REAPING THE HARVEST OF ECONOMIC REFORMS: THE CASE OF SOCIAL SAFETY NETS IN EGYPT*

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Working Paper no. 200
February 2019

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Abstract

This study explores the economic impact of the latest fiscal policies and social safety-net measures in Egypt, using a disaggregated Social Accounting Matrix and a Computable General Equilibrium model. Additionally, it examines the effect of the use of savings to expand pro-poor spending. This paper is differentiated by modeling a number of special features of value-added taxes and stimulating the combined effect of phasing out price subsidies of energy and food products. The findings suggest that recent fiscal reforms had a negative impact on private consumption, domestic demand and production. The increase in investment demand is mainly driven by a boost in construction sector that highly depends on unskilled labor and provides real estate products that are mostly demanded by high-income households. The results signal that Egypt's progress toward achieving structural transformation might be hindered, which increases the likelihood of reform reversals. The R&D sector was positively affected by the differentiated VAT rate that had a detrimental effect on tobacco, beverages production and telecommunication. The results indicate a harmful welfare impact on middle-income households, which are the most affected group by removing subsidies due to reduced wages and profits as well as price hikes. The planned full removal of energy and food subsidies over the coming years necessitates undertaking sustainable policy alternatives such as expanding pro-poor spending. This option is superior to other scenarios with respect to household welfare, production and demand for skilled labor in the R&D, health, and education sectors.

ملخص

تبحث هذه الدراسة الأثر الاقتصادي للسياسات المالية العامة وتدابير شبكة الأمان الاجتماعي التي جرى تطبيقها مؤخرا في مصر، وذلك باستخدام مصفوفة المحاسبة الاجتماعية المفصلة، ونموذج التوازن العام المحوسب. بالإضافة إلى ذلك، يتم تناول تأثير استخدام المدخرات لتوسيع الإنفاق لصالح الفقراء. وتختلف هذه الورقة في أنها تقوم بنمذجة عدد من السمات الخاصة بضرائب القيمة المضافة وتحفيز الأثر المشترك للإلغاء التدريجي لإعانات دعم أسعار الطاقة والمنتجات الغذائية. وتشير النتائج إلى أن الإصلاحات المالية العامة الأخيرة كان لها تأثير سلبي على الاستهلاك الخاص والطلب المحلي والإنتاج. وتُعزى الزيادة في الطلب على الاستثمار بشكل رئيسي إلى انتعاش قطاع التشييد والبناء الذي يعتمد إلى حد كبير على العمالة غير الماهرة ويوفر منتجات عقارية تطلبها في الغالب الأسر ذات الدخل المرتفع. وتشير النتائج إلى أن ما تحرزه مصر من تقدم نحو تحقيق التحول الهيكلي قد يواجَه بمعوقات، مما يزيد من احتمالية حدوث انتكاسات في مسيرة الإصلاح. وقد تأثر قطاع البحوث والتطوير بشكل إيجابي من ضريبة القيمة المضافة ذات الهيكل متعدد الأسعار والتي كان لها تأثير ضار على التبغ وإنتاج المشروبات والاتصالات السلكية واللاسلكية. وتشير النتائج إلى تأثير ضار على رفاهة الطبقة الوسطى، وهي المجموعة الأكثر تضررا من إلغاء الدعم بسبب انخفاض الأجور والأرباح بالإضافة إلى الزيادات السعرية. ويتطلب الإلغاء الكامل المقرر لإعانات الطاقة والمواد الغذائية على مدى السنوات القادمة اتخاذ بدائل سياساتية مستدامة مثل توسيع الإنفاق لصالح الفقراء. ويتفوق هذا الخيار على

سيناريوهات أخرى فيما يتعلق برفاهة قطاع الأسر والإنتاج والطلب على العمالة الماهرة في قطاعات البحوث والتطوير والصحة والتعليم.

JEL Classification: E16, C68, R20, O21
Keywords: fiscal policies, social safety nets, social accounting matrix, CGE models, Egypt.

1. INTRODUCTION

Following the Arab Spring in 2011, the political transition in Egypt and the deep-rooted structural challenges led to slow growth, overvalued exchange rate, shortage of foreign currency and lower reserves. Furthermore, weak revenues from tourism combined with poor targeted subsidies and a high wage bill led to a considerable budget deficit and public debt. After three years of economic slowdown, the government of Egypt (GoE) announced a transformational Economic Reform Program in 2014 that addresses macroeconomic imbalances, and targets social inclusion as well as sustainable economic growth.

The key pillars of this program include fiscal consolidation, strengthening social safety nets (SSN), improving the business climate to promote inclusive growth, and moving toward adopting a flexible exchange rate regime. The main measures undertaken by the GoE to achieve fiscal consolidation were introducing the value-added tax (VAT) to increase revenues, containing the wage bill of the government and public sector, as well as phasing out inefficient subsidies.[1] These measures were aimed at creating fiscal space to shift savings to social spending as well as financing the recent national targeted cash transfer program *Takaful and Karama*—translated as solidarity and dignity[2] (International Monetary Fund 2015; World Bank 2015). In support of this program, the International Monetary Fund (IMF) approved a three-year loan of USD 12 billion in November 2016 (International Monetary Fund 2018).

Egypt is a developing country that has a long history of using different social protection tools to maintain social cohesion and promote equitable development. Subsidizing food started in the

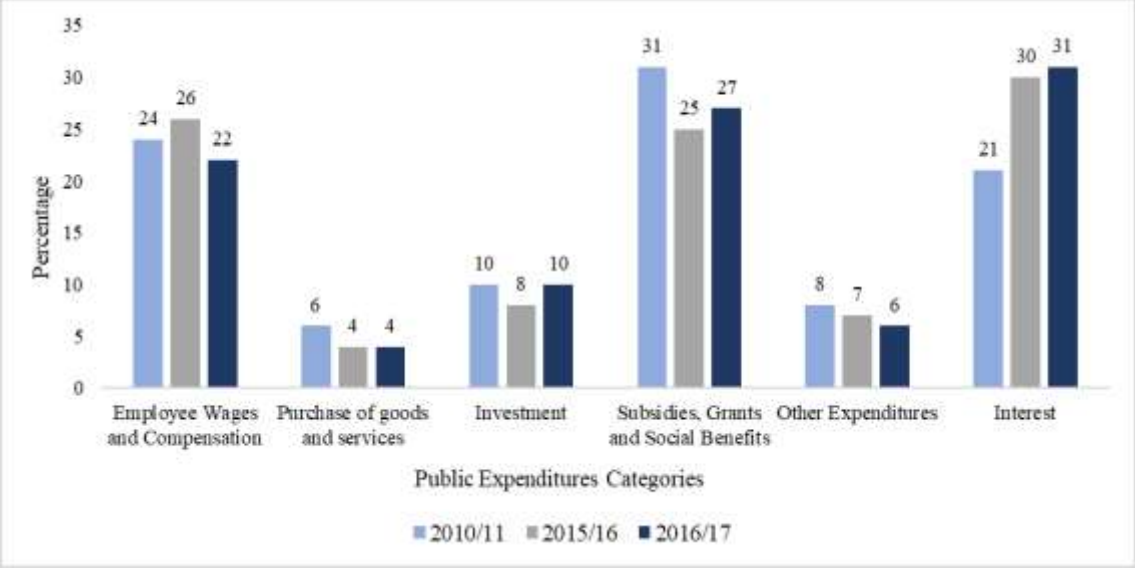
[1] A summary of key measures of the reform program that are relevant to the scope of this study is presented in Appendix I.

[2] Takaful provides conditional monthly income support to poor families with children whose age ranges from 0 to 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 EGP 60 to EGP 140 depending on the educational stage of the child (primary, preparatory, or high school). Karama is a social inclusion program for the elderly, orphans, and people with disabilities that affect their ability to work. It offers an unconditional monthly transfer of EGP 350-450 for the family who has one eligible case, EGP 700-900 for two persons, and EGP 1,050-1,350 for three persons.

1940s to ensure that all Egyptians can satisfy their basic food items given food shortages and the high inflation during World War II while energy subsidies started in 1974 when the increase in international prices pushed the GoE to protect energy users by covering a wide range of products (Abdalla and Al-Shawarby 2017; Akhter et al. 2002; Ecker et al. 2016; Harik 1992).

