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May 2007

Public Spending and Poverty Reduction in an Oil-Based Economy:

The Case of Yemen

Mohamed Abdelbasset Chemingui,
United Nations Economic Commission for Africa

Development Strategy and Governance Division

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ABSTRACT

This study is part of a collaborative project between the International Food Policy Research Institute and the Arab Planning Institute in Kuwait on public policy and poverty reduction in the Arab region. The purpose of this paper is to assess the impact of an increase in public spending in priority areas on economic growth and poverty reduction in Yemen. To accomplish this objective, the study builds a dynamic Computable General Equilibrium model to provide a baseline scenario of changes in the economy and poverty levels in Yemen during the period 1998-2016. Alternative scenarios are then compared to isolate the specific impact of several policies on poverty. The scenarios assume an increase in public spending devoted to three priority areas (agriculture, education, and health), which affect the economy through an increase in sectoral or economy-wide technical factor productivity.

Results of public spending experiments show that targeting increased amounts of public spending towards education and health services will generate more economic growth and poverty reduction than increasing public spending solely on the agricultural sector. However, when an oil sector is a prominent part of the economy, as in Yemen, additional public spending on health and education does not improve productivity in the oil sector. Therefore, spending on agriculture becomes the most important channel for poverty reduction and economic growth.

While increasing public spending in priority areas appears to be the best solution available for the government to reduce poverty during the next decade, the road is still long for Yemen to be able to achieve its Millennium Development Goals for poverty reduction. Re-allocating public expenditures from defense to key sectors appears to be an additional option for reducing poverty, given the financial constraints facing Yemen. However, in the current context of terrorism concerns, it will be difficult to convince policy-makers to reduce spending on defense and security. Seeking additional resources from international donors seems to be the only option available to increase benefits from increased public spending in the priority areas identified and assessed in this study.

1. INTRODUCTION

Yemen is one of the poorest countries in the world, with a GDP per capita of US$460 in 2006. To achieve sustainable employment-generating growth and to deliver the public services for achieving Millennium Development Goals (MDG) of halving the number of poor by 2015, Yemen faces severe structural and policy constraints. The country's problems are compounded by high population growth (about three percent per year), which results in a disproportionate number of young people (half of the population is below age 15).

Currently, the most important challenges for Yemen's economy are to accelerate growth and to reduce poverty. Public spending is an important instrument for achieving such targets where the private contribution to economic activity is weak. Public spending can indirectly help to develop the private sector and have a direct impact on the poor, through direct transfers to households and through public spending on social services and public investment. Furthermore, improved budget management, public administration, governance, and transparency and accountability benefit the poor through more efficient and better targeted use of public resources (Ames et al., 2001).

While consolidating public finances and rationalizing subsidies, Yemen expects to reach its MDG target by implementing a package of reforms outlined in its Five-Year Plan. The Plan calls for improving the quality of education and making it universal, ensuring gender equality, reducing child mortality and malnutrition rates, improving the health indicators, ensuring sustained economic growth, and improving governance. In other words, the government is required to do more with fewer resources. For these reasons, it is important to evaluate the contribution of public spending to poverty reduction both directly and indirectly. The objective of this study is to evaluate the impact of different types of government spending to better target available resources to achieve rapid economic growth and poverty reduction. This study is a part of a cooperative project between the International Food Policy Research Institute (IFPRI) and the Arab Planning Institute in Kuwait (API) to improve understanding of how public policy including government spending can bring about poverty reduction in the context of the MDG.

Empirical evidence has shown that investment in social services improves human capital and reduces poverty over the long run. Good education and health care help the poor lead more productive lives, increasing the return on investments. As growth is mostly driven by labor and total factor productivity (TFP), which includes human capital, any investment intended to improve the

productivity of labor and TFP will improve the sustainability of economic growth in a given country. A healthier and more productive labor force helps to stimulate development of the private sector.

While theoretical and empirical studies confirm that public spending on education and basic health care is anti-poverty, few studies have assessed the effect of targeted public spending on poverty. Moreover, none of these studies focuses on Arab countries. At a time when most developing countries need to reduce subsidies and other public spending to decrease budget deficits, it is important to set priorities for poverty reduction, targeting public spending to specific sectors. Several legitimate questions do arise: How effective has public spending been? What seems to work better for poverty reduction? Which types of spending are most likely to generate the highest rate of poverty reduction with minimum cost for the economy?

It is widely admitted that gains in TFP, reflecting more efficient use of inputs, have long been recognized as an important source of improvement in income and welfare. According to many recent studies, such as those conducted by Klenow and Rodriguez-Clare (1997) and Easterly and Levine (2000), cross-country differences in income levels and growth rates are mostly due to differences in productivity. Public spending on research and development (R&D), infrastructure, and human capital is believed to be one of the leading determinants of economic growth, mainly by improving TFP.

An indirect way of assessing the effect of public spending on economic growth is to use TFP as a dependent variable and to regress other variables on it, mainly those related to public spending, assuming that targeted public spending will improve TFP. Through improvement of TFP, the economy will grow faster. Consequently, poverty will decline. To do so, estimation of trends in TFP is required. However, some issues related to the estimation and interpretations of TFP tend to make such an approach problematic, especially for a country where good data are missing.

In general, public investment in R&D, in roads and other infrastructures, translates into future returns. There is a tendency to underestimate the true value of the independent variable in public spending today. According to the World Bank (2000a), estimation of TFP growth is very sensitive to the data used. Estimation of TFP growth requires data on the growth rate of real GDP, physical capital, and labor input adjusted for human capital. While real GDP growth rates are available from many sources, measuring growth rates of capital stock and human-capital-adjusted labor input is more difficult. Measuring growth rates of capital stock is highly sensitive to assumptions regarding initial stocks and depreciation rates. In addition, estimating human-capital-adjusted labor input is, in itself,

problematic (World Bank 2000a). Accordingly, the estimation of TFP growth carried out by the World Bank is sensitive to the choice of the production function and to the degree of scale economies.

Finally, the interpretation of estimates of TFP growth in itself matters, since TFP includes numerous specific sources of efficiency gains sources that can only be discovered with analysis of the TFP itself. In light of the drawbacks to estimating TFP growth, one might consider another option: directly estimating the production function econometrically to avoid assumptions of constant returns and perfect competition by regressing output growth on input growth. However, it is not possible to use that approach here because data are missing for Yemen.

Therefore, rather than doing regressions, it is justifiable to use results on growth elasticities of public spending obtained from other studies, mainly through cross-country analysis. Thus, the elasticities used in the empirical assessment of public spending on poverty in Yemen in this study come from empirical literature devoted to the determinants of economic growth at the aggregate level and for the agricultural sector. They are not specific to Yemen. Using these elasticities is appropriate if one believes that Yemen's economy will adjust and respond to the same basic economic forces of health and education that have made human capital more productive in a cross section of many other countries (see for instance Barro, 1997; Mundlak, Larson, and Butzer, 1997).

To assess the effect of public spending on poverty changes, the use of a comprehensive analytical tool – a computable general equilibrium model (CGE) - is needed. This type of model has become a standard tool for the integrated assessment of public policies and income distribution for small economies.[1] Its main advantage lies in the possibility of combining detailed and consistent databases with a theoretically sound framework. It is able to capture feedback effects and market interdependencies that may either mute or accentuate first-order effects.

For this purpose, a dynamic CGE model is constructed to provide a baseline scenario for the economy and poverty changes in Yemen during the period 1998-2016, to which alternative policy scenarios may then be compared to isolate the specific impact the latter. The alternative scenarios assume an increase in public spending devoted to a given sector, which will increase the TFP. Such improvements in TFP will affect the whole economy, in general, and the poverty level, in particular. The CGE model is used to assess the detailed effects of the alternative scenarios related to public spending experiments. Finally, the poverty elasticities with respect to real mean consumption per

[1] See for instance Rutherford, Rustrom, and Tarr (1997) for Morocco, or Dessus and Suwa-Eisenman (1999) for Egypt and Tunisia.

capita are estimated and used to calculate the new poverty measures generated both in the baseline scenario and the public spending experiments.

2. RECENT AND ECONOMIC TRENDS AND THE POVERTY PROFILE

The Economy of Yemen

Since unification, the government of Yemen has worked to integrate two relatively disparate economic systems. However, severe shocks—including the return in 1990 of approximately 850,000 Yemenis from the Gulf States, a subsequent major reduction of aid flows, and an increase in internal political disputes culminating in the 1994 Civil War ─ hampered economic growth. As a result, economic growth has been lower than population growth, financial imbalances have increased, workers' remittances have decreased substantially, the inflation rate has reached 71 percent, and external debt has mounted. During 1992-94 the parallel market exchange rate depreciated, causing GNP per capita to decline substantially from US$701 in 1990 to US$318 in 1995 (World Bank 2002). When the war ended in 1995, the government entered into agreement with the International Monetary Fund (IMF) to institute a macroeconomic adjustment and structural reform. The program included strong fiscal adjustment measures, liberalization of most interest rates and reform of the exchange rate system, including in 1996 the elimination of the official exchange rate and unification of exchange rates at the free market level and the adoption of a floating rate regime (IMF 2001). The impact of these measures on the balance of payments has been favorable. The current account recorded a surplus from 1996 to 2002 (with the exception of 1998) and the surplus peaked at about 14.2 percent of GDP in 2000, but dropped to 7.0 percent in 2001 and 5.4 percent in 2002. Furthermore, inflation rates continued to decline and reached a single digit in 1997, reflecting success in reducing the fiscal deficit, which allowed for tight monetary growth (World Bank, 2002).

Following a minor discovery of Oil in 1982 in the south, the share of oil and gas in the economy has increased from 13 percent of GDP in 1995 to 34 percent in 2000, while the share of agriculture dropped from 24 to 15 percent during the same period. Oil dependency is even more pronounced in public finances with oil and gas accounting for almost 90 percent of total government revenues, creating a boom-bust cycle in public finances, affecting the government's ability to finance essential services and investments.

Overall, despite severe shocks during the first half of the 1990s, GDP growth was particularly high relative to regional standards during the 1990s. During the pre-reform period (1991-94), real GDP growth averaged 4.1 percent, mainly due to high growth in the oil sector and government services. During the reform period and after (1995-2002), economic growth averaged 5.4 percent per year, driven mainly by the increase in agriculture value-added and the service sectors. Since the

majority of the poor work in services or in the agriculture sector, it is probable that the economic performance during the post-reform period has positively affected the incidence of poverty. The patterns of growth in the two periods are significantly different. During the first period (1991-94), the growth rate was up in only one year (1992), whereas growth was more sustained at the second period with relatively moderate rates (see the Appendix, Table 1A). In-depth analysis shows that different forces contributed to these growth rates. A closer look at the economic sectors is required to explain them. Agriculture remains the most important sector in the economy of Yemen. During the period 1990-2002, it accounted for about 19 percent of GDP and a more than 50 share of total employment. However, reliance on irrigation in a country with scarce water resources, prevalence of traditional methods of cultivation, and the cultivation of q*at*[2], has reduced the share of agriculture in the country's GDP during the last 13 years, which declined from 24 percent in 1990 to about 15 percent in 2002. During the period 1990-2002, real growth in the value-added of the agriculture sector averaged 5 percent per year, rising from just 2.7 percent during the pre-reform period to 6.1 percent during the post-reform period, a major achievement. However, fluctuations of production are a typical characteristic of the Yemeni agricultural sector, reflecting difficult climatic conditions. The real GDP for agriculture grew only 1.2 percent in 1999 and 3.6 percent in 2002.

As for the industrial sector, its contribution to real GDP averaged 34 percent during the period 1990-2002, with an average annual growth rate of about 5 percent (3.2 percent before the reforms and 6.0 percent after). However, during the last three years of the post-reform period, the industrial sector's real GDP declined by 1.8 percent in 2000 and grew by only 2.5 percent in 2001 and 1.7 percent in 2002. A drop in international oil prices during this period may explain the sector's slowdown during this period. Thus, the performance of the industrial sector in Yemen appears to be highly correlated with the growth in oil revenues, which registered an average annual growth rate of 7.4 percent during the period 1991-95, compared with 6.4 percent during 1996-2001.

