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ENERGY SUBSIDY REFORM AND POVERTY IN ARAB COUNTRIES: A COMPARATIVE CGE-MICROSIMULATION ANALYSIS OF EGYPT AND JORDAN

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This study simulates the macroeconomic and distributive impacts of real proposed (by local policy makers) energy subsidy reforms in Egypt and Jordan. To do that, we develop a dynamic CGE-microsimulation model that is able to reconcile the general equilibrium effects of the reform and the individual- and household-specific distributive effects. While the nature of the proposed reforms differs in the two countries, the study underscores the need, in both countries, for reform to generate fiscal savings to boost private investment and increase economic growth. It also shows that the reform alone would further exacerbate poverty through increased consumer prices. However, a modest reinvestment of fiscal savings into cash transfers creates a win-win scenario of reduced poverty without significantly sacrificing the fiscal and growth benefits from the reform. Impacts (prices, growth, fiscal savings, poverty) are greater in Egypt due to the extent of proposed reforms and the fact that a larger share of the energy products concerned are consumed directly by households, while in Jordan the major effects come from the increase in intermediate input costs which generate a fall in the aggregate demand and, so, in labor demand.

JEL Codes: D58, C50, I32, O57, H2

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1. Introduction

A key stated motivation behind energy subsidies is to protect the household purchasing power, especially among poor and vulnerable groups. However, they present a number of important drawbacks. They generally are ineffective tools of

Note: The analysis in Egypt was prevalently conducted in 2013 and in Jordan in 2014. This study is a synthesis of two studies conducted on Egypt and Jordan, and commissioned by UNICEF's MENA regional office with support from country offices and institutions (for Egypt: UNICEF Egypt, CAPMAS and the Ministry of Finance; for Jordan: UNICEF Jordan, Department of Statistics and the Ministry of Social Development). In particular, we would like to sincerely thank Roberto Benes, Leonardo Menchini, Maha Homsi and Samman Thapa (UNICEF) for their invaluable support during the project; Abdel-Rahmen El Lahga, Erwin Corong, Chahir Zaki and Orouba Al-Sabbagh for their contributions to the national reports; all the participants at the technical workshop held in Cairo (at CAPMAS and at the Ministry of Finance) on March 23-25 2013 for their inputs. We also acknowledge the excellent comments received during the CAPMAS-IARIW conference in Cairo (November 23-24 2015), in particular from our discussant, Shantayanan Devarajan. We also acknowledge the financial support from the Partnership for Economic Policy (PEP), with funding from the Department for International Development (DFID) of the United Kingdom (or UK Aid), and the Government of Canada through the International Development Research Center (IDRC).

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social protection. Unlike food subsidies, universal fuel price subsidies generally disproportionately benefit the rich, as they consume much more fuel than the poor. This is referred to as leakage in the targeting jargon. Furthermore, fuel subsidies can distort energy consumption by reducing incentives for its efficient use and discouraging the use of alternative energy products. In this sense, they are directly counter to current global efforts to reduce carbon emissions. Third, subsidies are likely to divert resources from other social expenditures (education and health care in particular), which may be more cost-effective at protecting the poor. Finally, the sustainability of these subsidies has been questioned in recent years due to mounting subsidy costs and greater budget constraints faced by many governments. In response, many Arab countries have started to reform their price subsidy policy, especially for energy products.

However, reforming the subsidy system raises a number of issues. Although reforming fuel subsidies can improve a country's macroeconomic performance and ease fiscal pressures, the associated price changes can generate adverse direct and indirect impacts on the welfare of vulnerable groups and consequently on poverty. Indeed, subsidy cuts imply higher prices for energy products (electricity, gas, petroleum, coal, etc.) directly consumed by households and, perhaps more importantly, higher prices for non-energy products resulting from increased energy input costs. Given these adverse effects on household welfare and the popularity of the subsidies, many governments find it too politically dangerous to reduce or eliminate them. A possible solution is to target compensatory policies to protect the most vulnerable and limit the potential political instability. The question is thus how to reconcile subsidy reform and poverty alleviation efforts, given that the resulting price increases (both direct and indirect) will impact the poor to some degree?

The objective of this study is to simulate the poverty impacts of energy subsidy cuts where a share of the budget savings are channeled to the most vulnerable through the introduction of new child benefits. As this type of reform can generate important general equilibrium effects, we develop a top-down sequential CGE-microsimulation model that is able to reconcile the large and complex general equilibrium effects of energy subsidy cuts—where energy is a major household consumption good, production input and direct source of employment—and the individual- and household-specific poverty and inequality effects of the resulting changes in wage rates, employment, self-employment income and consumer prices. The model is then used to compare the results obtained in a baseline scenario without energy subsidy reform and an alternative policy scenario developed through discussions with local authorities. The analysis makes use of the most recent available data from Egypt and Jordan.

The study contributes a number of important findings to the debate and, crucially, the decision to reform energy subsidies. First, a reform is necessary. In both countries, the reform of energy subsidies clearly reduces the fiscal deficit, while boosting investment and increasing economic growth. Second, without an appropriate "safety net" the reform of energy subsidies is bound to further exacerbate poverty, especially in the short term, through direct and indirect price increases. While the fiscal health of the country would improve and generate more growth, this is insufficient to offset the short- and medium-term poverty impacts. In fact, it takes several years for the impact of cumulative fiscal savings and increased investment to outweigh that of the price increase. Finally, the analysis shows that it is possible to reconcile subsidy cuts with the commitment to reduce poverty. This study simulates the effects of actual price subsidy reforms proposed by local policy makers in each country. Consequently, results are not always directly comparable between Egypt and Jordan. Indeed, the products targeted, as well as the size and timing of reform, differ substantially between the two countries. Egypt plans to cut subsidies on diesel, gasoline, fuel oil, natural gas and liquefied pure gas from about 8 percent to 0.7 percent of GDP over the period 2012/13–2017/18. Jordan plans to cut electricity subsidies, differentially across sectors and agents, from 4 percent to 1.2 percent of GDP over the period 2014–18. Hence, the channels of transmission of the reform are substantially different between the two countries. However, some interesting contrasts emerge, nonetheless, from the comparison of the two countries. In Egypt, the reform has strong impacts on prices: by the end of the simulation period in 2018, the prices of energy products in the reform scenarios are on average 50 percent higher than in the no-reform scenario, while the consumer price index is 8.5 percent higher. In contrast, while the increase in electricity prices directly raises intermediate input costs in Jordan, falling aggregate demand more than offsets this so that most consumer price indices fall (the consumer price index decreases by 0.45 percent by the end of the simulation period, with the exception of services). In Egypt, the real wage and unemployment rates do not differ significantly from the baseline scenario, while they both deteriorate in Jordan as a consequence of subsidy reform. In the latter, rising electricity prices translate into higher input costs, especially in the service and manufacturing sectors, which depresses labor demand. This increases unemployment rates by up to one percentage point, while reducing real wage rates by over one percentage point. In terms of the driving forces of poverty changes, there are also some important differences. In Egypt, poverty increases as the substantial improvement in factor income (i.e. higher nominal wages and profits) that follows fuel subsidy reform is not enough to offset the increase in consumer prices. In Jordan, poverty also increases, primarily driven by both unskilled wage reductions and an increase in the cost of living (notably housing and water, which are both electricity-intensive).The paper is structured as follows: we first provide a brief review of past studies on price subsidies reform around the world and, in particular, in the MENA region. We then present the methodology adopted in this study, the data, and the baseline and simulation scenarios. The discussion of the macro- and micro-economic results as well as a comparison between the two countries follow. Some final considerations close the paper.

2. Literature Review

There is a large empirical literature analyzing the impact of energy subsidy reforms on households and the economy as whole (see Bacon *et al.* (2010), for a review). Generally speaking, this literature can be classified according to the following questions: (i) What are the distributional impacts of energy subsidies across population and income groups? (ii) What is the impact of reforming subsidies on the welfare of households?

