Economy and Environment Program
for Southeast Asia
22 Cross Street
#02-55 South Bridge Court
Singapore 048421
Tel: (65) 6438 7877
Fax: (65) 6438 4844
E-mail: eepsea@idrc.org.sg
Website: www.eepsea.org

RESEARCH REPORT

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The Distributional Impact of Environmental Policy: The Case of Carbon Tax and Energy Pricing Reform in Indonesia

Arief Anshory Yusuf
Center for Economics and Development Studies (CEDS)
Faculty of Economics, Padjadjaran University
Bandung, Indonesia
Tel: 62 22 4204510
Email: arief.yusuf@fe.unpad.ac.id

This research is an attempt to further understand the social and environmental dimension of sustainable development focusing on the impact of environmental reforms, such as pollution reduction and energy pricing policy, has on inequality and poverty for the case of Indonesia. A multi-sector, multi-household, Computable General Equilibrium (CGE) model is used to provide the basis for two important empirical case studies: (i) the effects of a carbon tax, and (ii) energy pricing reforms.

The main finding from the carbon tax study suggests that in contrast to most studies from developed countries, the introduction of a carbon tax in Indonesia would not necessarily be regressive. It is shown to be strongly progressive in rural areas, and either neutral or slightly progressive in urban areas, with overall progressive distributional effect nationwide. The industries that experience the largest contraction are generally more energy intensive. The owners of factors of production in these industries are largely concentrated among higher income households and people living in the cities.

For the analysis of counter factual scenarios on energy price reforms, the results suggest recognizing the difference between urban and rural household's income and expenditure patterns are crucial in the attempt to minimize the adverse distributional impacts of the energy pricing reform. In general, this study shows there is not necessarily a conflict between environmental and equity objectives, especially when the policies or reforms to achieve environmental goals are carefully designed.

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A report submitted to the Economy and Environment Program for
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Arief Anshory Yusuf

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Comments should be sent to:

Arief Anshory Yusuf

Center for Economics and Development Studies, Department of Economics, Padjadjaran University Bandung, Jalan Cimandiri No.6, Bandung 40115 Indonesia

Tel: +6222 4204510. Fax: +6222 4204510

Email: arief.yusuf@fe.unpad.ac.id

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Arief Anshory Yusuf

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

This research is an attempt to further understand the social and environmental dimension of sustainable development focusing on the impact of environmental reforms, such as pollution reduction and energy pricing policy, has on inequality and poverty for the case of Indonesia. The success of the implementation of the reforms largely depend on the desirability of their distributional effects.

A multi-sector, multi-household, Computable General Equilibrium (CGE) model is used to provide the basis for two important empirical case studies: (i) the effects of a carbon tax, and (ii) energy pricing reforms. The CGE model captures the inter-dependence among markets in the determination of both price of commodities and factor of productions and how it will affect distribution of income. As a departure from the previous literature, the disaggregation of household by expenditure classes allows for precise estimates of the distributional impact and poverty incidence.

The main finding from the carbon tax study suggests that in contrast to most studies from developed countries, the introduction of a carbon tax in Indonesia would not necessarily be regressive. It is shown to be strongly progressive in rural areas, and either neutral or slightly progressive in urban areas, with overall progressive distributional effect nationwide. The industries that experience the largest contraction are generally more energy intensive. The owners of factors of production in these industries are largely concentrated among higher income households and people living in the cities.

For the analysis of counter factual scenarios on energy price reforms, the result suggests that reducing subsidy on fuels used for transportation purposes (diesel, and gasoline) constitute a progressive reform. However, a reform like the October 2005 package which includes a massive increase in the price of the fuel used for domestic purpose (kerosene) tends to be regressive unless accompanied by a proper and effective compensation scheme. However, the uniform transfer package implemented by the Indonesia government in October 2005 tends to over-compensate rural house-holds at the cost of under-compensating the urban poor. An alternative package that recognizes the difference between urban and rural households income and expenditure patterns are crucial in the attempt to minimise the adverse distributional impacts of the energy pricing reform.

In general, this study shows there is not necessarily a conflict between environmental and equity objectives, especially when the policies or reforms to achieve environmental goals are carefully designed.

1.0 INTRODUCTION

1.1 Background and Motivation

The linkage between the economic, environmental and social dimension of sustain-able development had been stressed since 1987 in the so-called "Brundtland report". More recently, it was mentioned as one of the three pillars of sustainable development at the 2002 Johannesburg World Summit. This three pillars concept is also known as the ESE triangle representing the Economic, Social, and Environmental dimension of sustainable development.[1]

It is widely acknowledged that the three dimensions of sustainable development are related. In many cases, the three pillars can conflict, when the goal of one of the aspects does not go hand in hand with any of the others. Azis and Salim (2005) suggest that for Indonesia, there has been greater emphasis on economic parameters and less emphasis on social and environmental parameters.

The linkage - including its possible conflict - between environmental and social objectives, especially equity objectives, seems less debated in the policy arena compared to the discussion on the interaction between the economy and equity, or between the economy and the environment. However, as environmental concern is getting more widespread attention, and intervention in the form of environmental policies is becoming more widely advocated, the equity aspect of such policies is becoming increasingly important. The equity dimension starts to become more important, when it is acknowledged that the natural consequences of any government policy, including environmental policy, carries a distributional effect.

If this distributional effect is undesirable, because for example, it could increase poverty and inequality, it may be perceived as having the potential to do harm to the society. If there is an expectation of such an adverse distributive effect, it may even prevent the policy from being implemented. In Indonesia, the plan to reduce fuel subsidies has always been followed by social protest. This also happens elsewhere as noted by OECD (2004, p. 79), "the social protest that followed the oil price increase of 2000 prompted reductions in environmentally-motivated taxes on oil products in countries such as France, Italy, and Australia, and the postponement of planned tax increases in others, like the United Kingdom or Germany delayed planned tax increases".

The complete picture of the distributional impact of environmental policies in general, has to consider two distinct but inseparable issues (OECD, 1994). The first is concerns related to distribution of the environmental benefit of the policy, i.e.,who gains more and who gains less. The second is associated with the distribution of financial effects of the environmental policies, i.e., who pays more and who pays less. This research focuses on the latter.

The trade-off between environmental and equity objectives, in the sense that lower income households pay proportionately more than higher income households following certain environmentally-motivated policies is supported by empirical evidence, especially for the case of pollution regulation or energy-related emission. For example, in developed countries, environmental policies to reduce pollution or discourage fossil fuel consumption are mostly regressive i.e., the burden of the regulations are mostly borne by lower income

[1] See OECD (1994) and Azis and Salim (2005).

households, thereby making income distribution less equal.[2]

However, whether or not a similar conclusion would apply to developing countries still has to be researched. The distributional impact of environmental policies depends on the income and expenditure patterns of households[3], which may naturally be different between rich and poor countries. Therefore, whether such environmental policies are equitable or not is an empirical question.

This research will use Indonesia as a case study in an attempt to answer this empirical question and also to contribute to the debate of whether there is a conflict between environmental and equity goals and to what extent policy design might be able to mitigate any adverse distributive effects of environmentally-motivated reforms.

Two empirical case studies are chosen. The first is the issue of climate change policy, and the second is the issue of energy pricing reform in Indonesia. Indonesia is chosen as a case study, not only because of its importance in global climate change policy, but also because fuel subsidy is such an important issue there. The author's knowledge of Indonesia, access to data, and the potential to contribute to the debate and to policy making in Indonesia, are considered to be the main advantages.

With regard to the carbon abatement policy, the main motivation here is to contribute to the existing literature which generally concludes a carbon tax in developed countries is regressive (OECD, 1994). In addition, Indonesia recently ratified the Kyoto Protocol[4]. As a party to the Convention, one of the obligations is to communicate actions taken to mitigate climate change and to establish the National Committee on Climate Change. Ratifying the protocol means the issue of reducing GHG emissions will have more priority in the public discourse. The likely distributive effect of undertaking GHG reduction in developing countries will be a crucial issue thereby giving more relevance to this research.

For the second case study, i.e., energy pricing reform, the main motivation is the concern that a fuel subsidy contributes to the deterioration of environmental quality in developing countries. Government-induced market distortion has long been considered dominant cause of environmental problems. Removing this distortion, therefore, constitutes one of the important environmental policies. This includes removing environmentally-harmful fuel subsidy which is highly relevant in the Indonesian current policy context.

1.2 Brief Literature Review

This review will focus more on the carbon tax. Most of the studies on the distributional impact of carbon tax are from developed countries. This is confirmed for example by Baranzini et al. (2000) which observe: "Unfortunately, there are few studies on the distributional effects of a carbon tax in developing countries or countries with economies in transition (p. 405)". The lack of studies from developing countries, to some extent, widens the relevance of the research in this paper.

Poterba (1991) analyses the distributional effect or carbon tax by examining the expenditure pattern of households, especially the pattern of energy spending. The policy proposed in the paper, is $100 per ton of carbon implemented in 1990. Using data from U.S. Consumer's Expenditure Survey. Poterba (1991) assumes that the $100/ton carbon tax is

[2] As concluded, for example in literature review by OECD (1994), OECD (1995), Kristorm (2003). This will be discussed further in chapter 2.
[3] Other factors include differences in taxation, transfers and social security system.
[4] on June 28, 2004

fully translated into purchaser's price[5] of various energy related products, and combined these with the data on energy expenditure pattern to estimate the distributional burden of the carbon tax. The result suggest that a carbon tax is regressive, and if it were adopted without any offsetting changes in other tax or transfer programs, the burden would fall more heavily on low-income than well-off households[6].

Another earlier work is a study by Pearson and Smith (1991) using more or less similar method with Poterba (1991). This study examines the distributive effect of carbon tax in European countries. For U.K. households, the result suggest, for example that, the poorest quintile pay 2.4% of their spending, while, the richest quintile pay only 0.8%. Pearson and Smith (1991, p. 42), concludes that the burden of the tax in relation to household spending being higher for the poor than for the rich.

The study for Canada was conducted by Hamilton and Cameron (1994), estimating the distributional impact of meeting the Rio target, stabilising CO2 emission at 1990 level by the year 2000. The methodology used is a combination of a Computable General Equilibrium (CGE), and micro-simulation model. The study suggests that carbon tax in Canada is mildly regressive[7].

Cornwell and Creedy (1996) investigates the distributional implication of meeting the Toronto target for Australia, a reduction in emissions of 20% per cent of 1988 levels by 2005. The methodology used is the combination of Input-Output analysis and household demand system. The general conclusion suggests that the distributive effect is regressive. The simulation for example, increase Gini coefficient from 0.2778 to 0.2838[8].

Barker and Kohler (1998) examines the distributional effects of imposing additional excise duties on energy product according to carbon content, which is essentially, a carbon tax. The countries studied are quite comprehensive, i.e., members of the European Union. The methodology used in this study is called the energyenvironment-economy model for Europe (E3ME), a sectoral, regionalised, econometric model. The policy scenario is the increase in excise duties on energy products, such that it escalates from 1999 to 2010 and achieve levels reducing CO2 emission by 10 per cent below baseline by 2010 for 11 EU member states. The results, with-out revenue recycling suggests that the excise duties are regressive, but progressive if revenue from the additional excise duties is recycling as lump-sum transfers[9].

Symons et al. (2000) examines the likely immediate impact of pollution tax on the tax burden of households in a number of European countries. Although a number of pollutants are examined, this paper focuses on CO2. The method is basically similar to many other studies, such as Labandeira and Labeaga (1999) and Cornwell and Creedy (1996),

[5] Producer's price is not affected.

[6] The source of the regressivity, apparently, are that the share of income which low-income households devote to heating fuel, electricity, and gasoline is significantly higher than that of better-off households. In other words, that energy-related commodity for American households, was in fact a necessity. Poterba (1991), for example reported: "Total energy outlays for households at the 25th percentile of the income distribution are approximately 16% of income, compared with only 7% for households at the 75th percentile of the distribution (p. 8).

[7] The distributional consequences of the simulated tax are moderately regressive: decrease in consumable income for the lowest quintile of households are from 1.1 to 1.2 percent larger than for the highest quintile (p. 394).

[8] Table 3 of Cornwell and Creedy (1996, p. 31)

[9] Barker and Kˆhler (1998) for example concludes that "the package of measures that is examined here is regressive across expenditure groups ..." (p. 399). It is also suggested that the results are dominated by the effects of domestic energy taxes, which are weakly regressive.

where input-output framework is used to assess the likely impact of pollution/energy taxes, via increases in the costs of using fossil fuels, upon the prices of consumer goods. The policy scenarios used in the study are a CO2 tax of 0.1ECU per kg emission of CO2 and an energy tax that raises the same revenues at the CO2 tax. Revenue recycling is not included in the analysis because as Symons et al. (2000, p. 7) states "we need to know the extent of the regressivity of the tax without any additional effects". The results suggest that both CO2 tax and energy tax are regressive in Germany, where for CO2, lowest income groups pay 8% of expenditure, while the highest income group pay just above 5%. The tax is also regressive for France and slightly regressive for Spain. The result for Spain is slightly different with the study by Labandeira and Labeaga (1999), in which they found the neutrality of a carbon tax. In Italy however, the result is neutral, and U.K., in contrast to other studies, is progressive.

Jacobsen et al. (2003) analyses the distributional implications of environmental taxation in Denmark. The taxes that are examined in the paper are various individual taxes, as well as the combination of all these taxes and duties related to environmental concerns. The distributional impact is examined by looking at tax payments relative to disposable income for each income deciles. Comparing the pattern of the tax payments, Jacobsen et al. (2003, p. 495) concludes, that "the distributional effects varies a great deal between different environmental taxes, with transport-related taxes reducing after-tax inequality, and green taxes [including CO2 tax] increasing inequality".

Bork (2003) studies the impact of ecological tax reform in Germany. The ecological tax reform is referred to energy taxation combined with the reduced social insurance contributions. The reform was launched in 1999 with the aim to reduce energy consumption and emissions and to promote the development of environmentally sound production and technologies. The methodology used is a combination of macroeconomic models and micro-simulation model. Bork (2003) concludes households with lower incomes will bear a somewhat heavier burden as a share of net household income[10]. In other words, the study by Bork (2003, p. 167) suggests that ecological tax reform in Germany is regressive. The introduction of fuel tax, which is mostly used for transportation purpose, as also shared by other studies, tends to be progressive.

Brannlund and Nordstrom (2004) analyse consumer response due to changes in energy or environmental policy in Sweden. The policy simulation is to illustrate response and distributional impact of non-marginal changes of the CO2 tax. It appears that the distributional impact is regressive, where household with lowest income quintile pay 0.52 per cent of their disposable income, and household with highest income quintile pay only 0.33 per cent. Brannlund and Nordstrom (2004, p. 225), conclude that ‘relative to disposable income the welfare loss will be greater for low income household indicating that the tax is regressive.

Wier et al. (2005), examine whether carbon tax is regressive in Denmark. The methodology used is a combination of Input-Output model and household survey data. The results suggest that carbon tax payment in Denmark is regressive. Wier et al. (2005, p. 245), for example, report that "as income rises, a falling share going to environmental taxes indicate a regressive tax".