Finally, despite the growth of the oil sector, the service sector remains the largest contributor to GDP in the country, averaging 47 percent during the period 1990-2002, higher than either the agricultural or industrial sectors. Its real value-added grew by 6 percent per year on average during the period 1990-2002. However, although the growth rate of real GDP was higher in the post-reform period than in the pre-reform period (6.3 versus 5.2 percent), its contribution to GDP declined from 49.0 percent in 1990 to 44.4 percent in 2002.

---

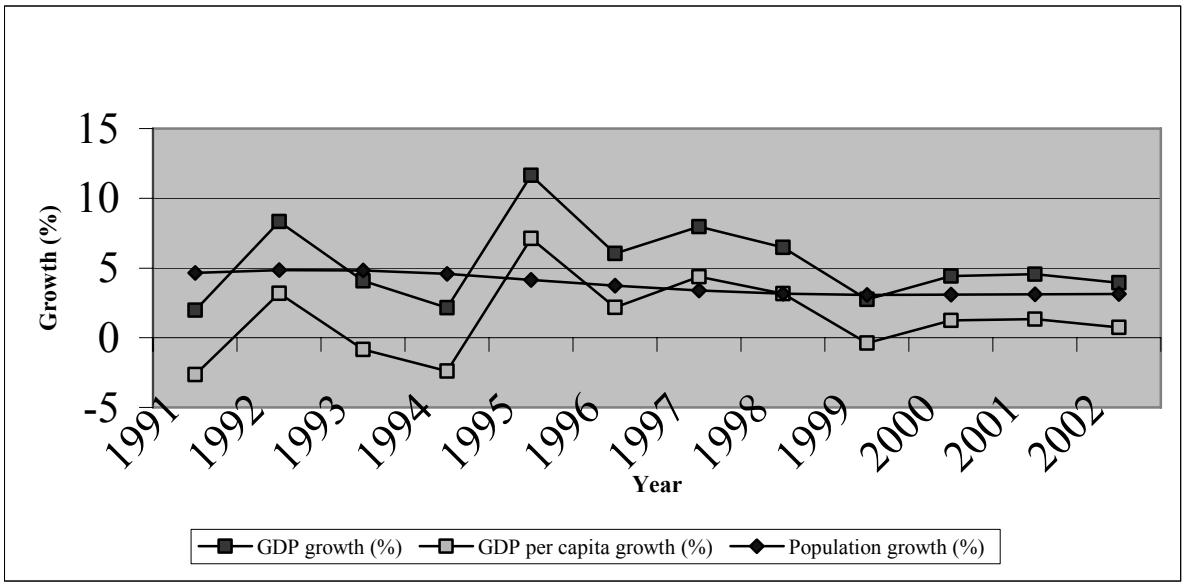
2 Qat comes from a plant scientifically known as Katia-adeblions. A light drug is obtained from chewing the leaves of a cultivated and irrigated tree, largely grown and consumed in Yemen, where people chew it every afternoon.

While GDP growth during the post-unification period (1990-2002) has been relatively high, it translates into only a 1.6 percent increase in GDP per capita due to the high population growth rate (Figure 1). This modest increase is reflected in the trend of private consumption per capita, which increased only 1.0 percent during the same period. Furthermore, during the post-reform period, real private consumption per capita declined by 0.3 percent. The development of other economic indicators is more encouraging. Investment and saving rates grew significantly but are still relatively low by international standards. Meanwhile, the government's spending grew by 3.5 percent on average during 1990-2002. The budget deficit was reduced to only 3 percent of GDP, which indicates that the economic reform successfully stabilized the economy, mainly by reducing indirect subsidies and transfers. As a result, the inflation rate dropped to about 5.0 percent and the current account balance was in surplus in all post-reform years, except for 1998. Nevertheless, this situation is not sustainable, and public revenues have increased at a slower pace than the increase in general expenditure. Moreover, macroeconomic stabilization success has not improved the attractiveness of the country for foreign direct investment, which remains very low and concentrated in the oil sector. While Yemen is a highly open economy, its trade structure is dominated by oil exports and by consumption product imports (mainly industrial) (Appendix Table 2A).

Poverty Profile

The poverty description and indicators used in this section are directly based on two recent studies carried out by the World Bank (2002) and the Central Statistical Organization of Yemen (1999), using the 1998 Household Budget Survey data (HBS). Earlier poverty estimates were based on the 1992 HBS as well as the 1999 National Poverty Phenomenon Survey (NPPS). Both data sets suffer from bias. The 1992 HBS is biased by the non-representativeness of the sample of households selected : urban observations represent 72 percent in the sample used, whereas the share of the urban population is estimated at about 20 percent for the same year. This lack of representative weight prevents any meaningful poverty comparisons with the 1998 HBS. Although the 1999 NPPS covers more households than the 1998 HBS (49,450 versus 3,780) and the sample is representative at the governorate level, its purpose is primarily to provide detailed information on access to services and other aspects of non-income living standards. Its results are biased by seasonality effects, as it was conducted over only one month.

Figure 1. GDP and GDP per Capita Growth Rate During the Period 1991-2002



Sources: Established using data from World Bank (2004)

Overall, the 1998 HBS is considered the only household budget survey providing adequate information on incomes and expenditures. Since it was carried out during a full year and over four rounds, seasonal patterns in consumption, expenditure, and income, are adequately taken into account. For these reasons, estimating the poverty trend between 1992 and 1999 cannot be done. Therefore, this analysis focuses on only one year of observation—1998.

Poverty Line and Poverty Measures in Yemen

Three main indicators are often used to measure poverty:

- Poverty incidence (P0)
- Poverty gap index (P1)
- Severity of poverty (P2)

The Gini coefficient (Gin) is the indicator used for measuring the inequality of the income distribution and consumption expenditures. Most of the poverty indicators related to Yemen have already been estimated by the World Bank (2002) and the Central Statistical Organization (1999).

Poverty Incidence (P0)

The most common standard indicator is the incidence of poverty (also called the poverty rate or head-count rate). *P0* describes the percentage of the population whose per capita incomes, or total expenditures, are below the poverty line, that is, the population that cannot afford to buy an internationally recognized basic basket of goods. The methodology used by the World Bank (2002) follows the approach developed by Ravallion (1994). According to this approach, people are classified as poor if their consumption expenditure falls below a poverty line, which is defined as the value of a commodity basket containing both basic foodstuffs and non-food goods. Hence, poverty lines are made up of two components: (1) a food poverty line, setting the cost of a food bundle to attain a food energy requirement equal to 2,200 calories per person per day, and (2) an allowance for basic non-food goods. Using the 1998 HBS, the food poverty lines for Yemen are estimated in Yemeni rial (YR) at YR25,212 per person per year at the national level: YR25,116 in urban areas and YR25,236 in rural areas.

Based on these food poverty lines, 18 percent of the population are classified as poor at the national level. The incidence of food poverty is 10 percent in urban areas and 20 percent in rural areas. Table 1 reports poverty estimates using three different poverty lines for the year 1998.

As food poverty lines provide a measure of extreme poverty, an allowance is usually added for non-food basic consumption. The resulting lines are usually referred to as lower poverty lines. Nationally, in 1998, the lower poverty lines for Yemen were YR38,520 per person per year, YR38,340 in urban areas, and YR 38,580 in rural areas. Using the lower poverty lines, the incidence of poverty in Yemen was 41.8 percent in rural areas, 30.8 percent in urban areas, and 45.0 percent in rural areas.

The upper poverty lines are estimated by adding the average non-food expenditure among households who actually spend on food an amount that is equal to the food poverty lines. In 1998, the upper poverty lines for Yemen were YR56,640 per person per year at the national level, YR57,168 per person in urban areas, and YR56,484 in rural areas. Based on the upper poverty lines, the incidence of poverty in Yemen reaches 66.9 percent at the national level, 69.6 percent in rural areas, and 57.8 percent in urban areas.

Poverty Gap Index (P1)

The poverty gap index[3] measures the depth of poverty, considering both the number of poor people and how poor they are. *P1* is the combined measurement of the incidence and depth of poverty. The estimated *P1* of 13.2 percent at the national level in 1998 provides a measure of the ratio of the minimum cost of eliminating poverty, with perfect targeting to the maximum cost with no targeting. As far as the severity of poverty is concerned, Table 1 shows the estimates of the squared poverty gap index (P1), a measure that takes into account not only the distance separating the poor from the poverty line, but also the degree of inequality among the poor. It is the average value of the square of the depth of poverty for each individual. The poorest people contribute relatively more to the index. For Yemen, this indicator equals 13.2 percent at the national level. However, rural poverty (at 14.7 percent) appears to be far more severe than urban poverty (at 8.2 percent).

Severity of Poverty (P2)

While *P1* has clear advantages for some purposes, such as comparing policies that aim to reach the poorest, a ranking of dates, places, or policies in terms of the *P2* should clearly reflect the severity of poverty. It is the ability of this measure to order distributions in a better way than the alternatives that makes it useful, not the precise number obtained (Coudouel and Hentschel, 2000).

[3] This measure is also called the Foster-Greer-Thorbeke (FGT) P1.

Table 1. P0, P1, and P2 estimates for Yemen, 1998 (%)

	Urban	Rural	National
Food Poverty Line			
P0	10	19.9	17.7
P1	2.1	5.2	4.5
P2	0.7	2.0	1.7
Lower Poverty Line			
P0	30.8	45.0	41.8
P1	8.2	14.7	13.2
P2	3.2	6.7	5.8
Upper Poverty Line			
P0	57.8	69.6	66.9
P1	19.8	28.7	26.6
P2	9.1	15.1	13.7

Source: World Bank (2002).

Gini Coefficient

For measuring inequality in the distribution of income and consumption expenditures, the Gini coefficient is a widely used indicator. Its value for the year 1998 at the national level is estimated at 0.32. The estimation of the Gini coefficient at the regional level shows a high disparity in inequality between regions, which is more pronounced in rural (0.43) than in urban areas (0.40).

Distribution of Total Expenditure Shares

The distribution of total expenditure shares across population shares ranked by per capita expenditure is the second indicator that is often used for measuring inequality at the expenditure level. According to the 1998 HBS, the richest 50 percent of the population spends 73 percent of the total expenditure at the national level, while the top 10 percent accounts for more than 25 percent of the total expenditure on consumption (Table 2).

Table 2. Distribution of total expenditures value by decile at the national level

Decile	1	2	3	4	5	6	7	8	9	10
Consumption share (%)	3.5	4.5	5.0	6.0	8.5	9.0	10.5	12.0	15.5	25.5

Source: Central Statistical Organization, Yemen (1999)

Socio-demographic Characteristics of the Poor in Yemen

The socio-demographic profile of the poor in Yemen fits a pattern common to many developing countries. According the World Bank (2002) and the Central Statistical Organization of Yemen (1999), poverty in Yemen is highly correlated with the following characteristics:

Household size: Data shows that the incidence of poverty in Yemen increases sharply with rising household size. In 1998, the average size of poor households was 8.2 (9.2 in urban areas and 8.0 in rural areas), compared with the national average of 7.1.

Child-adult ratio: Incidence and depth of poverty steadily increase with rising ratios of children to adults. In 1998, about 35 percent of households having more adults than children are poor, compared with 50 percent of households having a child-adult ratio between 2 and 3, and 66 percent of households with child-adult ratios greater than 4.

Dependency ratio: This ratio measures the number of the very young (under age 15) and the very old (greater than age 65) per 100 persons who are between the ages of 15 and 64, the most economically productive years. In 1998, the dependency ratio in Yemen was higher in poor households (158) than in better-off households (111).

Age of individuals: Incidence of poverty among children in 1998 was 21.1 percent higher than among adults. About 53 percent of the poor are children, and about 46 percent of all children are poor, compared with 38 percent of all adults.

Education level: Education in Yemen has a strong correlation to poverty incidence, depth, and severity. The higher the educational attainment of the head of the household, the lower the risk that the household will be poor. Results from the 1998 HBS show that poverty rates are highest for households headed by illiterate persons (47.3 percent nationally, 48.8 percent in rural areas, and 39.9 percent in urban areas). Rates are relatively high and similar among households in which the head can read and write or has attained a primary-level education (38.6 percent). Poverty rates are lowest for households headed by persons with a post-secondary education but still strikingly high in absolute terms: 22 percent nationally, 42 percent rural, and 11 percent urban. At the national level, households headed by top-educated breadwinners account for 2.2 percent of the observed incidence of poverty, compared with 59 percent for households headed by illiterate persons. More than 86 percent of poor households headed by illiterate breadwinners live in rural areas. A similar pattern, which points to a sizeable urban-rural divide, is found in both the depth and the severity of poverty.

