Chapter Five

Public Spending, Growth, and Poverty Reduction in Egypt: A Multi-level Analysis

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1. Introduction

Egypt is a lower middle-income country with a per capita GDP of US$ 3,949 in 2003 measured in international dollars (or purchasing power parity) (World Bank 2005). Over the 1975 to 1985 decade, Egypt enjoyed rapid economic growth. However, with the collapse of oil prices after 1986, Egypt faced a period of economic slowdown. Mounting poverty, unemployment and significant macroeconomic imbalances, led to the adoption of economic reform programs. Following these reforms, the Egyptian economy showed signs of steady improvement from, 1994 to 2004, with an annual GDP growth of 4.6% (World Bank, 2005).

Still, poverty remains a serious problem in Egypt today. About 16% of the Egyptian population was poor in 2000, most of whom live in the rural sector. Moreover, Egypt still lags behind many middle income countries in key social indicators. In order for Egypt to achieve the Millennium Development Goals of halving the number of poor between 1990 and 2015, a radical approach has to be taken.

Government expenditures are important instruments for promoting economic growth, reducing poverty, and for improving the distribution of income. As Egypt is undergoing macroeconomic adjustments and facing tight budgets, it is critical to analyze the relative contributions of various expenditures to growth and poverty reduction. Valuable insights can thus be gained to further improve the allocative efficiency of limited, even declining public resources.

The overarching objective of this report is to use a multi-level analysis approach to assess the ex-post effects of various government expenditures on growth and poverty reduction and their trade-offs between these two goals and to offer future policy options to achieve the Millennium Development Goals (MDGs). The study will involve analyses and simulations at the different levels: household, sectoral and regional as well as macro levels. Different analytical tools will be used at the different levels. Analyses at each level will be initially executed independently, but a final synergy will be drawn through an integrated macro-micro framework.

This study is organized as follows: The next section reviews the trends in economic and agricultural growth as well as poverty in Egypt. In the third section, the major trends in public expenditures in various sectors are discussed. Section four models the effects on income and poverty status of access to infrastructure and technology and human capital at the household level using the integrated household budget surveys conducted by IFPRI in 1997. Section five estimates the effects of public spending on growth and poverty reduction using the governorate level data. Section six simulates the effects of government spending and its allocation on economic growth and poverty reduction at the macro-level using an economy-wide approach. In particular, it will simulate how Egypt can achieve its MDGs by reforming its public spending policy. Finally, we conclude the report by providing a summary and synergy across different levels of analysis

2. Growth and Poverty in Egypt

This section offers a brief review of Egypt's economy, its agricultural sector, and its poverty trends. The associated changes in institutions and policies are also highlighted, in order to provide an analytical base for the evaluation of the impact of public investments on growth and poverty reduction.

Economic Growth

Egypt's economy has undergone significant transformation over the past four decades. During the 1960s and early 1970s, Egypt followed an inward looking economic strategy, characterized by a complete reliance on the domestic market and extreme skepticism of private foreign investment. GDP grew by 3.24% per annum from 1965 to 1974 (Table 1).

In 1974, an official open door policy was initiated, marking a shift towards greater integration into the world economy. Egypt increasingly liberalized foreign trade, increased private foreign investment, and became more open to modern technology. As a result of these reforms and with the oil sector booming, GDP grew quickly by an impressive rate of 8% per annum between 1975 and 1985 (Table 1).

However, Egypt suffered from the crash in oil prices in the mid-1980s. Economic performance slowed down, and GDP grew by a slower rate of 3.8% per annum between 1985 and 1994. The inflation rate was high and the total debt service accounted for over 20% of the exports of goods and services, and for 7% of the GNI. Facing a series of crises, the country embarked on a structural adjustment program in the early 1990s. As a result, inflation slowly reduced and markets opened to greater competition (El-Laithy, Lokshin, and Banerji, 2003). Since the

mid-1990s, Egypt experienced rapid economic growth, with GDP increasing by an annual rate of 4.6% per annum between 1994 and 2004.

Agriculture

Like many low middle-income countries, the reliance of the Egyptian economy on agriculture declined over the past 3 decades from about 30% in 1970 to 16% in 2004. The agricultural sector, however, remains an important sector of the economy as it provides employment to 33% of the country's labor force.

Covering only 3% of the country's total land, Egypt agriculture takes place essentially in the Nile Valley and the Delta region. The mild climate, assured water supply and fertile soil, allow Egyptian farmers to produce in one of the most productive agricultural systems. Nevertheless, Egypt is highly dependent on imports for its food supply due to the relative scarcity of arable land and water resources, high population growth, the relatively low investments directed to agricultural development, and insufficient funds for agricultural research and development agencies. One of the prominent characteristics of Egypt's agricultural sector is the dominance of small-scale farmers (Esfahani, 1987; Faris, 1995).

Agriculture GDP grew at a sustained growth rate of 2.7% per annum throughout the mid-1960s to the mid-1990s, and accelerated at 3.3% per annum after 1994 (Table 1). According to Nassar and Mansour (2003), a combination of technological progress (improved irrigation, drainage, fertilizers and crop varieties) and institutional reforms has contributed to this sustained growth. Policy changes have also taken place, moving from inward-looking policies, until 1986, to more liberalized reforms aimed at opening the agricultural sector to increase production and productivity. Some of the most important reforms were the gradual removal of governmental crop prices, the elimination of input subsidies, the reduction of tariffs and other protection measures, and the liberalization of the land tenure system (Nassar and Mansour, 2003; Shousha and Pautsch, 1997).

Poverty

To formulate poverty reduction strategies, measuring and tracking poverty trends over are crucial. To examine the poverty trends over time, we rely on the poverty estimates published in two studies. Adams (1985) assessed rural poverty in Egypt between 1958/89 and 1982 based on consumer budget surveys. Adams (2003) assessed the change in rural, urban, and total poverty during the 1980s and 1990s using the results from national household budget surveys. In both papers, the author measured poverty by estimating the percentage of population living below the poverty line. The poverty line was defined as the level of expenditures needed to meet the minimum food and non-food

requirement. Although the poverty incidence estimates from the two studies are not directly comparable due to differences in sample size, methodology, and expenditure level benchmark, it provides some indication on the changes in poverty over time.

One noticeable trend is the large regional variance that marks poverty in Egypt. As Table 2 shows, poverty is the worst in Upper Egypt.[1] More than 20% of the population was poor in seven out of the nine governorates located in the Upper Region in 1999-2000. In contrast, poverty is the lowest in the Metropolitan region where only 5.1% of households are poor and constitute only 4% of all poor in Egypt. Between 1995-96 and 1999-2000, poverty incidences declined by more than half in the Metropolitan region during the late 1990s, but increased significantly in Upper Egypt. In the Frontier region and in Lower Egypt, urban poverty declined during the 1990s whereas rural poverty increased. In addition to these regional variances, Datt, Jolliffe and Sharma (2001) further characterize the poor based on 1997 household survey data, revealing that the poor in Egypt tend to come from large, female-headed households that depend on agriculture and trade services for their livelihood.

3. Public Expenditures: Trends and Composition

Egypt's public spending is an important instrument for achieving economic growth and equity goals. It includes long-term investment on R&D, education, infrastructure and social spending Public Investment and Provision.

Agriculture

Public spending in agriculture in Egypt increased from $1.82 billion (international dollars at 1995 prices) in 1980 to $3.32 billion in 1998, or an average growth rate of 3.4% per annum (Table 3). Growth in agriculture expenditure stagnated during the 1980s, averaging a rate of 1.28% per annum, but accelerated in the 1990s at 7.51% per annum. As a percentage of AgGDP, public spending in agriculture declined in Egypt during the 1980s, a period of economic slowdown, but increased in the 1990s.

Historically, public investment in Egyptian agriculture has been geared mainly towards the provision of irrigation and drainage, in addition to agricultural research. Today, the Agricultural Research Center (ARC), under the Ministry of Agriculture, is the most important research

[1] These poverty estimates are based on the Household Income, Expenditures, and Consumption Surveys conducted by the Central Agency for Public Mobilization and Statistics of Egypt (CAPMAS) in 1995-96 and 1999-2000. The data are reported in a World Bank report published in 2002.

organization in Egypt, consisting of 16 research institutes, six central laboratories, 46 agricultural research stations, and account more than 2,500 PhD researchers (ARC, 2004). Academic institutions also play a role in agriculture research in Egypt, with 16 faculties of agriculture and 8 faculties of veterinary medicine in the country.

Health

In the past several decades, health status and conditions have improved in Egypt as shown by several indicators of health. Life expectancy has increased from 45 years in 1960 to 68 years in 2001, whereas the percentage of children under twelve years old that are immunized to measles increased from 41 percent in 1980 to 97 percent in 2001. Moreover, infant mortality per 1000 birth declined from 189 to 35 between 1960 and 2001 (WDI, 2003).

Public expenditures in health increased from $0.87 billion (international dollars, 1995 prices) in 1980 to $2.12 billion in 1998, averaging an annual growth rate of 5.07% (Table 3). Despite the fiscal austerity imposed by the structural reforms, health expenditures increased sharply during the 1990s, at an average growth rate of 8.42% per annum. Nevertheless health accounts for only 3.6% of total public expenditures in 1998. For comparison purpose, nearly 10% of public spending was devoted to the military sector.

A larger portion of Egypt's health care is privately financed. In 2000, public health expenditures represented 1.75% of GDP, whereas the corresponding share for private health expenditures was 2.05% (World Bank, 2003). Thus, total health expenditure represents 3.80% of GDP.

Education

Education expenditures grew at 6.57% per annum form 1980 to 1998. But public spending on education as a percentage of GDP falls short of similar figures in low middle income countries by just under 1%. During the early 1990's, the emphasis was on increasing the supply of education, between 1992 and 1996, the number of classrooms rose by 53% across Egypt and by 1997, nearly all of Egypt's villages had access to primary schools (El Saharty et al. 2005). Up until the mid nineties there was a significant and unchallenged gender bias in schooling and education in Egypt. In order to address that problem, and in an attempt to improve the quality of education in Egypt, the Egyptian government initiated the Basic Education Enhancement Program. Between 1992 and 2002, female literacy rose by 10% from 57 to 67%, and whilst that falls short of required objectives, however, it is considered a significant stride towards narrowing the existing gender gap in education (UNDP,

2004)[2]. Female illiteracy amongst the 15-24 age group fell by 10%, from 28% in 1990 to 18% a decade later (World Bank).

Infrastructure

From 1980 to 1998, public expenditures on transportation and communication grew significantly from 0.4 billion dollars to 3.1 billion with an annual growth rate of 11.64% (Table 3).

Whilst across Egypt there is no difference between the poor and non poor's access to electricity, there does seem to be a gap in availability of piped water and connection to a public sewerage systems between the poor and non poor. The rural areas have the least access to indoor drinking water and connections to public sewerage (World Bank). Within that regional discrepancy the poor are even more disadvantaged. Despite the improvements that have occurred in addressing this shortcoming in the late nineties, the figures still show a bias against the poor and inhabitants of the rural areas over urban areas.

Today, a rapidly growing population poses a daunting challenge for Egypt to boost the productivity of its infrastructure, particularly, its water systems. With 70 percent of the poor living in rural areas, boosting water use efficiency could result in substantive increase of on-farm and off-farm income and employment. With water services accounting for 10 percent of the government's total public expenditures, reforming water management has become critical to accelerating the country's economic growth.