To summarise, although not all of the studies reviewed above conclude the regressivity of environmental policy related to energy and carbon emission, the literature generally suggests that environmental policy in the form of carbon tax or energy tax is regressive. The

[10] The main reasons are the higher prices for electricity, heating oil and natural gas. By contrast, medium-income households will bear the greater burden as regard to the increased fuel taxes (p. 167).

burden is borne more proportionately by lower income households compared to richer households. Similar conclusion is also shared by some other studies that survey more or less similar literature. The survey by Baranzini et al. (2000), OECD (1994), OECD (1996), Kristőrm (2003), and Boyce et al. (2005) confirm this general tendency.

Baranzini et al. (2000), for example, in their evaluation of carbon taxes with regard to their competitiveness, distributional and environmental impact, suggest the tendency toward regressivity. In its survey on the distributive effect of carbon tax, OECD (1995), for example, concludes,

> With regard to income distributional effects, empirical studies suggest that a national carbon tax or trading programme would be at least mildly regressive (i.e., would impose greater percentage burdens on the lower income groups) in many OECD countries, although there is some evidence that such programmes might actually be progressive in developing countries (p.57).

More recent review by Kristőrm (2003, p. 44) also conclude that ‘Empirical evidence tends, on balance, to suggest that environmental policy is regressive (on a gross basis) Meanwhile, Boyce et al. (2005, p. 3), after reviewing studies on distributional impact of carbon tax in developed countries, concludes that studies in [European] and other industrialised countries generally have concluded that carbon charges are regressive’.

In other words, the general tendency of literature from developed countries suggests that environmental policies (in the form of energy-related policies, or climate change policy) tend to be regressive.

As suggested earlier, compared to numerous studies from industrialised countries, studies from developing countries that analyse the distributive effect of carbon abatement policies hardly exist. Among the few are early study by Shah and Larsen (1992), and very recent study by Boyce et al. (2005).

In their analysis Shah and Larsen (1992) the case for carbon taxes is examined in terms of their revenue potential, efficiency, and distributional implications. A small fossil fuel carbon tax of the order of $10/ton is selected. However, the distributional implication is only analysed for Pakistan case. The illustration for Pakistan uses four different cases. For the first case of ‘full forward shifting where the price increase is perfectly translated into final consumer’s prices, Shah and Larsen (1992, p. 8) shows that "the carbon tax burden falls with income, thereby yielding a regressive pattern of incidence. Such regressivity, nevertheless less pronounced with respect to household expenditure". However, with only partial forward shifting the results suggest "roughly proportional incidence of carbon taxes.. and a progressive incidence pattern. Shah and Larsen (1992, p. 10) then conclude that "the ... analysis suggests that the regressivity of carbon taxes should be less of a concern in developing countries than in developed countries".

Another study from developing countries found in the literature is a study for China by Boyce et al. (2005). In this study, Boyce et al. (2005) analyse the distributional impacts of carbon charges and revenue recycling in China. The study uses the data of a nationally representative household income and expenditure survey for the year 1995. They separate household spending into six categories, and apply a carbon loading factor to each of the categories to estimate the carbon usage embodied in these different types of household consumption.

The policy simulated is a charge of 300 yuan per metric ton of carbon. The results suggest that even without revenue recycling the effect of carbon charge would be progressive[11].

Boyce et al. (2005) then conclude that the results are primarily driven by differences between urban and rural expenditure pattern, and also conjecture that ‘a similar pattern may exist in other developing countries’.

1.3 Research Scope and Objectives

To summarise, in terms of the scope of the study, this research will look more closely at the equity aspect of environmental policy and focus on the environmental problems related to pollution and energy related emissions, using case studies of (i) carbon tax and (ii) energy pricing reform in Indonesia. The increasingly alarming problem of climate change[12] and the importance of fossil-fuel energy subsidies[13] in developing countries are the main motivations for the chosen emphasis. As briefly discussed above, the current state of the literature is also another main motivation. Environmental policies related to pollution and energy tend to be regressive according the literature from developed countries. The lack of studies from developing countries motivates the research because the typical characteristics of a developing country’s economy may lead to different conclusions.

The limiting scope of the study is that it focuses merely on the distributional cost of environmental policy that is how the financial or implementation cost of the policy is distributed. In other words, the question is about who pays for the implementation. For methodological reasons, such as the need for non-market valuation of the environmental benefit, the distribution of the benefit from better environmental quality is beyond the scope of this research.

The following are the specific objectives of the research.

1. In the context of the Indonesian economy, to provide a quantitative estimate of the impact of environmental policies in the form the introduction of a carbon tax and energy pricing reform. This refers to its economy-wide impact including output and its sectoral composition, prices, and returns to factors of production.
2. To analyse how the cost of environmental policy with the two case studies above (carbon tax and energy pricing reform) is distributed to households in order to examine whether the policy is progressive or regressive and how it may affect poverty incidence.
3. To assess the feasibility of making equitable environmental policies and how policies should be best implemented to reach the dual goal of equity and the environment. This includes how to design the policies or the reforms, as well as to compare alternative various compensation mechanisms to mitigate adverse distributional impact of environmental policies.

1.4 Methodology

The main methodology to be used in this research is a multi-sectoral, multi-household, Computable General Equilibrium (CGE) model which provides the basis

[11]As Boyce et al. (2005) report: The lowest decile pays 2.1% of their total expenditures ..., and the highest decile pays 3.2%. This reflects the fact that the mix of products that relatively rich people buy is, on average, more carbon intensive than what relatively poor people buy. This contrast with results from studies in other [industrialised] countries.... Our results call into question the generality of this conclusion (pp. 9-10).
[12]See Stern (2006) and IPCC (2007) for recent discussion.
[13]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)

for the two important empirical case studies. CGE modeling is an attempt to use general equilibrium theory[14] as an operational tool for empirically oriented analyses of resource allocation issues in market economies (Bergman, 2005).

There are several important distinguishing features of the CGE model used in this research. The model has detailed energy commodities[15]; allows substitution among energy types and substitution between energy and primary factors; distinguishes detailed labor classification, and between formal and informal labour which is relevant for developing countries; introduces emission accounting and carbon taxation; and fully integrates highly disaggregated households[16] in the model which is a necessary element for distributional analysis.

The properties of the CGE model very much depend on the Social Accounting Matrix serving as its database. A Social Accounting Matrix (SAM) is a matrix representation of transactions in a socioeconomic system[17]. It is a comprehensive, flexible, and disaggregated framework, which elaborates and articulates the generation of income by activities of production and the distribution and redistribution of income between social and institutional groups (Round, 2003).

The Indonesian Social Accounting Matrix, constructed in this study constitutes the biggest and most disaggregated Indonesian SAM ever constructed at the sectoral and household level, hence contributing to the literature on SAM construction especially for developing countries.

With the SAM that takes into account detailed household disaggregation, the CGE model not only allows for simultaneously taking into account both the income and expenditure pattern as inseparable driving forces in the distributional story in an economy-wide framework, but also allows for more direct and accurate calculation of inequality indicators and poverty incidences.

1.5 Expected Contribution

The expected contribution of this research is two-fold. The first relates to the understanding of the inter-related issues of equity and environmental policy. This study will emphasise and add characteristics specific to developing countries, using Indonesia as a case study, and hence will be amongst the few studies that provide quantitative estimates of the distributive effect of environmental policies outside developed countries.

To the author's knowledge, this will be the first research in Indonesia that explicitly analyses climate change policy to assess its impact on income distribution and poverty incidence. With regard to energy pricing reform, this will also be the first study using an economy-wide framework, with full integration of households disaggregated by

[14]General equilibrium theory is a formalisation of the observation that real-world markets are interdependent; changes in supply or demand conditions usually have repercussions on supply and demand conditions, and thus equilibrium prices, in several other markets.

[15] The model itself has 38 industries and 43 commodities, with detailed energy sectors. See Chapter 5 for detail.

[16] The model distinguishes 100 urban and 100 rural households, classified by percentile of expenditure per capita.

[17] A Social Accounting Matrix is an essential database for computable general equilibrium (CGE) modelling. In a SAM framework every agent's expenditure has to equal its receipt (in the form of equality between column and row sum), so that a SAM explicitly represents the initial equilibrium, or market clearing conditions in the economy. Every good and service produced by industry is equal to what is demanded. Each factor of production supplied has to be absorbed by industry, and household spending has to be equal to income. An exercise using a CGE model, is basically comparing this initial equilibrium condition, with other equilibrium induced by changing exogenous shocks to the model.

income/expenditure classes.

In the current literature, the methodology to assess the distributive effect of environmental policies is either micro-simulation, i.e., using household level data to examine income and expenditure patterns, or a Computable General Equilibrium (CGE) model but without detailed household level disaggregation. The methodology proposed in this research will combine these two approaches. The CGE model will capture the economy wide effect, i.e., inter-industry relationship of input-energy-emission, and the general-equilibrium mechanism of factor and commodity price determination, and disaggregation of household by income or expenditure size will provide precise estimates of the distributional impact and poverty incidence.

2.0 METHODOLOGY: INDONESIA-E3

2.1 Model Structure

The model developed in this study will be called INDONESIA-E3 (Economy-Equity-Environment). The CGE model is built based on ORANI-G model, an applied general equilibrium model of the Australian economy. Its theoretical structure is typical of a static general equilibrium 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 and utility maximisation) 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. For more detail about the specification of the model, please see Appendix. The important feature of the model, that also involve important modification to the standard ORANI-G model are the following.

The first modification is to allow substitution among energy commodities, and also between primary factors (capital, labor, and land) and energy because the standard model treats energy commodity as among intermediate inputs under Leontief production function, therefore, it does not allow price-induced energy substitution[18]. In this respect, this model has 38 industries, and 43 commodities with detail energy sectors. Energy commodity include coals, natural gas, gasoline, automotive diesel oil, industrial diesel oil, kerosene, LPG, and other fuels.

Secondly, the model incorporates carbon (CO2) emission accounting, and carbon taxation mechanism[19]. In this study, only CO2 emission from fossil-fuels burning are included. It means, it excludes other source of CO2 emission such as land-use change or deforestation. Data on detail emission by sector and by type-of fuel for Indonesia is not available. However, Statistics of Indonesian Energy Balance, report detail consumption of fossil-fuel by type of energy (natural gas, coal, gasoline, diesel, kerosene, LPG, others) in energy unit[20]. From data on energy consumption measured in unit of energy (e.g. BOE), we can calculate the amount of CO2 emission. Thirdly, multi-household feature is added to the standard model which only has single household. The multi-household feature is not only added to the expenditure or demand side of the model[21], but also from the income side of the households[22].

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[18] This modification is more or less similar to the modification in the INDOCEEM (Indonesian Comprehensive Economic and Energy Model) model, another ORANI-G based model built by Monash University and Indonesian Ministry of Energy.

[19] This modification, follow closely the treatment in MMRF-Green model, as described in Adams et al. (2000).

[20] In this case, Barrel of Oil Equivalent (BOE).

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

[22] 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.

2.2 Social Accounting Matrix

Indonesian Social Accounting Matrix 2003 serves as the core database to the CGE model. The distributional impact of policies analyzed in the CGE modelling frame-work has 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 report. The nature of constructing specifically-designed SAM with distributional emphasis not only requires 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 2.1.

Table 2.1: Structure of 768 x 768 Indonesian SAM

		Activities 1⋯181	Commodity Domestic 1⋯181	Commodity Imported 1⋯181	Factor labour 1⋯16	Factor 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	

The detail SAM used in this model not only provide detail household disaggregation, but also detail labor classification acknowledging the typical characteristics of labor market in developing countries like Indonesia. The Social Accounting Matrix distinguishes 16 classifications of labour. It recognises 4 skills types (agricultural, non-agricultural unskilled, clerical and services, and professional workers), urban-rural distinction, and formal and informal (unpaid) workers. Together, it distinguishes 16 labor categories.

Standard official SAM relies on the Input-Output table. However, the Input-Output table, only distinguishes a single type of labour recorded in the wage bills of industrial costs. Gross operating surplus is then calculated as residuals. In developing countries, where a significant portion of industry does not officially record all payments to labour, this practice, may lead to misleading information.

First, the economy will appear to be highly endowed with capital, which is unlikely to be the case for developing countries like Indonesia. For example, from the Input-Output table, compensation of employees in Indonesia only accounts for around 35% of value added, whereas in the European Union, for example, the number is around 65%[23].

Second implication is that certain industries which are supposed to be relatively labour intensive (e.g., agriculture compared with manufacturing) will instead appear to be capital intensive. Factor intensity is a very important driver of behaviour in the CGE model. For example, the parameters of most production functions used in the CGE model are function of factor shares. The reliability of some CGE models which rely purely on Input-Output table with understatement of labour, will be in question[24]. Understatement of labour compensation is quite common in a developing country Input-Output table. Cororaton (2003), for example shows the case for the Philippines.

The SAM constructed for this research has incorporated the above overlooked aspects utilizing both nation-wide data, as well as detail information from large-scale household survey data.

2.3 Closure

There are at least three considerations in specifying the closures for the simulations. First, the closures have to be able to accommodate the research questions specified. For example, when the research objective is to find out the aggregate welfare impacts of particular shocks, then aggregate real consumption, as indicator of welfare, has to be one of the endogenous variables. For example, as Horridge (2000) stated, the choice of closure is affected by the needs of a particular simulation. Second, the closure should also be able to minimise the weakness due to the feature of the real world that cannot be explained by the model. For example, because the model is static, to avoid the inter-temporal allocation of welfare impact, at the expenditure side, the real investment and the trade balance should be treated as exogenous (Warr, 2001). Finally, the closure is associated with the idea of the simulation timescale, meaning the period of time which would be needed to adjust to a new equilibrium (Horridge, 2000). The objective is to specify the closure as realistic as possible, representing the particular economy, and accommodating the research questions to be investigated.

In specifying a macroeconomic closure, on the aggregate demand side, aggregate real investment, aggregate real government consumption, and trade balance (in real terms)

[23] Source: GTAP Database.

[24] Standard WAYANG model, for example, is based mainly on Indonesian Input-Output table which records around 34.36% of the aggregate labor share (source: Wayang 2002 database).

are treated as exogenous, whereas the aggregate real consumption is endogenous hence can be interpreted as the aggregate index of welfare. This prevents, for example, inter-temporal allocation of welfare impact, due to capital accumulation that may increase welfare in the future (Warr, 2001).

For the case study on carbon tax, at the fiscal side, for some scenarios of revenue-neutral carbon tax, the government budget surplus/deficit is exogenised. The variable that is used to balance the government budget is general sales tax rate, or the amount of cash compensation to households, depending on the simulation objectives. This will be discussed in detail in Chapter 6.

For the case study on energy pricing reform, at the fiscal side, the government budget surplus/deficit is endogenous, while aggregate real government consumption is fixed. Any excess revenue from subsidy reduction left over after compensation may lead to the government running a budget surplus. Related to the fuel price increase in October 2005, 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.

The reason for this closure specification is to isolate the impact of policy scenarios to be investigated. The simulations try to mimic the policy scenarios as implemented in October 2005 and try to examine their income distributional impact. Exogenising the budget surplus requires fiscal adjustment that will have other distributional implications. In both carbon tax and energy price reform case studies, nominal exchange rate is the numeraire.