Economic Characteristics of the Poor

The 1998 HBS data show that poverty is determined both by working status and the sector employing the head of household. The World Bank (2002) and the Central Statistical Organization (1999) estimate that at the national level, 84 percent of the poor live in households headed by employed persons, 2.5 percent headed by the unemployed, and 13.5 percent headed by inactive breadwinners. This pattern does not change significantly from urban to rural areas.

The distribution of the poor by sector of activity of the head of household shows that, at the national level, most of the poor work in the agricultural sector (47.3 percent), followed by services (35.9 percent) and industry (16.8 percent). Compared with the overall population distribution, the poor are over-represented in industry and agriculture. In contrast, they tend to be under-represented in the service sector. More specifically, in urban areas, 39 percent of the poor breadwinners work in the merchandise service sector, 24 percent in public administration, and 21 percent in industry. In rural areas, 55 percent of the poor breadwinners work in agriculture, 29 percent in services, and 16 percent in industry. Among poor households, 84 percent work in the private sector and 15 percent in the public sector.

Regarding sources of income, rural households derive their income from multiple sources within the rural economy and even from the urban economy. According to the 1998 HBS, earnings from self-employment represent 39.1 percent of total income nationally, compared with 28.2 percent of wage earnings, and 8.3 percent of income from transfers. The relative importance of wage earnings versus earnings from self-employment is very different between urban and rural areas. In urban areas, wage earnings account for 43.3 percent and earnings from self-employment for 28.5 percent, while in rural areas, the larger share of total income originates from self-employment activities (42.3 percent), and wage earnings account for 23.7 percent. In urban areas, capital income has a 15 percent share of total income, which is five times the share of households in rural areas. Income from transfers represents 9.2 percent of total income in urban areas, compared with 8 percent for rural areas.

The 1998 HBS data also show that the composition of total income changes significantly across per capita expenditure deciles. The share of wage earnings decreases from 37.5 percent for the poorest decile to 23.0 percent for the richest decile. For rural households in the top decile, wage earnings account for only 14 percent, compared with 37 percent for urban households. Nationally, the share of income from self-employment increases from 32 percent for the richest decile to 43 percent for the poorest decile. In contrast, capital income as share of total income shows little

tendency to vary across deciles, especially in rural areas. The share of income from transfers tends to increase mildly in urban areas (from 8.6 percent for households in the poorest decile to 10.6 percent for the richest decile), while it hardly varies in rural areas.

3. PUBLIC SPENDING IN YEMEN

Structure of Public Spending

During the period 1996-2002, public spending averaged 31.5 percent of GDP, compared with 28 percent during the first half of the 1990s. More than 80 percent of the total budget expenditure was allocated to current spending with wages absorbing more than 41 percent of total spending. Nonetheless, it has declined since 1997 and currently constitutes about one-third of total spending. During 1996-2001, the government of Yemen paid more attention to the social sectors in an effort to improve the social conditions of the population. Total public spending in social sectors (including subsidies, education, health, social welfare, housing and utilities, and cultural and religious services) increased from 41 percent of total spending and 11 percent of GDP in 1991-95 to 50 percent of total spending and 17 percent of GDP in 1996-2001. Since subsidies are not targeted and are not pro-poor, including them in total social expenditures gives a misleading picture.

A stricter definition of social sectors – (excluding subsidies) – shows that government expenditures in the social sectors averaged about 30 percent of the total public expenditure and 10 percent of GDP during 1996-2001. In real terms, and despite rapid population growth, public expenditures in the social sectors increased faster than total expenditures during the second half of the 1990s. Real expenditures in social sectors per capita increased by 13 percent per year during 1996-2001, compared with 6 percent per year for total expenditures. Table 3 presents the trend in public spending from 1991 to 2002.

Table 3. Evolution of public spending on social sectors, 1991-2002 (values in YR billion and share in %)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total government spending	44	56	68	87	118	228	303	294	336	476	502	532
% of GDP	29.2	29.3	28.4	28.3	23.1	30.9	34	34.2	28.7	31.7	32.7	28.7
Social spending	18	23	30	34	47	115	163	164	164	272	212	
% of GDP	11.7	12.1	12.4	10.9	9.2	15.8	18.3	19	13.9	18	13.7	
% of total government spending	40.2	41.5	43.8	38.6	40	50.8	53.7	55.5	48.9	56.9	42.2	
1. Subsidies and Transfers	4	5	7	8	9	53	89	69	54	122	38	30
% of total government spending	8.3	8.9	9.9	9.1	7.6	23.5	29.3	23.4	16	25.5	7.6	5.6
2. Education spending	9	11	14	17	23	37	46	57	67	89	108	
% of total government spending	19.3	19	20.1	19.3	19.5	16.4	15.2	19.3	20	18.7	21.5	
3. Health spending	2.1	2.5	3.3	3.2	4.5	9.1	10	13.9	14.4	20.1	23.6	
% of total government sending	4.8	4.4	4.9	3.6	3.8	4	3.3	4.7	4.3	4.2	4.7	
4. Social security and welfare	0.6	0.7	0.8	0.9	1.1	1.6	1.7	4.4	5.9	7.7	8	
% of total government spending	1.4	1.3	1.2	1.1	1	0.7	0.6	1.5	1.8	1.6	1.6	
5. Housing and utilities spending	2	3	4	3	7	11	12	15	18	26	26	
% of total government spending	4.6	6.2	6.1	3.8	5.8	4.9	4	5.1	5.3	5.4	5.1	
6. Entertainment and religious spending	0.7	0.9	1.1	1.5	2.7	3.2	3.8	4.4	5.1	7.1	8.5	
% of total government spending	1.7	1.6	1.7	1.8	2.3	1.4	1.2	1.5	1.5	1.5	1.7	

Source: World Bank (2002)

Since food subsidies were not targeted and not particularly pro-poor, they were entirely phased out in 1999. The World Bank's (2002) assessment indicates that only 30 percent of the food subsidies reached consumers. The rest went to exporters, distributors, and smugglers to neighboring countries. The poorest groups of the population benefited very little from the subsidies because they spent disproportionately less on the subsidized food items than high-income groups.

Diesel fuel is the only consumer good that continues to be significantly subsidized in the country. It is used primarily to run irrigation pumps, electricity generators, and fishing boats. Some object to the diesel subsidy because they feel that it contributes to excessive pumping and inefficient use of water, to the detriment of the rural poor. According to a recent study carried out by the International Monetary Fund (IMF, 2005), about 60 percent of the direct diesel subsidy used by households is captured by the two top (income) deciles, while less than 2 percent filters down to the two lowest deciles. At the same time, the aggregate impact of eliminating subsidies is regressive because of the dominance of the indirect impact through the rural labor market. The government is under pressure from the IMF and the World Bank to phase out the diesel subsidy by the year 2006.

To compensate for any transitory negative effects associated with the removal of food subsidies in 2000, the government implemented several funds, such as the Social Welfare Fund (SWF), the Agriculture and Fisheries Production Promotion Fund (AFPPF), and the Social Development Fund (SDF).

The SWF is the government's main targeted social assistance program. This fund was originally conceived in 1996 as a way to compensate the poor for the progressive removal of food subsidies. In spite of drawbacks such as problems in reaching beneficiaries and extremely bureaucratic procedures (van de Walle, 2002) more than YR8 billion was spent on the SWF in 2001, benefiting 450,000 households, with a maximum of YR24,000 per household per year. For a family of six, this translates to about YR333 per person per month or only about 10 percent of the 1998 national poverty line. Based on van de Walle's (2002) evaluation of the program, 4.2 percent of the target group, or 0.88 percent of the population, received SWF transfers, and 57 percent of those who benefited from the program were not in the target group. Of these, 41 percent were not poor and 16 percent were poor.

AFPPF was launched in 1995 in light of concerns that increases in diesel prices and eventual elimination of the diesel subsidy would affect the poorest population groups in rural and coastal areas. The poor in these areas are highly dependent on agriculture and fisheries both as consumers and producers. The fund aims to promote agriculture, livestock and fisheries production through a wide range of activities in these sectors such as subsidizing the cost of agricultural inputs and equipment (seeds and fertilizer, for example), constructing water projects such as dams and smaller works to reduce the risks of drought and to recharge aquifers, and initiating production marketing schemes. The AFPPF is financed through a system whereby YR2.5 (increased from YR1.0 since 1995) is

deposited to the fund for every liter of diesel sold in the country. Resources also come from the general budget and foreign grants. The yearly budget is around YR 4.5 billion (US$25 to 27 million).

SDF provides assistance for long-term development projects aimed at providing social and economic services –such as education, health care, water supply, and microfinance - creating jobs; and enhancing the capacity of local communities. According to the IMF (2005), SDF has recently developed a strategy focusing on poverty alleviation in both rural and urban areas. However, success has been limited because banks are still reluctant to extend credit to the development of the small and medium enterprises that are the focus of the fund.

An Assessment of the Efficiency of Public Spending

While the various government programs directed toward poverty alleviation help reduce the growing number of poor in the country, several drawbacks still limit the efficiency of these programs. For example, the SWF's budget is generally too low to cover all of those potentially eligible. Concerning the AFPPF, resources are currently allocated to governorates on the basis of population and poverty indicators; governorates where q*at* is grown are considered rich and therefore excluded. Moreover, poverty indicators are imprecise.

Health Sector

While public spending in all social sectors has increased during 1996-2001, the level remains low in targeted sectors in comparison to other countries in the region. For the health sector, Yemen spent considerably less of its public budget in 1997 on health (3.3 percent) than most of its regional neighbors (unweighted regional average of 6.7 percent). And a far larger share of overall health expenditures comes from private sources– only 37.9 percent of health expenditures in Yemen are from the public sector compared with a regional average of 50.5 percent (World Bank, 2000b). Table 4 compares health spending in Yemen with the rest of the countries in the Middle East and North Africa (MENA) in 1997.

Table 4. Health spending in Yemen compared with other MENA countries, 1997

Country	Total (Public and Private) Health Expenditure as % of GDP	*Per capita* Health Expenditure (US$, official exchange rate)	Public Expenditure as % of Total Health Expenditure	Public Expenditure on Health as % of Total Public Expenditure
Algeria	3.1	44	50.8	4.9
Bahrain	4.4	478	58.5	9.6
Egypt	3.7	44	27	3.3
Iran	4.4	108	42.8	7.2
Iraq	4.2	251	58.9	
Jordan	5.2	59	67.2	8.5
Kuwait	3.3	572	87.4	8.4
Lebanon	10.1	461	29.6	7.8
Libya	3.4	296	54.2	2.7
Morocco	5.3	66	40.7	6.5
Oman	3.9	370	54.5	5.6
Qatar	6.5	1042	57.5	7.6
Saudi	3.5	260	80.2	9.4
Arabia	2.5	151	33.6	2.9
Syria	5.4	111	41.7	7.2
Tunisia	4.2	900	35.4	12.6
UAE	3.4	12	37.9	3.3
Yemen				
Unweight Avg	4.5	307	50.5	6.7

Source: World Bank (2000b)

Education

According to the World Bank (2002), the recent rise in education spending in Yemen is largely driven by rising employment opportunities for teachers and increasing wages than by increasing investment expenditures. These expenditures show a declining tendency. While school

enrollments in Yemen have increased substantially at all levels,[4] the coverage is still low, and access to education services is uneven between genders. Gaps between rural and urban areas and among governorates are still large (see World Bank 2002 for a detailed assessment of the education system in Yemen). The World Bank's assessment suggests that improving educational opportunities for the poor and under-served population should be considered as a top priority of the Poverty Reduction Strategy Paper (PRSP)[5]. In this context, strategies to increase public spending on education and better target additional capital investment to the poorest population seem to be effective in reducing poverty.

