenditure System (LES).

$$p_i x_i = p_i \gamma_i + \beta_i \left(y - \sum_j p_j \gamma_j \right)$$

Compared to Cobb-Douglas and CES demand system, LES is richer for distributional effect analysis, because income elasticity is not constant, hence the impact on the same percentage shock on each household income, would generate different behavioral responses by each households. The natural reason that income elasticity of households are different is that marginal utility of income vary with level of income. Poor households will have higher marginal utility of income, while rich household will have lower. In the LES, this is captured by Frisch parameter that varies with income level.

4.3 Model Database and Parameters

The database for the model is built based on the Social Accounting Matrix 2003 specifically constructed for this research, as described in detail in the earlier section. For the purpose of the case studies, the industry is aggregated into 38 sectors and the commodity is aggregated into 43 sectors.

There are some sets of parameters of which their values have to be estimated or borrowed from literature or other models. Those set of parameters are,

1. Armington elasticity between domestic and imported commodities, σ_c^{ARM}.
2. Export elasticity, ε_c^{EXP}.
3. Elasticity of substitution among labor types (or skills), σ_i^{LAB}.
4. Elasticity of substitution among primary factors, σ_i^{PRIM}.
5. CET transformation for industries with multiple commodities, σ_i^{CET}.
6. Elasticity of substitution among energy types, σ_i^{EN}.
7. Elasticity of substitution between energy composite and primary factor, σ_i^{VE}.
8. Expenditure elasticity for LES household demand system, ε_{ih}, and
9. Frisch parameter, elasticity of marginal utility of income, ϕ_h.

Parameter 1 to 5, σ_c^{ARM}, ε_c^{EXP}, σ_i^{LAB}, σ_i^{PRIM}, σ_i^{CET}, are taken from GTAP database. Parameter 6 and 7, σ_i^{EN} and σ_i^{VE}, is borrowed from INDOCEEM model. Parameter ε_{ih} are estimated econometrically, and Frisch parameter ϕ_h is calculated based on the study by Lluch et al. (1977).

It can be shown that all parameters of the LES household demand can be written as a function of only expenditure elasticity and Frisch parameter, the elasticity of marginal utility of income. Hence parameter of the demand system that are supplied to the model are those two parameters, expenditure elasticity for specific commodity and specific household, ε_{ih}, and Frisch parameter for each households, ϕ_h.

The best approach to estimate the parameter of the LES is using a demand system estimation model. However, the household survey data (SUSENAS) does not have data on most prices and obtaining prices from data on value and volume of consumption is not possible. The alternative is to estimate the expenditure elasticities by the regression of the Engel curves. Following Deaton and Case (1988), The Engel curve is specified for 44 broad commodity classification i for urban and rural sample, specified as,

$$w_i = \alpha_i + \beta_i \ln(y) + \gamma_i \ln(s) + \sum_j \theta_{ij} R_j + e_i$$

where w_i is expenditure share of commodity i, y is total expenditure, s is household size, R_j is regional (provincial) dummy variables, and e_i is error term. The engel curves are estimated using OLS method with robust (Hubber-White) standard error. Expenditure elasticity for commodity i, ε_i is calculated as

$$\varepsilon_i = 1 + \frac{\beta_i}{w_i}$$

Table 3 shows the regression result and the calculated expenditure elasticities using mean of expenditure share over the samples.

Frisch parameter is calculated based on the widely-known study by Lluch et al. (1977) that estimated the relationship between Frisch parameter and income per capita. The conjecture from the study is used to calculate the Frisch parameter for each household, that is

$$\phi_h = -36 \cdot y^{-0.36}$$

where y is income per capita in 1970 US Dollar.

Table 3: Estimation Result of the Engel Curve and Expenditure Elasticity

	Urban				Rural			
Commodity	β_i	s.e		ε_i	β_i	s.e.		ε_i
Automotive diesel oil	0.00061	0.00007	**	3.397	0.00074	0.00029	*	5.604
Food (agriculture)	-0.00794	0.00021	**	0.614	-0.01880	0.00060	**	0.551
Appliances	0.00234	0.00013	**	1.561	0.00540	0.00020	**	2.082
Beverages	0.00512	0.00020	**	1.559	0.00466	0.00024	**	1.776
Chemical products	-0.00849	0.00022	**	0.799	-0.00517	0.00026	**	0.874
Clothes	0.00118	0.00010	**	1.123	0.00282	0.00013	**	1.291
Coffee and tea	-0.00460	0.00008	**	0.497	-0.00469	0.00013	**	0.647
Communication equipment	0.00424	0.00026	**	1.989	0.00725	0.00040	**	3.426
Communication services	0.02341	0.00037	**	2.866	0.00330	0.00019	**	4.771
Dairy products	0.00875	0.00035	**	1.565	0.00933	0.00029	**	2.427
Drugs/medicines	0.00002	0.00012		1.004	-0.00015	0.00014		0.964
Edible oil	-0.00930	0.00012	**	0.475	-0.01108	0.00017	**	0.556
Education	0.01258	0.00055	**	1.575	0.00346	0.00031	**	1.453
Electricity	0.00083	0.00021	**	1.033	0.00126	0.00020	**	1.079
Fish	-0.01234	0.00038	**	0.754	-0.00277	0.00058	**	0.958
Flours/bread	0.00235	0.00015	**	1.242	0.00155	0.00022	**	1.166
Fruits	0.00612	0.00029	**	1.220	0.01019	0.00039	**	1.374
Furniture	0.00186	0.00011	**	1.810	0.00414	0.00019	**	2.787
Gasoline	0.01456	0.00031	**	2.270	0.01130	0.00028	**	3.063
Water and gas	0.00166	0.00012	**	1.275	0.00063	0.00006	**	1.674
Health	0.00731	0.00074	**	1.488	0.00985	0.00077	**	1.758
Hotel and restaurant	0.00753	0.00054	**	1.188	0.01268	0.00065	**	1.607
Jewelry	0.00218	0.00016	**	1.767	0.00563	0.00029	**	2.953
Kerosene	-0.01530	0.00020	**	0.228	-0.00302	0.00021	**	0.840
Livestock	-0.00331	0.00023	**	0.888	0.01122	0.00037	**	1.418
LPG	0.00424	0.00009	**	2.166	0.00182	0.00008	**	3.432
Meat	0.00894	0.00028	**	1.475	0.01483	0.00035	**	2.228
Noodles	-0.00112	0.00014	**	0.890	0.00329	0.00017	**	1.382
Other durable	-0.00397	0.00029	**	0.607	-0.01973	0.00052	**	0.358
Other fuels	0.00348	0.00009	**	2.177	0.00424	0.00020	**	3.175
Other transportation	0.00488	0.00058	**	1.238	0.00893	0.00075	**	2.072
Food (manufacturing)	-0.01072	0.00062	**	0.890	0.00368	0.00066	**	1.050
Other services	0.04807	0.00153	**	1.352	0.00459	0.00086	**	1.061
Paper/print products	0.00541	0.00017	**	1.623	0.00281	0.00024	**	1.500
Plastic, ceramics, etc	0.00092	0.00008	**	1.311	0.00232	0.00012	**	1.645
Recreation	0.00107	0.00008	**	2.162	0.00094	0.00007	**	2.643
Rice	-0.08405	0.00074	**	0.191	-0.12345	0.00101	**	0.358
Road transportation	0.00116	0.00016	**	1.134	0.00269	0.00014	**	1.774
Sugar	-0.00913	0.00012	**	0.423	-0.01000	0.00020	**	0.611
Textiles	-0.00001	0.00024		1.000	0.00450	0.00032	**	1.137
Tobacco products	-0.00813	0.00068	**	0.867	0.02490	0.00101	**	1.315
Vegetables	-0.02382	0.00029	**	0.498	-0.02076	0.00040	**	0.678
Vehicles	0.02141	0.00103	**	3.576	0.03471	0.00158	**	6.171

Note: **) significant at 1%, *) significant at 5%. Source: SUSENAS 2002 Consumption Module

4.4 Method for Analyzing Distributional Impact

In a general equilibrium framework, the distributional impact of any exogenous shocks to the model (e.g., policy or external shocks) works through the market mechanism. Optimising firms will change their demand for factor inputs, intermediate inputs, and their supply of commodities. Change in a firm's demand for factors will affect factor prices, i.e., wages and non-labour income or employment, in the factor market, and at the end affect household's incomes and its distribution across households. Change in the income of every household depends on the composition of factor ownership (unskilled labour, skilled labour, capital, or land) of the household.

Change in household income together with change in all commodity prices, will simultaneously change household expenditures on various commodities. This will affect distribution of income and expenditure. In a general equilibrium framework, this series of mechanisms, works simultaneously in inter-related markets. Therefore, any attempt to assess the distributional impact of policies, by identifying either their impact on household expenditure "or" household income will be considered incomplete, because it is a one-sided story. Both sides are endogenous, and a CGE model elegantly takes these two different forces into account.

Figure 4 illustrate how, for example, subsidy cut on fuels affect distribution across households. Government may affect commodity prices through indirect taxes and subsidies. Subsidy cut on fuels will increase price of fuels sold in the commodity market. Household's demand for fuels will fall. Household's demand for other commodities may change as well because in a demand system, commodities are inter-related. Household's total expenditure will change, and this will affect their welfare. How much each household's expenditure change depends on their consumption pattern, which vary across households. However, this is not the end of the story.

Since fuels are also used by industries as intermediate, the rise in their prices will affect industry's optimal decision on the production process. Transportation sectors, for example, will be heavily affected, and most probably will contract, as well as some other industries. Industry's decision on production will affect their demand for various factors of production such as skilled labor, unskilled labor, and capital. This will in turn will change their prices such as wages, or employment in the factor market. Since factors of production are supplied by households, will experience decline in their factor incomes.

How much each of the households experience income falls depend on their composition of factor ownership, and depend on how much their income will fall/rise from employment change or wages. When household's income falls, again this will affect household demand for commodities, and household's expenditures. When new equilibrium is found, the end results is the new distribution of household's welfare which could be measured by the new distribution of their (real) expenditure.

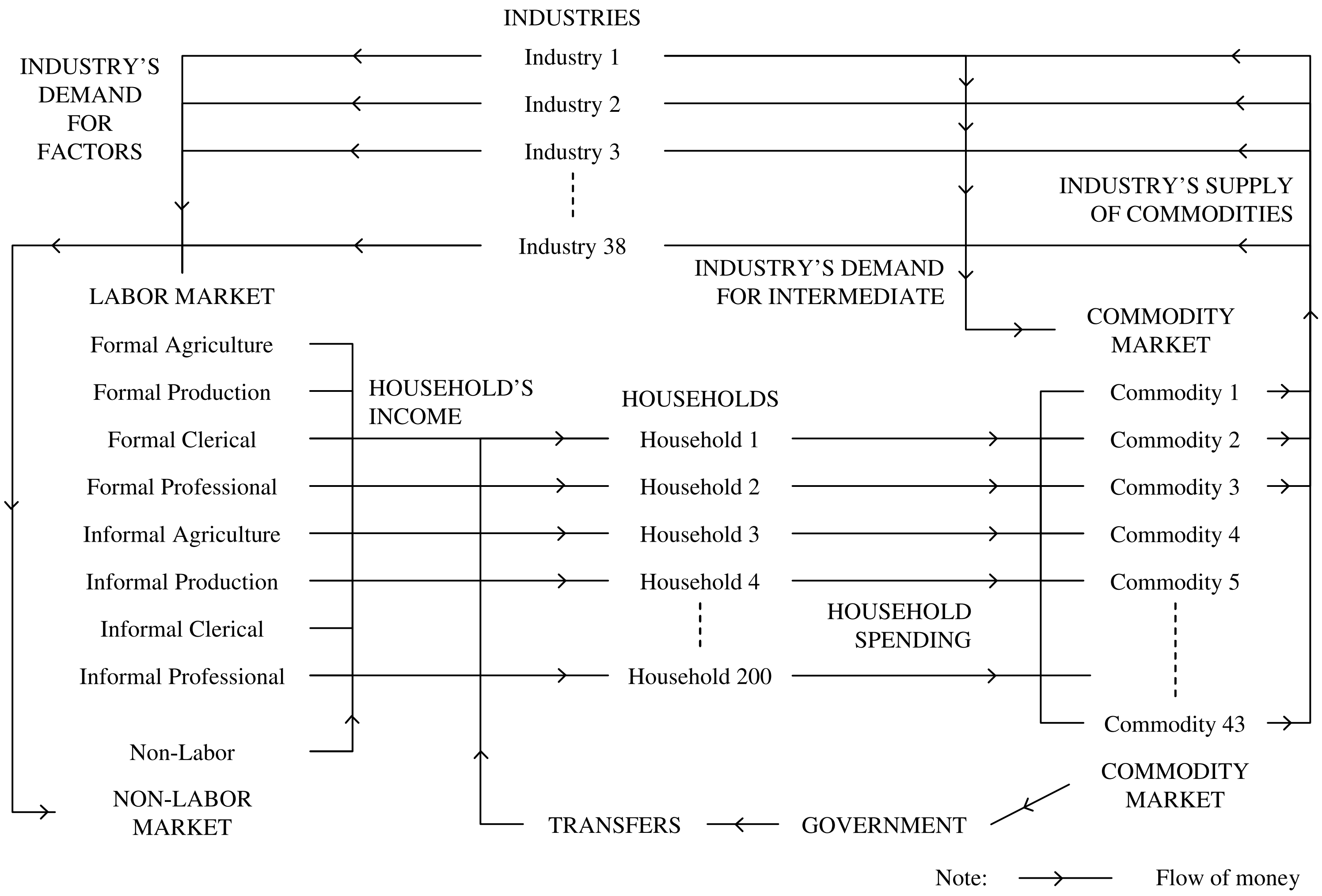

Figure 4: The Mechanism by Which Subsidy Cut on Commodities Affect Distribution of Income

There are a few approaches for dealing with income distribution analysis in a CGE model. The traditional one is the representative household method, where it is assumed income or expenditure of households follows a certain functional form of distribution[12]. Distribution is assumed to remain constant before and after the shock, and usually the behaviour of the group is also dominated by the richest. There has been growing evidences to suggest that variation within one single household-category is important and can significantly affect the results of the analysis (Decaluwé et al. 1999). Household-specific shocks, such as transfers to targeted household groups, are also impossible to carry out with this approach. Studies for Indonesia by Sugema et al. (2005) and Oktaviani et al. (2005), among others, belong to this type of approach.