To address the problem of inefficient water resources, the Ministry of Water Resources and Irrigation has launched a reform agenda for water management in collaboration with major donors. In May 2005, the World Bank approved a $120 million loan for an Integrated Irrigation Improvement and Management Project in Egypt. The project has set a target of increasing water productivity by 15 percent and increasing farm-related income for the 380,000 families in the project area, at least two-thirds of whom are living on less than $2 a day (World Bank 2005).

Spending on Social Safety Nets

Subsidies in Egypt have a history as far back as the Second World War when food rations and price ceilings were placed on staples to alleviate the pressures of scarcity. Subsidies on major consumer items such as sugar, coarse cotton fabric, kerosene, edible oil and tea were introduced

[2] Whilst there remain large regional gender gaps in education in general,specifically in rural Upper Egypt, over a five year period – between 1996/97 and 2001/2002, the national gender gap in primary education fell by 50%, from 7% to 3.5%. Discrepancies in the male/female literacy rates, however, have not yet petered out, whilst female literacy rates in 2002 vary from one source to another, they are close to 50% of the female population were still illiterate vis a vis 29% of their male counter parts (El Saharty et al. 2005).

and never removed (Alderman et al, 1982). With the start of the socialist era, housing, transportation, education and other social service subsidies were introduced. By the beginning of the eighties, the subsidy bill had reached it highest. Torn between maintaining the subsidy program for social equity, and a rapidly ballooning fiscal deficit, President Mubarak and his cabinet realized that reducing the subsidy bill was a necessity (Alderman et al, 1982). By the turn of the century, the government was successful in constricting the subsidy program to include only four food items – *baladi* bread, *baladi* flour, cooking oil and sugar. More recently, the subsidy program was expanded to include rice, pasta, tea, fava beans, margarine and lentils[3] (Morrow, 2004). As a result, the subsidy bill is expected to reach L.E. 6.5 billion, almost double its previous level (Morrow, 2004).

Despite the universal agreement that social safety nets play a prominent role in alleviating poverty amongst society's vulnerable, it has been acknowledged that the effectiveness of these programs in the absence of the appropriate targeting is questionable at best. Due to shortcomings such as inclusion and exclusion errors, high administrative costs and widespread "operational" inefficiencies, the introduction of a cross breed of safety nets is now becoming popular. This type of reform seeks to break poverty cycles by alleviating transitory and chronic/intergenerational poverty through monetary disbursements conditional upon education and health improvements[4].

The Egyptian government has acknowledged the necessity of reform as far back as the mid 70's. At that time, due to Egypt's mounting external debt, a standby agreement with the IMF was struck and reforms in the subsidy system were implemented. The consequences were the infamous 1977 food riots that have continued to set a political straitjacket to all food price reforms in Egypt. From then onwards, any food price reform initiatives had to take into account the political as well as the economic and social ramifications involved.

Today, two types of safety net programs are currently present in Egypt: development programs and welfare programs. Development programs refer to the Social Fund for Development (SFD) which is supported by the government (World Bank). Originating in the early nineties, it is considered the main poverty alleviation tool for the government.

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[3] Reversal in subsidy allocations is a common side effect behind a more gradual reform the subsidy structure (Gupta et al, 2000).

[4] A well cited example of such a program is Mexico's PROGRESA. Initiated in 1997, it initially targeted only Mexico's rural poor, two years later, the program had reached 40% of the rural poor (Coady and Harris, 2004). PROGRESA provides, cash transfers, family health care, and nutritional supplements to the poor. However, this provision is tied to the child(ren)'s school attendance. So far, there has been a marked improvement in child nutrition, school attendance and school drop out rates (Al Riffai, 2004).

However, despite its more than 14 years of operation, the SFD's impact on poverty alleviation in Egypt has yet to be determined. Welfare programs refer to the provision of subsidies on a multitude of private (food, electricity and fuel) and public goods (health and education). The subsidies are classified as implicit - revenue lost by the government for the provision of certain goods (and services) at below market prices to the consumer[5] - and explicit subsidies in the form of cash and commodity subsidies. For the purpose of this study, we will focus on the consumer food subsidy program, the largest component of all explicit subsidies existing in the Egyptian economy.

4. Household Level Analysis

In this section, we use the 1997 *Egypt Integrated Household Survey (EIHS)* conducted by IFPRI to link household income and poverty status to their endowments in human and physical capitals and their access to infrastructure, health services and agricultural technology. The household level analysis follows the framework in the Tanzania study by Fan, Nyange, and Rao (2003), and provides an opportunity to apply and adapt existing methods to the MEDA region.

Model

To model the impact of infrastructure access, education, and health on the welfare of households, we estimate three separate equations: income, expenditure, and poverty determination.

Since many households in Egypt engage in both agricultural and non-agricultural activities, it may be difficult to separate income sources between these two activities. On the one hand, even in urban areas a substantial share of many households' income comes from agriculture. On the other hand, nonagricultural activity has also gradually become an increasingly important source of income for rural residents (about two-thirds of total income). Therefore, total income, instead of agricultural income, is used in our estimation to reflect the whole picture of the household welfare.

Household income for a typical household depends on agricultural production assets, household characteristics such as household members' age, sex, education, and characteristics of the community where the household resides.

(1) TOTALIPP = f (HA, HC, CC, Z),

[5] The government of Egypt provides implicit subsidies on energy products.

where *TOTALIPP* is total income per capita, *HA* is a set of household production assets used for agricultural production; *HC* is a set of household characteristics, like education and telephone access; and *CC* is a set of community characteristics, including public facilities availability at the community level. The variable *Z* represents other factors that are not included in the equations, for example, regional agro-climatic conditions, and social and economic policies. Since these variables are not easy to quantify, regional dummy variables are used to control for the effects of such variables.

Similar to total income, household expenditure is also determined by households' production assets, household characteristics, and community characteristics.

(2) EXPPP = f (HA, HC, CC, Z),

where *EXPPP* is total expenditure per capita. For a particular household, whether it is under or above the poverty line is defined based on household per capita expenditure. As described above, the poverty line is defined either using per capita total expenditure or per capita food expenditure. How much a household can spend in turn, to a large extent, depends on how much the household can earn. Therefore, poverty can be modeled in terms of per capita income.

(3) POVERTY = F(TOTALIPP) or
= F(AGRIIN, NAGRIIN).

Through equations (1) and (3), we can link a household's poverty status to household assets and characteristics, and community characteristics through estimated income equations (both agricultural and non-agricultural). For example, the impact of certain community characteristics, say distance to public transport (DISPT), can be derived as:

(4) ∂POVERTY/∂AGRIIIN (∂AGRIIN/∂DISPT) + ∂POVERTY/∂NAGRIIIN (∂NAGRIIN/∂DISPT)

However, we can also model poverty directly as a function of *HA*, *HC*, and *CC*.

(5) POVERTY = F (HA, HC, CC, Z).

This is the so-called reduced form of the poverty determination. Since poverty is a binary variable at the household level, the OLS estimation will result in biased estimates. Therefore, a PROBIT model is used to estimate the poverty determination equation.

(6) Prob (POVERTY=1) = F (β'X),

(7) Prob (POVERTY=0) = 1-F (β'X).

Here βs are the parameters to be estimated. However, as for any other nonlinear regression model, parameters of the model are not the marginal effects of the variables on the right-hand side (Greene, 1999). If we assume F (.) is normally distributed, the marginal effect is:

(8) $\partial E[POVERTY]/\partial X=\Phi((\beta'X)\beta$

where Φ(.) is the standard normal density. STATA (A statistical and econometric software developed by StataCorp) gives the marginal effects of each independent variable through the command of DPROBIT. This will both avoid the bias by using the OLS and allow us to calculate the marginal effects of the independent variables directly.

Model Specification

As pointed by Datt and Jolliffe (IFPRI, 1999), before discussing what variables should be included among the set of explanatory variables, it is helpful to consider the issue of potential heterogeneity of the models of income and expenditure, i.e., whether we expect the models to be different across strata or regions. While there can be different levels of heterogeneity, the metropolitan and urban areas are sufficiently different from the rural areas in the Egyptian context, and lower rural area could be different from the upper rural area as well. Therefore, it is feasible to use different models for each stratum. For instance, it could be argued that public investment has different returns in rural and urban areas, and hence has different implications for income and expenditure patterns in different stratum.

Another practical reason for distinguishing separate models for the five strata is that while we can make use of a number of community-level variables available for the rural strata (lower rural and upper rural), such variables are unavailable for the metropolitan and urban strata, because the complete community module was not conducted in urban areas. Thus, when we estimate the model without community variables, we separate the whole sample into five strata: Metropolitan, Upper Rural, Upper Urban, Lower Rural and Lower Urban. But when we include community variables in our model, we only estimate equations for two strata: Upper Rural and Lower Rural.

In selecting potential determinants of living standards, a key consideration is to choose variables that are exogenous to current income or expenditure level. Fan, Nyange, and Rao (2003) purposed to select potential determinants that include education attainment, health status of household members, access to telecommunication and transportation. These variables either depend on household previous income or they are at the community levels and therefore exogenous to

the household. The selected variables can be grouped broadly into household- and community-level variables.

The household-level variables include a set of demographic variables, household assets, variables related to education attainment, and variables related to their distance to roads and telecommunication. The demographic variables included are ages of the household head, ratios of dependents to income-earners, and two binary variables for the gender and marital status of the household head. The household asset is measured as the area of cultivated land that is owned by the households and value of livestock. In the education category, completed school years of the household head is used. The infrastructure variables are the access to electricity and telephone. The electricity variable is later dropped due to its non-significance (95% of households in the sample had access to electricity, and this percentage is even higher in metropolitan and urban regions). Another variable, the time normally needed to reach closest paved road by foot from the household location, is also included as a measure of access to public infrastructure. Two binary variables for the usage of fertilizer and improved seed are used as proxies for technology. Improved seed is dropped later since it is highly correlated with fertilizer usage (average correlation is above 0.8 in most strata).

At the community level, a set of dummy variables related to the availability of a range of public facilities or services, including post offic , public telephone, bus stop, paved road, dirt road, local shop, market center, grain/oil mill, agricultural extension office, agricultural cooperative, commercial bank, village bank, primary school, preparatory school, high school, health post, hospital, clinic, private pharmacy, private doctor, visit of agricultural extension worker and veterinary, public canal, community canal, private canal, and tube well. Although there are no significant correlations among those variables, it is both confusing and infeasible to include all these variables in the model: a model with all community characteristics indicates severe multi-collinearity among these variables.

With the help of statistical testing, we include the following variables in our final specification: Whether the community has a post office (*postoffice),* a commercial bank service *(commbank),* a market *(market),* a primary school *(prepschool),* a bus stop *(busstop),* access to paved roads *(pavedroad),* access to extension service *(agextn),* a clinic *(clinic),* access to a public canal *(pubcanal),* and whether it has access to a private canal (*privcanal).* Other variables are not included because the null hypothesis of zero effects could not be rejected.

There may also be some concerns of potential bias in parameter estimates due to endogeneity or omitted variables. For instance, it could be argued that agroecological factors that determine the productivity of land are omitted from the regression, and hence implicitly included in

the error term of the model. If these factors are a significant determinant of income or expenditure, the mean of error term will not converge to zero in probability limit, and the parameter estimates for the included explanatory variables will be inconsistent.