Another important closure is the factor market closures. In an ORANI type of model, there are at least three factor market closures, each representing the timescale of the simulation (Horridge, 2000). For the carbon tax case study, the analysis will use a closure with the neoclassical full-employment assumption in the labour market. The real wages are endogenous serving as the equilibrating variable to satisfy the full employment conditions. The limitation of this closure is that the carbon tax will have a low impact on GDP because factors of productions are constrained from the supply side. Impact on GDP from a carbon tax is usually channeled through its impact on employment or capital stocks. However, because the focus of the case study is on its distributional implication channeled through the changing factor prices from resource reallocation, fixity of factors on the aggregate level is less of a concern.

In the analysis the case study on energy pricing reform, a short-run analysis is the focus. The ORANI short-run factor market closure is chosen with some slight modification to suit the condition in Indonesian economy. Because the objective of the exercise is to compare and contrast various scenarios of energy pricing reform with different type of compensation scheme, the amount of shock in the price of fuels and the amount of transfers to households should mimic what was implemented by the Indonesian government. Because 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.

2.4 Method for Analyzing Distributional Impact

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[25].

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

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 the one single household-category is important and can significantly affect the results of the analysis (DecaluwÈ et al., 1999). Household-specific shocks, such as transfers to targeted household groups, are also impossible to carry out with approach. Studies by 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 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 Bouruignon 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 information from household-level data, and avoids pre-judgment about aggregating households into categories. All prices are endogenously determined by the model, and no prior assumption of parameter distribution 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 implemented 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 are 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. It turns out that using only 100 representative household classified by centile for expenditure per capita, the calculation of poverty and inequality indicator could be fairly accurate[26].

In this study, poverty incidence, for example, is simply calculated using the following formula. Let y_c is real expenditure per capita of household of the c -th centile

[26] Calculation of Gini coefficient is carried out for the whole 29,278 sample of urban households from SUSENAS and using only 100 households grouped by centile of expenditure per capita. The results are almost identical.

where $c = 1, \ldots, n$, and $n = 100$. Poverty incidence then is calculated using

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

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.

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

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

where

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

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. The change in the real expenditure per capita across household will be used to investigate ex-ante distribution (before the policy change) and ex-post distribution (after the policy change).

3.0 CASE STUDY I: A CARBON TAX

3.1 Background

The problem of global warming has increasingly become more alarming, and scientific studies are now more conclusive that humans are responsible[27]. In a famous report, Stern (2006) suggests scientists are now able to attach probabilities to temperature outcomes and impacts on the natural environment associated with different levels of greenhouse gas stabilisation. For example, his report suggests that without appropriate action, there is at least a 50% chance of exceeding a 50C global average temperature change during the following decades. Such a change would transform the physical geography of the world. His report concludes:

> "Our actions over the coming few decades could create risks of major disruption to economic and social activity, later in this century and in the next, on a scale similar to those associated with the great wars and the economic depression of the first half of the 20th century. And it will be difficult or impossible to reverse these changes (Stern, 2006, p. ii)."

Despite these concerns, multilateral action for greenhouse gas stabilisation, such as proposed under the Kyoto Protocol, have been less than promising. One of the main reasons for this is the associated high cost of such action in terms of economic growth. This argument has been used by both the U.S. and Australian governments against ratifying the Kyoto Protocol and is a clear example of the perception or belief that economic and environmental objectives cannot go hand in hand.

The linkage between the economic, environmental and social dimensions of sustainable development was first introduced in the 1987 Bruntland report. It was again emphasised in the 2002 Johannesburg World Summit as being the three pillars of sustainable development and by this time the environmental link included climate change. With the issue of climate change, the inter-related elements of sustainable development could be in conflict.

Equity is an integrated part of global climate change policy. This includes how the responsibility of actions should be distributed 'fairly' across nations. This was the reason why the 1992 United Nations Framework Convention of Climate Change (UNFCC) declared that the responsibility of actions across nations should follow the principle of 'common but differentiated responsibilities'. Sharing the burden equally is regarded as unfair owing to developing countries' historically low greenhouse gas emissions. However, the lack of a formal commitment for developing countries under the Kyoto Protocol has been used as by the U.S. as an argument against ratification.

Participation by developing countries in stabilising global greenhouse gas emissions is crucial and would be the important driver needed to resume the halting progress of multilateral efforts. Per capita carbon emissions in developing countries are still much lower than that of developed countries. Nevertheless, developing countries are increasingly contributing to the accumulation of greenhouse gases. Developing countries already account for half of annual global greenhouse gas emissions, and future emission growth will mainly come from developing countries (Jotzo, 2004).

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[27] As reported by the recent fourth assessment report of the Intergovernmental Panel on Climate Change (IPCC), published in February, 2007 (source: The Economist, February 8th 2007, 'Climate change: Heating Up'.)

For the developing countries themselves, there are many reasons to justify more active participation in global carbon stabilisation. The impact of climate change tends to hurt the poorest countries most, and this includes Indonesia. Developing regions are already warmer, suffer from high rainfall variability, are heavily dependent on agriculture, and suffer from a lack of adequate health provision and low-quality public services. Being low income countries with low budget constraint, adaptation to harmful effects of climate change will be more difficult (Stern, 2006).

As the fourth largest country in the world in terms of population, Indonesia plays an important role in global climate change policies especially as it has been recognized by the international community that the active and committed participation of developing countries is indispensable in successfully mitigating global warming. In particular, Indonesia needs to pay more attention to its contribution to global carbon emissions. For the last three decades, its reduction in energy intensity (energy used per unit of output) has been among the lowest in the region unlike China, which managed to reduce its energy intensity by 4% per annum. Moreover, during the same period, Indonesia's growth in carbon intensity of energy (carbon content for every unit of energy used) has been among the highest in the region. Indonesia is increasingly becoming more dependent on fossil fuel, way above world and regional standards (Figure 3.1). This is, to some extent, correlated with the energy pricing policy in the country which maintains fuel prices distorted below international market prices, a classic example of policy failure being the cause of environmental problems.

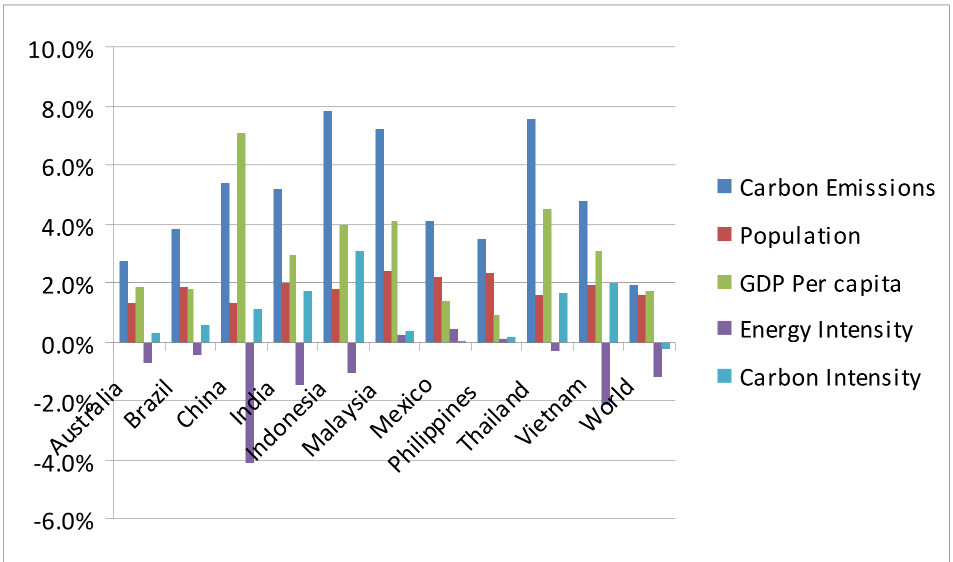

Figure 3.1. Growth of carbon emissions and its drivers (1971-2004)
Source: Author's calculation using data from the International Energy Agency (IEA). http://data.iea.org/ieastore/statslisting.asp

The changing composition of Indonesia's energy mix has also caused some concern about the Indonesian contribution to the global climate problem. Although emissions from consumption of liquid petroleum products is still dominant (amounting to 49% of Indonesia's 2002 fossil-fuel CO2 emissions), emissions from natural gas consumption and coal usage, although quite variable, have risen steadily since the early 1970s and accounted for 15% and 24% of Indonesia's total 2002 emissions. As Indonesia is running out of oil, the future priority of coal as an alternative fuel for electric power generation has become an important item on Indonesia's future agenda. Indonesia recently became a net oil importer, and its coal reserves with current production capacity will last for the next 50 years (Tanujaya, 2005). In addition, with a population exceeding 210 million people, although Indonesia's per capita emission rate of 0.39 metric tons of carbon in 2002 is well below the global average, it has grown ten-fold since the early 1950s (Marland et al., 2005).

Although discussion on the formal commitment of carbon emission stabilisation in developing countries, as well as in Indonesia, is perhaps still in its infancy, it has recently gained a lot more attention, even in Indonesia itself. Indonesia recently ratified the Kyoto Protocol[28]. One of the obligations as a party to the convention is to communicate actions taken to mitigate climate change and also to establish a National Committee on Climate Change. By ratifying the protocol, the issue of reducing greenhouse gas emissions will have more prominence in public discourse.

Carbon abatement policy, like many other environmentally-motivated policies, carries a distributional effect within a country that implements it. A complete picture of this distributional impact has to consider two distinct but inseparable issues (OECD, 1994). The first is the concerns related to the distribution of the environmental benefit of the policy, who gains more and who gains less. The second concern is associated with distribution of the financial effects of the policies, who pays more and who pays less.

In relation to potential distributional benefits from a global reduction in green-house gas emissions, in the case of Indonesia, the questions to be asked are, among others, which parts and/or sectors of the country and its population are likely to be affected. On the other hand, the distribution of financial effects relates more to how the costs of compliance or implementation of policy will be distributed across different groups. The implementation costs of environmental policies can be socially regressive. Lower-income groups may be subject to a disproportionately higher share of environmental compliance costs. The case study in this chapter is intended to address this part of the distributional story.

The conflict between environment and equity objectives in the case of carbon abatement policies has been prevalent, as the literature from developed countries has suggested. As discussed previously, a carbon tax has been mostly found to be regressive, that is, lower income households pay disproportionately more than higher income households.

As discussed previously, the increasing relevance of developing countries' role in global climate change policy is one of the motivations for this case study. However, this chapter is also motivated by the empirical regularities from developed country studies that carbon abatement policies are regressive. In short, this research is mainly motivated by the lack of emphasis in the literature on the distributional aspect of carbon abatement policy in developing countries.

As argued in the previous chapters, there are many possible developing-countries' characteristics that may point to a conclusion that environmental policies such as a carbon abatement policy may not necessarily be regressive in developing countries. In Indonesia, as in some other developing countries, although the manufacturing sectors, is relatively more energy-intensive, its share has increasingly been more dominant in the economy's output, yet the largest share of the labour forces is still employed in the agricultural sector and to some extent the services sector. A carbon abatement policy will most likely hit energy-intensive sectors which are typically also capital intensive. The returns to factors that are more intensively employed in these sectors, such as capital, skilled-labour, and formal urban workers, will be under more pressure than factors more intensively employed in less

[28] In July 2004 (Jotzo, 2004).

energy intensive sectors, such as agriculture and some of the services sector. These are, among others, land, informal urban, and rural agricultural workers. As the owners of factors in the less energy intensive sectors are most likely to be lower income households, this may drive the distributional impact of a carbon abatement policy to be more progressive than regressive.

Moreover, in contrast to developed countries, the expenditure pattern of lower income households in developing countries is likely to be less energy-intensive. For example, in countries like Indonesia, domestic heating is not part of everyday consumption, vehicle ownership is still a luxury for the majority of the population, and electricity consumption, including its use for energy-intensive household appliances, is still not regarded as a necessity, especially in rural areas, where most Indonesians live.

Encouraging developing countries to participate more actively in the global multilateral effort for greenhouse gas stabilisation has increasingly become necessary. If these typical characteristics of developing countries do drive the distributive effect of a carbon abatement policy to be more progressive, it may have important policy implications at both the local and global level. At the local level, if its known to be non-regressive, the effort to curb greenhouse gas emission will generate less political and social resistance. At the global level, understanding that carbon abatement policies may not necessarily carry adverse distributional effects in developing countries, may add more social benefit, in terms of distributional implication, when the location of carbon abatement is partially shifted from developed to developing countries.

3.2 Scenarios and simulation strategy

In contrast to developed countries who have a legal commitment under the Kyoto Protocol to cut CO2 emissions, Indonesia does not yet have to follow a certain scenario of emission reduction. In this case study, a carbon tax of Rp. 280,000 per ton of CO2 emission[29] is introduced with three different scenarios of revenue recycling[30].

In the first scenario (SIM 1), a carbon tax will be implemented without revenue recycling. That is, the revenue from the carbon tax is assumed to be used for fiscal adjustment, allowing the government to run a budget surplus. This is intended to see the direction of the distributional cost, if the tax revenue is not returned to the economy or used for compensation.

Two options will be considered for revenue-recycling in order for the carbon tax policy to be 'revenue-neutral'. In the second scenario (SIM 2), implementation of a carbon tax will be accompanied by a reduction in the uniform general *ad valorem* sales tax rate for all commodities, such that government revenue is in balance. To do this, a uniform sales tax shifter would be endogenised while government saving is exogenised. The other relevant scenario for the revenue-recycling mechanism is to give a uniform lump-sum transfer to all households. This will be the third scenario (SIM 3).

Another option is a reduction in the income tax rate, as widely discussed in the 'double-dividend-hypothesis' literature. This alternative is not implemented in this exercise for at least two reasons. First, for the double dividend hypothesis to work, it is necessary to

[29] Around US$ 32.6.

[30] A carbon tax of this amount is chosen to reduce emissions by 6.6%, i.e., the Indonesian historical growth rate of emission. So, essentially, this is a scenario of emission stabilisation. An arbitrary carbon tax can always be set, such as being equal to the social cost of carbon from the literature, or any level, but the direction of the distributional result, which is the focus of this chapter, will not significantly change.

have an endogenous labour supply, which is not specified in the CGE model. Second, income (especially labour income) tax collection in Indonesia is low in terms of population coverage, making the likelihood of reducing the income tax rate less feasible.

3.3 Results and discussion

3.3.1 Macroeconomic and industry results

The summary of the macroeconomic, emission, and factor market result is shown in Table 3.1, whereas Table 3.2 shows the results on industry output and the prices of several relevant commodities.

GDP, as well as consumption expenditure (which can be treated as an indicator of aggregate welfare) fall slightly in all three scenarios. However, the simulation suggests that SIM 2, where revenue from the carbon tax is returned to the economy as the uniform reduction in commodity tax rate, produces the lowest decline in welfare effect, where real aggregate consumption falls by only 0.03 percent. A reduction in the commodity tax rate, following the carbon tax implementation, minimises the impact on commodities prices, as can be seen in Table 3.2, from the lowest CPI percentage increase of 0.58%. This creates an expansionary effect on the economy because of the increase in the demand for commodities and the resulting output expansion. The uniform cash transfers (SIM 3) to all households do not generate as much expansionary pressure on the domestic economy as the reduction in commodity tax, although it may have a better distributional outcome.