The most common studies for Indonesia are CGE studies that use the official household classification of the SAM, i.e., 10 socioeconomic classes. The distributional impact is only analyzed by comparing the impact of policies among these socioeconomic classes. Studies by Clements et al. (2003) Resosudarmo (2003), Azis (2000), and Azis (2006), among others, follow this approach.

Another approach is a top-down method, where price changes produced by the CGE model are transferred to a separate micro-simulation model, such as a demand system model or an income-generation model. Price changes are exogenous in this micro-model, hence endogeneity of prices is ignored. Studies for Indonesia by Bourguignon et al. (2003) and Ikhsan et al. (2005) are among this type of approach. Some attempt has been made to improve this approach by providing feedback from the micro-model to the CGE model. Belonging to this category among others are studies by Filho and Horridge (2004) for Brazil, and Savard (2003) for the Philippines.

The most recent approach is multiplying the number of households into as many as households available in the household level data. Increasing computation capacity allows a large number of households to be included in the model. It allows the model to take into account the full detail in the household data, and avoids pre-judgment about aggregating households into categories. All prices are endogenously determined by the model, and no prior assumption of distribution parameter is necessary. Difficult data reconciliation and that the size of the model can become a constraint are among the drawbacks of this approach. This integrated-microsimulation-CGE model has been conducted in various studies including Annabi et al. (2005) for Senegal, Plumb (2001) for U.K., Cororaton and Cockburn (2005) and, Cororaton and Cockburn (2006) for the Philippines.

The last approach, to be used in this paper, is disaggregating or increasing the number of household categories by the size of expenditure or income per capita. If the categories is detailed enough, such as centiles, the distributional impact such as poverty incidences or standard inequality indicators can be estimated more precisely. For example, Warr (2006) used this approach for Laos in assessing the poverty impact of large scale irrigation investment.

The ideal approach in distributional analysis where disaggregated households are integrated in the CGE model is when all observations in the household survey are integrated in the model like in the Micro-simulation CGE models. If using only 100 representative household classified by centile for expenditure per capita, how accurate is the distributional story? As figure 5 illustrates poverty incidence and inequality calculation could be

[12] Of which the most popular one is log-normal distribution.

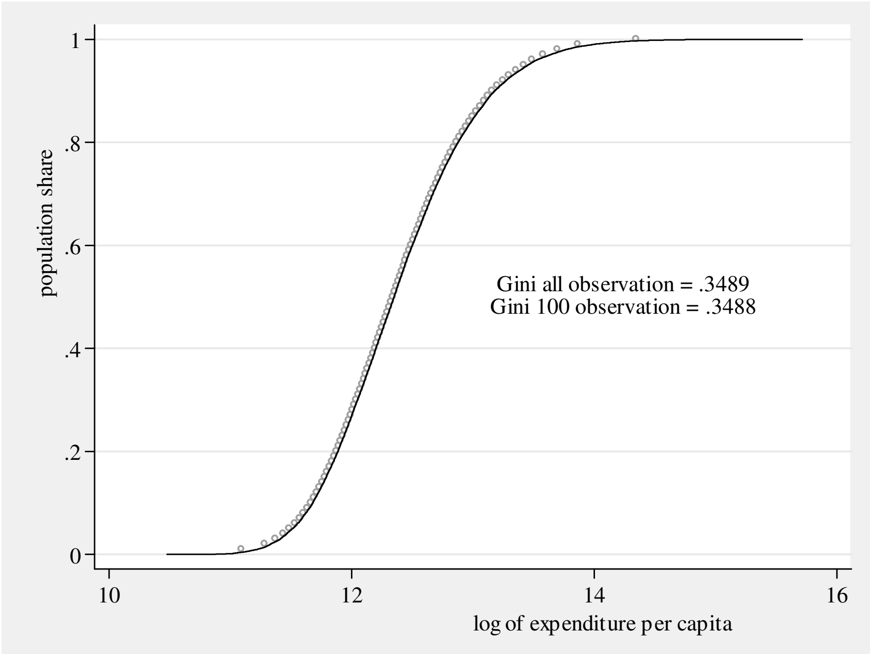

Figure 5: The accuracy of distributional analysis using 100 centiles

fairly accurate. The solid line represents the continuous data point of urban households of 29,278 observations using SUSENAS 2003 consumption module. This line can be used to calculate poverty incidence when we have the relevant poverty line. The gray circle points represent the data points where observations are collapsed or aggregated into 100 households by centiles of expenditure per capita. Calculating poverty incidences using only these 100 data points seems to be fairly accurate. Moreover, the calculation of Gini coefficient using all 29,278 observations and using only 100 observations produce almost identical results.

Poverty incidence is simply calculated by finding a point in the vertical axis in figure 5, where the expenditure curve cross the vertical line representing poverty line. Since using only 100 centiles, only discrete number of poverty incidence can be found, the exact poverty incidence is linearly approximated to find the residual decimal point.

Let y_c is real expenditure per capita of household of the c-th centile where $c = 1, \ldots, n$, and $n = 100$. Poverty incidence then is calculated using

$$P(y_c, y_P) = \max\{c | y_c < y_P\} + \frac{y_P - \max\{y_c | y_c < y_P\}}{\min\{y_c | y_c > y_P\} - \max\{y_c | y_c < y_P\}}$$

where y_P is the poverty line. The first term is simply the centile of which expenditure per capita is the closest from the origin (the left) to the poverty line. The second term is the linear approximation of the decimal point of the poverty incidence. This formula is illustrated in figure 6.

The change in poverty incidence after a policy shock (simulation) is calculated as

$$\Delta P = P(y'_c, y_P) - P(y_c, y_P)$$

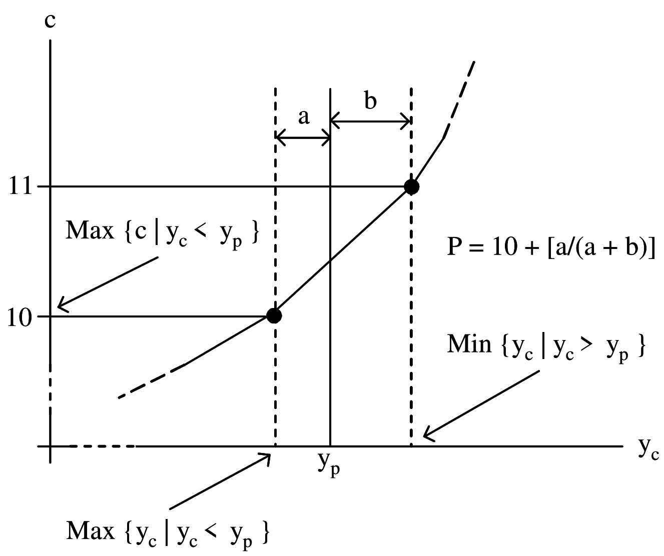

Figure 6: Calculating Poverty Incidence

where

$$y'_c = \left(1 + \frac{\hat{y}_c}{100}\right) \cdot y_c$$

where $\hat{y}_c$ is the percentage change in *real* per capita expenditure of household of the centile c produced from the simulation of the CGE model.

Gini coefficient is calculated as

$$G(y_c) = \frac{1}{n}\left(n + 1 - 2\frac{\sum_{c=1}^{n}(n + 1 - c)\, y_c}{\sum_{c=1}^{n} y_c}\right)$$

5 Scenario, closure and simulation strategy

5.1 Scenarios and simulation strategy

Table 4 summarises the scenarios to be simulated. All of the scenarios are related to the October 2005 package of fuel price reform i.e., increasing the price of gasoline by 87.5%, diesel by 104.7%, and kerosene by 185.7%. The initial database (which represent the equilibrium in the economy), is modified to mimic the fuel price system of the year 2005 before the implementation of the reform, in the sense that the rate of fuel subsidy represent the situation in 2005 where the market (or international) price of fuel products is relatively high due to rapid increase in the crude oil price.

There are two ways of conducting the simulation; first is by reducing subsidy rate and let the price determined endogenously by the model. However, it does not exactly mimic the implementation in the reality since fuel prices is administered or determined in Indonesia, and once it is announced it will stay the same until another adjustment. In this sense, fuel prices can be regarded as exogenous. It is also hard to determine how much the subsidy rate should be reduced to mimic the October 2005 package. The second

Table 4: Simulation Scenarios

	Scenario	Note
SIM 1.	NO-KER	October 2005 Package without increasing kerosene price (Gasoline 87.5%, Diesel 104.7%)
SIM 2.	ALL FUELS	October 2005 Package (Gasoline 87.5%, Diesel 104.7%, Kerosene 185.7%)
SIM 3.	100% UT	October 2005 Package with unconditional cash transfers to targeted household of Rp. 1.2 million with 100% effectiveness.
SIM 4.	75% UT	October 2005 Package with unconditional cash transfers to targeted household of Rp. 1.2 million with 75% effectiveness.
SIM 5.	100% UTUR	October 2005 Package with unconditional cash transfers to targeted household with higher amount to urban household and lower amount to rural household (100% effectiveness)
SIM 6.	CT ONLY	Conditional transfers to be spent on education and health
SIM 7.	CT	October 2005 Package with conditional transfers to be spent on education and health

approach then is used, i.e., the price of fuels are set exogenously and subsidy rate is set to be determined endogenously in the model. In this way the simulation can represent exactly the rate of price increase as exactly announced by the government on the first of October 2005.

The objective of Simulation 1 (SIM 1 NO-KEROSENE) is to see the economy wide impact and more importantly the distributional direction of October 2005 package, had the kerosene price increase were not included. Many Indonesian economists believed that fuel price subsidy in itself benefit mostly the riches, hence, its removal or its reduction will hurt the riches more relative to the poor. Therefore a reform will be considered progressive. However, it will be argued that in Indonesia, kerosene, is part of important consumption of the poor especially in urban area. It will be compared and shown that the expectation of progressive nature of fuel price reform will more likely to be the case if the reform reduced the subsidy of only gasoline and diesel which are very likely to be important part of the riches' expenditure and did not touch kerosene. The simulation is intended only to see the direction of subsidy reduction (or ceteris paribus), hence will exclude compensation.

In simulation 2 (SIM 2 ALL FUELS), October 2005 reform package in the form of increasing fuel prices is implemented without compensation scheme. It is again to see how its distributional impact would have been likely if the big reform like this was implemented without compensation.

Simulation 3 (SIM 3 100% UT) is exactly what was implemented by the Government i.e., increasing price of gasoline by 87.5%, diesel by 104.7% and kerosene by 185.7% plus unconditional cash transfers to targeted households. Being unconditional means that the transfers is lump-sum and recipients households have any discretion on how it can be spent.

To whom was the compensation be targeted? In the initial database, poverty incidence is calculated based on the official SUSENAS-based poverty incidence in 2005. The approach is to find poverty line in urban and rural area that will give exact number of official poverty incidence. The poverty incidence in urban area is 11.37%, 19.51% in rural area, and 19.65% nation-wide. However, it turned out that the target of the compensation is not only those below official poverty line, but also those who are called the near poor.

Initially, the program was targeted to 15.5 million poor and near-poor households (around 28 percent of the national population and in excess of the poverty rate of 16 percent) (ESMAP 2006). However, later on, the recipients list was blown up to 19.2 million households (BPS 2006). The recipients then are well beyond the poor as defined by SUSENAS poverty line. The number of recipients households (and population) is calculated and equivalent to, in proportion, almost twice poverty incidences in urban and rural area. Therefore, in the simulation, the cash transfers will be given to the lowest 24% of the population in urban area, and the lowest 42% in rural area. With this estimate, the total amount of transfers is Rp. 18.3 trillion rupiahs (in 2003 price level, since the model database is using SAM 2003)[13]. World Bank (2006) even considered this scheme as the world's largest ever cash transfer program. The actual size of the transfer was Rp 300,000 per household and disbursed every three months, totalling Rp 1.2 million in one year. For the purpose of the simulation, the nominal transfers is deflated to the year 2003.