In a recent study reviewing energy subsidy experiences from a selection of developing countries from different regions of the world, Coady *et al*. (2010) show a very clear pattern of regressivity in energy subsidies (i.e. the richest quintile benefits an average of five times more than the poorest quintile).[1] While subsidies are generally regressive, their distribution across income groups differs by specific energy products. As might be expected, subsidies for gasoline and diesel (used generally for transportation) are the most regressive. The problem is less pronounced for kerosene, which is widely used by the poor for cooking and heating. In the MENA region, according to the World Bank, 75 percent of Morocco's diesel and petroleum energy subsidies accrued to the top quintile, whereas only 1 percent accrued to the poorest. In Jordan, according to Sdralevich *et al*. (2014), the richest 20 percent of the households capture 40 percent of subsidies. Cooke *et al*. (2016) find that fuel subsidies in Ghana are strongly regressive, with the richest quintile receiving about 78 percent of total fuel subsidies, and the poorest quintile receiving as little as 3 percent.

A decrease in energy subsidies has both direct and indirect effects on household welfare. The *direct* effect on real household income results from higher fuel prices for cooking, heating, lighting and private transport. Beyond this, higher energy prices *indirectly* carry through to production costs and, consequently, consumer prices across the entire economy. According to Granado *et al*. (2012), the simulated increases in fuel prices in various regions of the world induce a substantial reduction in real household incomes: from 3.3 percent in South and Central America to 7.4 percent in the Middle East. The indirect effects on real household income account for more than half of the total effect, on average. The sources of negative effects on real household income vary considerably across regions, mainly depending on consumption patterns and the relative importance of each energy source in household budgets. In Africa and Asia-Pacific, price increases for kerosene induce the greatest negative direct effect, as opposed to the Middle East and Central Asia, where gasoline and electricity price hikes hit household welfare hardest. Cooke *et al*. (2016) use a partial equilibrium price-shifting approach on input-output tables to estimate the indirect price effects. They find that the removal of fuel price subsidies, as implemented in 2013, would hit the poorest households most and increased the incidence of poverty by 1.5 percentage points. For several European countries, Sterner (2012) uses a marginal, partial equilibrium approach where some indirect effects (on public transports) are introduced. They find that taxing fuel products can be regressive, neutral or progressive depending on the welfare measure used and the adoption of average or decile price elasticities.

[1]A review of incidence patterns of energy subsidies highlights the fact that there are more efficient alternative instruments that can be used to protect the poor than universal energy subsidies. Alternative policies, based on direct cash transfers or proxy means-tested fee waivers for public services, are more efficient to deliver benefits to low income population. Komives *et al*. (2007), using data from 26 country case studies, show that electricity subsidies are generally regressive, whereas cash transfers and near-cash transfers programs were progressive in 82 percent of cases.

Yet, the general equilibrium effects following a price subsidy reform normally go beyond the (direct and indirect) consumer price effects just listed above, so that a combined CGE-microsimulation model is the most suitable tool to assess the potential impact of the reform on household welfare.[2] Many studies have assessed the impacts of changes in oil prices using CGE models.[3] However, the literature dealing specifically with the Egyptian economy is not very abundant.[4] In Jordan, to our knowledge there are no previous studies on price subsidies reform using CGE models; some discussion on price subsidies in Jordan and the proposed reforms can be found in International Monetary Fund (2011) and Kojima (2013).

3. Country Context

Before moving to the methodology adopted in this study, it is useful to briefly describe the context of these two countries. Using the same micro data (presented below) as this study, Cockburn *et al.* (2014a) find that the most regressive subsidies in Egypt are those applied on gasoline/diesel (only 1 percent of subsidies go to the poorest quintile) and electricity (about 11 percent going to the poorest quintile), whereas those for kerosene and for LPG are the least regressive (16 and 20 percent of subsidies go to the poorest quintile, respectively). It is also noteworthy that, whereas kerosene and LPG subsidies are progressive in rural areas, their incidence is clearly regressive in urban zones, reflecting the fact that the poor consume kerosene and LPG proportionately more in rural areas. A similar picture emerges for Jordan, except that subsidies for electricity are less regressive than in Egypt (17 percent go to the poorest quintile).

In 2012 Egypt had among the largest subsidies (as rate of GDP) for diesel and gasoline in the MENA region (Sdralevich *et al.*, 2014). Egypt is in a period of profound change and political unrest since 2011. In response, the Egyptian government has implemented major policies: extended subsidies, public wage increases, tax cuts and infrastructure work. However, this spending has resulted in increased fiscal deficits and the depletion of fiscal reserves. Consumption subsidies represent a particularly heavy fiscal burden, recently reaching 10 percent of GDP (Ministry of Finance, 2012). Petroleum subsidies increased by 26 percent to reach EGP 120 billion (or 6.2 percent of GDP) in 2012. This contributed to an increase in the overall budget deficit-to-GDP ratio to 13.8 percent in financial year 2013 (FY13) (Ministry of Finance, 2013). Of total subsidies to energy products in 2010, 53 percent are for petroleum products, followed by 32 percent for electricity and 15 percent for natural gas. In 2013, the government established and began to implement a plan to progressively rationalize these subsidies. At the same time, spending on health and education, as a share of GDP, has been relatively constant over the last few years at around 1.4 percent and 4 percent,

[2]A nice discussion on alternative methodologies to study the effects of price subsidies reforms is provided in Coady (2006).

[3]See Clements *et al.* (2003); Energy Sector Management Assistance Program (ESMAP) (2004); PROVIDE (2005); Essama-Nssah *et al.* (2007); Kancs, A. (2007); Twimukye and Matovu (2009); Abouleinein *et al.* (2010); Chitiga *et al.* (2010); Naranapanama and Bandara (2012).

[4]Two examples are Lofgren (1995), and Aboulenein *et al.* (2009).

respectively. Public investment was negatively affected by the popular uprising, falling to 1.9 percent of GDP in FY12, down from 3.2 percent in FY10 and 2.4 percent in FY11. In contrast, spending on subsidies rose from 7.8 percent in FY10 to 8.8 percent in FY12, driven primarily by an increase in both food and energy subsidies.

In Jordan, where subsidies represented roughly 6 percent of GDP in 2011 (Sdralevich *et al.*, 2014), the government has started to reduce or eliminate subsidies on water, cooking fuel, food and electricity since 2008. Electricity subsidies in 2011 were among the highest in the MENA region. In 2012, the government eliminated subsidies on petroleum products—namely, gasoline (Octane-90), diesel and kerosene—except LPG gas cylinders, which are mainly used for cooking. The elimination of these petroleum subsidies resulted in a 14 to 33 percent increase in petroleum prices. On the other hand, in 2011, the government provided sales tax exemptions on products and services, which account for a large share in the household's consumption basket or those that were deemed as vital production inputs.

4. Methodology and Data

For both countries we use a combined computable general equilibrium (CGE)-microsimulation model to analyze the impacts of price subsidy reforms on poverty and inequality terms under various policy scenarios.[5] The model is designed to capture the strong economy-wide impacts of these major reforms and their many direct and indirect impacts on household income and consumption. These results are then used to study how poverty and inequality evolve in the short and medium terms. Here we provide a brief description of the macro and micro models[6].

4.1. *Macro*

The macroeconomic simulations make use of a recursive dynamic[7] computable general equilibrium model, based on the PEP 1-t standard model[8], adapted to each country's economy and to the issues to be tackled. The model below is for

[5]As shown in Cockburn *et al.* (2014a), within the limits of comparability, an analysis that only takes into account the partial equilibrium direct and indirect changes of consumer prices gives broadly consistent poverty effects of consumer price changes with respect to a CGE-microsimulation model. However, the latter captures general equilibrium and efficiency effects that provide a more accurate estimate of true impacts.

[6]Full details of the two models are provided in Cockburn *et al.* (2014b) (sections 8 and 9).

[7]In a recursive dynamic model, agents are myopic and make consumption and production decisions for the current period based on current prices. In contrast, in an intertemporal model, agents perfectly foresee all prices for all future periods and make consumption and production decisions for all periods at the same time. Given low savings rates and limited access to credit in both countries, agents have very few opportunities to smooth their consumption/production over time, thus using an intertemporal model does not seem appropriate. Another possibility would have been to have heterogeneous agents in our model (i.e. both myopic and forward-looking) based on their capacity to save and to access credit. However, as only a small share of agents could be classified as forward-looking in these countries, we expect that the differences with respect to the approach adopted in this study would be marginal.