The immediate effect of introducing carbon tax is an increase in the price of energy products because the carbon tax is implemented through an increase in the ad valorem tax rate on energy commodities, the magnitude of which depends mainly on their carbon content. The price of coal rises most (by more than 100%), followed by other energy and closely-associated products such as electricity and transportation.

Energy related sectors are hurt the most. For example, in SIM 1, output of petroleum refinery and coal mining fall by 3.9% and 2.9%, respectively. Other related sectors to experience significant contraction are natural gas, LNG, electricity, water and gas, road, and other transportation sectors.

In terms of factor reallocation, the simulations suggests that, in general, following implementation of the carbon tax, the energy and capital intensive manufacturing sectors tend to contract while agriculture and service sectors tend to experience a slight expansion. Resources have been reallocated from the energy sectors, most non-food manufacturing industries and utility sectors, to agriculturally-based sectors (such as paddy, other crops, and wood sectors), and to some food-manufacturing sectors and services sectors (such as hotel and restaurants).

As indicated in Table 3.3, industries which experience a significant decline in output are relatively energy intensive. Other than energy sectors (petroleum refinery, coals, crude oil, and natural gas), these industries are, among others, LNG, chemical products, pulp and paper, nonferrous metal, electricity, water and gas, construction, and transportation. As Table 3.3 also reveals, most of these industries are also capital intensive. This structural change would affect the functional distributional of income, by the tendency to reduce the return to capital more than to other factors. In turn, this would tend to hurt households proportionately more endowed with capital.

Table 3.1: Simulated Macroeconomic, Emission, and Factor Market Effects of a Carbon Tax

	SIM 1 No-revenue recycling	SIM 2 Uniform cut on com. tax rate	SIM 3 Uniform transfers
Macroeconomics			
GDP	-0.04	-0.02	-0.03
Consumption expenditure	-0.06	-0.03	-0.04
CPI	1.32	0.58	1.75
Export	-0.11	0.67	-0.12
Import	-0.16	0.93	-0.16
CO2 emission	-6.55	-6.39	-6.52
Real wage			
Agriculture, rural, formal	-0.58	1.62	1.28
Agriculture, urban, formal	-0.54	1.78	1.48
Agriculture, rural, informal	-0.48	1.63	1.61
Agriculture, urban, informal	-0.49	1.70	1.63
Production, rural, formal	-2.68	2.03	-2.73
Production, urban, formal	-4.65	0.56	-5.21
Production, rural, informal	-2.23	2.25	-2.55
Production, urban, informal	-2.24	2.22	-2.98
Clerical, rural, formal	-2.17	1.49	-2.92
Clerical, urban, formal	-3.12	0.66	-4.10
Clerical, rural, informal	-1.76	2.11	-1.64
Clerical, urban, informal	-1.78	2.05	-1.93
Professional, rural, formal	-3.19	0.50	-4.32
Professional, urban, formal	-3.55	0.54	-4.63
Professional, rural, informal	-2.19	1.49	-2.72
Professional, urban, informal	-2.06	2.46	-3.45
Average return to capital	-5.77	-1.86	-6.23
Average return to land	-0.41	1.81	1.78

Table 3.2: Simulated Industry and Prices Impacts of Carbon Tax

	SIM 1 No-revenue recycling	SIM 2 Uniform cut on com. tax rate	SIM 3 Uniform transfers
Output of industries			
Paddy	0.09	0.09	0.29
Other food crops	0.05	-0.09	0.09
Estate crops	-0.13	-0.08	-0.38
Livestock	0.13	0.14	0.35
Wood and forests	0.09	0.15	0.05
Fish	-0.08	-0.03	-0.02
Coal	-2.94	-2.88	-2.95
Crude oil	-0.29	-0.30	-0.28
Natural gas	-0.69	-0.69	-0.69
Other mining	-0.10	-0.23	-0.08
Rice	0.10	0.10	0.31
Other food (manufactured)	0.15	0.18	0.58
Clothing	0.41	0.96	0.64
Wood products	0.23	0.33	0.04
Pulp and paper	-0.07	0.17	-0.14
Chemical product	-0.66	-0.27	-0.41
Petroleum refinery	-3.87	-4.01	-3.83
LNG	-2.89	-2.83	-2.89
Rubber and products	-0.20	0.54	-0.51
Plastic and products	-0.05	0.46	0.07
Nonferrous metal	-1.61	-1.93	-1.49
Other metal	-0.37	-0.12	-0.28
Machineries	-0.50	2.45	-0.22
Automotive industries	0.35	-0.08	-0.47
Other manufacturing	0.20	0.38	0.76
Electricity	-1.44	-1.32	-1.29
Water and gas	-2.24	-2.13	-2.68
Construction	-0.01	-0.01	-0.02
Trade	0.05	0.09	0.29
Hotel and restaurants	0.30	0.10	0.24
Road transportation	-0.66	-0.67	-0.58
Other transportation	-1.44	-1.29	-1.43
Banking and finance	0.23	0.02	0.10
General government	0.00	0.00	0.00
Education	0.11	0.06	0.04
Health	0.31	0.17	0.49
Entertainment	0.60	0.49	0.23
Other services	0.29	0.04	-0.25
Prices of commodities			
Coal	131.80	131.95	132.47
Natural gas	26.35	27.27	26.50
Gasoline	24.61	24.72	24.59
Diesel (Automotive)	45.31	45.56	45.44
Diesel (Industries)	43.48	43.83	43.67
Kerosene	29.30	29.54	29.93
LPG	25.62	26.28	24.71
Other fuels	21.37	21.90	21.46
Electricity	16.93	16.97	17.38
Water and gas	12.38	12.13	12.16
Road transportation	1.77	1.30	1.58
Other transportation	2.36	1.00	2.31
CPI	1.32	0.58	1.75

Table 3.3: Cost Share of Industries and Changes in Output

	Share of total input					Change in
	labour	Capital	Land	Energy	Oth. Int	Output
Paddy	51.40	16.56	14.50	0.00	17.54	0.09
Other food crops	57.36	17.35	15.20	0.01	10.09	0.05
Estate crops	52.73	11.21	8.88	0.29	26.89	-0.13
Livestock	42.39	8.08	3.41	0.03	46.08	0.13
Wood and forests	36.37	21.78	21.34	0.42	20.09	0.09
Fish	38.96	8.77	27.19	1.98	23.09	-0.08
Coal	8.09	72.01		13.17	6.73	-2.94
Crude oil	5.80	80.74		6.41	7.06	-0.29
Natural gas	5.81	80.97		6.44	6.77	-0.69
Other mining	26.38	47.48		2.16	23.98	-0.10
Rice	6.17	8.32		0.02	85.49	0.10
Other food (manufactured)	15.23	18.59		0.84	65.34	0.15
Clothing	14.58	19.10		0.83	65.48	0.41
Wood products	18.24	25.36		1.05	55.35	0.23
Pulp and paper	13.92	22.79		1.51	61.79	-0.07
Chemical product	11.88	14.70		3.56	69.86	-0.66
Petroleum refinery	7.54	57.83		8.04	26.60	-3.87
LNG	1.66	51.77		40.05	6.51	-2.89
Rubber and products	15.80	14.82		1.82	67.56	-0.20
Plastic and products	7.81	20.26		0.82	71.11	-0.05
Non-ferous metal	20.40	34.71		6.82	38.07	-1.61
Other metal	9.90	14.06		1.79	74.26	-0.37
Machineries	9.35	13.31		0.63	76.71	-0.50
Automotive industries	15.67	29.73		0.80	53.80	0.35
Other manufacturing	14.06	26.56		1.40	57.98	0.20
Electricity	5.92	50.14		19.33	24.62	-1.44
Water and gas	17.27	26.37		13.42	42.93	-2.24
Construction	23.09	9.55		4.76	62.60	-0.01
Trade	35.27	26.83		1.48	36.42	0.05
Hotel and restaurants	36.93	10.99		0.04	52.04	0.30
Road transportation	21.40	22.11		8.31	48.17	-0.66
Other transportation	12.48	18.17		10.33	59.01	-1.44
Banking and finance	18.90	53.47		0.25	27.38	0.23
General government	53.98	5.62		2.14	38.26	0.00
Education	43.72	8.54		1.10	46.65	0.11
Health	54.50	9.02		0.19	36.29	0.31
Entertainment	17.24	18.11		0.10	64.55	0.60
Other services	25.06	34.83		0.31	39.79	0.29

The changes in the return to factors as shown in Table 3.1, clarify these points. The adjustment in the production sectors affects the prices of factors. In general, the capital owner is hurt more compared with other factors. The return to capital declines the most, followed by real wages, and return to land. In all scenarios, the return to capital falls. In the labour market, for SIM 1, real average return to capital falls most by -5.77%, while the return to land falls by only 0.41%, and the fall in real wages varies depending on skills, but it is always much less than the fall in the return to capital. Real wages fall more for urban and formal skilled labour, reflecting the contraction in the industries employing this labour more intensively. The real wage of urban formal production workers (mostly employed in the manufacturing sectors), urban formal clerical workers, and urban formal professional workers fall the most, by 4.6%, 3.1%, and 3.5%, respectively. On the other hand, agricultural labour only experiences a slight fall in real wages. This adjustment in the factor market will have an important impact because it can drive the distributional effect of a carbon tax to be more progressive from the income side.

As far as the macroeconomic impact or aggregate welfare is concerned, the revenue recycling mechanism in the form of lump-sum transfers is inferior to a commodity tax cut, given the same neutrality of the government budget. One possible explanation for this is that even though a lump-sum transfer for a rural household is a windfall, the economy is driven more by the spending of richer households. Therefore, a uniform tax rate cut for all commodities is more expansionary through the resulting increase in the demand for commodities.

3.3.2 Distributional results

Table 3.4 shows the summary of the distributional effect of a carbon tax for all three scenarios. In the table, both the poverty effect, indicated by the change in the head count poverty incidence, and inequality effect, indicated by the change in the Gini coefficients, are shown for urban, rural, and urban + rural households. Figure 3.2 illustrates in greater detail how each simulation affects household incomes, the household specific CPI, and household real expenditures across urban, rural, and expenditure classes.

In general, the simulations suggest that the introduction of a carbon tax in Indonesia would hurt urban households than rural households. Its impact in rural areas would be progressive, suggesting the poor would gain relatively more than the rich, whereas in urban areas its distributional direction depends on how the revenue from a carbon tax is recycled. It is relatively neutral for the case of no-recycling and tax rate reduction, but progressive for the case of uniform lump-sum transfers. The overall net-impact nationwide is progressive for all scenarios, as can be seen from the reduction in the Gini coefficient.

General results from the simulations suggest that almost all rural households experience a welfare gain as their real expenditure per capita rises. As can be seen from figure 3.2, these gains are distributed progressively, as the percentage changes in the welfare of poorer households are higher than for richer households. However, in simulations 1 and 2, almost all urban households are worse-off, and the effect is more or less neutrally distributed, while in simulation 3, the lowest 20% are better-off, and the distributive effect is progressive.

The driving forces behind these results are closely related to the impact of a carbon tax on both commodity prices and factor prices, combined with a distinct pattern of consumption and factor endowments for each household. From the simulations, it may be suggested that within the same expenditure class, households in rural areas tend to gain more (or to lose less) than households in urban areas. Both in urban and rural areas, poor households tend to gain more (or to lose less) than rich households, and the rural poor tend to gain greater benefit (or a smaller loss) than the urban poor.

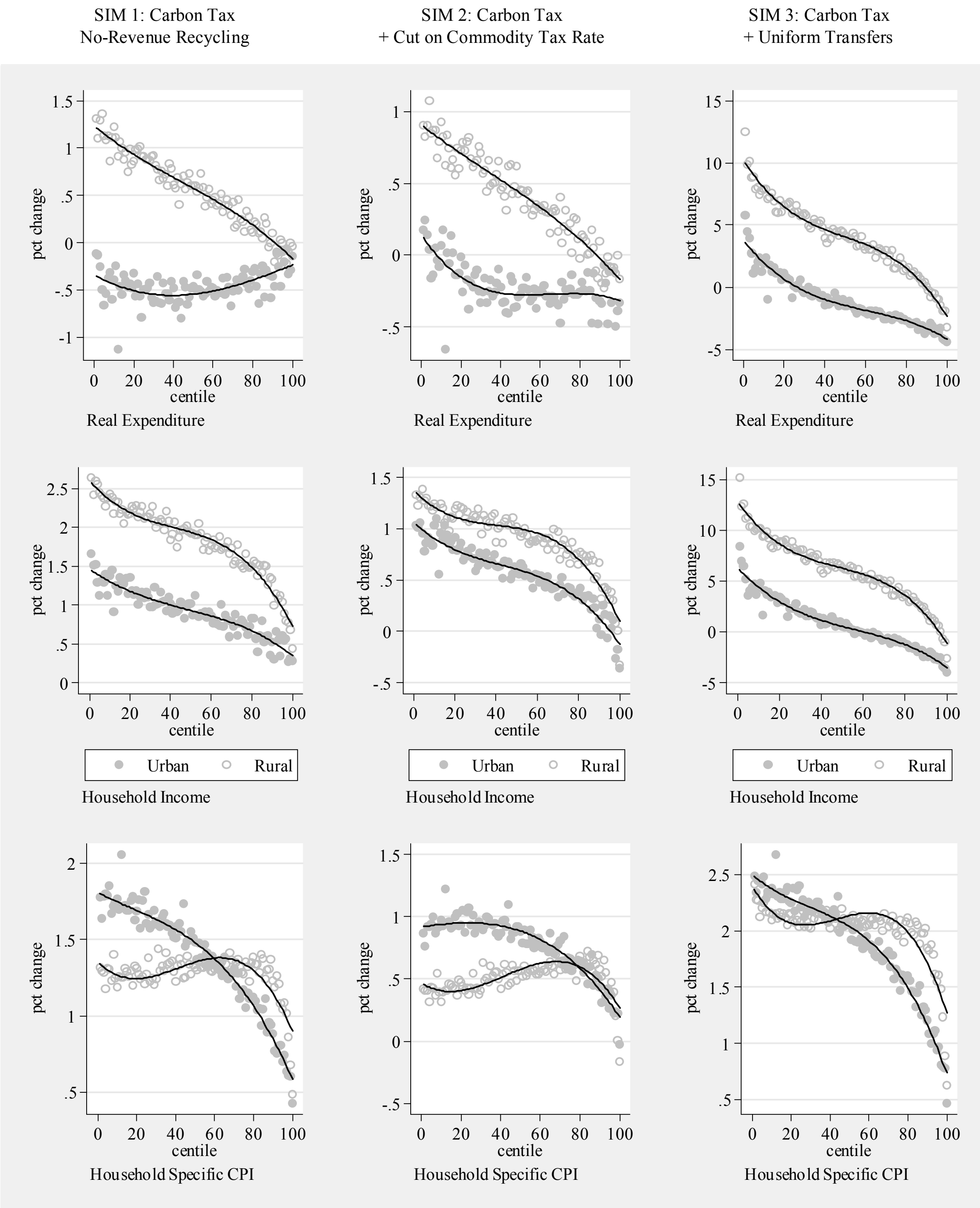

Figure 3.2: Simulated impact on households' real expenditure, income, and households' specific CPI