In simulation 3, it is assumed that the compensation scheme is 100% effective. This

[13]With 19.2 million households as beneficiaries the actual amount in 2005 price level will be around Rp 23 trilion rupiahs.

is clearly too idealistic. There are many possible sources of the ineffectiveness of the compensation. The ex-ante targeting may be imperfect, in the sense, that the entitled households were not among the target, and the households who are not entitled, on the other hand, were among the target. This source of ineffectiveness was mainly due to statistical error of recording. Another source of ineffectiveness is the possibility that the compensation did not reach the targeted households (although already disbursed) or not fully reach the target. This may happen due to ineffective administration or bureaucracy in the process of disbursement, as well as corruption.

There is not yet any consensus, however, on the degree of effectiveness of the compensation scheme. One study by SMERU (2006), however may give an indication. SMERU (2006) compared the number of recipient households with the number of poor households across regions and examined its correlation. This could be done, because SMERU (2006) uses the poverty mapping that enable observation in geographical detail. The exercise suggest a coefficient correlation of 0.65 to 0.72. Based on this result, another simulation, i.e. simulation 4 (SIM 4. 75% UT) is conducted by assuming that the effectiveness of compensation is 75 percent. In this simulation, the amount of cash that is given to every centile group of households is reduced by 25%. This can be interpreted as mistargeting of households within each centile group or it may also be interpreted as the amount of cash received by the targeted households die out by 25%. In practice, both cases could happen.

Another issue that seems missing in the public discussion with regard to the effectiveness of compensation scheme is the simplistic way of giving the same amount of money to all household across Indonesia. Indonesia is a large country, and its geographic nature (such as being an archipelago of thousand of islands) is among the reason why price level, for example, vary across regions. Even if, the setting and planning for various different amount of transfer geographically seems not to be a simple task, at least distinction between urban and rural household might have made more sense. Simply using information from the most recent household survey, It is not difficult to see that urban households will be hurt more by the jump in kerosene price, compared to rural households, simply because poor household consume a lot less of kerosene. Therefore, giving the larger amount of money to urban poor households and less money to rural poor households could have been regarded as a sensible option. Simulation 5 (SIM 5 100% UTUR), then, attempts to simulate slight modification in the scheme by giving different amount of transfer to urban and rural household, since might help preventing even urban households poor fell into poverty.

In this simulation, urban household receive higher amount of transfers than rural households, such that the total budget allocated for the scheme more or less the same. The amount of money transferred to urban household is increased by 70 percent, while to rural household is reduced by 30 percent. This number is ad-hoc, with the constraint that the total aggregate amount of the compensation is the same, and the results does not increase poverty in rural area. This simulation assume 100 percent effectiveness, so comparable to SIM 3.

The way that the compensation scheme is an unconditional lump-sum cash transfers invited quite many criticism. Giving a lump-sum amount of cash to poor households with total discretion of them in spending them can be seen by some people to be a less wise means of helping the poor compared to giving them education, for example. However, those critics may miss the point that the nature of this transfer is a compensation. The idea is mitigating the adverse distributional effect of fiscal and efficiency-motivated reform. However, with regard to this idea, it seems that the government take this idea into consideration, and indicate of introducing a conditional cash transfers in the near future. Conditional cash transfers is a transfers to household with the condition that the recipients will spend it into specific type of spending, such as those related to human capital investment (health and education spending). Had the compensation scheme built in the energy price reform is conditional, how would its distributional impact have been? To explore this issue, first simulation Simulation 6 (SIM 6 CT ONLY), introduce a conditional cash transfers (conditional on spending into health and education) to targeted household, unrelated to energy price reform, with the purpose of seeing the distributional direction of this sort of transfer. And finally, this conditional cash transfer is combined and built in to the fuel price reform of October 2005 package in Simulation 7 (SIM 7 CT).

Simulating the conditional transfers is carried out by giving price subsidy to targeted household for the targeted commodities. For comparison purposes, the subsidy rate for the targetted household is increased (in similar proportion between education and health) such that the budget allocated is equivalent to the unconditional cash transfers.

5.2 Closures

There are at least three consideration, in this paper, in specifying closures for the simulations. First, closures have to be able to accommodate the research questions specified. For example, when we would like to know the aggregate welfare impacts of the shocks, aggregate real consumption, as indicator of welfare, has to be one of the endogenous variables. As Horridge (2000), for example, stated, the choice of closure is affected by the needs of a particular simulation. Secondly, closure should also be able to minimise the weakness due to realism that can not be explained by the model. For example, because the model used is a static model, to avoid inter-temporal allocation of welfare impact, at the expenditure side real investment and trade balance is better treated as exogenous. Finally, closure is associated with the idea of the simulation timescale, the period of time which would be needed to adjust to new equilibrium (Horridge 2000). This is among many other consideration in order to specify the closure as realistic as possible, representing the particular economy, under the environment we would like to investigate.

In specifying macroeconomic closure, at the aggregate demand side, aggregate real investment, aggregate real government consumption, and trade balance (in real terms) are treated as exogenous, whereas aggregate real consumption is endogenous hence can be interpreted as aggregate index of welfare. This prevents, for example, inter-temporal allocation of welfare impact, for example, due to capital accumulation that may increase welfare in the future.

At the fiscal side, government budget surplus/deficit is endogenous, while aggregate real government consumption is fixed. Any excess revenue from subsidy reduction, for example, left over after compensation may lead to government running a budget surplus. The reason for this specification is to isolate the impact of policy scenario to be investigated (i.e., subsidy cut and compensation with specific exact amount as implemented in October 2005), because exogenising budget surplus requires fiscal adjustment that will have other distributional implications.[14]

Another important closure is factor market closure. In ORANI type of model, there are at least three factor market closure, each of which representing the timescale of the simulation (Horridge 2000). First is standard short-run closure, where capital is specific, can not mobile across sectors, and price of capital is the equilibrating variable. In this standard short-run closure, labor is mobile across industries, however, real wage is exogenous, i.e., all wages are indexed to CPI, and labor is demand-determined. Employment can change, hence it also allow for unemployment, where neoclassical full employment assumption is relaxed. Many other CGE models also have similar type of this closure specification. Another assumption underlying this specification is also that labor may be in surplus and thus hired at exogenous real wages (Janvry and Sadoulet 2002). A variant of the standard short-run closure is exogenising nominal wage, a more keynesian flavour. The other type of closure is long-run closure where aggregate employment is exogenous, a typical neoclassical closure with full employment. At the capital side, industries capital is endogenous.

In this analysis, standard ORANI short-run factor market closure is chosen for the following reasons. The objectives of the analysis are among others to compare and contrast various scenarios of energy price reform with its compensation. The amount of shock in energy prices and the amount of compensation are exactly what was implemented by Indonesian government. Since the idea of compensation is to mitigate the distributional and poverty impact following the increase in fuel prices, short-run time scale will be more realistic. Compensation is essentially not a long-run story. Moreover, in the long-run closure, where GDP at supply side is constrained by fixity of aggregate factor supply and full employment assumption (long-run closure), and real consumption expenditure follows exactly change in real GDP (because investment, government, and trade balance are exogenous), the impact on welfare will be so small that compensation (with the size implemented in October 2005) would have not been necessary. By fixing real wages and allowing for employment to change, we may be able to see the impact of such reform on employment[15]. Wage rigidities is also considered the main factors that causes unemployment in Indonesia (Basri and Patunru 2006).

6 Result and discussion

6.1 Macroeconomic and industry results

Table 5 shows selected macroeconomic impact as well as industry output result for various different scenarios. Increasing various fuel prices as implemented in October 2005 package (Simulation 2,3,4, and 5) reduce real GDP by about 3 percent[16]. Employment falls by about 6 percent under the same scenarios. Aggregate real household consumption can be interpreted as an index of aggregate welfare. It is also the summation of all household's

[14]Manning and Roesad (2006), for example, suggest that delays in spending early in the fiscal year 2006, both at the centre and in the regions, have meant that the fuel price increases have had an unnecessary and avoidable contractionary impact on aggregate demand.

[15]As suggested by Manning and Roesad (2006), for example, many anecdotal evidence suggests that the price rises also affected employment adversely.

[16]Compared to base line, without the shocks.

real consumption in the economy. In general, increasing all fuel prices (as implemented in October 2005, Simulation 2,3,4, and 5) reduced aggregate real household's expenditure by about 4.6 percent. Here, the simulations suggests that, the aggregate welfare impact is not sensitive to compensation since compensation were only given to the poorest households. The smaller fall in aggregate welfare under simulation 7 is mainly due to the increasing demands for factors employed in health and education sectors due to subsidisation of the commodities. These happens to be enjoyed by households with relatively higher endowment of skilled labors[17].

Output of all industries fall in all scenarios as a result of the increasing price of petroleum products. Huge increase in the price of fuels, lower the demands for fuels, and its immediate industry impact is the reduction in the output of refinery industry. The final (new equilibrium) reduction in the output of petroleum refinery is around 8 percent in simulation 2,3,4, and 5. Other industries which experience big contractions are those which closely related to petroleum products. In simulation 2, they are road transportation (−4.67%), other transportation (−5.59%), and utility sectors (electricity by −3.19%, and water and gas by −4.59%), and some manufacturing industry (Automotive by 5.17% and rubber and products by 4.30%) In simulating fuel subsidy reduction, Clements et al. (2003), also reports that the biggest contractions are in those type of industries.

6.2 Distributional results

The biggest advantage of the CGE model with disaggregated households by centile of expenditure per capita is direct calculation of inequality indicator such as Gini coefficient. Therefore, more objective answer to a question of whether or not a policy shock is progressive or regressive is readily available. When the policy simulation increases Gini coefficient, then the policy can be judged regressive. If it reduces Gini coefficient, it can be regarded as progressive. As shown, in previous section as well, that the model also allows direct calculation of poverty incidences, in urban area, rural area, and all Indonesia.

The following discussions will focus on the result on distributional story across the scenarios, in particular, with regard to inequality and poverty incidences. Table 6 summarises the distributional results of the simulations.

Figure 7 to figure 13 illustrate the impact of each scenarios on household's real expenditure, income, and household specific consumer's price index (CPI) for urban and rural households as well as across centiles. In the same figures, Gini coefficients for urban, rural, as well as nation-wide are reported, including their Lorenz curves. From figure 7 to figure 13, how each scenarios affect real expenditure of each household groups could be indicated. The percentage change in this real expenditure will be used to calculate inequality and poverty incidence after each shocks (ex-post). In addition, how change in household income and household specific CPI may give indication of how expenditure pattern and factor income pattern (in this case employment impact) of each household may contribute to the distributional results.

As explained in earlier section, in an economy-wide framework, both force contribute to the distributional story, integrated and taken into account simultaneously in the model.

[17]See discussion on distributional impacts on the next section.

Table 5: Simulated Macroeconomic and Industry Results

	Scenario						
	1	2	3	4	5	6	7
Macroeconomic							
Gross Domestic Product (nominal)	-1.16	-3.01	-3.07	-3.06	-3.05	0.51	-2.45
Gross Domestic Product (real)	-1.65	-3.04	-3.08	-3.07	-3.06	0.30	-2.66
Real household expenditure	-2.49	-4.60	-4.64	-4.63	-4.62	0.46	-4.02
Export (nominal)	-2.76	-6.30	-6.56	-6.50	-6.54	1.34	-5.07
Real export	-1.49	-2.33	-2.41	-2.39	-2.41	0.36	-1.96
Import (nominal)	-4.76	-9.34	-9.71	-9.62	-9.68	1.85	-7.66
Real import	-2.07	-3.25	-3.37	-3.34	-3.36	0.50	-2.73
Employment	-3.20	-6.10	-6.16	-6.14	-6.13	1.72	-4.55
Industry output							
Paddy	-0.61	-1.51	-1.10	-1.20	-1.22	0.28	-1.19
Other food crops	-1.22	-2.87	-2.60	-2.66	-2.64	0.34	-2.44
Estate crops	-1.77	-3.57	-3.45	-3.48	-3.46	0.56	-2.96
Livestock	-1.71	-3.83	-3.63	-3.68	-3.65	0.40	-3.32
Wood and forests	-1.17	-2.26	-2.25	-2.26	-2.27	0.43	-1.82
Fish	-1.19	-2.54	-2.41	-2.44	-2.44	0.20	-2.24
Coal	-0.08	-0.20	-0.20	-0.20	-0.20	0.04	-0.16
Crude oil	-0.20	-0.26	-0.27	-0.27	-0.27	0.02	-0.24
Natural gas	-0.18	-0.24	-0.24	-0.24	-0.24	0.02	-0.21
Other mining	-0.68	-1.14	-1.17	-1.16	-1.17	0.18	-0.95
Rice	-0.56	-1.42	-0.99	-1.10	-1.11	0.27	-1.11
Other food (manufactured)	-1.86	-3.95	-3.72	-3.77	-3.75	0.36	-3.47
Clothing	-1.87	-3.58	-3.51	-3.53	-3.52	0.47	-3.06
Wood products	-1.41	-2.65	-2.80	-2.76	-2.80	0.35	-2.26
Pulp and paper	-2.08	-3.72	-3.80	-3.78	-3.76	2.12	-1.93
Chemical product	-1.91	-3.39	-3.32	-3.34	-3.31	0.61	-2.77
Petroleum refinery	-5.44	-8.38	-8.42	-8.41	-8.42	0.16	-8.16
LNG	-0.90	-0.90	-0.91	-0.91	-0.91	0.02	-0.86
Rubber and products	-2.54	-4.30	-4.48	-4.44	-4.46	0.60	-3.69
Plastic and products	-1.88	-3.48	-3.50	-3.49	-3.53	0.43	-3.00
Non-ferous metal	-0.86	-1.51	-1.49	-1.49	-1.50	0.36	-1.17
Other metal	-0.98	-1.66	-1.70	-1.69	-1.71	0.39	-1.30
Machineries	-2.12	-3.45	-3.65	-3.60	-3.65	0.42	-3.02
Automotive industries	-3.33	-5.17	-6.09	-5.86	-6.08	0.44	-4.66
Other manufacturing	-2.14	-4.15	-3.91	-3.97	-3.95	0.73	-3.40
Electricity	-1.82	-3.19	-3.13	-3.14	-3.08	0.44	-2.68
Water and gas	-2.81	-4.59	-4.99	-4.89	-4.84	0.48	-4.03
Construction	-0.13	-0.23	-0.24	-0.24	-0.23	0.27	-0.01
Trade	-1.85	-3.65	-3.56	-3.59	-3.53	0.60	-3.02
Hotel and restaurants	-2.11	-4.38	-4.44	-4.42	-4.36	0.60	-3.72
Road transportation	-2.79	-4.67	-4.75	-4.73	-4.69	0.69	-3.95
Other transportation	-3.56	-5.59	-5.72	-5.69	-5.67	0.80	-4.76
Banking and finance	-1.74	-3.26	-3.51	-3.45	-3.44	0.44	-2.78
General government	-0.07	-0.13	-0.14	-0.14	-0.14	0.01	-0.12
Education	-1.47	-2.83	-2.86	-2.85	-2.73	12.61	7.04
Health	-1.46	-2.99	-2.98	-2.98	-2.99	13.79	8.15
Entertaintment	-2.47	-4.54	-4.98	-4.87	-4.93	0.69	-3.83
Other services	-2.37	-4.29	-4.77	-4.65	-4.71	0.40	-3.82