The different social protection programs in Egypt include cash transfers (contributory and non-contributory), in-kind transfers like ration cards and school feeding programs as well as price subsidies (energy, food, medicine and services). Nevertheless, the programs offered are highly fragmented, poorly targeted and suffer from leakages (World Bank 2015). A closer look at the breakdown of public expenditures prior to the 2014 reform shows that the highest share (around 31 percent) was dedicated to subsidies and grants (Ministry of Finance 2010-2018). In the same vein, spending on subsidies represented around 10 percent of GDP in 2013/14. While food subsidies accounted for 2 percent of GDP and cash transfers reached around 0.17 percent of GDP in 2013/14, energy subsidies had the lion's share, accounting for 6.5 percent of GDP compared to around 3.1 percent of GDP in 2017/18 (Abdalla and Al-Shawarby 2017; Banerjee et al. 2017; International Monetary Fund 2014, 2018; World Bank 2015).

Figure 1. Breakdown of Public Expenditures in Egypt-Percentage (2010/11-2016/17)



Source: Compiled by authors based on data from the Ministry of Finance (2010-2018).

This heavy burden of subsidies was a drain on public finances and hindered the efficient allocation of social spending. For instance, Egypt spent on average 4 percent of annual GDP on education while around 2 percent of GDP was spent on health, which is below the regional average

of 3 percent (2010-2014). In parallel, average out-of-pocket expenditures from 2000 to 2011 reached 56 percent to 61 percent out of total expenditure on health, which places Egypt among the top three countries in the Arab region that have an average of 44 percent. Additionally, this share is above the global average of 32.1 percent and the developing country average of 36.5 percent in 2011 (Banerjee et al. 2017; Ecker et al. 2016).

Consequently, multiple waves of energy subsidies reform began in 2014 by gradually phasing out fuel and electricity subsidies except for liquefied petroleum gas (LPG), as indicated in Table 1. In 2016 and 2017, the LPG price was raised by approximately 87.5 percent and 100 percent, respectively. Furthermore, ration cards of food subsidies were replaced by a voucher-based system with smart cards in 2014-2015.[3] The monthly allowance per card increased from EGP 15 to EGP 50 in 2017-2018 along with capping the number of loaves of subsidized Baladi bread and removing wheat flour subsidies to reduce leakages (Abdalla and Al-Shawarby 2017; Breisinger, et al. 2018a; Ecker et al. 2016). In 2016, Egypt introduced the VAT (13 percent) to replace the General Sales Tax (GST) (around 10 percent) and included more products and services that had previously been exempted. In July 2017, the GoE increased the VAT to 14 percent. (Ministry of Finance 2017).

Table 1. Growth Rates of Prices of Fuel and Electricity Commodities, percent

Commodity	2014	2015	2016	2017
Natural gas	144	0	45	25
LPG	0	0	87	100
Gasoline 80	78	0	47	55
Gasoline 92	41	0	35	43
Gasoline 95	7	0	0	6
Diesel	64	0	31	55
Electricity	31	19	33	40

Source: World Bank (2017).

A number of studies had highlighted the inefficiencies of Egypt's longstanding subsidy system and suggested a positive economic impact when subsidies are replaced with cash transfers or targeted to the needy (Abdel-Baki 2011; Abouleinein, El-Laithy, and Kheir-El-Din 2009; Aboulenein et al. 2010; Akhter et al. 2002; Fan et al. 2006; Kherallah et al. 2000; Löfgren and El-

[3] For a comparison between ration cards and the voucher system as well as eligibility criteria under each system, see Abdalla and Al-Shawarby (2017).

Said 2001). Few studies attempted to simulate the impact of removing energy subsidies at early stages of implementing the reform program in 2015. These papers concluded that energy reforms represent an important step in reducing government deficits and stimulating growth despite their potential adverse effect on welfare (Banerjee et al. 2017; Fathy et al. 2016; Griffin, Laursen, and Robertson, 2016). Additionally, a paper by Elshennawy (2014) found that the gradual removal of energy subsidies combined with the elimination of tariffs have a considerable effect on reducing the burden of phasing out subsidies.

A recent study by Breisinger et al. (2018a) studied the impact of removing energy subsidies by using the standard IFPRI CGE model. The findings of the study indicate that energy reforms negatively affected the macroeconomy in the short-run, but it is expected to accelerate economic growth in the long run. The impact on household consumption is projected to be negative despite the fact that SSN measures mitigated the negative effects on poor households, especially in rural areas.

Nevertheless, these studies narrowly focus on the removal of one type of subsidy (food or energy) and did not sufficiently address the impact of alternative social policies that efficiently allocate government savings following subsidy reforms. Examples include the impact of expanding conditional cash transfers as opposed to unconditional cash transfers,[4] improving progressive direct taxes and expanding pro-poor spending. Furthermore, some measures, such as removing wheat flour subsidies in 2017 and introducing VAT, were neglected or superficially treated. For instance, the IFPRI study by Breisinger et al. (2018a) assumed the VAT to be a uniform rate replacing GST on all goods and services, which disregards the different structure of VAT as well as the necessity to disaggregate the Social Accounting Matrix (SAM) data in order to reflect exempted products and apply different rates to specific products as implemented by the GoE.

Using a computable general equilibrium (CGE) model calibrated to a pre-reform disaggregated dataset, the SAM of the Egyptian economy (2012-2013),[5] and based on actual data on key measures (2014-2018), this paper attempts to fill the aforementioned gaps in the literature by quantifying the effect of fiscal policies and SSN measures undertaken by the GoE. The scope

[4] The impact of conditional and unconditional cash transfers had been recently addressed by Helmy, Richter, Siddig, and Ghoneim (2018).

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

of measures simulated in the paper is limited to: a) fiscal consolidation: the gradual phasing out of subsidies (fuel, electricity, and food) and introducing the Value-Added Taxes (VAT) on domestic products; and b) strengthening SSN by increasing cash transfers.

Given that cash transfers are a transitional mitigation measure undertaken by the government in the short run, an additional objective of this study is to explore the impact of more sustainable policy options like the use of savings from subsidies removal and indirect taxes to increase pro-poor spending, including infrastructure, human capital (health and education), research and development,[6] and SSN. If cash transfer programs are implemented in the absence of complementary policies, they could represent a fiscal drain in the long run.

The contribution of this paper is twofold. First, it models the introduction of differentiated VAT rates to the economy, which had been neglected by previous studies. Modeling VAT is motivated by the anticipated improvement of indirect tax collection and increase of government revenues available to finance cash transfers. Furthermore, the interlinkage of implementing VAT and subsidies reform is expected to affect demand and household welfare. By the same token, imposing multiple VAT rates for commodities and applying exemptions is required for an accurate examination of the impact of indirect taxes and welfare analysis.

For this purpose, a single country CGE model, STAGE, is modified to incorporate the distinct structure of the VAT. Studying the impact of the VAT by using the CGE model adds to the literature showing inconclusive evidence on the impact of the VAT. For example, a study in Vietnam found that the VAT improved household welfare (Giesecke and Hoang Nhi, 2010). On the other hand, the VAT led to a reduction in the welfare of households over the long run in Cameroon and Fiji, while in Iran it led to a decline in GDP (Emini 2009; Narayan 2003; Sajadifar Khiabani, and Arakelyan 2012).

Additionally, this study simulates the combined effect of phasing out energy and food subsidies on Egypt's economy and the welfare of households, a subject that has not been sufficiently addressed by previous studies focusing on studying the impact of removing a single type of subsidies. Countries could seize momentum to twin food and energy subsidy reforms given

[6] According to Article 23 in Egypt's constitution issued in 2014, the government should allocate a percentage of government spending equivalent to at least 1 percent of gross national product to scientific research.

the political and economic window of change during the era of reform (Banerjee et al. 2017).

This paper informs policymakers about the economy-wide effect of key measures of the economic reform program and lays the groundwork for recommending alternative interventions for an efficient allocation of resources. Being a net importer of subsidized products and one of the main countries in the world that highly subsidizes energy and food, the case of Egypt needs to be thoroughly studied. It is expected that the economic costs of reforming subsidies will exceed the direct budgetary costs, given their impact on distorting consumption and investment as well as adversely affecting productivity and growth.

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 simulations. Section 5 discusses the main findings of the paper and Section 6 concludes.

2. METHOD

An economywide model, namely a CGE model, is calibrated to the Egyptian economy to address the aforementioned research objectives. The analysis of the impact of economic policies entails an economywide framework that takes into account factor markets, commodity markets, households, government, and external trade; which is accommodated by CGE models and cannot be studied in a partial equilibrium framework. Additionally, CGE models are suitable for linking households to the macroeconomy, capturing direct and indirect effects as well as estimating the welfare impact of specific policies by comparing the pre- and post-policy analysis.