Table 3.4: Simulated Distributional Effect of a Carbon Tax

	SIM 1 No-revenue recycling	SIM2 Uniform cut on com. tax rate	SIM3 Uniform transfers
Urban			
Ex-ante Poverty Incidence	13.600	13.600	13. 600
Ex-post Poverty Incidence	13.768	13.613	12.915
Change in Poverty Incidence	0.168	0.013	-0.685
Rural			
Ex-ante Poverty Incidence	20.200	20.200	20.200
Ex-post Poverty Incidence	19. 430	19.743	16. 198
Change in Poverty Incidence	-0.770	-0.457	-4.002
Urban + Rural			
Ex-ante Poverty Incidence	17. 194	17.194	17. 194
Ex-post Poverty Incidence	16.852	16.951	14. 703
Change in Poverty Incidence	-0.343	-0.243	-2.49 2
Urban			
Ex-ante Gini Coefficient	0.347	0.347	0.347
Ex-post Gini Coefficient	0.347	0.347	0.337
Change in Gini Coefficient	0.000	0.000	-0.010
Rural			
Ex-ante Gini Coefficient	0.277	0.277	0.277
Ex-post Gini Coefficient	0.2 74	0.275	0.260
Change in Gini Coefficient	-0.003	-0.002	-0.017
Urban + Rural			
Ex-ante Gini Coefficient	0.350	0.350	0.350
Ex-post Gini Coefficient	0.347	0.348	0.333
Change in Gini Coefficient	-0.003	-0.002	-0.017

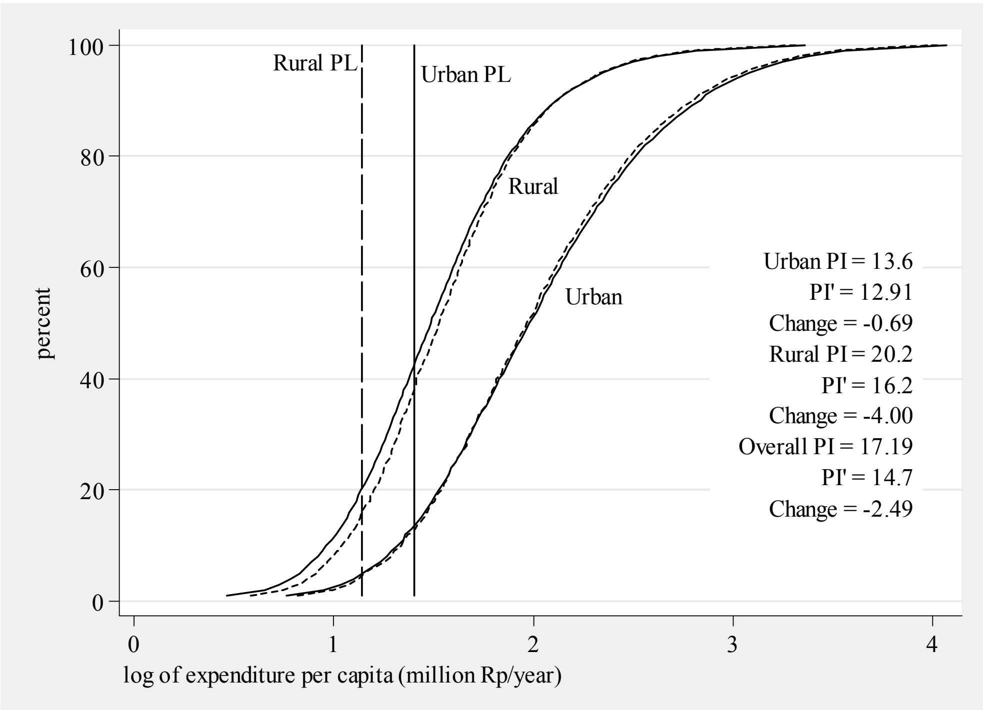

Figure 3.3: Simulated Poverty Impact of a Carbon Tax (SIM 3)

One of the contributing features of the CGE model with full-integration of dis-aggregated households is that it can reveal what causes the distributive effect from both the expenditure and the income pattern. Unlike a partial equilibrium analysis, which only looks at the demand side and is associated only with the expenditure pattern of the households, or even a CGE model with a separate top-down micro-simulation model, the CGE model used in this study is able to offer deeper analysis on its distributive effect from the income side. From the story of the industry results, the factor reallocation in the economy tends to be biased against capital and skilled labour, and in favor of the agriculture and the services sectors, and hence agricultural, unskilled, and informal workers. This may explain why its distributive effect is progressive from the income side of households. As can be seen from Figure 3.2, in all scenarios, the percentage change in household incomes is clearly declining (suggesting progressivity) as expenditure centiles rise, both in rural and urban areas. Meanwhile, rural household incomes, in general, increases more than urban household incomes.

This result is more or less explained by the typical characteristic of a developing country economy, where abundant unskilled and prevalently rural labour are employed in less energy-intensive and less capital-intensive sectors. In general equilibrium mechanics, there would be factor reallocation from energy-intensive sectors (which are mostly also capital intensive) into less energy-intensive (and less capital-intensive) sectors such as agriculture. Expansion in these sectors would have favourable distributional consequences in a developing country like Indonesia. For example, as shown before, the return to land, and the return to informal, unskilled, rural, agricultural workers rise relative to the return to capital or to formal skilled workers. This would drive the favourable distributional impact from the income side, as also illustrated by the declining percentage change in (nominal) income over expenditure centile both in urban and rural areas.

It may be expected that the characteristics of the economy are different in more developed countries, where most of the sectors are energy-intensive, capital-intensive and less agricultural. This may explain why the distributive effect of a carbon tax in developed countries has been reported in various studies as generally regressive. This study shows that the distributive effect of a carbon tax in developing countries may not necessarily be the same. This is still the case even if only looking at the income side pattern of households, which is related to typical factor market features in developing countries.

Moreover, the other side of the story is that the consumption basket of poorer households in Indonesia tends to be less energy intensive. For example, electricity usage, not to mention vehicle ownership, is not as common as in richer countries. So, there is an expectation that progressivity may also originated from the expenditure side.

As illustrated in the bottom panel of Figure 3.2, progressivity from the expenditure side could be determined if household specific CPI is increasing over the centiles, suggesting that the price paid for the total consumption bundle increases more for richer households than it does for poorer households. As shown in those figures, in rural areas this may be true from the poorest to around the 80th centile, as from the 80th centile, its pattern is declining. Hence, from the expenditure side, it is progressive for the lower and middle income classes.

The story is rather different in urban areas. Poorer urban households are under pressure from the expenditure side. The household specific CPI is declining over the expenditure centile in urban areas, suggesting that the price paid by poorer households for their consumption basket increases more than that paid by richer households. This means urban household consumption is more sensitive to the price of energy-related products than rural households' consumption. Among others, these products are fuels, electricity, and transportation. What drives the regressivity from the expenditure side in urban areas is actually the lower-income households' dependence on domestic fuel, especially kerosene. The dependence on kerosene is explained, among others, by the high kerosene subsidy, making its price much lower than the competitive market price. In turn, the regressivity from the expenditure side, and the progressivity from the income side, drive the neutrality of the distributive effect of a carbon tax in urban areas. However, overall the nationwide distributional impact is still progressive, despite the regressivity from the expenditure side in urban areas.

With regard to the impact on poverty, because rural households (especially lower income ones) experience an increase in real-expenditure, poverty in rural areas falls in all scenarios. As expected, rural poverty falls most (by 4%) when the revenue from a carbon tax is returned in the form of uniform lump-sum transfers (see Figure 3.3). Because the rural population is a lot larger than the urban population, the declining poverty incidence in rural areas helps nation-wide poverty incidence fall in all simulations, despite increasing poverty incidence in urban areas (for SIM 1 and SIM 2).

Comparing alternative revenue-recycling schemes suggests a uniform reduction in the general commodity tax rate has a favourable aggregate welfare impact (in terms of aggregate real consumption and GDP). GDP falls the least in SIM 2, with a magnitude of half of SIM 1. However, the uniform lump-sum transfer has more favourable distributional impact and inequality falls the most nation-wide. The Gini coefficient falls significantly by 0.017 compared with only 0.002 with a uniform sales tax cut. The poverty impact of uniform lump-sum transfer is also most favourable. Poverty falls nationwide by 2.5%, which is due to the fall in rural poverty incidence of 4%, as shown in Figure 3.3.

However, a uniform reduction in the rate of commodity tax has a more favorable macroeconomic impact because of its potential for boosting consumption spending, as shown in the discussion of the macroeconomic impact in the earlier section. Moreover, a uniform cash transfer is not a common instrument of redistribution, and may be difficult to implement both administratively and politically.

It should also be noted that introducing a uniform reduction in commodity tax, may affect the direction of the initial distributive effect of a carbon tax when the carbon tax revenue is not recycled. First, the reduction in inequality (in terms of the reduction in Gini coefficient) is lower in SIM 2 (with tax-cut) compared to SIM 1 (no-recycling). Because the pattern of the change in the household specific CPI over the centiles from both simulations seems similar (except in its overall magnitude), it is less likely that commodity price rises contribute to the different result. This is understandable because the reduction in commodity taxes is uniform across commodities, hence will have a more or less similar impact on commodity prices. However, the pattern of the change in household income is relatively different between the two simulations. Comparing the change in income of urban and rural households, the figures show the gap between the change in income of urban and rural households is narrower in SIM 2 (tax-cut) compared to SIM 1 (no-recycling). This result may therefore suggest that what is happening in the factor market has driven the different distributional result between the two simulations.

Table 3.1 may help explain this result. The outputs of industries tend to fall with less magnitude in SIM 2, simply because of the increasing demand due to reduced prices brought about by a uniform sales tax-cut. The increase in demand for commodities offsets the decline in demand for labour by industries that would have happened without the tax-cut. Real wages of all types of labour rise instead of fall, and the return to capital falls much less in SIM 2 than in SIM 1. Some industries (such as pulp and paper, rubber, plastics, and machineries) manage to avoid contraction and some others contract a lot less. Most of these industries are capital intensive, and employ more intensively urban-formal production workers and so may contribute in minimising the urban bias of the distributive effect of a carbon tax. However, despite these factors, a carbon tax with revenue recycled through a uniform reduction in the general sales tax is still progressive, inequality-reducing, adding to its preferability because of its more favourable macroeconomic effects.

4.0 CASE STUDY II: ENERGY PRICING REFORM

4.1 Background

In NEF (2004), it was suggested that the global fuel subsidy could amount to between 250 and 300 billion dollars a year, which could comfortably pay off sub-Saharan Africa's entire debt burden and still leaves billions of dollars to spare. The fuel subsidy creates a distortion by disregarding the economic value of fuel, creating excess consumption and discouraging energy substitution. The fuel subsidy has been a constraint on the agenda to switch the future direction of the country's energy mix following Indonesia being a net oil importer since 2004.

The fossil fuel subsidy is also regarded as a major cause of environmental problems, not only from the pollution created by excessive fossil fuel combustion by industry and vehicles, but also due to excessive traffic and the inconvenience it causes. The fuel subsidy also discourages the development of a more traffic-free public transport infrastructure. In most big Indonesia cities, this is already a major public concern.

In addition to the above efficiency-related problem, the fuel subsidy is often regarded as inequitable. Vehicle owners benefit greatly from the subsidy, and fuel price reform has been widely advocated as a means of promoting efficiency as well as equity.

However, in the Indonesian context, the biggest concern is the fiscal burden of the subsidy. For example, in the year 2000 the fuel subsidy amounted to 40.9 trillion rupiah, or almost a third of total central government spending. Since the government always has a political constraint with regard to reducing this subsidy, spending has been heavily constrained by the fluctuation in the world oil price.

When the world oil price started to rise rapidly from 2004 onward, the government saw no option but to reform its fuel pricing policy radically. In October 2005, the government made a big adjustment in fuel prices following a rapid rise in the world crude oil price. So, in the end, it was international market and not the efficiency argument campaigns from energy-pricing reformists that urged the government to implement the reform.

Over the fast few years, reduction of the fuel subsidy has been one of the Indonesian government's main agendas. It has made a gradual reform in fuel pricing policy through adjustments in fuel prices since the year 1999 However, strong opposition from the people and parliament has slowed the reform. Most arguments against the reform were based on the concern that an increase in fuel prices would translate into an increase in other prices, and that would reduce purchasing power, and exacerbate poverty. The fear was that the rise in fuel prices would create a chain reaction, affecting other costs like transportation and other important commodities, thereby hurting the economy, and the most vulnerable.

4.2 Scenario and simulation strategy

In this case study, the CGE model described in Chapter 5, will be used to simulate the economy-wide and distributional impact of the October 2005 package. It attempts to answer in greater detail whether the reform is progressive or regressive, as well as its likely impact on poverty incidence. It also evaluates various scenarios of reform each with a different types of compensation schemes with the aim of providing better alternative scenarios for further future reform. This is relevant because, even after the last shocking fuel price increase in October 2005, the price of gasoline and kerosene were still only 70% and 31% respectively of the market price. The government plans to remove this subsidy totally in the next one to two years. Therefore, this is still an important policy that will remain in the near future, especially because kerosene is consumed proportionally more by the urban poor.

Table 4.1 summarises the scenarios to be simulated. All of these scenarios are related to the October 2005 package of fuel pricing reform, i.e., increasing the price of gasoline by 87.5%, diesel by 104.7%, and kerosene by 185.7%. The initial database is modified to mimic the fuel price system of the year 2005 before implementation of the reform, in the sense that the rate of fuel subsidy represents the situation in 2005 where the market (or international) price of fuel products was relatively high due to the rapid increase in the crude oil price.

There are two ways to conduct the simulations. The first is by reducing the rate of subsidy on fuels and let their price be determined endogenously by the model. However, this would not exactly mimic implementation of the reform in reality because fuel prices are administered or determined in Indonesia. Once new fuel prices are announced they stay the same until another adjustment and can be regarded as exogenous in this sense. In addition, it is difficult to determine how much the subsidy rate should be reduced to mimic the October 2005 package. The second approach is then used, in which the price of fuels is set exogenously and the subsidy rate is set to be determined endogenously in the model. In this way, the simulation can exactly represent the rate of the price increase as announced by the government on the 1st of October 2005.

Table 4.1: Simulation Scenarios: Energy Price Reform

	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.	SUB ONLY	Transfers as subsidy on education and health
SIM 7.	SUB	October 2005 Package with subsidy on education and health

The objective of Simulation 1 (SIM 1 NO-KEROSENE) is to see the economy wide impact of the October 2005 package and more importantly, its distributional direction had the kerosene price increase not been part of the reform. Many Indonesian economists believe a fuel price subsidy benefits the rich more, hence its removal or reduction will hurt them more than the poor, and would therefore be considered progressive. This expectation is usually based on anecdotal evidence of vehicle ownership where vehicle fuels are an important part of the expenditure of the rich. However, because kerosene is an important part of the consumption of the poor in urban areas, it may be incorrect too generalise that a subsidy on all types of fuels is regressive. In this scenario, the price of gasoline and diesel will be increased, but kerosene will be excluded. Compensation is also excluded to examine the initial distributional direction of the impact of the subsidy reduction policy.

