Distributional impacts of energy consumption subsidy phase out in Indonesia: A computable general equilibrium analysis

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ABSTRACT

This paper focuses on the distributional impacts of a phasing out of energy consumption subsidies in Indonesia. Macroeconomic and environmental consequences are also considered. The analysis highlights the importance of redistribution schemes that can replace subsidies to make the reform progressive while being neutral for the government's budget. A new version of the OECD ENV-Linkages CGE model is used that integrates more than 10 000 representative household groups for Indonesia, taken from IFLS4 survey data, to simulate a full phasing out of energy consumption subsidies for both households and firms at horizon 2020. Three alternative stylized redistribution schemes are considered: direct payment on a per household basis (*cash transfer* scenario), support to labour incomes (*labour support* scenario), and subsidies on food products (*food subsidies* scenario). It appears that the direct effect of the reform due to the increase in commodity prices (mostly energy) is regressive but that the cash transfers, and, to a lower extent the food subsidies, can make the total effect progressive. In contrast, the scenario with support to labour income is regressive, given that it fails to reach households with revenues from the informal sector, which are overrepresented among the poor. Depending on the redistribution scheme, the GDP impact ranges from +0.7% to +0.5% compared with a baseline. Beneficial impacts come from both the reduction of deadweight losses due to the subsidy phase out and from increased savings and investments. The best GDP performance is achieved by the cash transfers scenario, while food subsidies harm efficiency in the long run and labour support is detrimental to investment. The phasing out of subsidies contributes to a decrease of national energy-related CO_2 emissions (w.r.t. baseline) by 10-12%, with the bulk of the emission reduction effort coming from the households. The more progressive the scheme is, the larger the contribution of high income household groups to total emission reductions.

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1. INTRODUCTION

1. In many emerging countries, governments subsidise energy consumption to keep domestic prices low and to make energy more affordable for consumers and firms. According to the IEA (2013), in 2012 worldwide consumption subsidies totalled $544 billion for fossil fuels and $135billion for electricity. The subsidies were concentrated in non OECD countries where they could represent a substantial share of the governments' budget.

2. For years, international organisations, such as the IMF, OECD, and the World Bank pledge for a decrease or a phase out of these subsidies. They consider that they induce wasteful energy consumption, contribute to uncontrolled Greenhouse Gas emissions and fail to support the most vulnerable populations, since they massively leak to well-off household categories.

3. In several non-OECD oil importing countries, incentives to reform the subsidy system were given to the governments, as the surge of international energy prices and the fast increase of domestic energy demand increased the risk of uncontrolled current account and budget imbalances.

4. Even though the idea of reducing energy subsidies gains ground, the reforms are politically very difficult to implement. The reduction of subsidies tends to create large discontent and sometimes violent demonstrations, so that government often have to step back. This is not surprising since consumption subsidies are often the main instrument to redistribute wealth and are a crucial support for some categories of households, especially among the poorest whose consumption is close to the vital subsistence minimum. To be acceptable and equitable, such reforms of energy subsidies must include well-defined redistribution schemes that can alleviate the potential negative impacts on households. Examples of such redistribution schemes include cash transfers, a change in taxation of non-energy products, or improved access to public services.

5. Consequently, when considering the subsidy reforms, it is particularly important to complement the macroeconomic and environmental impact analysis with a close examination of the distributional impacts and the possibilities to design compensatory measures to alleviate potentially negative outcomes on inequalities and poverty. This approach helps to understand what type of compensation can make the reform progressive and beneficial to poor households.

6. Indonesia is an interesting case study for investigating energy consumption subsidy reform. Firstly, it has large energy subsidies, while being an oil-importing country. Secondly, for years the subsidy reforms ranks high in the Indonesia political and more recently high oil price accrued the burden of subsidies in the government's budget and reinforced the impediment for a reform. Thirdly, the subsidy reform could help Indonesia to fulfil its commitment made in the 2009 Copenhagen Accord and 2010 Cancún Agreement to reduce its GHG emissions by 26% with respect to a baseline scenario (and by 41% below baseline with sufficient international support). Fourthly, Indonesia was chosen because of the availability of public household budget survey data. Lastly, there were already studies about micro-macro reform, in this country, which help to benchmark our simulation results, to put forward the specificities our methodological approach what it can bring to the analysis of energy subsidy reforms

.7. This report, based on a simulation approach, proposes an analysis of the distributional impact of energy subsidy phase out policies in Indonesia under various redistribution schemes. The aim is not to bring a proper socio economic impact assessment, but rather to help to understand the essential driving forces that determine the answer to the two following questions: What type of redistribution scheme can make the phase out pro-poor and progressive? What are the trade-off between the macroeconomic and environmental impacts of the reform and its distributional consequences? Such a perspective will allow us to draw conclusions that can extend, beyond the Indonesia case, to energy subsidy reforms in other non-OECD countries.

8. To simulate household group specific welfare impacts and to conduct distributional analysis, a new version of ENV-linkages - the OECD multi-region, multi-sector and multi-period CGE model - has been elaborated. In the standard version of ENV-Linkages, regional economies feature a single representative household portrayed by a single demand system and owing the whole regional income. This standard model can evaluate welfare impacts of the policies only at the country regional level of aggregation. In the new version, in Indonesia, the representative household is replaced by multiple household groups, each having its own demand system and owing a share of regional production factors. The model is set up such that multiple households can in principle also be specified in other regions, if sufficient data is available.

9. In this modelling framework, the Indonesian household groups are impacted by the changes in both consumption price and income induced by the energy subsidies phasing out reforms. The reforms impacts the energy prices directly, and indirectly the prices of all the goods. These indirect effects come from the decrease in subsidies to energy use by industries and to interaction effects within the economy, as all sectors are linked to each other (so-called general equilibrium effects). The households' disposal incomes are impacted firstly by the changes in factor prices (for instance wages and capital return rates), created by the adjustment of the economy to the phase out, and secondly by the changes in transfers and income taxation included in the policy as compensatory mechanism.

10. The impacts of the revenue changes on the household groups depend on their characteristics, in particular on their consumption patterns, their sources of revenues and the ability to adjust demand to changes in revenues and prices. For instance, the higher the budget share of energy products and the lower the price elasticity of energy demand, the more a household may suffer from the effect of the phase out, unless their income is sufficiently raised by compensatory measures.

11. In practice, disaggregated information about household consumption and revenues from household budget surveys (HSB) have been found and reconciled with social accounting data and with all the other data sources used in the CGE model. Since the household budget surveys are done at the country level and in formats that are not standardized, the analysis focuses on a single country – Indonesia – to illustrate the potential of the modelling framework for distributional impact analysis.

12. It is important to realise that the model used remains stylised. First, even if there have been substantial efforts to produce a data set that reflects the revenue and expenditure information available in the household budget survey, the model remains a statistical construction and some extrapolations were necessary. Secondly, there is uncertainty on the specification of households' behavioural parameters and consequently on the projected adjustments of their consumption patterns to price changes.

13. This report is organised as follows. Section 2 describes the energy subsidy system in Indonesia and the efforts to reform it. It also provides, based on micro data, an overview of its distributional characteristics. The description of the methodology used for simulating energy subsidy reforms is given in Section 3. Key descriptive statistics concerning the household data set constructed for the simulation analysis are provided in Section 4. Then, Section 5 presents the phasing out policies that are simulated. The

results of the policy simulations are presented in Section 6 and analysed in terms of economic, environmental and distributional performances. Section 7 concludes. Additional technical material is provided is appendix.

2. OVERVIEW OF THE ENERGY SUBSIDIES IN INDONESIA

15. The Indonesian government subsidises electricity and oil products consumption for both households and firms. These subsidies, measured with the price gap approach (see IEA, 2006) are large given the net energy importer position of the country. In 2011, Indonesia was the 10th country in the world in terms of total government expenditures on fossil fuel consumption subsidies (see Figure 1) following mostly big energy exporters (e.g. Iran, Saudi Arabia, Russia, Iraq, UEA and Venezuela) and larger economies (e.g. China and India). Figure 2 shows that Indonesia, was ranked 18th for the share of energy subsidies in gross domestic product (2.5%). The only oil-importing countries with a higher share were Egypt, Ukraine Pakistan and Bangladesh. But in Indonesia the subsidies per capita, amounting to 88 USD, were higher than in Bangladesh and Pakistan.

16. Energy subsidies also absorb a considerable share of budget resources that consequently cannot be allocated to other government priorities. The spending on subsidies became very high in the recent year, In 2011, the energy subsidies represented 29% of the Central government expenditures (Dartanto 2013). The spending on energy subsidies were, in 2012, slightly higher than the government investments in Infrastructure (Diop, 2014). Until 2010, the Indonesian government spent more on energy subsidies than on defence, education, health, and social security combined (Cheon *et al.*, 2013).

17. The high international energy prices and the high domestic energy demand impact the Indonesian trade position and financial situation. Recently, the combination of increasing oil price with the stabilization of the prices of the raw products which traditionally represent a large share of Indonesian export, gave way to a significant worsening of the country's trade position. This situation led in 2012[2], to a current account deficit with a small depreciation of the Rupiah.

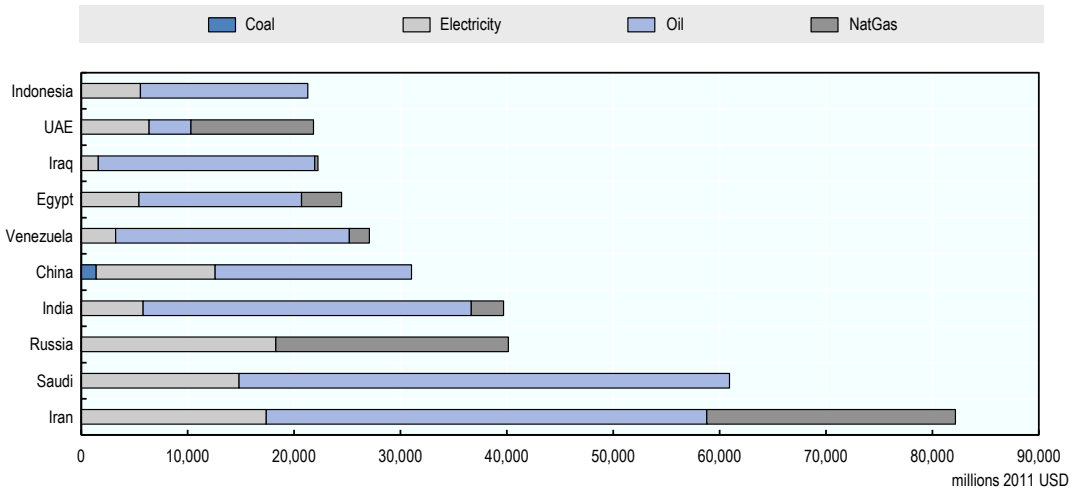
18. While they represent a burden and a source of unpredictability for the economy, the energy subsidies perform badly for leveraging inequalities. Given that commercial energy consumption increases with income, the subsidies are more beneficial to wealthier households (Mourougane, 2010). According to the IEA definition, in 2011 37% of Indonesian did not have access to electricity, mostly in rural areas (IEA, 2013). Augustina et al. (2008) quote a World Bank calculation which estimated that in 2007, 70% of fuel subsidies were received by the 40% wealthiest households.

