Implementing Cash Transfer Programmes in Egypt Differently: An Economic Impact Analysis

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Abstract: *Using a Computable General Equilibrium model, this study simulates replacing in-kind subsidies in Egypt with targeted unconditional and conditional cash transfers as well as a universal basic income scheme financed through subsidies removal and progressive income taxes. The findings of this study show a strong complementarity between cash transfer and productive investment in health and education. Accordingly, combining targeted cash transfer with education and health conditionality is more likely to stimulate the economy and generate better outcomes in terms of welfare effect, demand for labour and production in addition to the positive human capital impact expected in the long-run. Universal basic income would not be a panacea for mitigating the adverse effect of subsidies removal on the Egyptian economy and the welfare of low and middle-income households.*

Keywords: conditional cash transfer, universal cash transfer, social accounting matrix, CGE models, Egypt

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1. Introduction

Cash transfer programmes are increasingly recognized by development scholars and policy makers in the 21st century as an alternative poverty reduction policy to in-kind subsidies. Conditional Cash Transfer (CCT) programmes, which started historically in Latin America with Mexico's *PROGRESA (Oportunidades)*, are currently expanding in all regions and have increased from 27 countries in 2008 to 64 countries in 2014 (Kurdi et al., 2018; World Bank, 2015b). Furthermore, Unconditional Cash Transfer (UCT) programs are becoming popular in African countries. Empirical evidence shows that these social assistance programs contribute to improvements in income, food security and investments in education (Kurdi et al., 2018).

At the same time, the idea of universal cash transfer, also known as Universal Basic Income (UBI) or Basic Income Guarantee (BIG), is gaining unprecedented popularity across the world, including middle-income countries. This scheme offers unconditional, untargeted and regular cash transfers to all individuals/households, independent of their income or employment status (Francese & Prady, 2018; Hanna & Olken, 2018; Van Parijs, 2013).

Proponents of UBI argue that targeting involves high administrative costs and requires extensive credible information about households which might lead to high rates of inclusion or exclusion errors[2] as well as high level of corruption. Additionally, imposing and monitoring conditionality on health and education pre-assumes the existence of a basic infrastructure of health and education that enables adequate supply of these services to meet the demand. By contrast, UBI promotes social equity and liberty while being anti-paternalistic. UBI saves administrative cost, improve

[2] Exclusion error is defined as the failure to include those who should be included in the program while Inclusion error is defined as providing assistance to those who do not need the program (Hanna & Olken, 2018; Kurdi et al., 2018).

transparency and have a potential positive impact on human capital by reducing working hours and permitting more time for trainings and skills development. It avoids the distortion of labour supply given that payments are not reduced when beneficiaries get a job. Finally, the income provided to high-income households could be recovered by alternative policies like progressive income taxation (Francese & Prady, 2018; Hanna & Olken, 2018; Ministry of Finance of the Government of India, 2017; Tabatabai, 2012; Van Parijs, 2013; World Bank, 2018).

On the other hand, opponents of UBI highlight the high financial cost of this type of cash transfer, which threatens its sustainability. Moreover, UBI might be perceived as a luxury that developing countries can not afford given that it crowds out resources that could be invested in areas of higher priority such as health and education. UBI is also expected to have a negative impact on labour supply and incentives to work (Francese & Prady, 2018; Hanna & Olken, 2018; Van Parijs, 2013).

Mongolia is one of the countries that implemented this universal scheme (2010-2012) while Iran had a similar programme for one year covering 96 percent of the population to mitigate the impact of the 2010/11 energy subsidies reforms (Van Parijs, 2013; World Bank, 2018). Consequently, the idea of UBI/BIG could be among the options to be considered by developing countries in their package of antipoverty policies (Ravallion, 2017). Additionally, it could be a strategic option to support structural reforms like removing energy subsidies (Coady & Prady, 2018). Nevertheless, the fiscal implications of such schemes and their welfare effect in identifying winners and losers are insufficiently investigated, particularly in developing countries (Francese & Prady, 2018; World Bank, 2018).

Most empirical studies have focused on analysing the microeconomic effects of cash transfer while giving little attention to the economy-wide effects of different cash transfer policies which allow for assessing the potential benefits or risks associated with these programs. For instance, contradictory findings about the impact of different cash transfer programs on poverty, income, consumption, risk coping, labour supply, entrepreneurship and schooling were reported in Albania (Dabalen, Kilic, & Wane, 2008), Argentina (Heinrich, 2007), Mexico (Davis eta al., 2002) and Brazil (Lichand, 2010) by studies analysing microdata using different methods like Propensity Score Matching (PSM), Difference-in-Differences (DID), regression discontinuity design (RDD) and instrumental variables (IV). Consequently, more research on the economic impact of different cash transfer programs is needed to generate comparative conclusions (Levy & Robinson, 2014).

Nevertheless, some empirical evidence on the economy-wide impacts of cash transfer programs was reported using Computable General Equilibrium (CGE) models. In Cambodia, a study by Levy and Robinson (2014) showed that unconditional cash transfer increase demand for goods and services, yet this increase does not stimulate domestic production or real GDP. In contrast, the same study found that having better access to health services through enforcing conditionality is expected to improve agriculture labour productivity which mitigate the effect of cash transfer on markets and allow production to increase. By integrating CGE and microsimulation methods, it was estimated that unconditional cash transfer reduces poverty and income inequality in both rural and urban areas in Laos (Kyophilavong, 2011). On the other hand, in Brazil, the two main cash transfer programs *Bolsa Família* and *Benefício de Prestação Continuada* contributed to reducing inequality while the effect on poverty was insignificant (Cury, Pedrozo, & Coelho, 2016). In Mexico, the results of a study by Coady and Harris (2004) indicated that reforming inefficient tax

systems reinforces the welfare gains obtained by switching from universal food subsidies to the targeted cash transfer program, *PROGRESA.*

Recently, the debate about UBI has gained fresh prominence with a limited number of studies that attempted to evaluate the impacts of UBI and reached different conclusions. Using household data from selected countries, Francese and Prady (2018) found that UBI is a powerful option to substitute existing non-contributory transfer programs when they are fairly progressive. However, in countries where transfer programs are progressive, introducing UBI leads to welfare loss of low-income households. By the same token, in India, replacing the 2011 Public Distribution System, which subsidizes selected food and energy products, with UBI will result in welfare losses for low-income households due to leakage of benefits to high-income groups (Coady & Prady, 2018). Simulations of data from Indonesia and Peru showed that targeted cash transfer programs have higher social welfare impact even with targeting errors (Hanna & Olken, 2018).

Using a CGE model calibrated to South Africa's data, a study by Thurlow (2002) simulated financing UBI through an increase in sales taxes, direct taxes, reduced government spending and a balanced approach. The later outperforms other scenarios, yet it showed a decline in GDP and employment despite the progressive impact of UBI, which increased the consumption of poor households more than high-income households. Using Value-Added-Taxes (VAT) as a financing tool for BIG in Côte d'Ivoire, François (2016) combined CGE and microsimulation and found that UBI improve household welfare and reduce inequality.

Starting in 2014, the Government of Egypt embarked on replacing price subsidies with targeted cash transfers and launched its flagship programme, *Takaful and Karama*[3]. These reforms followed a number of studies that analysed the economic impact of removing subsidies and offering cash transfer (Abouleinein et al., 2009; Aboulenein et al., 2010; Akhter et al., 2002; Fan et al., 2006; Kherallah et al., 2000; Löfgren & El-said, 1999). A study by World Bank (2005) attempted to evaluate the effectiveness of switching to targeted cash transfer programs by estimating targeting cost based on international evidence and using a simple proxy means test formula based on electricity consumption. The authors concluded that using geographic targeting and proxy means test have promising effect on poverty reduction.

Apart from this preliminary attempt, earlier studies on Egypt have been mostly restricted to studying the impact of removing a single type of subsidy (e.g. food or energy) and offering unconditional cash transfer without accounting for special features of targeted cash transfer and offering CCT. These features include modelling administrative and targeting costs as well as reflecting the necessary growth in the supply of education and health sectors to meet the expected increase in demand due to enforcing conditionality.

This paper is motivated by the knowledge gap in studying the economy-wide impact of different cash transfer modalities, the insufficient evidence on the economic impact of offering universal grant schemes in middle-income countries and the lack of knowledge on modelling special features of targeted and conditional cash transfer programs. Using a CGE model calibrated to a pre-reform

[3] Takaful provides conditional monthly income support to poor families with children aged from 0-18 in order to improve human capital investment in health and education. It offers 325 EGP as base payment, with increments per child ranging from 60 EGP to 140 EGP depending on the educational stage of the child (primary, preparatory, or high school). Karama is a categorical social inclusion program for the elderly, orphans, and people with disabilities that affect their ability to work. It offers an unconditional monthly transfer of 350-450 EGP for families with one eligible person, 700-900 EGP for two persons, and 1,050-1350 EGP for three persons (Breisinger, Eldidi, et al., 2018).

disaggregated dataset, the Social Accounting Matrix (SAM) of the Egyptian economy (2012-2013)[4], this study contributes to filling these research gaps by quantifying the general equilibrium effects of implementing different cash transfer modalities upon the removal of prices subsidies. For this purpose, the paper distinguishes between targeted unconditional and conditional cash transfers and seeks to provide ex-ante assessment of the effect of introducing universal grant schemes financed by the combined removal of energy and food subsidies and progressive income taxes. Another contribution is to examine the effect of expanding targeted cash transfer to cover the middle-income households, which is not sufficiently addressed by previous researches focusing on targeting poor households.