In Simulation 2 (SIM 2 ALL FUELS), the October 2005 reform package, i.e., increasing the price of gasoline, diesel, and kerosene, is implemented without compensation to see the likely distributional impact if a major reform were to be implemented without compensation.

Simulation 3 (SIM 3 100% UT) is exactly what was implemented by the government. It is an increase in the price of gasoline, diesel, and kerosene, plus unconditional cash transfers to targeted households. Being unconditional means the transfers are lump-sum and recipient households have discretion over its use.

In all the simulations, initial or ex-ante poverty incidence is based on the official SUSENAS-based poverty incidence in 2005[31]. However, it transpired that the target of the compensation was not only those below the official poverty line, but also those known as near poor. The number of targeted households was greater than the number of the ‘officially’ poor.

Initially, the program targeted 15.5 million poor and near-poor households (around 28 percent of the national population and in excess of the poverty rate of 16 per-cent) (ESMAP, 2006). However, the recipients’ list was later inflated to 19.2 million households (BPS, 2006) and far outnumber the poor as defined by the SUSENAS poverty line. The calculation suggests the number of recipient households is almost twice the poverty incidence in urban and rural areas. Based on this calculation, cash transfers in the simulation will be given to the lowest 24% of the population in urban areas, and the lowest 42% in rural areas (twice the percentage of the poor in the respected population). With this assumption, the total amount transferred is Rp. 18.3 trillion rupiah[32]. The World Bank (2006) considered this scheme to be the world’s largest ever cash transfer program. Rp 300,000 per household and was disbursed every three months, totalling Rp 1.2 million in one year.

In Simulation 3, it is assumed that the compensation scheme is 100% effective, although this is clearly too idealistic. There are many possible sources for the ineffectiveness of the compensation. The ex-ante targeting may be imperfect, in the sense that some entitled households were not included while some households not entitled were targeted. This source of ineffectiveness was mainly due to statistical recording errors. Another source of ineffectiveness is the possibility that compensation did not fully reach the targeted households (although the cash has already been disbursed). This may happen due to ineffective administration or bureaucracy in the disbursement process, as well as to corruption.

However, there is not yet any consensus on the degree of effectiveness of the compensation scheme. An estimate of the degree of effectiveness of the scheme may be indicated by a study conducted by SMERU (2006). The study compares the number of recipient households with the number of poor households across regions and examines their

[31] Poverty line is calculated based on this official poverty incidence. This poverty line then will be used to calculate ex-post poverty incidence from ex-post distribution of real expenditure per capita. The calculation of poverty incidence is all in real term based on the change in real expenditure per capita. Real poverty line, then is a constant.

[32] At the 2003 price level, since the model database is using SAM 2003. For comparison with the actual amount of transfers, it is calculated that with 19.2 million households as beneficiaries, the actual amount at the 2005 price level will be around Rp 23 trillion rupiah.

correlation. This was possible because the study uses a type of poverty mapping that enables observation in geographical detail. The exercise suggests a coefficient of correlation of 0.65 to 0.72. Based on this, another simulation, Simulation 4 (SIM 4. 75% UT), is conducted, assuming the effectiveness of compensation is 75 percent. In this simulation, the amount of cash given to every centile group of targeted households is reduced by 25%[33].

Another issue that seems to be missing in the public discussion with regard to the effectiveness of the compensation scheme is the rather simplistic approach of giving the same amount of money to all households across Indonesia. Indonesia is a large country, and its geographic nature comprising an archipelago of thousands of islands is one of the reasons why price level, for example, vary greatly across regions. Even though setting and planning different amounts of transfers to different regions may seems to not be a simple task, some distinction between urban and rural households could have made more sense. Simply by using information from the most recent household survey, it is easy to see that urban households will be hurt more than rural households by any jump in the kerosene price simply because poor rural households consume much less kerosene. Therefore, giving more money to urban poor and less to rural poor be regarded as a sensible option. Simulation 5 (SIM 5 100% UTUR) attempts to simulate a slight modification in the scheme by giving different amounts of transfers to urban and rural households recognising the possibility that urban households would be affected more by the reform.

In this simulation (SIM 5), the same amount of the total budget is allocated but urban households receive a higher amount of transfer than rural households. The amount of money transferred to urban households is increased by 70 percent and the transfers to rural households are reduced by 30 percent. This figure is ad-hoc, with the constraint that the total aggregate amount of the compensation is the same, and the results would not increase poverty in rural areas. As this simulation assumes 100 percent effectiveness, it is comparable to SIM 3.

The compensation scheme being an unconditional lump-sum cash transfer invites much criticism. Giving a cash lump-sum to poor households with total discretion as to its spending left up to them can be seen to be a less wise way of helping the poor compared to giving them education, for example. However, critics may be missing the point that this transfer is by nature a compensation. The idea is to mitigate the adverse distributional effect of fiscal and efficiency-motivated reform.

SIM 6 (SUB ONLY) and SIM 7 (SUB) are implemented to account for the idea of subsidising human capital investment as a compensation for fuel pricing reform. Had the compensation scheme built in this kind of subsidy, what would its distributional impact have been? To explore this issue, Simulation 6 (SIM 6 SUB ONLY) first introduces a subsidy to targeted households for spending on health and education unrelated to fuel pricing reform. The purpose is to discover the distributional direction of this sort of compensation scheme. In Simulation 7 (SIM 7 SUB), the subsidy is combined and built into the fuel pricing reform of the October 2005 package. For comparison purposes, the subsidy rate for targeted households is increased (in similar proportions between education and health) so that the budget allocated is equivalent to the unconditional cash transfers.

[33] This can be interpreted as mistargeting households within each centile group or it may also be interpreted as the amount of cash being received by the targeted households diminishes by 25%. In practice, both cases could happen.

4.3 Results and discussion

4.3.1 Macroeconomic and industry results

Table 4.2 shows the impact of various different scenarios on selected macroeconomic variables and industry output. The increase in the price of gasoline by 87.5%, diesel by 104.7%, and kerosene by 185.7% reduces real GDP by around 2.7% for Simulations 2, 3, 4, and 5[34]. Employment falls by around 5.5 percent and aggregate real household consumption, which can be interpreted as an index of aggregate welfare, falls by around 4 percent under the same scenarios. The decline in real GDP and aggregate consumption for Simulation 1 is much smaller because it does not include an increase in the price of kerosene. In Simulation 7, the smaller decline in real GDP and aggregate consumption can be explained by the increasing demand for factors employed in the health and education sectors due to the subsidisation of these sectors.

In all simulations, except for Simulation 6, industry output falls as a result of the increase in the price of petroleum products. The increase in fuel prices lowers fuel demand resulting in an immediate reduction in the output of the refinery industry. The final (new equilibrium) reduction in the output of petroleum refineries is around 8 percent in Simulations 2, 3, 4, and 5. Other industries which experience big contractions are those closely related to the petroleum refinery sector. For example, in Simulation 2, these are road transportation (-4.87%), other transportation (-6.62%), utility sectors (electricity by -3%, and water and gas by -4.15%), and some manufacturing industry (automotive by -4.4% and rubber and products by -4.91%). After simulating an increase in the price of petroleum products, Clements et al. (2003) report that industries which experience a large contractions are similar type of industries to those just mentioned.

4.3.2 Distributional results

One of the advantages of the CGE model with households disaggregated by centile of expenditure per capita, is direct calculation of the inequality indicator such as (but not limited to) the Gini coefficient[35]. Therefore, an objective answer to the question of whether a policy shock is progressive or regressive is readily available. When the policy simulation increases the Gini coefficient, the policy can be judged regressive. If it reduces the Gini coefficient, it can be regarded as progressive. In addition, as shown in Chapter 5, the model also allows direct calculation of poverty incidence, in urban areas, rural areas, and all of Indonesia.

The following discussion focuses on the distributional results, i.e., with concentration on inequality and poverty incidence, for all the simulated scenarios. In an economy-wide framework, both expenditure and income patterns contribute to the distributional story. They are integrated and taken into account simultaneously in the model. Household specific CPI is a consumption-weighted average of the price increase of every commodity consumed by the respective household. It reflects the contribution of its household expenditure pattern and behaviour. On the other hand, the change in household income reflects the changes in all sources of household income, comprising income from labour by skill types, capital, land, and transfers (such as from compensation).

[34] Compared to base line, without the reform.
[35] See detailed discussion in Chapter 5.

Table 4.2: Simulated Macroeconomic and Industry Results: Energy Price Reform

	Scenario						
	1	2	3	4	5	6	7
Macroeconomic							
Gross Domestic Product (real)	-1.72	-2.67	-2.68	-2.68	-2.67	0.24	-2.42
Household expenditure	-2.61	-4.03	-4.03	-4.03	-4.02	0.36	-3.65
Export	-1.72	-2.40	-2.46	-2.44	-2.45	0.37	-2.07
Import	-2.38	-3.32	-3.40	-3.38	-3.39	0.51	-2.86
Employment	-3.32	-5.52	-5.53	-5.53	-5.52	1.57	-4.19
Industry output							
Paddy	-0.57	-1.22	-0.88	-0.96	-0.97	0.24	-0.97
Other food crops	-1.04	-2.06	-1.81	-1.87	-1.85	0.22	-1.81
Estate crops	-1.57	-2.81	-2.71	-2.74	-2.72	0.43	-2.39
Livestock	-1.67	-3.13	-2.91	-2.97	-2.94	0.30	-2.81
Wood and forests	-0.96	-1.71	-1.69	-1.69	-1.70	0.31	-1.40
Fish	-1.08	-1.91	-1.76	-1.80	-1.80	0.11	-1.76
Coal	-0.06	-0.12	-0.12	-0.12	-0.12	0.02	-0.10
Crude oil	-0.14	-0.16	-0.17	-0.16	-0.17	0.01	-0.15
Natural gas	-0.19	-0.21	-0.21	-0.21	-0.21	0.01	-0.19
Other mining	-0.52	-0.75	-0.76	-0.76	-0.76	0.11	-0.64
Rice	-0.52	-1.14	-0.79	-0.87	-0.89	0.23	-0.91
Other food (manufactured)	-1.91	-3.37	-3.13	-3.19	-3.16	0.27	-3.07
Clothing	-2.14	-3.71	-3.67	-3.68	-3.68	0.51	-3.23
Wood products	-1.10	-1.98	-2.10	-2.07	-2.11	0.23	-1.74
Pulp and paper	-2.32	-3.57	-3.63	-3.61	-3.59	1.87	-2.02
Chemical product	-2.79	-4.08	-4.02	-4.04	-4.03	0.61	-3.53
Petroleum refinery	-4.57	-7.93	-7.95	-7.94	-7.95	0.10	-7.85
LNG	-0.83	-0.79	-0.79	-0.79	-0.79	0.02	-0.77
Rubber and products	-3.34	-4.91	-5.09	-5.05	-5.08	0.63	-4.35
Plastic and products	-1.97	-3.16	-3.18	-3.18	-3.21	0.38	-2.80
Nonferrous metal	-1.09	-1.63	-1.61	-1.61	-1.62	0.33	-1.34
Other metal	-1.53	-2.19	-2.22	-2.21	-2.23	0.39	-1.85
Machineries	-3.16	-4.79	-4.95	-4.91	-4.97	0.60	-4.27
Automotive industries	-3.10	-4.42	-5.02	-4.87	-5.01	0.44	-4.03
Other manufacturing	-2.36	-3.87	-3.70	-3.74	-3.73	0.64	-3.28
Electricity	-1.98	-2.99	-2.91	-2.93	-2.86	0.41	-2.60
Water and gas	-2.98	-4.15	-4.49	-4.40	-4.35	0.39	-3.78
Construction	-0.15	-0.22	-0.22	-0.22	-0.22	0.26	-0.01
Trade	-1.95	-3.29	-3.17	-3.20	-3.14	0.52	-2.81
Hotel and restaurants	-2.13	-3.78	-3.81	-3.80	-3.73	0.50	-3.30
Road transportation	-3.53	-4.87	-4.91	-4.90	-4.86	0.62	-4.32
Other transportation	-5.18	-6.62	-6.70	-6.68	-6.66	0.74	-5.97
Banking and finance	-1.63	-2.72	-2.90	-2.85	-2.85	0.37	-2.38
General government	-0.08	-0.12	-0.13	-0.13	-0.13	0.01	-0.11
Education	-1.58	-2.52	-2.52	-2.52	-2.40	12.31	7.29
Health	-1.50	-2.56	-2.51	-2.52	-2.52	13.63	8.69
Entertainment	-2.26	-3.86	-4.22	-4.13	-4.19	0.64	-3.29
Other services	-2.36	-3.65	-4.05	-3.95	-4.00	0.29	-3.36

Table 4.3: Summary of distributional results: Energy Price Reform

	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	11.37	11.37	11.37	11.37	11.37	11.37	11.37
Ex-post Poverty Incidence	12.525	14.002	12.485	12.78	11.4	9.444	12.311
Change in Poverty Incidence	1.155	2.632	1.115	1.41	0.03	-1.926	0.941
Rural							
Ex-ante Poverty Incidence	19.51	19.51	19.51	19.51	19.51	19.51	19.51
Ex-post Poverty Incidence	20.067	21.341	17.415	17.9	19.158	17.36	19.864
Change in Poverty Incidence	0.557	1.831	-2.095	-1.61	-0.352	-2.147	0.354
Urban + Rural							
Ex-ante Poverty Incidence	15.803	15.803	15.803	15.803	15.803	15.8	15.803
Ex-post Poverty Incidence	16.632	17.999	15.17	15.568	15.625	13.76	16.424
Change in Poverty Incidence	0.829	2.196	-0.633	-0.235	-0.178	-2.046	0.621
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	0.345	0.347	0.341	0.341	0.346
Change in Gini Coefficient	-0.003	0.005	-0.001	0	-0.006	-0.006	-0.001
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	0.262	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	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Ex-post Gini Coefficient	0.345	0.35	0.339	0.342	0.34	0.344	0.344
Change in Gini Coefficient	-0.005	0	-0.011	-0.008	-0.01	-0.006	-0.006