19. There have been several efforts to reduce the energy consumption subsidies in the country. The fossil fuel subsidy mechanism has been progressively reformed since the early 2000's. In 2001, the fuel prices for industries were anchored to 50% of international prices provoking violent demonstrations (Dartanto, 2013; OECD 2010). In 2004-2005, the increase of international prices crated a rise of fossil fuel subsidy expenditure (Dartanto, 2013; Mourougane, 2010). In 2005, energy prices for households and small businesses were significantly increased, (Dartanto, 2013). To limit the poverty impacts, for the poorest households, unconditional cash transfer mechanisms through the postal system were introduced, but wealthier households also benefitted. In 2008, electricity subsidies ceased for large industrial consumers (OECD, 2010) and for households beyond a consumption threshold (Mourougane, 2010), and fuel prices increased, following the world prices, in order to limit the pressure on public finances. In 2010, the average electricity price increased for most consumers, including households (IISD, 2012). In 2012, an attempt to prohibit government and four-wheel vehicles from using subsidized gasoline was abandoned due to strong public discontent and only the government vehicles were excluded from the subsidies (IISD, 2012). In 2013, a revision of Indonesian Budget introduced the repeatedly announced cut of fossil fuel subsidies, increasing diesel and gasoline price of respectively 22% and 44% (IEA, 2013). However, even with such

[2] IMF World Economic Outlook data base, November 2013

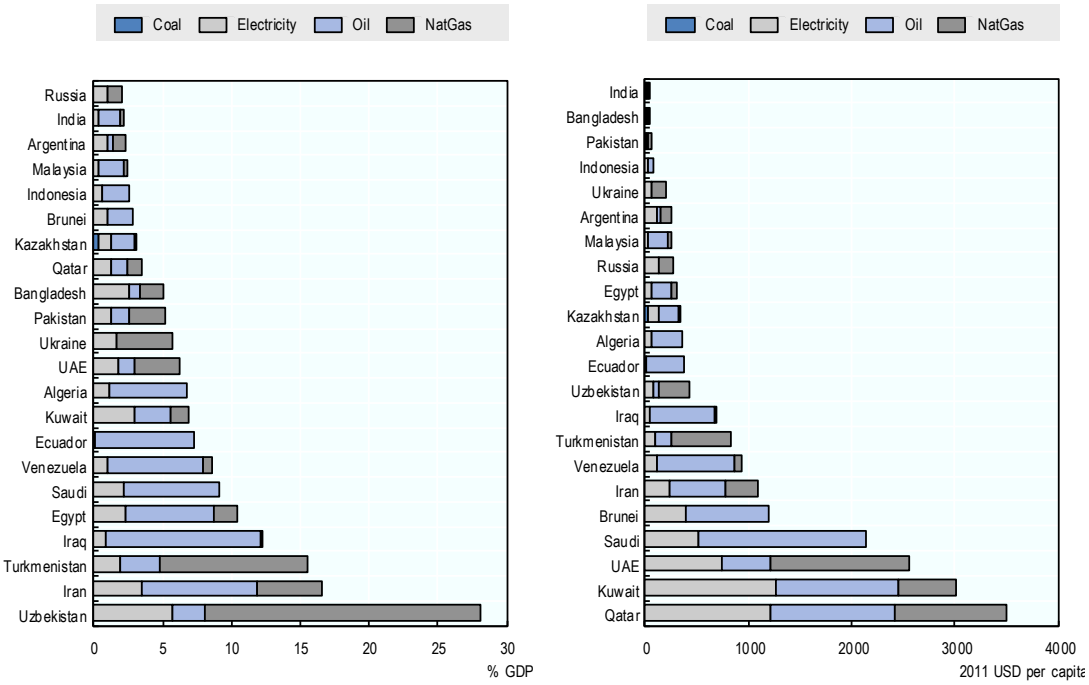
an increase of, the Indonesia fuel prices remain largely subsidized and the pressure on public finances and current account remains high.

Figure 1. Top 10 countries for energy consumption subsidies in 2011



Source: IEA

Figure 2. Energy consumption subsidies in USD by capita (left) and as share of GDP (right) in 2011 in selected countries



Source: IEA

20. There has been several quantitative assessments of the macroeconomic environmental and distributional impacts of energy subsidies phasing out in Indonesia and selected references are presented in Table 1. Note that, to our knowledge, there has not been yet studies taking into account the three impacts simultaneously, or considering the reforms in a multi-period setting

21. The results of the various studies as summarized in Table 1 are not fully comparable, as they correspond to different base years, energy subsidy reforms and modelling approaches. However, there are some similarities in their results. The reform has non negligible impact on GDP, from +0.24% to -2.42% .The sign of the effect largely depends on the type of approach. The assessments with SAM, which is essentially an input output (IO) approach, give negative effects on GDP. The CGE approaches, (Burniaux and Chateau 2009, Yusuf et al. 2010), give positive impacts, as the decease of subsidies leads to a reallocation of inputs and consumption that increases economic efficiency (reducing the deadweight losses due to the subsidies). The impacts on emissions, when they are assessed, are quite substantial (-10.97% in IEA and -6.7% in Yusuf et al.). Note that has been concerns on the possible consequences of the reform on deforestation because of substitution of wood to kerosene. Some relatively old studies discard this effect, based on empirical evidences (Dick, 1980; Pitt 1983).

22. The studies in Table 1 are quite in line in terms of distributional impacts. The direct effect of the phase out reform, due to the increase in final consumer prices, is progressive. The progressivity is largely due to the decrease of gasoline taxes (World Bank 2006, 2011). In the SAM-based models, mainly because of the negative effects on GDP, the reform increases poverty. In addition, the reform affects more the urban than the rural poor (Clements et al ,2003; Yusuf and Resosudarmo 2008; Widodo et al, 2012). But it also appears, from the various studies; that redistribution schemes, for instance with cash transfers or subsidies on food products can be efficient to alleviate poverty. For Dartanto (2014), investing in infrastructure and introducing cash transfers can, using only 50% of the government's expenditures saved with the subsidy reform, contribute to a significant reduction of poverty. It means that the reform can both reduce poverty and consolidate the government's budget.

Table 1. Selected quantitative assessment of the impact of energy demand subsidy reforms in Indonesia

Authors and method	Type of reform	Impact on GDP	Impact on emissions	Distributional impact
IEA (1999) Partial equilibrium model (feedback on GDP)	Phasing out of energy consumption subsidies	0.24% (in 2020 w.r.t baseline)	-10.97% for CO2 (in 2020 w.r.t baseline)	-
Clements et al (2003) SAM complemented with information on household group,	25% of final consumer price increase	Real output reduction of 1.6% if prices are rigid (SR), no reduction, if prices are flexible (LR)	-	Progressive, Increased poverty on the short run The urban households are more affected
World Bank (2006) Household micro data	October 2005 package (fuel price adjustment and cash transfers)	-	-	Progressive largely through gasoline expenditures effects; progressivity improved by the cash transfers
Yusuf and Resosudarmo (2008) SAM + information on many household groups	October 2005 package but with a alternative recycling schemes	-1.72% to -2.42% w.r.t baseline	-	Progressive and more detrimental to poor urban households. Poverty effect can be offset by recycling schemes e.g. by cash transfers
Widodo et al (2012) SAM model	Removal of fuel subsidies by IDR 1 billion	Decrease of GDP by IDR 88 million but negative effect partially mitigated recycled to support some sectors of the economy.	-	Rural households less affected. Recycling schemes that support s agriculture can compensate the rural household through income and lower-class urban households through expenditures.
Burniaux et al (2009) CGE model	Gradual phasing out of all energy demand subsidies (achieved in 2020)	For Middle East, Algeria-Lybia-Egypt, Indonesia, and Venezuela gains +0.5 by 2050 (w.r.t baseline) if unilateral removal	For Middle East, Algeria-Lybia-Egypt, Indonesia, and Venezuela, decrease by 20.% in 2050 (w.r.t baseline) if unilateral removal	-
World Bank (2011) Descriptive statistics based on survey	-			Fuel subsidies and in particular gasoline subsidies are regressive as higher in absolute level for richer than for poorer households.
Yusuf et al (2010) CGE model with representative household groups	Phasing out of energy subsidies	0.43% w.r.t. baseline on the long run	-6.7% for CO2 the long run	-
Dartanto (2013) CGE model combined in top down fashion with survey data	25% to 100% removal of fuel subsidies with alternative recycling schemes	-	-	25% removal of fuel subsidies increases poverty by 0.26 percentage points. But recycling with government development spending reduces poverty even if they are 50% less important than the subsidy removal.

Source: Authors' review, inspired from Mourougane (2012)

3. THE MODELLING APPROACH

23. The impacts of the policy reforms discussed in this paper are simulated with the OECD in-house model ENV-Linkages (Chateau et al., 2014). ENV-Linkages is a dynamic global and multi-sectoral computable general equilibrium (CGE). For this study ENV-Linkages has been improved by directly integrating more than 10000 representative household groups for Indonesia, while in other regions, the final consumers are still portrayed by a single representative household.

24. The representative Indonesian household of the ENV-Linkages CGE model is disaggregated to 10018 household groups. While the representative household's characteristics in terms of preferences and endowments were based on social accounting data, the characteristics of the multiple households groups are based on budget survey data from IFLS4.

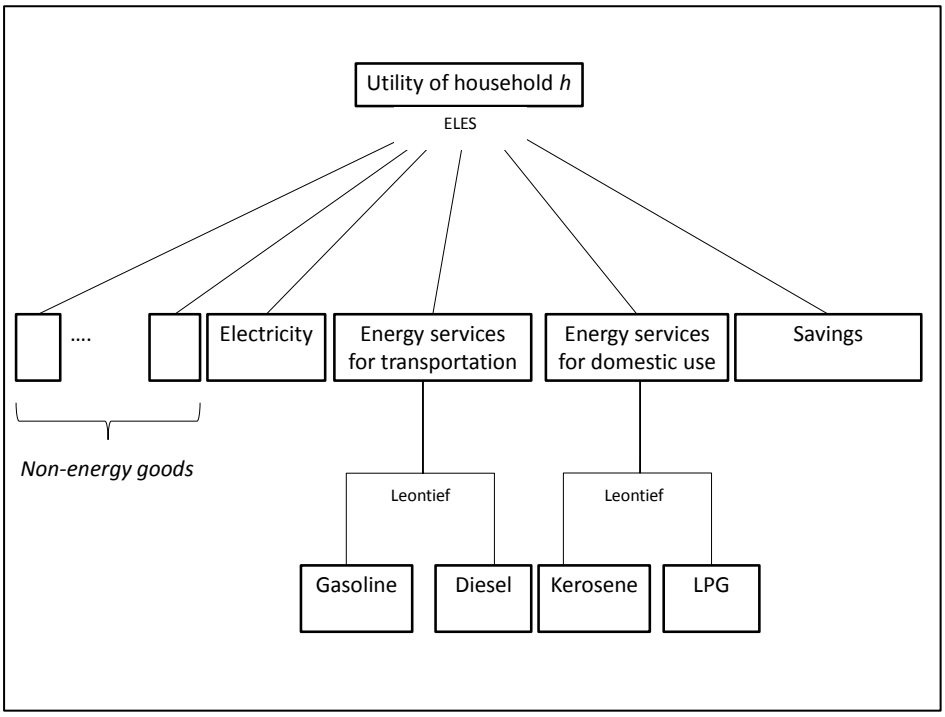
25. The household-level information from the survey data and the ENV-linkages data are reconciled in order to produce, for the base-year, a data set where individual revenues and expenditures are consistent with country-level totals that are used in ENV-Linkages. First, the revenues and expenditure categories from the survey data are assigned to social accounting categories. This step involves matching the micro accounting categories used in the survey with the macro accounting categories of the CGE model (Ivanic, 2004). For instance, categories the goods whose consumption was reported in the survey have to be mapped into the good categories used in the CGE model. In the second step, the data are adjusted so as to ensure that, for each expenditure and revenues category, the sum over household is equal to the country-level total. This procedure is based on two successive cross-entropy minimization problems[3]: one for the revenues, one for the expenditures. As a result of these problems, the household-level data are modified, but the weights of each household in total consumption that were given by the survey data are preserved. Note that some adjustments to the reconciliation problem have been necessary in order to ensure that, at the household level, the saving rates are consistent with the capital incomes. Details about the reconciliation procedure are given in the Appendix. Once the micro data are consistent with the macro data, the individual household's characteristics are calibrated.

27. For consistency, the structure of the household-specific demands is largely inspired by the CGE model. They are based on the same form of extended linear expenditure system (ELES, ref to the model's documentation) that represents demand for the various goods and services. The household-specific demand functions are calibrated on the survey data and the aggregate elasticity values of the CGE model that describe how consumers respond to changes in income or relative prices.

28. The structure of the individual Indonesian households' utility function is represented in Figure 3. Whereas in the standard version of the ENV-Linkages model, the representative Indonesian household consumed a single non-electric fuel aggregate, in this version of the model, taking advantage of additional information of fuel use provided in the survey each household group can consume 4 types of non-electric energy good: Kerosene, LPG, Gasoline and Diesel. Moreover, energy demands specifies two aggregates, the first is represent energy use for transportation and the second energy services for domestic use (lighting and cooking). The first aggregate combines gasoline and diesel and the second aggregate combines kerosene and LPG. The proportion of fuels within these aggregates are household-specific and calibrated on the reconciled survey data.

[3] See Golan and Judge (1996) for details about cross entropy minimization problems

Figure 3. Structure of household groups level utility function Indonesia



29. The endowment in land and natural resource of each household group is fixed[4]. The household's labour supply is exogenous and the share of each household in the total labour supply is constant, fixed at the base-year level. The households' capital incomes are determined by initial capital endowments and household-level savings, which are endogenous. Consequently, a policy that asymmetrically affects the saving level of the households influence the distribution of capital incomes.

