The Bang for the *Birr*:
Public Expenditures and Rural Welfare in Ethiopia

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INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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CONTENTS

TABLES

FIGURES

ACKNOWLEDGMENTS

ABSTRACT

This paper explores and compares the impact of different types of public spending on rural household welfare in Ethiopia. The analysis of public financial and household-level data reveals that returns to road investments are significantly higher than returns to other spending, but are much more variable across regions. This regional variability in returns to road investment suggests that the government should carefully consider region-differentiated investment priorities. Some evidence suggests that the returns to road spending are increasing over time, with higher returns to road investments seen in areas with better-developed road networks. Among the other types of public spending, the household expenditure impacts of per capita public expenditure in agriculture and education are smaller, but these effects are also less variable across regions than the effects of road infrastructure spending. The largest effects of agricultural expenditures on rural households are observed in the most urbanized regions, pointing to the potentially important impact of market proximity on returns to public interventions in agriculture. Despite the importance of agriculture to the economy of Ethiopia we found that returns to agricultural spending were fairly low, suggesting the need for further research into the drivers of efficiency and effectiveness of public investments in this important sector.

Keywords: Public investment, Public spending, Ethiopia, Rural welfare.

1. PUBLIC SPENDING AND RURAL WELFARE IN ETHIOPIA

Over the last decade and a half, Ethiopia's approach to bringing about development and to improving the lives of the country's rural population has been driven by a governmental development strategy called "Agricultural Development Led Industrialization", or ADLI.[1] The main intention articulated in this development strategy is to attain fast and broad-based development within the agricultural sector and use this to power economic growth. While ADLI stipulates regulatory, trade, market, and other policies as an engine of agricultural growth, it has also relied heavily on increasing public expenditure in agriculture and other types of infrastructure and social sectors perceived as contributing to agricultural productivity.

Thus, Ethiopia's public expenditure policy is at the heart of the policy measures intended to translate ADLI into reality. Several prior studies have sought to evaluate the success or failure of ADLI by examining other governmental policies considered central to agricultural and rural development, such as the land tenure policy (e.g. Deininger and Jin 2005), reforms in agricultural input markets (e.g. Jayne et al. 2002) and agricultural output markets (e.g. Dercon 1995), policies on the agricultural extension system (e.g. Alene and Hassan 2005, Belay and Abebaw 2004, Benin et al. 2004), food security programs (e.g. Farrington and Slater 2006, Gelan 2006), and rural energy policy (Wolde-Ghiorgis 2002, Teferra 2002).[2] However, few if any studies have explored whether the government's public budget allocations have been consistent with the stipulated development strategy or with 'good practice' for achieving development. Even less is known regarding the extent to which the actual public investments have achieved improvements in household incomes.

Given the budget constraints faced by governments, often the critical and actionable research question with regard to public expenditures is not whether or not certain types of public investments contribute to welfare improvements, but rather how different types of public investments compare in terms of their relative contributions to welfare. Any answer to this question will have important implications for expenditure policy, especially in terms of the portfolio composition of public resources.

This paper explores and compares the impacts of different types of public spending on rural household welfare in Ethiopia. As with the literature on public investment in other developing countries (discussed below), the few published papers on public expenditure in Ethiopia have either been based on general equilibrium models that simulate the effects of changes in overall public spending (Agenor et al.

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[1] This is not to be confused with Irma Adelman's concept of ADLI (agricultural demand led industrialization) (Adelman, 1984) although the Ethiopian government's development strategy has several features that appear to draw from Adelman's concept.

[2] These are but a few examples of this extensive body of literature, the bulk of which falls outside the scope of the present paper.

2004), or have concentrated on examining how public spending in one particular sector affects performance in that sector (Collier et al. 2002). We are not aware of any other study comparing the welfare or poverty effects of different types of public expenditure in Ethiopia.

For the purposes of this paper, we use the terms 'public investment' and 'public expenditure' interchangeably. This distinction, while critical in other contexts, is not useful in the present work because we are interested in more than just the physical outcomes of public investment. When considering the number of school buildings, for example, one might examine the role of only capital expenditure (which is often referred to as 'public investment' in other contexts) in education as it relates to the number of schools in a given region, without inclusion of recurrent expenditures in teacher salaries, supplies, etc. However, when one is interested in a broader measure of performance in the education sector (e.g. the primary enrollment ratio), then both recurrent and capital expenditure in education must be seen as forms of public investment in human capital. Therefore, unless otherwise noted, we herein refer to the total (i.e. recurrent and capital) amount of public expenditure interchangeably as 'public expenditure' or 'public investment.'

The following section (Section 2) will first discuss the empirical literature on public investment and development goals in developing countries, followed by a discussion of the existing evidence on public investment impacts in Ethiopia. To place the empirical strategy and estimation of public expenditure effects into context, Section 3 begins by giving a brief overview of the key currents of Ethiopia's development strategy and the development outcomes seen over the past fifteen years. This will be juxtaposed in Section 4 against broad trends in public expenditure, with further detail provided for selected sectors, development strategies, expenditure trends, and performance. Section 5 presents the conceptual context for this paper and explores some of the challenges inherent in such public expenditure analysis. Section 6 describes the empirical strategy based on the conceptual frame of the preceding section. A description of the data and the results of this estimation approach are given in Section 7, with overall conclusions presented in Section 8.

2. EMPIRICAL APPROACHES TO ASSESSING THE IMPACT OF PUBLIC SPENDING

Most of the studies examining the link between public expenditure and development outcomes fall into one of two categories. Studies in the first category explore how the size of *overall* public expenditure or public investment affects growth or poverty. Examples of this category include Agenor et al. (2004) (described in more detail below), who examined the impact of shifting resources from recurrent to capital expenditure in Ethiopia, and Aschauer (2000), who compared the contributions of overall stocks of public and private capital to the national income while accounting for the size, financing, and efficiency of public capital. The second category includes studies in which the authors sought to correlate spending in one economic sector with outcomes in that sector, or with broader welfare measures (e.g. Collier et al. 2002 on the health sector in Ethiopia; Roseboom 2002 on agricultural research). Also included in this category are studies seeking to assess the effectiveness of aid by determining the extent to which aid contributes to growth and poverty reduction by supporting increases in certain types of public investment (e.g. Gomanee et al. 2003 on social sector investment). Both types of studies can provide useful input into policy-making decisions. However, there is a striking lack of research aimed at examining how the *composition* of public spending affects key development outcomes, which is a particularly policy-relevant question.