For the purpose of this analysis, we draw on the experience of the recent introduction of *Takaful and Karama* cash transfer program in Egypt, which could be used as a prototype for similar programs in middle-income countries. Egypt is useful case to examine the effect of different cash transfer programs beyond the intensive research on Latin America and sub-Saharan Africa, particularly given the previous little attention paid to these programs in Middle East and North Africa (MENA) region (Bastagli et al., 2016). By this way, this study informs policy makers about potential reforms options that mitigate the harmful impact of subsidies removal.

The remainder of this paper is organized as follows: section 2 presents the CGE model, while section 3 describes the data. Section 4 is devoted to the simulations. Section 5 discusses the main findings of the study, and section 6 concludes.

[4] The authors are grateful to the National Accounts Department of CAPMAS for providing the SAM data.

2. Research Method

An economywide model, namely a CGE model, is calibrated to data depicting the Egyptian economy to address the aforementioned research objectives. The study uses the STAGE1 model, which is a single-country static general equilibrium model developed by McDonald (2007)[5] and solved in GAMS (General Algebraic Modelling System). STAGE has eight main sets: commodities, activities, factors, households, government, enterprises, investment, and rest of the world. Furthermore, the model has seventy-nine equations (excluding closures) that capture the full circular flow of payments/income. These equations are included in blocks: trade, commodity price, numéraire, production, factor, household, enterprise, government, capital, foreign institutions, and market clearing (Appendix I).

The model specifies production technologies in terms of a nested Constant Elasticity of Substitution (CES) while household consumption expenditure is represented by Stone-Geary utility function[6]. This allows for subsistence-level consumption, which is generally preferred for a developing country in which there are a large number of poor consumers. The primary factors of production, land, labour and capital, are input used for production and owned by households. The labour market is assumed to follow the neoclassical approach with full employment. Key features of the model are presented in Table 1.

[5] For a detailed technical documentation of the STAGE 1 model see http://cgemod.org.uk/stage1.html.

[6] Stone Geary Function has the form: $u(x) = \prod_{i=1}^{n}(x_i - a_i)^{b_i}$ where x_i is the consumption of different goods, $b_i \geq 0$ and $a_i \geq 0$ are interpreted as subsistence level of respective commodities (Jehle and Reny, 2011).

Table 1 STAGE Model Key Features

Time Frame	Static
Theoretical Basis	Neo-Classical
Household	Stone-Geary Utility Function
Trade	Trade is modeled using the Armington insight assuming imperfect substitutability between domestically produced and imported goods which is represented by Constant Elasticity of Substitution (CES) function. Exports are assumed to be imperfect substitutes for domestically produced goods. This is represented by Constant Elasticity of Transformation (CET) function.
Production	Two Stage Production Process: 1. Output of activities are generated by combining aggregate intermediate and aggregate value added (primary) input using CES or Leontief specification depending on the structure of each sector. 2. Aggregate intermediate input use Leontief technology while primary inputs are combined to form aggregate value added using CES technology.
Small/Large Country	World prices of commodities (exports/imports) are exogenous if it is a small country (price taker) or selected export commodities can have downward sloping demand function (large country specification).

Source: Authors 'compilation based on MacDonald (2007)

The specifications of STAGE model imply that total government expenditures (Equation 1) are defined as the sum of expenditures on consumption demand, government transfers to enterprises and real transfer to households, $hogovconst$, that could be adjusted using $HGADJ$ to reflect uniform change in transfers across all households or could be used to increase/decrease monetary values of targeted transfers to specific households. On the other side, government transfers are part of households' income in addition to factor income, inter-household transfer, payment or dividends from enterprises and transfers from rest of world in domestic currency (Equation 2). Accordingly, $hogovconst$ is a parameter of interest that will be changed to depict introducing cash transfer as it will be explained in more details in the following section.

$$EG = \left(\sum_c QGD_c * \mathrm{PQD}_c\right) + (hogovconst_h * HGADJ * CPI) + +HOENT_h + (entgovconst_e * EGADJ * CPI) \quad (1)$$

$$YH_h = \left(\sum_f hovash_{h,f} * YFDIST_f\right) + \left(\sum_{hp} HOHO_{h,hp}\right) + (hogovconst_h * HGADJ * CPI) + (howor_h * ER) \quad (2)$$

On the side of expenditures, households pay direct/income taxes, save at a fixed exogenous factor and use the residual after paying inter-household transfer for consumption expenditures (Equation 3). The model assumes that households maximize their Stone-Geary utility function given their budget constraint. This utility function assumes two components of consumption demand: 'subsistence' demand (*qcdconst*) and 'discretionary' demand. The latter is modelled, in Equation 4, by the marginal budget share (*beta*) spent on each commodity after spending on subsistence (out of uncommitted income).

$$HEXPEQ_h: \ \mathrm{HOEXP}_h = \left(\left(YH_h * (1 - (\mathrm{TYH}_h)\right) * (1 - \mathrm{SHH}_h)\right) - \left(\sum_{hp} HOHO_{hp,h}\right) \quad (3)$$

$$QCDEQ_c: \ \mathrm{QCD_c} = \frac{\left(\sum_h \left(\mathrm{PQD_c} * \mathrm{qcdconst_{c,h}} + \sum_h \mathrm{beta_{c,h}} * \left(HEXP_h - \left(\sum_c \mathrm{PQD_c} * \mathrm{qcdconst_{c,h}}\right)\right)\right)\right)}{PQD_c} \quad (4)$$

Price of commodities is expressed as the supply price plus ad valorem sales tax (TS_c) and excise taxes (TEX_c) (Equation 5). It worth mentioning that subsidies on commodities are expressed in the model as negative indirect tax rates.

$$PQD_c = PQS_c * (1 + TS_c + TEX_c) \quad (5)$$

Equation 4 illustrates that Sales Tax on commodities has either multiplicative adjustment mechanism by allowing *TSADJ* to vary across all commodities, or additive adjustment mechanism to allow for deterministic adjustment of tax rate per commodity. Sales tax revenues, that constitute

a part of government revenues, are defined as the sum of the product of sales tax rates and the value of domestic expenditures on commodities (Equation 6).

$$\mathrm{TS}_c = \left((tsb_c + dabts_c) * TSADJ\right) + (DTS * ts01_c) \quad (6)$$

$$STAX = \sum_c (\mathrm{TS}_c * PQS_c * \mathrm{QQ}_c) \quad (7)$$

To adjust the macro-closures of the model to the specific conditions of the Egyptian economy, Egypt is declared as a small country (price taker). Given that Egypt started to move towards a flexible exchange rate regime following the devaluation of the Egyptian Pound, in November 2016, the current account balance is assumed to be fixed, while the exchange rate is flexible (Foreign Exchange Market Closure). The capital market closure is adjusted to reflect a saving-driven economy following the neo-classical approach.

For the government account closure, tax rates are endogenously adjusted while government savings are fixed. On Factor Market Closure, Capital and Land are assumed be fully employed, fixed, and immobile. On labour market, the model deviates from the neoclassical full employment assumption and incorporate unemployment of labour, which is a major feature characterizing labour markets in Egypt. For this purpose, real wages are fixed while labour supply acts as the market clearing variable. The model specification allows for selecting a *numéraire* that serves as a base. CPI was selected as a *numéraire.*

3. DATA

This paper uses SAM of the Egyptian economy (2012-2013)[7] developed by the Central Agency for Public Mobilization (CAPMAS) based on data from supply and use tables; balance of payment issued by the Central Bank of Egypt (CBE), the Household Income, Expenditure and Consumption Survey (HIECS), as well as data from the Ministry of Finance (MOF), Ministry of Planning, Monitoring and Administrative Reform (MOPMAR), Ministry of Petroleum, and Ministry of Agriculture (Central Agency for Public Mobilization and Statistics, 2016).

Marco-SAM aggregates multiple accounts, such as products, activities, and households, into single accounts (Appendix II). The disaggregated Micro-SAM is composed of ten main categories and 231 accounts, including ninety-nine accounts of products (goods and services), and ninety-two accounts of production activities. The factors of production are capital, land, and labour. Labour are divided by level of skill, gender, and region (urban or rural), resulting in fourteen accounts. "Skilled labour" are those who have at least a university degree, "semi-skilled" are those who obtained a secondary education, and "unskilled" are graduates of primary school or less.

In addition to a government account, SAM has different accounts for public and private as well as financial and nonfinancial enterprises while households are differentiated by region (Urban (U) and Rural (R)) and income quintiles (1=poorest to 5=richest quintile). Taxes were included as tariffs, sales tax on domestic products, excise taxes, subsidies, and direct taxes, while accounts are included for savings/gross capital formation, rest of world (ROW), and trade and transport margins on merchandise products.

[7] The authors would like to thank the National Accounts Department at CAPMAS for providing SAM 2012-2013 data.

SAM (2012/2013) is distinguished by a disaggregation of energy commodities: LPG, gasoline 80-92-95 kerosene, diesel, natural gas, and crude oil, in addition to the different food commodities. Furthermore, details on different types of taxes and subsidies are incorporated in the micro SAM, which are necessary for the purpose of this study.

In addition to SAM data, data such as head count of population per quintiles of households and population per household in adult equivalent by quintiles was obtained from CAPMAS to be used in the model for generating per capita/per adult equivalent results. While the base model does not account for exogenous unemployment data, the version used in this study accounts for it. The labour unemployment rate was set to 13 percent (2012-2013) while unemployment of capital and land was assumed to be equal to zero (i.e. fully employed). It is expected that labour unemployment differ among skilled and unskilled labour in Egypt and by regions. However, due to lack of data, the national unemployment rate is used for the labour account.