Household specific CPI is a consumption-weighted average of the price increase of every commodities consumed by the household, hence reflects the impact of household expenditure pattern and behaviour. These price changes reflects adjustment in the market for commodities. On the other hand, household income, reflect changes in all source of household income (i.e., labor by skill types, capital, and land, including transfers, as compensation), and hence reflect the impact of what happens in market for factors. Poverty impact of each scenarios are illustrated in figure 14 to 20, where change in poverty incidence both in urban and rural area, as well as nation-wide is also reported.

Table 6: Summary of distributional results

	SIM 1 PAKTO'05 NO-KER	SIM 2 PAKTO'05	SIM 3 PAKTO'05 100 UT	SIM 4 PAKTO'05 75 UT	SIM 5 PAKTO'05 100 UTUR	SIM 6 CT	SIM 7 PAKTO'05 CT
Urban							
Ex-ante Poverty Incidence	11.370	11.370	11.370	11.370	11.370	11.370	11.370
Ex-post Poverty Incidence	12.511	14.367	12.824	13.234	11.515	9.403	12.486
Change in Poverty Incidence	1.141	2.997	1.454	1.864	0.145	-1.967	1.116
Rural							
Ex-ante Poverty Incidence	19.510	19.510	19.510	19.510	19.510	19.510	19.510
Ex-post Poverty Incidence	20.001	21.759	17.519	17.971	19.397	17.331	20.079
Change in Poverty Incidence	0.491	2.249	-1.991	-1.539	-0.113	-2.179	0.569
Urban + Rural							
Ex-ante Poverty Incidence	15.803	15.803	15.803	15.803	15.803	15.803	15.803
Ex-post Poverty Incidence	16.590	18.393	15.381	15.814	15.808	13.720	16.621
Change in Poverty Incidence	0.787	2.589	-0.422	0.011	0.005	-2.083	0.818
Urban							
Ex-ante Gini Coefficient	0.347	0.347	0.347	0.347	0.347	0.347	0.347
Ex-post Gini Coefficient	0.344	0.352	0.346	0.348	0.341	0.341	0.347
Change in Gini Coefficient	-0.003	0.005	-0.001	0.001	-0.006	-0.006	0.000
Rural							
Ex-ante Gini Coefficient	0.277	0.277	0.277	0.277	0.277	0.277	0.277
Ex-post Gini Coefficient	0.272	0.274	0.258	0.262	0.263	0.271	0.268
Change in Gini Coefficient	-0.005	-0.003	-0.019	-0.015	-0.014	-0.006	-0.009
Urban + Rural							
Ex-ante Gini Coefficient	0.350	0.350	0.350	0.350	0.350	0.350	0.350
Ex-post Gini Coefficient	0.345	0.350	0.338	0.341	0.339	0.344	0.345
Change in Gini Coefficient	-0.005	0.000	-0.012	-0.009	-0.011	-0.006	-0.005