[8]www.pep-net.org/pep-standard-cge-models

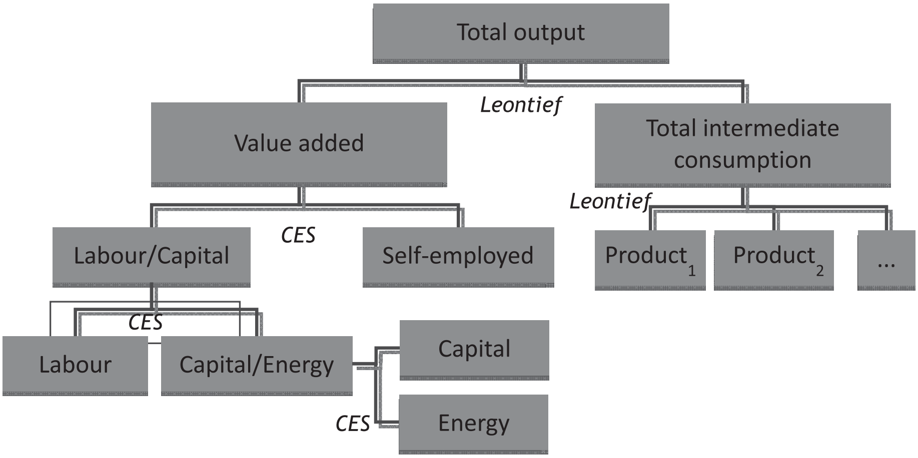

Figure 1. Structure of Production in the Non-Energy Sectors
Source: Authors' elaboration.

Egypt[9] and, for sake of space, we focus primarily on the non-standard aspects of the model.

Firms are assumed to operate in a perfectly competitive environment. Each industry's representative firm maximizes profits subject to its production technology and considers the prices of goods, services and factors as given (price-taking behavior). Industries are distinguished between energy sectors and others, as their production processes are assumed to be different. In the case of the *energy sectors*, which are all highly capital intensive, we use a Leontief production function where total production is directly determined by the stock of capital (proportional relationship) and there are no substitution possibilities between inputs. Over time, the production of the energy sector grows according to capital investments made in these specific sectors, where investment in each sector depends mainly on its profitability relative to the other sectors.

Production is modeled differently for the *non-energy sectors*. Energy consumption is assumed to be related to the amount and type of equipment used. Energy sources are assumed to be imperfect substitutes to capital, and productive activities can use less energy per unit of output if they invest in less energy-intensive technologies. The relative price of energy to capital is thus crucial in determining the incentive to use energy-intensive equipment. The imperfect substitution possibilities between different inputs are characterized by a CES (Constant elasticity of substitution), as depicted in Figure 1.[10] The producer chooses the combination of inputs that minimizes total costs, subject to the price of each input and substitution possibilities.

[9]Although the model for Jordan differs from that of Egypt, the overall structure is similar.

[10]CES elasticities—Egypt (they are in line with Hertel *et al.* (2008): value added (VA) = 1.5; Labour/Capital = 0.8; Capital/Energy = 0.8; Trade = 2 (for this last only, see Maskus and Konan, 1997). CES elasticities—Jordan (from Hertel *et al.*, 2008): valued added = 0.2(agriculture); 1.2 (manufacturing); 1.4(services); 0.1(electricity); Labour categories = 2 x VA elasticities; Imports = 5 (agriculture); 3(manufacturing); 2(services).

In some sectors, value added includes wages, capital income and mixed income. The latter is assumed to reflect the presence in these sectors of self-employed, whose income is a mix of wages and profits. Self-employed labor is thus considered to be a substitute to composite capital and salaried workers. Again, a CES represents the imperfect substitution between the two inputs and, cost minimization subject to the price of each input yields relative demand.

On the supply side, most energy sectors produce only one output, i.e. crude oil, natural gas or electricity. Refineries, however, produce different types of fuels: gasoline, kerosene, LPG, gas oil (diesel), and fuel oil. A barrel of crude oil can only yield a certain quantity of each type of fuel and thus it is assumed that the production of each fuel by the refineries is a fixed proportion of total output. As we mentioned before, total local supply is fixed and determined by installed capacity. Hence, at the regulated price, if local demand exceeds local supply, the difference will be imported (at world prices) and sold on the market at the regulated price. Conversely, if local supply exceeds local demand, the difference will be exported (at world prices). As prices are assumed to be fixed, even on the domestic market, subsidies are thus implicit and are determined such that the price received by the producer (inclusive of the subsidy) covers the costs of production (and/or imports).

Modeling of the supply side for non-energy commodities is standard. Each sector can sell either on the domestic market or export at world prices. Commodities sold on each market are assumed to be heterogeneous and the quantity sold on each market depends on prices and on the ease for producers to switch from one destination to the other. The representative producer is assumed to follow a CET (constant elasticity of transformation) function in allocating sales between the domestic market and exports, which is consistent with the hypothesis that producers react to prices they receive on each market. Prices are determined by the equilibrium between supply and demand, with world prices assumed fixed.

The demand side is modelled symmetrically. Commodities are assumed to be heterogeneous according to their origin—imported or local—i.e. the quantity purchased on each market depends on prices and on the degree of substitutability for consumers between the commodities. On the domestic market, prices adjust in order to clear markets and world prices are assumed to be exogenous.

Most of the time, CGE modelers assume that there is no, or fixed, unemployment and that the wage rate adjusts to clear the labor market. In the case of the two countries included in this study, though, this hypothesis might not be suitable as variations in unemployment are a major concern (e.g. Egypt experienced a sharp increase between 2010 and 2012 from 9.8 to 13, Cockburn *et al.*, 2014a). Modeling assumptions in both countries are based on direct discussions with government experts in each country to reflect their respective specificities. In both countries, we explicitly model unemployment using a wage curve; i.e. unemployment is negatively related to the real wage rate.[11] The breakdown of labor

[11]For Egypt we used a wage elasticity of −0.099 and −0.05 for wage workers and self-employed respectively. The first value was borrowed from Baltagi *et al.* (2012), while for the self-employed it is expected that they are less responsive than wage workers so we simply assumed that the wage elasticity is half that of wage workers. For Jordan we used a wage elasticity of −0.099 for both skilled and unskilled workers (again from Baltagi *et al.*, 2012).

categories – wage workers and self-employed in Egypt, skilled and unskilled in Jordan—is dictated by data availability. In Egypt, we assume that workers are mobile in that all unemployed wage workers migrate to self-employment, as is observed (the discussion provided in Asaad and Krafft (2016), is in line with our assumptions about labor market mobility).[12] As mobility between skilled and unskilled labor categories requires education and training, we assume that there is no movement of workers between categories in Jordan. Thus our assumptions best reflect medium-term impacts.

The rest of household behavior is standard. Their income is composed of wages, part of capital income and transfers from other agents. They pay indirect taxes and save a fixed share of their disposable income. What is left determines their consumption budget which is allocated between the different commodities based on utility maximization (Cobb-Douglas).

Finally, both public current and investment spending-to-GDP ratios are assumed constant and public transfers per capita are constant. The overall deficit is thus endogenous and any reduction in the amount of subsidy will translate into a smaller deficit, which was identified as one of the main motivations for reducing fuel subsidy. Reducing the public deficit decreases the crowding out of private investment and thus allows for greater capital accumulation.

All markets for goods and services clear: supply equals demand. Likewise, total investment equals the sum of agents' savings. Most of the model closure decisions are intended to help isolate the specific impacts of our policy shocks without introducing confounding factors. The current account balance is exogenous (no free lunch), as are inventory changes, public expenditures and public investment. Dynamics are introduced through growth in the supply of production factors. Labor supply, like most exogenous variables, grows at an exogenous rate. Capital stock is equal to its level in the preceding period, less depreciation, plus new investment. The allocation of new private capital between categories and industries follows a modified version of the Jung-Thorbecke (2001) investment demand specification and varies according to the ratio of the rental rate to the user cost of that capital.[13]

4.2. *Micro*

The distributive and welfare effects of the price subsidies' reform, as well as of social protection schemes, are estimated using a microsimulation model, which is combined with results from the CGE model through a top-down sequential approach.[14] The microsimulation component makes it possible to identify which individuals are most likely to be affected by macroeconomic changes. This is particularly relevant as the main focus of the proposed social protection scheme is a

[12]In addition, such a hypothesis seems particularly appropriate especially in cases like Egypt where capital intensity is quite low, while in Jordan we observe significant unemployment among both skilled and unskilled workers (22.73 and 16.65 percent, respectively).