Usually, the main public investment decision facing policymakers is that of how to allocate an existing pool of public resources across various sectors, rather than whether to increase or decrease the public budget. This question is typically deliberated on an annual basis or within a medium-term strategy in a given country. Budget allocation is inherently a political process in developing and industrialized countries alike, and budget decisions will typically reflect a range of considerations in addition to overall economic growth or poverty reduction. There is considerable need for studies on which types of public investments contribute most to development goals, as this information may help shape aspects of the budgeting process.

Paternostro et al. (2005) noted that the relative lack of research-based studies comparing the effectiveness of different types of public expenditure in contributing to poverty reduction has prompted international donors and the governments of developing countries to equate pro-poor spending with social sector investments, leading to corresponding expenditure policies. However, a number of studies (discussed below) have suggested that in many developing countries the greatest contributions in poverty reduction are not necessarily derived from social sector spending, but rather arise from investments in "hard" infrastructure such as roads, electrification, and agricultural research systems. In the absence of

empirical evidence supporting development-returns to public spending, considerations other than economic development may fill the vacuum created by this knowledge gap. Hence, research on the relative returns to different types of public investment may contribute a great deal to improving policy decisions.

Several methods have been used to examine the relative contributions toward development outcomes of public spending in different sectors. Marginal benefit incidence analysis has been commonly used to assess the relative poverty orientation of various forms of investment. Ajwad and Wodon (2001) examined municipalities with different income levels in Bolivia, and compared the benefit incidence of education, water, sewerage, electricity, and telephone services. However, this and several other studies employing marginal benefit incidence analysis failed to incorporate the actual expenditure outlays for these public services. Other studies have used general equilibrium models to project public investment effects into the future; these include Lofgren and Robinson (2005) on several African countries, Dabla-Norris and Matovu (2002) on Ghana, and Jung and Thorbecke (2003) on Tanzania and Zambia. Several of these studies focused on the effects of education, although other types of investment were analyzed as well. Devarajan et al. (1996) used regression analysis (OLS and fixed effects models) to compare the growth effects of public expenditures across functional and economic classifications.

A series of studies have used panel data simultaneous equation models to study the effect of a range of sectoral expenditures on agricultural growth and poverty outcomes at the country level (e.g. Fan et al. 2000, Fan et al. 2002). These studies used aggregate state-level data on public expenditure, public capital, sectoral performance indicators, labor and wage variables, and agricultural productivity and poverty. The utilized models incorporated the various pathways by which spending may affect poverty, and generally showed that public spending on agriculture, health, education, and other sectors built up public capital and improved public services at the sector level. Furthermore, they showed that better public services and sector-level development increased the incomes of rural residents both by fostering agricultural productivity, which improved agricultural incomes, and by enabling more non-farm income earning opportunities, which increased both wages and off-farm employment. Agricultural productivity was found to have a price effect, as it reduced agricultural prices relative to other prices. However, both the price and the (farm and off-farm) income effects were found to contribute positively to poverty reduction.

The previous studies have yielded mixed findings on the relative contributions of public investment in different sectors, perhaps reflecting the range of methodologies employed, variation in the types of economies studied, and differences in the target sectors. Education spending was found to have the largest poverty-reducing effect in several of these studies (e.g. Fan et al. 2002 and Fan, Zhang and Rao 2004), especially in studies that specifically focused on the education sector (e.g. Jung and

Thorbecke 2003, and Dabla-Norris and Matovu 2002). In contrast, transportation spending was found to have limited or even negative impacts on poverty (e.g. Ajwad and Wodon 2001, and Lofgren and Robinson 2005). Devarajan et al. (1996) found weak evidence that expenditure in certain types of education (subsidiary services such as school feeding and transportation to schools) and health (public health research) had a positive effect on growth, whereas capital-intensive spending categories such as infrastructure had a negative effect on growth. Interestingly, several other studies found that road infrastructure investment was the first or second most effective category in terms of reducing poverty (Fan et al. 2000 and Fan, Zhang and Rao 2004).

This relatively large variation among these study results suggests that the methodologies used to analyze the relative returns to public spending should be carefully considered. A thorough methodological review goes beyond the scope of this paper, but the quality of analysis is likely to be enhanced when: 1) the effects of different types of spending are assessed in a common empirical framework; 2) the estimation accounts for the multiple pathways by which spending may affect growth or poverty; and 3) the common simultaneity problem of a policy variable (e.g. public expenditure) is appropriately addressed (see Paternostro et al. 2005 for further discussion of methodological approaches).

To date, relatively few studies have provided guidance to public resource allocation across sectors, and the available reports have focused on the econometric analysis of differential returns to public expenditure in terms of poverty. Even fewer such studies have been performed at the country level, especially in African countries. This constitutes an important knowledge gap for the continent, especially given the centrality of public expenditure policy in many African economies. This shortage of research likely stems at least in part from the relative lack of data on regionally and sectorally disaggregated expenditures, sector-specific outcome variables, and region-specific poverty, income and growth indicators. Given the potentially high policy relevance of research into public investment priorities, however, such data constraints call for the adaptation of existing empirical methods to allow analysis of the data landscape in Africa.

As with the literature on public investment in other developing countries, the few such papers on Ethiopia are based either on general equilibrium models simulating the effects of changes in overall public spending, or else concentrated on how public spending in one particular sector affected performance in that sector.[3] We are not aware of any other study comparing the welfare or poverty effects of different types of public expenditure in Ethiopia.[4]

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[3] Seifu (2002) conducted a preliminary benefit incidence analysis of public spending in education and health.
[4] As in the earlier section, we herein focused specifically on studies explicitly analyzing public expenditures. Several other studies have examined the effects of public investments by determining the impact of access to public services for welfare or poverty in Ethiopia. However, only a few of these studies compared the relative contributions of

Agenor et al. (2004) and Collier et al. (2002) reported two of the more careful studies on this topic in the context of Ethiopia. These two studies differed from each other in the scope of public spending examined, the type of effect explored, and the methodology employed, but both focused on the relative returns of reallocating resources from recurrent to capital expenditures. Agenor et al. (2004) applied an aggregate one-representative-household, one-good macroeconomic model to Ethiopia, and used it to explore the links among foreign aid, the composition of public investment, growth, and poverty. Policy experiments were conducted to assess the poverty and growth effects of changes in the composition of public spending. In this study, however, the main distinction was made between government consumption (recurrent expenditure) and public investment (capital expenditure) across the broad sectors of health, education, and infrastructure. Hence, rather than a policy simulation in which the sectoral allocation was changed, the authors simulated the effects of a shift from recurrent to capital expenditure.