The series of elasticity included in the model encompasses the elasticity of substitution for imports and exports relative to domestic commodities, the elasticity of substitution for the CES production functions, the income elasticity of demand for the linear expenditure system, and the Frisch (marginal utility of income) parameters for each household In the absence of comprehensive sets of calculated elasticity, values were assigned based on input from CAPMAS and they were benchmarked with the literature and the application of other models on Egypt (e.g. IFPRI model by Breisinger et al (2018)).

4. SIMULATIONS

The three simulations analysed in this study, summarized in table 2, are analysed against a baseline scenario, which is used as a reference point reflecting the economy without shocks or policy changes (pre-reform). The first "non-baseline" simulation models the comprehensive removal of subsidies (energy and food), while offering targeted "labelled cash transfer" (unconditional cash transfer explicitly considered as "energy and food compensatory cash transfer") to poor and middle-income households. The inclusion of middle-income households is suggested by Helmy et al. (2019) who found that middle-income households are the most harmfully affected income group by recent reforms. It is assumed that the program is perfectly targeted to cover households in the lower three income quintiles. Following the current distribution of transfer among income quintiles, around half of the transfers go to poorest quintile while the second- and third-income quintiles share the second half equally (Kurdi et al., 2018).

This simulation will include the administrative cost of implementing the program, estimated at $25 million, which involved increased government demand for labour and public administrative expenditures (wages) to establish the project management unit as well as targeting costs that encompassed expenditures on developing systems and databases for proxy means testing as well as computers and equipment (e.g. registration of Takaful and Karama is done in social units using tablets and a new Management Information System was established for the programme) (World Bank, 2015a).

The second simulation analyses the impact of removing subsidies and offering targeted conditional cash transfer to the poor and the middle-income households, which entail increasing government spending on health and education to meet the expected increase in demand in the near future due

to enforcing conditionalities in addition to targeting and administrative costs. Conditionality is not enforced by the Government of Egypt up to date, yet this simulation assumes that targeted households will fully comply with health and education conditionality and prefer using social services over sanctions leading to partial or full reduction of transfers. It is expected that increasing access to health services and education is likely to increase productivity of labour in the long-run, yet this effect is not captured in this simulation that analyses short-term impacts.

Finally, the third simulation reflects removing subsidies and offering equal universal cash transfer to all households regardless of their level of income. These funds are financed using a mixed approach: savings from subsidies reform in addition to progressive direct income taxes. The latter is modelled as an increase in direct income taxes of households at the top two income quintiles by 5 percent coupled with decreasing tax rates for low income quintiles by 2 to 3 percent to raise the needed fund to cover UBI. As per the study by Coady & Harris (2004), the higher the tax burden shared by rich households, the lower the social welfare cost of financing cash transfer programs. Moreover, this mixed approach was selected given that highly depending on direct taxes to finance UBI might not be optimal in a developing country like Egypt where relatively fewer number of households earn the level of income that is entitled to contribute to high taxes which restrict the availability of funds for UBI (Hanna & Olken, 2018).

It worth mentioning that Egypt imposes a direct tax rate on household income that varies from 10 to 25 percent depending on income brackets. This top rate of income taxes is below the average for developing countries and it is imposed on excessively high-income bracket (those who earn at least 10 times the average per capital income) which exclude a large portion of well-off

households. Consequently, tax reforms are suggested for both the 4th and 5th high income quintiles coupled with lower rates for lowest income earners (Jewell et al., 2015).

Table 2 Summary of Simulations

Baseline: Pre-Reform
Sim 1: Full removal of subsidies and offering labelled cash transfer to poor and middle-income households.
Sim 2: Full removal of subsidies and offering conditional cash transfer to poor and middle-income households.
Sim 3: Full removal of subsidies, increase direct income taxes for high income households and offering universal cash transfer.

Source: Compiled by authors

5. RESULTS AND DISCUSSION

Selected figures based on the analysis of SAM data are presented in Appendix III. A closer look at households' accounts (Figure a), which are of high interest to this research, shows that the highest urban quintile (U5) spends about 23 percent of total households' final consumption expenditure, compared to 18 percent for the highest rural quintile (R5). On the other hand, the lowest quintiles in urban and rural spend around 5 and 4 percent, respectively. These figures indicate that 20 percent of the population spends around 40 percent of total household final consumption expenditure, while 20 percent of population spends less than 10 percent (Central Agency for Public Mobilization and Statistics, 2016).

As for household and factors of production (Figure b), the distribution of returns to factors of production factors (labour, land, and capital) shows that 63 percent of income of the highest urban quintile is derived from capital (profits), while 37 percent comes from labour (33 percent) and land (4 percent). Comparatively, the income of the lowest urban quintile of households (U1) comes from labour (wages 56 percent), capital (profits 43 percent), and land (rents 1 percent). The

considerable share of profit may be due to the contribution of this quintile to informal microenterprises. As for rural areas, the income of the highest quintile is distributed as follows: capital (57 percent), labour (36 percent), and land (7 percent). The lowest quintile's income comes from labour (52 percent), capital (47 percent), and land (1 percent). Labour income is thus the dominant source of income for poor households, whether rural or urban. In addition, rural households are the primary recipients of remittances from abroad.

Figure c indicates that the highest income quintile in rural areas (R5) make the highest tax contribution (16 percent of total income tax) as opposed to 11 percent for urban highest quintile. These contributions decrease to 8 percent and 5 percent for poorest income quintile in rural areas (R1) and urban areas (U1) respectively. As for structure of government income, Figure d, direct taxes represent the lion's share of income (42 percent) followed by indirect taxes (34 percent).

Removing distorting subsidies and expanding cash transfer is expected to stimulate various changes within the economy, especially by affecting household welfare and income. Given changes in patterns of production and demand, there is a different impact on returns to factors. Consequently, the effect of the simulations on these key variables will be discussed in this section[8].

The welfare effect, as measured by Equivalent Variation (EV) in Table 3, indicate that the comprehensive removal of energy and food subsidies and expanding targeted cash transfer to cover the middle-income households has a progressive effect given that high-income households are more adversely affected (Sim 1 and Sim 2). These results differ from the regressive effect reported in the simulations of Helmy et al. (2019) in case the middle-income households are not covered

[8] For a detailed discussion of the economic impacts of gradually removing energy and food subsidies in Egypt, see Helmy et al. (2019).

by social assistance. Low-income households in rural areas face a lower welfare loss (Sim 1) or higher welfare gain (Sim 2) compared to urban areas when cash transfer is expanded.

Modelling CCT (Sim 2) represents a superior policy for mitigating the harmful effect of subsidies reform on poor household and the middle-income households. While poor households in rural and urban areas have a welfare gain of 3.89 and 2.47 respectively (R1 and U1), the second- and third-income quintiles face lower welfare losses compared to UCT. On the other hand, simulating UBI (Sim 3) signals a regressive welfare effect since poor households in urban areas (U2) and middle-income households in rural areas (R3) are the most harmfully affected households. This probably due to the leakage of benefits to high-income households comparted to targeted transfers.

While UBI might overcome the problem of identifying the poor, its negative impact on the welfare of low-income households echo the findings of Coady and Prady (2018); Francese and Prady (2018) as well as Hanna and Olken (2018) while it contradicts with earlier findings by the studies of François (2016) and Thurlow (2002).

Table 3 Equivalent Variation relative to base consumption expenditure (percentage)

	U1	**U2**	**U3**	**U4**	**U5**	**R1**	**R2**	**R3**	**R4**	**R5**
Sim 1	-2.59	-4.23	-3.28	-3.88	-4.14	-0.07	-2.48	-3.80	-3.82	-3.38
Sim 2	2.47	-2.42	-2.50	-4.32	-4.48	3.89	-0.18	-2.88	-4.24	-3.78
Sim 3	-3.47	-4.40	-3.23	-3.71	-4.00	-3.62	-3.59	-4.12	-3.64	-3.21

Source: Results from Egypt's CGE model

Removing distorting subsidies reduces households' income with a varying extend (Table 4). The decline in income is mostly driven by the negative returns to factors which indicates that there a short-term downturn in demand for factors of production upon removing subsidies. For low and middle-income households, the impact of labour income is more significant, as previously shown by analysing SAM data, which explains the reduction in household income due to reduced income

to labour (Table 5). Capital returns are more important for high-income households while land returns are significant for high-income households in rural areas.

Table 4 Household Income (percentage change from base)

	U1	**U2**	**U3**	**U4**	**U5**	**R1**	**R2**	**R3**	**R4**	**R5**
Base Value (Billion EGP)	66.57	99.59	125.53	171.66	437.07	79.35	113.45	142.12	173.36	340.03
Sim 1	-2.84	-3.77	-4.02	-4.20	-4.33	0.17	-2.60	-3.51	-4.10	-4.26
Sim 2	3.08	-1.59	-3.03	-4.67	-4.81	4.59	-0.01	-2.39	-4.54	-4.72
Sim 3	-3.89	-3.99	-3.99	-4.02	-4.14	-3.75	-3.86	-3.91	-3.93	-4.07

Source: Results from Egypt's CGE model

By comparing between the effect of different cash transfer programs on income of household, unconditional cash transfer (Sim 1) indicates a marginal increase in the income of poor rural households (R1) while urban poor households face a decline of around 3 percent (Sim 1). On the other hand, conditional cash transfer shows a positive income effect on low-income households in both rural (R1) and urban areas (U1) which does not only offset the impact of subsidies removal but also bring them to a better position than pre-reform. Similarly, the second- and third-income quintiles face a lower decrease in income compared to pre-reform (baseline scenario).