30. The household are also characterized by the shares of aggregate transfers they receive from the government (e.g. as direct transfers), and by their share in total labour income taxation. The share of transfers received is an element of the fossil fuel subsidy reform scenarios. For instance, in the policy scenario where the reform is compensated by cash transfers, the entitlement to the additional transfers made possible by the decrease in subsidies is assumed to be unconditional, each household receives the same amount of extra payment. The contribution to the labour income tax depends of the occupational status of the households. Only the households whose head is in the formal sector contribute to these payments and then benefit from possible labour tax cuts in a scenario where the decrease of subsidies leads to a lower labour taxation.

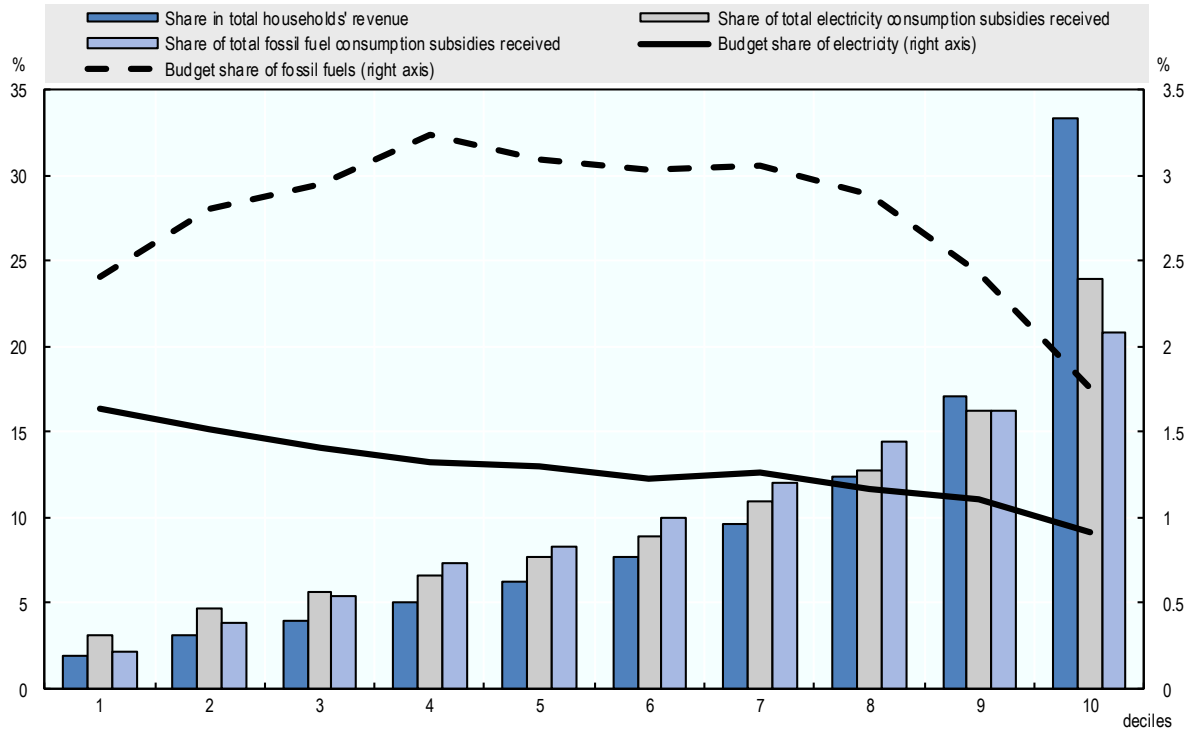
31. The integration of the full set of Indonesian households within the mathematical formulation of the ENV-Linkages model is impossible because the individual households' equations would have made the problem non tractable with commercial solver. This is the reason why, following the decomposition algorithm of Rutherford et al. (2006), the CGE and the household-level models have been formulated separately and adjusted iteratively until convergence.

[4] see: Van der Mensbrugghe (2005)

4. OVERVIEW OF THE RECONCILED HOUSEHOLD SURVEY DATA

32. It is important to present the reconciled household data that are used as input in the model. Firstly, because this data set is a construction, elaborated from different sources, sufficient information must be provide to make possible comparisons with other data. Secondly, by considering the budget shares of energy in total consumption by household quintiles, it will be possible to assess whether, based on these data, the initial subsidy mechanism is progressive of regressive. Thirdly a presentation of these data will help to understand which element of the household heterogeneity drives the distributional impact in the various scenarios.

Figure 4. Budget share of Fuels and electricity and share in total subsidies received and share in total households' incomes



Source: Authors's caluclation based on IEA, IFLS4

33. Figure 4 shows that, for all the deciles the budget shares of fossil fuel products (Kerosene, LPG, Gasoline, Diesel) is below 3.3% for all the households), and that share of electricity is below 1.5% by household deciles, for all the households. Total share of energy is low, compared with other emerging economies (World Bank, 2008). These low levels are largely due to the high subsidies. The budget share of fuel energy increases with income until the 4th decile and then decreases, reaching its lowest level in the last decile. At the same time, the budget share of electricity uniformly decreases with income. These patterns of electricity and fuel consumption suggest that, based on our data, the current subsidy system is not necessarily regressive. Until the 8th income decile, the proportion of the total subsidies payment (the light grey bars for electricity and the light blue bars for fuels) received is higher than the share in total national income (the dark blue bars). It means that the subsidies reduce inequalities between the lower 8 deciles and the top 2 deciles. In addition, the lower the decile, the more the share in subsidy payment exceeds the share in national revenues. Based on these considerations, even if in absolute terms the

subsidies benefit most to the wealthiest households (since energy consumption increases with income), the subsidy scheme is progressive. The problem is that the progressivity is not sufficient to contribute significantly to the reduction of the huge income inequalities in Indonesia.

34. Table 2 gives the budget shares for households and rural households by energy products and by income decile. Total energy expenditures are a higher fraction of consumption expenditures for urban than for rural households. The budget share of the fuels used transportation (gasoline and diesel) tends to increase with income up to the 8th decile consequently on these products can be regarded as regressive. The share of expenditures for domestic fuels (Kerosene and LPG) and for electricity decreases with income. The subsidies on these products are progressive, and they offset the regressivity of the transportation fuel subsidies.

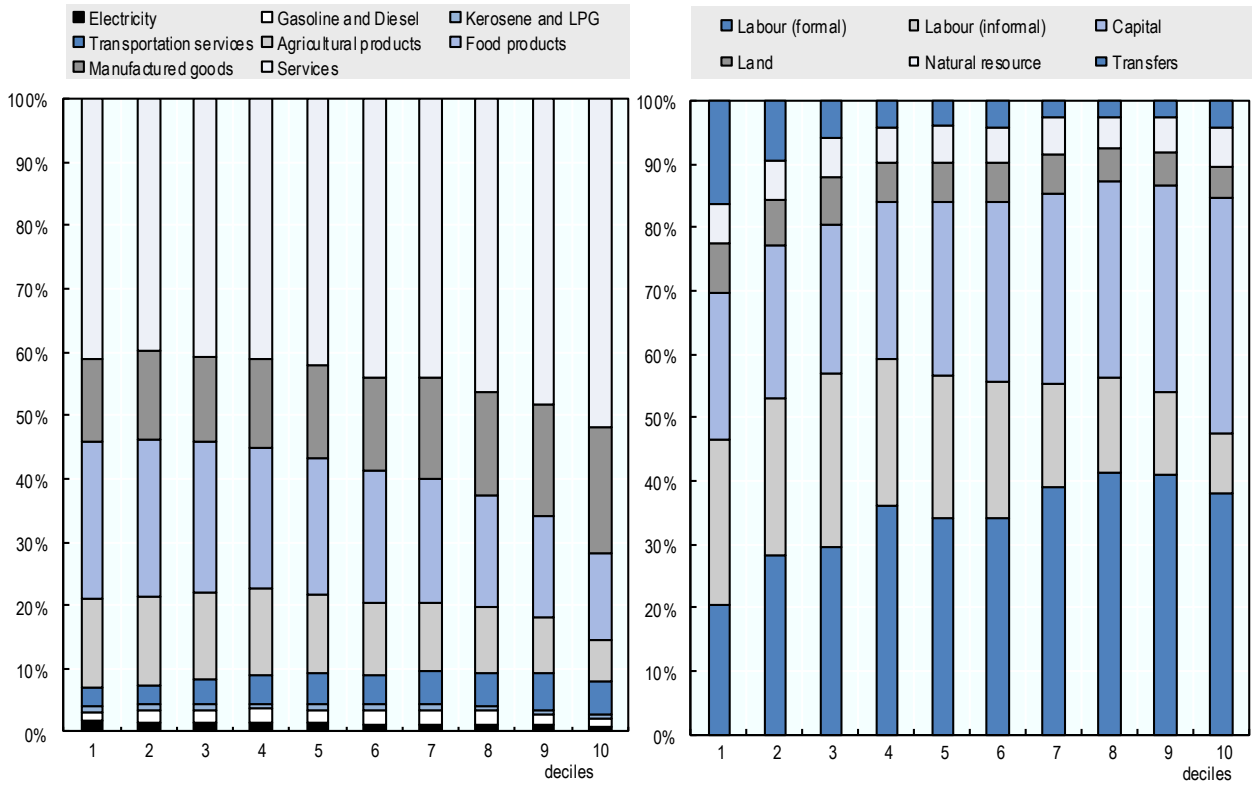
Table 2. Budget shares of energy products for urban and rural households

Decile		1	2	3	4	5	6	7	8	9	10
Urban and rural											
	Electricity	1.633	1.509	1.408	1.318	1.292	1.224	1.257	1.158	1.104	0.907
	Gasoline and diesel	1.297	1.849	2.030	2.382	2.019	2.113	2.232	2.151	1.745	1.252
	Kerosene and LPG	1.103	0.948	0.919	0.849	1.068	0.920	0.820	0.738	0.686	0.496
	Total Energy	*4.033*	*4.306*	*4.356*	*4.549*	*4.379*	*4.257*	*4.308*	*4.047*	*3.535*	*2.654*
Urban											
	Electricity	1.985	1.565	1.492	1.392	1.463	1.363	1.329	1.355	1.207	0.911
	Gasoline and Diesel	1.990	2.321	2.271	2.805	2.376	2.573	2.563	2.171	1.702	1.173
	Kerosene and LPG	1.237	1.058	1.152	0.982	1.239	1.127	0.917	0.757	0.680	0.507
	Total Energy	*5.212*	*4.944*	*4.916*	*5.179*	*5.078*	*5.063*	*4.809*	*4.282*	*3.589*	*2.591*
Rural											
	Electricity	1.467	1.476	1.358	1.263	1.159	1.106	1.173	0.894	0.935	0.895
	Gasoline and Diesel	0.972	1.579	1.885	2.066	1.742	1.724	1.846	2.124	1.814	1.444
	Kerosene and LPG	1.041	0.886	0.779	0.751	0.936	0.744	0.707	0.714	0.697	0.471
	Total Energy	*3.480*	*3.941*	*4.022*	*4.079*	*3.837*	*3.575*	*3.726*	*3.732*	*3.446*	*2.810*

Source: IFLS4 and authors' calculations

35. An energy subsidy reform will not only impact households through energy expenditures, but through changes in the prices of other commodity, return on production factors, transfers and taxations. This is the reason why, it is necessary to consider the full structure of household's expenditures and incomes. Figure 5 shows that the budget share of food consumption (food products and agricultural products) decreases with income. On the revenue side, the share of capital in revenue is not higher for the top deciles. The most striking features, is that even if the total share of labour revenues is relatively stable across deciles, the share of formal labour revenues increases with incomes.

Figure 5. Structure of expenditures (left) and revenues (right) by income decile



Source: IFLS4 and authors' calculations

5. DESCRIPTION OF THE PHASING OUT POLICY SCENARIOS

36. The macroeconomic assumptions used in the *baseline* scenario are those of the current policy scenario (CPS) from the World Energy Outlook 2013 (IEA, 2013). For all the regions, the energy policies assumed after 2011 in the CPS scenario are all taken into account except the energy consumer subsidies reforms. Hence the climate policy assumptions correspond to the government policies and measures that had been enacted or adopted at the base year but contrarily to the CPS scenario energy subsidies are assumed to remain constant after 2011[5].