In contrast, Collier et al. (2002) focused on the health sector, exploring how different types of health sector public spending determined the extent to which health services were used by rural residents in various areas of the country. They found that reallocation of public resources for health away from spending that sought to increase the 'quantity' of healthcare toward spending aimed at enhancing the 'quality' of healthcare would increase usage rates. In this sense, as in Agenor et al. (2004), the authors found that the key tradeoff in public expenditure was that between recurrent and capital expenditure.

Aside from academic literature on public investment, a range of policy and review papers have been made available through development finance organizations, most notably the World Bank through its Public Expenditure Reviews and similar reports. These show trends in public expenditure in Ethiopia, describe fiscal policy and how it affects public resource allocation, and make recommendations for public expenditure management (e.g. World Bank 2002, 2003, 2004).

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different types of public services, with the exception of Dercon et al. (2006), who carefully analyzed the role of access to all-weather roads and extension services in the consumption growth and poverty of rural households in Ethiopia.

3. DEVELOPMENT STRATEGY AND DEVELOPMENT OUTCOMES IN ETHIOPIA

Development Strategy

In 2002, the Ethiopian government spelled out a four-pronged development strategy consisting of: i) continuation of Agricultural Development Led Industrialization (ADLI); ii) fiscal and administrative decentralization; iii) reform of the civil service and justice system; and iv) capacity building. The latter is a crosscutting element pertaining to enhancing skills and institutions in the agricultural sector, the civil service system, and the lower tiers of government. Thus, the development strategy currently in use involves both economic policies and the transformation of non-economic institutions.

The government's public expenditure priorities have been shaped by ADLI and the trend toward increased fiscal decentralization. ADLI, which was conceived at the inception of the current government in 1993, was formulated as a long-term strategy to bring about economic growth and poverty reduction by focusing on agriculture as the engine of growth. Within this focus on the agricultural sector, ADLI emphasizes the development and use of labor-intensive and land-augmenting technologies, the commercialization of agriculture, and the expansion of markets for agricultural products through a greater emphasis on export.

The second pillar of Ethiopia's long-term development strategy, decentralization, has affected public investment by causing the budget process to be restructured. The federal structure of the government is enshrined in the 1994 constitution, which stipulates that the regional levels of government are to hold significant autonomy in administrative, political, and fiscal affairs. Politically, the constitution provides wide executive and legislative powers to each region, and even ensures their right to secession. Fiscally, the power of revenue generation lies predominantly with the federal government, with financial transfers from the central administration to the various regions given formally as untied block grants.[5]

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[5] Untied block grants refer to intergovernmental transfers that are made without conditions on the use of these funds.

Table 1: Per capita own-source and federal transfer components of regional budgets in Ethiopia (*birr*), 1997[6]

Region	Own-source	Transfers	Total budget	Transfers as % of budget	Population share[1]
Addis Abeba	280	12	292	4%	4%
Afar	57	159	216	73%	2%
Amhara	19	46	65	72%	26%
Beneshangul-Gumuz	46	308	354	87%	1%
Dire Dawa	57	126	183	69%	1%
Gambella	264	406	670	61%	0%
Harari	139	433	572	76%	0%
Oromia	17	43	60	71%	35%
SNNP	13	19	32	60%	19%
Somale	62	163	225	72%	6%
Tigray	24	79	103	77%	6%
Average	89	163	252	66%	

Source: Own calculations using data from MOFED.
[1]Based on the 1994 Population and Housing Census; some very small figures appear as zero due to rounding.

Table 1 shows that federal grants tend to comprise a large share of a given region's total budget, ranging from 60% to 87% (except for Addis Abeba, which receives practically no federal subsidies because it has a substantially high income in comparison to the other regions, and therefore has a superior own-revenue raising capacity). From 1996 until recently, public expenditure decisions were made primarily at the regional level of government. As is apparent from Table 1, considerable regional variation could be seen in the size of the transfers, even once these were normalized by population size. Addis Abeba aside (for the abovementioned reasons), the Oromia region received by far the smallest block grants, amounting to 19 *birr* per person, whereas transfers to Harari and Gambella were over 20 times higher, at over 400 *birr* per person (see the map in the Appendix for the location of each region).

Interestingly, federal transfer allocations do not seem to have strong redistributive properties on regional budgets; the order of magnitude of difference between the largest and the smallest per capita transfer was the same as the analogous values for the total regional budgets, and the same as the spread in the own-source component of the budget. Further comparison of the size of transfers with the prevalence of poverty (see Table 2) or with average rural welfare (see Figure 1a) does not reveal any positive or negative relationship between transfers on the one hand, and poverty or welfare on the other. However, when the size of the region (in terms of population) is compared with the per capita transfers received, a pattern emerges to partially illuminate how transfers are allocated across regions. An almost perfect

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[6] Technically, Ethiopia consists of nine administrative regions and two city administrations (Dire Dawa and Addis Abeba). However, in common parlance all eleven administrative units are referred to as 'regions;' this practice is adopted in the present paper for convenience.

inverse relationship can be seen between the population size and the size of the per capita federal transfer. The larger the region, the smaller the amount of per-person budget transfer. The strictly inverse relationship is only disrupted by the two city-states of Addis Abeba and Dire Dawa.

In 2002, however, spending responsibility was shifted to the wereda (district) level[7] in the four largest regions of Ethiopia[8], which taken together comprise over 85% of the population. Mirroring the 1996 devolution of fiscal responsibility to the regions, this second round of decentralization meant that the weredas began receiving a large share of their revenue as block grants from the regions. At present, nearly half of the regional budgets are transferred to the weredas of the four largest regions.