2.1. Model Structure

The study uses the STAGE1 model, which is a single-country static general equilibrium model developed by McDonald (2007).[7]The General Algebraic Modeling System (GAMS) software is used to generate the calibrated SAM and to implement the model. STAGE has eight main sets: commodities, activities, factors, households, government, enterprises, investment, and rest of the world. Furthermore, the model has ninety-nine variables, seventy-six parameters, and 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

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

II).

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.[8] 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, labor and capital, are inputs used for production and owned by households. Key features of the model are presented in Table 2.

Table 2. STAGE Model Key Features

Time Frame	Static
Theoretical Basis	Neo-Classical
HH Utility Function	Stone-Geary
Trade	Trade is modeled using the Armington insight assuming imperfect substitution between domestically produced and imported goods, which is represented by the Constant Elasticity of Substitution (CES) function. Exports are assumed to be imperfect substitutes for domestically produced goods. This is represented by the 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. 2. Aggregate intermediate inputs use Leontief technology while primary inputs are combined to form aggregate value added using CES technology.
Small/Large Country	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 McDonald (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 transfers 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 household income in addition to factor income, inter-household transfer, payment or dividends from enterprises and transfers from rest of world in domestic currency

[8] 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).

(Equation 2). Accordingly, $hogovconst$ is a parameter of interest that will be shocked to reflect introducing cash transfers as it will be explained in more detail in the following section.

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

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

As for commodities, their price is expressed as the supply price plus ad valorem sales tax (TS_c) and excise taxes (TEX_c) (Equation 3). It is worth mentioning that subsidies on commodities are expressed in the model as negative indirect tax rates.

$$PQD_c = PQS_c * (1 + TS_c + TEX_c) \quad (3)$$

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 sales tax rates and the value of domestic expenditures on commodities (Equation 5).

$$\mathrm{TS}_c = \left((tsb_c + dabts_c) * TSADJ\right) + (DTS * ts01_c) \quad (4)$$

$$STAX = \sum_c (\mathrm{TS}_c * PQS_c * \mathrm{QQ}_c) \quad (5)$$

2.2. Incorporating VAT in the model

The standard model includes eight tax instruments: tariffs, export duties, sales tax, excise tax, production tax, factor use tax, factor income tax and direct income tax. In order to capture the economic and distributional impact of introducing VAT, a separate account for VAT is created and assigned a value of zero in base scenario. Equation 6 was added to define the value added tax rate and indicate multiplicative or additive adjustment mechanisms, which is similar to other tax instruments in the model.

$$\mathrm{TV}_c = \big((tvb_c + dabtv_c) * TVADJ\big) + (DTV * tv01_c) \tag{6}$$

Value added taxes, $VTAX$, are defined in Equation 7 where tv_c is the value added tax rate applied to household purchases, $QCD_{c,h}$. For the government, revenues from VAT are added to total revenues as shown in Equation 8.

$$VTAX = \sum_{c,h}\big(TV_c * PQD_c * \mathrm{QCD}_{c,h}\big) \tag{7}$$

$$YGEQ:\ YG = \mathrm{MTAX} + \mathrm{ETAX} + \mathrm{STAX} + \mathrm{EXTAX} + \mathrm{FTAX} + \mathrm{ITAX} + \mathrm{FYTAX} + \mathrm{DTAX} + \mathrm{VTAX} + \big(\sum_f govvash_{h,f} * YFDISP_f\ \big) + \mathrm{GOVENT} + (govwor * ER) \tag{8}$$

It is assumed that VAT is applied to household purchases since VAT is rebated later to enterprises after reporting to tax authorities. Therefore, the prices of domestically consumed commodities, PQD_c , remain the same for all sources of domestic demand except for households for whom prices are defined as $PQCD_c$ which include VAT (Equation 9). This price replaced PQD_c in household expenditure equation (Equation 10).

$$PQCD_c = PQD_c * (1 + (TVADJ * tv_c)) \tag{9}$$

$$QCDEQ_c:\ \mathrm{QCD}_{c,h} = \frac{\Big((\mathrm{PQCD}_c * \mathrm{qcdconst}_{c,h}) + \mathrm{beta}_{c,h} * \big(HEXP_h - (\sum_c \mathrm{PQCD}_c * \mathrm{qcdconst}_{c,h})\big)\Big)}{PQCD_c} \tag{10}$$

2.3. Model Closures

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) and thus world prices are fixed (Equations 11, 12). Given that Egypt started to move towards a flexible exchange rate regime following the

liberalization of the Egyptian Pound in November 2016, the current account balance is assumed to be fixed (Foreign Exchange Market Closure) (Equation 13).

$$PWE_c = \overline{PWE_c} \quad (11)$$

$$PWM_c = \overline{PWM_c} \quad (12)$$

$$CAPWOR = \overline{CAPWOR} \quad (13)$$

The capital market closure is adjusted to reflect a saving-driven economy and hence allows investment to be flexible depending on savings following the neo-classical approach (Equation 14a-c).

$$SADJ = \overline{SADJ} \quad (14a)$$

$$SHADJ = \overline{SHADJ} \quad (14b)$$

$$SEADJ = \overline{SEADJ} \quad (14c)$$

For the government account closure, tax rates are endogenously adjusted while government savings are fixed. On Factor Market Closure, Capital and Land are assumed to be fully employed and immobile in short run. On labor market, the model deviates from the neoclassical full employment assumption and incorporates unemployment of labor, which is a major feature characterizing labor markets in Egypt. For this purpose, real wages are fixed while labor supply acts as the market clearing variable (imposing Equation 15 and relaxing Equation 16). CPI was selected as a numéraire. Table 3 summarizes the key model closures.

$$WF_{fact} = \overline{WF_{fact}} \quad (15)$$

$$FS_f = \overline{FS_f} \quad (16)$$

Table 3. Key Model Closures

Foreign exchange market	The equilibrating variable is exchange rate (fixed current account balance).
Capital market (Savings-Investment)	The equilibrating variable is investment (savings-driven model)
Government account	Tax rates adjust and government savings are fixed.
Factor markets	- Capital and Land: full employment and immobile in the short run. - Labor: unemployed factor

Source: Compiled by authors.

3. DATA

This paper uses the SAM of the Egyptian economy (2012-2013)[9] aggregated by the Central Agency for Public Mobilization and Statistics (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 (MOP), and Ministry of Agriculture (MOA) (Central Agency for Public Mobilization and Statistics 2016).

Marco-SAM aggregates multiple accounts, such as products, activities, and households, into single accounts (Appendix III). 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—capital, land, and labor—are divided by level of skill, gender, and region (urban or rural), resulting in fourteen accounts. "Skilled labor" 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, public and private as well as financial and nonfinancial enterprises are included in the Micro-SAM while households are differentiated by region (Urban (U) and Rural (R)) and income quintiles (1=poorest quintile to 5=richest quintile). Taxes are included as tariffs, sales tax on domestic products, excise taxes, subsidies, and direct taxes. Additional accounts include savings/gross capital formation, rest of world (ROW), and trade and transport margins on merchandise products.

[9] 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, as they are necessary for the purpose of this study.

In addition to SAM, data such as population per income quintiles and population in adult equivalent by quintiles were obtained from CAPMAS to be used in the model in generating per capita/per adult equivalent results. While the standard model does not account for exogenous unemployment data, the authors integrated it during the calibration process. The labor unemployment rate was set to 13 percent (2012-2013) while unemployment of capital and land was assumed to be equal to zero. It is expected that labor unemployment differs among skilled and unskilled labor in Egypt and by regions. However, due to lack of data, the national unemployment rate is used for the labor 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 the literature applying CGE models on Egypt (e.g. Breisinger et al. (2018a)) in addition to input from CAPMAS[1] .

4. SIMULATIONS

The simulations included in this study, summarized in Table 4, have a baseline scenario that is used as a reference point where the economy has no shocks or policy changes (pre-reform). The first simulation reflects the gradual removal of energy subsidies that took place in 2014-2015, previously illustrated in Table 1, and the increase in cash transfer following the introduction of Takaful and Karama program. Around EGP 1 billion was transferred to Egyptian households during the first year of the program. It is estimated that beneficiaries in the poorest quintile get double the cash amount received by the second quintile while around 80 percent of beneficiaries live in rural areas (Breisinger et al. 2018b; Ministry of Finance 2014-2018.; Ministry of Social Solidarity 2017).

[1] A sensitivity analysis for these values was done and the results remain robust.

In addition to expanding cash transfers and continuing the gradual removal of energy subsidies, the introduction of VAT in 2016 as non-uniform taxes across commodities is simulated in the second simulation. Based on the disaggregation of products included in SAM, VAT was introduced to commodities that were previously charged GST (10 percent). Exempted commodities from GST were identified and taxed if they were not exempted from VAT. By the same token, non-exempted commodities from GST were excluded if they were included in the VAT exemption list. This study followed the rates included in the executive regulations of VAT law given that some commodities (such as tobacco, machinery and equipment) and services (such as telecommunication and construction services) were charged different rates (Ministry of Finance 2017).