Another variant of this problem could be described by the argument that some of the determinants themselves depend on some omitted variables. For instance, whether there is a market in the village may depend on the omitted agroecological factors. Because the omitted factors are subsumed by the error term, these determinants are now correlated with the error term, and hence give rise to inconsistent parameter estimates.

One solution to the potential problem of omitted variables is the use of a fixed effects model. Thus, a fixed effect at the governorate level is introduced. There are 20 governorates in our sample. A governorate fixed effect model views the governorate not only being distinct in entities administration or institutions, but also differ in natural endowments (agroclimatic conditions, soil fertility, etc.).

Data Description

The primary data used in this paper are from the Egypt Integrated Household Survey (EIHS), a multi-topic, nationally representative household survey carried out by the International Food Policy Research Institute (IFPRI) in collaboration with the Ministry of Agriculture and Land Reclamation (MALR) of the Government of Egypt (GOE) and the Ministry of Trade and Supply (MOTS) of the GOE. Fieldwork began during the first week of March 1997 and concluded in the third week of May 1997.

The questionnaire was administered to 2,500 households from 20 governorates using a two-stage, stratified selection process. In the first stage, 125 primary sampling units (PSU) were randomly selected with probability proportional to size. The second stage of the process entailed randomly selecting 20 households from each PSU. The advantage of a two-stage process over a pure random selection process is that it dramatically reduces the scope of fieldwork and therefore reduces the cost of the survey. The disadvantage is that standard errors resulting from two-stage samples tend to be significantly larger than those resulting from pure random samples. Details on this questionnaire are available in the EIHS 1997 documentation (IFPRI, 1999).

The design of the survey also stratified selection on the following five regions of Egypt: Metropolitan, Lower urban, Lower rural, Upper urban, and Upper rural. This regional classification for Egypt has been used often in the tabulation of data from the Household Income and Expenditure Surveys conducted by the Central Agency for Public Mobilization and Statistics (CAPMAS). It has also been commonly

deployed in the literature on poverty in Egypt (see, for instance, El-Laithy and Osman 1996, Korayen 1994, and Ali, El-Laithy, Hamza, et al. 1994).

The survey questionnaire consisted of 18 sections on a series of topics that integrated monetary and non-monetary measures of household welfare and a variety of household behavioral characteristics. There are both household level and community level data.

The household data contain responses from the male and female household questionnaires, while the community data contain overall characteristics of the community/villages containing the surveyed households. The variables used in our model are defined and explained as follow:

agipp. Agricultural income per capita (in Egyptian pounds) measures yearly income per person from agricultural products or agricultural activities, which is calculated as the sum of market value of homegrown products consumed within household, income from crop sale, livestock and livestock products sale.

Market value of homegrown products includes food that the household has grown and received from other sources over the past 7 days, which is converted to yearly consumption. Income from crop sale is the summation of total values for both sale and remaining crops produced in the past agricultural year. Livestock and livestock products sale are computed from the female questionnaire of section 13. Livestock sale is the value received for selling animals over the past 12 months. Livestock products sale includes milk, butter, cheese that were sold, consumed at home, or given as gifts. It also includes eggs and slaughtered animals for sell, consumption or for gifts over the past 12 months.

nonagipp. Nonagricultural income per capita (in Egyptian pounds) measures yearly income per person derived from non-agricultural activities. It includes sources from dwelling rent income, short-term wage income, long-term salary income, land rent income, miscellaneous agricultural activity income, enterprise income, asset rent income, remittance and transfer income, and other incomes.

Dwelling rent is the monthly amount the household received for renting out part of the dwelling unit, and it is converted to yearly rent income. Information on wage income for casual or temporary labor is obtained from the wage employment section for all persons 10 years or older. It is the product of three components: average daily wage and non-cash benefits, average working days per month, and average working months during the last 12 months. Salary income is the sum of take-home pay and bonuses, tips, incentives, and allowances minus contribution to an employee providence fund, over past 12 months. Land rent income includes all cash and in-kind a household received for renting out any land that it owned over the past agricultural year.

Miscellaneous agricultural revenues include incomes both from selling crop by-products (straw, husk, etc.) and from renting draft animals, tractors, threshers, other machineries, and other miscellaneous income over the past agricultural year. Income from enterprises activities is computed as the share of net revenues over past 12 months that is kept by the household. Income from asset renting is the amount a household received from renting the land or property, which is neither cultivated or lived in by the household, or from any other real assets, over the past 12 months.

totalipp. Total income per capita (in Egyptian pounds) is the yearly sum of agricultural and nonagricultural income per person.

exppp. The measure of total yearly expenditure per capita (in Egyptian pounds) is taken from the research of Datt, Jolliffe, and Sharma (IFPRI, 1998) and Datt and Jolliffe (IFPRI, 1999), which is quite extensive and draws upon responses to several sections of the household survey. Total expenditure is the sum of total food consumption (including tobacco and alcohol), total nonfood non-durable good expenses, estimated use value of durable goods and an actual or imputed rental value of housing. This monthly total expenditure is converted to yearly expenses for consistency.

Estimated Results

Table 4 presents the estimated total income per capita determination equations controlling for the fixed effect at the governorate level. The estimated results show that the dependent ratio affects per capita household income significantly. The more dependents or the less income earners a household has, the lower income per capita tends to be in the household. Gender or marital status of a household head is not a significant factor in affecting household income. The coefficient of household head marital status is marginally significant at the 10% level. Age of household head is found significant in Lower urban and Lower rural Egypt.

Education level achieved by the household head contributed most significantly to per capita household income, and the coefficients are significant in all strata. Access to telephone is also an important influence on income improvement in urban areas. The coefficients of improved seed usage are statistically significant and of the expected sign in both Upper and Lower rural strata, implying that improved policy with a focus on new seed availability could boost rural income substantially.

Estimated results of per capita household expenditure are also summarized in Table 4. Education of household head, dependent ratio, and telephone access are found to be significant and they are positively correlated with per capita expenditure. Consistent with Datt and Jolliffe (1999) we found that school attainment and reducing the number of

unemployed individuals are the main beneficial effects from policy changes.

Table 5 provides estimated results from the probit model of the reduced form for poverty status. Again, education, dependent ratio, and telephone availability are revealed as determinants of household poverty status.

As mentioned before, community characteristics could be well exploited when we consider rural sectors only. Similar to the case of strata, education attained by household head and dependent ratio are universally related to total income, expenditure, and poverty status in both Lower and Upper rural Egypt, as shown in Table 6. In general, the community characteristics do not provide significant welfare effects on expenditure or poverty, except for the existence of preschool, paved roads in Lower rural areas. In Lower rural Egypt, infrastructure, such as post office, bus stop, and agricultural extension, help residents to increase their total incomes, while canal service (both public and commercial canals) decrease incomes. Some of the community level variables may have high correlation with the household access to public services such as distance to paved roads, telephone, and the use of modern seeds.

The household level analysis gives us information on how household and community characteristics correlate with household income and poverty status. But there are several disadvantages. For example, it is difficult to control for endogeniety and multicollinearity problems unless there is a long time series of a household panel. As well, household level analysis can not capture the market, regional, and macro-level effects due to various government interventions. Finally, it is difficult to link improved public provisions to meaningful government investment programs. Therefore, regional and macro analyses are required to complement the household level analysis.

5. Regional Level Analysis

This section of the report evaluates the impact of various government investments on agricultural growth and on poverty reduction using the data from different governorates over 1980-2000. This level of analysis captures some of the effects that the household level analysis can not capture, for example effects on labor and product markets.

Model

Public investment affects rural poverty through many channels. It increases farmers' income directly by increasing agricultural productivity, which in turn reduces rural poverty. Indirect impacts include higher agricultural wages and improved nonfarm employment opportunities, In addition to its productivity impact, public investment

directly promotes rural wages, nonfarm employment and migration, thereby reducing rural poverty.

Public investments in rural sectors not only contribute to growth, employment, and wages in rural areas, but also help the development of the national economy by providing labor, human and physical capital, cheaper food, and markets for urban industrial and service development. Growth in the national economy reduces poverty in both rural and urban sectors. In an era of macroeconomic reforms, understanding these different effects provides useful policy insights to improve targeting efficiencies, budgeting and ultimately the effectiveness of government poverty reduction strategies.

Few studies have linked poverty reduction to the driving forces behind economic growth and income distribution. The determination of rural poverty adds a greater complexity. Rural residents draw their income from multiple sources. Farm activities are still major sources of income for many rural residents, but increasingly nonfarm activities such as rural industry and services have also become important. Another important income source is seasonal migration and employment in the urban sector. Building on earlier work by the senior author on India (Fan, Hazell and Thorat, 1999), we model the rural poverty determination as follows:

(9) $P = f(LP, RWAGE, NFE)$

Equation (9) models the determinants of rural poverty (P), which is defined as the percentage of the rural population living below the poverty line. They include agricultural labor productivity (LP), nonagricultural employment (NFE), rural wages (RWAGE).

Equation (10) models the agricultural labor productivity function. The dependent variable is gross value of agricultural production per agricultural worker in the agricultural sector (LP). The independent variables are a set of technology, infrastructure, and education variables that are used to capture their impact on labor productivity growth. These variables include agricultural research stock variables constructed from past government expenditures on agricultural research and development (RDS); irrigated areas (IRRIA) per agricultural worker; illiteracy rate of the rural population (ILIT); length of rural roads per agricultural worker (ROADS); and number of rural telephone sets per agricultural worker (PHONE).

(10) $LP = f(RDS, IRRIA, ILIT, ROADS, PHONE)$

Equations (11) and (12) are wage and nonfarm employment determination functions. Rural nonfarm wages and employment are determined by development in infrastructure, improved education and

growth in agricultural productivity. Growth in agricultural productivity is included to model the linkage between growth in the agricultural sector and nonfarm employment and rural wages.

(11) RWAGE = f(LP, ROADS, PHONE, ILIT)

(12) NFE = f(LP, ROADS, PHONE, ILIT)

The marginal impact of public capital expenditures on poverty can be derived from this system of equation by taking the total derivatives as follows, taking agricultural research and rural education as examples:

(13) $dP/dRDS = (\partial P/\partial LP)(\partial LP/\partial RDS) + (\partial P/\partial NFE)(\partial NFE/\partial LP)(\partial LP/\partial RDS) + (\partial P/\partial RWAGE)(\partial RWAGE/\partial LP)(\partial LP/\partial RDS)$

(14) $dP/dILIT = (\partial P/\partial LP)(\partial LP/\partial ILIT) + (\partial P/\partial NFE)(\partial NFE/\partial LP)(\partial LP/\partial ILIT) + (\partial P/\partial RWAGE)(\partial RWAGE/\partial LP)(\partial LP/\partial ILIT) + (\partial P/\partial NFE)(\partial NFE/\partial ILIT) + (\partial P/\partial RWAGE)(\partial RWAGE/\partial ILIT)$

Equation (13) measures the marginal effect on poverty reduction of the research stock variable. It also decomposes the different pathways through which impacts occur (see Fan, Hazell and Thorat (1999) for a more detailed discussion). The first term on the right hand side is the direct poverty impact of growth in agriculture due to agricultural research and extension, while the remaining terms measure the effects of agricultural research and extension through improved nonfarm employment and wages.

Equation (14) is the marginal poverty reduction effect of improved education. Similar to equation (13), the first three terms on the right hand side are poverty reduction effects of improved education through growth in agricultural production directly and indirectly by improving nonfarm employment opportunities and rural nonfarm wages. The last two terms capture the impact on poverty reduction by directly improving nonfarm employment and nonfarm wages.