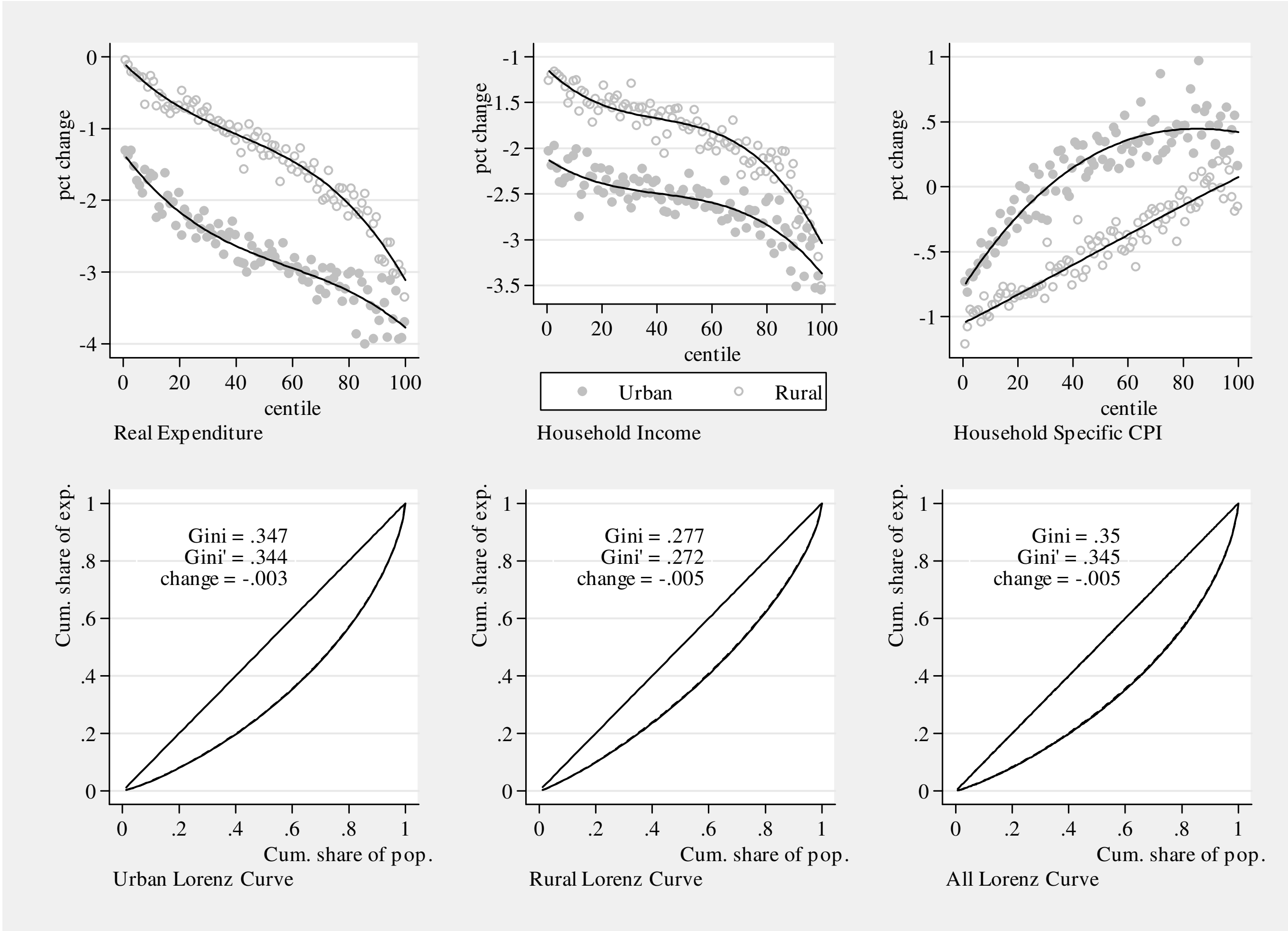

Figure 7: Simulated Distributional Impact of SIM 1 NO-KEROSENE

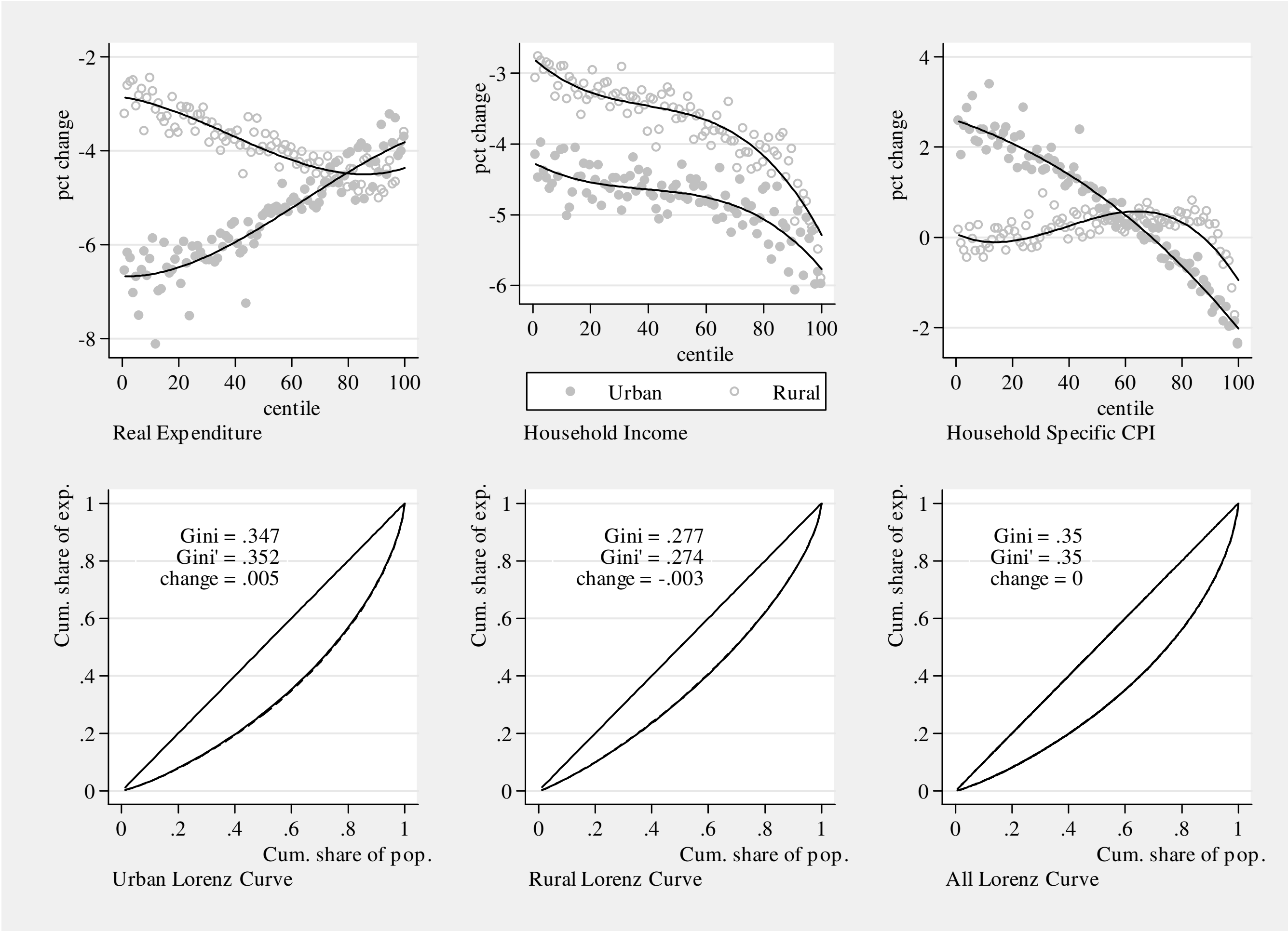

Figure 8: Simulated Distributional Impact of SIM 2 ALL FUELS

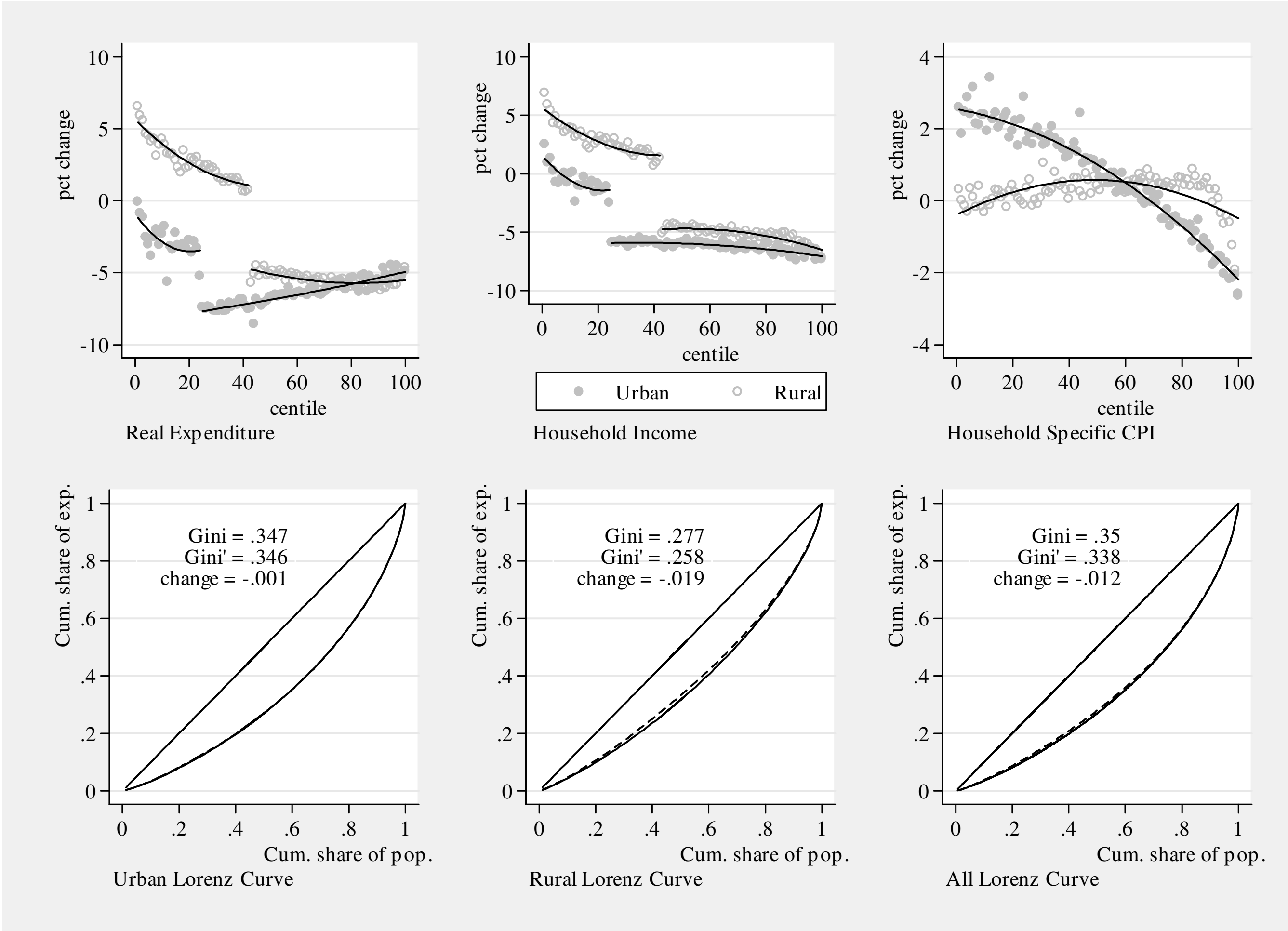

Figure 9: Simulated Distributional Impact of SIM 3 100% UT

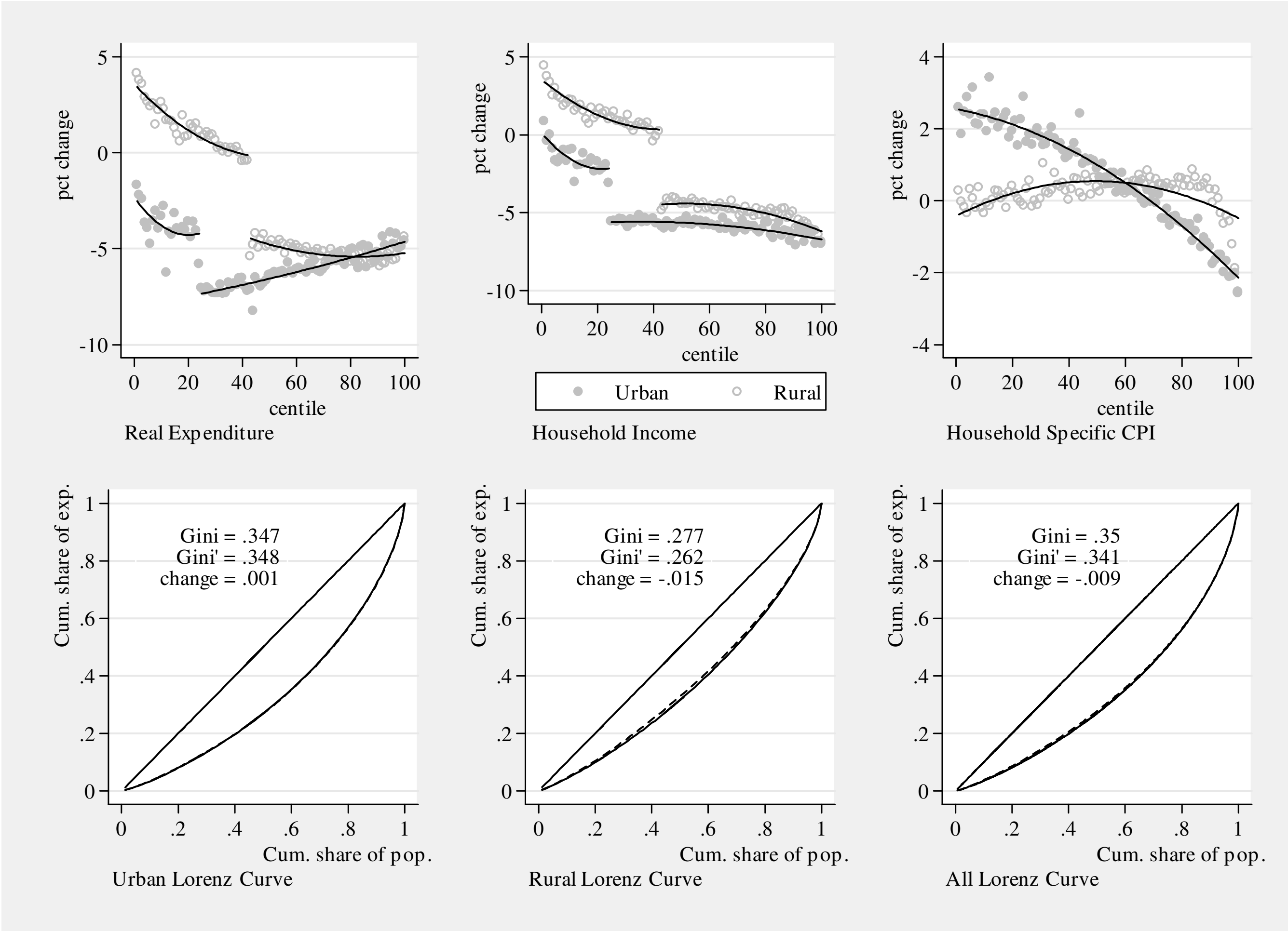

Figure 10: Simulated Distributional Impact of SIM 4 75% UT

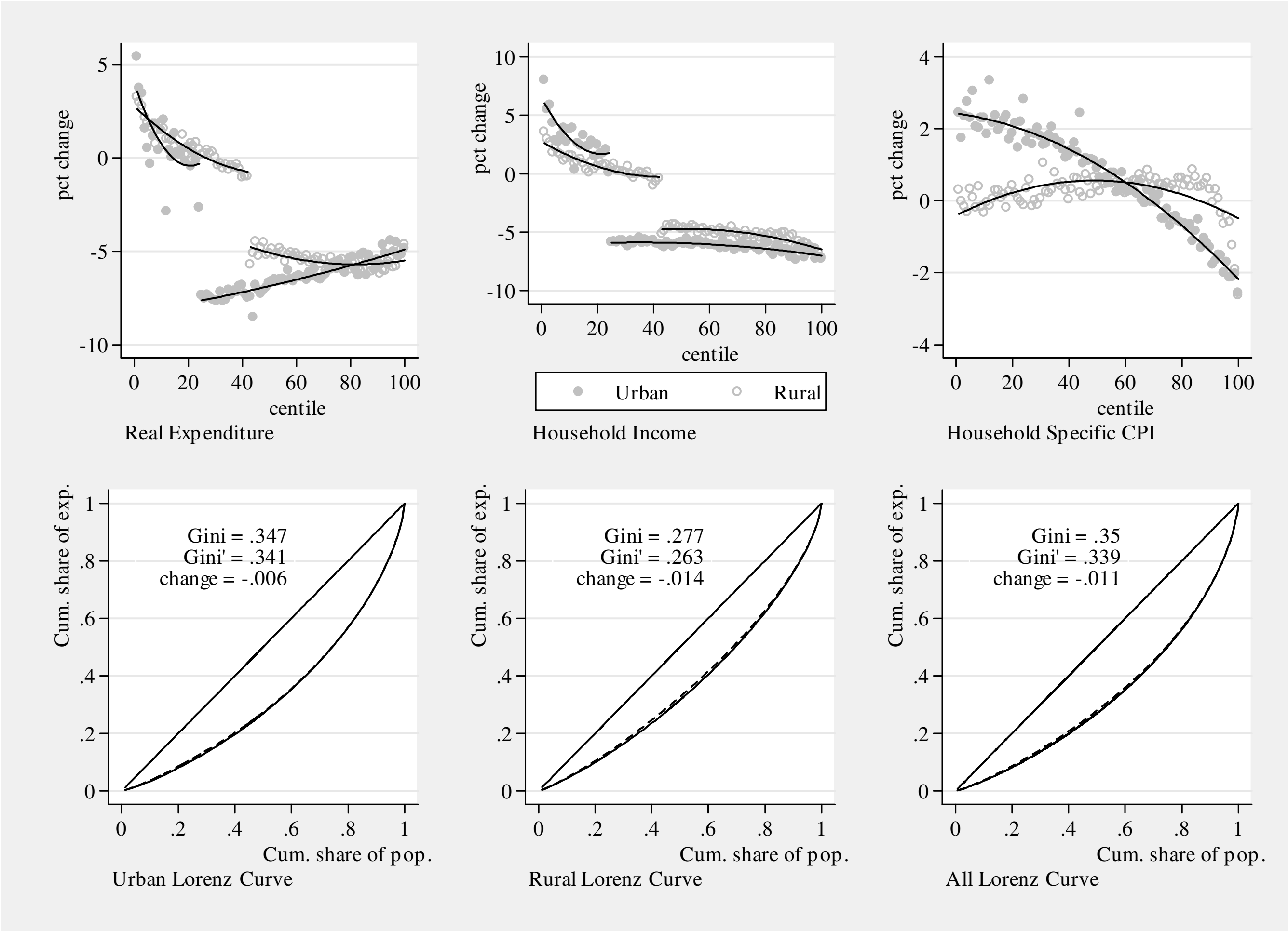

Figure 11: Simulated Distributional Impact of SIM 5 100% UTUR

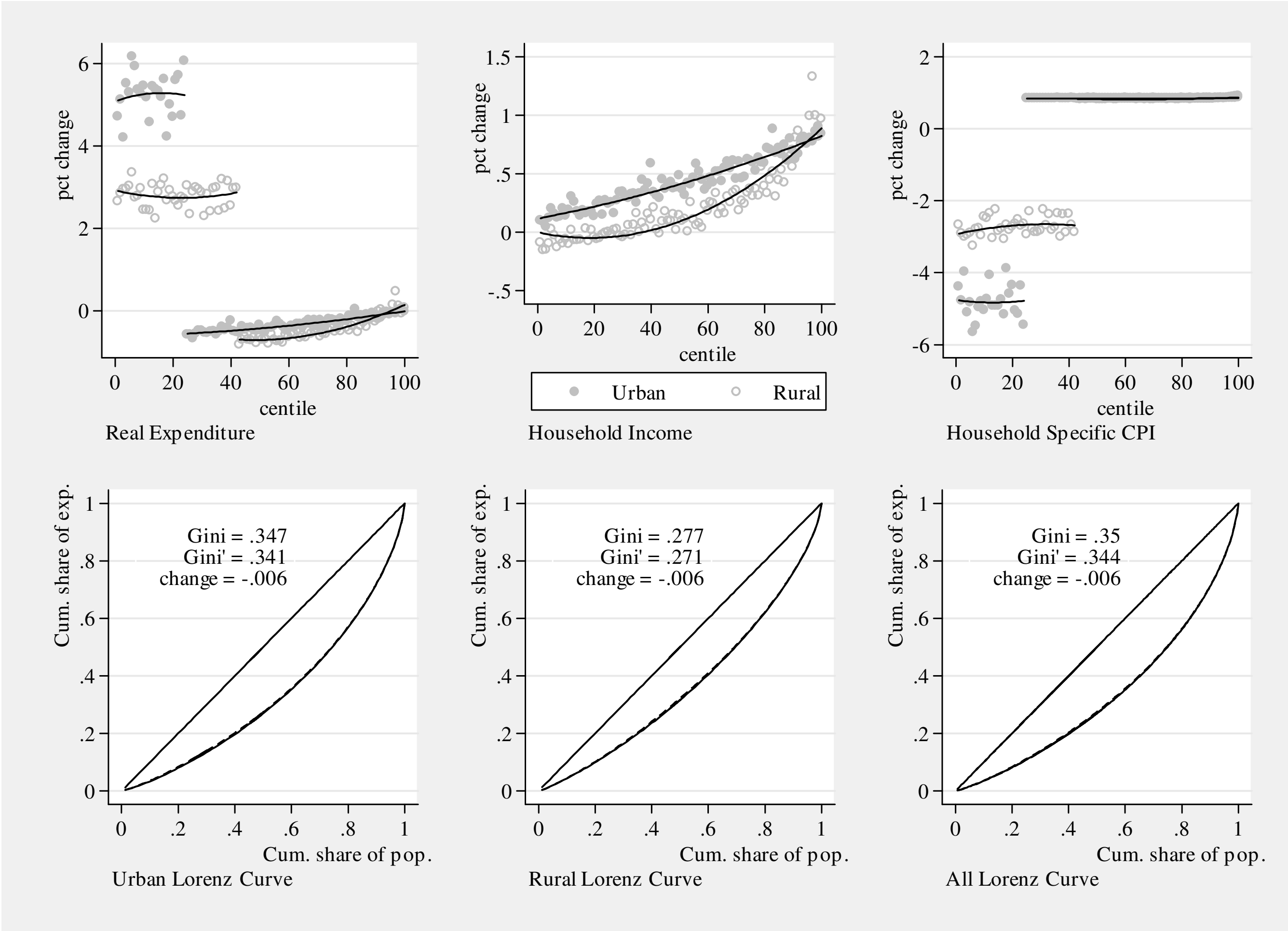

Figure 12: Simulated Distributional Impact of SIM 6 CT ONLY

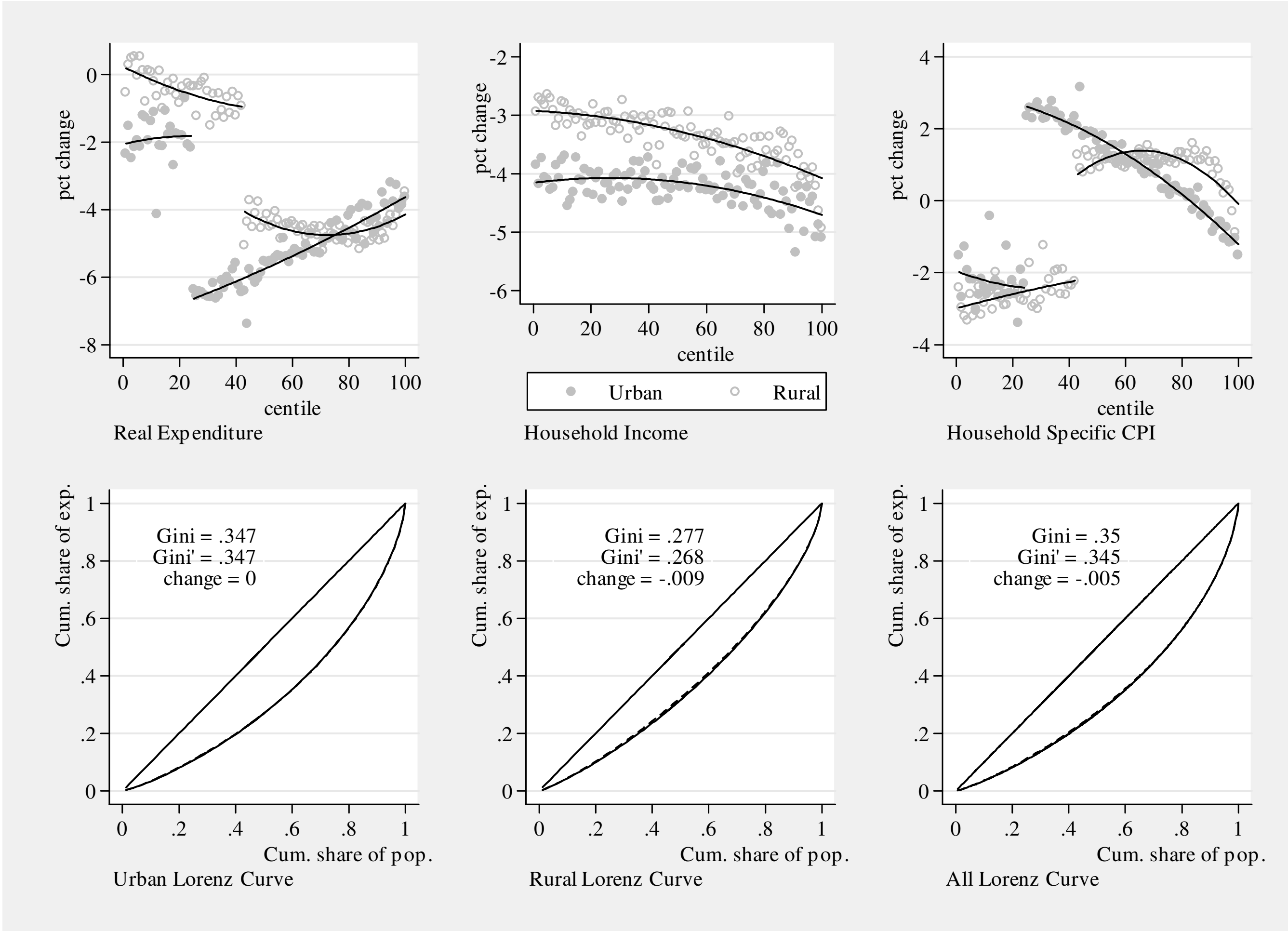

Figure 13: Simulated Distributional Impact of SIM 7 CT

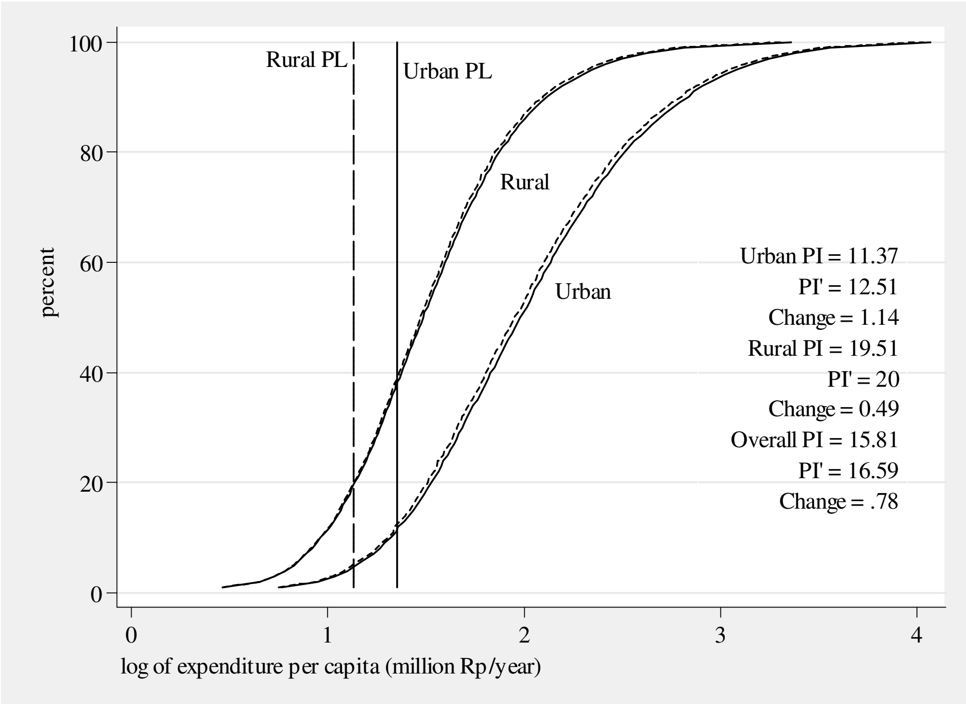

Figure 14: Simulated Poverty Impact of SIM 1 NO-KEROSENE

Subsidy on vehicle fuels is regressive, its removal is equitable.

As mentioned previously, long before the implementation of fuel price reform in October 2005, fuel subsidy had been regarded as both inefficient and inequitable. Because the rich was regarded as the big consumers of fuel, especially vehicle fuels, it had been a long-held view, that reducing fuel subsidy will hurt the non-poor more, and such reform would be progressive. Simulation 1 (SIM 1 NO-KEROSENE) to some extent support that long-held view. Fuel subsidy on gasoline and diesel had been inequitable. Therefore, cutting the subsidy on such vehicle fuels is a progressive reform. In this simulation, October 2005 package without compensation is simulated but only to non-kerosene commodity.

As can be seen from figure 7, the obvious declining pattern of the fall in real expenditure over expenditure centile clearly suggest the progressivity of this sort of reform. This happens both in urban and rural area. As a result, inequality drops both in urban and rural area, as well as nation-wide, as indicated by the falling Gini coefficient. This progressivity is driven both from the household consumption pattern (from the pattern of the change in household CPI) and household income pattern (from the pattern of the change in household income). Richer households experience far more rise in their consumer's price, reflecting their higher dependence on non-kerosene vehicle fuel consumption, as well as lower fall in their income, reflecting the adjustment in factor market which is not in favor of the higher income class' factor endowment.

Despite its progressivity, however, it should be noted that without compensation, such reform would still have adverse poverty impact. Figure 14 shows that nation-wide poverty slightly rises by 0.78 percent.