The substantial and far-reaching decentralization policy of the Ethiopian government has necessitated a shift in the priorities of public expenditure, both through the need for capacity building at the lower tiers of government and through differences in policy priorities at the local levels. However, we are not aware of any research yet undertaken to examine the extent to which actual expenditure decision-making matches the fiscal autonomy formally given to the weredas (for a detailed study exploring the divergence between actual and formal political autonomy at the wereda level, see Pausewang 2002).

Growth, Welfare and Poverty in Ethiopia

Macroeconomic performance in Ethiopia was positive during the 1990s, when macroeconomic policies sought to control the size of the government deficit, keep inflation low and generally restore macroeconomic stability. Aside from the transition period of the early 1990s, when the inflation rate spiked to above 30%, inflation has remained within single digits. The budget deficit was maintained at between approximately 2% and 10% of GDP, and was therefore within moderate bounds, with the exception of the period of the border war with Eritrea (1998-2000), when the deficit increased to some 12-13% (IMF 2002, World Bank 2005b).

During the 1990s, growth performance in Ethiopia was moderate and highly volatile. The beginning of the decade was marked by instability after the overthrow of the Marxist dictatorship, which created a transition period during which per capita GDP growth reached a low of -11% (WDI 2005). With the end of the civil war, the establishment of a provisional government, and the restoration of political stability (1992 to 1993), GDP increased by 17%. While the mean of annual per capita GDP growth was 1.5% from 1991 to 2002, 1998 marked another reversion to negative growth. This was the first year of the

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[7] Weredas are administrative units below zones, which in turn lie below regions. There are approximately 550 weredas in Ethiopia, each having an average population size of 100,000.
[8] These regions (excluding the city administrations of Dire Dawa and Addis Abeba) are Amhara, Oromiya, SNNP (Southern Nations, Nationalities and Peoples) and Tigray.

Ethiopia-Eritrea war, which brought about large losses in agricultural production and the diversion of a substantial amount of expenditure for war purposes.

Despite modest but on average positive growth in Ethiopia over the 1990s, the country's per capita GDP in 2002 was only 8% greater than income levels 20 years earlier, reflecting the overall very weak performance of the economy during the 80s, a decade of stagnation and even decline (average annual growth was negative from 1982 to 1992). In this sense, part of the initial growth seen after the emergence of the current government reflected a recovery from the long civil war and the damaging economic policies of the preceding government.

The moderate economic growth seen in the 1990s failed to fully translate into noticeable poverty reduction. While poverty rates decreased slightly from the 1995 to 2000, with the poverty head count ratio falling from 45.5% to 44.2% over this 5-year period, this was not driven by declines in urban poverty. On the contrary, urban poverty increased markedly from 33% to 37% during this period, while the poverty incidence in rural areas fell by two percentage points (MOFED 2002). This rural-urban differential in incidence change was even more pronounced when poverty rates were measured using spatially- and temporally-specific poverty lines (World Bank 2005d). This difference may reflect the emphasis on the agricultural sector as the engine for development through ADLI, as well as other factors such as out-migration of rural poor to the towns and cities.

A regional disaggregation of poverty rates (Table 2) shows that the marginal poverty reduction over the latter half of the 1990s was derived almost exclusively from poverty reduction in the Amhara region, where the poverty rate fell by 10 percentage points.[9] For most other regions, poverty either increased or declined marginally.

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[9] The distinction between upper and lower poverty lines is derived from two different ways of calculating the poverty line, with the former using a 'poorer' reference group for calculation of the poverty compared to the latter. For more details, see World Bank (2000d), p. 16.

Table 2: Geographic distribution of poverty: headcount poverty rates across regions

Region	Lower poverty line			Upper poverty line		
	1995	**1999**	Diff. (% points)	**1995**	**1999**	Diff. (% points)
Addis Abeba	34	41	7	50	57	7
Afar	20	43	23	26	63	37
Amhara	45	36	-9	65	55	-10
Beneshangul-Gumuz	49	54	5	72	71	-1
Dire Dawa	47	49	2	65	68	3
Gambella	35	66	31	48	79	31
Harari	25	29	4	43	47	4
Oromia	28	32	4	46	52	6
SNNP	49	48	-1	67	65	-2
Somale	8	15	7	18	33	15
Tigray	45	49	4	66	69	3

Source: World Bank (2005d)

Poverty was most prevalent in the two small western regions, Beneshangul-Gumuz and (especially in 1999) Gambella, while the poverty rate in SNNP was among the highest in 1995. As discussed in Section 3.1 and below, while poverty and income measures showed the two western regions to be among the worst off, they scored very high in investments and public capital variables that reflect investments. Interestingly, the Somale region enjoyed the lowest poverty incidence by far, during both time periods and using either poverty line. Afar (in the earlier period) and Harari (in 1999) had the next lowest rates of poverty. It is also noteworthy that the two city-states, Addis Abeba and Dire Dawa, were at or below the median in terms of poverty rates by region.

In assessing average welfare, we will concentrate on rural welfare because it is the central variable of interest in our subsequent analysis of public investment impact. While on average the percentage of people in poverty moderately declined in rural areas over the second half of the 1990s, average rural welfare actually fell, as seen in Figures 1a and 1b (which reflect Table A1 in the Appendix). Overall, rural household welfare declined by 2%, driven by welfare declines in eight out of the eleven regions. Figures 1a and 1b rank the regions by their initial (1995) average per capita household welfare, with Figure 1a showing an inverse relationship between initial welfare and subsequent welfare growth in Ethiopia.