37. Following the work done for IEA, OECD, OPEC & World Bank (2010a), the policy scenarios assume that, between 2012 and 2020, Indonesia enforces a gradual phasing out of all electricity and fossil fuel subsidies expenditures for final consumers (households) and for firms. In practice, these scenarios are modelled through a linear decrease of the energy subsidies rates from their 2011 values to zero in 2020 (a full phase out). All the consumption subsidies are included in the reform: they include all the existing electricity and other fuel subsidies for both final energy demands from the household and intermediate energy consumptions by the various industries.

38. The scenarios, summarised in Table 3 consider alternative compensating schemes for the households. Each of them is budget-neutral and financed by the decrease of subsidies expenditures. The compensating schemes include cash transfers, supports to food prices and decrease of labour taxation. Note that the scenarios are relatively stylized, since, for each of them, the compensation given to households is based a single redistribution instrument although several could be used in practice. However, they give precious insights about the strengths and weakness of the components of potential fuel subsidy phase out policy reforms.

39. In the *cash transfer* scenario, the subsidy reform is compensated by unconditional cash payments on a per-household basis. Each household receives the same amount of additional transfers. A key attractiveness of this redistribution scheme is that cash transfers do not distort relative prices, as they are not linked to specific source of income or expenditures. They are therefore economically efficient. However, in practice cash transfers may not be easy to implement. Given the high level of income inequality, such a redistribution mechanism is very progressive. This scenario, albeit stylised, relates to the unconditional cash transfer programs (Bantuan Langsung Tunai), implemented in 2005-2006 and in 2008-2009 to compensate the decrease in energy subsidies (Mourougane, 2008; Miranti et al 2013) and which concerned more than 19 million households[6].

40. In the *food subsidy* scenario, the phasing out is accompanied by an increase of the subsidies on food products. The rationale for this scenario is that if cash transfers are not an option, subsidies on "dirty goods" can be replaced by support for other basic commodities that are less carbon-intensive. The downside of this option is that it still distorts commodity markets and is a costly, imperfect way of supporting poor households. This reform is expected to be progressive, given that the budget share of food decreases with income (see Figure 5). However, in this scenario, the increase in subsidy rates can lead to economic inefficiencies. Even if it has a larger food product coverage, this scenario relates to the - Rice Subsidy for the Poor programs (Raskin) that were introduced on several occasions since the late 1990's[7].

[5] More detail on the calibration procedure can be found in Chateau et al. (2014) that describe how the IEA scenarios are reproduced in ENV-Linkages.

[6] See http://www.ilo.org/dyn/ilossi/ssimain.viewScheme?p_lang=en&p_geoaid=360&p_scheme_id=3162

[7] http://www.ilo.org/dyn/ilossi/ssimain.viewScheme?p_lang=en&p_geoaid=360&p_scheme_id=3153

41. In the *labour support* scenario, the households are compensated by a decrease in labour income tax. Given the low initial level of labour taxation (less than 2% of aggregate labour revenue), this recycling scheme even involves a negative tax rate (e.g. a subsidy on labour). The policy in this scenario is in line with the green tax reforms proposed in OECD countries where an increase in environmental taxation (corresponding here to increase in subsidies) is used to decrease labour income taxation. While the labour support scenario may be close to cash transfers in developed economies, in countries with a large informal sector and high unemployment rates such a policy may not reach the poorest households. The decrease in labour income taxation is regarded as progressive in OECD countries, given that the share of rental incomes increases with total incomes. Consequently, the decrease in labour taxation can limit the potential regressive effect of the green tax reform. Here this type of scenario is used in the context of Indonesia in order to show that the recycling by means of a labour income tax cut has very different implications in emerging countries like Indonesia where the informal sector is very important. In this case the revenue recycling through a decrease in labour income tax will impact only the formal sector workers, given that the workers of the informal sector are not affected by labour income taxation. Since formal sector workers are in general better off than informal sector workers, the distributional effect might end-up being less progressive or even regressive[8].. In addition, as labour supply is exogenous in ENV-linkages, there is no distortive effect from this redistribution scheme, and the scenario is almost equivalent to cash transfers proportional to the pre-reform labour revenue from the formal sector.

42. The *cash transfer multilateral* scenario corresponds to the *cash transfer* scenario, but in a context of global multilateral subsidy phase out. This scenario aims at showing that the outcomes of the reform in Indonesia depend on the level of multilateral coordination of the national subsidy policy reforms. The main intuition is that the multilateral phase out of energy subsidies can negatively impact global energy demand and energy prices, and that the negative impact on energy price can partially offset the inflationary impact of the subsidy reform on final energy prices, thus limiting the detrimental effect for the households of decreasing energy subsidies.

Table 3. Decrease in subsidies and recycling schemes in the various scenarios

Secnarios	Baseline	Cash transfers	Cash transfers multilateral	Food subsidies	Labour taxation
Decrease of subsidy rate (2011-2020)					
Indonesia					
Kerosene (households)	0%	100%	100%	100%	100%
LPG (households)	0%	100%	100%	100%	100%
Gasoline (households)	0%	100%	100%	100%	100%
Diesel (households)	0%	100%	100%	100%	100%
Oil products (firms)	0%	100%	100%	100%	100%
Rest of the world					
All energy products	*0%*	*0%*	*0%*	*0%*	*0%*
Share of revenue saved allocated to					
Cash transfers on a per household basis	-	100%	100%	0%	0%
Decreasing food product tax or subsidising food products	-	0%	0%	100%	0%
Decreasing labour tax or subsidising labour	-	0%	0%	0%	100%

[8] Note that here do not discuss the economic efficiency dimension of the labour tax scenario in the context of OECD and emerging countries. This dimension cannot be capture in ENV-linkages because the labour supply is exogenous and consequently there is no distortive effect from this redistribution scheme, and the scenario is almost equivalent to cash transfers proportional to the pre-reform labour revenue from the formal sector. For an explanation of the impact of the formal and informal sector on efficiency of labour taxation policies, see Goulder (2013)

6. SIMULATION RESULTS

43. For each energy consumption phasing out scenario, the models' outcomes are compared to the *baseline scenario,* where the subsidy levels remain at their 2011 levels. In order to capture both the short and longer run impacts of the reforms, the impacts of the policy shocks are simulated until 2020. Besides the distributional impacts, the economic efficiency and environmental impacts of the policy reform will be considered. As in mainstream policy analysis with economy environment CGE models, the efficiency of the reforms can be assessed by the variations in the aggregate consumers' welfare and greenhouse gas emissions induced by the policy.

5.1 Macroeconomic impacts

44. The changes in 2020 in final consumer price indexes for various groups of commodities, as deviations to the baseline, are shown in Figure 6. The *cash transfer*, *cash transfer multilateral* and *labour support* scenarios give way to a significant increase close to 3.5% of the consumer price index (CPI), which represents a basket of all consumed commodities. On the contrary, the *food subsidy* scenario creates a decrease in consumer prices, which is due to the decrease in food prices.

45. Unsurprisingly, as they are directly concerned by the subsidy phasing out, the final energy commodity prices are most impacted. In 2020, in all scenarios, fuel and electricity prices are respectively about 80% and 100% percent higher than in the *baseline*. The increase in fuel prices is slightly more limited in the *cash transfer multilateral* scenario because of an indirect effect through global energy markets: in this scenario, the phasing out of energy subsidies in other regions negatively affects the global oil demand and consequently lowers international oil prices, and compensates the domestic impact of the phasing out of energy subsidies on the final energy prices. But the small difference in fuel prices with the other scenarios shows that this effect remains limited.

46. The prices of non-energy commodities are affected indirectly by the phasing out, since their production requires to the use of the previously subsidized energy and because the policy reform induces a complete realignment of all relative prices to ensure a new general equilibrium is reached. The price of transportation services is the most impacted, because of the high dependence of the sector of fossil fuels, but the increase is limited to 7% w.r.t. the baseline. For the other non-energy goods, the increase is lower than 1%. These relatively modest indirect impacts on non-energy commodity prices are largely due to our assumption that the base-year energy subsidies rates were significantly lower for firms than for the households. Because of this assumption, the phasing out corresponded to a much bigger energy price shock for the households than for the firms.

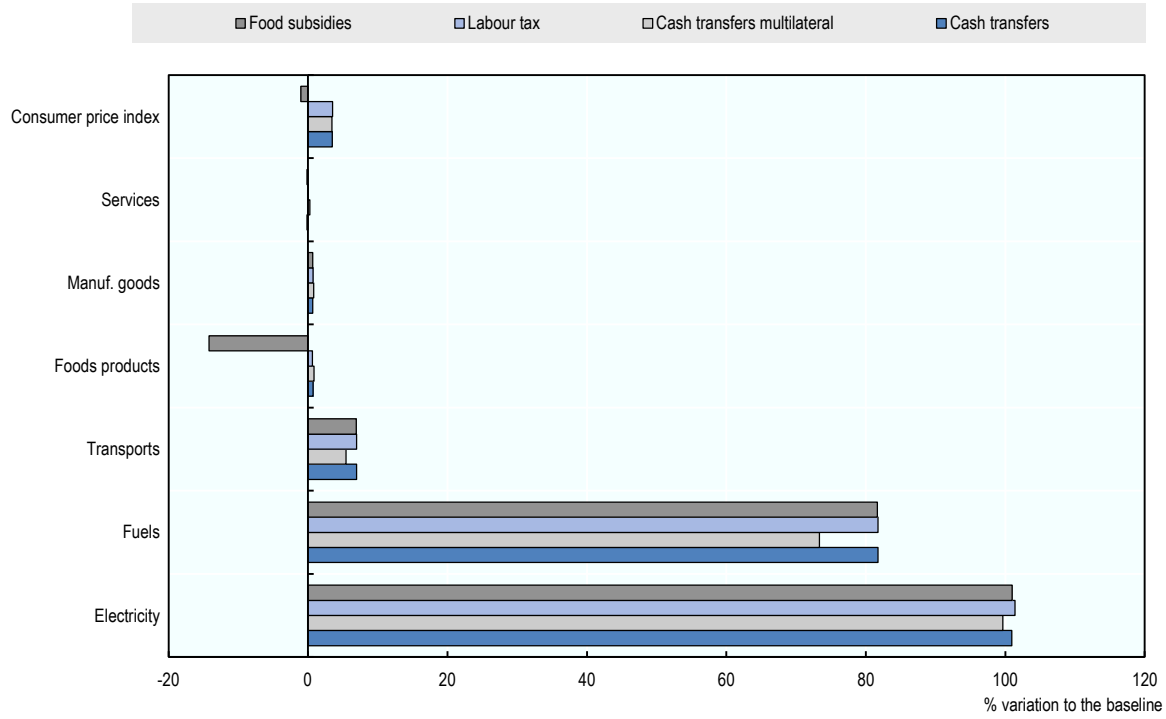
47. The negative impact on food prices observed in Figure 6 in the *food subsidy* scenario stems from indirect effects on the tax and subsidy system, through budget recycling. In this scenario, the phasing out of energy subsidies is compensated by fiscal support to food prices. Given the high initial energy subsidy rates and the low initial food subsidy taxation, the full recycling of the energy subsidies requires the introduction of a subsidy on food products. This subsidy, which reaches an aggregate rate close to 17% over the food product basket, significantly lowers final food prices.

48. The phasing out also impacts the real return on production factors net of the factor tax rates as shown in Figure 7[9]. The changes in net return reflect the variation of the relative marginal productivities of

[9] We do not present in this figure the changes in "natural resource" return price, given that this production factor does not really have a straightforward interpretation. It is largely a computational artefact used in ENV-Linkages to calibrate supply curves in the fossil fuel extraction sectors (see).

the factors induced by the policy. In the case of labour productivity in the *labour support* scenario it also reflects the change in labour taxations.