To convert annual government expenditures on public capital into stocks in monetary terms, we use the following procedure:

(15) $K_t = I_t + (1-\delta)K_{t-1}$.

Where K_t is the capital stock in year t, I_t is gross capital formation in year t, and δ is the depreciation rate (5%). To obtain initial values for the capital stock, we used a similar procedure to Kohli (1982).

$$(16) \qquad K_0 = \frac{I_0}{(\delta + r)}.$$

Equation (16) implies that the initial capital stock in year 0 (K_0) is capital investment in year 0 (I_0) divided by the sum of real interest rate (r) and depreciation rate. In the case of Egypt, we assume a real interest rate of 3%. Sensitivity analyses were conducted to see whether different depreciation rates and real interest rates would affect our final results. We found the impact of different real interest rates to be negligible. But different depreciate rates do express some difference.[7] But the ranking of returns among different types of investment and among regions remains the same.

After we obtained stocks for various types of public investment, we ran the following regressions to determine the relationship between these stocks in monetary terms and physical stocks:

$$(17) \qquad P_{i,t}=f(K_{i,t}, Z_{i,t})$$

where $P_{i,t}$ is physical stock of public investment i in year t , for example road density, years of schooling, rural literacy rate, electricity consumption, or irrigated areas; and $K_{i,t}$ is capital stocks in monetary terms for investment i in year t constructed from *equation* (15). To control other factors that may be omitted from the equation ($Z_{i,t}$), both year and regional dummies are added during the estimation.
To calculate the marginal return in terms of poverty reduction of different types of government spending such as roads, education, and irrigation, we use derivatives of the following form, using education as an example:

$$(18) \qquad dP_t / dK_{e,t} = dP_t / dILIT_t * \partial ILIT_t / \partial K_{e,t}$$

Equation (18) implies that marginal return to capital stock in education ($K_{e,t}$) is the product of marginal return to improved literacy (derived in Equation (14)) and marginal impact of capital stock on the years of schooling.

Data

Most of the data used in this study come from various agencies of the Egyptian government.

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[7] Sensitivity analyses of different interest rates and depreciation rates for roads were conducted for the following scenarios: (a) 3% real interest rate and 10% depreciation rate, (b) 5% real interest rate and 10% depreciate rate, (c) 3% real interest rate and 5% depreciation rate, and (d) 5% real interest rate and 5% depreciation rate. The estimated marginal returns were 0.86, 0.84, 0.61 and 0.63, respectively.

Poverty

The poverty variable is measured as the percentage of the rural population living below the poverty line.

Agricultural labor productivity.

Agricultural labor productivity is measured as gross agricultural production value per agricultural worker.

Nonfarm employment

Rural nonfarm employment is measured as the percentage of the rural abor force engaged in nonfarm activities such as manufacturing, construction, trading, and services.

Wages.

Rural wages are the average daily compensation for rural workers.

Agricultural research

Agricultural research in Egypt is conducted at the national level. But national research affects production throughout the country through so-called spillover effects. Therefore, we include the same agricultural research stock variable constructed from past expenditures in all regions. When we calculate returns to agricultural research investment, we also add agricultural extension to determine total investment in agricultural R&D.

Infrastructure

Most of the infrastructure and education variables used in the model are defined in physical terms and data for suitable measures are available at the national and regional levels. The greatest difficulties arose in collecting data on government expenditure by type of investment and region, which are needed for calculating the value of the existing stocks of these investments and their unit costs. Like many countries, Egypt compiles data on public spending by different types of investments at the national level, but there is much less data on how these expenditures are allocated to different regions and by rural and urban areas. Therefore, some techniques and assumptions had to be used to make these allocations.

Irrigation.

Both irrigated areas and investment costs are available at the regional level.

Rural education

Illiteracy rate is used to proxy the improvement in education.

Roads

Road length and public expenditure data on roads are available by region from the government office.

Rural telephones

Number of telephone sets are used as proxy for improved telecommunication.

Model Estimation

We use the double-log functional forms for all equations in the system.

More flexible functional forms such as translog or quadratic impose fewer restrictions on the estimated parameters, but many coefficients are not statistically significant due to multicollinearity problems. Regional dummies are added to equations of poverty, productivity, employment, migration, and terms of trade to capture the fixed effects of regional differences in agroclimatic and socio-economic factors. The time trend variable is also added to these equations except for the poverty equation to control for any macroeconomic polices that have the same impact on every region. The model is estimated for the period of 1981 to 2000.

There are two approaches in estimating an equation system: the single equation approach and the multiple equations system approach. Single equation techniques such as instrumental variable estimators, two-stage least squares, and limited information maximum likelihood are easy to estimate and requires only limited information. However, the single equation technique often neglects information contained in the other equations of the system. For this reason, we use the full information maximum likelihood (FIML) estimation technique. Among all estimators, FIML is the most efficient. The only disadvantage is its estimation complexity but with the rapid development of econometric softwares, this task has become increasingly easier and more accessible.[8]

The estimated results are shown in Table 7 Rural poverty is negatively correlated with labor productivity, rural wages and the level of nonfarm employment (Equation 1). But rural wages is not statistically significant. The insignificance of rural wages on nonfarm employment is similar to the findings in many Asian countries (Thailand and Vietnam). This may indicates that there is an inelastic supply of rural labor or there is large

[8] We use SAS window version 8.0 in our estimation.

labor surplus in these economies. Rural nonfarm employment has the largest poverty reduction elasticity among all explanatory variables.

The estimated agricultural labor productivity equation indicates that improvement in telephone and rural education has large impact on labor productivity. In particular, higher illiteracy rate is strongly correlated with lower labor productivity with an elasticity of -1.16. The roads variable is also correlated with labor productivity, but not statistically significant.

Equations 3 and 4 show that development in telecommunication (proxied by telephone) and improvement in education are statistically significant in promoting rural wages and nonfarm employment. But rural roads are not statistically significant. Improved labor productivity is also not statistically significant in helping to increase rural wages and nonfarm employment.

Marginal returns in agricultural growth

We first calculate the marginal returns in agricultural growth per additional physical unit. Then, using the parameters estimated through equations 9-12, we are able to calculate the unit cost of public capitals. Comparing the unit cost with the marginal benefit, we can easily estimate the benefit-cost ratios, presented in Table 8.

For telephone, the benefit-cost ratio is 3.13 for the national average. However, in Metropolitan area, the ratio is less than one, i.e., return from the telephone investment can not cover its cost. For Lower Egypt, the ratio is more than 6, which indicates that even return from agricultural production is 6 times larger than its cost. If we include the effect on nonfarm GDP and rural GDP, the benefit-cost ratio would be much larger. The Upper Egypt has a ratio of 4.36. The benefit-cost ratio of road investment is 2.84 at the national average. Again it is the metropolitan area where the benefit-cost ratio is less than one. The largest return is from the Upper Egypt where the ratio is 4.8. The Lower Egypt has a ratio of 3.7. Education investment has the highest return among all types of investment with a benefit-cost ratio of 4.8 for the nation as a whole.

Lower Egypt has the highest marginal return with a benefit-cost ratio of 5.8. Upper Egypt has a ratio of 4.4, 75% of the effect in Lower Egypt. Irrigation has the lower benefit-cost ratio among all types of investments with a ratio of 1.94. It suggests that irrigation is still a good investment, and compared to Asia, this ratio is high.[9] Among all investment, education ranks first followed by agricultural R&D, telephone, roads and irrigation at the national level. For Lower Egypt, telephone and roads have high returns, followed by education and irrigation. For

[9] In the case of India, the benefit-cost ratio of irrigation is less than one (Fan et al, 1999). For China, the ratio is just marginally above one (Fan et al 2002).

Upper Egypt, roads rank first, followed by phone and education which have similar marginal returns. Irrigation has the lowest returns similar to other regions.

Marginal Returns in Poverty Reduction

Similar to returns in agricultural growth, we calculate returns in poverty reduction in terms of both physical and monetary units. From this, Table 8 presents the estimated number of poor reduced per thousand LE. At the national level, Education has the largest impact per unit of investment. Every million LE investment, more than 200 poor would be lifted above the poverty line. Agricultural research follows education effect closely. The poverty reduction effect is 176 for every million LE invested. Two infrastructure variables, telephone and roads have similar poverty reduction impact per unit of spending. Irrigation investment has the smallest marginal impact on poverty reduction, and its effect is only 40% of education and 47% of R&D.

There exists large regional difference on the marginal effect of different investments. It is the Upper Egypt where all kinds of investment except irrigation have the largest impact. Except for irrigation, all kinds of investment in Metropolitan area have the lowest marginal impact.

6. Macro-level Analysis

The CGE model used in this report is a dynamic computable general equilibrium (CGE) model of the Egyptian economy and is used to quantify the effect of public spending on promoting pro-poor growth, equity, and poverty. It follows Lofgren and Robinson (2004) and Al-Riffai et al. (2005) in its explicit formulation of the potential channels through which different kinds of government spending influence productivity and economic performance and is set to analyze alternative public policy spending scenarios and alternative subsidy treatments in terms of their potential impact in promoting growth, poverty alleviation, and an egalitarian distribution of income. The model is solved simultaneously for all time periods. However, in the current version, its structure is dynamic recursive, making it possible to describe the model as being composed of within-period and between-period modules. The dynamic-recursive nature of the model is manifested in that economic agents are treated as "myopic", making their decisions on the basis of current conditions.

What follows provides a description of the model, its extension to explicitly introduce price subsidies, and cash transfers, as well as a presentation of the Egypt 1997 SAM. Also a discussion on the approach used to analyze the distribution and poverty implications is considered.

Model Structure

In a dynamic recursive CGE model, it is typical to follow a two-stage approach. In the first stage, a within-period static CGE model is solved for a new equilibrium, where as in the second stage, a between-period model provides the necessary linkages to update variables that drive growth in the static first stage model.

Within-period Module

The production technology is represented by a nested CES (constant-elasticity-of substitution) and Leontief (fixed-coefficient) functions. Domestic output in each sector is a CES function of value added and an intermediate input aggregate. In turn, value added is a CES function of primary factors, while intermediate input use is determined by sector specific fixed input-output coefficients multiplied by sectoral activity levels. Producers seek to maximize their profits yielding sector-specific factor demand. The model solves for long-run equilibrium in that all factors of production (agricultural labor, nonagricultural labor, capital, and land) are assumed to be sectorally mobile. Factor supplies are fixed for each product activity. Even though economy-wide wages adjust to clear the factor markets, each activity pays an activity-specific wage rate that is the product of the economy wide wage rate and a term that captures activity-specific wage "distortions" (or differentials).

The markets of goods and services are competitive: economic agents take all output prices as given. Each production sector is assumed to produce differentiated goods for the domestic and foreign (export) markets, allocating their goods between these two markets in a revenue-maximizing manner subject to imperfect transformability (captured by a CET [constant-elasticity-of-transformation].[11] For sales to foreign markets, the prices paid to producers depend on world prices, the exchange rate, transactions costs, and an export tax.