The results of the second simulation suggest that implementing CCT induces the lowest decline in returns to factors of production by 2.63 percent for labour income, 4.81 percent for capital returns and 4.9 percent for return on land (Table 5). This effect is triggered by investing in health and education sectors to meet the expected increase in demand due to enforcing conditionality as well as the increased administrative cost which simulate demand for labour and production in these sectors (Table 6 and Table 7).

Table 5 Income to factors (percentage change from base)

	Labor	**Capital**	**Land**
Base Value (Billion EGP)	411.44	1,392.69	16.51
Sim 1	-2.70	-5.05	-4.86
Sim 2	-2.63	-4.81	-4.91
Sim 3	-2.97	-5.63	-4.77

Source: Results from Egypt's CGE model

Table 6 Demand for Labor by sector (percentage change from base)

	Base Value (Billion EGP)	**Sim 1**	**Sim 2**	**Sim 3**
Agriculture	31.10	-3.31	-3.49	-3.26
Mining	4.57	-7.36	-7.88	-7.17
Food Production	9.71	-8.04	-7.87	-8.15
Beverages Production	0.88	-2.97	-2.79	-3.02
Tobacco Production	1.11	-4.15	-4.00	-4.23
Manufacturing	41.73	-3.30	-3.79	-3.14
Utilities	19.63	-5.85	-5.30	-6.18
Construction	9.22	23.34	19.21	24.93
Services	293.09	-0.58	-2.00	-0.04
Education	62.63	-1.54	1.85	-1.49
Health	23.35	-5.55	3.17	-5.78

Source: Results from Egypt's CGE model

The third simulation points out that untargeted cash transfer makes a difference in the pattern and magnitude of income gains/losses. UBI induces income losses to poor and middle-income households by around 3.9 percent by distributing cash benefits to well-off households. High-income households in urban and rural areas face lower income losses when UBI is simulated compared to UCT and CCT, despite the higher direct tax rate.

Table 7 Domestic Production by sector (percentage change from base)

	Base value (Billion EGP)	**Sim 1**	**Sim 2**	**Sim 3**
Agriculture	436.49	-0.22	-0.60	-0.08
Mining	265.81	-0.45	-0.71	-0.35
Food Production	198.13	-3.70	-3.36	-3.84
Beverages Production	18.32	-3.38	-2.88	-3.53
Tobacco Production	10.86	-2.54	-2.15	-2.68
Manufacturing	805.14	-2.32	-2.84	-2.14
Utilities	148.33	-6.74	-6.23	-7.04
Construction	212.98	18.93	15.57	20.20
Services	1,210.55	-3.13	-3.03	-3.19
Education	89.43	-0.95	0.36	-0.91
Health	60.94	-3.72	1.61	-0.48

Source: Results from Egypt's CGE model

In general, the macroeconomic impacts of the subsidies reform and expanding cash transfer are negative since they induce a decline in real GDP by 0.19 percent, 0.24 percent and 0.29 percent in sim 1 to sim 3 respectively (Table 8). This adverse effect on GDP derived by a decrease in private consumption, a major component of GDP by 4.27 percent, 3.65 percent and 4.51 percent in sim 1 to sim 3 respectively. The decline in aggregate consumption is triggered by price hikes resulting from removing subsidies and the overall decrease of household income that was previously illustrated. Nevertheless, targeted transfers to poor households (Sim 1 and Sim 2) leads to a lower decline in private consumption and GDP given that poor households have higher propensity to consume the cash transferred to them compared to well-off households (Cury et al., 2016; Sdralevich et al., 2014).

Table 8 Real Macroeconomic Indicators (percentage change from base)

	Private Consumption	**Government Consumption**	**Total Investment**	**Real GDP**
GDP Share	83	11	18	
Sim 1	-4.27	1.36	17.76	-0.19
Sim 2	-3.65	1.03	14.82	-0.24
Sim 3	-4.51	1.46	18.88	-0.29

Source: Results from Egypt's CGE model

These findings trigger exploring the differences in expenditure patterns of Egyptian Households by income level. Looking at the reallocation of household expenditures across selected commodities (Table 9 and Table 10), CCT supports directing the expenditures of poor households towards health and education compared to UCT and UBI. For instance, in Sim 2 poor urban households (U1) increase their spending on education and health by around 4.5 percent and 5.19 percent respectively, compared to base scenario. These figures increase to 7.5 percent and 8.9 percent for expenditures on education and health by poor rural households (R1).

Remarkably, expenditures of poor households on food products like meat, fruits, vegetables and dairy products improve when they are targeted by cash transfers even if food subsidies are removed indicating a potential improvement in quality of diets.

Table 9 Household Expenditures on Selected Commodities under Sim 2 (percentage change from base)

	Meat	Vegetables	Fruits	Dairy Products	Pasta	Tea	Education	Health
U1	1.84	0.72	0.80	1.74	1.41	2.24	4.53	5.19
U2	-1.21	-0.96	-0.89	-1.29	-1.56	-0.88	-4.82	-4.28
U3	-1.26	-1.15	-1.04	-1.38	-1.82	-0.73	-5.60	-4.73
U4	-2.48	-1.66	-1.60	-2.55	-2.80	-2.18	-8.72	-8.23
U5	-2.42	-1.65	-1.59	-2.50	-2.77	-2.09	-8.63	-8.09
R1	3.24	1.16	1.34	3.05	2.35	4.10	7.57	8.97
R2	0.26	-0.26	-0.16	0.15	-0.27	0.77	-0.73	0.10
R3	-1.00	-1.28	-1.10	-1.20	-1.92	-0.12	-5.84	-4.40
R4	-2.18	-1.87	-1.72	-2.36	-2.99	-1.41	-9.24	-7.97
R5	-1.44	-1.96	-1.68	-1.76	-2.92	-0.02	-8.87	-6.55

Source: Results from Egypt's CGE model

Table 10 Household Expenditures on Selected Commodities under Sim 3 (percentage change from base)

	Meat	Vegetables	Fruits	Dairy Products	Pasta	Tea	Education	Health
U1	-2.13	-1.42	-1.38	-2.19	-2.39	-1.74	-7.42	-6.64
U2	-2.57	-1.67	-1.63	-2.63	-2.84	-2.18	-8.81	-8.03
U3	-1.85	-1.42	-1.35	-1.97	-2.33	-1.17	-7.13	-5.74
U4	-2.16	-1.45	-1.41	-2.23	-2.45	-1.75	-7.58	-6.74
U5	-2.19	-1.49	-1.44	-2.26	-2.50	-1.74	-7.73	-6.82
R1	-2.00	-1.63	-1.54	-2.16	-2.65	-1.08	-8.07	-6.19
R2	-2.13	-1.52	-1.46	-2.22	-2.53	-1.55	-7.78	-6.62
R3	-2.04	-1.76	-1.65	-2.23	-2.82	-0.92	-8.57	-6.28
R4	-1.95	-1.66	-1.56	-2.12	-2.67	-0.91	-8.10	-6.00
R5	-1.28	-1.73	-1.55	-1.61	-2.59	0.59	-7.65	-3.82

Source: Results from Egypt's CGE model

6. CONCLUSION

This paper contributes to the literature of the economy-wide impact of implementing different cash transfer modalities in middle-income countries, drawing on the experience of Takaful and Karama Program in the recent economic dynamics in Egypt. Using a Computable General Equilibrium model, this study simulated replacing subsidies with expanded targeted unconditional and conditional cash transfers as well as universal basic income scheme financed through a mixed approach.

The findings of this study suggest that removing price subsidies and expanding targeted cash transfer to cover the middle -income households has a progressive welfare effect. Even if financed by removing distortionary subsidies and increasing direct income taxes on high-income households, this research signals that universal basic income would not be a panacea for mitigating the adverse effect on the Egyptian economy and the welfare of low and middle-income households.

The results of this research show a strong complementarity between cash transfer and productive investment in health and education. Accordingly, combining targeted cash transfer with education and health conditionality is more likely to stimulate the economy and generate better outcomes in terms of welfare effect, demand for labour and production in addition to the positive human capital impact expected in the long-run; which is beyond the scope of this paper.

Taken together, these results suggest that poor and middle-income households would strongly benefit from a significant expansion in targeted cash assistance when distorting subsidies are removed. However, implementing cash transfer programs necessitates undertaking complementary measures like investment in health and education to mitigate the harmful welfare effect that remains persistent even if unconditional cash transfer is expanded or a universal basic income scheme is implemented. Therefore, policies should be designed and implemented in conjunction since cash transfer programs are likely to have better economic and welfare impact when integrated into larger productive investment and development programs.

Egypt's experience points to lessons for other countries that could be developing their cash transfer programs. Usually, policymakers have limited funding capacity and hence the efficiency of cash transfer programs in Egypt could be improved by offering targeted conditional cash transfer that cover poor and middle-income households while taking into account the capacity to boost productive investment in health and education sectors as complementary measures to maximize the benefits of cash transfer.