Infrastructure

Despite improvements realized over the past years in infrastructure, it is still below the desired standard and is characterized by geographical variances and bias toward the urban areas and the most fortunate groups. Infrastructure services also suffer from numerous difficulties due to population growth and high rate of migration to urban areas, leading to increased pressure on infrastructure. Many projects and high financing are needed to improve infrastructure services, especially in rural areas. Thus, increasing water production for domestic uses, expanding the scope of wastewater sanitation services, rehabilitating existing power stations, increasing investment in electricity generation and distribution, construction of a road network to link industrial and agricultural production centers are among the priority areas for improvement of infrastructure identified in the PRSP.

Furthermore, expansion of basic education and heath services, improvement of vocational training and technical education, and reform of higher education are considered to be the main factors for improving human capital, rather than infrastructure. Finally, the expansion of agricultural production, which remains the source of income for most of the Yemeni population, may be achieved mainly through irrigation improvement and by encouraging agricultural research to better manage irrigated agriculture and natural resources.

[4] During the period 1995-2000, enrollments increased by about 30 percent in basic and 50 percent in secondary education. Higher education more than doubled, and vocational and technical training enrollments increased by about 40 percent (World Bank, 2002).

[5] The PRSP is a government document that sets priorities of government interventions to achieve clear poverty reduction goals. The document is prepared in line with the government's development programs, the principles of the economic reforms program and the overall framework of the Second Five-Year Plan for Social and Economic development 2001-2005.

4. EVALUATION OF INCREASING PUBLIC SPENDING ON POVERTY REDUCTION IN PRIORITY AREAS

Description of the Model Structure and Main Features

The model used in this study originates from a prototype model (Beghin et al., 1996) built for trade analysis at the Development Centre of the Organization of Economic Cooperation and Development. It is a standard neoclassical recursive dynamic model with imperfect substitution between domestic and foreign goods. Prices are endogenous in each market (goods and factors) and equalize supply (imports, Yemeni production for the domestic market, and factor supply) and demand (final demand from households, the government, investors and the rest of the world, intermediate demand from producers, and factor demand), at the equilibrium. The equilibrium is general in the sense that it concerns all the markets simultaneously. The model is dynamic and is solved recursively every two years from 1998 to 2016.

Production

Supply is modeled using nested Constant Elasticity of Substitution (CES) functions, which describe the substitution and complementary relations among the various inputs. Producers are cost-minimizers and constant return to scale is assumed. Output is produced from two inputs, an intermediate aggregate and a value-added aggregate. The intermediate aggregate is obtained by combining all products in fixed proportions (Leontief structure). The value-added components are decomposed into two parts: aggregate labor and capital. Given the crucial importance of labor demand and labor remuneration in poverty incidence variation, the labor modeling is described in more detail below.

The capital bundle incorporates three types of capital: land, non-renewable resources in oil and gas, and physical capital accumulated through past investment. The first two capital stocks are sector-specific. The third decomposes itself between two generations of capital: "old" and "new." New capital results from contemporary investment and may be allocated more flexibly than “old” capital. Substitution possibilities of all inputs and labor (which are functions of relative prices) will

be greater with the new vintage of capital (that is, the contemporary investment) than with the other (that is, the installed capital).[6]

Income and Absorption

Income from labor and land is allocated between the various households using a standardized fixed-coefficient distribution matrix. Income from capital is allocated in the same way between households and the rest of the world. Income from oil is paid totally to the government. Household total demand is derived by maximizing the utility function derived from the Extended Linear Expenditure System (ELES). The household's utility is a function of consumption of different goods and savings and is constrained by disposable income. Income elasticities are differentiated by product and households; they vary from 0.80 for agricultural and minerals products to 1.20 for services. The calibration of the model determines a per capita subsistence minimum for each product whose aggregate consumption grows with population, while the remaining demand is derived through an optimization process. Household utility is a positive function of consumption of the various products and savings, with income elasticity for each product being set to unity. Households pay taxes on this income and save the remainder. Government and investment demands are disaggregated in sectoral demands once their total value is determined according to fixed coefficient functions.

International Trade

The model assumes imperfect substitution among goods originating from the domestic market and the rest of the world. Import demand results from a CES aggregation function of domestic and imported goods. Export supply is symmetrically modeled as a constant elasticity of transformation function. Producers decide to allocate their output to domestic or foreign markets responding to relative prices. Substitution elasticity between domestic and imported products is set at 2.2. The elasticity of transformation between products intended for the domestic market and products for export is 5.0.[7]

The small country assumption holds. Since Yemen is unable to change world prices, its import and export prices are therefore exogenous. Capital transfers are exogenous as well and determine the trade balance.

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[6] Elasticities are derived from the available relevant literature (see Burniaux and Oliveira-Martins 1992). For instance, the substitution elasticity between labor and old and new capital is set respectively at 0.1 and 1.0. Elasticities between intermediates and value-added are set at 0 (if the latter incorporates old capital) and 0.5 (in the case of new capital).

[7] Trade elasticities come from the empirical literature devoted to CGE models. They are not specific to Yemen. See for instance Burniaux and Oliveira-Martins (1992), Konan and Maskus (1997), or more recently, Gallaway, McDaniel, and Rivera (2000). These elasticities are not distinguished by product, which explains to a large extent, their low levels. They are not statistically significant either.

Labor Specifications

The assumption of full employment and flexible wages for achieving equilibrium in the labor market cannot be used for any study related to labor market or poverty analysis. In fact, labor demand and remuneration by segment and skill are among the main factors explaining poverty. For this reason, a realistic modeling of labor market behavior and wage setting is crucial for any poverty analysis study.

The modeling of the labor market in the present study follows the work of Dessus and Suwa-Eisenman (1999) for Egypt. Labor supply at each period depends first on an exogenous factor affected by demographic trend and external migration. Between two periods, migration movements occur between segments, depending on relative expected earnings, that is wages multiplied by the employment rate of the previous period. A change in relative expected wages thus induces migration (the cost of migration and the non-wage benefit in the public sector being constant). Due to the segmentation of markets, it is assumed that a worker can only modify one of his job's characteristics at a time. For instance, a rural worker in the private sector would compare his state with that of a rural worker in the public sector or an urban worker in the private sector. Conversely, he cannot move directly to the urban public sector. Finally, it is assumed that households follow the migrants and adopt the consumption behavior of their new location.

Labor supply in the private sector is also a function of real wages, differentiated by skills the higher the skill, the higher the supply elasticity. The unskilled part of the private labor market accounts for the informal sector. It is assumed that most workers (skilled and unskilled) queuing for a public job are actually working in this informal sector, thus augmenting the labor supply in that segment. This assumption is realistic in the case of Yemen as average wages in the public sector are higher than in the private sector by approximately 30 percent.

Model Closure and Dynamics

The model is solved for each period, under several macro-closures. First, as the small country assumption is adopted and capital transfers are also exogenous, the trade balance is fixed so as to achieve a balance-of-payments equilibrium. Second, the model imposes a fixed real government deficit and fixed real public expenditures. Thus, public receipts adjust endogenously to achieve the predetermined net government position by shifting households' income tax.[8] Third investment is determined by the availability of savings from households, the government, and abroad. Since

[8] This closure policy may be understood as a net transfer from households to government (or the reverse).

government and foreign savings are exogenous in this model, changes in investment volumes reflect changes in household savings and changes in the price of investment. The sequential dynamic path of the model results from this closure on investment, the assumptions on labor supply explained above and exogenous growth rates for the natural reserves and the TFP. Agents are assumed to be myopic and to base their decisions on static expectations about prices and quantities. However, the closure rule for the government fiscal balance is modified for the purpose of this study. [SENSE?: more clear!] In fact, any additional public spending needed for poverty reduction has to be financed. Many options exist for this, such as shifting the rate of current tax instruments to achieve a target, reducing expenditures in other sectors, or increasing foreign aid. For each available option, a sensitivity analysis may be carried out to select the most appropriate tool to improve public spending without compromising budget stability and economic growth in the country.

Policy Impact

To assess the policy effects of the reform, macro-economic aggregates, trade volumes, sectoral outputs, household welfare, and poverty indicators are compared with those in the baseline scenario. The chosen yardstick for welfare is the assessment of equivalent variation, which is the sum of two terms. The first measures the gain (or the loss) of disposable income caused by the reform (producer surplus), and the second measures the income needed after the reform to obtain the same level of utility as before the reform (consumer surplus).

The Social Accounting Matrix and the Structure of the Economy in the Base Year

The model uses information contained in Yemen's Social Accounting Matrix (SAM) for 1998 built especially for the purpose of this study. It considers two representative Yemeni households, one rural and one urban. In all, nine economic sectors and eight types of work are taken into account, the latter being distinguished notably by the skills required, area, and status. The model takes into account three types of capital: physical capital, land, and oil rent.

Appendix Table 3A shows the macro SAM for Yemen for the year 1998, which is a tabular presentation of the National Accounts. Each entry presents a payment by a column account to a row account, and the corresponding row and column sums must be equal. They represent the income and expenditure accounts for various economic actors, and the SAM effectively shows the circular flow of income and expenditure from producers through factor markets to different non-government institutions households and the rest of the world and back to producers through commodity markets. The CGE model is based on a more detailed SAM – a "micro" SAM– with disaggregation of

activities, commodities, factors, domestic non-government institutions, and a macro-savings investment account (S-I), The rest of the world is also an actor buying exports, selling imports, and providing and receiving transfers and factor income.

In the SAM, GDP at factor cost is the payment by activities to factors (YR714,407.6 million). Government revenue is shown along the government row and is largely from oil (42.4 percent) and transfers from abroad (17.3 percent). Tax revenue is also an important share of total government revenue. It represents 40.2 percent of total government revenue. Taxes on income and profits are largely the most important source of government tax revenue (48.7 percent), followed by tariffs (27.8 percent), and indirect taxes on production net of subsidies (23.5 percent). Among its current expenditure, wages and salaries represent, so far, the most important share (60.2 percent) followed by public final consumption on goods and services (28.2 percent) and direct transfers to households (11.6 percent). Government saving (government to S-I) is large, with a share equal to 37.6 percent of total savings. Aggregate saving from abroad is also important in Yemen, mainly in the oil and gas sector. Its share exceeds 13.5 percent of total savings in the country. Private saving represents about half of aggregate investment, where "private or households" refers to all domestic non-government saving. Exports (world to commodities) represent just under a third of GDP at factor cost, while imports (commodities to world) are much bigger (56.7 percent) ─ foreign savings (minus world to S-I, the current account balance) is then large.

Table 5 provides information about the sectoral structure of value-added and trade. Services (dominated by public administration and defense) represent 51 percent of total value-added and the next largest sector, mining and quarrying (mainly oil and gas), represents around 14.3 percent. Imports are concentrated in manufactured products (45.1 percent of total imports) and services (27.7 percent). Exports, however, are dominated by mining and quarrying products (83.5 percent of total exports), followed by services (10.6 percent), and plants (2.8 percent).

Table 5. Economic structure in 1998 (%)

	Value-added (VA)	Output (X)	Exports (E)	Export/ Output (E/X)	Imports (M)	Import/Final Demand (M/Q)
Plants	9.1	7.4	2.8	5.6	12.1	31.3
Livestock	4.9	3.9	0.2	0.6	5.6	28.6
Fishing	2.3	1.7	1.8	14.7	0.1	2.3
Other agriculture	4.1	3.3	0.5	2.3	4.3	26.2
Mining and Quarrying	14.3	16.7	83.5	72.3	5.1	39.9
Manufacturing	8.9	18.0	0.6	0.5	45.1	53.7
Electricity, Water, and	0.8	1.0	0.0	0.0	0.0	0.0
Construction	4.6	7.0	0.0	0.0	0.0	0.0
Services	51.0	40.9	10.6	3.8	27.7	49.5
Total	100	100	100	14.5	100	38.8

Source: Social Accounting Matrix for Yemen, 1998.
Note: Data are rounded to one decimal point.

Table 6 shows the distribution of workers among the different sectors of the economy. Public administration and defense are excluded. Private workers are mostly employed in the agriculture sector. Private urban workers are mostly occupied in the service sectors. Public workers are mostly employed in the mining and service sectors. Regarding the source of income for households in Yemen, Table 7 shows that capital income represents the main income source (57.5 percent), followed by wages (20.2 percent), and by remittances from abroad (19.4 percent). The contribution of each source of income is slightly different according to the area of residence of the households.