Similarly, domestic demanders differentiate between domestic products and imports. For each commodity, the composite commodity that is demanded is modelled as a CES aggregate of imports and domestic products. Domestic demanders minimize the cost of obtaining a given amount of this composite good. The price paid for imported goods depends on the world price, the exchange rate, import tariffs, and transaction costs (of moving the imported good into the domestic market). The price of domestically produced goods used domestically is a function of the supplier price and transaction costs (of physically moving the good from the supplier to the demander. Such product differentiation permits two- way trade, gives some realistic autonomy to the domestic price system, and allow for a continuum of tradability

[11] Domestic markets and foreign markets (exports).

and two-way trade, which is commonly observed even at very fine levels of disaggregation (de Melo and Robinson, 1981)[12]. Households maximize a Stone-Geary utility function subject to a budget/spending constraint, yielding linear expenditure system (LES) demand functions. Household income is made up of factor income and transfers from the government. The typical household spends on commodity consumption, taxes (income, sales) and savings.

Government income is made up of direct and indirect taxes. The government spends this income on consumption, investment and interest payments (domestic and foreign). Real government consumption and investment are exogenous (varying across the different simulations) and disaggregated by spending type into agriculture, human capital (education and health), infrastructure, social security, defense, and other).

The model follows the small-country assumption under which the world prices of exports and imports are given. For domestically produced goods; prices are flexible and market-clearing. The economy earns foreign exchange from exports, net transfers from abroad to domestic institutions, public foreign borrowing, foreign grants, and foreign direct investment (FDI). These foreign exchange earnings are spent on imports (of goods and services), interest payments on foreign and domestic debt, and repatriation of domestically earned profits of foreign investors (which depend on capital rents, and the share of the private capital stock that is owned by foreigners, in its turn a function of FDI. In this model, exports, imports, interest payments on all debt – foreign and domestic – and repatriation of foreign investors' profits are all endogenous. The rest of the items in the balance of payments are exogenous.

"Closure rules" or "system constraints" are constraints that have to be satisfied by the economic model, but are not considered in the optimizing decision of any micro agent (Robinson 1989) [13]. These include three macroeconomic balances (associated with the accounts for the government, the rest of the world, and savings-investments) and supply-demand balances in the product and factor markets. The "closure rules" of the model indicate the mechanisms on the basis of which the model satisfies these constraints. For these three macro balances, receipts/revenue earned must equal spending from that account. According to the closures used in the simulations, for the government balance, flexible government savings ensure the equality between government receipts and government spending. A flexible real exchange rate equilibrates foreign exchange earnings and receipts through its influence on exports and imports. In the savings-Investment balance, the value of investments is determined by available savings, i.e. investment is savings-driven.

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[12] For a more detailed description of the features of the model see: Lofgren et al. (2002).
[13] For a discussion on macro balances see Lofgren et al 2002 *pp. 13-17*.

Between-period Module

The between period module in a dynamic recursive CGE model provides the changes in parameters and variables in the economy over successive periods. In this model, the stocks of production factors, population, and debts (domestic and foreign) change over time. The stocks of labor, land, and population are exogenous whereas, as noted above, capital stocks are endogenous along with TFP. Debt stocks are endogenous: the stock of foreign borrowing in time period t+1 is a function of the stock of foreign borrowing in previous time periods and "new borrowing".

The between-period module then passes the updated information to the within-period module allowing it to solve under an updated "information set" for the consecutive period. The model is solved in a single pass for the period 1997-2015. Given the dynamic-recursive structure, the solution values for each time period (year) represents an equilibrium for that year that depends on the current and past parameters and relationships, not the future. For each period, the model solution generates a rich set of economic indicators, ranging from national accounts to sectoral and household level information. The baseline growth path is then used as a benchmark (a counterfactual) for comparing the effect of a policy reform that generates a new growth path with a comparable set of results.

Poverty Module

In addition to the within-period and the between-period modules discussed above, a separate poverty module is used to compute the inequality and poverty indicators[14]. The poverty module follows a representative-household (RH) approach along the lines described in Lofgren et al (2002). It is used at two different stages, once after the within-period module is solved for the baseline growth path, and once after every policy simulated growth path. Initially, the module generates benchmark inequality and poverty indicators for comparison with new ones generated when the module is used for the second time.

Using data from the within-period module on mean consumption and a CPI for each household group, the poverty module computes a poverty line to replicate exogenous poverty rates. For the case of Egypt, rural and urban poverty rates using the head count index are obtained from the World Bank's Poverty Reduction Study (2002). In addition, the poverty module permits the user to choose between two approaches to the specification of the within-group distribution, a parametric approach based on a log-normal distribution and a non-parametric approach, which is directly based on household survey data.

[14] Inequality and poverty indicators include Atkinson, Gini, and Theil inequality measures and the FGT poverty measures (P_0, P_1, P_2).

Earlier examples of studies using the first approach include Adelman and Robinson (1978) and de Janvry et al. (1991). In this case, a log-normal distribution is used to specify the distribution of income within each household group. According to this approach, only the first moment, the distribution mean, would shift to the right or to the left as a result of a policy change, while higher moments are fixed. Empirically, poverty and inequality indicators are generated from the overall distribution which is generated by summing up the within-group and the between-group distributions.

The second approach offers a relatively straightforward method for linking the CGE model with a household survey data. Poverty and inequality indicators are computed using a distribution from a sample of actual household consumption expenditure. Each household observation is mapped to one of the RH groups in the CGE model. In the case of the Egypt model, the observations are mapped to ten household groups by quintiles for both rural and urban households to form a within group distribution. When a new policy is introduced (for example change in the composition of public spending) relative prices and the pattern of each RH income and consumption expenditures is altered. Measuring the percentage change in a RH group consumption and applying the same rate of change to each household observation in the survey yields a new distribution following the new policy. Comparing the difference between a new set of poverty and income inequality indicators (computed using the endogenously adjusted poverty line and the new distribution of per-capita consumption expenditure) to the baseline ones is a measure of the effect of a policy reform on distribution and poverty[15].

Egypt SAM

The Egypt social accounting matrix (SAM) for 1997 is the main database for the CGE model. A SAM is a snapshot in time that, most importantly, portrays the flow of incomes from production activities, in the form of factor payments to the households, and the consequent flow back to product markets through household spending on goods and services. The SAM is a square matrix whose row totals have to equal its column totals. Each cell in the SAM can either represent the payments from a column account to a row account, or, an income received by an activity account from a column account.

The accounts included in the SAM may be divided into production activities, commodities, institutions, and factors of production. Subject to data availability the SAM accounts in each category may be disaggregated appropriately to address the policy questions explored by the underlying model. In this paper, the disaggregation of production

[15] For more description of the approach see Agénor, Izquierdo and Fofack (2003). A similar method is followed by Löfgren, Robinson and El-Said (2002), and Coady and Harris (2001).

sectors, households, and the government has been informed by the objective of the paper, to explore the impact of government spending on poverty[16].

In addition to the SAM, the model requires information about elasticities (for production, consumption, trade, and the productivity effects of government capital stocks), base-year stocks of factors and debts, as well as data showing anticipated trends for government policies and other exogenous elements that may change over time (international prices, population, and selected factor stocks).

Modeling of Subsidies

The Egypt CGE model has been extended to explicitly account for subsidies as included in the 1997 SAM for Egypt. According to the SAM, subsidies include transfers to households as payments for four commodities, bread, flour, transportation, and electricity. For the model to account for the subsidy data, a number of equations in the model had to be modified to as to ensure that the model's base solution replicates the initial data in the SAM. That entails calibrating the subsidy data into the model. In addition to including existing subsidy data, the model was also extended to include a cash transfer treatment. What follows provides a brief description of these modifications.

Subsidy Rate Treatment

In the model, the household demand is modeled as a Stone-Geary LES functional form. Given the commodity prices and incomes, a typical household would optimize its objective function by choosing an optimal consumption basket. After introducing the subsidy rate, the first order conditions explicitly include an endogenous subsidy rate that can apply to the different commodities in the model. Following the 1997 data in the SAM, these apply to existing subsidized commodities (bread, flour, transportation, and electricity). The subsidy rate can be easily modified (for existing commodities as well as added to new ones) as needed for the purpose of implementing a particular policy scenario.

Cash Transfer Treatment

The cash transfer is a lump sum that the government decides to spend to target needy household groups. In contrast to the subsidy rate treatment which operates through prices, the cash transfer treatment amounts to an increase to the recipient's total income. The lump sum transfer comes out of the government budget, where financing the transfer may be coming from increasing the fiscal deficit, increasing tax revenue, or reducing expenditures. Alternatively, financing could be associated with foreign grants, which would be reflected as part of the

[16] A micro version of the SAM that is used is available upon request.

current account[17]. However, this will have different implications as it depends on the assumptions introduced for the current account equilibrium. Typically this would tend to appreciate the exchange rate and a potential Dutch disease story can be analyzed.

Policy scenarios

Two sets of policy experiments are implemented using the Egypt-CGE model. The first analyzes the restructuring of the subsidy system and uses the resultant savings from targeting along with a reallocation of public investment towards one specific sector (agriculture, infrastructure and human capital [education and health]) at a time. The other policy scenario eliminates the price subsidy program completely and instead, introduces a targeted cash transfer program with a similar use of saved resources and a reallocation of public funds towards one of the above-mentioned sectors. The effects on poverty, growth and efficiency in the economy will be assessed and compared to BASE line growth path. Table 9 provides a brief description of all the simulations under the two sets of policy experiments.

The Distribution of Subsidies

The model solution generates a baseline growth path for the economy with a consistent general equilibrium set of results in each period. The baseline growth path serves as a benchmark for comparing the results from the two sets of policy experiments. Results from the baseline growth path are listed under the second column of Tables 10 and 11.

Targeting Through Restructuring the Current Subsidy System

Currently, the subsidy system is untargeted and thus inefficient hence exerting an unnecessary strain on government funds. This set of policy scenarios will remove subsidies altogether from society's upper two quintiles in an attempt to remedy the problem of inclusion errors in a subsidy system. At the same time, subsidies for the middle quintile are halved, whereas the lowest two quintiles, who are considered the most vulnerable, will still receive the full subsidy.

The results are summarized in Tables 10 and 11 and are compared to the BASE scenario, the economy's growth path where existing subsidies remain. Relative to the BASE scenario, a reallocation of government spending towards a specific sector, combined with additional investment from restructuring the subsidy program entails a positive increase in GDP. Overall, it seems that fiscal prudence pays off only when the government targets infrastructure and human capital development. The results of the macro indicators are quite disappointing when the

[17] These are alternatives the model can address through a change in the closure rules related to how the government account maintains a new equilibrium.

government decides to invest heavily in the agricultural sector. Heavy government investment in the agricultural sector has led to such interesting results in this exercise that it was deemed worthwhile to conduct a sensitivity analysis to show the movement of key macro and household indicators when the agricultural sector is targeted for investment by the government.

Looking at the household and welfare indicators (Table 11), it can be found that, except for the scenario for agricultural sector investment, consumption per capita rises across quintiles and regions. However, under the scenario of agricultural sector investment, it is clear that any increases in per capita consumption are biased in favour of the urban households. Exclusive investment in the agricultural sector does not improve poverty figures (over the base results) for the rural sector. This result implies that the negative poverty impacts on the rural poor hampers the government's policy efforts to significantly reduce nationwide poverty.

The consistent results in these three scenarios are that public investment in agriculture show relatively poorer results relative to public investment in human capital and infrastructure. These results are especially true when evaluating growth.

Targeting Through Cash Transfers

Cash transfers have several advantages over subsidies such as their allowance for existing price mechanisms and choice in consumption patterns. There are, however, disadvantages to cash transfers, namely the requirement for overly extensive information about the needy than other social protection programs, in addition to the high administrative costs of setting up such programs. This study does not take into account the administrative costs incurred in the initiation and expansion of a cash transfer program in Egypt.