This paper uses a static CGE model which does not carry any dynamic or intertemporal analysis. Static models identify the winners and losers from economic shocks which is adequate for addressing the objectives of this paper, yet a drawback is not showing the adjustment path over

time. Static CGE models still have to include intertemporal components, like savings and investment, which might not be fully reflected in one single period. Moreover, parameters are estimated based on one-year data which is make estimates sensitive to any specific fluctuations during the reference year.

Another limitation of this study is the inability to distinct between formal and informal labour as well as ignoring intra-household transfers due to lack of data. Furthermore, the simulations of reflecting the future expansions of cash transfers assume a perfectly targeted transfer from the government to households which is likely to overstate the take-up of transfers. Future research could extend this analysis by using a dynamic CGE model or linking results to microsimulations in order to delve into impact of reforms on household poverty, income inequality or nutrition.

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Appendix I: STAGE Model

a. Sets and Accounts

sac	**global set**
Subsets:	
c(sac)	**Commodities**
cagr(c)	Agricultural Commodities
cnat(c)	Natural Resource Commodities
cfd(c)	Food Commodities
cind(c)	Industrial Commodities
cuti(c)	Utility Commodities
ccon(c)	Construction Commodities
cser(c)	Service Commodities
cagg	Aggregate commodity groups
m(sac)	Margins
a(sac)	**Activities**
aagr(a)	Agricultural Activities
anat(a)	Natural Resource Activities
afd(a)	Food Activities
aind(a)	Industrial Activities
auti(a)	Utility Activities
acon(a)	Construction Activities
aser(a)	Service Activities
aagg	Aggregate activity groups
f(sac)	**Factors**
l(f)	Labour Factors
ls(l)	Skilled Labour Factors
lm(l)	Skilled or Unskilled Labour Factors
lu(l)	Unskilled Labour Factors
k(f)	Capital Factors
n(f)	Land factors
h(sac)	**Households**
g(sac)	**Government**
gt(g)	Government tax accounts
tff(g)	factor tax account used in GDX program
e(sac)	**Enterprises**
i(sac)	**Investment**
w(sac)	**Rest of the world**

List of Parameters	
ac(c)	Shift parameter for Armington CES function
actcomactsh(a,c)	Share of commodity c in output by activity a
actcomcomsh(a,c)	Share of activity a in output of commodity c
adva(a)	Shift parameter for CES production functions for QVA
adx(a)	Shift parameter for CES production functions for QX
adxc(c)	Shift parameter for commodity output CES aggregation
alphah(c,h)	Expenditure share by commodity c for household h
at(c)	Shift parameter for Armington CET function
beta(c,h)	Marginal budget shares
caphosh(h)	Shares of household income saved (after taxes)
comactactco(c,a)	intermediate input output coefficients
comactco(c,a)	use matrix coefficients
comentconst(c,e)	Enterprise demand volume
comgovconst (c)	Government demand volume
comhoav(c,h)	Household consumption shares
comtotsh(c)	Share of commodity c in total commodity demand
dabte(c)	Change in base export taxes on comm'y imported from region w
dabtex(c)	Change in base excise tax rate
dabtfue(c)	Change in base fuel tax rate
dabtm(c)	Change in base tariff rates on comm'y imported from region w
dabts(c)	Change in base sales tax rate
dabtx(a)	Change in base indirect tax rate
dabtye(e)	Change in base direct tax rate on enterprises
dabtyf(f)	Change in base direct tax rate on factors
dabtyh(h)	Change in base direct tax rate on households
delta(c)	Share parameter for Armington CES function
deltava(f,a)	Share parameters for CES production functions for QVA
deltax(a)	Share parameter for CES production functions for QX

List of Parameters	
deltaxc(a,c)	Share parameters for commodity output CES aggregation
deprec(f)	depreciation rate by factor f
dstocconst(c)	Stock change demand volume
econ(c)	constant for export demand equations
entgovconst(e)	Government transfers to enterprise e
entvash(e,f)	Share of income from factor f to enterprise e
entwor(e)	Transfers to enterprise e from world (constant in foreign currency)
eta(c)	export demand elasticity
factwor(f)	Factor payments from RoW (constant in foreign currency)
frisch(h)	Elasticity of the marginal utility of income
gamma(c)	Share parameter for Armington CET function
goventsh(e)	Share of entp' income after tax save and consump to govt
govvash(f)	Share of income from factor f to government
govwor	Transfers to government from world (constant in foreign currency)
hexps(h)	Subsistence consumption expenditure
hoentconst(h,e)	transfers to hhold h from enterprise e (nominal)
hoentsh(h,e)	Share of entp' income after tax save and consump to h'hold
hogovconst(h)	Transfers to hhold h from government (nominal but scalable)
hohoconst(h,hp)	interhousehold transfers
hohosh(h,hp)	Share of h'hold h after tax and saving income transferred to hp
hovash(h,f)	Share of income from factor f to household h
howor(h)	Transfers to household from world (constant in foreign currency)
invconst(c)	Investment demand volume
ioqintqx(a)	Agg intermed quantity per unit QX for Level 1 Leontief agg
ioqvaqx(a)	Agg value added quant per unit QX for Level 1 Leontief agg
kapentsh€	Average savings rate for enterprise e out of after tax income
predeltax(a)	dummy used to estimated deltax
pwse(c)	world price of export substitutes

List of Parameters	
qcdconst(c,h)	Volume of subsistence consumption
rhoc(c)	Elasticity parameter for Armington CES function
rhocva(a)	Elasticity parameter for CES production function for QVA
rhocx(a)	Elasticity parameter for CES production function for QX
rhocxc(c)	Elasticity parameter for commodity output CES aggregation
rhot(c)	Elasticity parameter for Output Armington CET function
sumelast(h)	sumelast(h) Weighted sum of income elasticities
te01(c)	0-1 par for potential flexing of export taxes on comm'ies
tex01(c)	0-1 par for potential flexing of excise tax rates
tfue01(c)	0-1 par for potential flexing of fuel tax rates
tm01 (c)	0-1 par for potential flexing of Tariff rates on comm'ies
ts01(c)	0-1 par for potential flexing of sales tax rates
tx01(a)	0-1 par for potential flexing of indirect tax rates
tye01(e)	0-1 par for potential flexing of direct tax rates on e'rises
tyf01(f)	0-1 par for potential flexing of direct tax rates on factors
tyh01(h)	0-1 par for potential flexing of direct tax rates on h'holds
use(c,a)	use matrix transactions
vddtotsh(c)	Share of value of domestic output for the domestic market
worvash(f)	Share of income from factor f to RoW
yhelast(c,h)	(Normalized) household income elasticities

List of Variables	
KAPGOV	Government Savings
CAPWOR	Current account balance
CPI	Consumer price index
DTAX	Direct Income tax revenue
DTE	Partial Export tax rate scaling factor
DTEX	Partial Excise tax rate scaling factor
DTFUE	Partial Fuel tax rate scaling factor
DTM	Partial Tariff rate scaling factor
DTS	Partial Sales tax rate scaling factor

DTX	Partial Indirect tax rate scaling factor
DTYE	Partial direct tax on enterprise rate scaling factor
DTYF	Partial direct tax on factor rate scaling factor
DTYH	Partial direct tax on household rate scaling factor
EG	Expenditure by government
EGADJ	Transfers to enterprises by government Scaling Factor
ER	Exchange rate (domestic per world unit)
ETAX	Export tax revenue
EXTAX	Excise tax revenue
FD(f,a)	Demand for factor f by activity a
FS(f)	Supply of factor f
FUETAX	Fuel tax revenue
FYTAX	Factor Income tax revenue
GOVENT(e)	Government income from enterprise e
HEADJ	Scaling factor for enterprise transfers to households
HEXP(h)	Household consumption expenditure
HGADJ	Scaling factor for government transfers to households
HOENT(h,e)	Household Income from enterprise e
HOHO(h,hp)	Inter household transfer
IADJ	Investment scaling factor
INVEST	Total investment expenditure
INVESTSH	Value share of investment in total final domestic demand
ITAX	Indirect tax revenue
MTAX	Tariff revenue
PD(c)	Consumer price for domestic supply of commodity c
PE(c)	Domestic price of exports by activity a
PINT(a)	Price of aggregate intermediate input
PM(c)	Domestic price of competitive imports of commodity c
PPI	Producer (domestic) price index
PQD(c)	Purchaser price of composite commodity c
PQS(c)	Supply price of composite commodity c
PVA(a)	Value added price for activity a
PWE(c)	World price of exports in dollars
PWM(c)	World price of imports in dollars
PX(a)	Composite price of output by activity a
PXAC(a,c)	Activity commodity prices
PXC(c)	Producer price of composite domestic output
QCD(c,h)	Household consumption by commodity c
QD(c)	Domestic demand for commodity c
QE(c)	Domestic output exported by commodity c
QENTD(c,e)	Enterprise consumption by commodity c