The third simulation depicted food subsidies reform that was applied in 2017 in addition to the ongoing removal of subsidies and the increase in cash transfers to reach a cumulative amount of around EGP 16 billion. Subsidies of main food items included in smart cards (like rice, cooking oil, sugar, and pasta) were increased as per the government budget announced by the Ministry of Finance. Moreover, the simulation includes shifting from input- to output-based subsidies by removing subsidies on wheat flour for bakeries and keeping subsidies on the final product (bread) (Ministry of Finance 2014-2018).

Finally, the last simulation models a hypothetical scenario the potential increase in pro-poor spending by using savings from fiscal reforms to increase public spending on infrastructure (e.g., sanitation, roads, and electricity transmission); human capital (health and education) as well as research and development; while expanding cash transfers (spending on SSN).

Table 4. Summary of Simulations

Baseline: Pre-Reform	
Reforms (2014-2017)	Sim 1: Partial removal of energy subsidies and increasing cash transfers (2014/15)
	Sim 2: Further removal of energy subsidies, cash transfers are expanded and VAT is introduced (2016)
	Sim 3: Further removal of energy subsidies, cash transfers are expanded, subsidies increased for selected food commodities while wheat flour subsidies are removed (2017)
Potential Reforms	Sim 4: Full removal of food and energy subsidies and increased pro-poor spending (infrastructure, human capital, research and development and social safety nets).

Source: Compiled by authors.

5. RESULTS

5.1. Analysis of SAM Data

Selected figures based on SAM data are presented in Appendix IV. A closer look at household accounts (Figure a), which are of high interest to this research, shows that the highest urban quintile (U5) spends about 23 percent of total household final consumption expenditure, compared to 18 percent for the highest rural quintile (R5). On the other hand, the lowest quintiles in urban and rural areas 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 (CAPMAS 2016).

The share of household final consumption expenditures on selected commodities indicates that more than 50 percent of energy expenditure on Gasoline 80, 90, and 92 comes from the highest urban quintile, followed by the highest rural quintile that spends around 15 percent of total expenditures on these commodities. By the same token, the biggest share of spending on electricity and Diesel is derived from the highest urban and rural quintiles. This trend is reversed for LPG, Gasoline 95, and Kerosene since the highest rural quintile spends more than their urban counterpart. Minor shares of expenditures on energy products are spent by the lowest income quintiles except for LPG and Kerosene. These numbers point out that high-income households tend to spend more on energy products than low-income households, especially in urban areas, which indicates that the former group benefits more from universal energy subsidies. Spending on education is mainly derived from urban households, while rural households lead spending on health and sanitation services.

As for household and factors of production (Figure b), the distribution of returns to factors of production (labor, land and capital) shows that 63 percent of income of the highest urban quintile is derived from capital (profits), while 37 percent comes from labor (33 percent) and land (4 percent). Moreover, the income of the lowest urban quintile of households (U1) comes from labor (wages 56 percent), capital (profits 43 percent), and land (rents 1 percent). This considerable share of profit could be potentially derived by the contribution to informal microenterprises. As for rural areas, the income of the highest quintile is distributed as follows: capital (57 percent), labor (36 percent), and land (7 percent). The lowest quintile's income comes from labor (52 percent), capital (47 percent), and land (1 percent). Labor 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.

5.2.Macroeconomic Indicators

Fiscal reforms lead to a redistribution between GDP components from private consumption (a major component of GDP) to investment, given that investment is estimated to increase between 2 percent (gradual removal of subsidies in Sim 1) and 16 percent (full removal of subsidies in Sim 4)[1] . However, the increase in investment could not compensate for the decrease in private consumption that reaches up to 4 percent compared to baseline scenario, leading to a decline in real GDP as subsidies are removed and VAT is introduced (Table 5).

This adverse effect on GDP and the increase in investment are in line with the results of Breisinger et al. (2018a). As will be explained subsequently, inflationary pressures that resulted from subsidies removal and VAT had a detrimental effect on production, demand for labor and private demand leading to a reduction in GDP. While reforming subsidies is projected to have a positive effect on long-term growth due to removing distortions and rationalizing use of commodities, in the short run it might have a contractionary effect (Sdralevich, Zouhar, and Albertin 2014).

It is worthy of note that Sim 4 indicates that government consumption demand will be directed to sewage and electricity transmission by 5 percent, followed by health services (3 percent), education (1 percent).

Table 5. Real Macroeconomic Indicators (percentage change from base)

	Private Consumption	Government Consumption	Total Investment	Real GDP
GDP Share	83	11	18	
Sim 1	-0.94	2.43	2.48	-0.93
Sim 2	-4.26	1.15	15.11	-0.89
Sim 3	-3.53	1.61	11.4	-0.06
Sim 4	-3.82	1.63	16.35	-0.15

Source: Results from Egypt's CGE model.

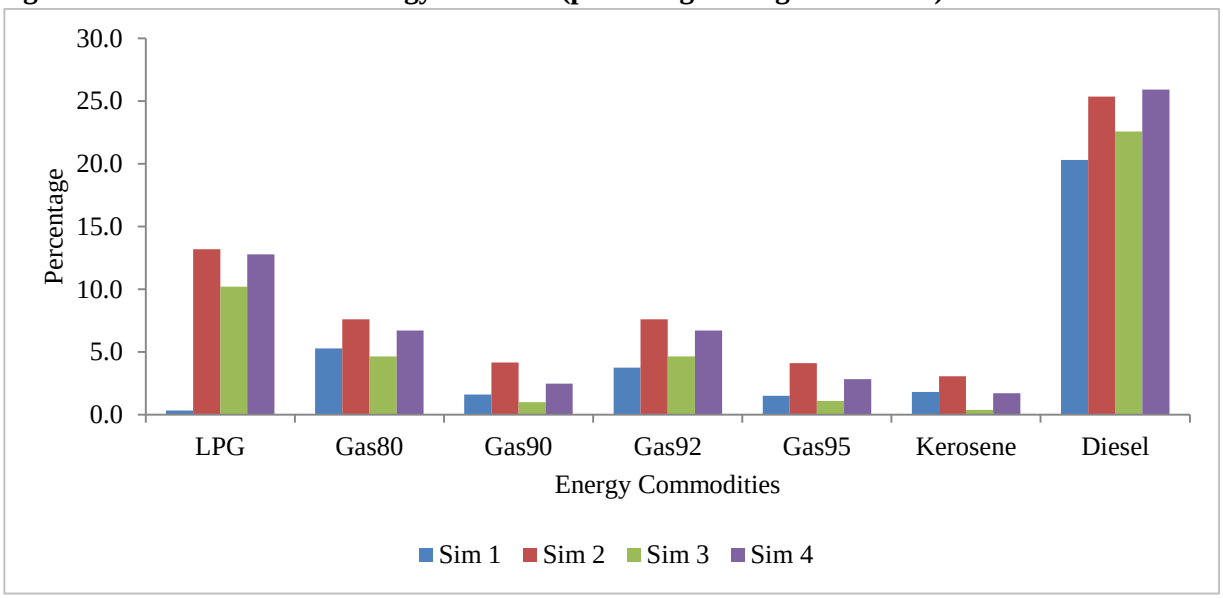
[1] According to IMF (2019), the contribution of private consumption to real GDP growth declined from 5.0 percent in 2011/12 to 3.8 percent in 2015/16 and 1.0 percent in 2017/18. On the other hand, the contribution of investment increased from 0.8 percent in 2011/12 to 1.7 percent in 2015/16 and 2.4 percent in 2017/18.

5.3. Sectoral Effects

The percentage change in consumer prices of selected energy products due to different simulations is shown in Figure 2. Looking at different commodities, LPG, which is mostly consumed by poor households, experiences a high increase in prices that reaches around 13 percent with the removal of subsidies. Moreover, prices of diesel largely increases by around 25 percent in addition to the increase in consumer prices of gasoline. Figure 3 explains the change in prices of other commodities. Prices of tobacco and telecommunications experience a large increase with introducing VAT (Sim 2) in addition to the inflationary pressures on food commodities[1] . The combined removal of subsidies had the largest adverse impact on the price of sugar, which increases by 11 percent, followed by rice (10 percent).