In this scenario, subsidies are completely eliminated and cash transfers – equivalent in amount to the value of the subsidy received before its elimination - are distributed amongst the lowest two income quintiles, and amongst the third income quintile. However, the cash transfers distributed amongst the middle income group are only half the value of the subsidies that group received under the eliminated subsidy program. The highest two quintiles do not receive any cash transfers under this scenario. Again, the savings accruing to the government are in turn invested exclusively, once in agriculture, once in infrastructure and once in human capital along with an investment reallocation from the government's "other" investments. Looking at the macro economy, Table 12 shows that GDP growth achieves its highest growth with human capital development and public investments in infrastructure - a 7.22% annual increase over the period vis a vis a 3.98% increase under the base run and 4.4% - respectively. Total factor

productivity, across all scenarios rises. However the largest increases are under the TRHH+QG-HUM+-2 scenario followed by TRHH+QG-AGR+-2 and TRHH+QG-TRN+-2 scenarios. Total factor income rise by less than 1% over the base run with public spending in the infrastructure and agriculture and by slightly less than 3% when the government develops human capital. However, with the deterioration in the agricultural terms of trade, one can see a fall in agricultural labour income and land rent.

Looking at nationwide and regional per capita consumption and the welfare indicators (Table 13), one can see again that due to the deterioration in the agricultural terms of trade, welfare indicators are favourable for urban lower income groups and unfavourable for the rural lower income groups. Throughout this scenario it may be concluded that despite the unfavourable results of the exclusive public spending in the agricultural sector, overall poverty reduction and growth have been successful, albeit within a narrow margin.

Sensitivity Analysis to Public Investment in the Agricultural Sector

Throughout this study, it was found that increased investment in the agricultural sector does not bring about growth and poverty reduction to that sector. Despite the increase in factor productivity in that sector, results indicated that agricultural labour and land incomes deteriorated and so did certain welfare indicators, such as per capita consumption and an across the board worsening of rural poverty.

In order to further explore this result a sensitivity analysis was conducted across the two main safety net programs, subsidy restructuring vs cash transfers. The level of investments in the agricultural sectors varied. For the first set of sub experiments, all of the subsidy savings accruing to the government from, either, restructuring the existing subsidy program or replacing it with a cash transfer program, where injected into the sector. The second set of sub experiments entailed reducing public investment in the sector to three quarters of the savings accruing to the government from modifying the consumer subsidy program. Finally, to complete the picture, one half of the savings were targeted for the agricultural sector. Table 14 shows total factor productivity falling with lower investments in the agricultural sector, however, there is a negative relationship between the level of investments in the agricultural sector and nationwide growth, absorption, and agricultural factor income. On the micro level, there seems to be a steady improvement in rural per capita consumption and rural poverty incidence when less investments are allotted to the agricultural sector.

These results may be explained through the link between productivity increase and the inelastic demand for food in Egypt. Productivity increases raise agricultural production, coupled with low demand elasticities of agricultural products, and an almost nonexistent outlet for

a higher volume of agricultural exports in Egypt (agricultural exports were only 0.5% of total exports in 1995/96), domestic prices of agricultural goods fall. Agricultural terms of trade deteriorate and the net buyers of agricultural goods reap the benefits, whilst the net sellers are harmed.

One can therefore argue that a cash transfer scenario may be superior over a restructuring of the current subsidies. Cash transfers increase real incomes and do not interfere with the consumer's utility maximization and seem to compensate ruralites for their loss of revenue as a result of the agricultural sector's deteriorating terms of trade.

Conclusion, Policy Recommendations and Areas for Future Research

Overall, targeted social safety nets not only reduce the fiscal burden and make available funds that could be used to promote growth and alleviate poverty, but also help promote efficient use of resources and are more equitable. The latter is of significant importance in the case of Egypt as they correct for a long overdue bias, towards higher quintiles, in the subsidy program.

The analysis showed the benefits from restructuring the existing price subsidy program in favor of the lowest household quintiles (minimizing the inclusion error) and at the same time using the resultant savings to promote and target public spending. In a similar approach, the existing subsidy program was contrasted with an alternative cash transfer program.

Aside from achieving a more equitable distribution of benefits, the results indicate that a targeted cash transfer program promotes higher GDP growth, and higher aggregate household consumption, than targeted subsidies. Both macro as well as micro indicators, are higher under a cash transfer program than under a program targeting subsidies, with the exception of poverty which maintains similar figures under both. It was also found that, given the structure of the agricultural sector in Egypt, the rise in productivity is translated into lower domestic prices of agricultural goods and lower agricultural factor incomes ultimately driving down rural consumption per capita and raising its urban equivalent. By conducting a sensitivity analysis on the level of public investment in the agricultural sector, it was found that the lower the investments are in that sector the higher the macro and micro indicators become. However, given the inelastic demand for agricultural goods, it was found that cash transfers compensate the rural sector for its loss of revenue than does the existence of consumer subsidies. Another common finding is that across the board, government spending on human capital development circumvents the deterioration in agricultural terms of trade and thus produces higher growth and more substantial poverty alleviation than investment in infrastructure or agriculture.

It is difficult to argue that the present state of the subsidy program in Egypt is fiscally unsound, and neither can it be said that the program, as it stands, is efficient in providing the truly needy with a social safety net. The merits of undertaking a subsidy reform policy using any of the above scenarios have to take into account an administratively-feasible program and factor in the stylized socio-political dimension.

Even with a means proxy test available for Egypt, a geographical targeting of subsidies may prove to be beneficial given that the majority of the poor live in rural areas. One can argue further that geographical targeting of public spending on the social services sector and infrastructure would more likely reap greater benefits given the structure of the Egyptian agricultural sector. Especially that the highest illiteracy rates and least access to health care are concentrated in specific regions in Egypt[18].

Another area of potential gain from targeting is the provision of support based on gender. Female headed households compromise 15% of total Egyptian households. If we add illiteracy, social intolerance, poor access to capital and gender bias in the workplace, female headed household end up amongst the most vulnerable groups of society. Gender targeting can therefore help. Supplementing the analysis with data on gender is likely to yield positive results.

7. Summary and Synergy

This study differs from previous ones by analyzing the effects of public spending on growth and poverty reduction at different levels of analysis. It involves analyses and simulations at the levels of household, sectoral, regional and macro levels. Different analytical tools are used at the different levels. The approach we followed has enabled us to gain additional knowledge as well as new policy insights.

1. Our findings conform with results from earlier studies that universal subsidies are inefficient and usually achieve the intended goals at a much higher cost. A targeted approach is preferred since it is more effective in reducing poverty and attaining an equitable distribution of income. Moreover, saved government resources can be used for productive investments in human capitals, infrastructure, and agricultural technology that would have long term impacts on growth and poverty reduction. Among all types of targeted programs, direct income transfer as well as targeting to the aged, women and children deserve special attention.

[18] Extending the current CGE model to incorporate regional/governorate breakdowns may provide additional analyses and useful results.

2. In order to achieve economic growth and higher poverty reduction, public investment needs to be better prioritized. Investing in human capital and infrastructure, particularly in rural Egypt, offers the highest return in terms of both growth and poverty reduction. Regionally, investment in Upper Egypt would lead to larger poverty reductions as the poor are increasingly concentrated here

3. Investing in agriculture is potentially pro-poor and can contribute to long term national food security. But the current trade policy that isolates domestic market from the international one leads to lower returns to these investments, particularly in terms of rural income and rural poverty reduction. Most of the benefits from agricultural investment, under an autarky economy, are reaped by urban consumers and majority of rural population may suffer and they account for majority for Egyptian poor population. In summary, investing in agriculture and in rural areas is a must to lift rural poor out of poverty, but free trade in agriculture is a pre-condition for this to happen.

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Table (1)
Economic and Agricultural Growth in Egypt

	GDP	AgGDP		GDP per capita	Ag GDP per worker
	Million of 1995 constant US$			International dollars per person, 1995 prices	
1965	13,398	4,382		1,199	618
1970	15,785	4,684		1,273	617
1975	18,731	5,622		1,385	702
1980	29,896	6,302		2,020	743
1985	41,410	7,232		2,480	885
1990	50,915	8,263		2,723	1,091
1995	60,159	9,452		2,785	1,182
2001	80,093	12,177		3,129	1,447
Annual Growth Rate (%)					
1965-1974	3.24	2.63		1.27	1.38
1975-1984	7.99	2.78		5.78	2.39
1985-1994	3.85	2.68		1.26	3.12
1995-2001	5.06	4.02		2.13	3.14
1965-2001	5.56	2.84		3.20	2.61

Sources: GDP and Agricultural GDP are from the World Bank, World Development Indicators (WDI) database. Population and economically active agricultural population data used to calculate GDP per capita and AgGDP per worker are from FAOSTAT.

Table(2)
Poverty Incidence in Egypt by Governorates, Headcount Index

	1995/96				1999/00		
	Urban	**Rural**	**All Egypt**		**Urban**	**Rural**	**All Egypt**
Metropolitan							
Cairo	9.42		9.42		5.01		5.01
Alexandria	23.15		23.15		6.24		6.24
Port Said					0.90		0.90
Suez	6.45		6.45		1.91		1.91
Lower Egypt							
Damietta	3.74	11.53	9.10		0.25		0.07
Dakahlia	1.57	10.90	8.67		7.79	17.55	14.88
Sharkia	10.5	17.83	16.55		9.12	13.71	12.70
Qaliubia	0.57	34.11	26.14		6.05	9.09	7.94
KafrEl-Sheikh	4.55	18.74	16.27		3.77	5.90	5.42
Gharbia	2.75	10.26	8.17		4.51	7.84	6.85
Menufia	20.00	26.68	25.48		9.81	21.12	18.96
Beheira	13.81	37.59	33.12		6.16	8.36	7.85
Ismailia	2.03	8.01	4.93		0.90	11.12	6.02
Upper Egypt							
Giza	3.42	5.49	4.34		9.43	16.97	12.89
Beni-Suef	17.44	32.97	29.57		32.35	51.66	47.26
Fayoum	6.56	32.10	27.22		19.76	34.27	31.18
Menia	14.71	27.58	25.64		9.12	24.03	21.41
Assiut	22.79	51.96	44.78		39.21	56.76	52.08
Sohag	17.98	26.79	24.87		35.61	41.09	39.88
Qena	14.22	33.65	29.52		13.3	24.85	22.46
Aswan	9.73	9.97	9.89		18.33	18.81	18.61
Louxor	na	na	na		25.35	34.8	29.20
Frontier							
Red Sea		4.96	2.46		7.52	12.22	9.52
El Wadi El-Gedid	3.83	4.55	4.13		4.85	10.94	7.36
Matrouh	2.90		1.40		5.43	26.21	14.13
North Sinai	15.05	43.52	29.55			36.49	16.17
South Sinai	na	na	na			2.70	1.16
Total	**11.02**	**24.8**	**19.41**		**9.21**	**22.07**	**16.74**

Source: Table A2.4a&b from: World Bank. 2002. *Arab Republic of Egypt: Poverty Reduction in Egypt - Diagnostic and Strategy Volume 2: Annex Tables.*
Notes: n.a. refers to non available. In 1995/96, North Sinai includes poverty incidence estimates of South Sinai.