Figure 1: Per capita household expenditure by region
Figure 1a: Household expenditure levels
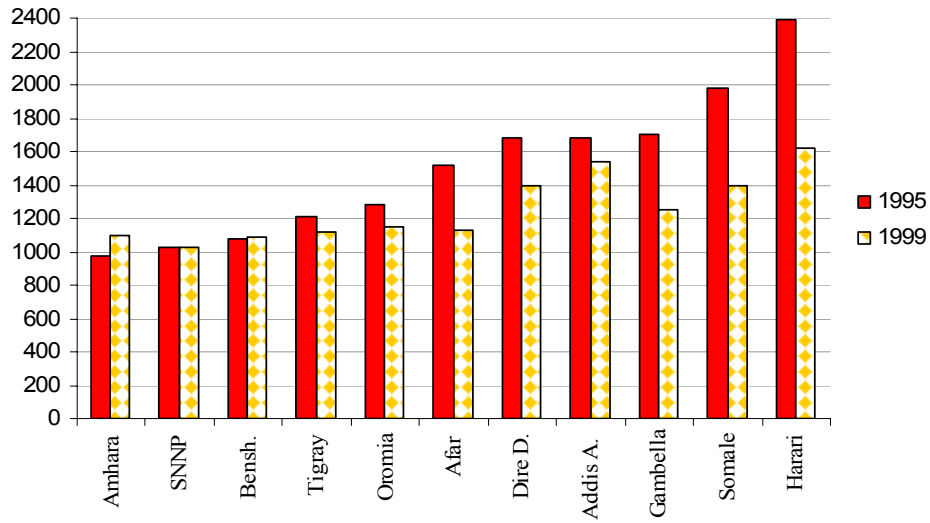
Figure 1b: Household expenditure changes from 1995 to 2000
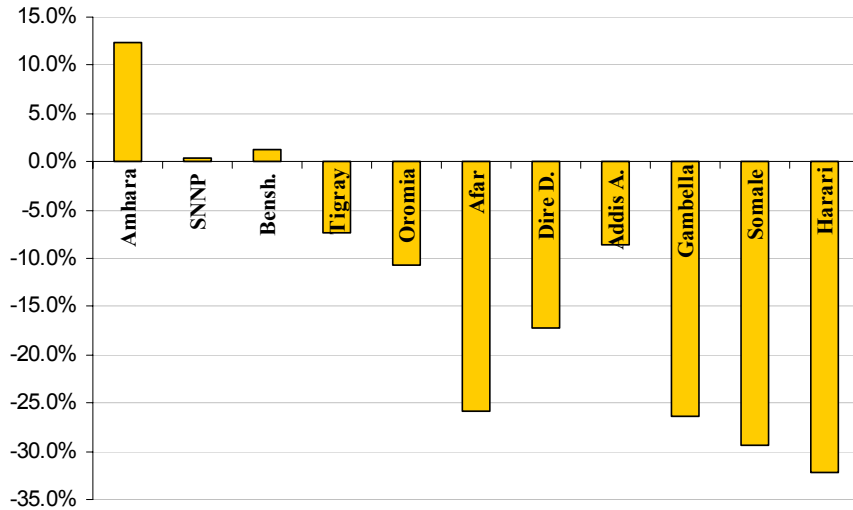
Based on the Household Income, Consumption and Expenditure (HICE) surveys. Source: CSA (2001).

Figure 2 represents a similarly disaggregated picture of household welfare, but it is based on a different nationwide survey and provides a further breakdown of mean household expenditures in the large regions, divided by groups of zones (see Table A2 in the Appendix for further details on Figure 2). The two representations of the geographic distribution of welfare found in Figures 1 and 2 are broadly consistent with each other.

Figure 2: Real per adult-equivalent household expenditure
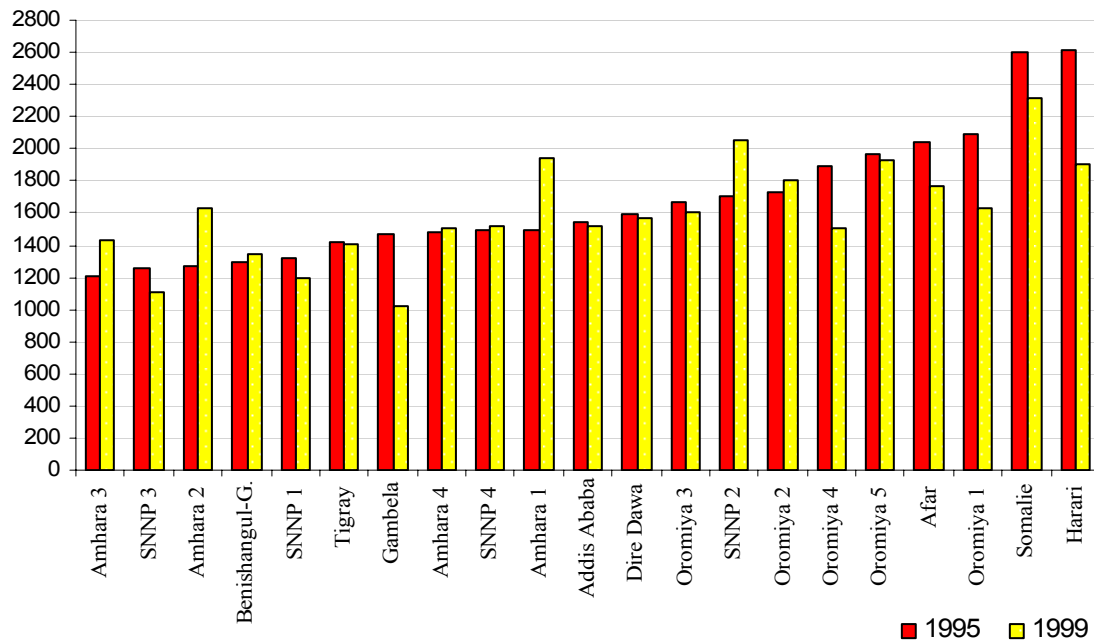
Based on the Welfare Monitoring (WM) surveys. Source: World Bank (2005d).

Thus, the geographic distribution of well being in Ethiopia (based on both poverty and mean income estimates) indicates that in the second half of the 1990s, residents of the Southern region and the two western regions, Gambella and Beneshangul-Gumuz, are the least well off. In contrast, the highest incomes and lowest poverty rates are found in the pastoralist region of Somale and the small, dominantly urban eastern region of Harari. The only notable improvement in poverty incidence and average household income during this period was achieved in the Amhara region.

4. STRATEGIES, PUBLIC SPENDING, AND PERFORMANCE IN KEY SECTORS

Multiple data sources are represented in both the descriptive and econometric analyses. The public expenditure data, drawn from the Ministry of Finance and Economic Development (MOFED), comprises annual data from fiscal year 1993/94 to 2000/01 and includes federal and regional expenditures, with the later years including expenditure data from the districts and other administrative units. These data are disaggregated by functional and economic classification. Further sector-specific data, usually disaggregated by region and available for multiple years, were obtained from the respective line ministries and are primarily contained in the following descriptive sections. The latter also include agricultural variables, such as yield, labor productivity in agriculture, etc.; these were obtained from multiple years of the CSA Agricultural Sample Survey (AgSS).