Phasing out subsidies acts as a negative shock for the production sector, particularly with the price hike of energy products. The impact of this negative shock might extend from energy-intensive industries to less-energy intensive sectors such as agriculture (Sdralevich et al. 2014). As indicated in Table 6 , higher prices have a harmful impact on total domestic production due to the increased production cost, especially in energy-intensive sectors like transport, mining, and utilities.

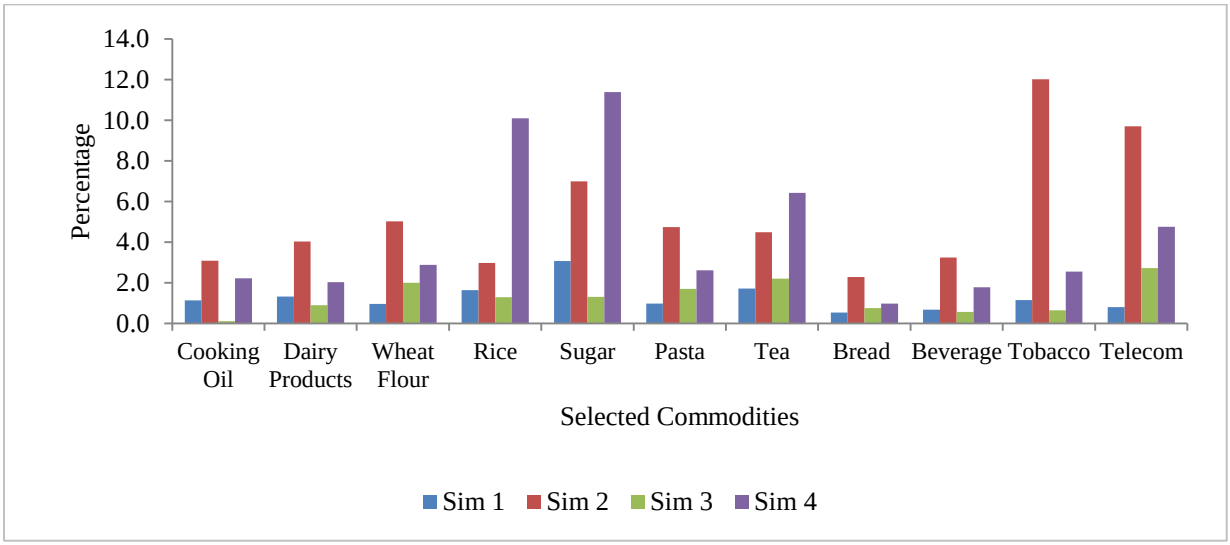
Figure 2. Prices of Selected Energy Products (percentage change from base)



Source: Results from Egypt's CGE model.

[1] IMF (2019) shows that the hikes in headline inflation are mostly driven by increase in energy and food prices.

Figure 3. Prices of Selected Products (percentage change from base)



Source: Results from Egypt's CGE model.

As subsidies are gradually removed and VAT is introduced, the production of economic sectors are affected differently. For instance, significant growth occurs in the construction sector, where domestic production increased up to 17 percent[1] . Accordingly, the aforementioned increase in investment is probably derived from the boost in the construction sector, given that SAM data shows that construction services are strongly related to investments (around 65 percent of investment demand) (Breisinger et al. 2018a).

The results show that when VAT excludes the majority of activities related to scientific research, the sector starts to pick up. On the other hand, beverages, tobacco production and telecommunications activities are highly affected by the differentiated VAT rate. Increasing food subsidies (Sim 3) will slightly improve food production compared to other simulations due to the increase in production of sugar (5 percent) and cooking oil (3 percent), compared to the decline of wheat flour by 4 percent. A closer look at the results of Sim 4 signals its positive impact on various sectors, including sewage (19 percent), education (15 percent) and health (5 percent).

In the process of fiscal reforms, demand for labor declines in most sectors except construction, which is consistent with production changes (Table 7). The construction sector's

[1] According to IMF (2019), the contribution of construction to real GDP growth rate increased from 0.1 percent in 2011/12 to 0.5 in 2015/16 and 2017/18.

demand for labor increases by 1 percent (Sim 1), 17 percent (Sim 2), 15 percent (Sim 3), and 21 percent (Sim 4). However, the majority of labor working in this sector are semi-skilled and unskilled males.

Table 6. Domestic Production (percentage change from base)

	Base value (Billion EGP)	Sim 1	Sim 2	Sim 3	Sim 4
Agriculture	437	-1.29	-2.94	-1.43	-2.40
Mining	266	-1.24	-2.97	-2.70	-2.67
Food production	198	-0.01	-4.78	0.08	-3.54
Beverages production	18	-0.50	-6.02	0.51	-3.04
Tobacco production	11	-0.66	-24.87	-23.32	-23.34
Manufacturing	805	-2.74	-3.19	-2.07	-2.82
Computer and electronics	10	-2.41	-3.33	3.18	5.23
Machinery and equipment	13	-3.85	0.83	1.62	2.85
Motor vehicles	17	-2.84	-3.77	2.81	4.86
Utilities	148	-2.22	-2.60	-4.37	1.51
Sewage	2	-0.72	-4.31	-0.44	19.81
Construction	213	2.05	2.28	12.01	17.41
Services	900	-1.67	-3.37	-2.03	-3.50
Transport	104	-4.70	-5.90	-7.26	-29.37
Telecom	56	-0.64	-6.08	-2.00	-3.18
R&D	5	-0.04	0.36	0.24	0.55
Education	89	-1.43	-2.41	-0.42	15.14
Health	61	-3.08	-4.54	-1.98	4.81

Source: Results from Egypt's CGE model.

Structural change involves relocating output and jobs from less-productive sectors (traditionally agriculture and mining) to more-productive ones like manufacturing or services (R&D, finance… etc.). Within manufacturing, it can take place by moving away from sectors based on natural resources (petroleum, textiles, food industry) to higher value-added and technology-intensive subsectors like electronics and computers (El-Haddad 2015). On the positive side, the dynamics within the manufacturing subsectors start to change in favor of computers and electronics production that improves by 3 to 5 percent, pushing up demand for labor by around 2 percent. By the same token, production of machinery and equipment was positively affected by the differentiated VAT rate and started to increase in Sim 2 to Sim 4 by 1 to 3 percent.

Table 7. Demand for Labor (percentage change from base)

	Base Value (Billion EGP)	Sim 1	Sim 2	Sim 3	Sim 4
Agriculture	31	-2.53	-5.32	-1.83	-3.49
Mining	5	-5.12	-7.40	-4.77	-7.73
Food production	10	-1.83	-4.95	-0.15	-8.03
Beverages production	1	-0.63	-3.70	-0.80	-2.81
Tobacco production	1	-1.75	-2.61	-2.11	-4.21
Manufacturing	31	-2.53	-5.32	-1.83	-3.49
Computer and electronics	1	-2.30	-0.40	2.21	1.95
Machinery and equipment	1	-3.73	0.84	1.32	0.29
Motor vehicles	1	-2.77	-0.31	2.03	1.52
Utilities	20	-3.55	-6.14	-2.31	3.07
Sewage	1	-1.83	-4.42	-0.72	21.47
Construction	9	1.28	16.97	14.82	20.98
Services	293	-1.95	-3.73	-0.83	2.39
Transport	18	-1.77	-4.67	-1.15	-2.90
Telecom	5	-1.06	-10.50	-3.16	-5.42
R&D	0.2	-0.46	12.11	14.99	20.8
Education	63	-2.08	-3.66	-0.67	18.82
Health	23	-4.72	-7.36	-3.05	5.61

Source: Results from Egypt's CGE model.

Nevertheless, there is no large-scale reallocation of labor from high to low productive industries, but rather jobs are reallocated to the informal unskilled sector such as the construction sector that has poor labor productivity, as per the study of Morsy, Levy, and Sanchez (2014), and provides real estate products that are demanded by the richest quintile of rural households (R5). The findings suggest that even when Egypt removes distorting subsidies the trend of growing without structural transformation discussed by Morsy, Levy, and Sanchez (2014) may continue, which increases the likelihood of reform reversals.

Demand for labor in the R&D sector is stimulated by the non-uniform VAT rate, which is expected to foster productivity growth (El-Haddad 2015). On the other hand, telecommunications services face a strong decline in labor given that VAT rates are particularly high for these services. Sim 4 indicates that labor demand will start to be directed to other sectors such as R&D, education and health. These sectors employ mostly skilled/semi-skilled males and females, which is expected to contribute to improving productivity and increasing female employment in Egypt.