QENTDADJ	Enterprise demand volume Scaling Factor
QGD(c)	Government consumption demand by commodity c
QGDADJ	Government consumption demand scaling factor
QINT(a)	Aggregate quantity of intermediates used by activity a
QINTD(c)	Demand for intermediate inputs by commodity
QINVD(c)	Investment demand by commodity c
QM(c)	Imports of commodity c
QQ(c)	Supply of composite commodity c
QVA(a)	Quantity of aggregate value added for level 1 production
QX(a)	Domestic production by activity a
QXAC(a,c)	Domestic commodity output by each activity
QXC(c)	Domestic production by commodity c
SADJ	Savings rate scaling factor for BOTH households and enterprises
SEADJ	Savings rate scaling factor for enterprises
SHADJ	Savings rate scaling factor for households
STAX	Sales tax revenue
TE(c)	Export taxes on exported comm'y c
TEADJ	Export subsidy Scaling Factor
TEX(c)	Excise tax rate
TEXADJ	Excise tax rate scaling factor
TFUE(c)	Fuel tax rate
TFUEADJ	Fuel tax rate scaling factor
TM(c)	Tariff rates on imported commodity c
TMADJ	Tariff rate Scaling Factor
TOTSAV	Total savings
TS(c)	Sales tax rate
TSADJ	Sales tax rate scaling factor
TX(a)	Indirect tax rate
TXADJ	Indirect Tax Scaling Factor
TYE (e)	Direct tax rate on enterprises
TYEADJ	Enterprise income tax Scaling Factor
TYF(f)	Direct tax rate on factor income
TYFADJ	Factor Tax Scaling Factor
TYH(h)	Direct tax rate on households
TYHADJ	Household Income Tax Scaling Factor
VENTD (e)	Value of enterprise e consumption expenditure
VENTDSH(e)	Value share of Ent consumption in total final domestic demand
VFDOMD	Value of final domestic demand
VGD	Value of Government consumption expenditure
VGDSH	Value share of Govt consumption in total final domestic demand
WALRAS	Slack variable for Walras's Law

WF(f)	Price of factor f
WFDIST(f,a)	Sectoral proportion for factor prices
YE(e)	Enterprise incomes
YF(f)	Income to factor f
YFDISP(f)	Factor income for distribution after depreciation
YFWOR(f)	Foreign factor income
YG	Government income
YH(h)	Income to household h

b. Equations:

1. Exports Block:

a) $PEDEF_c$: $PE_c = PWE_c * ER * (1 - TE_c) \quad \forall ce$

b) CET_c: $QXC_c = at_c * \left(\gamma_c * QE_c^{rhot_c} + (1 - \gamma_c) * QD_c^{rhot_c}\right)^{\frac{1}{rhot_c}} \quad \forall ce \; AND \; cd$

c) $ESUPPLY_a$: $\frac{QE_c}{QD_c} = \left[\frac{PE_c}{PD_c} * \frac{(1-\gamma_c)}{\gamma_c}\right]^{\frac{1}{rhot_c}} \quad \forall ce \; AND \; cd$

d) $EDEMAND_c$: $QE_c = econ_c * \left(\frac{PWE_c}{pwse_c}\right)^{-eta_c} \quad \forall (cen \; AND \; cd) OR \; (ce \; AND \; cdn)$

e) $CETALT_c$: $QXC_c = QD_c + QE_c \quad \forall (cen \; AND \; cd) OR \; (ce \; AND \; cdn)$

2. Imports Block

a) $PMDEF_c$: $PM_c = PWM_c * ER * (1 - TM_c) \quad \forall cm$

b) $ARMINGTON_c$: $QQ_c = ac_c * \left(\delta_c * QM_c^{-rhoc_c} + (1 - \delta_c) * QD_c^{-rhoc_c}\right)^{\frac{1}{rhot_c}} \quad \forall cm \; AND \; cx$

c) $COSTMIN_a$: $\frac{QM_c}{QD_c} = \left[\frac{PD_c}{PM_c} * \frac{\delta_c}{(1-\delta_c)}\right]^{\frac{1}{(1+rhoc_c)}} \quad \forall cm \; AND \; cx$

d) $ARMALT_c$: $QQ_c = QD_c + QM_c \quad \forall (cmn \; AND \; cx) OR \; (cm \; AND \; cxn)$

3. Commodity Price Block

a) $PQDDEF_c$: $PQD_c = PQS_c * (1 + TS_c + TEX_c)$

b) $PQSDEF_c$: $PQS_c = \frac{(PD_c * \; QD_c + PM_c * \; QM_c)}{QQ_c} \quad \forall cd \; OR \; cm$

c) $PXCDEF_c$: $PXC_c = \frac{(PD_c * \; QD_c + (PE_c * \; QE_c)\$ce_c)}{QXC_c} \quad \forall cx$

4. Numeraire Block

a) $CPIDEF$: $CPI = \sum_c comtotsh_c * \quad PQD_c$
b) $PPIDEF$: $PPI = \sum_c vddtotsh_c * \quad PD_c$

5. Production Block

a) $PXDEF_a$: $PX_a = \sum_c ioqxacqx_{a,c} * \quad PXC_c$
b) $PVADEF_a$: $PX_a * (1 - TX_a) * QX_a = (PVA_a * QVA_a) + (PINT_a * QINT_a)$
c) $PINTDEF_a$: $PINT_a = \sum_c \left(ioqtdqd_{c,a} * \quad PQD\right)_c$
d) $ADXEQ_a$: $ADX_a = [(adxb_a + dabadx_a) * ADXADJ] + (DADX * adx01_a)$
e) $QXPRODFN_a$: $QX_a = AD_a^x * \left(\delta_a^x QVA_a^{-rhoc_a^x} + (1 - \delta_a^x)\, QINT_a^{-rhoc_a^x}\right)^{\frac{1}{-rhoc_a^x}} \qquad \forall aqx_a$
f) $QXFOC_a$: $\frac{QVA_a}{QINT_a} = \left[\frac{PINT_a}{PVA_a} * \frac{\delta_a^x}{(1-\delta_a^x)}\right]^{\frac{1}{(1+rhoc_a^x)}} \qquad \forall aqx_a$
g) $QVADEF$: $QVA_a = ioqvaqx_a * QX_a \ \ \forall aqxnx_a$
h) $QINTDEF$: $QINT_a = ioqintqx_a * QX_a \ \ \forall aqx_a$
i) $QVAPRODFN_a$: $QVA_a = AD_a^{va} * \left(\sum_{\delta_{f,a}^x} \delta_{f,a}^x * ADFD_{f,a} * FD_{f,a}^{-\rho_a^{va}}\right)^{\frac{-1}{\rho_a^{va}}}$
j) $QVAFOC_{f,a}$: $WF_f * \quad WFDIST_{f,a} * \left(1 + TF_{f,a}\right) = PVA_a * QVA_a * AD_a^{va} * \left(\sum_{\delta_{f,a}^x} \delta_{f,a}^x * ADFD_{f,a} * FD_{f,a}^{-\rho_a^{va}}\right)^{-1} * \delta_{f,a}^x * ADFD_{f,a}^{-\rho_a^{va}} * \delta_{f,a}^x * FD_{f,a}^{(-\rho_a^{va}-1)}$
k) $QINTDEQ_c$: $QINTD_c = \sum_a ioqtdqd_{c,a} * \quad QINT_a$
l) $COMOUT_c$: $QXC_c = adxc_c * \left(\sum_{\delta_{a,c}^{xc}} \delta_{a,c}^x * QXAC_{a,c}^{-\rho_c^{xc}}\right)^{\frac{-1}{\rho_c^{xc}}} \ \ \forall cx_c \ and \ cxac_c$

$$QXC_c = \sum_a QXAC_{a,c}$$

m) $COMOUTFOC_{a,c}$: $PXAC_{a,c} = PXC_c * QXC_c * \left[\sum_{\delta_{a,c}^{xc}} \delta_{a,c}^x * QXAC_{a,c}^{-\rho_c^{xc}}\right]^{-\left(\frac{1+\rho_c^{xc}}{\rho_c^{xc}}\right)} * \delta_{a,c}^x * QXAC_{a,c}^{(-\rho_c^{xc}-1)} \ \ \forall cxac_c$

$$PXAC_{a,c} = PXC \ \ \forall cxacn_c$$

n) $ACTIVOUT_{a,c}$: $QXAC_{a,c} = ioqxacqx_{a,c} * QX_a$

6. Factor Block:

a) $YFEQ_f$: $YF_f = \left(\sum_a WF_f * WFDIST_{f,a} * FD_{f,a}\right) + \left(factwor_f * ER\right)$

b) $YFDISPEQ_f$: $YFDISP_f = \left(YF_f * \left(1 - deprec_f\right)\right) + \left(1 - TYF_f\right)$

7. Household Block:

a) $YHEQ_h$: $YH_h = \left(\sum_f hovash_{h,f} * YFDIST_f\right) + \left(\sum_{hp} HOHO_{h,hp}\right) + (hogovconst_h * HGADJ * CPI) + (howor_h * ER)$

b) $HOHOEQ_{h,hp}$: $\mathrm{HOHO}_{h,hp} = hohosh_{h,hp} * (YH_h * (1 - (\mathrm{TY}H_h)) * (1 - \mathrm{SHH}_h)$

c) $HEXPEQ_h$: $\mathrm{HOEXP}_h = \left(\left(YH_h * (1 - (\mathrm{TY}H_h)\right) * (1 - \mathrm{SHH}_h)\right) - \left(\sum_{hp} HOHO_{hp,h}\right)$

d) $QCDEQ_c$: $\mathrm{QCD}_c = \frac{\left(\sum_h\left(\mathrm{PQD}_c * \mathrm{qcdconst}_{c,h} + \sum_h \mathrm{beta}_{c,h} * \left(HEXP_h - \left(\sum_c \mathrm{PQD}_c * \mathrm{qcdconst}_{c,h}\right)\right)\right)\right)}{PQD_c}$