[13]A complete description of the PEP 1-t model is available at www.pep-net.org/pep-standard-cge-models

[14]See Cockburn *et al.* (2014), for a recent review on the different CGE-micro simulation approaches.

specific population group—children—and because the CGE alone cannot analyze the evolution of within-group inequality.

We follow a top-down macro-micro simulation framework where explicit microeconomic behaviors are considered. Some behavior (notably labor force participation, employment status and consumption choices) is, indeed, likely to be sensitive to macroeconomic changes. Macro results on variations in prices, employment and income from labor activities serve as the key inputs to the microeconomic analysis policy. As described below, the average variations (from benchmarks) in the micro data must be equal to those estimated by the CGE model. Also, the micro data are mapped in a way that consumption and labor categories, as well as the labor market functioning, are the same as in the CGE model (as described in the previous section). For example, for Egypt the micro model also distinguishes between wage and self-employed workers, remunerated by wages and profits respectively; for Jordan, the micro model distinguishes skilled and unskilled workers, where incomes (which are not distinguished between wages and profits) vary according to workers' skills. Consequently, the income factors affecting household welfare necessarily differ between the two countries.

The microsimulations are composed of two main modules: income generation and real consumption. We start with the income generation module, aiming first to identify those individuals who, according to their predicted probabilities, are most likely to migrate between different occupational choices in response to the macro shocks, and then to estimate the new vectors of wages and income for all workers.

For both the labor supply model and the wage and profit estimations, we estimate reduced-form models to recover the relevant stochastic terms, which are then used to run the simulations. The stochastic terms, which are simulated according to observed occupational choices, are estimated by following the methodologies proposed in Bourguignon *et al*. (2001) for the multinomial logit labor supply model (for Egypt), and Gourieroux *et al*. (1987) for the probit labor supply model (for Jordan). The probabilities of being employed (which include the simulated stochastic terms in accordance with Train(2003), predicted from the multinomial (for Egypt) and probit (for Jordan) models, are used to identify the movement of workers from one sector to another in accordance with the CGE results. In particular, a job-queuing procedure is adopted to calibrate the micro data to the macro results (i.e. in the case of an increase/decrease in the labor demand in a given sector, the unemployed/employed with the highest/lowest probabilities in that sector is employed/fired until the changes in the micro data exactly replicate the variation estimated by the macro data). In the wage and profit models (estimated through standard Mincer and Cobb-Douglas functions, respectively), the residual term is drawn randomly from a normal distribution with their respective observed variance. In Jordan, in accordance with the macro data and mode, occupational and income models are run separately for skilled and unskilled workers. Micro wages and profits are adjusted so that they are fully consistent with the macro variations.

At the end of this income-generation module, we obtain the new total household income vector for each year of simulation. The relative change in household income, with respect to the base year, is applied to initial household consumption.

By doing so, the results are not affected by potential discrepancies usually observed between incomes and consumption (with the first normally underestimated); also we implicitly make the assumption that the marginal propensity to save is constant over time. After some necessary adjustments (household composition, and spatial and temporal differences in prices), we use real, per adult equivalent household consumption for poverty and distributive analysis. The household-specific price deflator is derived from a Cobb-Douglas utility function, with the implicit assumption that households do not adjust their relative consumption with respect to price and income changes.[15] We abstract from all issues of intra-household allocation, which, while justified, go beyond the scope of this study. Instead, we assume that an adult equivalent member is poor if s/he lives in a household that is poor (i.e. below the country official per person annual poverty line—3076 LE in Egypt,[16] 813.7 JOD in Jordan). In this study we focus only on the monetary dimension of poverty.

According to the methodological framework we follow, fuel price subsidy reform is expected to affect individual welfare through changes in the employment, wages and consumer prices that their households face. The final impact depends on the relative size and direction of these changes, but also on household initial income, factor endowments and consumption preferences.

The microsimulation module also serves to model the different compensatory social protection schemes proposed below.

4.3. *Data*

The CGE model in Egypt is built on a SAM that was constructed for 2009/2010,[17] based on national accounts (NA; Ministry of Planning, 2010) and on 2008/2009 Supply and Use Tables (SUT; Central Agency for Public Mobilization and Statistics (CAPMAS)). Additional data on the sources of government income and its expenditures were used to complete the SAM. Economic projections from IMF, released in April 2013, serve to describe the evolution of the economy over time.

In addition, given that the purpose of this analysis is to assess the impact of reducing subsidies on specific energy commodities, we could not treat subsidized fuels as one homogenous commodity. Therefore, the refined petroleum commodity in the SAM must be disaggregated into the various types of fuels distinguished in the

[15]Ideally, we would have estimated a complete demand system to allow households to adjust their consumption following a price variation. However, with a regulated price system, prices do not vary enough so that a complete system cannot be estimated. In any case, demand of fuel products is generally found to be price inelastic, at least in the short run. Hughes *et al*. (2006), for example, find a price elasticity for gasoline demand ranging between −0.034 and −0.077, while Bernstein and Griffin (2006) find that for residential electricity it is −0.24. For Egypt, Abdel-Khalek (1988) finds that the price elasticity of demand for an aggregate energy product is −0.151 in the short run and −0.517 in the long-run.

[16]Egypt has three definitions of poverty lines, estimated at the regional level. Their average (national) level is roughly equivalent to 2061 LE (food poverty line), 3076 (lower poverty line) and 4003 LE (upper poverty line). In the analysis below we use the lower poverty line, as recommended by local experts.

[17]The year 2009/2010 was chosen following discussions with MoF, who suggested that this would be representative of a "standard" period, i.e. not influenced by the worldwide crisis or revolution.

subsidy reform, i.e. LPG, kerosene, gasoline, gas oil, and fuel oil and other products. To do so, we used data on production and consumption from CAPMAS, data on subsidy per fuel from MoF, data from IEA and a SAM for 2006/2007 (Abouleinein *et al.*, 2009).

The Jordanian CGE model uses a newly constructed 2006 SAM of Jordan as its benchmark data. This SAM represents the actual structure of the economy for the year 2006 and takes into account fiscal instruments such as subsidies on products and activities. To understand the economy-wide effects of energy price reforms, the SAM disaggregates output and subsidies in the petroleum refining sector into five commodities (namely, LPG, Gasoline, Kerosene, Diesel, and Other petroleum). The Jordanian SAM also distinguishes labor by skill level (skilled, unskilled). The 2006 SAM was updated to 2012 using available data on economic growth and population changes. This updated SAM serves as the base year for the analysis in Jordan.

The dataset used for the micro analysis in Egypt is the nationally representative 2010/11 Household Income, Expenditure and Consumption Survey (HIECS), which includes around 15500 households and 68000 individuals. For Jordan, the 2010 national Household Expenditure and Income Survey (HEIS) is used. This survey includes around 11200 households and 73800 individuals. All surveys also provide sampling weights, which are used to extrapolate to national totals[18].

5. Simulation Scenarios

The model presented above is used to simulate various scenarios in order to better understand the short- and medium-term impacts of fuel subsidy reform and various possible designs of a child cash transfer program as an accompanying measure. For Egypt, simulations are run from 2009/10 to 2017/18; for Jordan, from 2013 to 2020.

5.1. *Reference Scenario*

The reference scenario depicts the evolution of each country's economy without any changes in energy policy. In Egypt, total energy subsidies are predetermined (by government projections) for the 2009/10 to 2012/13 period and are thereafter assumed to maintain a fixed ratio to GDP. The distribution of subsidies between types of fuel is assumed to be the same as 2009/2010 throughout. Predictions from the IMF[19] were used to estimate the average annual real GDP growth rate for the simulation period. It is important to note that GDP forecasts from the IMF vary from one year to the other, as they take into account, among other things, political and economic aspects that are not fully accounted for in a CGE model. Labor supply is assumed to grow at the same rate as CAPMAS estimates

[18]For Egypt, according to internal rules, CAPMAS only provides the public with a representative 25 percent random selection of the full sample. These results should thus be interpreted with some caution.