Figure 6. Effect of the energy subsidies' phasing out on final consumer prices in 2020



Source: Authors' calculations

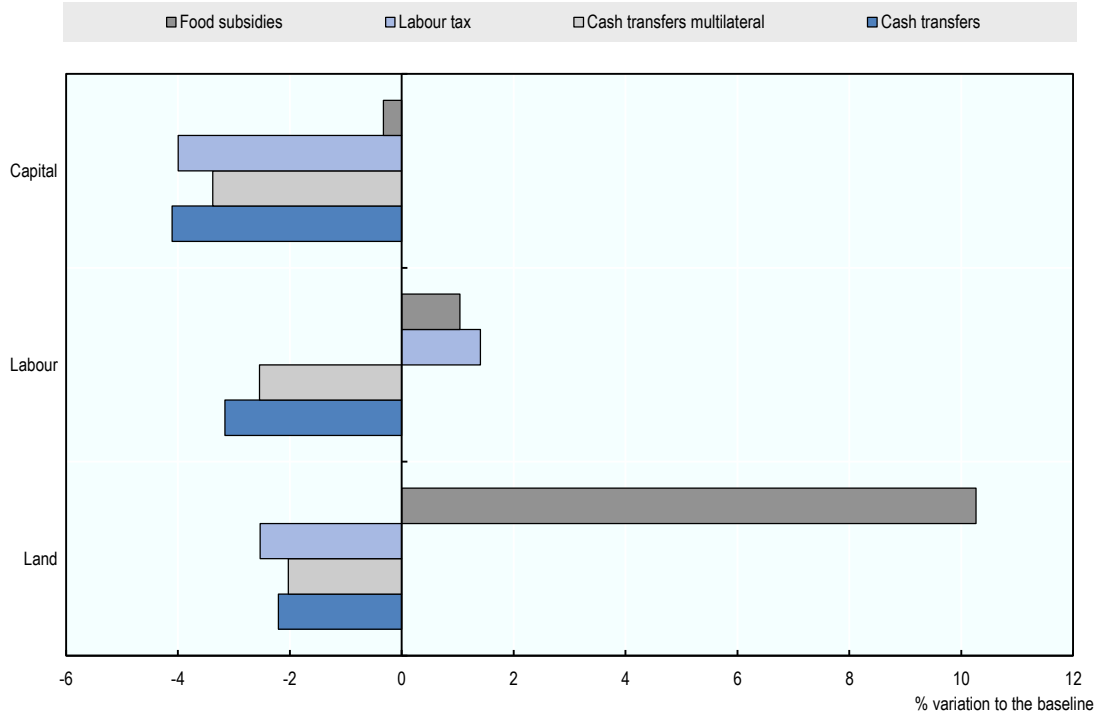
49. The decrease in the rate of return on capital can be explained by a general decrease of capital productivity in the fossil fuel extraction sector and to a lesser extent by a decrease of productivity stemming from other sectors. This latter point relates to two effects. The first one is due to the complementarity at the economy-wide level between capital and energy. Because of this complementarity, a lower energy consumption from firms decreases the marginal productivity of capital and the remuneration of capital, which is equal to its marginal productivity, decreases. The second effect comes from higher household savings created by the subsidy reform: as will be explained later in this section, the policies can give way to an increase in households' savings. The increase in savings accrues the capital stock and decreases its marginal productivity.

50. The net return on labour is negatively impacted in the *cash transfer* and cash *transfer multilateral* scenarios, translating a decrease in net return, which, as in the case of capital can be explained by complementarities between energy and labour that led to a decrease in the marginal productivity of labour. The positive effect of the *labour support* scenario on the net return to labour comes from an indirect effect of the phasing out policy on the tax and subsidy system, through budget recycling. In this scenario, the phasing out of the subsidies is fully used to fiscally support labour income and therefore contributes to increasing the net return on labour. In the *food subsidy* scenario, the subsidies on food products are beneficial to the agricultural sector and to its workers, positively affecting real labour remuneration at the national level.

51. The relatively decrease of the return on land in all the scenarios but *food subsidies* is due, as for labour and capital, to the complementarity with energy in the production process. But as expected, in the

food subsidy scenario, the food subsidies that compensate for the energy subsidies phasing out support the food product demand and increase the return on land.

Figure 7. Net real return on production factors in the various scenarios



Source: Authors' calculations

52. Figure 8 shows that the impact of the policies on GDP is positive in all the scenarios. However, the gains remain very limited; until 2020, they are not higher than 0.7% above the baseline. These limited gains are explained by the modest share of energy consumption is total household consumption, which limits the potential impacts of the subsidy reform on the overall economy. The most performant scenarios in terms of GDP are *cash transfer* and *cash transfer multilateral*, which are almost identical. As they reduce externalities, they lead to continued GDP gains, whereas the *food subsidies* and the *labour support* scenarios have smaller GDP gains, that eventually start to fade away.

53. To explain the macroeconomic performance of the policy in the modelling inter-temporal framework proposed here, it is necessary make the distinction between "static" and "dynamic" mechanisms. The static mechanisms relate to changes in production factor and consumptions good allocation efficiency created by the reform for a given stock of capital. Typically, subsidies create inefficiency (deadweight loss) in consumption good and factor reallocation, and removing them tends to have a positive direct effect. In addition, the revenue recycling schemes, as they affect other existing taxes, influence the efficiency of the policy. The dynamic mechanisms come from impact of the policy on households' savings. A reform whose consequence is an increase in aggregate savings and consequently capital accumulation in the economy will have better long-term GDP growth performances[10].

[10] In particular if, as in this study, the current account is fixed.

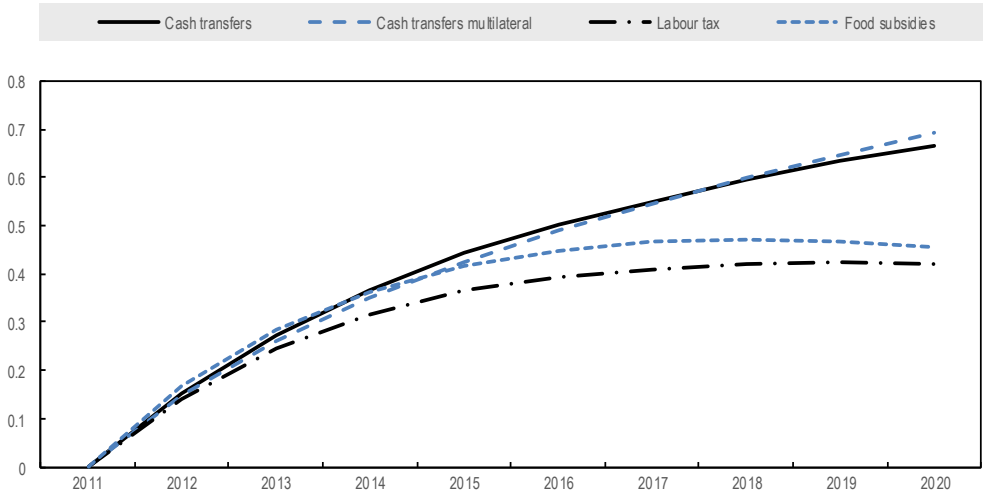
54. The subsidy removal has a positive direct impact on the economy, since it reduces allocation inefficiencies. However, depending on the scenario, the recycling schemes adopted may create new inefficiencies in the economy. The lump sum transfers used in the *cash transfer* and *cash transfer multilateral* scenario do not create inefficiencies, because they do not influence production factor allocations. Similarly, given that the total labour is exogenous, the recycling through changing taxation operated in the *labour tax* scenario doesn't households' supply of labour and is equivalent to a lump-sum transfer. But in the *food subsidies* scenario, the recycling scheme consists of reducing taxes and then introducing subsidies on food products. The reduction of food taxes tends to have an immediate positive role, explaining the slight better growth performance in this scenario than in the others scenario during the first year of the model horizon. But the subsidies on food products appear after a few years and create inefficiencies that partially offset the positive impact of removing subsidies.

55. Figure 9 illustrates the dynamic effects by showing the impact that the policies have a significant impact on the capital stock by presenting the ratio between the two most important production factors, capital and labour (in efficiency units, i.e. including human capital). The *cash transfer* and *cash transfer multilateral* scenarios and, to a lesser extent, the *labour support* scenario, induce more capital accumulation. In the latter case this comes mainly from the monetary redistribution of the subsidies to the households that have accrued their disposable incomes and encouraged savings. Savings rates, and hence capital accumulation, are also affected by the changes in consumption prices. As seen in Figure 5, the consumer price index increases in all scenarios except the *food subsidies* scenario. Hence, consumers are induced to substitute away from consumption into savings. The food subsidies, in contrast, make short-term consumption more attractive, thereby putting a downward pressure in savings rates.

56. The difference in terms of capital formation between the two *cash transfer* scenarios and the *labour tax* scenario is due to effects stemming from households' heterogeneity. The labour subsidies largely accrue to those parts of the population that have a relatively low marginal propensity to save. First, they have lower capital incomes and lower savings. Second, the labour support attains only the groups which are in the formal sector, excluding thus self-employees who have a relatively high marginal propensity to save as they often have to invest in their own small business.

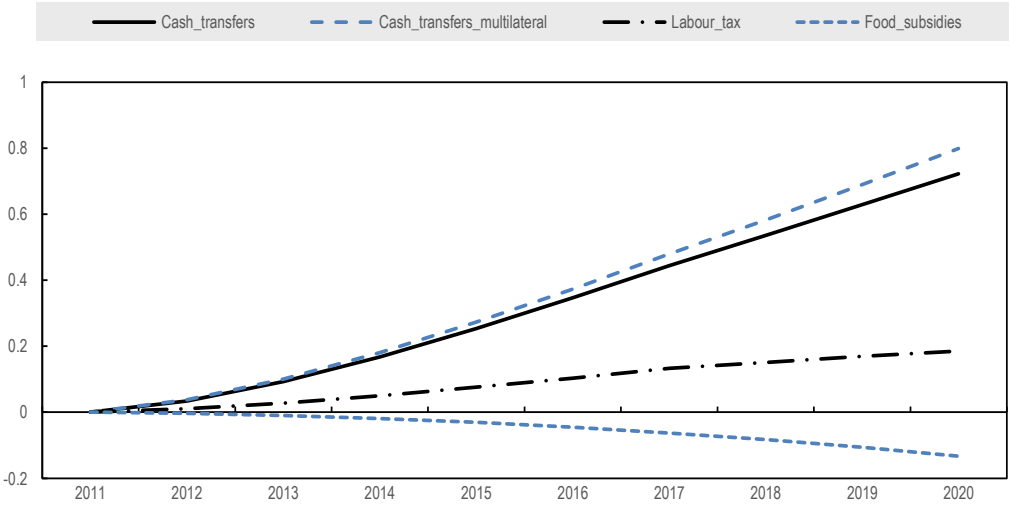
57.

Figure 8. Real GDP as percent deviation to the baseline in the various scenarios



Source: Authors' calculations

Figure 9. Capital to efficient labour ratio, as % variation from to the baseline



Source: Authors' calculations

6.2 Distributional impacts

58. The welfare impacts on the various household groups are express in monetary units. More precisely, the income equivalent (IE) is used as a measurement of the welfare impacts[11] An income equivalent variation (EV) is computed as the percent variation between the income equivalent in the scenario considered and the income equivalent in the *baseline*. A Positive (a negative) equivalent income variation means that the policy reform is beneficial (detrimental) to the household group considered. The

[11] This measure translates the change in utility induced by the policy reform in terms of change in income that would have been necessary to reach the same level of utility in the *baseline* scenario

simulated distribution of the EV across the household groups is used to conduct the distributional analysis of the policy scenarios.

59. Table 4 shown statistics about the distribution of EI for year 2020 in the various scenarios. Two dispersion statistics, Gini and the Theil indexes, provide insight on whether the policies give way to higher or lower overall inequalities than in the *baseline*, and can be, in this sense, regarded as progressive or regressive. In the *cash transfer* and *cash transfer multilateral* scenarios, the Gini and the Theil indexes, significantly decrease, and these scenarios can be regarded as progressive. These dispersion statistics decrease slightly, but very moderately in the *food subsidy* scenario which can, therefore, be regarded as slightly progressive or distribution neutral. The labour support scenario has higher Gini and Theil indexes and appears to be regressive.

60. When considering, the inter quintile ratios and the EV per centiles of Table 4, it appears that the progressivity of the *cash transfer* and *cash transfer multilateral* scenarios comes from the fact that they are pro-poor. First, in these two scenarios, the gap between the upper and the lower quintiles decreases. The ratio between the 99th centile (the wealthiest 1%) and the 1st centile (the poorest 1%) shrinks from 45 to about 39, and the ratio between the 95th and the 5th centile decreases from 14,2 to 12,7. In addition, in these scenarios, the households of the 5th centiles have EV of more than 9%. The increase in equivalent income is also very import, in the 10th centile. This means that theses policies are first of all beneficial to the very poor. Diminishing ratio between higher and lower quintile and significant EI increase is also observed, but to a lower extent, in the *food policy scenario*. However, the *labour support* scenario increases the ratios between higher and lower quintiles, while the EI in the 5th and 95th centiles (by 1.21 to 0.92 respectively).