Table 6. Sectoral distribution of workers (%)

	Private Rural Workers	Private Urban Workers	Public Rural Workers	Public Urban Workers	Total in persons
Plants	34.2	2.2	6.3	0.6	1157486
Livestock	18.4	1.2	4.6	0.5	625358
Fishing	0.4	0.1	14.9	16.0	26073
Other agriculture	15.7	1.0	1.4	0.3	530571
Mining and Quarrying	0.1	0.3	11.0	40.4	23719
Manufacturing	3.4	9.4	6.6	13.3	189582
Electricity, Water and Gas	0.1	1.8	14.8	7.3	26743
Construction	4.7	5.1	14.3	9.3	205482
Services	23.1	78.9	26.1	12.4	1368370
Total	100	100	100	100	4153384

Source: Author's compilations based on many Central Statistical Organization (CSO) publications.
Note: Public administration and defense are excluded.

Table 7. Income sources for rural and urban households (%)

	Urban Households	Rural Households	Aggregated Households
Wages	31.2	15.7	20.2
Land Rent	0.2	0.7	0.6
Capital	65.6	54.1	57.5
Transfers from Government	2.0	2.5	2.3
Remittances from Abroad	1.0	27.0	19.4
Total	100	100	100

Source: Social Accounting Matrix for Yemen, 1998

Estimation of Growth Poverty Elasticities

The international record based on the experiences of many countries, shows that economic growth is the most effective anti-poverty tool. Growth-oriented policies are considered to be the most effective vehicle for expanding the revenue base, which, in turn, leads to a reduction in poverty. In their paper, van Eeghen and Soman (1996) argue that empirical results are consistent with international evidence for most countries in the world. The MENA region provides clear evidence for such an assumption. Experience in the MENA, over the past decade, suggests that there is indeed a strong empirical relationship between poverty alleviation and economic growth, which is shown by a relatively high growth elasticity of poverty reduction. Results from the World Bank's poverty assessments in four countries in the region for the period 1985-94 highlight the link between growth and poverty reduction despite the important contrast in growth achievements in these countries.

While sustained growth in per capita GDP occurred in Morocco and Tunisia and poverty declined, Jordan suffered a sharp drop in per capita GDP and poverty increased (van Eeghen and Soman 1996). The growth elasticity is negative and varies from –2.5 to –6.2 for the three countries (when estimated at a poverty line of US$1 per day at 1985 Parity Purchase Power (PPP). This means that for every 1 percent increase in real GDP growth, the number of poor people declines by 2.5 to 6.2 percent in the country. Conversely, this also means that a fall of 1.0 percent in real GDP growth increases the number of poor people by 2.5 to 6.2 percent. According to van Eeghen and Soman (1998), the relatively high growth elasticity may be explained by the fact that MENA's income inequality was initially low and by the choice of $ 1 per person per day as the poverty line.

CGE models allow the identification and quantification, albeit at rather disaggregated levels, of some of the most important transmission channels relevant to poverty changes, including relative factor and commodity price changes and capital deepening caused by domestic savings. Just using the growth figures estimated by a CGE model would forfeit most of the model's explanatory and numerical measurement power. Instead, such a model is primarily an instrument for counterfactual (what if?) analysis, rather than a tool for growth forecasting. For these reasons, using estimates on real mean consumption per capita rather than per capita income growth allows both the income distributional effect among the different household categories in the analysis and the changes in consumption patterns to be taken into account. The latter depends on changes in income and consumption price vectors.

Thus, the CGE model provides results on changes in real per capita consumption by household category. The use of estimates on growth elasticity of real per capita consumption for poverty reduction by household category allows for the estimation of some poverty measures related to any simulation provided in the medium to long run. Results of different household surveys are used to estimate the growth elasticity of real private consumption per capita for poverty reduction.

Despite the fact that (1) very few shocks to an economy are distributionally neutral over sectors and income groups, and (2) an approach that combines the mean real per capita consumption figures from a CGE with a poverty elasticity (here growth of real per capita consumption elasticity for poverty reduction) does not seem very promising in evaluating the full poverty impact of public policy reform within each household category, this approach nevertheless represents an intermediate tool to assess the change in poverty level between the representative household (RH) approach and the micro-simulation approach. Using only the RH approach does not help estimate poverty changes, and the analysis is limited to evaluating welfare change for the representative household. In contrast,

the micro-simulation approach allows the evaluation of the effect of any economic reform on an individual household, which in turn, allows new poverty indicators to be estimated related to any given reform (P0, P1, and P2).

In the case of Yemen and for the purpose of this study, the poverty line used in the estimation of the growth of the mean real per capita consumption elasticity of poverty reduction is the lower poverty line estimated by the World Bank at national as well as at regional levels. The approach used to estimate the elasticity of poverty reduction with respect to the mean real consumption per capita entails increasing per capita consumption by x percent and estimating the new poverty rates at the national and regional levels for the whole sample in the 1998 HBS. It is supposed that consumption distribution remains unchanged between the two situations: the initial or base year (1998) and the simulation period for each household category. Thus, for the given new level of poverty in Yemen, the rate of poverty reduction associated with a 1 percent increase in real consumption by year and by person is estimated.

In addition, to estimate the elasticities for P1 and P2 with respect to the mean real consumption per capita, formulas derived from Kakwani (1990) are used. Accordingly, the elasticity for the Poverty gap index (P1) is measured by

$$\varepsilon_{P1} = 1 - P0/P1 \quad (1)$$

Similarly, the elasticity for P2 with respect to the mean real consumption per capita is estimated using the following formula:

$$\varepsilon_{P2} = 2(1 - P1/P2) \quad (2)$$

The results obtained are presented in Table 8.

Table 8. Elasticity with respect to mean real consumption per capita

	P0	P1	P2
Yemen	–1.8	–2.8	–3.1
Urban Areas	–2.5	–2.1	–2.4
Rural Areas	–1.7	–2.2	–2.6

Note: The poverty line used is the lower poverty line. Figures are rounded to one decimal point.

For Yemen, an increase of 1 percent in the mean real private consumption per capita reduces the number of the poor by 1.8 percent. The effect of growth in real private consumption is more important for urban households than for rural. An increase of 1 percent of the mean real consumption per capita reduces the number of the poor in urban areas by 2.5 percent, while it reduces the number of poor in rural areas by only 1.7 percent. The reason behind this may be found in the poverty gap index, which is higher in rural areas than in urban areas. The use of these elasticities enables each simulation on increasing public spending per sector to be associated with new poverty indicator numbers.

Economic and Poverty Trends in the Baseline Scenario

In the CGE modeling framework, it is essential to establish a baseline scenario that is counterfactual for comparing the outcome of a policy shock. In a dynamic analysis, this involves drawing on additional exogenous information to define what seems to be a plausible growth path for the Yemeni economy up to 2016. Such information would include data on projected growth trends for macro variables such as population, labor force, and depreciation of capital stock. This should not be interpreted as an exercise in forecasting but as an attempt to define a benchmark for comparing alternative policy scenarios in order to isolate their specific effects.[9]

In constructing the baseline scenario, a figure is defined for the rate of growth in the economy. TFP is then endogenous. When simulating alternative policies, the previously estimated TFP becomes exogenous and GDP endogenous.

9 The fact that the value of exogenous variables are set on a priori basis within a realistic confidence interval, does not, however, have any major consequences. When the impact of alternative economic policies is assessed, it may be seen that these choices have very little effect on either amplitude or sign of the variations in the different aggregates relative to the baseline scenario (Chemingui and Dessus 2001).

Growth Hypotheses

To construct a baseline scenario, the values of a number of variables are set exogenously. These include the rate of growth in GDP, which is set over the time horizon of the model to match actual growth rates as well as to follow rates projected by the World Bank (2002). The actual average of annual GDP growth is 4.5 percent for the period between 1998 and 2001. A 3 percent annual growth is projected for the period between 2001 and 2016. Similarly, population growth rates follow the government forecasts, where rural population is assumed to grow at an average annual rate of 1.9 percent, while the annual average growth rate for the urban population is expected to be 5.7 percent during the same period (the numbers account for the expected migration flows between rural and urban areas). Labor supply over the same time period is expected to continue to grow at high rates, compared with other MENA countries.

In the rural areas, labor supply grows by 3.5 percent per year, while urban labor force categories grow at an annual average growth rate of 3.4 percent. Annual growth rates for the labor market categories take into account the expected increase of women's participation in the labor market and labor mobility from one sector of employment to another (from rural to urban areas) and from unskilled to skilled categories. In addition, the baseline growth path assumes that oil and gas extraction is expected to decline by an annual average rate of 2 percent during the period 1998-2013 to become constant by the year 2013 (a result of newly planned investments in oil and gas over the coming years). Total cultivated area declines by 2 percent yearly as a result of high urbanization and scarce water resources. Workers' remittances, which represent an important source of household income in Yemen remain unchanged during the simulation period.

Economy and Poverty in Yemen in the Absence of Public Spending Reforms

It is assumed here that the government abandons its policy of fiscal stabilization, given the high poverty rate in the country and the difficulties associated with any cut in direct and indirect transfers to households, mainly for the poorest. For this reason, the model imposes an increase in budget spending (excluding investment) in real terms by 4 percent between 1998 and 2001, by 3.7 percent between 2001 and 2010 and 3.2 percent after 2010. Public receipts are adjusted endogenously to achieve the predetermined net government position by shifting the household income tax. This closure policy may be understood as a net transfer from households to government (or the reverse). This type of policy is considered by economists to be the most neutral way to assess economic policy reform. Other closures may be tested, adjusting indirect taxes, for instance. However, this would bear the risk of introducing new distortions into the economy, thereby making it

more difficult to conceptually isolate the impact of the public spending policy. Tables 9 to 12 present economic and poverty trends in the baseline scenarios.

Table 9. Macroeconomic trend in the baseline scenario

	1998 (YR billion)	2016 (%)
Real Gross Domestic Product	811.2	3.2
Total Production	1478.0	3.0
Private Consumption	592.5	2.7
Real Urban Available Income	216.3	5.0
Real Rural Available Income	528.4	1.4
Investment	338.9	0.6
Exports	228.0	2.1
Imports	405.2	1.3
Government Revenue	277.6	-1.0
GDP deflator	100	-0.9

Notes: Macroeconomic aggregates in the base year (1998) are expressed in billions of 1998 YR, whereas for the simulation period, these aggregates are expressed in average yearly percentage changes compared to the base year. Real available income levels are the available income levels in 1998 YR, divided by the consumer price index for each area.

Source: Model results

Table 10. Trend in real wages by segment in the baseline scenario

	1998 (YR billion)	2016 (%)
Rural Unskilled Workers in the Public	192.5	-5.8
Rural Skilled Workers in the Public	192.6	-5.8
Rural Unskilled Workers in the Private	16.7	-1.1
Rural Skilled Workers in the Private	20.3	-2.8
Urban Unskilled workers in the public	192.7	-5.8
Urban Skilled Workers in the Public	192.5	-5.8
Urban Unskilled Workers in the Private	16.9	-1.3
Urban Skilled Workers in the Private	20.3	-3.0

Notes: Real wages in the base year (1998) are expressed in billions of 1998 YR, whereas for the simulation period these wages are expressed in average yearly percentage changes compared to the base year.

Source: model results

The rate of growth in TFP (which relates to physical capital and labor) is also determined endogenously in this initial scenario. Notably, it is dependent on the rate of growth in the economy and the initial stock of physical capital, which in turn determines the rate at which the latter accumulates. Results show that the investment rate (expressed as percentage of GDP) falls from 41.8 percent in 1998 to 26.3 percent in 2016. Finally, the assumption is made that there is a hardening in external constraints. In 2016, the deficit in the trade balance falls to 12.4 percent of GDP, compared with 21.8 percent in 1998.

Although an increasing trend is assumed toward achieving a constant annual growth rate of real public sector wages (after a 10 percent decline during the period 1998-2001), wages in real terms do not recover to the initial level and continue to report a decline over the simulation period (Table 10). Thus, workers in the public rural sector end up with their wages reporting an annual decline of 5.8 percent in real terms while the drops in real wages are less pronounced for the private sector in the rural areas. Real wages for unskilled workers in the rural private sector decline by 1.1 percent per year, and real wages for skilled workers in the rural private sector decline by 2.8 percent. The expected increase in the skilled labor force, compared to the unskilled, in the coming years may explain such differentials in wage evolution in the private sector. The same tendency is observed for urban public workers where their real wages decline by 5.8 percent per year, on average.