[19]Downloaded from http://www.imf.org/external/pubs/ft/weo/2012/02/weodata/index.aspx in October 2012 (5.14 percent for 2010; 1.78 percent for 2011; 1.96 percent for 2012; 3.03 percent for 2013; 4.51 percent for 2014; 6.00 percent for 2015; 6.49 percent for 2016 and 6.51 percent for 2017).

for Egypt's total population.[20] We further assumed that current and investment public spending would grow at the same rate as GDP.

For Jordan, the reference scenario is based on the IMF's economic projections for Jordan's GDP growth rate from 2013 to 2020. Labor supply is assumed to grow at the same rate as UN Population Fund estimates for Jordan's total population. We further assume that current and investment public spending would grow at the same rate as GDP. Consistent with current government policy, fuel derivatives subsidies are removed in 2013 and accompanied with the mitigating measures already in place (Jordan established a means-tested cash transfer program in 1986). This reference scenario thus includes the current fuel subsidy reform.

5.2. *Policy scenarios*

Egypt

In all simulations, energy subsidies are gradually reduced following a reform plan suggested by the MoF. Simulations start from 2012–2013. At the end of the reform, fuel subsidies are almost entirely eliminated (the full details of the simulated reform are provided in Cockburn *et al.*, 2014a, Table 13). The plan put forth indicates very specific savings in terms of subsidy costs, which we introduce into the model, allowing prices and quantities to adjust accordingly.

Furthermore, some policies would require a more disaggregate model. For example, although the subsidy reforms distinguish gasoline by octane levels, our data do not allow us to make this distinction in our model. In these cases, the subsidy cut is simulated at the aggregate level for all types of gasoline. In contrast, some policies are not specific. For example, it is assumed that what government identifies as "non-identified reforms" would further reduce energy subsidies. In this case, we assume that this would be achieved through a proportional reduction in subsidies for all fuels. Finally, it is not possible to reduce subsidies on fuels that were not initially subsidized in our database. The plan that is implemented in the model hence does not take into account reforms affecting "other petroleum products".

As suggested in the reform, the price paid by the electricity sector for fuel oil and natural gas increases over time, thus increasing production costs for that sector. If electricity prices are maintained at their current levels, then the government would need to subsidize this sector by the exact same amount that is proposed as fuel subsidy savings, or the electricity companies would make less profits, which would in turn translate into reduced income for the government. In other words, maintaining current electricity prices would simply cancel out the savings suggested by the government. Hence, the only way the government can indeed save the proposed amount is by letting the price of electricity increase, which is what is done in the macro model.

[20]Specifically, we applied the following annual population growth rates: 2.09 for 2009, 1.81 percent for 2010, 1.75 percent for 2011, 1.71 percent for 2012, 1.67 percent for 2013, 1.63 percent for 2014, 1.58 percent for 2015, 1.54 percent for 2016 and 1.54 percent for 2017. Also note that, in the microsimulation model (for the two countries), this is done by following a common "static ageing" technique, as proposed by Deville and Särndal (1992).

We present here two of the four policy scenarios originally agreed with the staff of the Ministry of Finance and UNICEF Egypt (the other two consist of targeted or universal cash transfers with a low budget). In the first (SIM1), the government only implements the above subsidy reform, without any compensation scheme. In the second (SIM2), a compensatory measure is introduced in order to mitigate the potentially negative impacts of the fuel subsidy reform on poorer households with children. Hence, part of the subsidy savings is used to introduce a child-focused cash transfer. Specifically, 10 percent of the total fiscal savings is invested in a proxy-means targeted cash transfers for poor children. Twenty percent of the resulting total budget is deducted to cover implementation costs.[21] In all simulations, fiscal savings from the subsidy reform, net of transfers when applicable, are entirely used to reduce the fiscal deficit.

Jordan

In the first policy scenario (SIM1), electricity prices increase over a period of four years beginning in 2014, without additional compensatory measures. The price increase is specific to the type of product. As suggested by the Ministry of Social Development and UNICEF Jordan, we simulate no increase in the price of electricity consumed by households[22] and the food sector, a 5 percent increase for the "other services" sector, a 7.5 percent increase for the mining and crude gas sectors, and 15 percent for all remaining sectors.

In the second scenario (SIM2), we replicate SIM1 coupled with universal child cash transfers designed to mitigate the impact of subsidies removal, providing pro-child and more efficient social protection. The budget allocated to cash transfers corresponds to 10 percent of the savings from subsidy reform.

6. Results

6.1. *Macroeconomic Impacts*

Results from a CGE model should not be interpreted as forecasts. They compare a reference (BaU) scenario to some other path in which most exogenous variables are maintained at their BaU values in order to isolate and better understand the transmission channels between the shocks of interest and key dimensions of the economy. In our case, only fuel subsidies and/or transfers to households are "shocked" and the key transmission channels on growth and poverty are through changes in household income (factor markets) and consumer prices.

Egypt

In the reference case (BaU), the cost of subsidies on energy (SUB_ENE) increases steadily and reaches about 8 percent of nominal GDP in 2012/13, as observed in reality (Figure 2). This level is assumed to remain constant subsequently. This creates pressure on the government's budget such that the current

[21]See Grosh *et al.* (2008) for the implementing costs of targeted and universal cash transfers.

[22]The planned increase in electricity prices will only affect households whose electricity consumption is greater than 600 watts.

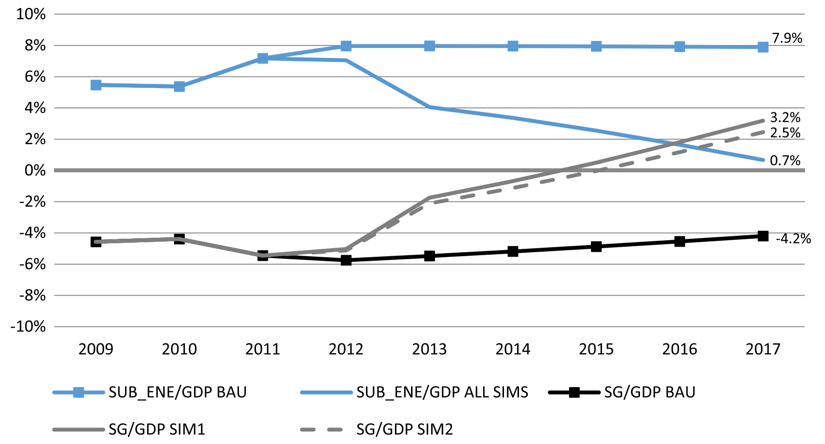

Figure 2. Energy Subsidies and Government Deficit as % of GDP in Egypt
Source: Authors' computations. [Colour figure can be viewed at wileyonlinelibrary.com]

deficit[23]—the negative of government savings (SG)—exceeds 4 percent of GDP throughout the period.

The proposed subsidy reforms markedly reduce the budget allocated to energy subsidies (SUB_ENE/GDP ALL SIMS), thus relaxing fiscal pressure and allowing the deficit to GDP ratio (SG/GDP) to fall significantly, since government savings are endogenous, and even leading to projected fiscal surpluses by 2014–15.

In each period, savings of all agents are pooled and used to finance total investment.[24] Public investment is maintained fixed at BaU levels throughout the period of simulation. Hence, everything else being equal, smaller deficits (i.e. government dissavings) translate into greater funds available for private investment and thus real investment is far above what it would have been in the reference. Greater investment translates into higher GDP growth rates, and thus in 2017 real GDP would be 2.35 percent higher without the fuel subsidy than what it would have been under the reference scenario. This increase is not significantly diminished (2.11 percent in 2017) if the government redirects some of these savings to finance cash transfers (SIM2). In other words, the better economic performance resulting from gradually eliminating the fuel subsidy would still prevail, even if the government decides to compensate poorer households. These results do not appear surprising from an economic viewpoint as a distortionary measure is eliminated and, in the second scenario, replaced by a less distortionary measure.

As can be anticipated, gradually reducing energy subsidies leads to an increase in fuel prices paid by households, by 50 percent on average by the end of the simulation period, in comparison with the case where the reforms would not have taken place (i.e. BaU scenario). LPG and gasoline prices rise most, whereas

[23]The current deficit is the difference between current expenditures and government revenues.
[24]In other words, investment is savings-driven.

natural gas prices are only minimally affected. As the subsidy reform implemented in both scenarios is the same, the impacts on fuel prices are similar, regardless of the simulation scenario (SIM1-2).