The analysis of the determinants of rural household welfare draws on an Ethiopian national household budget survey, referred to as the Household Income Consumption and Expenditure Survey (HICE), which was collected by the Central Statistical Authority (CSA) in 1999/2000. Given that we focus on rural welfare herein, only the rural household observations of the HICE are used. Part of the data on household access to public services is drawn from the CSA's Welfare Monitoring Survey of the same year. The analysis also includes data on sectoral performance drawn from a World Bank database including a range of economic, agricultural, and demographic variables at the zone level.

Public expenditure trends since the conception of the ADLI strategy in 1993 have only partially reflected the agricultural development orientation of the government's strategy. Sectors seen as important to poverty reduction (agriculture, natural resource development, health, education, road infrastructure, etc.) have absorbed a relatively steady share of total spending. In contrast, the proportion of expenditure on agriculture and natural resources, while high compared to those in most other African countries,[10] has declined moderately (see Table 3).

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[10] The various African governments recently agreed to strive toward allocating at least 10% of public spending to agriculture, as called for by NEPAD's CAADP (Comprehensive African Agriculture Development Program), but only few governments, including Ethiopia, have met this goal in one or more years over the past decade.

Table 3: Public expenditures on selected sectors (as % of total public expenditure)

	Year	Energy & Mining	Agriculture & Nat. resources	Education	Health	Transport & Communic.	Road[1]	All six sectors
	1984	6.8	15.8	9.7	3.2	2.6	2.1	40.1
	1989	4.7	12.8	9.4	3.3	1.7	1.0	32.9
	1994	3.4	13.1	13.5	5.1	2.3	9.0	46.4
	1995	4.4	12.7	15.1	5.3	2.5	7.4	47.4
Actual	1996	8.0	13.4	14.5	5.8	4.0	8.1	53.9
exp.	1997	3.7	11.3	14.0	5.9	1.9	8.6	45.5
	1998	3.1	11.2	11.6	4.3	2.5	7.0	39.8
	1999	1.8	8.3	9.5	3.3	1.9	6.2	31.1
	2000	2.8	9.4	13.4	4.0	2.7	8.4	40.8
	2001	0.4	12.4	16.4	4.8	3.0	10.6	47.5
Provisional	2002	2.8	11.3	16.6	5.1	1.5	9.6	46.9
exp.[2]	2003	2.5	15.6	20.6	4.3	1.2	9.1	53.3
	2004	0.5	21.0	19.9	4.9	2.9	10.7	59.9
	2005	1.0	21.3	21.8	4.6	4.2	11.8	64.6

Source: World Bank 2004.

[1]Only capital expenditure; however, road capital expenditure tends to make up nearly all of the road expenditures that go through the public budget (see also Table 6).

[2] 'Provisional expenditure' refers to estimates of actual expenditure in years for which the accounts were not yet closed when the data were compiled.

In addition, ADLI mandates greater investment in public goods that predominantly benefit households relying directly on agriculture, as well as goods aimed at transforming the agricultural sector from a subsistence sector to one that contributes to commercial activity and the country's export revenue. The government's expenditure policy in these sectors is discussed in more detail below.

As shown in Table 4, the decentralization of public investment responsibility has progressed further in the social sectors compared to infrastructure sectors such as energy, roads, transport and communication. The ratio of federal level expenditure to countrywide expenditure in the energy sector is as high as 97%, whereas federal expenditures in education and health comprise only 25% and 16%, respectively, of total government spending in these areas.

Table 4: Composition of total expenditure by level of government (in million *Birr* and as % of national total), 1998

	Federal government	Regional governments	National Total
Roads	598.7	461.1	1059.8
	56.5%	*43.5%*	*100.0%*
Education	429.9	1272.8	1702.7
	25.2%	*74.8%*	*100.0%*
Health	104.5	533.8	638.4
	16.4%	*83.6%*	*100.0%*
Agriculture	569.6	589.7	1159.2
	49.1%	*50.9%*	*100.0%*
Natural resource devt.	122.2	366.9	489.0
	25.0%	*75.0%*	*100.0%*
Energy & Mining	437.8	12.8	450.6
	97.2%	*2.8%*	*100.0%*
Transp. & Communication	354.4	17.3	371.6
	95.4%	*4.6%*	*100.0%*

Source: Own calculations using data from MOFED.

Energy

Ethiopia suffers from a general lack of infrastructural development, particularly in the area of energy supply. This constitutes a tremendous constraint limiting the development of agriculture and rural towns. Agricultural productivity is severely inhibited by reliance on rain-fed production in volatile climates, where irrigation facilities are nonexistent in part due to the lack of a suitable power supply. In rural towns lacking electricity, residents, shops and small-scale industries must all rely on inefficient and insufficient traditional energy technologies, limiting commercial activity, production and rural growth.

As is the case in several other Sub-Saharan African countries, the main energy sources in rural Ethiopia are biomass resources such as fuel wood and dung. The use of electricity in Ethiopia is minuscule, with only 0.7% of rural households using electricity for lighting in 1995 (Wolde-Ghiorgis 2002). This level of access to electric power is actually lower than that in many other poor countries; for example, electricity consumption per capita in 2001 was 22 kWh in Ethiopia, whereas those values for Sub-Saharan Africa as a whole, South Asia, and Least-Developed Countries[11] for the same year were 456, 331, and 89 kWh, respectively (World Bank 2005b). Other sources, including solar power and other renewables, petroleum, and natural gas, represent only a negligible share of total rural energy consumption.

Access to electric power in general, and rural electrification in particular, remains low in Ethiopia despite the fact that electricity-related expenditures have comprised around 90-95% of the energy sector

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[11] United Nations classification.

capital budget over the past decade (Wolde-Ghiorgis 2002) and public expenditure on energy is comparable to that in other important sectors such as public health. While public investment in infrastructure is an important part of the government's agriculture-led growth and poverty reduction strategy, the energy sector is not among the key priorities of this strategy. As laid out in Ethiopia's poverty reduction strategy paper (MOFED 2002), the priority sectors slated to receive escalated financing are agriculture (with an emphasis on the provision of extension services and food security), water (with a focus on rural water supply), roads (with an emphasis on construction and upgrading of trunk roads), education (primary education), and health (maternal and child health, malaria, and TB).