Total final domestic demand in Egypt's economy witnesses a decline as subsidies are removed and VAT is introduced (Table 8). Reforming subsidies will reduce the final demand for energy commodities with a larger percentage for diesel (12 percent) and electricity (10 percent) in Sim 4, as well as the demand for transport products in favor of construction services, whose demand increases by 2 percent (Sim 1) to 16 percent (Sim 4). Differentiated VAT rates had

negatively affected tobacco products and telecommunications services, while demand for R&D services will slightly increase. The results of Sim 4 indicate an improvement in demand for education, sanitation services (15 percent) and health (5 percent). Moving to food products, Sim 3 shows that demand for sugar, rice, cooking oil and bread will increase when food subsidies increase as opposed to a decline in demand for wheat flour.

Table 8. Domestic Final Demand (percentage change from base)

	Base Value (Billion EGP)	Sim 1	Sim 2	Sim 3	Sim 4
Agriculture commodities	400	-0.66	-1.90	-1.42	-2.48
Natural resources	192	-2.53	-2.79	-2.40	-3.03
Food products	215	-0.08	-0.87	-0.28	-3.65
Cooking oil	22	0.19	-1.67	2.63	-7.05
Wheat flour	24	0.20	-4.77	-4.29	-4.93
Rice	7	0.10	-0.96	1.43	-4.42
Sugar	13	0.47	-6.81	5.92	-6.68
Bread	62	-0.56	-2.42	1.74	-2.82
Tobacco	10	-0.49	-16.31	-12.16	-12.17
Manufacturing	403	-2.26	-1.20	-0.65	-0.68
LPG	36	-3.73	-6.98	-6.48	-8.98
Gasoln80	27	-4.69	-6.69	-6.19	-8.62
Gasoln90	4	-3.76	-5.81	-5.29	-7.59
Gasoln92	27	-4.29	-6.69	-6.19	-8.62
Gasoln95	0.22	-3.77	-5.82	-5.34	-7.71
Kerosene	1	-3.35	-3.82	-3.64	-5.28
Diesel	115	-7.02	-9.79	-9.20	-12.01
Electricity	18	-1.83	-7.15	-5.97	-10.52
Utilities	146	-1.02	-5.54	-4.39	-6.90
Sanitation	3	7.80	-5.49	-2.65	15.02
Construction	209	1.69	15.05	11.31	16.19
Services	1142	-1.71	-3.85	-2.31	-3.09
Transport	127	-3.19	-6.17	-5.13	-7.10
Telecom	53	-0.29	-7.57	-2.34	-3.67
R&D	5	-0.04	0.33	0.24	0.55
Education	89	-1.43	-2.40	-0.42	15.14
Health	65	-2.94	-4.13	-1.90	4.67

Source: Results from Egypt's CGE model

5.3. Welfare Effects

Moving on to the impact of reforms on households, real income decreases for all households during fiscal reforms by a varying extent (Table 9), despite the effective role played by SSN measures in

protecting the poor from short-term negative effects at early stages of reform (Sim 1). Although the main recipients of government protection measures like cash transfers, poor households in the first and second quintiles face a reduction in real income when energy subsidies are phased out and VAT are introduced (Sim 2). On the other hand, Sim 3 indicates that expanding food subsidies in 2017 mitigated the adverse effect of fiscal reforms. Sim 4 reveals that rural households in the lowest quintile have a slight improvement in income even if food and energy subsidies are fully removed due to increasing cash transfers.

This reduction in income is explained by the drop in income to factors of labor and capital (wages and profits), which particularly constitute a large share of poor households' income (Table 10). The decrease in income to labor factors ranges from 1 to 7 percent, while the decline in profits reaches up to 6 percent. The decrease in return on capital can potentially be explained by the decrease of capital productivity in energy sectors, and to a lesser extent by the decrease of productivity in other sectors.

Table 9. Household Income (percentage change from base)

	U1	U2	U3	U4	U5	R1	R2	R3	R4	R5
Base Value (Billion EGP)	66	99	125	171	437	79	113	142	173	340
Sim 1	0.34	-0.13	-0.21	-0.44	-1.24	0.81	0.33	-0.19	-0.13	-0.75
Sim 2	-5.28	-5.58	-5.68	-5.68	-5.75	-4.42	-5.19	-5.60	-5.61	-5.71
Sim 3	-2.00	-2.30	-2.41	-2.42	-2.52	-1.15	-1.81	-2.30	-2.31	-2.44
Sim 4	-2.39	-3.31	-3.71	-3.74	-3.86	0.51	-2.23	-3.69	-3.70	-3.82

Source: Results from Egypt's CGE model.

Table 10. Income to Factors (percentage change from base)

	Labor	Capital	Land
Base value (billion EGP)	411	1,392	16
Sim 1	-7.15	-2.88	-1.99
Sim 2	-4.58	-6.54	-5.38
Sim 3	-1.28	-3.02	-1.55
Sim 4	-2.48	-4.45	-4.93

Source: Results from Egypt's CGE model.

Furthermore, household welfare, measured by the Slutsky equivalent variation, is adversely affected by the gradual removal of subsidies and introducing VAT (Table 11). Increasing food subsidies (Sim 3) tends to lower the welfare losses of poor rural households, given that welfare decreased by 2.3 percent and 1.3 percent for R1 and R2, respectively. When cash transfers increased (Sim 4), poor rural households face a marginal gain in welfare (2.8 percent). It is worth

mentioning that fully removing energy and food subsidies (Sim 4) has the largest negative impact on the welfare of the middle-income households in rural areas (R3), which declines at a larger percentage than low-income households (R1 and R2) as well as high-income households (R4 and R5). These results differ from previous studies, which found that phasing out subsidies has the largest adverse impact on the welfare of rich households compared to middle and lower income households (Abouleinein et al. 2009; Banerjee et al. 2017).

Table 11. Equivalent Variation relative to Base Consumption Expenditure (percentage)

	U1	U2	U3	U4	U5	R1	R2	R3	R4	R5
Sim 1	5.10	-5.80	-1.10	-7.10	-7.30	12.30	6.90	-0.70	0.80	-5.10
Sim 2	-3.16	-4.35	-3.58	-3.76	-3.89	-2.21	-3.01	-3.83	-3.54	-2.93
Sim 3	-1.38	-2.49	-1.72	-2.15	-2.79	-2.30	-1.30	-2.26	-1.92	-1.85
Sim 4	-2.17	-3.79	-2.98	-3.46	-3.72	2.80	-2.10	-3.90	-3.40	-2.93

Source: Results from Egypt's CGE model.

A detailed look at the consumption of different types of households by commodities[14] reveals that energy consumption drops instantaneously as energy subsidies are gradually removed and VAT is imposed. The full removal of subsidies mainly affects consumption of energy products of high-income households in rural areas (R5) despite their lower share of consumption compared to urban regions. The consumption of poor households is largely affected by removing LPG subsidies compared to other energy products, which confirms the relative importance of this product to the poor and the progressive nature of these subsidies compared to other subsidies (Sdralevich et al. 2014).

Regarding food commodities, increasing food subsidies on other items (Sim 3) has a strong regressive impact in rural areas where households at the highest income quintile will have the largest increase in food consumption, showing that this group benefits most from inefficient and untargeted food subsidies. Cutting food subsidies in the fourth simulation indicated that the consumption of sugar of poor households is particularly affected, which supports the progressivity of this subsidy (Sdralevich et al. 2014).

When food subsidies are phased out and households are provided with expanded cash transfers in Sim 4, poor rural households (R1) spent more on food items like meat and dairy products by around 1 percent. These results echo the conclusion of Ecker et al. (2016) who showed

[1] Selected results are presented in Appendix V- Table a and Table b for Sim 3 and Sim 4, respectively.

that subsidizing food might lead to overconsumption of calorie-rich food items, like sugar, cooking oil and rice, instead of balanced diets, which contributed to a high rate of malnutrition in Egypt. Similarly, the expenditures of poor rural households on health and education improved by around 2 percent, which is expected to positively affect their human capital in the long run.

6. CONCLUSION AND POLICY IMPLICATIONS

This paper explores the economy-wide impact of recent fiscal policy reforms and social safety net (SSN) measures in Egypt, using a CGE model calibrated to data representing the Egyptian economy, namely a disaggregated SAM (2012-2013). Additionally, it studies the impact of the use of savings from subsidies reform and indirect taxes to increase pro-poor spending on infrastructure, human capital (health and education), research and development, and SSN. The study is distinguished by modeling a number of features of VAT such as multiple rates and exemptions, as well as stimulating the combined effect of phasing out consumer price subsidies on both energy and food products. The simulated fiscal reforms led to a decline in real GDP during the reform process, given the estimated decline in private consumption, which offset the increase in investment.