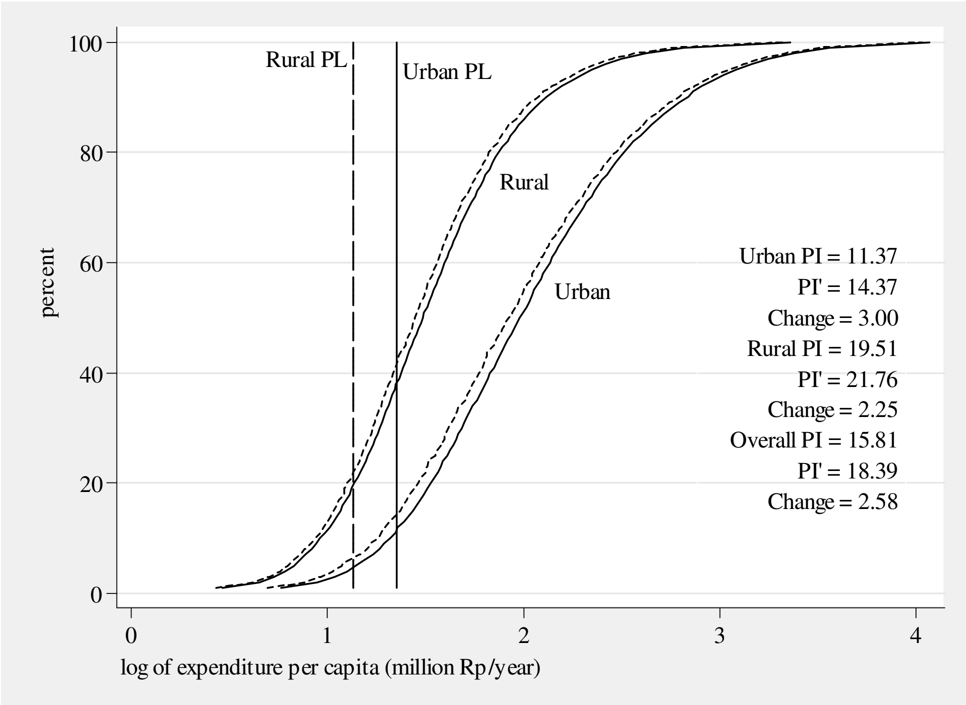

Figure 15: Simulated Poverty Impact of SIM 2 ALL FUELS

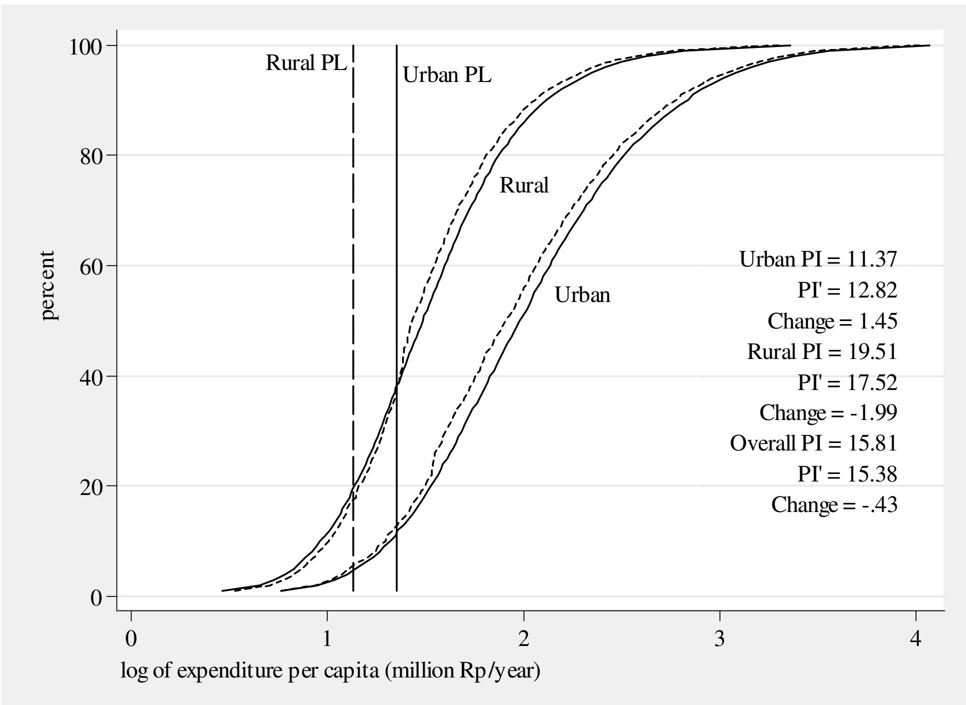

Figure 16: Simulated Poverty Impact of SIM 3 100% UT

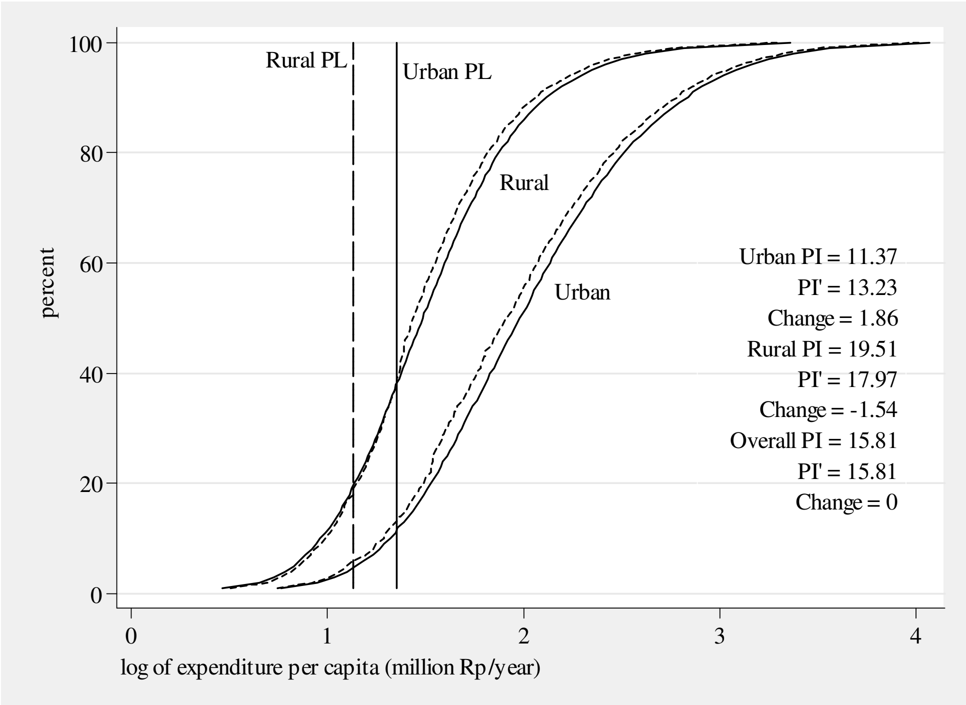

Figure 17: Simulated Poverty Impact of SIM 4 75% UT

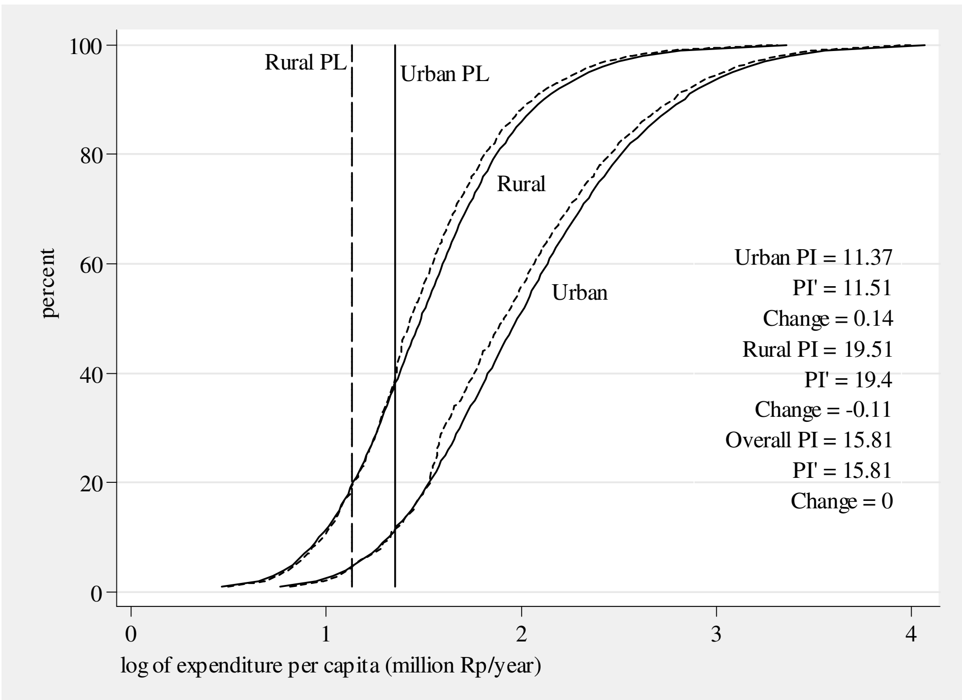

Figure 18: Simulated Poverty Impact of SIM 5 100% UTUR

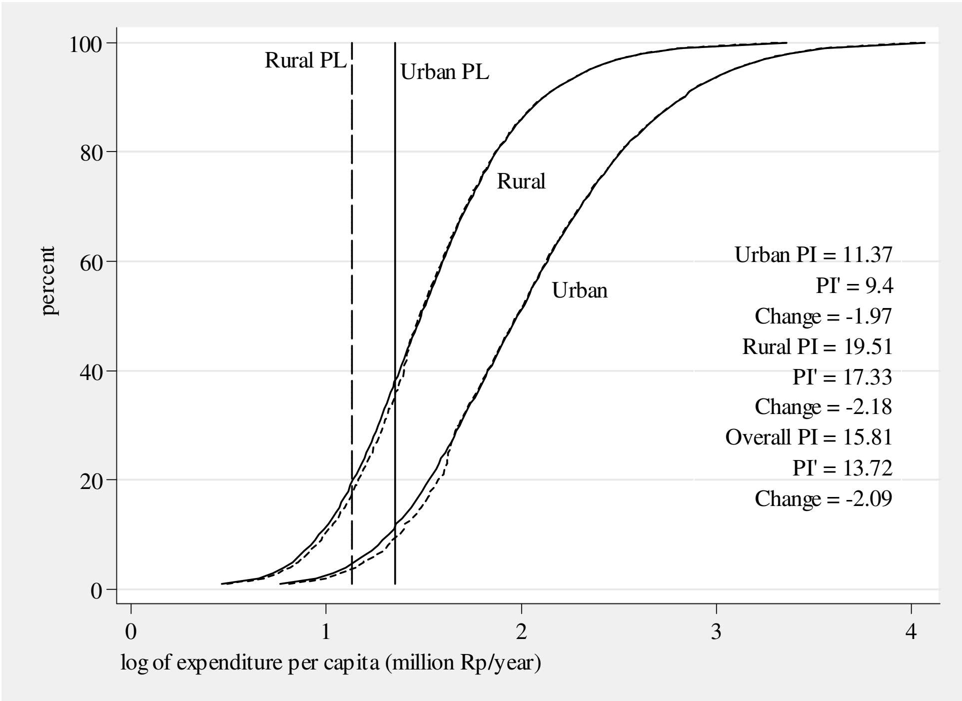

Figure 19: Simulated Poverty Impact of SIM 6 CT ONLY

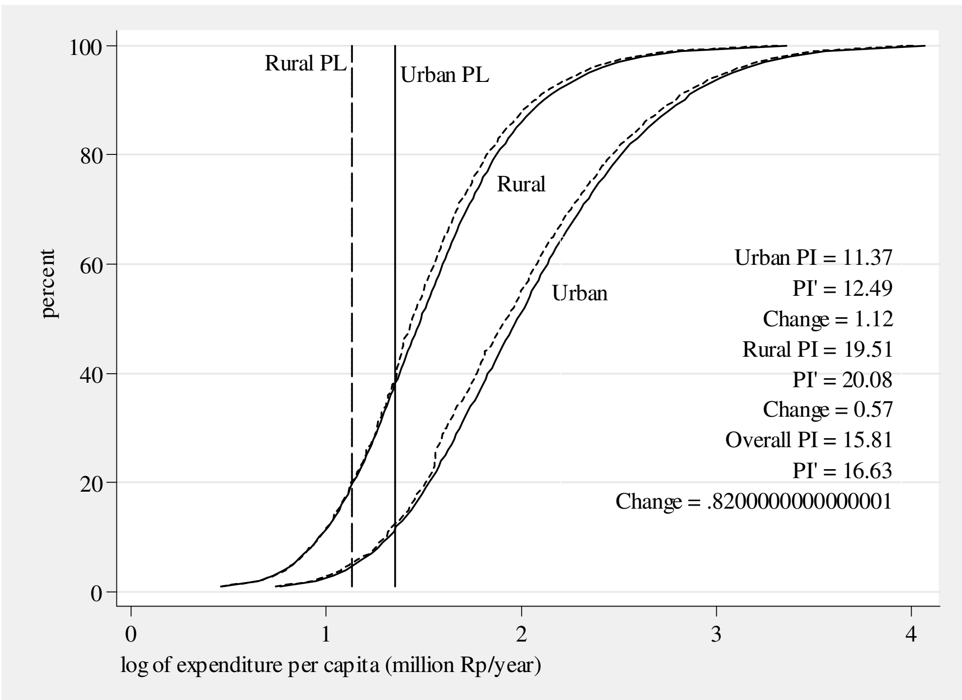

Figure 20: Simulated Poverty Impact of SIM 7 CT

Including kerosene, however, is regressive, especially in urban area.

However, the actual real reform package implemented in October 2005, not only touched kerosene commodity, of which urban poor is its bigger consumers, but also increase the price of kerosene even higher than the increase in other fuel prices. Kerosene administered price was drastically increased almost tripled (185.7 percent), a lot higher compared to the increase other fuel prices (87.5 percent for gasoline, and 104.7 percent for diesel). Being implemented in this way, will this package of reform still be progressive?

To find out the impact of this package might have been on distribution, the increase in the administered prices of fuel without compensation is simulated in SIM 2 (ALL FUELS). It turns out, that the simulation produce markedly different distributional story compared to the first simulation. In urban area, the decline in the real expenditure of the 20 percent poorest households, fall within the magnitude of about 6 to 8 percent, whereas the richest 20 percent households experience decline in real expenditure of between about 3 to 5 percent only. The pattern of the fall in real expenditure of the urban households is clearly increasing over centile of expenditure. As a result, inequality increase in urban area, as Gini coefficient increase from 0.347 to 0.352 (see figure 8).

In rural area, on the other hand, the distributional impact is slightly progressive. Rural real expenditure of the poorest 20% falls only around 3%, while, the richest 20% falls more than 4%. Overall, the impact is reducing inequality slightly. Over the nation (urban and rural area combined) October 2005 package of fuel price rise (including kerosene) without compensation, is neutral, with negligible impact on Gini coefficient. As figure 8 suggests, the main driver of the regressive result in urban area is urban lower income household's dependence on kerosene consumption, as well as increase in other commodities related to fuels, such as transportations. This is reflected in the increase in their household consumer's price which is far higher than that of higher income households.

To investigate more, figure 8, however, shows that the impact of the fuel price rises as implemented in October 2005 through factor income, i.e., through employment, borne mostly by the higher income households. Urban households in general experiences lower drop in their incomes compared to rural households, and both in urban and rural households richer households experience more adverse income shocks. This clearly shows that the impact of fuel price rises through industry employment in capital and labor, are biased against urban and richer households. In rural area, this helps in shaping the progressivity of the reform. However, in urban area since the impact on consumption is a lot more severe, it could not help avoid the regressivity of the reform.

Had October '05 Package been without compensation, additional large number of household would have become poor.

The impact of October 2005 package without compensation, might have on poverty could have been significant. As shown in figure 15, poverty incidence in urban area increase by 3 percent from 11.37 to 14.37 percent, whereas in rural area it rises by 2.25 percent from 19.51 percent to 21.76 percent. In all, poverty incidence, nation-wide, rise by 2.58 percent. Using the population in 2005, the package without compensation might have driven around 5.5 million people into poverty.

The above exercise of what-if scenarios suggest that although the reduction in fuel subsidy as part of the energy price reform might have unambiguous ground in term of economic efficiency, the way the reform is implemented matter when the concern is its distributional costs. Reducing fuel subsidy per se, without careful prior examination on how the reform will affect the poorer part of population, may have adverse distributional impact. This is something that should be avoided even by the pro-energy price reformist, because the reform should be carried out with the least cost including distributional cost in terms of inequality and poverty implication.

Most probably, the above concern was the main reason why the actual fuel price reform in October 2005 package was combined with a compensation scheme. The choice was lump-sum cash transfers to targeted households (households considered as poor and near poor). Targeted households was given a cash transfers of 1.2 million rupiahs (annual) in 4 installments. The government claimed that the amount of transfers was more than adequate to compensate the potential fall in the welfare of the poor. Some studies, such as Ikhsan et al. (2005), backed this claim, as well as later study by World Bank (2006). Simulation 3 (100% UT) is carried out to see the distributional impact of this reform that was actually implemented. Simulations assumes 100 percent effectiveness of the cash transfers in reaching the targeted households.

October '05 Package + Compensation might reduce inequality.