Table (3)
Public Expenditure in Egypt

Year	Total	Capital	Agriculture	Defense	Education	Health	Social Security and Welfare	Transportation and Communication
	Billions of international dollars, 1995 prices							
1980	41.78	8.95	1.82	3.72	3.03	0.87	3.49	0.42
1981	39.29	7.76	1.96	5.32	3.36	0.88	4.76	0.53
1982	52.87	10.25	1.95	6.73	4.87	1.27	5.89	0.89
1983	47.14	6.56	2.21	7.39	5.03	1.34	5.81	0.91
1984	50.61	6.95	2.2	9.29	5.31	1.31	6.14	1.02
1985	51.92	7.14	2.2	9.68	5.86	1.35	6.01	1.17
1986	54.06	7.69	2.21	9.54	5.91	1.27	5.87	1.63
1987	42.49	7.24	1.77	8.27	5.11	1.05	4.71	1.58
1988	46.6	7.42	2	6.63	5.46	1.13	6.03	1.85
1989	41.69	6.62	2.04	5.28	5.58	1.16	5	1.03
1990	39.36	6.81	1.86	4.52	5.51	1.11	5.07	1.13
1991	45.65	7.82	1.91	5.07	6.13	1.26	5.11	1.2
1992	58.69	18.26	2.21	4.84	6.07	1.24	5.33	1.4
1993	54.87	10.31	2.32	4.79	6.76	1.34	6.02	1.65
1994	59.69	11.42	2.58	4.87	7.64	1.41	7.14	2.02
1995	56.3	10.84	2.47	5.14	7.79	1.41	7.46	2.4
1996	56.93	12.41	2.57	5.32	8.07	1.59	2.53	2.33
1997	56.74	13.64	2.99	5.35	8.38	1.87	2.67	2.58
1998	58.9	14.16	3.32	5.36	9.52	2.12	2.44	3.05
	Annual Growth Rate (%)							
1980-1989	-0.02	-3.30	1.28	3.97	7.02	3.25	4.08	10.48
1990-1998	5.17	9.58	7.51	2.15	7.07	8.42	-8.74	13.21
1980-1998	1.93	2.58	3.40	2.05	6.57	5.07	-1.97	11.64

Source: Total Expenditures, capital expenditures are from the World Bank, World Development Indicators 2000; All other data are from issues of the International Monetary Fund's Government Finance Statistics Yearbook.

Table (4)
. Estimated results of total income and expenditures equations

Income per capita equation, lgtotipp										
	metropolitan obs=322 R-squared=0.1810		lower urban obs=349 R-squared=0.2841		lower rural obs=647 R-squared=0.3117		upper urban obs=357 R-squared=0.3886		upper rural obs=630 R-squared=0.2737	
	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value
landpp					0.02	3.88			0.03	2.09
lglvskvalue					0.04	3.73			0.05	4.57
hhhsex	0.23	1.16	0.18	0.73	-0.13	-1.00	-0.10	-0.49	-0.24	-2.22
hhhmarr	-0.28	-1.46	-0.45	-1.90	0.11	0.90	-0.17	-0.89	-0.12	-1.04
hhhedu	0.03	3.71	0.06	4.28	0.04	6.75	0.04	4.20	0.04	6.13
hhhage	0.00	1.42	0.01	2.68	0.01	3.09	0.01	3.32	0.01	2.25
dependratio	-0.09	-4.00	-0.18	-5.20	-0.12	-7.27	-0.18	-6.35	-0.09	-6.56
telephone	0.30	3.33	0.26	1.58	0.08	0.87	0.41	3.85	0.12	0.83
improvedseed					0.49	5.99			0.52	6.54
walkroad	-0.37	-0.42	-1.18	-1.34	-0.27	-0.81	-0.39	-0.57	0.19	1.05
constant	6.63	20.23	6.09	14.91	5.87	28.94	6.54	21.20	5.39	20.75
Expenditure per capita equation , *lgexpp*										
	metropolitan obs=321 R-squared=0.3122		lower urban obs=346 R-squared=0.3968		lower rural obs=636 R-squared=0.3135		upper urban obs=355 R-squared=0.4373		upper rural obs=624 R-squared=0.2938	
	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value
landpp					0.00	0.40			0.02	1.81
lglvskvalue					0.02	3.08			0.02	3.29
hhhsex	0.04	0.33	0.16	1.20	-0.21	-2.44	-0.10	-0.76	0.01	0.18
hhhmarr	-0.07	-0.57	-0.33	-2.29	0.15	1.77	-0.17	-1.38	-0.01	-0.18
hhhedu	0.04	5.52	0.04	5.95	0.04	9.70	0.03	5.35	0.03	7.30
hhhage	0.00	0.39	0.01	2.34	0.01	5.18	0.00	1.56	0.00	1.97
dependratio	-0.09	-5.12	-0.09	-5.51	-0.07	-6.66	-0.05	-3.77	-0.05	-5.28
telephone	0.22	3.01	0.35	5.02	0.31	4.93	0.42	6.08	0.33	3.78
improvedseed					-0.04	-0.76			0.00	-0.01
walkroad	-0.81	-1.24	-0.53	-1.44	-0.26	-1.50	-1.63	-3.72	-0.06	-0.44
constant	7.90	28.66	7.00	29.77	6.91	47.53	7.85	40.11	6.84	47.51

Table (5)
Estimated results of the poverty equation, the reduced form.

poor	metropolitan obs=320 Pseudo R2=0.2270		lower urban obs=327 Pseudo R2=0.2244		lower rural obs=636 Pseudo R2=0.2207		upper urban obs=349 Pseudo R2=0.3345		upper rural obs=624 Pseudo R2=0.1888	
	coefficient	z-value	coefficient	z-value	coefficient	z-value	coefficient	z-value	coefficient	z-value
landpp					-0.07	-1.99			-0.14	-3.85
lglvskvalue					-0.07	-3.25			-0.05	-2.57
hhhsex	-0.40	-0.95	-0.55	-1.74	0.34	1.32	0.42	0.98	-0.13	-0.66
hhhmarr	0.21	0.48	0.40	1.19	-0.27	-1.14	0.04	0.12	-0.10	-0.49
hhhedu	-0.09	-3.87	-0.10	-4.74	-0.11	-6.52	-0.08	-3.67	-0.06	-4.13
hhhage	0.00	-0.33	-0.01	-1.22	-0.02	-3.28	0.00	-0.02	0.00	-0.18
dependratio	0.16	2.97	0.19	3.43	0.01	0.07	0.09	2.01	0.08	0.47
telephone	-0.61	-2.58	-0.66	-2.02	0.14	4.60	-1.46	-3.14	0.10	3.97
improvedseed					-1.40	-2.91			-1.04	-2.96
walkroad	1.97	0.95	1.47	1.26	0.23	0.38	0.95	0.55	-0.28	-0.85
constant	-0.56	-0.72	-1.07	-1.63	0.33	0.80	-0.61	-0.83	-0.72	-1.75

Table(6)
Estimates of total income per capita, total expenditure per capita and poverty status with community variables

	lgtotipp				lgexppp				poor			
	lower rural obs=416 R-squared=0.3868		upper rural obs=503 R-squared=0.3147		lower rural obs=406 R-squared=0.2961		upper rural obs=499 R-squared=0.3111		lower rural obs=406 Pseudo R2=0.2748		upper rural obs=499 Pseudo R2=0.2229	
	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value	coefficient	t-value
landpp	0.03	3.07	0.02	1.77	0.01	1.08	0.01	1.56	-0.13	-1.78	-0.14	-3.67
lglvskvalue	0.05	3.64	0.05	4.50	0.01	1.39	0.03	3.03	-0.08	-2.36	-0.07	-3.01
hhhsex	-0.04	-0.24	-0.22	-1.76	-0.18	-1.61	0.06	0.75	0.16	0.46	-0.09	-0.39
hhhmarr	0.02	0.12	-0.20	-1.50	0.13	1.19	-0.09	-1.07	-0.17	-0.53	0.04	0.15
hhhedu	0.04	5.65	0.04	4.46	0.03	6.63	0.03	5.65	-0.09	-4.00	-0.07	-3.68
hhhage	0.01	2.43	0.01	2.06	0.01	3.22	0.00	1.48	-0.02	-2.35	0.00	-0.50
dependratio	-0.13	-6.86	-0.08	-5.57	-0.06	-4.33	-0.05	-4.84	0.13	3.09	0.11	3.57
telephone	0.05	0.45	0.27	1.93	0.22	3.07	0.37	3.78	-1.21	-2.85	-1.06	-2.76
Improvedseed	0.40	4.47	0.49	5.84	0.09	1.64	-0.01	-0.19	-0.28	-1.11	0.17	0.90
walkroad	-0.73	-1.81	0.11	0.61	0.09	0.46	-0.09	-0.60	-0.91	-0.90	-0.28	-0.74
Postoffice	0.37	2.47	-0.06	-0.29	0.01	0.12	0.09	0.59	0.02	0.06	-0.01	-0.02
commbank	-0.19	-0.67	-0.27	-1.19	0.23	1.26	0.19	1.04	-0.20	-0.27	-0.74	-1.44
market	0.26	1.35	-0.48	-1.99	0.14	1.07	-0.04	-0.33	-0.56	-1.04	-0.93	-1.96
prepschool	-0.83	-3.51			-0.38	-2.96			1.62	2.93		
busstop	0.39	2.48	0.16	0.93	0.09	0.97	0.13	1.11	-0.63	-1.84	-0.13	-0.39
pavedroad			-0.28	-1.64			-0.19	-2.07			0.36	1.22
agextn	0.30	1.72	-0.13	-0.71	0.15	1.28	-0.06	-0.48	-0.40	-0.87	0.26	0.77
clinic	0.27	1.50	0.00	-0.03	-0.13	-1.16	-0.02	-0.20	0.10	0.23	-0.18	-0.72
Pubcanal	-0.68	-2.46	0.23	1.04	0.05	0.35	0.09	0.59	-0.03	-0.04	-0.14	-0.33
Commcanal	-0.56	-2.62	0.06	0.42	-0.24	-1.81	-0.10	-1.22	0.68	1.14	0.29	1.18
Constant	6.90	21.56	6.30	13.66	7.39	20.88	6.80	22.21	0.21	0.23	-1.39	-1.56

Note: Pavedroad and prepschool are dropped due to collinearity.

Table (7)
Estimated Results Using the Regional Level Data

(1)	P	=	–	0.232 LP (–2.78)*	–	0.109 RWAGE (–0.95)	-	1.068 NFE (-2.56)*	R^2 = 0.303
(2)	LP	=	+	0.239 PHONE (2.21)*	+	0.046 ROADS (1.56)	-	1.62 ILIT (4.68)*	R^2 = 0.298
			+	0.247 RDS (2.13)*	+	0.254 IRRI (3.45)*			
(3)	RWAGE	=	+	0.054 PHONE (2.04)*	+	0.01 ROADS (0.00)	+	3.38 ILIT (6.49)*	R^2 = 0.312
			+	0.232 LP (1.56)					
(4)	NFE	=	-	0.151 PHONE (4.82)*	+	0.017 ROADS (0.37)	+	3.38 ILIT (6.49)*	R^2 = 0.833
			-	0.001 LP (-0.002)					

Note: Explanation of variable abbreviations found in text.