As energy is used in the production of other commodities, it is not surprising to see prices for non-energy commodities rise by roughly 5 percent by the end of the simulation period. Food prices are affected slightly more than non-food manufacturing goods and services. The consumer price index, which factors in the increase in both energy (5 percent of total consumption) and non-energy prices, is 8 percent higher in 2017/18 compared to what it would have been under the BaU scenario. In response to rising prices, demand for fuel products decreases over time. Indeed, producers switch away from energy-intensive equipment and households switch away from energy-intensive commodities to more affordable ones. Overall, thus, total demand for energy falls. LPG and gasoline demand fall most, as their prices increased the most, while demand for natural gas falls least.

Decreased activity in the energy-intensive sectors translates into smaller demand for production factors (labor and capital), but this reduction is more than compensated by the expansion in other sectors of the economy (induced by the reallocation of consumption and increased investment and growth). Thus, wage and profit rates—and thus household income—increase. Given the assumed mobility of workers between wage and self-employed work, unemployment levels are not affected significantly.

Jordan

The low fixed prices for electricity under the subsidy regime result in losses for the national electric company—NEPCO—which are covered through transfers from the government. In the reference case (BAU), these transfers rise slightly from their base of 4 percent of nominal GDP in 2010. This level is assumed to remain constant subsequently. Simulations of the gradual reduction of these subsidies beginning in 2013, with (SIM2) or without (SIM1) a cash transfer, show that this would markedly—and identically—reduce these transfers.

As in the case of Egypt, where modeling assumptions are similar, the reduction in government transfers to NEPCO relaxes fiscal pressure and reduces the current public deficit to GDP ratio significantly (Figure 3). Whereas it was projected to rise to nearly 9 percent by 2020 in the base scenario, the elimination of electricity subsidies beginning in 2013 stabilizes it between 6 and 7 percent. The introduction of universal cash transfers (Sim2) only marginally reduces these savings. Note that the small reduction in the government deficit in 2013 is due to the elimination of fuel derivatives subsidies, which is included in all three scenarios.

As we observed in Egypt, smaller deficits translate into greater funds available for investment and thus increased growth rates. However, as shown in Figure 3, the deficit-to-GDP ratio falls less in Jordan (from −8.8 percent to −6.1 percent, i.e. an improvement of slightly less than 3 percentage points, compared to Egypt, where it goes from −4.2 percent to 3.2 percent, an improvement of more than 7 percentage points). It thus takes several years for the effects of the cumulative savings and investments to outweigh those of the price increase resulting

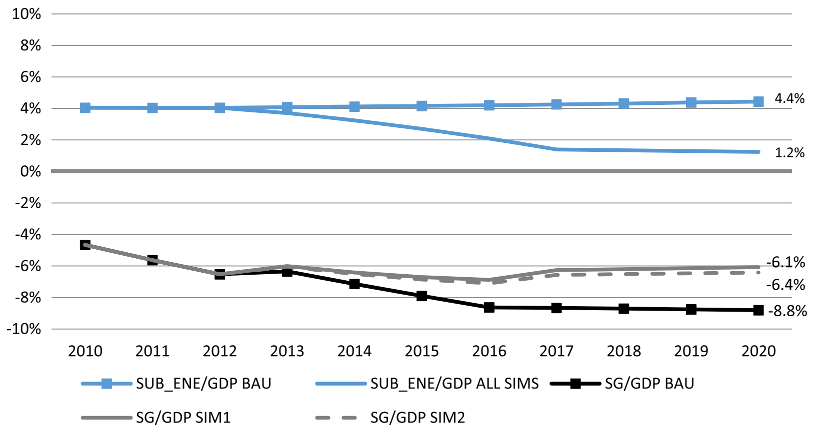

Figure 3. Energy Subsidies and Government Deficit as % of GDP in Jordan
Source: Authors' computations. [Colour figure can be viewed at wileyonlinelibrary.com]

from subsidy cuts. Real GDP growth rates initially fall (by no more than 0.2 percent) as a result of these cuts, but begin increasing from 2017 on, and real GDP in 2020 exceeds its BaU level by 0.4 percent. As in Egypt, this increase is not significantly diminished (0.3 percent in 2020) if the government redirects some of these savings to finance cash transfers (SIM2).

Only the wealthiest households are affected directly by subsidy cuts (see footnote 22). Thus, impacts on the labor market and households stem primarily from the fact that the cuts in electricity subsidies apply overwhelmingly to producers, who consume electricity as an input. Subsidy cuts result in substantial increases in input costs, particularly for the service and manufacturing sectors, as these sectors use electricity more intensively than agricultural sectors.

As a result, demand for labor falls, leading to increases in unemployment and a fall in real wages. Skilled workers are hit more through unemployment (up 1.2 vs. 0.9 percent by 2017), whereas unskilled workers are more affected through wage rates (−1.5 vs. −1.4 percent by 2020). The addition of a mitigating cash transfer mechanism (Sim2) slightly exacerbates these effects.

Thus, while households do not suffer directly from increased electricity prices, they suffer rising unemployment and falling wage rates. The resulting income losses translate into depressed household real consumption (which, by 2017, falls 1.6 and 1.4 percent, respectively, under Sim1 and Sim2).

While the increase in electricity prices directly raises intermediate input costs, falling demand more than offsets this effect so that most price indices fall in comparison with the case where the reforms would not have taken place (i.e. BaU scenario). The exception is the price index for services, which we recall is the sector that experiences the biggest increase in input costs. The overall CPI falls by just under a half a percent relative to the BAU (Figure 4). It is important to note that services, for which prices increase, represent over 40 percent of household consumption.

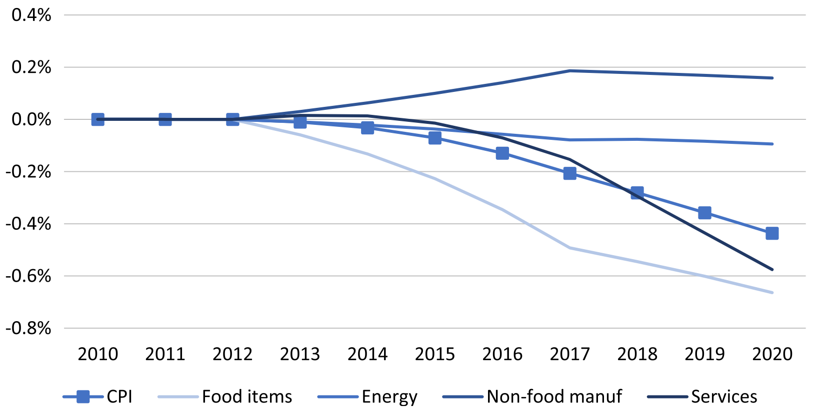

Figure 4. Price Effects (% Change from BAU) in Jordan
Source: Authors' computations. [Colour figure can be viewed at wileyonlinelibrary.com]

6.2. *Impacts on Poverty and Inequality*

We now turn our attention to the impacts of these prices and employment changes on poverty and inequality.

Egypt

Overall, we observe a substantial decline in poverty in the reference scenario (BaU), without fuel subsidy reform, based on IMF forecasts of economic recovery (used for the simulations). The share of the individuals living below the poverty line (headcount) falls from 24.4 percent in 2010/11 to 15.5 percent in 2017/18, a decline of around a third. This decrease (by 9.7 percentage points) is primarily driven by the wage sector (−6.8 points), followed by the improvement in self-employment income (−3.1 points). The increase in consumer prices only marginally offsets this improvement (+0.2 points).[25] As shown in Figure 5, without any compensating measures, the incidence of poverty is never statistically different from the baseline, whereas it decreases 21 percent when a protection system is put in place.[26]

Poverty impacts differ markedly between the simulation scenarios. As said earlier, energy subsidy reductions alone (Sim1)—without any compensatory cash transfers—lead to no significant variations in poverty throughout the simulation period. However, interesting contrasting effects take place. The increasing effect of consumer prices (around +3.2 percentage points) is offset by the increase in wages and profits, which contribute to reducing poverty by about 1.4 and 2.1 points respectively (Table 1). Such results confirm the importance of including general equilibrium effects in the analysis.

[25]This decomposition is not shown here for lack of space.