The decline in real wages in the private sector is more important in the urban than the rural sector (–1.3 percent for unskilled workers and –3.0 percent for skilled workers in the urban private sector). Given the conditions defined above for the baseline scenario and the simulated declines in

real wages as a result of the public wage policy, demand for labor will increase for all categories and consequently unemployment is expected to decline. The declines in unemployment are more important for skilled workers than unskilled (–6.9 percent and 0 percent per year, respectively, on average, in rural areas and –1.9 percent and –0.3 percent per year, respectively, on average, in urban areas) (Table 11).

Table 11. Trend in unemployment rates by skill and areas in the baseline scenario

	1998 (%)	2016 (%)
Rural Unskilled	16.4	0.0
Rural Skilled	6.4	–6.9
Urban Unskilled	12.01	–0.3
Urban Skilled	8.1	–1.9

Source: Author's estimation using various CSO publications

Table 12. Poverty incidence trend in the baseline scenario

	1998	2016
Poverty Incidence in %		
National Level	41.8	29.2
Urban Areas	30.8	14.3
Rural Areas	45.0	29.6
Number of Poor (in 1,000 persons)		
National Level	7895.6	1.2%
Urban Areas	1685.1	1.3%
Rural Areas	6210.5	–0.5%

Note: Poverty incidence is expressed in percentage of total population in each year. The number of poor is expressed in 1,000 persons in the base year (1998) and in the annual average percentage change to 2016. Data are rounded to one decimal.

As for the effect on poverty in the baseline scenario, P0 is expected to decline as a result of growth. At the national level, the number of people living below the poverty line falls from 41.8 percent in 1998 to 29.2 percent in 2016. The decline in poverty is more important in urban areas (4.2 percent per year) than in rural areas (2.3 percent), falling from 30.8 percent of total population in urban areas in 1998 to 14.3 percent in 2016 and from 45.0 percent for rural populations in 1998 to 29.6 percent in 2016. Although P0 declines during the simulation period, the absolute number of poor will increase by 1.2 percent per year at the national level. The number of poor increase only in

the urban areas, with an annual average increase of 1.3 percent, while the number of poor in rural areas declines by nearly 0.5 percent per year.

Public Spending Experiments

The assumptions for the public spending experiments are presented in Table 13. All the simulations involve an increase of public spending for priority areas while keeping the level of public spending in the other areas constant. Rather than assuming a reallocation of public spending into alternative priority areas, following the work of Lofgren and Robinson (2004), an increase in public spending is justified and more suitable for Yemen. According to the World Bank (2002) and the PRSP, public investments in the social sectors and infrastructure are considered low by international standards. Furthermore, expenditure shares on health and education services are low, and gaps between rural and urban areas and among governorates are still very large.

Infrastructure is still below the desired standard and is characterized by geographical variances and bias toward the urban areas and against the most vulnerable groups. For these reasons, reallocating public spending into alternative priority areas may not be feasible politically, socially, and economically. It is not feasible politically since the reallocation of public spending necessarily consists of reducing current spending in one area and reallocating it to another area. This is politically sensitive because public spending is dominated by current spending (mostly wages). Thus, cutting wages is often not feasible politically and socially. And according to the PRSP, reduction of poverty in Yemen will be achieved through improvement of infrastructure and social services in the country, which will be done through additional public spending. Effectively, this type of spending increases a country's institutional, infrastructural, and human capital. The private sector has less incentive to provide this type of capital, since its provision by one private firm tends to make the services of this capital available to all. The private firm cannot internalize all of the benefits of its investment in this type of capital and consequently tends to be under-supplied.

Both better targeting of new government spending and international aids are identified as the two complementary instruments for poverty reduction. Thus, additional public spending has to be designed to generate a faster growth rate of GDP, which should reduce poverty. The empirical literature strongly suggests that faster GDP growth is associated with more rapid poverty reduction. Lofgren and Robinson (2004) present a detailed review of literature on the positive correlation between growth and poverty reduction.

In this context, the work of Barro (1997) illustrates this point. Barro's study focuses on the institutional factors found to be most conducive to and most harmful for growth and rising standards of living in more than 100 countries around the world since 1960. He focuses on the statistical correlations between institutional influences and average rates of economic growth in various countries. His empirical hypothesis is the idea of "conditional convergence." If all national economies were basically the same except for the respective amounts of capital with which they were endowed, then the hypothesis suggests that the countries with smaller amounts of capital would experience higher annual per capita rates of real growth than countries with larger endowments of capital. The long-run tendency, therefore, is for poorer countries to catch up with richer countries in terms of GDP per capita.

According to Barro's study, government policies with respect to levels of consumption spending, protection of property rights, and distortions of domestic and international markets are among the main factors affecting the level of economic growth. Thus, investments in human capital in the form of secondary and higher education are highly significant in their effects on potential rates of growth. The better and more highly trained the work force, the more productive they are in helping to enhance the rate of annual real output in a society. At the same time, the lower the rate of population increase relative to the rate of growth in the capital supply, the more capital may be invested per worker to increase the average output of each member of the work force. After looking at various types of government policies and their effects on economic growth in the surveyed countries, Barro concludes that "The growth rate tends to be higher if the government protects property rates, maintains free markets, and spends little on non-productive consumption."

In this study, two categories of financing of additional public spending are assessed. Both of them consist of increasing public spending in priority areas while keeping its level unchanged in the remaining areas. For the first category of public spending experiments, additional government spending on social sectors and infrastructure is generated through an adjustment of direct public transfers to households. In fact, according to the closure rules adopted in this study, the model generates a new coefficient of public transfers to households (net of direct taxes). This situation is compared with that prevailing in the baseline scenario to meet the additional spending level for selected areas. In the second category, and given the weak level of government resources, it is assumed that any additional government spending will be financed by direct international transfers in the form of foreign aid. Considered a less-developed country, Yemen benefits from high international assistance in the form of aid, representing almost 23 percent of government expenditures in the year 1999 (World Bank 2004).

For every financing schema adopted, three alternative public spending scenarios are assessed at the beginning. The scenarios are (1) increasing public spending on agricultural infrastructure (SIMAGR), (2) increasing public spending on education services (SIMEDU), and (3) increasing public spending on health services (SIMHEA). The assumptions for these scenarios are presented in Table 13.

Table 13. Assumed elasticities of public spending

Public Spending Category	Elasticity of public spending	Linkage channel
Agriculture	0.3700	TFP in agriculture
Education	0.0098	TFP in all sectors
Health	0.0418	TFP in all sectors

Sources: Elasticity estimates are from Barro (1997) and Mundlak, Larson and Butzer (1997).

The first experiment (SIMAGR) consists of evaluating the effect of a gradual increase in public spending allocated to agriculture from 0.5 percent of GDP in 1998 to 1.5 percent in 2010 and after. Its aim is to improve agricultural yields through investment in public agricultural research and infrastructure, which is assumed to increase the long-run TFP level by 33 percent in agricultural sectors by 2016.

The second experiment (SIMEDU) focuses on increasing public spending on education through a gradual increase from 6.6 percent in 1998 to 9.6 percent in 2010 and after. This increase in public spending is envisioned to raise the long-run TFP level by 19.8 percent for all productive sectors by 2016.

Finally, the third experiment (SIMHEA) introduces an increase in public spending on health services from 1.6 percent of GDP in 1998 to 2.6 percent in 2010 and after. The expected increase in public spending on the health sector will raise the long-run TFP level by 21.5 percent for all sectors by 2016.

For all the experiments described above, two schemas are used:

1. Additional public expenditures related to each experiment will be financed by an endogenous shift in the total public transfers to households (net of direct taxes), henceforth labeled as SIMAGR1, SIMEDU1 and SIMHEA1.

2. Additional public expenditures related to each experiment are financed by foreign aid, henceforth labeled as SIMAGR2, SIMEDU2 and SIMHEA2.

Appendix Tables 4A to 8A present the results of the six experiments performed.

The simulation of a gradual increase in public spending on the agriculture sector suggests that the overall impact of this policy should be high but smaller than the expected impact of increasing public spending on education or health, as generally reported in the literature. For all three experiments, the expected benefits should be higher when additional public expenditures are financed through foreign resources in the form of aid than by reducing direct public transfers (net of direct taxes) to households, which may be achieved through an increase of direct taxes or a reduction in direct transfers.

The first policy simulation (SIMAGR1) provides interesting results. GDP grew by 3.7 percent per year, compared with 3.2 percent in the baseline scenario. Given the relatively inelastic demand for agricultural commodities, the productivity gains in agriculture tend to reduce the demand for labor in agricultural sectors, with surplus labor moving to other sectors. This explains why this reform mostly benefits urban households ─ a gain of 5 percent relative to their disposable income in 2016 under the baseline scenario, compared with a gain of 2.3 percent for rural households.

Increasing public expenditures on education (SIMEDU1) provides higher gains in GDP at the economy-wide level, with an annual increase of 4.0 percent, compared with 3.2 percent in the baseline scenario and 3.7 percent in SIMAGR1, as a result of an increase in production growth in all economic sectors by an average yearly rate of 3.6 percent, against only 3.0 percent in the baseline scenario and 3.3 percent in the SIMEDU1 scenario. The effect on household welfare is quite small, with less than a 1 percent gain for both rural and urban households, compared with their disposable income in 2016 under the baseline scenario.

This may be explained by the fact that productivity gains tend to reduce the demand for labor in all sectors in the first stage, which in turn, affects real wages negatively. In the second stage, the demand for labor increases as a result of output expansion and cost reduction. The overall result is a more rapid decline in unemployment rates for all segments compared with the baseline scenario. While the macro-economic effects are more beneficial than in the previous scenario, the effects on unemployment rates and poverty levels are less promising. The high cost of this policy in terms of public budget expenditures, which have to be financed through direct transfers from households, accounts for its limited impact on poverty. The net effects, while positive, are less beneficial than those in the previous scenario.

The results of the last scenario, which relates to a gradual increase in public spending (as a share of GDP) on the health sector, are more positive, given the relatively high value of the linkage elasticity between output and expenditures on health through the pronounced improvement in TFP. The growth rate of GDP goes from 3.2 percent per year in the baseline to 4.3 percent per year in this simulation. The effect on household welfare is impressive with a more than 11 percent increase for rural households and almost 17 percent for urban households, compared with their disposable income in 2016 under the baseline scenario. This improvement in both the macroeconomic situation and welfare level of all households may be explained by the higher return of public spending on health. In fact, in comparison with the increase in public spending on education in the previous simulation, this policy greatly improves productivity with fewer public resources (see Appendix Table 8A, which provides the costs and benefits for the three public spending experiments with domestic financing).

While all of the simulation experiments improve the macroeconomic situation of the country through higher GDP and export growth rates, the reduction in the poverty rate remains too low and the number of poor remains too high. This is largely because the rate of population growth is so high. The poverty rate at the national level, which runs from 41.8 percent in 1998 to 29.2 percent in 2016 in the baseline scenario, declines the most in the experiment related to increased public spending on health (as reflected by a higher increase of TFP with fewer resources used). For this public spending policy, the poverty rate declines to 20.2 percent where additional foreign aid is the means of financing the additional public expenditures (SIMHEA2). It stands at 21.6 percent in the option where the additional public expenditures are financed locally through a shift in direct government transfers to households (SIMHEA1).

Reduction of poverty is much greater in urban than rural areas. Poverty incidence is projected to be only 8.3 percent in urban areas and 9.4 percent in rural areas in 2016, with additional public spending (SIMHEA1 or SIMHEA2) compared with 14.3 percent in the baseline scenario. In contrast, the poverty rate in rural areas goes from 29.6 percent in 2016 in the baseline scenario to 30.9 or 29.4 percent, depending on the source of additional public financing.

Appendix Table 7A summarizes the results of the first six experiments along with the baseline scenario. It shows the changes in the poverty incidence and the number of poor as well as changes in the poverty gap index and the severity of poverty. These indicators are measured at national as well as at rural and urban areas.