Table 4. Inequality indexes and poverty indexes in 2020 in the various scenarios

Secnarios		Baseline	Cash transfers	Cash ransfers multilateral	Labour tax	Food subsidies
Inequality index						
	Gini coeffcient	0.445	0.436	0.436	0.450	0.443
	Theil Index	0.348	0.336	0.336	0.357	0.346
Inter-quintile ratios						
	Dec8/Dec3	2.4	2.3	2.3	2.4	2.3
	Dec10/Dec1	8.2	7.6	7.6	8.4	8.1
	Cent95/Cent5	14.2	12.7	12.7	14.6	14.0
	Cent100/Cent1	45.2	39.0	38.8	46.4	43.8
Equivalent income variations (in %) per quintile						
	Cent5	-	9.06	9.26	-1.21	2.11
	Cent10	-	6.79	6.97	-0.92	2.51
	Cent90	-	-0.13	0.31	1.51	0.02
	Cent95	-	-0.23	0.13	1.98	0.25

Source: Authors' calculations

61. Figure 10 shows for the various scenarios the EV by income centile groups in 2020 and thus provides more details about the distribution of the gains and losses due to the policies across the centiles groups. As the EV are expressed as percent deviation from the baseline, a scenario with EV for the lower income quintiles can be interpreted as progressive as it denotes that the lower the initial income, the higher the proportion of income equivalent gains from the policy.

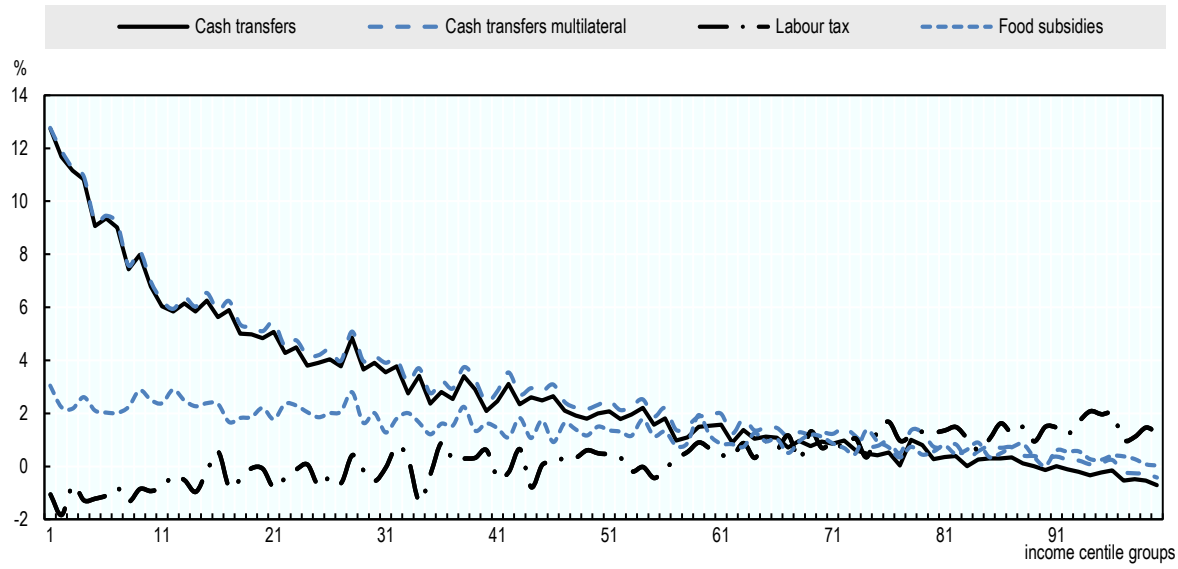
62. All the scenarios yield positive welfare impacts (the EV is positive) for the vast majority of the household centile groups, showing that most of the household groups gain from the reform. This reflects, at the household group level, the positive macroeconomic impacts of the scenario. In addition, except for *the*

labour support scenario, the EV are higher for the lower centile groups, meaning that these scenarios are progressive.

63. The *cash transfer* and *cash transfer multilateral* scenarios have very similar impacts across the household groups. They are the most progressive and they benefit to all the household centile groups except the very last ones. This result is largely due to the natural progressivity of unconditional cash transfer schemes (the identical payments received by the household are identical and represent a much higher share of revenue for poor than for richer households) reinforced by the fact that in Indonesia, the initial level of inequality in very high.

64. The *food subsidy* scenario is also progressive and beneficial to all the income centiles. The relative benefit of the reform is higher for the lower centile, due to their larger share of food and agricultural product consumption (see Figure 5). The *labour support* scenario is regressive, and detrimental to lower income household groups. In this case the revenue recycling scheme misses its target of making the reform progressive.

Figure 10. Equivalent income variations by income centiles in 2020 in the various policy scenarios



Source: Authors' calculations

65. Each policy impacts household's welfare through multiple canals: through changes in final prices, changes in factor incomes and in transfers. In addition, the ability to adjust their demands can help the households to limit the potential detrimental effects. To identify the main drivers of the distributional impacts of each reform the welfare changes of the household groups is decomposed into the following effects:

1. The direct effect of the *final price* change, i.e. the change in expenditures that would have occurred in the absence of household demand response.

2. The effect through change in *net labour income*: the change in revenue that comes from the variation of the return on labour. This latter reflects not only the change in labour marginal productivity, but also, in the case of the labour support scenario, the introduction of the subsidies on labour.

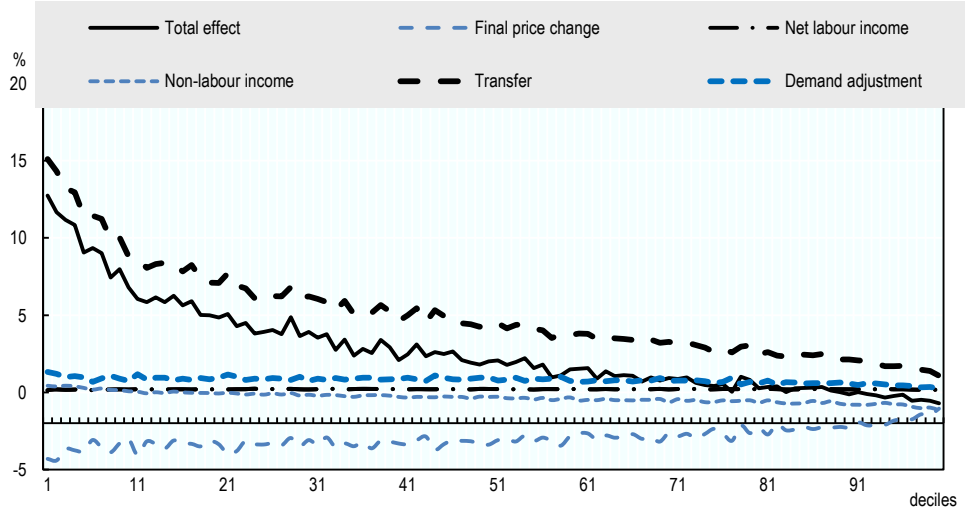
3. The effect of the change in *non-labour incomes* (i.e. revenues from capital, land, and natural resources).

4. The effect through increasing *transfers* that accrue the households' disposable income

5. The effect through *demand adjustment*, which takes into account the impact on welfare due to the response of demand to the changes in final prices.

66. These components are shown on Figure 11 for the *cash transfer* scenario. It appears that the direct effect of the policy through changes in final prices is regressive. The effect is equivalent to a 5% decrease of the revenue for the lower centile group, but to less than 3% for the wealthiest groups. The overall progressivity of the cash transfer scenarios is almost entirely due to the changes in transfers. The effects through labour and non-labour incomes and through demand are distribution neutral, and the effect of demand adjustment is neutral and relatively limited compared to the effect of final price changes.

Figure 11. Decomposition of the welfare effects, by income centiles in the Cash Transfer scenario



Source: Authors' calculations

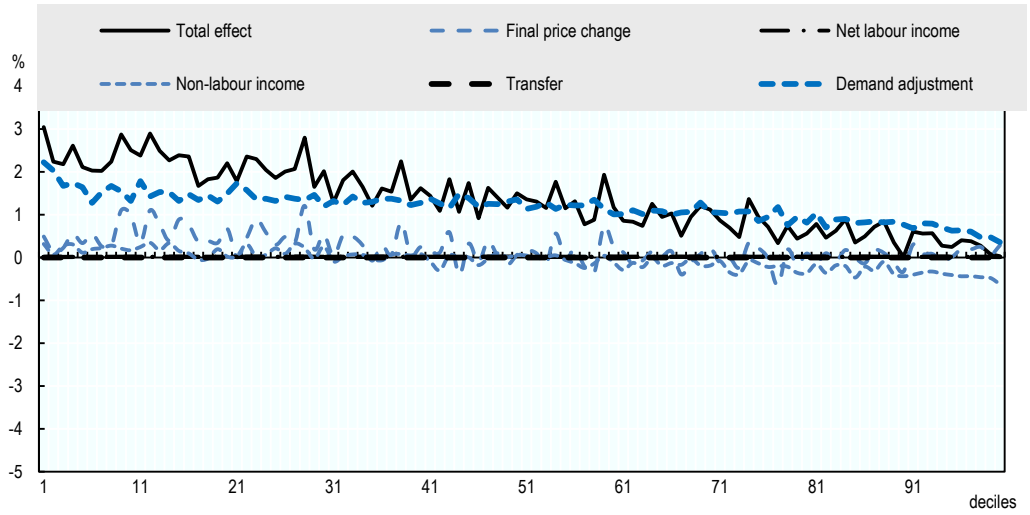
67. When considering the effect in the labour support scenario, in Figure 11, it appears that the regressive impacts through net labour incomes reinforce the regressivity of the final price changes effect. This result is counterintuitive given that the effect of labour income was distribution-neutral in the *cash transfer* scenario, translating relatively homogenous shares of labour incomes across the household centiles. But the explanation comes from the very nature of the recycling scheme. Transfers proportional to the labour income, as used in the *labour support* scenario are regressive, as the revenues from formal labour are a lower proportion of total revenues for higher-income than for lower-incomes households (see figure ?).

68. The decomposition of the effects for the *food subsidies* scenarios presented in figure 12 shows that the final price change effect is progressive. It reflects that the subsidies on food products are sufficiently progressive to offset the regressive impacts of the increase in final energy prices. The progressivity of the food subsidies is due to the higher budget shares of food for poor than for rich households (see figure 3). In addition, in this scenario, the non-labour revenue effect is relatively progressive, due to the positive impacts of the food subsidies on the land returns (see Figure 7) and to the relatively high proportion of incomes from land in low-income households' revenues (see figure 5).

Figure 12. Decomposition of the welfare effects, by income centiles in the Labour support

Source: Authors' calculations

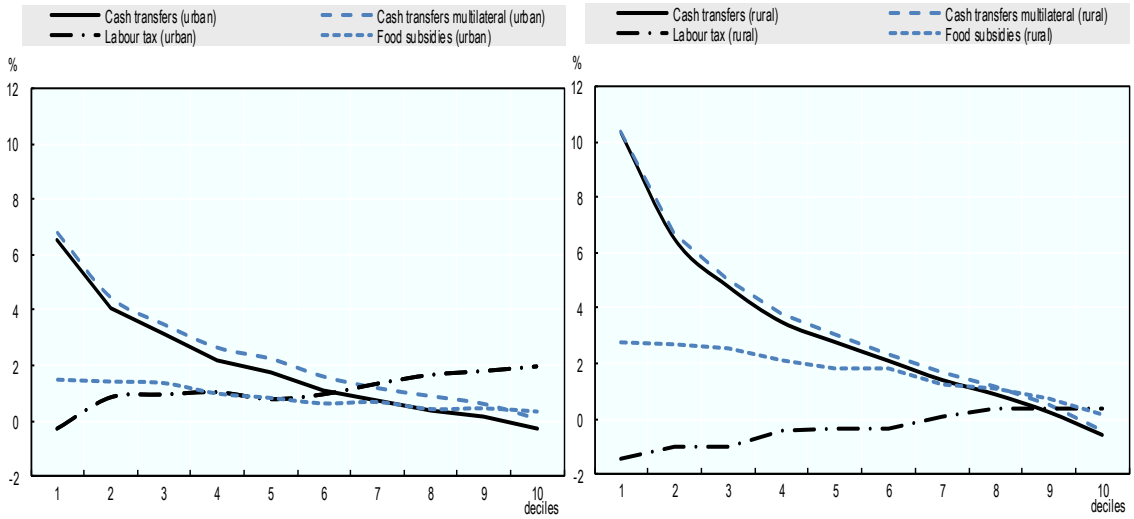
Figure 13. Decomposition of the welfare effects, by income centiles in the food subsidy scenario



Source: Authors' calculations

69. The reform has different impacts in urban and rural areas, as shown by figure 11. Until the 9th decile, the *cash transfer* scenario and the food subsidy scenarios are more beneficial to rural than to urban households The main reason is that the rural households have lower initial budget shares of energy expenditures and they are consequently less affected by the impact of the reform on final energy prices. The *labour support* scenario, on the contrary, is less beneficial to the rural households, because of the greater importance of the informal sector in these areas. On the contrary, the *food subsidy* scenario; due to the higher share of food product consumption in rural than in urban areas, and to an increase in land returns; is more beneficial to rural than to urban households.