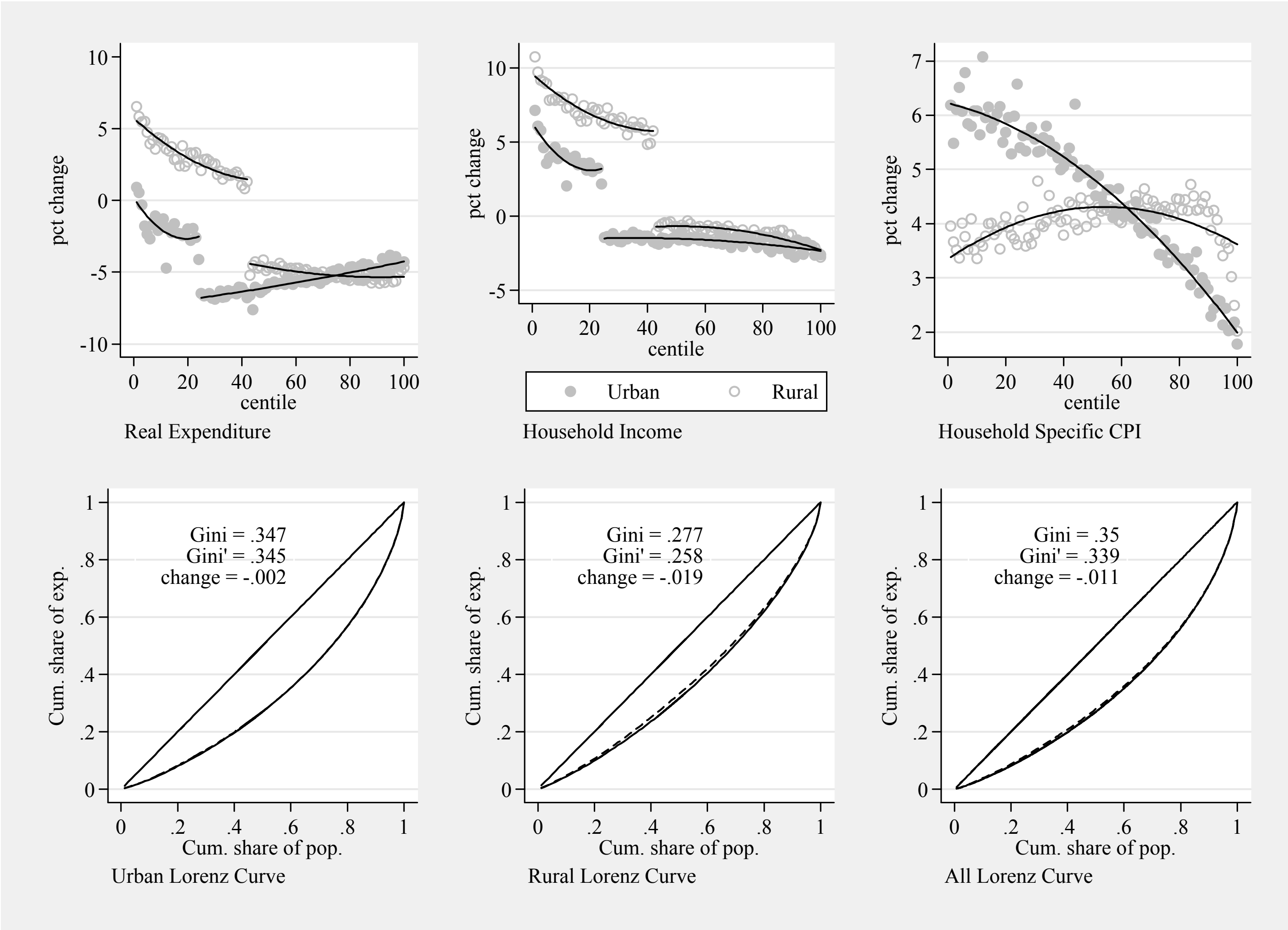

Figure 4.1: Simulated Distributional Impact of Energy Price Reform (SIM 3)

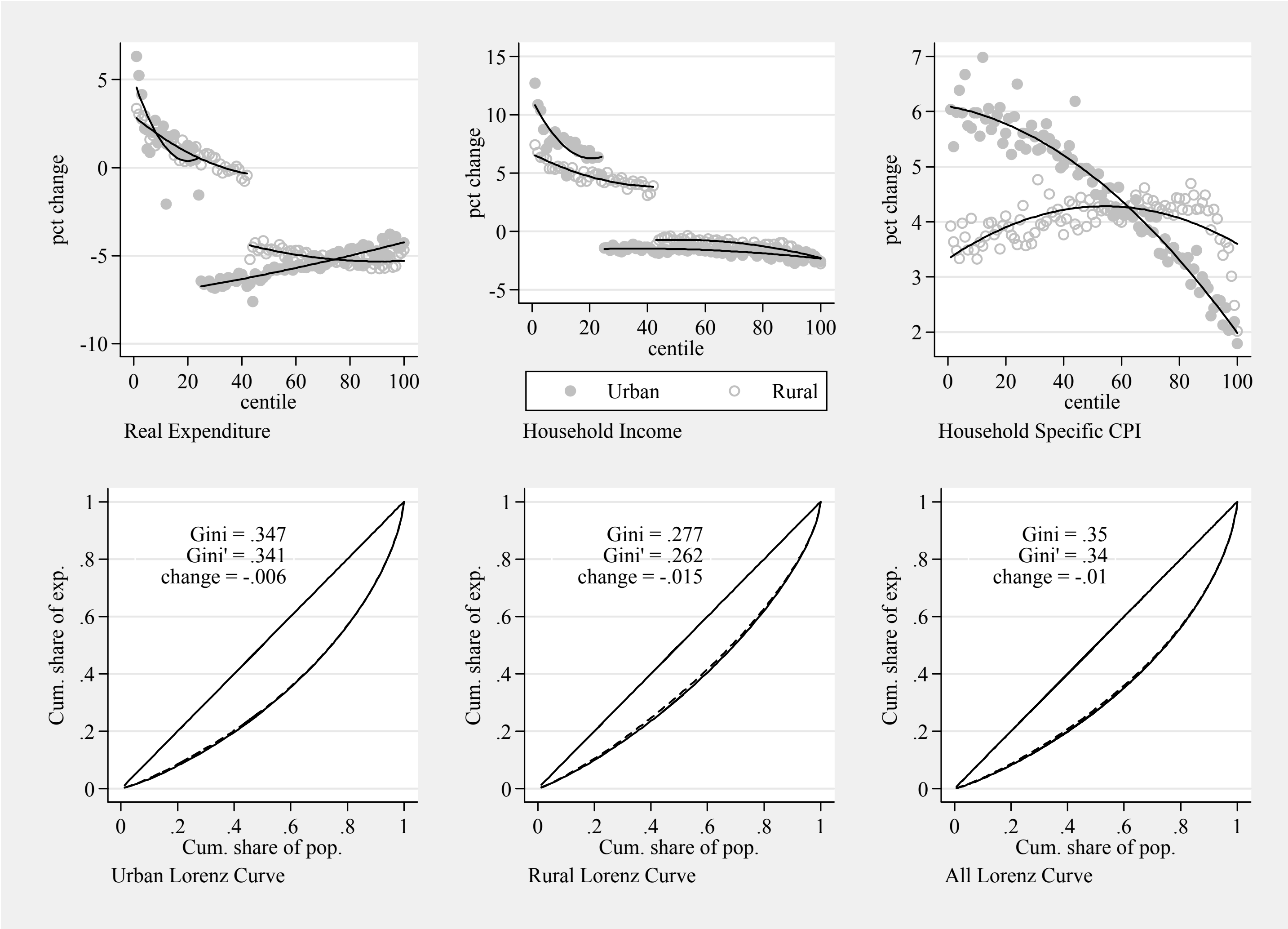

Figure 4.1: Simulated Distributional Impact of Energy Price Reform (SIM 3)

SIM 1: Increasing the price of fuels (except kerosene) without compensation

Before the implementation of the fuel price reform in October 2005, the fuel subsidy was regarded as both inefficient and inequitable. Because the rich are regarded as the biggest consumers of fuel, especially vehicle fuels, it has been a long-held view that reducing the fuel subsidy would hurt them more, and would therefore be progressive. To some extent Simulation 1 (SIM 1 NO-KEROSENE) supports this view. The fuel subsidy on gasoline and diesel has been inequitable, so that cutting the subsidy on these vehicle fuels would be a progressive reform. In this simulation, the October 2005 package without compensation is simulated but only for non-kerosene commodities.

This progressivity is driven both by household consumption (by the pattern of the change in household CPI) and income pattern (by the pattern of the change in household income). Richer households tend to experience a greater increase in consumer price, reflecting their higher dependence on non-kerosene vehicle fuel consumption. The fall in their income is also higher compared to poorer households, reflecting the adjustment in the factor market which does not favour the factor endowment of high income households.

However, the urban poor are the bigger consumer of kerosene and the actual reform package implemented in October 2005 increased its price much more than other fuels. The kerosene administered price was drastically increased (185.7 percent), much more than the increase in other fuel prices (87.5 percent for gasoline, and 104.7 percent for diesel). Simulation 2 attempts to examine whether the reform being implemented this way can still be regarded progressive.

SIM 2: Increasing the price of all fuels (without compensation)

To find out the distributional impact of this package, the increase in the administered price of fuels without compensation is simulated in SIM 2 (ALL FUELS). The simulation produces a markedly different distributional story. In urban areas, real expenditure of the 20 percent poorest households declines within the magnitude of about 5 to 7 percent, whereas the richest 20 percent households experience a decline of only about 2 to 4 percent. The pattern of the fall in the real expenditure of urban households clearly increases over centiles. As a result, inequality increases in urban areas, as the Gini coefficient increases from 0.347 to 0.352.

In contrast, the distributional impact is slightly progressive in rural areas. Real expenditure of the poorest 20% falls by around 3%, while the richest 20% falls by around 4%. Overall, the impact reduces inequality. Nationwide (urban and rural areas combined) the October 2005 package without compensation is neutral with a negligible impact on the Gini coefficient. The main driver of the regressive result in urban areas is the dependence of urban lower income households on kerosene consumption, as well as on other commodities related to fuels such as spending on transportation. This is reflected by the increase in their household specific CPI which is far higher than that of higher income households.

Urban households, in general, experience a lower fall in income compared to rural households. In addition, in both urban and rural areas, richer households experience more adverse income shocks. This clearly shows the impact of fuel price rises through industry employment of capital and labour are biased against urban and richer households. In rural areas, this helps in shaping the progressivity of the reform. However, in urban areas, because the impact through the consumption pattern is far more severe, the reform cannot avoid being regressive.

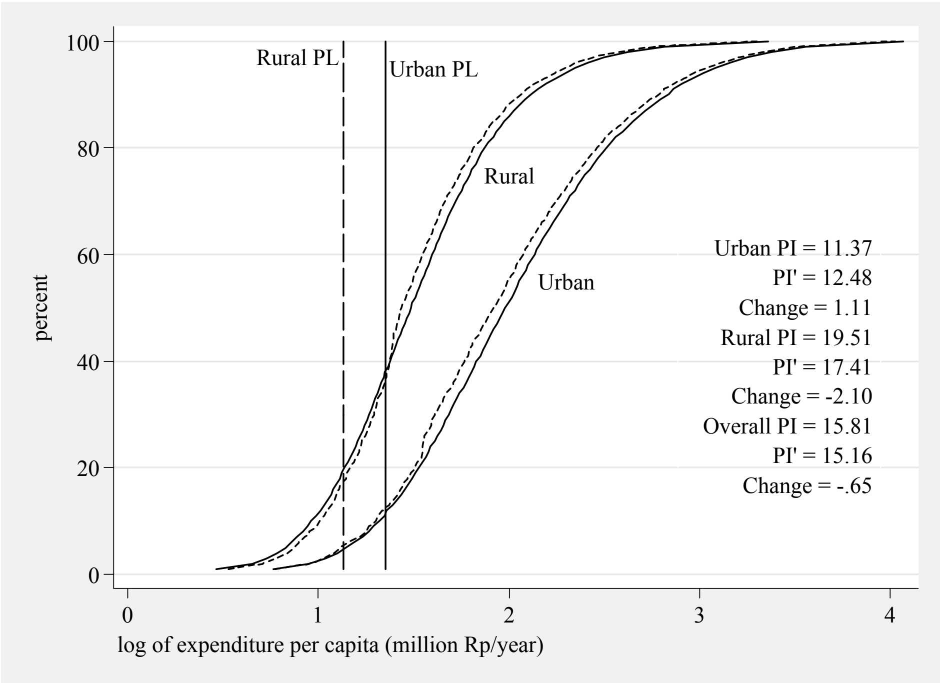

Figure 4.3: Simulated Poverty Impact of Energy Price Reform (SIM 3)

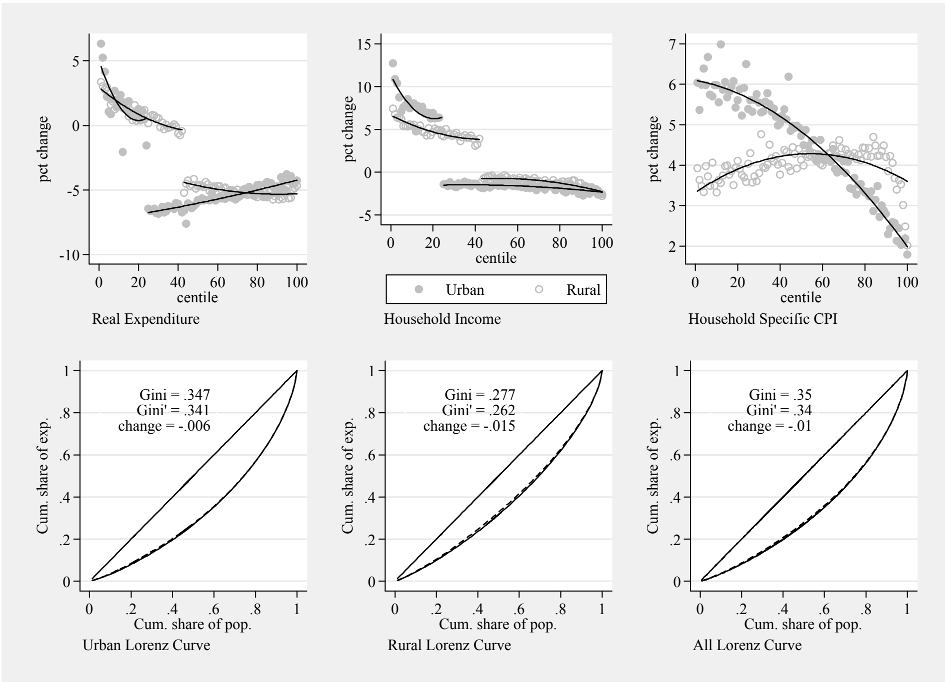

Figure 4.4: Simulated Poverty Impact of Energy Price Reform (SIM 5)

The October 2005 package without compensation may have a significant impact on poverty as well. Poverty incidence increases by 2.63% in urban areas and by 1.83 percent in rural areas. In all, poverty incidence, nation-wide, rises by 2.19 percent. Using the population data for 2005, Simulation 2 suggests that without compensation the reform package could have driven around 5 million people into poverty.

The analysis of the ‘what-if’ scenarios exercised in SIM 2 suggests that while the reduction in fuel subsidy as part of the energy pricing reform has a strong basis in term of economic efficiency, how it is implemented is important in relation to the concern about distributional effects. Reducing the fuel subsidy per se, without careful prior examination as to how the reform will affect the poor, may generate an adverse distributional impact. This should be avoided because the reform should be carried out with the least cost and that includes the distributional cost in terms of its inequality and poverty implications.