[26]When estimated just on children, results are a bit different. Under sim1, the incidence of child poverty lies above the baseline over most of the period, and under sim2—mostly due to the higher impact of the child cash transfer and the larger change in the consumer price—the reduction in child poverty, with respect to the reference scenario, is bigger than for the whole population.

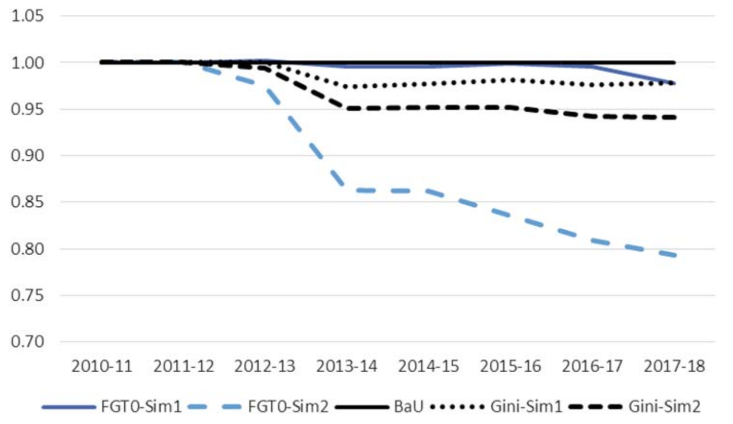

Figure 5. Change in National Poverty Headcount (FGT0) and Gini (BAU=1) in Egypt [Colour figure can be viewed at wileyonlinelibrary.com]

Source: Authors' elaboration.

Notes: With respect to BaU, differences with FGT0-Sim1 are never statistically different; with FGT0-Sim2 are always statistically different starting from 2012–13 (when policy scenarios start); with Gini-Sim1 are statistically significant starting from 2013–14; with Gini-Sim2 are always statistically different starting from 2012–13 (when policy scenarios start).

However, when as little as 10 percent of the savings on fuel subsidies are channeled into cash transfers (Sim2), poverty falls significantly with respect to the reference scenario without reforms.[27] The decomposition of these changes in poverty is broadly comparable under the two simulation scenarios, except that the cash transfer contributes an additional 3 percentage point reduction in total poverty in Sim2. This illustrates the possibility to combine government objectives to cut energy subsidies and the fiscal deficit, stimulate investment and growth, while combating poverty. It also underscores the inefficiency of fuel subsidies, compared to cash grants, as a tool to combat poverty. Results are robust (in the sense of stochastic dominance) to a wide range of poverty lines (ranging from the food poverty line to the upper thresholds).

The subsidy cuts, both alone and with the cash transfer, significantly reduce inequality, although the impact is greater with the cash transfer (by up to 6 percent at the end of the period).

In Figure 6—which reports a selection of the most meaningful years—we analyze the real consumption effects of the various simulations over the whole distribution by using growth incidence curves (defined over the whole population). These curves plot the absolute variation of the logarithm of mean real consumption relative to the BaU in each percentile of the distribution (this closely approximates the percentage change). The horizontal line, set at "zero," represents our benchmark (i.e. the BaU) against which the curves associated to Sim1 and Sim2 are compared. The impacts of the fuel subsidy cuts alone (Sim1) show a relatively larger negative impact on richer percentiles (starting by around the 80th) from the second year of the reform. This is in line with the reduction in inequality

[27]Simulations, not shown here, indicate that—with the same overall budget—targeted cash transfers reduce poverty more than a universal program.

TABLE 1

Decomposition of Change in the Incidence of Poverty in 2017–2018 in Egypt for the Different Simulation Scenarios (*Versus* the Baseline), by Factors (Percentage Points Difference)

Factors	Sim1	Sim2
Wages	−1.38	−1.32
Profits	−2.11	−1.93
cash transfer	0.00	−2.95
consumer prices	3.17	3.18
total change	−0.32	−3.01

Source: Authors' estimation.

Notes: The Shapley/Shorrocks decomposition has been performed with the STATA routine adecomp (Azevedo *et al*., 2012). Note that the factors "wages" and "profits" include the combined effect on income and employment in the wage and self-employment sectors respectively.

as discussed just above. In contrast, the lump-sum cash transfer is strongly progressive, benefiting the poorest far more (Sim2). Also, the benefits generated by the targeted transfers are progressively larger over time; this is reflected in the growing gap between the Sim1 and Sim2 curves. Starting from 2014/15, for the population up to (around) the median percentile, well-being increases relative to the reference scenario.

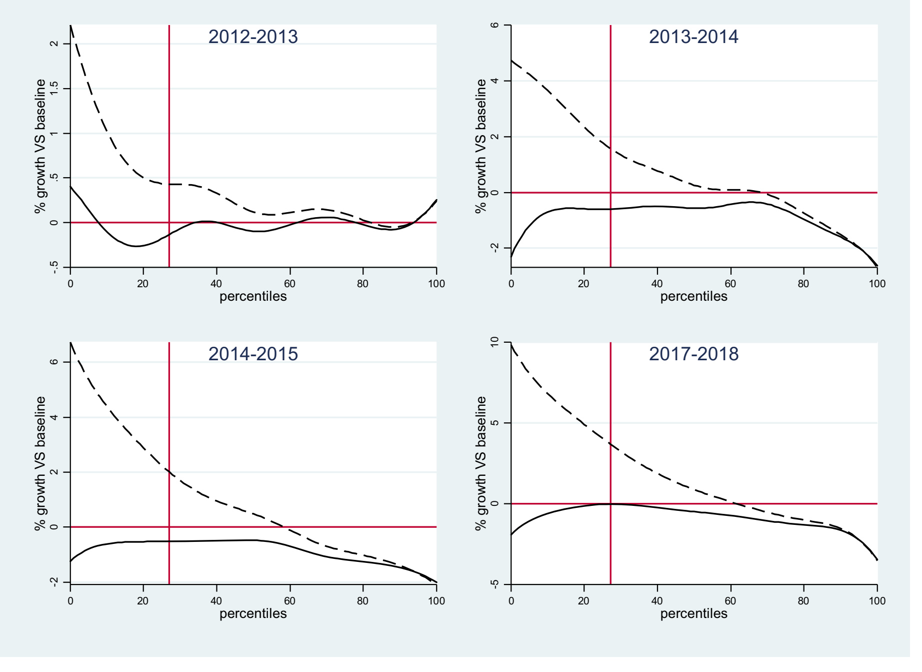

Figure 6. Incidence Growth Curves in Egypt
[Colour figure can be viewed at wileyonlinelibrary.com]

Source: Authors' estimation. Notes: the incidence growth curves are reported as the difference from the baseline scenario (horizontal line set at zero); the vertical line is set at 24.4 (which corresponds to the headcount index). The solid curve represents "Sim1" and the dashed curve represents "Sim2".

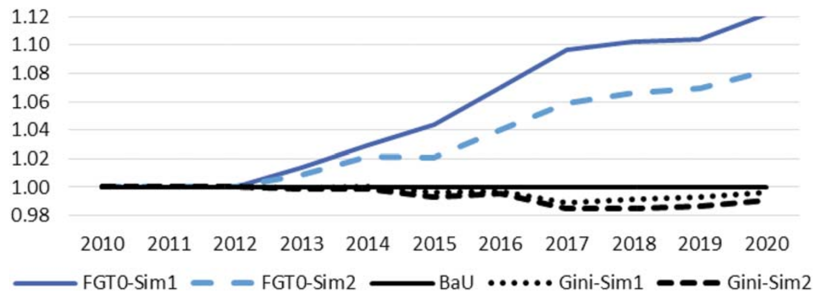

Figure 7. Change in Headcount Poverty (FGT0) and Gini (BAU=1) in Jordan Relative to BaU [Colour figure can be viewed at wileyonlinelibrary.com]

Source: Authors' estimation.

Notes: Differences with respect to the baseline scenario (BaU) are statistically significant starting from 2012–13 (when policy scenarios start) except for the Gini index under Sim1 in 2013–15 and 2020.