Table (8)
Effects of Public Investment on Agricultural Growth
Benefit-Cost Ratio

Region	Phone	Roads	Education	R&D	Irrigation
Metropolitan	0.25	0.31	n.a.		7.89
Lower Egypt	6.37	3.73	5.81		1.85
Upper Egypt	4.36	4.79	4.43		1.97
Egypt	3.13	2.84	4.86	4.12	1.94
Poverty Reduction Effect, number of poor per 1 million LE					
Metropolitan	17.31	21.19	9.98		545.16
Lower Egypt	129.68	75.97	59.15		37.56
Upper Egypt	335.27	368.40	170.53		151.42
Egypt	133.95	121.47	208.26	176.31	83.16

Table(9)
Assumptions for Non-Base Simulations

Simulation name	Description
Set 1: Targeting the price subsidy program	
SUB1+QG-AGR+-2	Increasing government spending by amount equivalent to government savings upon restructuring the price subsidy program and shifting government spending from "other" to agriculture
SUB1+QG-TRN+-2	Increasing government spending by amount equivalent to government savings upon restructuring the price subsidy program and shifting government spending from "other" to infrastructure
SUB1+QG-HUM+-2	Increasing government spending by amount equivalent to government savings upon restructuring the price subsidy program and shifting government spending from "other" to human capital
Set 2: A cash transfers program	
TRHH+QG-AGR+-2	Increasing government spending by an amount equivalent to net savings from eliminating the price subsidy program and introducing a cash transfers program (which is equal in value to the price subsidy program) and from shifting government spending from "other" to agriculture
TRHH+QG-TRN+-2	Increasing government spending by an amount equivalent to net savings from eliminating the price subsidy program and introducing a cash transfers program (which is equal in value to the price subsidy program) and from shifting government spending from "other" to infrastructure
TRHH+QG-HUM+-2	Increasing government spending by an amount equivalent to net savings from eliminating the price subsidy program and introducing a cash transfers program (which is equal in value to the price subsidy program) and from shifting government spending from "other" to Human Capital

Notes: In all public spending simulations, expansion or reallocation refers to a change in 1998 corresponding to 10 percent of 1997 government demand (or 1.9 percent of GDP). Starting from 1998, all government demand areas grow at a uniform annual real rate of 1.9 percent. Unless otherwise noted.

Table(10)
. Subsidy Restructuring Scenario and Reallocation of Public Spending: Summary Results

	1997	BASE	SUB1+QG-AGR+-2	SUB1+QG-TRN+-2	SUB1+QG-HUM+-2
	Annual growth rates, 1998-2015 (%)				
Absorption	266.32	4.03	3.98	4.41	6.80
Household consumption	195.10	3.90	4.01	4.24	6.60
Gov. consumption & inv'ment	26.00	4.58	5.06	5.06	4.83
Private investment	45.22	4.27	3.16	4.73	8.85
Exports	59.42	4.17	3.61	4.59	7.89
Imports	66.77	4.32	3.84	4.69	7.66
Real exchange rate	100.00	-0.65	0.43	-0.59	-1.08
Total GDP (at factor cost)	241.09	3.98	3.96	4.38	7.18
TFP index		2.53	2.85	2.84	4.29
Total factor income	241.84	3.58	4.02	3.97	6.48
Private capital	153.82	3.37	4.32	3.80	6.19
Land	19.40	5.89	1.54	5.93	8.76
Agricultural labor	11.23	3.76	-0.46	3.87	6.76
Non Agricultural labor	57.38	3.14	4.48	3.66	6.23
Ratios to GDP	**Percentage point deviations from 1997 values**				
Investment	22.48	0.38	0.14	0.68	2.14
Government expenditure	22.61	-2.92	-1.22	-2.88	-5.44
Private saving	16.96	-1.02	-1.15	-1.16	-1.41
Government saving	8.59	-1.64	-1.74	-1.19	0.50
Foreign saving	-3.07	3.03	3.03	3.04	3.05
Poverty headcount rate (P0)	16.77	-11.16	-11.72	-12.08	-15.47

Table (11)
Subsidy Restructuring Scenarios For Reallocation of Public Spending: Welfare Indicators

	1997	BASE	SUB1+QG-AGR+-2	SUB1+QG-TRN+-2	SUB1+QG-HUM+-2
Annual growth rates, 1997-2015 (%)					
Household consumption per capita					
Rural upper income	8.25	2.70	1.78	2.97	5.65
Rural lower income	0.98	3.53	3.17	3.88	6.79
Urban upper income	18.78	1.04	1.57	1.45	3.84
Urban lower income	1.23	2.83	4.05	3.36	6.18
Average, all households	3.20	2.22	2.36	2.60	5.23
Rural	2.43	2.89	2.22	3.19	5.93
Urban	4.22	1.65	2.46	2.10	4.65
Percentage point deviations from 1997 values					
Poverty headcount, P0					
Total	16.77	-11.16	-11.72	-12.08	-15.47
Rural	22.03	-14.66	-14.26	-15.59	-20.15
Urban	9.78	-6.52	-8.35	-7.43	-9.25
Elasticity		-1.37	-1.34	-1.23	-0.61
Poverty gap, P1					
Total	5.34	-3.92	-4.07	-4.17	-5.07
Rural	7.28	-5.35	-5.30	-5.66	-6.89
Urban	2.75	-2.01	-2.44	-2.20	-2.65
Elasticity		-1.52	-1.46	-1.33	-0.63
Squared poverty gap, P2					
Total	2.41	-1.87	-1.93	-1.97	-2.32
Rural	3.37	-2.61	-2.60	-2.74	-3.24
Urban	1.14	-0.87	-1.04	-0.95	-1.11
Elasticity		-1.60	-1.53	-1.40	-0.64

Notes: Household consumption is real per capita consumption. Elasticities for P0, P1, and P2 are the ratios between the percent change in the poverty indicator and the percent change in aggregate per capita consumption.

Table (12)
Cash Transfers Scenario for Reallocation of Public Spending: Summary Results

	1997	BASE	TRHH+QG-AGR+-2	TRHH+QG-TRN+-2	TRHH+QG-HUM+-2
	Annual growth rates, 1998-2015 (%)				
Absorption	266.32	4.03	4.01	4.43	7.17
Household consumption	195.10	3.90	4.08	4.31	7.01
Gov. consumption & inv'ment	26.00	4.58	5.06	5.06	4.83
Private investment	45.22	4.27	3.00	4.55	8.72
Exports	59.42	4.17	3.63	4.60	7.93
Imports	66.77	4.32	3.85	4.70	7.70
Real exchange rate	100.00	-0.65	0.40	-0.62	-1.11
Total GDP (at factor cost)	241.09	3.98	3.99	4.40	7.22
TFP index		2.53	2.85	2.84	4.29
Total factor income	241.84	3.58	4.06	4.00	6.52
Private capital	153.82	3.37	4.33	3.80	6.22
Land	19.40	5.89	1.73	6.11	8.94
Agricultural labor	11.23	3.76	-0.29	4.02	6.93
Non Agricultural labor	57.38	3.14	4.50	3.68	6.27
Ratios to GDP	Percentage point deviations from 1997 values				
Investment	22.48	0.38	-0.47	0.05	1.65
Government expenditure	22.61	-2.92	-1.20	-2.86	-5.42
Private saving	16.96	-1.02	-1.00	-1.02	-1.30
Government saving	8.59	-1.64	-2.49	-1.96	-0.09
Foreign saving	-3.07	3.03	3.02	3.02	3.04
Poverty headcount rate (P0)	16.77	-11.16	-11.72	-12.03	-15.47

Table (13)
Cash Transfer Scenarios for Reallocation of Public Spending: Welfare Indicators

	1997	BASE	TRHH+QG-AGR+-2	TRHH+QG-AGR+-2	TRHH+QG-AGR+-2
Annual growth rates, 1997-2015 (%)					
Household consumption per capita					
Rural upper income	8.25	2.70	1.80	2.98	5.67
Rural lower income	0.98	3.53	3.35	4.03	6.93
Urban upper income	18.78	1.04	1.54	1.44	3.85
Urban lower income	1.23	2.83	4.28	3.52	6.33
Average, all households	3.20	2.22	2.41	2.63	5.28
Rural	2.43	2.89	2.29	3.24	5.98
Urban	4.22	1.65	2.49	2.13	4.69
Percentage point deviations from 1997 values					
Poverty headcount, P0					
Total	16.77	-11.16	-11.72	-12.03	-15.47
Rural	22.03	-14.66	-14.26	-15.59	-20.15
Urban	9.78	-6.52	-8.35	-7.30	-9.25
Elasticity		-1.37	-1.33	-1.22	-0.61
Poverty gap, P1					
Total	5.34	-3.92	-4.06	-4.14	-5.06
Rural	7.28	-5.35	-5.28	-5.61	-6.87
Urban	2.75	-2.01	-2.43	-2.18	-2.64
Elasticity		-1.52	-1.45	-1.32	-0.62
Squared poverty gap, P2					
Total	2.41	-1.87	-1.92	-1.96	-2.32
Rural	3.37	-2.61	-2.59	-2.72	-3.23
Urban	1.14	-0.87	-1.04	-0.94	-1.11
Elasticity		-1.60	-1.52	-1.38	-0.63

Notes: Household consumption is real per capita consumption. Elasticities for P0, P1, and P2 are the ratios between the percent change in the poverty indicator and the percent change in aggregate per capita consumption.

Table (14)
Sensitivity Analysis of Agricultural Spending or Cash Transfer

		Subsidy Restructuring Scenario			Cash Transfer Scenario		
		Allocation of Subsidy Savings to Agricultural Sector					
	Base Scenario	Full	Three Quarters	Half	Full	Three Quarters	Half
Growth, 1998-2015 (%)							
Per Capita Consumption							
R1	3.53	3.17	3.27	3.37	3.35	3.27	3.55
R2	3.14	2.93	3.01	3.10	3.07	3.01	3.24
R3	2.98	2.22	2.33	2.45	2.30	2.33	2.53
R4	2.68	2.03	2.13	2.24	2.05	2.13	2.25
R5	2.70	1.78	1.90	2.02	1.80	1.90	2.04
U1	2.83	4.14	4.14	4.13	4.28	4.14	4.28
U2	2.55	3.58	3.60	3.61	3.68	3.60	3.71
U3	2.17	3.15	3.16	3.16	3.19	3.16	3.20
U4	1.49	2.38	2.39	2.39	2.37	2.39	2.38
U5	1.04	1.55	1.58	1.61	1.54	1.58	1.60
Total	2.22	2.36	2.42	2.47	2.41	2.42	2.52
Rural	*2.89*	*2.22*	*2.33*	*2.44*	*2.29*	*2.33*	*2.51*
Urban	1.65	2.46	2.48	2.49	2.49	2.48	2.52
Poverty Incidence							
Total	-11.16	-11.72	-11.93	-12.09	-11.72	-11.93	-12.09
Rural	-14.66	-14.26	-14.64	-14.91	-14.26	-14.64	-14.91
Urban	-6.52	-8.35	-8.35	-8.35	-8.35	-8.35	-8.35
Macro Economy							
GDP at Factor Cost	3.98	3.96	4.03	4.09	3.99	4.03	4.09
Absorption	4.03	3.98	4.05	4.12	4.01	4.05	4.12
Total Factor Productivity	2.53	2.85	2.83	2.81	2.85	2.83	2.81
Factor Income							
Land	5.89	1.54	1.97	2.43	1.73	1.97	2.43
Agricultural Labour	3.76	-0.46	-0.03	0.42	-0.29	-0.03	0.42
Non Agricultural Labour	3.14	4.48	4.51	4.51	4.50	4.51	4.51

Source: Simulation Results