SIM 3 and 4: Increasing the price of fuels with compensation

It could be that the distributional concern was the main reason why the actual fuel pricing reform in the October 2005 package was combined with a compensation scheme. The scheme chosen by the Indonesian government was a lump-sum cash transfer to targeted households (households considered poor and near poor). Targeted households were given an annual cash transfer of 1.2 million rupiah in four installments. The government claimed the amount of the transfer was more than adequate to compensate for the potential fall in welfare of the poor. Some studies, such as Ikhsan et al. (2005) and the World Bank (2006) backed this claim. Simulation 3 (100% UT) is carried out to see the distributional impact of this reform package. The simulation assumes 100 percent effectiveness of the cash transfers in reaching the targeted households.

As shown in Figure 4.1, the claim that the cash transfer more than compensated for the adverse welfare impact on the poor is only true in the case of the rural poor. Although some of the poorest centiles of the urban poor gain positive (nominal) income because of the transfer, when it is deflated with the increase in their specific CPI, the net real expenditure effect is still negative. In urban areas, none of the targeted households experience a positive welfare gain. The scheme over-compensates the rural poor and under-compensates the urban poor. However, the October 2005 package reduces inequality, especially in rural areas, by 0.019 point, and reduces the overall Gini coefficient from 0.35 to 0.339. This decline in inequality is driven mainly by the significant increase in the real expenditure of the rural poor; the less severe fall in the real expenditure of the urban poor (due to the compensation) than the urban non-poor, and the sharp decline in the real expenditure of the non-targeted (non-poor or richer) households.

Figure 4.3 illustrates the poverty impact of Simulation 3 (100% UT). Due mainly to under-compensation of the urban poor, the October 2005 package (with compensation) still can not prevent urban poverty incidence from rising by 1.11 percentage points, despite the fall in the rural poverty incidence by almost 2.1 percentage points. However, the overall net nationwide impact is a slight decline of 0.65 percent. As the population is higher in rural areas, the decline in rural poverty incidence helps prevent an overall increase in the nation-wide poverty incidence.

The poverty impact is even higher when the compensation scheme is 75% effective. Urban poverty incidence increases by 1.41% instead of 1.11% (with 100% effectiveness) and the fall in rural poverty incidence is only 1.61% instead of 2.01%. The fall in inequality is also lower compared to the case of 100% effectiveness (See Table 4.3).

SIM 5: Increasing the price of fuels and giving more transfers to the urban poor

Given the tendency for uniform cash transfers to over-compensate rural and under-compensate urban households, the scheme is slightly modified in Simulation 5 (100% UTUR) by giving more cash to urban and less to rural targeted households. The result suggests this modification may prevent quite a significant number of urban households from falling into poverty, by still leaving the poverty incidence in rural areas intact. In this simulation, the poverty incidence in urban area increases by a negligible amount, in contrast to 1.11 percent if the amount of money is uniform across urban and rural households. In rural areas, poverty incidence still falls by 0.35 percent. The number of people in urban areas falling into poverty due to the reform might have been reduced significantly had the compensation been modified in this way. Uniform cash transfers could produce a much larger number of additional poor, compared to this slightly modified compensation.

The purpose of the compensation scheme is to mitigate the poverty or distributional impact of a reform. Naturally, it is not a structural poverty eradication program. The objective of the scheme is to compensate households for any adverse impact from the reform. Therefore, even if the uniform compensation scheme could potentially reduce poverty nation-wide due to the over-compensation in rural areas, if this was at the cost of a huge increase in poverty in urban area, a slightly modified compensation scheme may still be preferable. In terms of policy effectiveness, it might even have another advantage by minimising resistance to the reform due to the fact that the urban poor are generally stronger politically than the rural poor.

SIM 6 and 7: Increasing the price of fuels and subsidising education and health expenditure as compensation

Simulation 6 tries to reveal the likely distributional impact of a price subsidy given to targeted households in the form of an education and health subsidy (more or less using the same budget as the cash transfers). Simulation 6 is not related to energy pricing reform or the increase in fuel prices, but only seeks the economy wide impact of the price subsidy, including distributional consequences, with other policies remaining unchanged. On the other hand, Simulation 7 combines SIM 6 with the increase in the price of fuels as implemented in October 2005. The result of SIM 6 suggests a price subsidy for the spending of the poor on education and health increases the output of education sectors by 12.31%, and the health sector by 13.63% (see Table 4.2). Because the subsidy is given only to the lower income classes, the simulation tends to be progressive, reducing the Gini coefficient in urban and rural areas, as well as nationwide. However, from the point of view of the factor market, the subsidy expands the output of certain sectors that favour the higher income class. This happens because the education and health sectors employ factors such as skilled-labour which are owned by higher income households more intensively. The percentage change in household income is greater for higher income groups both in urban and rural areas. However, because the subsidy is given to the poorer part of the population, the decline in their household specific CPI drives the distributional impact to be more progressive.

When conditional transfers like these are used as a compensation scheme together with the October 2005 package, the story turns out to be rather different. The results from Simulation 7 (SUB) suggest the inequality impact is neutral in urban areas, progressive in rural areas and slightly progressive nationwide. Because the expansion in the education and health sectors increases demand for more skilled-labour and capital, for which higher income households have proportionally greater endowments, it drives the regressive results through the income pattern. The pattern on the fall in household income shows increasing trends toward higher income groups. In urban areas, the progressivity is weakened by the high dependence of the urban poor on kerosene and other fuel-related consumption, such as transportation.

More importantly, the fall in household purchasing power (as indicated by the increase in household specific CPI) does not help compensate the poor. Both in urban and rural areas, almost all households (including the poor) experience a fall in real expenditure. As a result, poverty rises in urban areas by 0.9%. In contrast to the cash transfers, a subsidy on education and health as compensation increases poverty in rural areas by 0.35% and because most of the poor population is rural, poverty incidence rises nationwide by 0.62%. A subsidy on health and education may be good as an incentive for human capital investment, but may not necessarily be effective as a means of short-run compensation to mitigate the adverse poverty impact of a fuel pricing reform. It may be better suited for longer-term objectives, especially if combined with policies to promote education spending by modifying the expenditure pattern or demand behaviour toward education, especially for rural households. However, this is a longer-term approach of a structural poverty alleviation program, not an ad-hoc occasional compensation scheme to minimise the short term distributional cost of a particular reforms such as energy pricing.

5.0 CONCLUSION

5.1 Key Findings and Contributions

It is widely acknowledged that the three dimensions of sustainable development - economic, social, and environmental - are crucial, inseparable and interrelated. In many cases, the three dimensions can conflict when the goal of one aspect does correspond with any of the others. This thesis attempts to look more closely at the social and environmental dimensions of sustainable development. The analysis focuses on the equity aspect of environmental policy in the case of environmental problems related to pollution and energy-related emissions.

This thesis first looks at what the literature generally finds on the distributional impact of environmental policies related to pollution and energy-related emissions. This literature is mostly from industrialised countries, but this thesis demonstrates cases where these findings cannot be generalised to developing countries. Using the case study of Indonesia, this thesis also aims to provide a quantitative estimate of the impact of the introduction of a carbon tax and energy pricing reform chosen to be the case studies on the economy, and to analyse how the cost of the policy is distributed to households in order to examine whether it is progressive or regressive and how it may affect poverty incidence. This thesis also attempts to assess the feasibility of designing equitable environmental policies and how they should best be implemented to reach the dual goals of equity and the environmental improvement.

The literature review confirms that environmental policies aimed to reduce energy-related emissions or pollution, such as carbon or energy taxes, are generally regressive. The burden is borne more proportionately by lower income households. However, it is argued that due to the difference in characteristics, such policies may not necessarily be regressive if implemented in less developed countries.

The examination of the expenditure patterns of Indonesian and European house-holds reveals that their spending patterns are different and this may play an important role in the distributional analysis of environmental policies. In Europe, the share of energy spending in total expenditure declines with income, suggesting energy is a necessity. However, the share of energy spending in Indonesia does not necessarily decline with income, and certain types of energy, such as electricity, can be regarded as a luxury in that their share of expenditure increase with income.

The distributional effect of environmental policies is not only driven by households' spending patterns. Household income may also be affected by how the policies affect the markets for factor of production. In this regard, the type of factors households are endowed with, and the institutional setting that may play a role in the factor market adjustment, may also drive the direction of the distributional impact. In this respect, certain characteristics of developing countries may make a difference. This thesis conducts an analytical exercise using a simple model that emphasises a dualistic labour market to illustrate this issue, and provides certain cases where environmental policies in developing countries may not necessarily be regressive from the perspective of the factorial distribution of income. The main result suggests that when an economy has a capital-intensive formal sector, a labour-intensive in-formal sector, and a distortion in the labour market due to the existence of minimum wage policy in the formal sector, an environmental policy implemented through a pollution tax may improve factorial income distribution.

This thesis also offers some methodological contribution. In Indonesia, this will be the first[36] research that explicitly analyses climate change policy to assess its impact on income distribution and poverty incidence. With regard to energy pricing reform, this research will also be the first study using an economy-wide framework with full integration of households disaggregated by income/expenditure classes.

The analysis of the distributional impact of policies in the CGE modelling frame-work has been constrained in part by the absence of a Social Accounting Matrix (SAM) with disaggregated households. The Indonesian Social Accounting Matrix constructed in this study constitutes the biggest and most disaggregated Indonesian SAM yet constructed at the sectoral and household level, hence contributing to the literature on SAM construction especially in developing countries. A SAM is also a basic and necessary element in CGE modelling and its construction has provided a pathway for later studies to analyse relevant policy issues. In addition, since SAM construction is rarely well-documented, the transparency of description in this case will hopefully provide greater replicability for future SAM construction as well as for other researchers.

Using the case study on carbon abatement policy (an increasingly more widely-discussed and topical global issue) and energy pricing reform in Indonesia (a recently implemented relevant local issue in Indonesia), this thesis attempts to answer questions such as whether a conflict between the environment and equity exists and to what extent policy design can mitigate the adverse distributional effect, if any, of environmentally-motivated policies.

In the case study on a carbon abatement policy via the introduction of a carbon tax, the results from various simulations suggest that, in contrast to most studies from developed countries, its introduction in Indonesia would not necessarily be regressive. It is shown to be strongly progressive in rural areas, and either neutral or slightly progressive in urban areas. Its overall distributive effect nationwide is shown to be progressive.

The industries which experience a larger contraction generally are more energy intensive, and happen to be those which employ proportionally more capital, skilled-labour, and urban formal labour relative to unskilled, rural, and informal labour. These industries will tend to reduce employment of these factors or reduce their wages. The ownership of these factors of production tends to be concentrated among higher income households, and those who live in the cities. In contrast, the income sources of the largely rural poorer part of the population are mostly wages from employment as informal agricultural or unskilled labour. Sectors which happen to employ these factors intensively experience less contraction or even expansion.

For example, the demand for the products of the food crops sector, other agriculture, or even food-manufacturing, may increase due to the increase in income of lower income households, because these products constitute the largest share of their consumption. As these sectors are also relatively less energy intensive, they do not face constraint in expanding supply. Because these sectors largely employ informal, agricultural, and unskilled labour, the poor may also benefit from the rise in their income and therefore a carbon tax may work to the benefit of these vulnerable households.

The typical expenditure pattern in developing countries, which is less energy sensitive, also helps drive the progressivity of the result especially in rural areas. For lower income households, the increase in the cost of acquiring their consumption bundle is lower than for the wealthy in the cities. Together with the increase in their factor income, this implies that rural households, especially poorer ones, may experience a welfare gain.

[36] To the author's knowledge.

In the analysis of counter factual scenarios on the energy pricing reform of the October 2005 package in Indonesia, the simulations suggest reducing vehicle fuels subsidy hurts higher income classes more and hence constitutes a progressive reform. It supports the claim that a subsidy on vehicle fuels is regressive. However, in the case of Indonesia, where urban lower income households constitute the biggest consumers of domestic fuel like kerosene, a reform like the October 2005 package, with a massive increase in the kerosene price (almost tripled), tends to be regressive unless accompanied by a proper and effective compensation scheme.

The comparison of various types of compensation in the simulations suggests designing an effective form of compensation does matter in mitigating the distributional impact of energy pricing reforms. A well-targeted scheme will recognise the fact that the poor differ in terms of their income and consumption patterns. The uniform transfers implemented in the October 2005 reform tends to over-compensate rural households at the cost of under-compensating the urban poor. The example of a slight modification to the scheme that gives more to urban and less to rural households may significantly help minimise the rise in urban poverty incidence. With regard to the recent widely-discussed subsidy targeting education and health spending as an alternative compensation scheme, the simulation suggests it may not be effective in minimising the poverty impact of an energy pricing reform. It might be better suited for the longer-term objectives of poverty alleviation programs.

To conclude, this study shows there is not necessarily a conflict between environmental and equity objectives, especially when the policies or reforms to achieve environmental goals are carefully designed. Moreover, the result from the case study of the carbon abatement policy may have an important global policy implication. Encouraging developing countries to reduce carbon emissions not only increases the efficiency of carbon abatement globally but may have a favourable distributional implication for the developing countries themselves, in contrast to a less favourable distributional impact in developed countries. Whereas a global 'efficiency gain' from shifting the location of carbon abatement from industrialised to developing countries has been widely acknowledged, this study introduces the additional notion of a 'global equity gain'.

5.2 Future Research

This thesis may still have many weaknesses both in terms of the generalisation of the results and the caveats of the methodology. The issue of the conflict between environment and equity may also be relevant for other types of environmental problems. For Indonesia, they are, among others, deforestation and the depletion of other natural resources such as marine resources.

The exclusion of carbon emissions from land use change in the model used in this thesis is a weakness in itself. In Indonesia, carbon emissions from deforestation constitute the biggest source of emissions. It is important for further research to model explicitly the emissions from land use change to obtain a better picture of the distributional impact of climate change policies.

The generalisation of the results to conjecture that the distributional impact of energy-related environmental policies may not be regressive or could even be progressive in developing countries, calls for wider coverage of other developing countries, apart from Indonesia, including the other biggest carbon emitters such as China and India. To the author's knowledge, a study for these countries using the CGE framework does not yet exist. The results of this future research may strengthen the result and provide a stronger argument to accelerate the active participation of developing countries in future action to reduce global warming.

Action to reduce greenhouse gases should be a global multilateral effort in order to be effective. That is why analysis in a multi-country setting such as examining global carbon trading is highly relevant. However, among numerous multi-country studies on this issue using a global CGE model hardly any touch on the distributive effect within countries. Incorporating a detail distributive effect within a country in a global CGE model in the setting of a global climate change policy would be a worthwhile effort and difficult task.

The model used in this thesis is comparative static. Extending the model to make it dynamic would provide a time path of how an environmental policy and its impact on the economy and income distribution would evolve over time. Another possible useful extension to the model would be extending the detail at the household level. This could be done, for example, by building an integrated-microsimulation CGE model, where the household level details in the survey data are integrated in a CGE model. With this extension, more flexible analysis would be possible such as the ability to look at the distributional impact across other categories of households, not only by income size but by other socioeconomic characteristics. Extending the model to become a multi-regional model would also make possible the analysis of the distributional impact of an environmental policy across regions. All of these issues are open for further research.

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