The findings of this paper suggest that the recent fiscal measures had a negative impact on private consumption and domestic demand. Inflationary pressures crowd out the production and demand for labor in food production and energy-intensive sectors that were heavily subsidized by the government, such as transport, mining, and utilities, in favor of the construction sector. The latter constitutes a large share of investment demand in Egypt and is characterized by employing semi-skilled and unskilled males. These results indicate that even if inefficient subsidies are removed, structural transformation may be hindered. Nevertheless, the dynamics within the manufacturing subsectors start to change in favor of computers and electronics, machinery and equipment, and motor vehicle production, signaling a potential move toward structural transformation when distorting subsidies are removed.

Introducing differentiated VAT rates to the Egyptian economy has a favorable impact on the R&D sector, which starts to pick up in terms of production and demand for labor. In contrast, beverages, tobacco and telecommunications sectors are among the sectors that are adversely affected by price increases as well as reduced production and demand for labor.

This paper investigates alternative policies for an efficient use of government savings by expanding pro-poor spending following the full removal of energy and food subsidies. The results of this scenario signal that fiscal reforms start to pay off when combined with efficient allocation of savings. Sectors such as sanitation, health, and education will improve in terms of consumer demand and production, which boosts demand for skilled/semi-skilled males and females. This scenario adds synergy to the boost in the R&D sector and shows a large positive impact on the production of manufacturing subsectors like computers, and electronics.

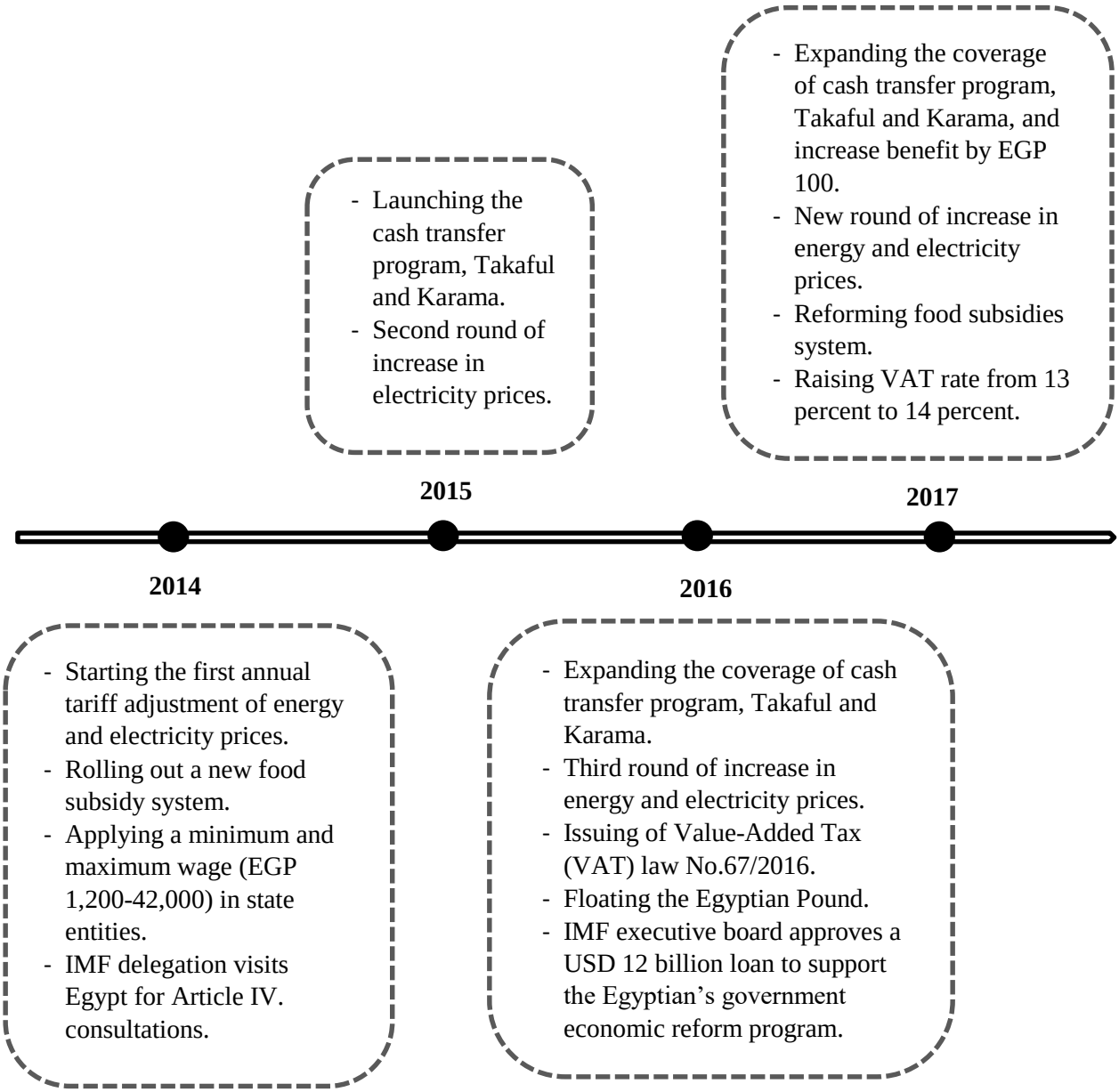
Egyptian households are affected through different channels in the process of fiscal reforms, including direct impact of consumer prices on expenditures and indirect impact on return to factors, which affect their income. Unlike previous studies, the welfare effects imply that middle-income households will be the most harmfully affected group in rural areas by fiscal reforms. The scenario simulating the full removal of all subsidies and increasing pro-poor spending reveals that rural households in the lowest income quintile face a marginal gain in welfare. These results imply that they are better off compared to other scenarios, including the increase in food subsidies, given the equitable effect of increasing targeted cash transfers and increasing investment in infrastructure and human capital.

The results of this study suggest some important policy implications. The planned full removal of energy and food subsidies over the coming years needs to be backed up by substantial pro-poor spending on infrastructure, human capital, and R&D to maintain the reform momentum, make progress in achieving structural transformation and avoid being locked in a low productivity trap. Accordingly, fiscal policies could create the necessary fiscal space to make strategic public investment choices that stimulate demand for skilled labor. Reallocating government savings could also create positive externalities beyond the impact discussed in this study by inducing high social return, improving human capital, and reducing inequality and poverty in the long run. Finally, expanding targeted cash transfers that allow poor households to maintain their pre-reform welfare and addressing the harmful impact of reforms on the middle class are fundamental building blocks for the future.

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.

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. Despite capturing the economy-wide impacts of reforms, CGE models have limited predictive capacity of replicating the development path of a country which is determined by multiple interdependent policies and events. Future work 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 and nutrition.

APPENDIX I. SUMMARY OF KEY MEASURES OF ECONOMIC REFORM PROGRAM (2014-2017)



Source: Authors' compilation based on International Monetary Fund (2018); World Bank (2017) and the Egyptian Center for Economic Studies (2015-2018).

APPENDIX II. STAGE MODEL

a. Sets and Accounts

a.1 Sets	
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**

a.2 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
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

a.2 List of Parameters	
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
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

a.3 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

a.3 List of Variables	
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 comm'y 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

a.3 List of Variables	
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:

b.1 Exports Block:

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

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

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

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

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

b.2 Imports Block

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

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

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

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

b.3 Commodity Price Block

a) $PQDDEF_c$: $PQD_c = PQS_c * (1 + TS_c + TEX_c)$
b) $PQSDEF_c$: $PQS_c = \frac{(PD_c * QD_c + PM_c * QM_c)}{QQ_c}$ $\forall cd\ OR\ cm$

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

b.4 Numeraire Block

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

b.5 Production Block

a) $PXDEF_a$: $PX_a = \sum_c ioqxacqx_{a,c} * PXC_c$
b) $PVADEF_a$: $PX_a * (1 - TX_a) * QX_a = (PVA_a * QVA_a) + (PINT_a * QINT_a)$
c) $PINTDEF_a$: $PINT_a = \sum_c \left(ioqtdqd_{c,a} * PQD\right)_c$
d) $ADXEQ_a$: $ADX_a = [(adxb_a + dabadx_a) * ADXADJ] + (DADX * adx01_a)$
e) $QXPRODFN_a$: $QX_a = AD_a^x * \left(\delta_a^x QVA_a^{-rhoc_a^x} + (1 - \delta_a^x) QINT_a^{-rhoc_a^x}\right)^{\frac{1}{-rhoc_a^x}}$ $\forall aqx_a$

f) $QXFOC_a$: $\frac{QVA_a}{QINT_a} = \left[\frac{PINT_a}{PVA_a} * \frac{\delta_a^x}{(1-\delta_a^x)}\right]^{\frac{1}{(1+rhoc_a^x)}}$ $\forall aqx_a$
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) $QVAFOC_{f,a}$: $WF_f * WFDIST_{f,a} * \left(1 + TF_{f,a}\right) = PVA_a * QVA_a * AD_a^{va} * \left(\sum_{\delta_{f,a}^x} \delta_{f,a}^x * ADFD_{f,a} * FD_{f,a}^{-\rho_a^{va}}\right)^{-1} * \delta_{f,a}^x * ADFD_{f,a}^{-\rho_a^{va}} * \delta_{f,a}^x * FD_{f,a}^{(-\rho_a^{va}-1)}$

k) $QINTDEQ_c$: $QINTD_c = \sum_a ioqtdqd_{c,a} * QINT_a$

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

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

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

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

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

b.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) $GOVENT_e$: $GOVENT_e = goventsh_e * (YE_e * (1 - (\mathrm{TY}E_e)) * (1 - \mathrm{SEN_e}) - \sum_c QED_c * \mathrm{PQD}_c$