Road Infrastructure

Table 5a gives the road densities in km per 1000 km^2 for the 15 countries with the lowest road density values. Even though Ethiopia ranks tenth among them, the countries listing lower road densities also have vast areas of uninhabited land (e.g. the desertous countries of the Sahel zone). When road density in Ethiopia is measured as km of road per million people (Table 5b), comparison with other eastern and southern African countries reveals that the road infrastructure in Ethiopia is highly inferior to that in other poor countries in the region. With 75 km per million people, Ethiopian road infrastructure is substantially worse than that in the country with the next smallest road capital (Uganda with 120 km per million people). However, the drastic upscaling of public investment in roads since the mid 1990s has increased the total roads network in Ethiopia from about 23,500 km in 1995 to 32,000 km in 2001 (Ethiopian Roads Authority road network data). While this only constitutes a 35% increase, it is a much more rapid increase than the growth in road infrastructure seen in prior years.

Table 5: International comparison of road infrastructure

Table 5a: Countries with lowest physical road density		*Table 5b: Road density in Southern and Eastern Africa*	
Road density in km / 1000 km^2		Road density in km / million persons (1993)	
Sudan	5	Ethiopia[a]	75
Mauritania	7	Uganda	120
Niger	8	Tanzania	129
Mali	12	Malawi	277
United	13	Mozambique	277
Botswana	18	Lesotho	315
Chad	27	Kenya	334
Kazakhstan	31	Madagascar	366
Mongolia	31	Zambia	744
Ethiopia	32	Swaziland	765
Russian	32	Angola	816
Afghanistan	32	Zimbabwe	1,360
Gabon	33	South	1,433
Somalia	35	Botswana	2,022
Congo, DR	37	Namibia	2,722

Source: WDI 2005   Source: FIAS. [a]1991 data

At present, about half of Ethiopia's roads networks are made up of trunk and link roads administered by a federal roads agency called the Ethiopian Roads Authority. The remaining are the so-called rural roads, which are administered by regional agencies called Rural Roads Authorities.

Public investment and other policies regarding roads are laid out in the Road Sector Development Program (RSDP) developed by the Ethiopian Roads Authority in 1997. The RSDP outlines a long-term strategy (over a 10 year period) for developing road infrastructure. During the first phase from 1997 to 2002, road building projects were to give priority (in this order) to providing improved access to ports, as well as existing and new resource areas and food deficit areas, and to maintaining a certain degree of equity of transport infrastructure between the regions. Given these priorities, a relatively large share of capital expenditures were allocated for asphalt and gravel roads. However, the increase of unpaved roads in the latter half of the 1990s (by 34%) was much higher than the increase of paved roads (7%) over the same period (MOFED 2002).

The second phase of the RSDP, from 2003 to 2007, was designed to address the low level of road connectivity among the regions. The main roads typically radiate from Addis Abeba to the various regions, but travel between regional towns is difficult. The second phase of the RSDP also emphasized the development of the types of roads that were more likely to immediately benefit poor populations (i.e. village rural roads). Village-level associations were assigned the task of proposing and implementing

roads projects. However, institutions across all tiers of administration (villages, weredas, regions, and the federal level) are expected to be involved in the various stages of rural road development.

Public investment in roads saw a large increase as a share of spending in the agriculture, social and infrastructure sectors, beginning with the change of government in 1991. As seen in Table 3 above, this share rose from 3%-5% in the 1980s to 15%-20% of spending in these sectors during the 1990s. Indeed, the relative increase in road construction spending is unrivalled by that in any of the other social, agricultural or infrastructure sectors in Ethiopia.

Table 6 shows the geographic distribution of road spending. When the share of each region's (capital) expenditure, given as total capital spending of all regions, is compared with the population shares, it becomes evident that the capital city-state Addis Abeba and the more marginal areas of Beneshangul-Gumuz, Gambella, and (to some extent) Afar, have allocated resources to roads well beyond their population shares.

Table 6: Capital and recurrent road infrastructure expenditures for each region, in million *Birr* and as % of total regional expenditures (1998)

	Addis Abeba	Afar	Am-hara	Bene-sh.-G.	Dire Dawa	Gam-bella	Har-ari	Oromia	SNNP	So-male	Tigray	Regions total
Capital	117.9	17.7	78.3	23.5	-	13.8	0.0	98.5	48.4	24.0	20.6	442.8
%	26.6%	4.0%	17.7%	5.3%	-	3.1%	0.0%	22.2%	10.9%	5.4%	4.7%	100.0%
Recurrent	8.4	0.0	3.9	0.2	-	0.0	0.00	4.7	0.0	0.0	1.1	18.3
%	46.0%	0.0%	21.1%	1.2%	-	0.0%	0.0%	25.9%	0.0%	0.0%	5.8%	100.0%
Recurrent as % of total	6.7%	0.0%	4.7%	0.9%	-	0.0%	0.0%	4.6%	0.0%	0.0%	4.9%	4.0%
Pop. (in '000)[1]	2,570	1,243	16,748	551	330	216	166	23,023	12,903	3,797	3,797	65,344
%	3.9%	1.9%	25.6%	0.8%	0.5%	0.3%	0.3%	35.2%	19.7%	5.8%	5.8%	100.0%

Source: Own calculations using data from MOFED.

Tables 7 and 8 show road density by region, with Table 7 showing density over time and Table 8 showing these data disaggregated by road type. A comparison of Tables 7 and 8 with Table 6 shows that in the case of the road sector, the geographic distribution of sectoral performance may be broadly aligned with the expenditure distribution. Road density, measured as km of roads per 1000 people, was consistently highest in Gambella, and second-highest in either Beneshangul-Gumuz or Afar, depending on the year. However, while population-based road density was highest in the marginal regions, it was lowest (or to be precise, zero) for asphalted roads in regions such as Beneshangul-Gumuz, Gambella, and Somale. Interestingly and surprisingly, though, Table 8 shows that it was highest for Afar, possibly due to the low population density in this pastoralist region. When road density was measured in terms of area (km of roads per 1000 km^2), Addis Ababa followed by the city-state Harari had the highest density.