Jordan

In the reference scenario (BaU), where this is no electricity subsidy reform, we observe a substantial decline in poverty. The share of the population living below the poverty line (headcount index) falls from 15.3 percent in 2010 to 12.7 percent in 2020, a decline of just under a sixth. As in Egypt, poverty impacts differ markedly in the simulation scenarios. The elimination of electricity subsidies (Sim1)—without any compensatory cash transfers—leads to an increase in the incidence of poverty relative to the BaU over the entire simulation period, rising to nearly two percentage points by 2020 (or 10 percent—see Figure 7). When 10 percent of the savings on electricity subsidies are channeled into universal cash transfers (Sim2), the increases in the headcount index, relative to BaU, are cut by roughly one third. This suggests that a larger share of the savings—roughly 30 percent—would be required to fully offset the impact of the cut in electricity subsidies on poverty. Nonetheless, this would still leave the government with 70 percent of the savings, illustrating, as in the case of Egypt, the possibility to combine government objectives to cut energy subsidies and the fiscal deficit, stimulate investment and growth, while combating poverty. Results are robust over a wide range of poverty lines. Inequality changes do not differ substantially between the reference and the simulation scenarios, with the Gini index lying statistically significantly below the baseline for most of the period. Given the universal nature of the cash-transfer program proposed in Jordan, the mitigating effects on inequality are relatively small compared to Egypt, where a proxy-means tested cash transfer targets the poor.

In Table 2, we explore the sources of the increases in the poverty headcount index noted in Figure 7, focusing on the year 2017. The 1.3 percentage point increase resulting from the subsidy cut—relative to the reference (BaU) scenario—is primarily driven by an increase in the cost of living and unskilled wage reductions (among poor workers, more than 90 percent are unskilled). Inflation is largely driven by a roughly 10 percent increase in the cost of housing and water, as a result of rising electricity prices. Cash transfers reduce the negative effect on poverty by about 40 percent.

TABLE 2

Decomposition of the Change in the Incidence of Poverty in 2017 (Relative to BAU; Percentage Points Difference) in Jordan, by Source

Factors	Sim1	Sim2
Income, skilled	0.043	0.046
Income, unskilled	0.548	0.481
cash transfers	0.000	−0.532
Consumer prices	0.741	0.817
total change	1.332	0.812

Source: Authors' estimation.

Notes: The Shapley/Shorrocks decomposition has been performed with the STATA routine adecomp (Azevedo *et al*., 2012).

In Figure 8 we analyze the real consumption effects of the various simulations over the whole distribution by using growth incidence curves. We present some selected, and most significant, years. The impacts of the electricity subsidy cuts alone (Sim1; solid curve) is fairly evenly distributed. The lump-sum cash transfer (Sim 2; dashed curve) is more progressive because of the larger concentration of children among poorer households. A more targeted cash transfer would be even more progressive.

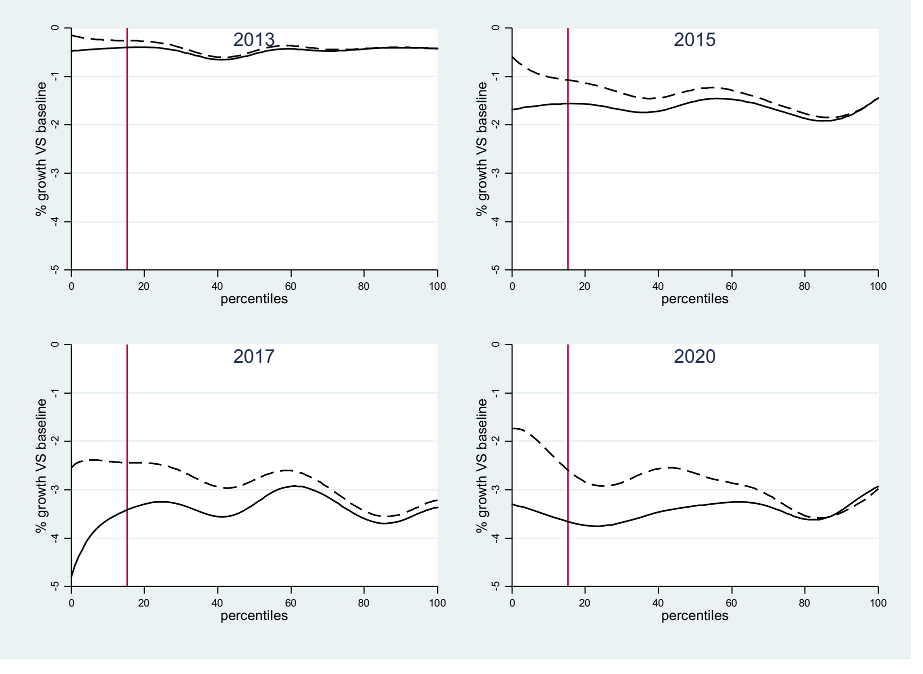

Figure 8. Incidence Growth Curves in Jordan

[Colour figure can be viewed at wileyonlinelibrary.com]

Source: Authors' estimation.

Notes: The incidence growth curves are reported as the difference from the baseline scenario; the vertical line is set at 15.3 percent, which corresponds to the headcount index in 2010; the solid curve identifies "Sim1", the dashed curve "Sim2".

7. Comparison of Impacts in Egypt and Jordan and Concluding Remarks

Most of the countries in the Middle East and North Africa region have started to reform their price subsidy systems. Food and, especially, fuel subsidies are normally found to be regressive and represent a heavy and unsustainable fiscal burden on government budgets. General equilibrium effects following a price subsidy reform can go beyond the (direct and indirect) price effects and should be carefully considered when the welfare impacts of reform are estimated. This paper presented two case studies in the region: Egypt and Jordan. Using a combined CGE-microsimulation model, the effects of price subsidies reforms on growth, poverty and inequality, as well as mitigating social protection measures, were estimated for the short and medium terms.

When comparing the results between the two countries, a note of caution is important as the nature of the energy subsidy reform scenarios in Egypt and Jordan—designed to reflect real proposed (by local policy makers) reforms in each country—differ significantly. In Egypt, the energy commodities covered by the reform are used both for household consumption and as intermediate inputs (notably in the transport and electricity sectors). In Jordan, the subsidy reforms focus on electricity, which is mostly used as an intermediate input in manufacturing and service sectors. The channels of transmission of a reduction in energy subsidies are therefore considerably different between the two countries. Furthermore, the size of the subsidy also differs: it represents close to 8 percent of GDP in Egypt, whereas it is a little above 4 percent in Jordan. Finally, the GDP growth predictions from the IMF and the labor supply growth rates are quite different for the two countries. In other words, the reference scenarios are quite different. For these reasons, we limit ourselves to a qualitative comparison of the results for both countries.

Nonetheless, some interesting similarities and differences between the two countries nonetheless emerge. In both countries, subsidy cuts generate fiscal savings, which frees up savings for increased private investment and thus improved growth. The subsidy cuts translate into price increases, which more than offset increased income from growth, such that poverty increases. Moderate reinvestment of savings from the subsidy cuts into child cash transfers is able to offset the poverty increases without sacrificing growth significantly.

However, there are also important differences. In Egypt, the reform strongly increases prices, given that the subsidy cuts are larger and they impact consumers directly: by the end of the simulation period in 2018, the price of energy products in the reform scenarios is on average 50 percent higher than in the no-reform scenario, while the consumer price index is 8.5 percent higher. In contrast, while the increase in electricity prices directly raises intermediate input costs in Jordan, falling aggregate demand more than offsets this so that most consumer price indices fall slightly (the consumer price index decreases by 0.45 percent by the end of the period with the exception of services).

Income effects also differ. In Egypt, energy subsidy cuts only partially affect input costs, as a large share concern final consumption. Thus the investment and growth impacts are greater, translating into higher wage and profit rates, and higher household nominal incomes. In Jordan, rising electricity prices translate into higher input costs, especially in the services and manufacturing sectors, which depresses labor demand, particularly for unskilled workers. This increases unemployment rates by up to one percentage point, while reducing real wage rates by over one percentage point.

In terms of the driving forces of poverty changes, there are also some important differences. In Egypt, increased factor returns following fuel subsidy reform are not enough to offset the increase in consumer prices. In Jordan, the poverty increase resulting from the subsidy cut is primarily driven both by unskilled wage reductions and an increase in the cost of living (through the rise in the cost of housing and water, which is largely affected by the increase in the price of electricity). Finally, while the impacts of the proposed child-focused protection programs are progressive in both countries, the negative impacts of fuel subsidy cuts alone are relatively larger on richer people in Egypt while they are fairly evenly distributed in Jordan.

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