The large estimated effects of additional targeted public spending on health and education, rather than agriculture, may be surprising, in light of other studies that have assessed returns to public expenditures. While the results of this study are consistent with some previous studies (Lopez 2004), many others report different returns to public spending in selected sectors. Generally, rate-of-return studies have become standard practice in assessing the economic impact of public spending. The reported ex-ante rates of return vary substantially, but in general it is admitted that public spending on agriculture, human capital, or infrastructure constitutes a sound investment in poverty reduction and economic growth.

Thus, it is important to understand the variations in estimated rates of return to public spending in selected sectors and why they differ across countries and economic tools used. Taking a comprehensive look at all the available evidence on rates of return to public spending, in Yemen, results show that spending on health generates the most economic growth and poverty reduction. For the same level of public spending, investment in agriculture generates the second best result. However, education seems to be the least promising channel of economic growth and poverty reduction. Comparing the findings of this study with other studies on assessment of public spending is undertaken through two main steps. In the first step, this study is compared with case studies that use different economic tools for the assessment. In the second step, this study is compared with studies that use the same assessment tool. This allows us to draw some conclusions on the robustness of these findings in order to prioritize sectoral public spending in Yemen.

Public spending affects growth and poverty reduction in two ways: first, it can raise the overall growth performance of the economy, and second, it can increase the ability of the poor to contribute to the growth process. In a recent paper published by the World Bank Institute, Wilhelm and Fiestas (2005) explore the link between spending and pro-poor growth through a review of recent analytical work covering several developing countries. They review recent literature to establish which tools are generally used to analyze this link. Then, based on their findings, they attempt to determine the relevant sectors for achieving poverty reduction and economic growth and to understand the variation in the levels of return to public spending when the tools used are different. From a review of various case studies, they find that investment in agriculture, education, and infrastructure, all have a positive effect. However, investing in agriculture yields the highest returns in both growth and poverty reduction, whereas investing in health has a positive effect on poverty reduction, but the impact on growth is much weaker.

Four main approaches are usually used to assess returns of public spending: (1) benefit incidence, (2) labor intensity, (3) regression, and (4) CGE. Given the different limits addressed by the first two approaches and the dominance of the use of the second two, this analysis focuses on case studies using either regressions or CGE models. Benefit incidence analysis has a number of shortcomings, according to Bourguignon, da Silva, and Stern (2002). First, benefit incidence analysis cannot be conducted in isolation from a macroeconomic framework. Second, when applied to public expenditures, benefit analysis focuses on the average ex-post incidence of all expenditures at a point in time, rather than the marginal ex-ante incidence of a policy, which increases expenditures on a service or the coverage of that service or both. In addition, this kind of analysis gives information on the marginal incidence only where the expansion of expenditures improves the quality of the service uniformly for all initial users, with absolutely no change in the identity of users, which is a restrictive assumption. A third serious drawback is that standard analysis, or even marginal incidence analysis that would simulate the change in the identity of users, assumes no behavioral response from recipients of subsidies. A fourth shortcoming is that incidence analysis needs to be dynamic rather than static. Some of these difficulties have to do again with the lack of reference to a macro-economic framework. It may often be irrelevant to consider public spending and fiscal policy independently of each other. This kind of concern should in theory be included in incidence analysis, but this requires an interaction with macro-economic modeling.

For regression studies, mostly household level data are used to link household access to infrastructure, technology, and human capital with their per capita income or expenditure, poverty status and income distribution (Deninger and Okidi 2003; Nkonya et al 2004). But as these studies have not linked household welfare indicators to government investment at the regional and national levels, a second category of regression analysis has emerged, which builds on a conceptual framework developed and applied by IFPRI in a number of developing countries around the world.

The IFPRI list includes many studies such as those carried out by Fan, Hazell, and Thorat (1999); Fan and Hazell (2001); Fan and Rao (2003); Fan, Huong, and Long (2004a); Fan, Zhang, and Rao (2004b); and Fan, Nyange, and Rao (2005). Unlike most former studies on government spending and investment, the approach developed by Shenggen Fan and others at IFPRI attempts to capture synergies across investments by comparing and ranking the returns of various types of investment and by calculating the number of poor people raised above the poverty line for additional units of expenditure on different items. At the same time, the IFPRI method evaluates the impact of sectoral expenditure on growth and poverty reduction. The results for Vietnam show, for example, that the greatest returns in terms of growth and poverty reduction come from agricultural research and

development, followed by investments in telephones and education. In Uganda, agricultural research and development is also the most significant sub-sector, followed by feeder roads and education. The results for India also show that government spending on productivity-enhancing investments (especially agricultural research and extension), rural roads, and education targeted directly to the rural poor all contribute to reductions in rural poverty and also lead to increased agricultural productivity.

However, there are some slight differences in the relative ranking of expenditures depending on whether the primary objective is growth or poverty reduction. For instance in Uganda, investments in roads are not important for growth, but they are significant for poverty reduction (fourth place after education). Similarly, in India, irrigation is the third most important investment in terms of growth but has a smaller impact on poverty reduction. With respect to regions, there is significant divergence in all three countries on where governments should allocate their marginal resources, depending on whether the priority is poverty reduction or growth. Accordingly, investments in specific sectors such as agriculture, education, and infrastructure appear to be important for both growth and poverty reduction, although some trade-offs may exist.

The main policy recommendation emerging from Fan's work is that public expenditures aimed at reducing rural poverty should focus on improvements in education, agricultural research and development, and infrastructure. Most of the case studies using Fan's approach show that education expenditures positively affect both poverty reduction and growth, whereas health expenditures seem to have a positive impact on poverty reduction but may not have the same effect on growth. Lastly, infrastructure spending seems to have a positive impact on both poverty reduction and growth.

However, these findings vary greatly depending on the specific country context and the different specifications of the models being used. In addition, a number of critical issues emerge from the series of studies by Fan and others. In the first place, the robustness of the results is often sensitive to the empirical strategy employed and the countries and time period covered by the sample. Another important finding is related to the assumption made that growth is defined as rural income growth: the effect of agriculture expenditure on overall growth might not be that significant. Furthermore, this kind of analysis does not take into account fiscal policy and how additional investments will be financed.

In some cases, if additional investment is financed through higher income taxes, the effect of increasing public spending could differ from the findings of these studies. Moreover, this kind of

analysis ignores the feedback effects that could emerge from higher public spending. In general, this analysis, which takes into account only the first-order effect and ignores the mechanism of public financing of additional investments, will generate results different from those drawn from a CGE model. Comparing the robustness of the results of this study with those carried out using regression techniques is not very fruitful ─ given the huge differences in model structures and assumptions. For this reason, it seems more relevant to compare the author's results with similar case studies using dynamic CGE models.

The results of the dynamic CGE model developed by Lofgren and Robinson (2004) for Sub-Saharan Africa to evaluate the impact that one specific policy has on the economy as a whole may be considered as the benchmark for results of this study. As a regression method, the CGE model developed by Lofgren and Robinson allows the ranking of spending priorities depending on the primary policy objective. Their results show that investing in agriculture brings the highest reduction growth and poverty levels. Additionally, investment in human capital (education and health) yields higher returns in both growth and poverty reduction than does infrastructure investment.

Three main reasons explain the difference in ranking between this study and the one done by Lofgren and Robinson prioritizing public spending by sector. First, Lofgren and Robinson's study simulates the effect of a reallocation of government demand to alternative priority areas (agriculture, human capital, and infrastructure), while keeping the real growth of total government demand constant. Second, this study analyzes the effects of increasing public spending on alternative priorities. Given that increasing public spending leads to additional resources for the government, the additional spending can be financed in two ways: either directly through additional foreign aid, or through a shift in public direct transfers to households. This assumption makes a huge difference in the results of this model, given that the additional income generated from higher public spending in selected areas might be reduced or exceeded by the losses in public direct transfers to households. The third reason is derived from the importance of oil in the Yemeni economy, compared with the Sub-Saharan African countries. More spending on selected sectors will not generate the same level of returns at the economy-wide level for a country dominated by oil as it would for a nonoil country.

Overall, the results of the two approaches (Fan's and the CGE models) suggest that there are no major differences when ranking expenditures. However, within the CGE models, results may differ based on the values of the key parameters as well as the assumption regarding the way public investment is financed: through a reallocation across sectors or through additional investment. The

dynamic as well as the second-order effects may also help explain the differences in estimated rates of return to public spending.[10]

In addition, from reviewing country studies that assess the link between public spending, poverty reduction and growth, it is also clear that expenditure priorities are highly country-specific. Thus, outcomes of a specific country study cannot be duplicated for other countries, given the large variation in initial country conditions, the complex chain of linkages, the time lags involved and the interdependence among development outcomes, in addition to differences in the structure and features of the tools (Paternostro, Rajaram, and Tiongson 2005).

The above findings highlight the importance and need for rigorous country specific analysis of public resource allocations across and within sectors, which could help to evaluate the marginal returns on different types of government spending. However, each of the four tools has severe limitations and rather than using one approach, it may be useful to draw from various tools and techniques to get a more comprehensive view on the potential return of alternative allocations of public resources.

Therefore, to provide a better understanding of the impact of public investment across sectors, it may be useful to use a combination of different approaches. This may allow more solid evidence on the potential return of alternative combinations of public resources to be derived and may be a way to address some of the limitations associated with the different models and techniques. This approach was used in the work of Mosley, Hudson and Verschoor (2004) who tried to construct a "pro-poor expenditure index". Using four different methods ─ benefit incidence, labor intensity, regression, and CGE ─they attempt to establish in which sectors the expansion of expenditures is likely to be poverty reducing (Wilhelm and Fiestas 2005). More recently, Fan et al. (2006) applied both approaches (regressions and CGE model) to assess the effects of public spending on poverty in Egypt (regressions and CGE model).

Given the difficulty of estimating econometrically the different parameters used for calibrating a CGE model, it may be argued that differences in the ranking of public spending in selected areas may be explained by differences in the values of the various parameters or the structure of both of the models used. However, given the specific structure of the Yemeni economy compared

[10] Data availability for the India study goes back to 1970, so time lags are empirically taken into account. However, in Vietnam and Uganda, the lack of long-term time series data on regional public expenditures and other indicators, such as infrastructure, does not allow this (Wilhelm and Fiestas 2005).

with the other countries analyzed by Lofgren and Robinson (2004) or Fan et al. (2006), improvements in productivity as a result of increasing public spending in health and education should take into account the importance of the oil sector in the Yemeni economy.

Accordingly, two additional simulations (SIMEDU-NOIL and SIMHEA-NOIL) are undertaken on increasing public spending in the education and health sectors. Contrary to the previous simulations, both new scenarios assume that the additional public spending will not improve the productivity of the oil sector in Yemen because the oil sector is a capital-intensive sector, and its productivity is not closely linked to human capital, as it is in sectors that are labor-intensive or not tradable. The results of the two simulations are presented in Appendix Tables 4A to 7A.

Appendix Table 8A shows the marginal returns of public spending in the three sectors: agriculture, health, and education for all simulations. Results show that when the improvement in TFP does not cover the oil sector, the same level of public spending in the agricultural sector generates higher returns both in terms of economic growth and poverty reduction. In addition, the two additional simulations increase the level of poverty in the country given that the cost of this policy, which is financed through higher taxes (less subsidies) on households, exceeds the level of returns in terms of welfare for both household categories included in the study. Accordingly, the main difference in prioritizing public spending between this analysis and the others performed by Lofgren and Robinson and Fan et al. may be explained by the importance of the oil sector in the Yemeni economy.

5. CONCLUSION

This paper has provided evidence suggesting that the structure of public spending is an important factor of economic growth and poverty reduction. Preliminary simulations show that increasing public spending in health and agriculture could benefit the country more than spending focused only on the education sector. Accordingly, the results of these experiments show that public spending targeted more toward improving health and education services generates more economic growth and thereby reduces the poverty level. However, because public spending in health and education sectors does not improve productivity in the oil sector, spending on agriculture infrastructure generates the higher return in both economic growth and poverty reduction.

In any case, the road still appears to be long for Yemen to be able to achieve its MDG in terms of poverty reduction. Re-allocating public expenditures from defense to these key sectors for example, seems to be the best option to reduce poverty, given the financial constraints facing Yemen. However, in the current context of terrorism concerns, it will be very difficult to convince policy-makers to reduce spending on defense and security. Targeting additional resources from international donors seems to be the only option available to increase public spending in the key sectors, given that Yemen's level of crude oil exports is declining and is expected to do so for the next decade.