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

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

b.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) $DTAXEQ$: $DTAX = \sum_h(\mathrm{TYH_h} * \mathrm{YH}_h) + \sum_e(\mathrm{TYE_e} * \mathrm{YE})$

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

b.12 Investment Block

a) $SHHDEF_h$: $SHH_h = \left(\left(shhb_h + dabshh_h\right) * SHADJ * SADJ\right) + \left(DSHH * DS * ssh01_h\right)$

b) $SENDEF_e$: $SEN_e = \left(\left(sen_e + dabsen_e\right) * SEADJ * SADJ\right) + \left(DSEN * DS * sen01_e\right)$

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) $INVEST$: $INVEST = \sum_c\left(\mathrm{PQD}_c * \left(QINVD_c + dstocconst_c\right)\right)$

b.13 Foreign Institutions Block

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

b.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) $WALRASEQ$: $TOTSAV = INVEST + WALRAS$

b.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 $\overline{PPI}$

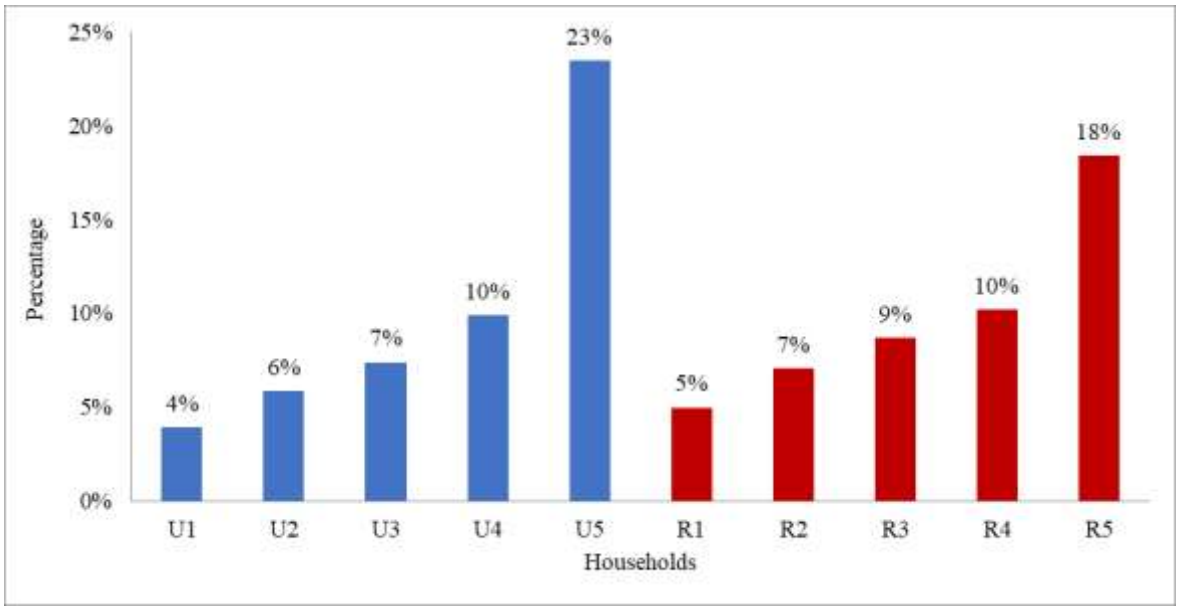
APPENDIX III. EGYPT MACRO-SAM DATA (BILLION EGP)

	Products	Activities	Production Factors	Households Sector	Enterprises Sector	Government	Saving/Gross Capital Formation	Rest of 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 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).

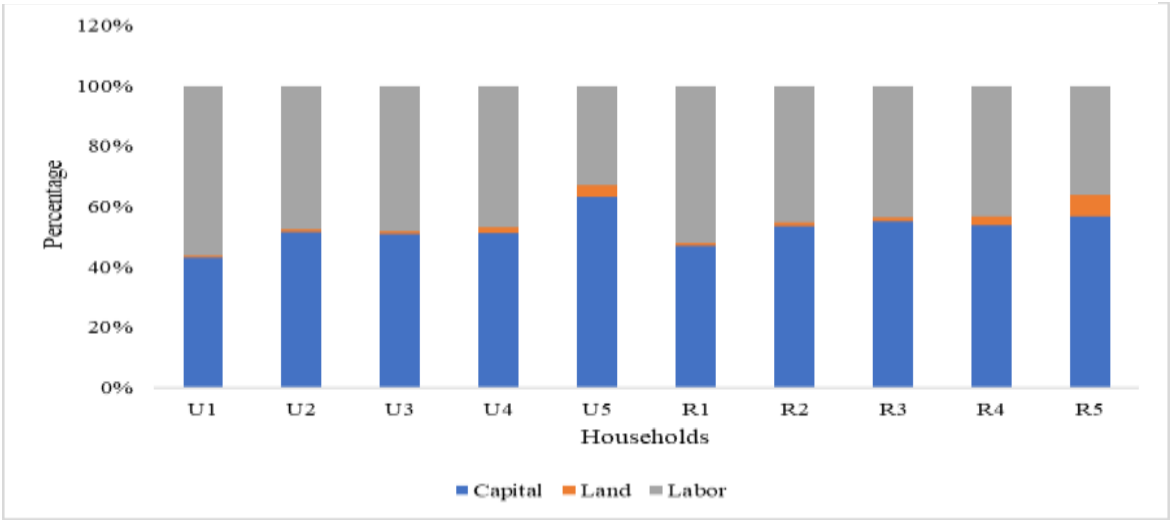
APPENDIX IV. ANALYSIS OF SAM DATA-SELECTED FIGURES

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).

APPENDIX V. HOUSEHOLD CONSUMPTION BY COMMODITIES (PERCENTAGE CHANGE FROM BASE)- SELECTED RESULTS

Table a: Sim 3

	LPG	Real Estate	Wheat Flour	Rice	Sugar
U1	-8.19	-1.20	-1.98	0.73	3.38
U2	-9.29	-3.03	-2.55	0.14	2.77
U3	-12.76	-0.75	-2.89	1.60	5.98
U4	-9.17	-2.42	-2.41	0.37	3.10
U5	-10.13	-3.16	-2.76	0.20	3.10
R1	-15.42	-2.54	-2.87	3.35	9.44
R2	-10.91	-0.22	-2.39	1.54	5.39
R3	-19.56	0.50	-4.13	3.13	10.23
R4	-18.10	0.40	-3.83	2.87	9.43
R5	-30.08	3.90	-5.78	6.10	17.74

Table b: Sim 4

	LPG	Real Estate	Wheat Flour	Rice	Sugar	Education	Health
U1	-9.83	-1.97	-2.43	-2.88	-4.39	-4.74	-4.10
U2	-11.35	-4.86	-3.29	-3.71	-5.17	-7.52	-6.92
U3	-15.43	-1.91	-3.60	-4.34	-6.85	-6.50	-5.45
U4	-11.27	-4.25	-3.16	-3.60	-5.11	-7.01	-6.39
U5	-11.97	-4.13	-3.28	-3.76	-5.41	-7.14	-6.45
R1	-16.71	-7.05	-2.22	-3.31	-7.06	2.21	1.77
R2	-12.98	-0.53	-2.83	-3.48	-5.72	-4.61	-3.68
R3	-23.49	-0.38	-5.02	-6.22	-10.33	-7.89	-6.18
R4	-21.79	-0.56	-4.70	-5.80	-9.59	-7.48	-5.90
R5	-35.21	5.74	-6.36	-8.37	-15.23	-6.80	-3.94

Source: Results from Egypt's CGE model.

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