Figure 14. Welfare impact of the subsidy reform for the urban (left) and rural populations (right) by income decile groups in 2020



Source: Authors' calculations based on IFLS4

6.3 Environmental impacts

70. Table 5 shows that the phasing out contributes to a 10% to 12% decrease in energy-related CO_2 emissions at horizon 2020 compared with the baseline, in line with the decreases of energy consumption (ranging from 10.9 to 12.7%). As could be expected from the phasing out, the emission reduction efforts are achieved by energy conservation and not by a reduction of the CO_2 intensity of energy. The conservation effort is born by the households, who reduce their energy consumption by 42 to 46%, whereas the energy consumption by the firm declines by only 4.9 to 6.2%. This effect is mainly due to the much lower energy consumption subsidies for firms than for household in the base year.

71. But for the two other scenarios, the differences in emission reduction performance are not explained by growth. The food subsidy scenario has both better growth and environmental performance than the labour support scenario. This can be explained by two effects. First, in this scenario, the capital accumulation has been more limited, which made energy less productive in the industry. In addition, the relative final price increase of energy products has been exaggerated by the subsidies on food products thus reinforcing the decrease of households' energy demand.

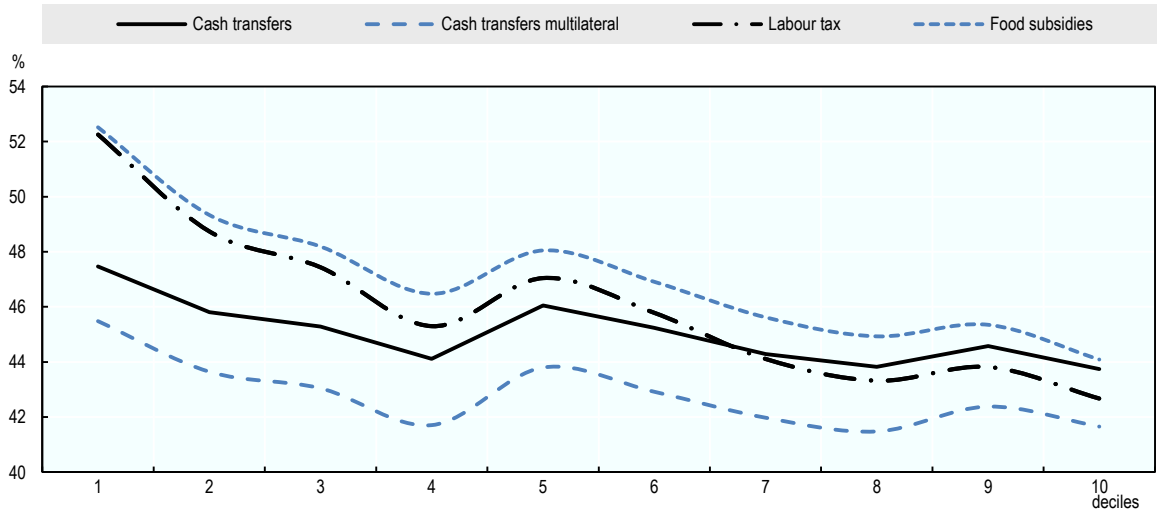
Table 5. CO2 emission reduction in 2020 w.r.t. the basline in the various scenarios

Secnarios	Cash transfers	Cash transfers multilateral	Labour tax	Food subsidies
CO2 emissions	11.8	10.8	12.3	12.6
Total energy consumption	12.1	10.9	12.5	12.7
Households	44.6	42.4	44.8	46.0
Firms	5.8	4.9	6.2	6.2

Source: Authors's calculations

72. The level of energy consumption reduction achieved varies across household deciles, as shown by Figure 15.The *cash transfer* scenario lead to lower emission reduction for the lower income quintile. This sort of rebound effect is due to the revenue effect on energy consumption.

Figure 15. Energy-consumption reduction achieved by household decile in the various scenarios

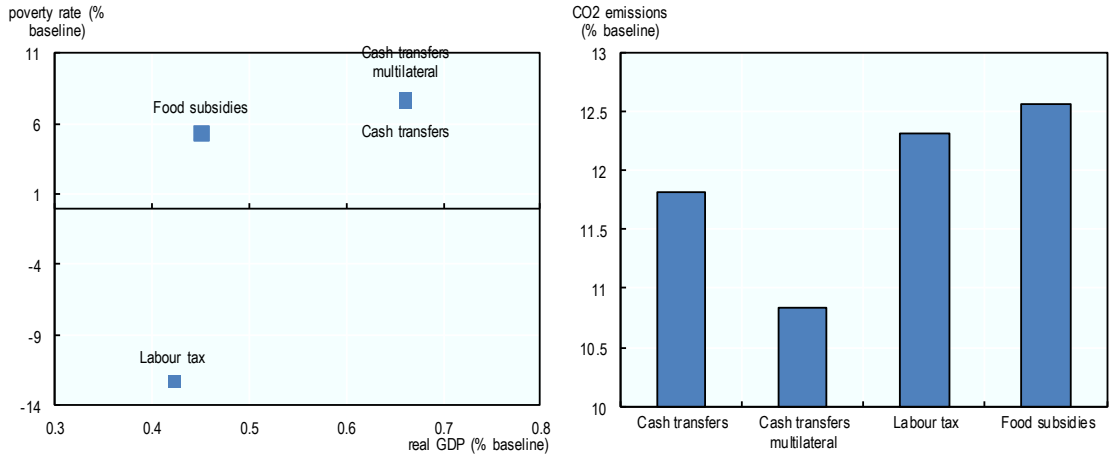


Source: Authors' caluclations

6.4 Synthesis of the results

73. The main simulation results are summarized in Figure 16.

Figure 16. Economic, environmental and distributional performances of the 3 scenarios at horizon 2020



Source: Authors' calculations

7. CONCLUSIONS

74. In the simulations proposed, the phasing out of the energy consumption subsidies contributes to a 10% to 12% decrease in energy-related CO2 emissions at horizon 2020 compared with the baseline. Since most of the initial energy consumption subsidies rates were relatively low for the industries and high for the household, the emissions reduction effort is mainly driven by the households who decrease their energy consumption by 42 to 46%. All the scenarios give way to positive impacts on GDP at horizon 2020 (+0.4 to +.7% in 2020 w.r.t. baseline), due to a decrease of the deadweight loss caused by the subsidies and also, in some scenarios, to higher savings and investments.

75. Concerning the distributional impacts, it appears that for the households the direct effect of the subsidy reform, arising from higher energy prices is regressive, especially in urban areas, and that the effect through revenues is distribution neutral. But the redistribution schemes can make the total effect of the reform progressive and pro-poor. The *cash transfer* scenario is the most progressive. Given and has the most positive impact on GDP, it also leads to less emission reduction. The cash transfers, as they increase the revenues in the lower income quintiles, lead to a lower decrease in energy consumption and associated CO2 emissions for these household categories. The recycling with food subsidies is less progressive than with cash transfers, and the effect on GDP is less important, as food subsidies create inefficiencies and induce less savings and investments This recycling schemes is the most performant option in terms of emissions reduction, but this largely due to the less positive impacts on GDP. Transfers proportional to the labour income, as used in the *labour support* scenario are regressive, as the revenues from formal labour are a lower proportion of total revenues for higher-income than for lower-incomes households. This poor distributional performance comes along with less positive impacts on GDP than in the case of the introduction food subsidies, but gives way to comparable levels of emission reduction.

76. But before drawing policy conclusions, it is necessary to consider the feasibility of such mechanisms and their performances with respect to other mechanisms that were not embraced in the policy scenarios. If used as the sole way to compensate the household for the energy subsidy phase out, the cash transfer would reallocate a fraction of domestic wealth almost equivalent to the one previously managed by energy subsidies: more than 2.5 % of GDP. The feasibility and the transparent implementation of such massive cash transfer programs over long periods can be questioned. It could create huge incentives for predation and diversion. Alternatively, cash transfers might be more limited and targeted to more specific household groups. But over time the mechanism is not without problem, as entitlement to the cash transfers can create dependence to these and interplay with households' activity choice and at the expense of their contribution to economic growth. In addition, the implementation of large-scale and long-lasting cash transfers systems represents, for the public authorities a challenge comparable to the implementation of a proper social security system, but with ultimately less benefit for the population. For these reasons, the cash transfer can be only considered as a transitional response to the decrease in energy subsidies. Its role is to limit, on the short and medium run, the detrimental effects on poor households and it has to be deigned in the perspective, on the longer run, of the construction of a proper social security systems.

77. In addition, even if this aspect was not captured in the scenario proposed, subsidy reform is an opportunity to reallocate government expenditures to the development of infrastructures and public services and public goods which can create positive externalities, have very high social return, boost potential growth through human capital and reduce inequalities and poverty on the long. However, simulating such policies, their economic, environment and distributional impacts, remains a challenge, requiring additional time for model development.

REFERENCES

Agustina, C.D., Arze del Granado, J. Bulman, T., Fengler, W., Ikhsan, M. (2008) "Black Hole or Black Gold? The Impact of Oil and Gas Prices on Indonesia's Public Finances" Policy Research Working Paper 4718, The World Bank East Asia and Pacific Region Pacific Poverty Reduction and Economic Management Unit, September 2008

Burniaux, J.M., J. Chateau, R. Dellink, R. Duval and S. Jamet (2009), "The Economics of Climate Change Mitigation: How to Build the Necessary Global Action in a Cost-Effective Manner", *OECD Economics Department Working Paper*, No. 701.

Chateau, J, R., Dellink, and E. Lanzi (2014), "An overview of the OECD ENV-Linkages model: version 3", OECD Environment Directorate Working Paper, No65.

Cheon, A., Uperlainen, J. and M. Lackner (2013) , Why do governments subsidize gasoline consumption? An empirical analysis of global gasoline prices, 2002-2009, *Energy Policy* 56, pp. 382-386

Clement, B., H.-S. Jung and S. Gupta (2007). "Real and Distributive Effects of Petroleum Price Liberalization: The Case of Indonesia," *Developing Economies*, Vol. 45(2), pp. 220-237.

Dartanto T., (2013) Reducing fuel subsidies and the implication on fiscal balance and poverty in Indonesia: A simulation analysis, *Energy Policy* 58(2013)117–134

Dick, H. (1980) "The Oil Price Subsidy, Deforestation and Equity", Bulletin of Indonesian Economic Studies, 16:3, 32-60, DOI: 10.1080/00074918012331333829

Diop, N. (2014), Why is reducing Energy Subsidies a Prudent, Fair and Transformative policy for Indonesia?, *World Bank Economic Premise*, No. 136

EC, (2010) The distributional impact of imputed rent in EU-SILC, Eurostat Methodologies and Working Papers

Golan, A. and G. Judge (1996) , "Recovering information in the case of underdetermined problems and incomplete economic data", journal of statistical planning and inference, Vol. 49, No. 1, pp. 127-136, doi: http://dx.doi.org/10.1016/0378-3758(95)00033-X

Goulder, L. H. (2013) "Climate change policy's interactions with the tax system", Energy Economics http://dx.doi.org/10.1016/j.eneco.2013.09.017.

IEA, (1999) *World Energy Outlook 1999*, IEA/OECD Publishing.

IEA, (2012) *World Energy Outlook 2013*, IEA/OECD Publishing.

IEA, (2013) *World Energy Outlook 2013*, IEA/OECD Publishing.