As shown in figure 9, the claim that the cash transfers would, in theory, more than compensate the adverse welfare impact on the poor is only true for the rural poor. For the urban poor, although, some of the poorest centile gain positive (nominal) income, when deflated with their specific consumer's price rise, the net real expenditure effect is still negative. In urban area, none of the targeted households experience positive welfare gain. The compensation scheme over-compensate the rural poor but under-compensate the urban poor.. However, in term of inequality, despite the drastic rice in the price of kerosene, the October 2005 package reduce inequality, especially in rural area, by 0.019 point, and reduce overall Gini coefficient from 0.35 to 0.338. This was mainly driven by significant increase of real expenditure of the rural poor, less severe fall in the real expenditure of the urban poor (due to compensation) than the urban non-poor, and the sharp decline in the real expenditure of the non-targeted (non-poor) households.

However, even if 100% effective, compensation could not help preventing poverty from rising in urban area.

Figure 16 illustrates the poverty impact of simulation 3 (100% UT). Due to under-compensation of the urban poor, October 2005 package (with compensation) could not prevent urban poverty incidence of rising by 1.45 percentage point, despite the fall in the poverty incidence in rural area by almost 2 percentage point. However, the overall net nation-wide impact is a slight decline in national poverty incidence by 0.43 percent. The decline in the rural poverty incidence by 2 percent help prevent the overall rise of nation-wide poverty incidence, mostly because the rural population is higher than in urban area.

Compensate more to urban, less to rural. It might help.

Given, the tendency that uniform cash transfers may over-compensate rural but under-compensate urban households, in simulation 5 (100% UTUR), the scheme is slightly modified by giving more cash to urban and less to rural targeted households. The result suggests that this modification might have prevent quite significant number of urban household fell into poverty, by still leaving poverty incidence in rural area intact In this simulation, poverty incidence in urban area increase by only 0.14 percent, in contrast to 1.45 percent if the amount of money is uniform across urban and rural. In rural area, poverty incidence still fall by 0.1 percent. The number of people in urban area that fell into poverty due to the reform might have been reduced significantly, equivalent to almost 3 million urban population Uniform cash transfers might produce a lot larger number of additional new poor people, compared to this the slightly modified compensation.

The very purpose of the compensation scheme is mitigating the poverty or distributional impact of the reform. In nature, it is not a means of structural poverty eradication program. The objective of the compensation scheme is "compensating" households from the adverse impact of the reform. Hence even if the uniform compensation scheme may potentially reduce poverty nation-wide due to the over-compensation in rural area, if it was at the cost of huge increase in poverty in urban area, the slightly modified compensation scheme may be preferable.

Conditional transfers might not have been effective as compensation.

Price subsidy given to targeted households to be spent on education and health (with more or less using the same budget as the cash transfers) not as a means of compensating fuel price reform increases the output of education sectors by 12.61%, and health sector by 13.79% (see table 5). Since it is given only to lower income classes, the simulation is progressive, reducing Gini coefficient in urban, rural area, as well as nation-wide (see figure 12). The subsidy, however, from the point of view of factor market, expand the service sectors like education and health in favor of higher income class, due the distribution of factor ownership (such as skilled-labor employed in these sectors). The percentage change in household's income is higher for higher income groups both in urban and rural area. However, since the subsidy is given to poorer part of the population, the decline in their household specific CPI drives the distributional impact to be more progressive.

However, when conditional transfers like this is used as a compensation scheme together with October 2005 package, the story turns out to be rather different. As figure 13 shows, Simulation 7 (CT) suggests that inequality impact is neutral in urban area, progressive in rural area and slight progressive nation-wide. Since expansion in the education and health sectors increase demand for more skilled-labor and capital which are more endowed by higher income classes, it drives regressive results from the income pattern. The pattern on the fall in household income shows increasing trends toward higher income groups. It is worse in urban area, because of their high dependence on kerosene consumption, and others fuel-related consumptions, such as transportation.

More importantly, the fall in households purchasing powers (as indicated too by household's specific CPI) does not help compensate the poor. Both in urban and rural area, almost all households, including the poor experience fall in their real expenditure. As a result, poverty rises in urban area, by 1.12%. Compared to other compensation scenario, subsidy on education and health as compensation, increase poverty in rural area by 0.57% and because most poor population are rural this might drive up the head count poverty index nation-wide (0.82%). Conditional transfers may be good as an incentives for human capital investment, but may not be effective as a means of short-run compensation to mitigate adverse impact of a fuel price reform. It may be better suited for longer-term objectives, especially if combined with encouraging its demand to change the expenditure pattern or demand behaviour toward education, especially to rural households. This is however a longer-term approach of structural poverty alleviation program, not an ad-hoc occasional compensation scheme to minimise distributional cost of energy price reforms.

7 Systematic Sensitivity Analysis

In a CGE exercise, because some of the parameters are taken from other sources such as others studies, models, or literature. It is necessary to examine the reliability of the results with respects to uncertainty in the parameters. In a standard or ad-hoc sensitivity analysis, one or two different sets of parameters are selected and the model is solved and then the sensitivity of the change in endogenous variables are examined. However, since there are many parameters are imputed into the model, this approach is difficult or less practical to be implemented when we want to examine the sensitivity of the results on the independent uncertainty about the values of several parameters or shocks. In this model, for example, for Armington elasticity alone, since the model has 38 different commodities, the sensitivity analysis to each of the parameters would be computationally burdensome.

Recent advances in the literature on sensitivity analysis offer a rather convenient approach to what is called systematic sensitivity analysis[18]. The question to be asked in this sensitivity analysis is, how reliable is the results if we vary 'all' the parameters in the model, let's say by 50%. Hence, if for example, the Armington elasticity of commodity A is 5, then we allow it to vary between 2.5 and 7.5. We will do it for all the parameters. The popular approach is a typical Monte Carlo simulation, where we draw independently enough number from each of the range value of the parameters, and do that in a sufficiently large draw such that the result is statistically accurate. However, with this kind of approach, time and computational constraint will prevent the accuracy of the estimates.

The new approach is the so-called Systematic Sensitivity Analysis (SSA) via Gaussian Quadrature. This is a type of programming or optimisation method. Given the distribution of M parameters, what is the best possible choice of shocks in N simulations if we want to estimate means and standard deviations for all endogenous variables. A procedure for choosing the N shocks made in this way is often referred to a Gaussian quadrature. However, this assumes (1) the simulation results are well approximated by a third-order polynomial in the varying parameters; (2) that parameters which vary all have a symmetric distribution[19]; (3) the parameters vary quite independently (zero correlation). Arndt (1996) for example demonstrates that the results are often surprisingly accurate, given the relatively modest number of times the model is solved.

In this SSA, all parameters are assumed to vary by 50%, and the SSA is implemented in Gempack (Pearson and Arndt 2000). The result are shown in table 7, where means, standard deviation, and confidence interval[20] for selected variables are reported.

[18]See Arndt (1996), Pearson and Arndt (2000), and its implementation among others in Hertel et al. (2003), and Plumb (2001).

[19]The SSA carried out in this paper, the parameters are assumed to have uniform distribution.

[20]The confidence interval is calculated by employing the Chebyshev's inequality. Suppose that we

Table 7: Systematic Sensitivity Analysis of SIM 4 (50 percent Variation in All Parameters)

			Confidence Interval			
			90 percent		95 percent	
	mean	s.d.	lower	upper	lower	upper
Macro						
GDP	-3.00	0.13	-3.41	-2.59	-3.58	-2.42
Consumption	-4.52	0.19	-5.12	-3.92	-5.37	-3.67
Export	-2.34	0.10	-2.66	-2.02	-2.79	-1.89
Import	-3.26	0.15	-3.73	-2.79	-3.93	-2.59
Employment	-5.99	0.26	-6.81	-5.17	-7.15	-4.83
Output						
Refinery	-8.34	0.51	-9.96	-6.73	-10.63	-6.06
Road transport	-4.64	0.17	-5.19	-4.09	-5.42	-3.86
Other Transport	-5.58	0.24	-6.34	-4.83	-6.65	-4.52
Automotive	-5.72	0.35	-6.83	-4.61	-7.29	-4.15
Electricity	-3.06	0.16	-3.58	-2.55	-3.79	-2.34
Water Gas	-4.78	0.19	-5.38	-4.18	-5.63	-3.93
Othr manufacture	-3.86	0.28	-4.75	-2.97	-5.11	-2.61
Consumption (urban)						
Centile 1	-1.55	0.22	-2.25	-0.86	-2.54	-0.57
Centile 5	-3.82	0.23	-4.54	-3.09	-4.84	-2.79
Centile 10	-3.17	0.25	-3.94	-2.39	-4.27	-2.07
Centile 11	-2.65	0.24	-3.40	-1.90	-3.71	-1.58
Centile 12	-6.14	0.20	-6.79	-5.49	-7.05	-5.22
Consumption (rural)						
Centile 1	4.24	0.23	3.52	4.97	3.21	5.27
Centile 5	2.75	0.19	2.17	3.34	1.92	3.58
Centile 10	2.72	0.18	2.15	3.30	1.91	3.54
Centile 19	0.91	0.17	0.36	1.46	0.13	1.69
Centile 20	0.96	0.19	0.35	1.57	0.10	1.82

The SSA produces the mean and standard deviation of all percentage change in endogenous variables, and the confidence interval is calculated using Chebyshev's inequality which does not require any assumption about the distribution of the endogenous variables.

Looking at the standard deviation and the confidence interval, it suggests that the percentage change in endogenous variables is fairly robust or insensitive to variations in extraneous parameters. The confidence interval can tell us, for example, that we can be 95% confidence that the shock will reduce GDP by between −3.41% to −2.59%, or there is at least 95% probability that the shock reduce aggregate real consumption between −5.12% to −3.92%. In addition, the sensitivity analysis may suggests that employment is more sensitive to variations in parameters compared to GDP, for example. The range of the change in employment is almost twice as the range in the change in GDP.

Distributional results seems also robust to the sensitivity analysis. Looking at the sensitivity analysis for the change in real expenditure per capita of the households below the poverty line, it suggests for example, that there is at least 95% chance that simulation 4 (October 2005 package + cash compensation with 75% effectiveness) will increase poverty in urban area but will reduce poverty in rural area.

8 Concluding Remarks

From methodological perspective, this paper demonstrates that with households disaggregated by centile of expenditure per capita, integrated into a CGE model, not only allows for taking into account simultaneously both income pattern and expenditure pattern as inseparable driving forces into distributional story in an economy-wide framework, but also allows for more direct and accurate calculation of inequality indicators and poverty incidences.

Implementing the methods for the analysis of counter factual scenarios on energy price reform, of October 2005 package in Indonesia, the results suggests that reducing vehicle fuels subsidy hurt the higher income classes more and hence constitutes a progressive reform. It supports the claim that subsidy on vehicle fuels are regressive. However, in the case of Indonesia, where urban lower income classes constitute the biggest consumers of domestic fuel like kerosene, a reform like October 2005 package with drastic increase in kerosene price tends to be regressive, unless accompanied by a proper and effective compensation scheme.

The comparison of various type of compensation in the simulations suggests that designing an effective form of compensation do matter in mitigating the distributional impact of energy price reforms. Uniform cash transfers to all targeted households, by disregarding the facts that they may have different type of consumption and income pattern, such as the one implemented in October 2005 reform, may reduce the effectiveness of the scheme. It tends to over-compensate rural households at the cost of under-compensation of the urban poors. An example of the slight modification to the uniform amount of

have an endogenous variable y with mean $\bar{y}$ and standard deviation σ. Chebyshev's inequality says that, whatever the distribution of the variable in question, for each positive real number k, the probability that the value of y does not lie within k standard deviations of the mean $\bar{y}$ is no more than $\frac{1}{k^2}$. The confidence interval is calculated as $\bar{y} \pm k \cdot \sigma$, where $k = 3.16$ for 90% confidence interval, and $k = 4.47$ for the 95%.

cash compensation, by giving more to urban households and less to rural households may significantly help in minimising the rise in urban poverty incidences. With regards, to recent widely-discussed of conditional transfers targeted to education and health spending as compensations, the simulation suggests that it might not have been an effective way to be accompanied in an energy price reforms as a means of compensation. It might be better suited for longer-term objectives of poverty alleviation programs.

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A Appendixes

A.1 Labour Classification

Table 8: List of (official SAM) Labor Classfication

	Urban/ Rural	Formal/ Imputed	Skill type
1.	Urban	Formal	Agricultural Workers
2.	Rural	Formal	Agricultural Workers
3.	Urban	Imputed	Agricultural Workers
4.	Rural	Imputed	Agricultural Workers
5.	Urban	Formal	Production, Transport Operator, Manual, and Unskilled Workers
6.	Rural	Formal	Production, Transport Operator, Manual, and Unskilled Workers
7.	Urban	Imputed	Production, Transport Operator, Manual, and Unskilled Workers
8.	Rural	Imputed	Production, Transport Operator, Manual, and Unskilled Workers
9.	Urban	Formal	Clerical, Services workers
10.	Rural	Formal	Clerical, Services workers
11.	Urban	Imputed	Clerical, Services workers
12.	Rural	Imputed	Clerical, Services workers
13.	Urban	Formal	Administrative, Managerial, Professional, and Technician Workers
14.	Rural	Formal	Administrative, Managerial, Professional, and Technician Workers
15.	Urban	Imputed	Administrative, Managerial, Professional, and Technician Workers
16.	Rural	Imputed	Administrative, Managerial, Professional, and Technician Workers