8. Enterprise Block:

a) $YEEQ$: $YE_e = \left(\sum_f entvash_{e,f} * YFDIST_f\right) + (entgovconst_e * EGADJ * CPI) + (Entwor_e * ER)$

b) $QENTDEQ_c$: $\mathrm{QED}_{c,e} = qedconst_{c,e} * QEDDADJ$

c) $VENTDEQ$: $\mathrm{VED}_e = \left(\sum_c QED_{c,e} * \mathrm{PQD}_c\right)$

d) $HOENTEQ_h$: $HOENT_{h,e} = hoentsh_{h,hp} * (YE_e * (1 - (\mathrm{TY}E_e)) * (1 - \mathrm{SEN}_e) - \sum_c QED_{c,e} * \mathrm{PQD}_c$

e) $GOVENT_e$: $GOVENT_e = goventsh_e * (YE_e * (1 - (\mathrm{TY}E_e)) * (1 - \mathrm{SEN}_e) - \sum_c QED_c * \mathrm{PQD}_c$

9. Tax Rate Block:

a) $TMDEF_c$: $\mathrm{TM}_c = \left((tmb_c + dabtm_c) * TMADJ\right) + (DTM * tm01_c)$

b) $TEDEF_c$: $\mathrm{TE}_c = \left((teb_c + dabte_c) * TEADJ\right) + (DTE * te01_c)$

c) $TSDEF_c$: $\mathrm{TS}_c = \left((tsb_c + dabts_c) * TSADJ\right) + (DTS * ts01_c)$

d) $TEXDEF_c$: $\mathrm{TEX}_c = \left((texb_c + dabtex_c) * TEXADJ\right) + (DTEX * tex01_c)$

e) $TXDEF_a$: $\mathrm{TX}_a = \left((txb_a + dabtx_a) * TXADJ\right) + (DTX * tx01_a)$

f) $TEFDEF_{f,a}$: $\mathrm{TF}_{f,a} = \left(\left(tfb_{f,a} + dabtf_{f,a}\right) * TFADJ\right) + \left(DTF * tf01_{f,a}\right)$

g) $TYFDEF_f$: $\mathrm{TYF}_f = \left(\left(tyfb_f + dabtyf_f\right) * TYFADJ\right) + \left(DTYF * tyf01_f\right)$

h) $THYDEF_f$: $\mathrm{TYH}_h = \left((tyhb_h + dabtyh_h) * TYHADJ\right) + (DTYH * tyh01_h)$

i) $TYEDEF_e$: $TYE_e = \left((tyeb_e + dabtye_e) * TYEADJ\right) + (DTYE * tye01_e)$

10. Tax Revenue Block

a) $MTAXEQ$: $MTAX = \sum_c (\mathrm{TM}_c * \mathrm{PWM}_c * \mathrm{ER} * \mathrm{QM}_c)$
b) $ETAXEQ$: $ETAX = \sum_c (\mathrm{TE}_c * \mathrm{PWE}_c * \mathrm{ER} * \mathrm{QE}_c)$
c) $STAXEQ$: $STAX = \sum_c (\mathrm{TS}_c * PQS_c * \mathrm{QQ}_c)$
d) $EXTAXEQ$: $EXTAX = \sum_c (\mathrm{TEX}_c * \mathrm{PQS}_c * \mathrm{QQ}_c)$
e) $ITAXEQ$: $ITAX = \sum_a (\mathrm{TX}_a * \mathrm{PX}_a * \mathrm{QX}_a)$
f) $FTAXEQ$: $FTAX = \sum_{f,a} \left(\mathrm{TF}_{f,a} * \mathrm{WF}_f * WFDIST_{f,a} * FD_{f,a}\right)$
g) $FYTAXEQ$: $FYTAX = \sum_f \left(TYF_f * \left(YF_f * (1 - \mathrm{deprec_f})\right)\right)$
h) $DTAXEQ$: $DTAX = \sum_h (\mathrm{TYH_h} * \mathrm{YH}_h) + \sum_e (\mathrm{TYE_e} * \mathrm{YE})$

11. Government Block

a) $YGEQ$: $YG = \mathrm{MTAX} + \mathrm{ETAX} + \mathrm{STAX} + \mathrm{EXTAX} + \mathrm{FTAX} + \mathrm{ITAX} + \mathrm{FYTAX} + \mathrm{DTAX} + \left(\sum_f govvash_{h,f} * YFDISP_f\right) + \mathrm{GOVENT} + (govwor * ER)$

b) $QGDEQ_c$: $\mathrm{QGD}_c = (qgdconst_c * QGDADJ)$

c) $VGDEQ$: $VGD = \left(\sum_c QGD_c * \mathrm{PQD}_c\right)$

d) $EGEQ$: $EG = \left(\sum_c QGD_c * \mathrm{PQD}_c\right) + (hogovconst_h * HGADJ * CPI) + (entgovconst_e * EGADJ * CPI)$

12. Investment Block

a) $SHHDEF_h$: $SHH_h = \left((shhb_h + dabshh_h) * SHADJ * SADJ\right) + (DSHH * DS * ssh01_h)$
b) $SENDEF_e$: $SEN_e = \left((sen_e + dabsen_e) * SEADJ * SADJ\right) + (DSEN * DS * sen01_e)$
c) $TOTSAVEQ$: $TOTSAV = \sum_h \left(\left(YH_h * (1 - TYH_h)\right) * SHH_h\right) + \sum_e \left(\left(YE * (1 - TYE_e)\right) * SEN_e\right) + \sum_f \left(YF_f * deprec_f\right) + \mathrm{KAPGOV} + (\mathrm{CAPWOR} * \mathrm{ER})$
d) $QINVDEQ_c$: $QINVD_c = (IADJ * qinvdconst_c)$
e) $INVEST$: $INVEST = \sum_c \left(\mathrm{PQD}_c * (QINVD_c + dstocconst_c)\right)$

13. Foreign Institutions Block

a) $YFWOREQ_f$: $YFWOR_f = worvash_f * YFDISP_f$

14. Market Clearing Block

a) $FMEQUIL_f$: $FS_f = \sum_a FD_{f,a}$

b) $QEQUIL_f$: $QQ_c = QINTD_c + \sum_h QCD_{c,h} + \sum_e QED_{c,e} + QGD_c + QINVD_c + dstocconst_c$

c) $CAPGOVEQ$: $KAPGOV = YG - EG$

d) $CAEQUIL$: $CAPWOR = (\sum_c pwm_c + QM_c) + \left(\sum_f {YFWOR_f}/{ER}\right) - (\sum_c pwe_c + QE_c) - \left(\sum_f factwor_f\right) - (\sum_h howor_h) - entwor - govwor$

e) $VFDOMDEQ$: $VFDOMD = \sum_c PQD_c * \left(\sum_h QCD_{c,h} + \sum_e QED_{c,e} + QGD_c + QINVD_c + dstocconst_c\right)$

f) $VENTDSHEQ$: $VENTDSH_e = {VENTD_e}/{VFDOMD}$

g) $VGDSHEQ$: $VGDSH = {VGD}/{VFDOMD}$

h) $INVESTSHEQ$: $INVESTSH = {INVEST}/{VFDOMD}$

i) $WALRASEQ$: $TOTSAV = INVEST + WALRAS$

15. Market Closures Rules

a) $\overline{ER}$ *or* $\overline{CAPWOR}$

b) $\overline{PWM_c}$ *and* $\overline{PWE_c}$ *or* $\overline{PWE_{cedn}}$

c) $\overline{SADJ}, \overline{SHADJ}, \overline{SEADJ}$ *or* $\overline{IADJ}$ *or* $\overline{INVEST}$, $\overline{INVESTSH}$

d) $\overline{QEDADJ}$ *or* $\overline{VED}$ *or* $\overline{VEDSH}$

e) At least one of tax rates is fixed and $\overline{KAPGOV}$ or at least two of $\overline{QGDADJ}$, $\overline{HGADJ}$, $\overline{EGADJ}$, $\overline{VGD}$, $\overline{VGDSH}$.

f) $\overline{FS_f}$ *and* $\overline{WFDIST_{f,a}}$

g) $\overline{CPI}$ *or* $\overline{PPI}$

Appendix II: Egypt Macro-SAM Data (Billion EGP)

	Products	Activities	Production Factors	Households Sector	Enterprises Sector	Government	Saving/Gross Capital Formation	Rest of the world	Margins	Total
Products		1211.9		1418.1		211.2	303.6	331.8	275.7	3752.2
Activities	3031.5									3031.5
Production Factors		1819.6								1819.6
Households Sector			760.8		888.8	4.9		117.6		1772
Enterprises Sector			975	20.5		167.6		1.4		1164.5
Government	-70.3			39.4	183.3	63.9		4.9		221.1
Saving/Gross Capital Formation			83.8	292.3	55.1	-230.6		103		303.6
Rest of the world	515.4			1.8	37.4	4				558.6
Margins	275.7									275.7
Total	3752.2	3031.5	1819.6	1772	1164.5	221.1	303.6	558.6	275.7	

Source: CAPMAS (2016)