IEA, OECD, OPEC & World Bank (2010a) Analysis of the scope of Energy Subsidies and Suggestions for the G-20 initiative, IEA, OPEC, OECD, World Bank Joint Report, Prepared for submission to the G-20 meeting, Toronto (Canada)

Ivanic, M., (2004) Reconciliation of the GTAP and Household Survey Data, *GTAP Technical paper 31*

Miranti, R. et al. (2013), "Trends in Poverty and Inequality in Decentralising Indonesia", OECD Social, Employment and Migration Working Papers, No. 148, OECD Publishing. http://dx.doi.org/10.1787/5k43bvt2dwjk-en

Mourougane, A. (2010), Phasing Out Energy Subsidies in Indonesia. OECD Economics Department Working Papers, No. 808, OECD Publishing

Pitt, M. (1983), "Equity, Externality and Energy Subsidies, The case of Kerosene in Indonesia"; Journal of Development Economics 17, (1985), North Holland

Reimer, J. and T. Hertel , (2003) International Cross Section Estimates of Demand for Use in the GTAP Model, GTAP Working Papers 1190, Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University.

Rutherford, T., Tarr, D., and O. Shepotylo (2006), "The Impact on Russia of WTO Accession and The Doha Agenda: The importance of liberalization of barriers against foreign direct investment in services for growth and poverty reduction" in, Hertel, T. W. and L. A. Winters, (eds.) (2006)

UNECE (2011), *Canberra Group Handbook on Household Income Statistics*, United Nations Economic Commission for Europe, Geneva

Van der Mensbrugghe, D. (2005), "Linkage Technical Reference Document Version 6.0", Development Prospects Group, The World Bank, Washington, January 2005.

Widodo, T., G. A. Sahadewo, S. U, Setiastuti and M. Chaerriyah (2012), 'Cambodia's Electricity Sector in the Context of Regional Electricity Market Integration' in Wu, Y., X. Shi, and F. Kimura (eds.), *Energy Market Integration in East Asia: Theories, Electricity Sector and Subsidies*, ERIA Research Project Report 2011-17, Jakarta: ERIA, pp.173-206.

World Bank (2006), *Making the new Indonesia work for the poor*, The World Bank Washington D.C.

World Bank, (2008), Climate Change and the World Bank Group, Phase 1: An Evaluation of World Bank Win-Win Energy Policy Reforms . Washington, DC , pp.114–119.

World Bank (2011) Indonesia Economic Quarterly, March 2011

Yusuf, A. A., Komarulzaman, A., Hermawan W. Hortono, D. and K. R. Sjahrir,(2010) Scenarios for Climate Change Mitigation from the Energy Sector in Indonesia: the Role of Fiscal Instruments, Working Paper in Economics and development Studies, No , 201005, Department of Economics, Padjadjaran University

Yusuf, A. A. and B. P. Resosudarmo (2008), "Mitigating Distributional Impact of Fuel ¨Pricing Reform, The Indonesian experience", ASEAN Economic Bulletin, Vol. 25, No. 1, pp. 32-47

APPENDIX

A Reconciliation of the budget survey and CGE data

A.1 Imputation of the survey incomes and expenditure to the social accounting categories

78. The expenditure module of the IFLS4 budget survey collects information on food, non-food goods and services on a weekly base, household items monthly and durable goods bought in the analysed year. For the sake of comparability with the national accounting data, the value of self-produced or not purchased goods was not considered as part of total expenditures as well as gifts given outside the household (Reimer and Hertel, 2003).

79. To map the survey's categories into the detailed (25 items) product categories used in ENV-Linkages, the approach used depended on the type of good considered. Special attention was paid to the imputation of energy products consumptions. The kerosene and the electricity expenditures could be obtained by a direct mapping with the corresponding survey category. Given that the IFLS4 survey does not isolate expenditures for Gasoline, diesel and LPG, the expenditures for these products had to be extracted from broader consumption categories using additional information included in the survey. For the households owing a LPG stove, the LPG expenditure was approximated by total fuel expenditures. The gasoline and diesel consumptions were derived from the transportation expenditure categories of the survey (since this latter include the expenditures for "gasoline and the like") and from information about the vehicle ownership.

80. A specific imputation method is also used for housing services. The survey provides a detailed breakdown of expenditure components including actual housing rents and estimated ones for self-owned or occupied dwellings. Special attention is devoted to this latter category that usually is not considered for the income and expenditure computations in a micro framework. Whether actual rent is clearly a cost for tenants and rent contributes to form income of housing owners, the macro framework, classifies the ownership of dwellings as an industry that sells housing services to owners and receives a gross-rent at competitive prices (UNECE, 2011). This value, net of current expenses, enters also in the income computation of housing owners. In the choice of the imputation model, we followed the literature on estimation of dwelling services (EC, 2010) that considers location and household characteristics (rural/urban area, household size, availability of electric equipment and other facilities) as main explanatory variables, and expresses the rent in a logarithmic scale to better capture the non-linearity in the relation. Among explanatory variables we also considered non-food expenditure which results significant and positively correlated. Subsequently, we replaced the missing data with the average of generated values across imputations.

81. For the other goods and services, a simplified imputation method, using two two-steps was used. First, the survey's expenditure were mapped into 5 broad categories (agricultural products, food products manufactured goods, transportation, services). Then, the breakdown of these broad categories into the more detailed ENV-linkages categories was done with a proportional allocation based on the aggregate consumption structure in the ENV-linkages base year (2011) consumption expenditure for Indonesia.

82. The IFLS4 also collects information on total income received by all household's members, surveying the five main components of income: flows connected to economic activities (cash and in-kind), remuneration due to assets ownership, value of services produced for own consumption, transfers and inter-household flows (e.g. gifts). Expected, but not materialized earnings are excluded from income computation as well as holding gains/losses and irregular gains: e.g. lottery winning and lump sum pensions (UNECE, 2011).

83. The labour market section describes the occupation status of individuals (employed and self-employed), the sector of occupation and the remuneration (respectively wages and net-profits). For sake of micro-macro harmonization, the considered sectoral aggregation is: agriculture, electricity, manufacturing, transportation, construction and services. When the information about occupation was completely missing, we dropped the observations; instead, the missing yearly salary was integrated using the monthly data multiplied by the number of working month in the year. The sectoral detail, in addition to province and urban/rural locations, was used for replacing the few left missing data using the conditioned mean technique. The year-end bonuses were included in the computation of yearly wage.

84. The salary section was merged with more specific information on net-profits of household businesses (farm and non-farm). Regarding the farm activity, the difference between revenues and total production costs was used to fill the numerous missing data on net-profits. For firm businesses, revenues used for household consumption were considered a more reliable estimate of net-profits; they were elicited as the sum of "the value of production used for household consumption, the value of business net income used on household expenditures and the amount of cash left over" (Strauss et al., 2009); whether missing, we used the net-profit data. Moreover, net-profits both for farm and non-farm businesses were complemented taking into account yield loss experienced and income generated from other production assets (purchases, sales and rent of land, livestock, buildings...) in order to obtain the total income from production.

85. The property income considers the revenues generated by household financial and non-financial assets not used in the production process. As anticipated before, the imputed rent (net of housing costs) from owned/occupied dwellings is an important component of income and is considered as the remuneration received for self-produced services.

86. The incomes are more difficult to be matched with the SAM categories. The main problems come from the choice of mapping procedure of business profits and wages from the survey to Capital, Labour, Natural Resources and Land remunerations in the Social Accounting Matrix. Following Ivanic (2004), we consider wages directly as labour remuneration as well as a portion of profits in farm and non-farm business computed using the average wage, sector and region specific. The left over profits from business and self-employed activities, in addition to property rents and dividends are accounted as generalised capital factor remuneration (capital, land and natural resources). The repartition of this aggregate is operated using the sector specific ratio of capital, land and natural resources coming from the CGE model.

87. The transfer aggregate includes monetary flows from government and non-profit institutions in the form of conditional and non-conditional support programs. Only 300 households report positive transfers, therefore for the other observations we imputed an average transfer depending on household size and income decile. We excluded from the computation inter-household flows.

A2 Reconciliation procedure

88. After the imputation process, the discrepancies between the aggregate figures in the CGE mode and the total over households in the survey data have to be eliminated by reconciliation. The reconciliation procedure was designed to fulfil the following requirements:

1. For each good category, total the expenditure over the households must add-up to the CGE base-year value

2. For each income category (labour, capital,…), the total over the households must add-up to the CGE base-year value

3. At the household level, the total disposable income must be equal to the sum of expenditures and savings

4. For all the households, the ratio between savings and capital revenues must be the same.

89. Requirements (1) and (2) are standard for the micro macro data reconciliation. But (3) was specified due to the inconsistencies observed at the household level between declared incomes and expenditures. Last, (4) was imposed, for the sake of the multi-period modelling exercise, in order to avoid in the baseline big reallocations of capital ownership between the households. Such reallocation would have significantly affected the dynamic of inequalities in the baseline and blurred the distributional analysis. A low saving rate would have been is translated into a low marginal propensity to save (see Appendix B) and consequently into a low capital accumulation in the baseline scenario. Identical savings to capital revenues ratios across households are used to avoid massive reallocation of capital incomes from households with low initial saving rates and high contribution of capital in their revenue to households with high saving rates with low initial contribution of capital in their revenue. A consequence of this rule is that there are no households with negative savings after the reconciliation.

90. The reconciliation procedure used to meet the four requirements was based on cross-entropy minimization problems (Golan and Judge,1996) and can be summarized as follows. First, the expenditures of are reconciled using cross entropy. Then, the household-level capital incomes and savings are computed by allocating the CGE model aggregate saving proportionally to the share of each household in total capital incomes as observed in the survey. Last, the households' non-capital incomes are reconciled with the survey using cross entropy minimization.

B Calibration of the household's preferences parameters based on the survey

91. Each household group *h* containing population pop_h has the following type of utility function[12]:

$$u_h = \sum_i \left\{ mpc_{h,i} \cdot \ln(c_{h,i} - pop_h \cdot \theta_{h,i}) + mps_h \cdot \ln(s_h - pop_h \theta_{h,s}) \right\}$$

with $c_{h,i}$ the consumption of good *i*, and s_h the savings. The preference parameters are the marginal propensities to consume $mpc_{h,i}$, the marginal propensity to save $mpc_{h,i}$ and adjustment parameters $\theta_{h,i}$, and $\theta_{h,s}$.

The household's demand for consumption good and the saving behaviour results from the utility maximization under budget constraint:

$$(c_h, s_h) = argmax \left\{ u(c_h, s_h) \mid \sum_i p_i s_{h,i} + s \le yd_h \right\}$$

The demand for good *i* and the savings are given by:

[12] This form is very close to the utility function used for ELES demand system. The main difference is the adjustment term $\theta_{h,s}$ for savings. This term is used here to make possible the survey replication for alternative Frisch parameters. This property would allow to do sensitivity analysis on the price elasticities by changing the Frisch parameters.

$$c_{h,i} = pop_h \cdot \theta_{h,i} + \frac{mpc_{h,i}}{p_i}(yd_h - \sum_{i'} p_{i'} \theta_{h,i'} + \theta_{h,s})$$

$$s_h = pop_h \cdot \theta_{h,s} + \frac{mps_h}{p_i}(yd_h - \sum_{i'} p_{i'} \theta_{h,i'} + \theta_{h,s})$$

92. The household-group utility functions are calibrated on the consumption in volume ($\overline{c}_{h,i}$), consumption good prices[13], ($\overline{p}_i$) and savings ($\overline{s}_h$) taken from the reconciled survey; and also based on assumption about the income elasticities of demand ($\eta_{h,i}$) and income elasticity of savings ($\eta_{h,s}$) and for the Frisch parameter (fr_h). By default, the Frisch parameters are equal for all the households, and the income elasticity parameters are based on the value used for the representative household in the standard version of the model.

First, the marginal propensities to consume and to save are:

$$mpc_{h,i} = \eta_{h,i} \cdot \frac{\overline{p}_i \overline{c}_{h,i}}{\overline{yd}_{h,i}},$$

$$mps_h = \eta_{h,s} \cdot \frac{\overline{s}_h}{\overline{yd}_h}$$

Then, based on the Frisch parameter, the θ parameters are calibrated with formulas

$$\theta_{h,i} = (\overline{c}_{h,i} - mpc_i \frac{\overline{yd}_h}{\overline{p}_i \cdot (-fr_h)}) / pop_h$$

$$\theta_{h,s} = (\overline{s}_h - mps \frac{\overline{yd}_h}{\overline{p}_i \cdot (-fr_h)}) / pop_h$$

[13] The consumptions in volume are retrieved from the households expenditures using the CGE price base year price

C The model's decomposition algorithm at iteration k