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Appendix: Supplementary Tables

Table 1A. Aggregate and sectoral growth in GDP

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Real GDP (Annual Growth Rate)	..	2.0	8.3	4.1	2.2	11.6	6.0	8.0	6.5	2.7	6.5	4.7	3.6
Real Oil GDP (Annual Growth Rate)	..	–5.7	–15.9	4.3	43.7	20.0	13.0	5.0	3.0	10.0	0.0	..	..
Real GDP *per capita* (Annual Growth Rate)	..	–9.7	4.9	0.7	–1.1	8.6	3.1	5.0	3.5	–0.1	3.6	1.6	0.5
Real GDP PPP *per capita* (Growth Rate)	..	–8.6	10.8	1.9	5.5	7.5	0.5	2.3	–2.8	3.7	5.7	0.5	0.9
GDP Agriculture (% of Total Real GDP)	24.2	21.3	23.0	21.4	22.6	20.0	16.9	16.3	20.3	16.7	14.1	15.3	15.2
GDP Agriculture (Annual Growth Rate)	..	–7.4	19.1	4.4	–3.4	9.6	2.6	8.1	14.0	1.2	4.6	5.9	3.6
GDP Industry (% of Total Real GDP)	26.8	24.5	22.7	21.8	24.0	32.0	41.5	43.2	32.5	42.0	47.3	42.2	40.4
GDP Industry (Annual Growth Rate)	..	–0.2	–3.9	4.5	13.1	21.2	10.5	7.6	2.7	4.8	-1.8	2.5	1.7
GDP Services (% of Total Real GDP)	49.0	54.2	54.3	56.8	53.4	48.0	41.6	40.5	47.2	41.4	38.6	42.5	44.4
GDP Services (Annual Growth Rate)	..	7.8	9.9	3.7	–0.2	7.7	51.0	8.1	5.4	2.3	12.4	5.3	4.5

Source: World Bank (2004), Al-Asaly (2003) and author's calculations

Table 2A. Macroeconomics indicators

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Final Expenditures, Saving and Investment													
Final Consumption Expenditures (Share of GDP)	91.2	105.7	106.6	117.2	86.4	85.4	83.9	84.0	88.4	78.4	75.1	81.8	84.0
Final Consumption Expenditures (Annual Growth Rate)	..	21.6	6.1	14.5	–24.7	10.4	4.1	8.1	12.1	-8.9	2.0	14.1	6.3
General Government Final Consumption Expenditure (Share of GDP)	17.5	19.1	19.4	19.1	18.8	14.4	13.1	13.0	14.5	13.4	12.7	13.6	13.9
General Government Final Consumption Expenditure (Annual Growth Rate)	..	14.5	6.8	2.6	0.6	–14.7	–3.1	7.2	18.5	-4.8	0.7	12.3	6.1
Household Final Consumption Expenditure, Etc. (Share of GDP)	73.8	86.6	87.2	98.2	67.6	71.1	70.8	71.0	73.9	65.0	62.4	68.2	70.0
Household Final Consumption Expenditure, Etc. (Annual Growth Rate)	..	23.3	–2.7	15.3	–9.6	18.7	–7.5	5.3	10.9	-9.7	2.1	14.8	4.6
Gross National Saving (Share of GDP)	8.8	–5.7	–6.6	–17.2	13.6	14.6	16.1	16.0	11.6	21.6	24.9	18.2	16.0
Gross National Saving (Annual Growth Rate)		–177.8	47.3	224.0	–201.2	80.3	59.4	19.9	-30.7	152.5	51.4	-22.9	-4.0
Gross Fixed Capital Formation (Share of GDP)	11.9	13.9	19.9	17.5	19.0	20.6	21.3	21.4	31.2	22.8	16.5	16.4	15.8
Gross Fixed Capital Formation (Annual Growth Rate)	..	–4.3	92.3	–8.5	11.2	21.0	9.5	8.4	55.5	-24.9	-22.8	3.9	0.0
Inflation Rate (GDP Deflator, %)	..	17.1	17.4	19.2	25.8	50.7	35.9	11.8	-10.1	31.9	22.9	1.0	5.2
External Sector													
Exports (Share of GDP)	14.3	13.7	21.5	27.4	51.2	50.7	42.3	35.8	26.6	35.6	42.6	37.1	37.9
Exports (Annual Growth Rate)	..	–1.8	69.1	33.0	90.9	10.5	–11.7	-8.6	-20.9	37.8	27.3	-8.8	5.9
Imports (Share of GDP)	20.1	35.6	50.5	64.9	58.7	58.0	49.2	44.5	47.2	38.0	35.0	36.1	38.6
Imports (Annual Growth Rate)	..	80.7	53.7	33.8	–7.7	10.4	–10.2	-2.4	13.1	-17.2	-2.0	8.1	10.5
Current Account (Share of GDP)	15.3	–13.0	–18.8	–25.5	6.6	4.3	1.8	0.3	-5.0	7.4	14.2	7.0	5.4
Foreign Direct Investment, Net Inflows (% of GDP)	–2.7	5.6	12.5	18.4	0.4	–5.1	–1.0	-2.0	-3.5	-4.1	0.1	1.6	1.1
Trade (% of GDP)	34.4	49.3	71.9	92.3	109.9	108.8	91.4	80.2	73.8	73.7	77.6	73.2	76.5
External Balance on Goods and Services (Share of GDP)	–5.8	–21.8	–29.0	–37.5	–7.4	–7.3	–6.9	-8.7	-20.6	-2.4	7.6	0.9	-0.6

Source: World Bank (2004) and author's calculations

Table 3A. Yemeni macro social accounting matrix, 1998 (YR million)

	Activities	Commodities	Factors	Households	Government	Indirect Taxes	Taxes on incomes and profits	Savings-Investment	Tariffs	Rest of World	Total
Activities		1247249.2									1475269.5
Commodities	734646.2			592491	45396			310946.7		228020.3	1683479.9
Factors	714407.6				96751						
Households			625559.4		18680					154869.9	799109.3
Government			117772			26215.7	54441.1		31036.3	48165.4	277630.5
Indirect Taxes Net of Subsidies	26215.7										26215.7
Taxes on Income and Profit				54441.1							54441.1
Savings-Investment				152177.2	116803.5					41966	310946.7
Tariffs		31036.3									31036.3
Rest of World		405194.4	67827.2								473021.6
Total	1475269.5	1683479.9	811158.6	799109.3	277630.5	26215.7	54441.1	310946.7	31036.3	473021.6	

Source: Author's estimations.

N.B. Data are rounded to one decimal point.

Table 4A. Macroeconomic results

	BASE	SIMAGR1	SIMAGR2	SIMEDU1	SIMEDU2	SIMHEA1	SIMHEA2	SIMEDU-NOIL	SIMHEA-NOIL
Real Gross Domestic Product	3.2	3.7	3.7	4	4.3	4.3	4.4	3.3	3.7
Total Production	3	3.3	3.3	3.6	3 9	3.9	4	3	3.4
Private Consumption	2.7	2.9	3	2.7	3.5	3.4	3.6	2.7	3.4
Real Urban Available Income	5	5.3	5.4	5.1	6.2	6	6.2	5	5.9
Real Rural Available Income	1.4	1.6	1.6	1.5	2.2	2.1	2.3	1.4	2
Investment	0.6	0.8	0.9	0.5	1	0.9	1	–1.1	-0.5
Exports	2.1	2.9	2.9	2.8	3.4	3.3	3.5	1.9	2.5
Imports	1.3	.8	1.8	1.7	2.1	2.1	2.2	1.2	1.6
Government revenue	–1	–0.6	–1	0.7	–1.3	–0.7	–1.3	–1.4	-3.6
GDP deflator	–0.9	–0.7	–0.7	–1	–0.9	–0.9	–0.9	–1	-1

Source: Model's results

N.B. Macroeconomic aggregates are expressed in annual percentage changes during the period 1998-2016 compared to 1998.

Table 5A. Changes in real wages by segment and simulation

	BASE	SIMAGRI1	SIMAGR2	SIMEDU1	SIMEDU2	SIMHEA1	SIMHEA2	SIMEDU-NOIL	SIMHEA-NOIL
Rural unskilled workers in the public sector	–5.8	–5.8	–5.8	–6	–6.1	–6.1	–6.1	-5.8	-5.9
Rural skilled workers in the public sector	–5.8	–5.8	–5.8	–6	–6.1	–6.1	–6.1	-5.8	-5.9
Rural unskilled workers in the private sector	–1.1	0.7	0.6	–0.6	–0.3	–0.3	–0.2	-1.3	-0.9
Rural skilled workers in the private sector	–2.8	–2.6	–2.6	–2.2	–2.5	–2.4	–2.5	-2.7	-2.8
Urban unskilled workers in the public sector	–5.8	–5.8	–5.8	–6	–6.1	–6.1	–6.1	-5.8	-5.9
Urban skilled workers in the public sector	–5.8	–5.8	–5.8	–6	–6.1	–6.1	–6.1	-5.8	-5.9
Urban unskilled workers in the private sector	–1.3	–0.2	–0.2	–0.9	–0.7	–0.7	–0.6	-1.5	-1.3
Urban skilled workers in the private sector	–3	–2.9	–2.9	–2.6	–2.8	–2.7	–2.8	-3.1	-3.2

Notes: Real wages are expressed in percentage changes compared to the base year.

Table 6A. Trend in unemployment rates by skill and areas and simulation

	BASE	SIMAGR1	SIMAGR2	SIMEDU1	SIMEDU2	SIMHEA1	SIMHEA2	SIMEDU-NOIL	SIMHEA-NOIL
Rural Unskilled	0	0.2	0.2	–0.4	–0.4	–0.5	–0.5	0.3	0.3
Rural Skilled	–6.9	–10.7	–9.2	–9	–13.7	–29.5	–14.5	–5.5	-4.1
Urban Unskilled	–0.3	–0.8	–0.7	–0.6	–0.7	–0.7	–0.8	0.2	0.2
Urban Skilled	–1.9	–2.5	–2.3	–3.2	–2.6	–2.9	–2.7	–1	-0.7

Table 7A. Poverty indicators in 2016 by simulation

	BASE 1998	BASE LINE 2016	SIMAG R1	SIMAG R2	SIMED U1	SIMED U2	SIMHE A1	SIMHE A2	SIMED U-NOIL	SIMHE A-NOIL
Poverty Incidence (P0)										
National Level	41.8	23	26.2	25.3	27.4	20.8	21.6	20.3	23.9	24.3
Urban Areas	30.8	14.3	12.8	12	14.8	8.6	9.4	8.3	15.2	12.1
Rural Areas	45	29.6	36.4	35.5	37	30	30.9	29.4	30.6	33.5
Poverty Gap Index (P1)										
National Level	13.2	13.2	13.8	13.6	14	12.7	12.9	12.7	13.1	12.8
Urban Areas	14.7	15.2	14.9	14.8	15.2	14.3	14.4	14.2	14.7	14.2
Rural Areas	8.2	8	8.6	8.5	8.6	8	8.1	8	8.1	8.1
Severity of Poverty(P2)										
National Level	5.8	5.7	6.5	6.3	6.8	5.2	5.2	5.1	5.7	5.6
Urban Areas	6.7	7.3	7	6.8	7.4	6.2	6.2	6.1	6.7	6.5
Rural Areas	3.2	2.9	3.7	3.7	3.8	2.9	2.9	2.9	3.1	3.1

Notes: P1, P2, and P3 are expressed in percentages at the end of the simulation period (2016). Data are rounded to one decimal.

Table 8A. Cost/benefits for each public spending experiments: Domestic financing

	SIMAG R1	SIMED U1	SIMHE A1	SIMEDU-NOIL	SIMHEA-NOIL
GDP	0.056	0.0365	0.1	0.004	0.046
Poverty Incidence Changes					
National Level	0.336	0.082	0.693	0.039	0.119
Urban Areas	(0.168	0.022	(0.447	0.039	0.201
Rural Areas	0.761	0.32	0.119	0.043	0.356

Source: Author's calculations

Note: For every 100 billion YR spent during the simulation period, the annual percentage change is given, compared with the baseline scenario.

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