Appendix III: Analysis of SAM data- Selected Figures

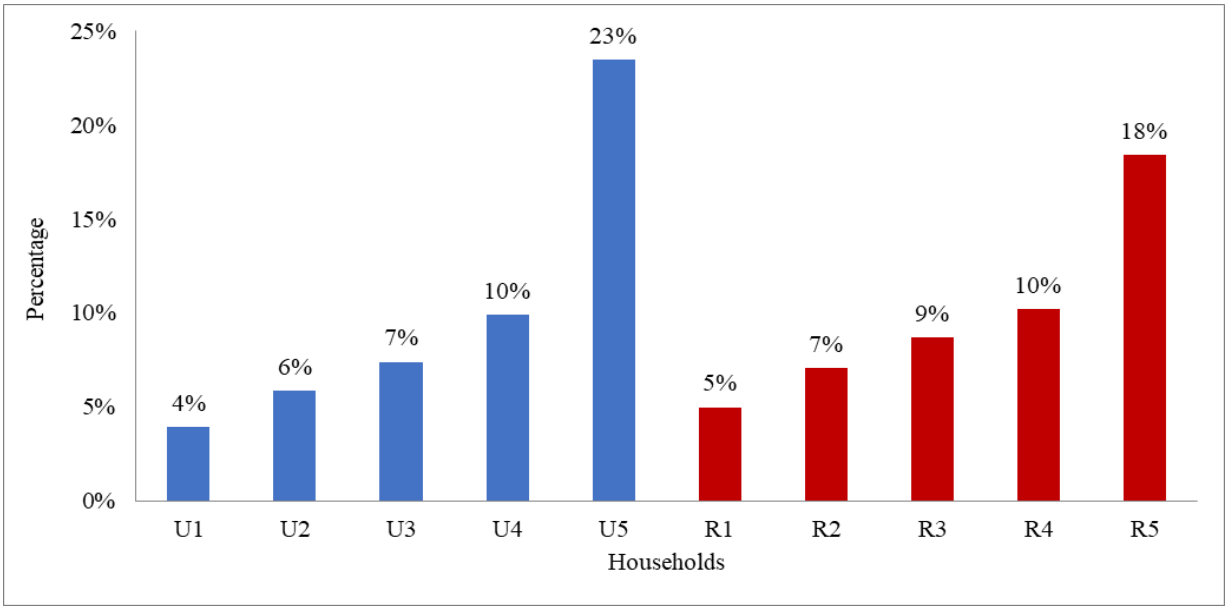

Figure a: Share of households in final household consumption expenditure by quintiles (percentage)

Source: CAPMAS (2016)

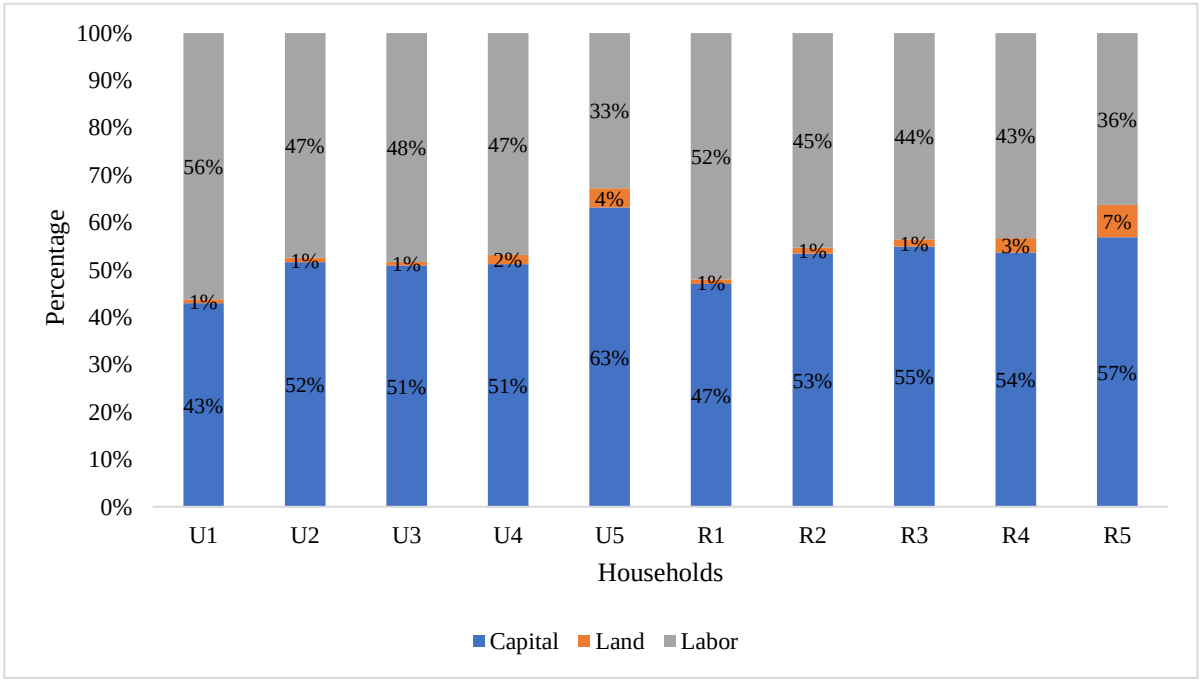

Figure b: Distribution of Returns of Factors of Production to each quintile of households (percentage)

Source: CAPMAS (2016)

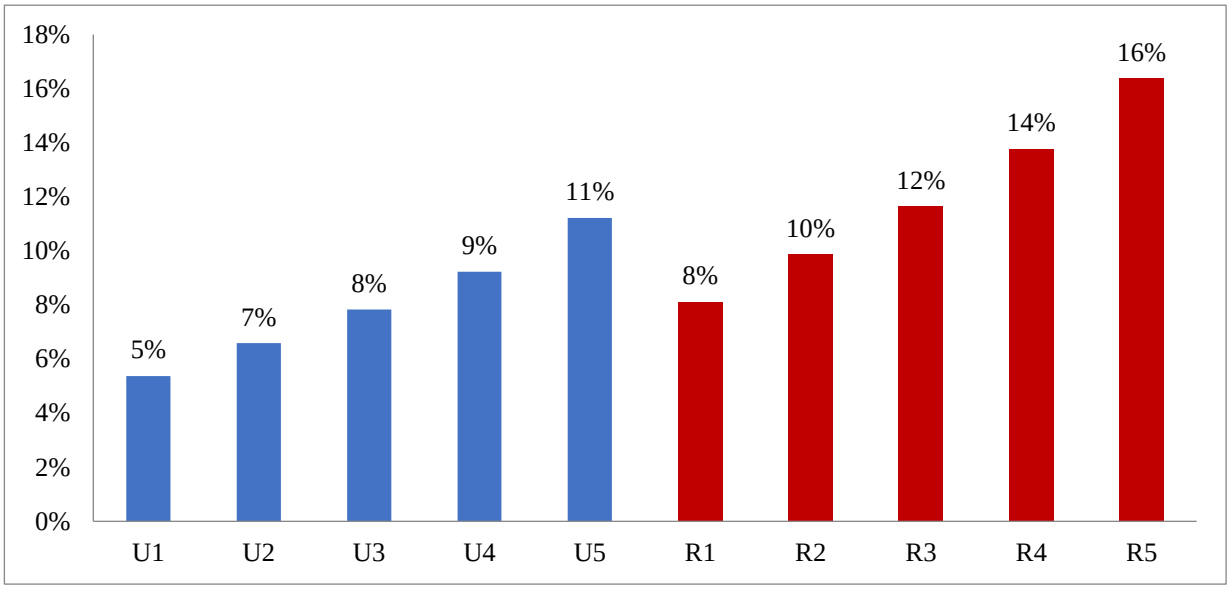

Figure c: Structure of Taxes Collected from Household Sector (percentage)

Source: CAPMAS (2016)

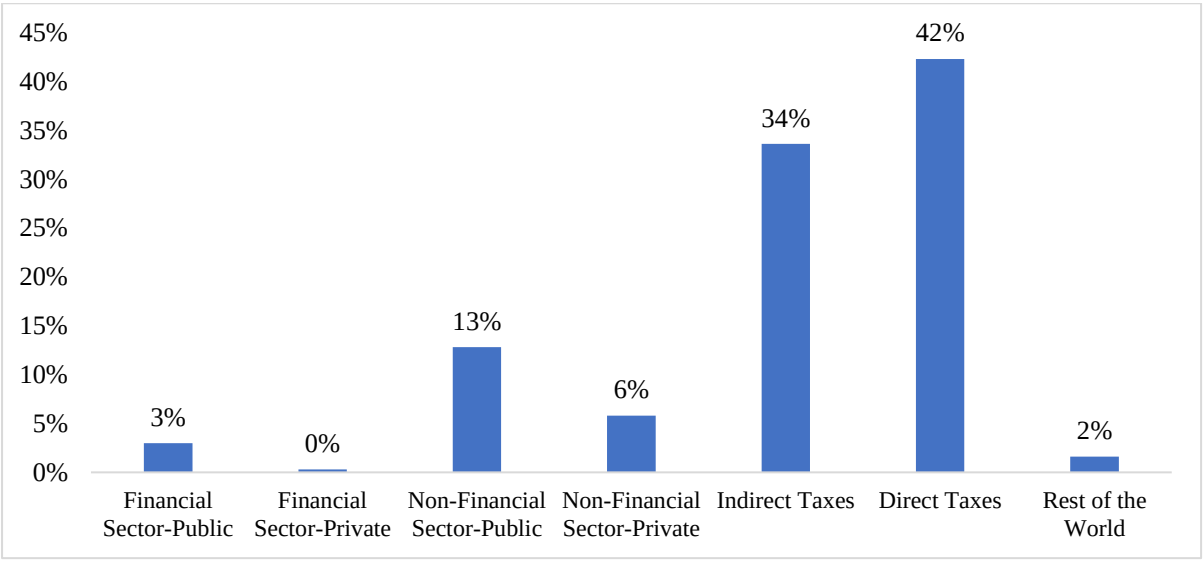

Figure d: Structure of Government Income (percentage)

Source: CAPMAS (2016)