Table 7: Density of all-weather roads

Region	km/1000 persons					km/1000 km^2				
	1995	1996	1997	2003	2004	1995	1996	1997	2003	2004
Addis Abeba	n.a.	n.a.	n.a.	0.7	0.7	n.a.	n.a.	n.a.	3659.4	3849.7
Afar	0.7	1.0	1.0	1.5	1.6	8.7	12.6	12.7	21.3	23.7
Amhara	0.2	0.3	0.3	0.4	0.4	20.8	32.1	32.9	46.0	48.5
Beneshangul-Gumuz	0.8	0.9	0.8	2.5	3.1	8.0	8.4	8.4	29.1	36.4
Dire Dawa	n.a.	n.a.	n.a.	0.4	0.5	n.a.	n.a.	n.a.	93.6	126.8
Gambella	1.7	4.8	4.7	5.9	6.6	12.6	36.3	36.3	52.1	60.5
Harari	n.a.	n.a.	n.a.	0.4	0.7	n.a.	n.a.	n.a.	188.8	315.7
Oromia	0.4	0.5	0.5	0.4	0.4	22.5	34.4	34.4	29.8	31.0
SNNP	0.2	0.3	0.3	0.4	0.4	19.5	25.2	26.5	43.8	46.8
Somale	0.4	0.4	0.4	0.8	0.8	3.8	4.0	4.2	10.1	10.6
Tigray	0.2	0.5	0.5	0.6	0.7	12.0	29.1	30.0	44.1	51.0
Ethiopia	0.3	0.4	0.4	0.5	0.5	14.0	21.2	21.6	30.1	32.5

Source: CSA Transportation and Communications Bulletin; Ethiopian Roads Authority.

Table 8: Road density by road type (2003)

Region	km/1000 persons				km/1000 km^2			
	Asphalt Roads	Gravel Roads	Rural Roads	All roads	Asphalt Roads	Gravel Roads	Rural Roads	All roads
Addis Abeba	0.155	0.550	0.000	0.706	804.948	2854.424	0.000	3659.372
Afar	0.539	0.277	0.673	1.489	7.720	3.971	9.648	21.340
Amhara	0.049	0.112	0.230	0.391	5.739	13.208	27.010	45.957
Beneshangul-Gumuz	0.000	1.302	1.243	2.540	0.000	14.910	14.238	29.148
Dire Dawa	0.075	0.244	0.078	0.395	17.650	57.528	18.446	93.624
Gambella	0.000	2.661	3.199	5.860	0.000	23.650	28.437	52.087
Harari	0.105	0.133	0.179	0.418	47.462	60.152	81.218	188.832
Oromia	0.073	0.117	0.194	0.383	5.735	9.190	15.196	30.121
SNNP	0.031	0.153	0.245	0.428	3.600	18.090	28.913	50.603
Somale	0.000	0.292	0.523	0.815	0.000	3.632	6.511	10.143
Tigray	0.060	0.313	0.249	0.622	4.253	22.222	17.672	44.146
Ethiopia	0.065	0.184	0.255	n.a.	3.977	11.288	15.661	167.408

Source: Ethiopian Roads Authority (data on road length); Central Statistical Authority (population data); Dataset for World Bank (2005b) (data on land area).

Agriculture

As discussed above, agriculture forms the heart of the ADLI strategy and is expected to fuel economic growth and poverty reduction. Given such a focus on the agricultural sector, one would expect to see strong resource allocation toward agriculture since 1993 (when ADLI was first conceived). Indeed, despite fluctuations, real agricultural expenditure has been on an increasing trend since that time (Table 9). Through the decentralization and intensification of extension services, which is one of the key features of ADLI, expenditure on agricultural extension approximately doubled over the 1990s (although it continues to constitute a rather small share of agricultural spending). Table 9 also suggests that, over time,

allocations have shifted slightly away from natural resource and environment-related spending in favor of agriculture.

Table 9: Total national expenditure on agriculture and natural resources
(in millions, constant 1995 *birr*)

Expenditure category	1993	1994	1995	1996	1997	1998	1999	2000
Ministry of Agriculture	196.2	224.9	304.1	363.5	373.1	417.1	388.3	451.0
Ag. research	78.8	61.5	15.8	31.8	74.0	98.2	105.1	170.1
Ag. extension	10.7	9.8	18.5	16.9	23.9	26.0	22.2	19.4
Other ag. services	306.1	223.3	311.3	296.9	181.2	553.9	417.6	303.8
Seed	-	-	0.3	0.4	0.8	2.7	1.9	3.2
Fertilizer	-	-	-	0.5	0.6	0.7	0.7	9.8
Coffee and Tea Authority	60.2	63.4	24.8	19.5	5.4	7.3	33.6	27.3
Livestock	-	-	-	-	-	1.6	1.5	2.0
Co-operatives development	-	-	-	-	-	-	-	3.4
Integrated development	-	-	-	-	-	0.6	1.4	2.2
Rural infrastructure	16.7	-	-	-	44.6	57.9	-	-
Other ag. expenditure	-	-	-	-	-	-	-	3.2
Ministry of Water	69.4	109.4	61.5	61.3	55.5	57.6	65.5	93.9
Water supply	-	248.9	220.5	345.0	346.8	293.4	254.4	196.4
Other water expenditure	-	-	-	119.2	92.0	134.5	49.1	122.2
Environment	-	-	-	1.1	1.3	1.6	1.8	3.1
Biodiversity	-	-	-	-	1.2	1.5	1.6	4.2
Other nat. res. expenditure	411.8	262.1	202.7	127.5	51.7	-	-	-
Total	879.3	1,203.4	1,159.4	1,383.6	1,252.2	1,654.5	1,344.6	1,415.3
% Subnational	69.8%	63.4%	71.0%	79.5%	76.2%	58.0%	58.4%	58.1%

Source: Own calculations using data from MOFED.

Regarding the administrative sources of spending in the 1990s, i.e. the share of expenditure executed by subnational administrative units versus the federal government, the last row of Table 9 shows that regions handled the majority of expenditures in the agricultural and natural resources sector. This share has declined in recent years, even though decentralization to the regions would seem likely to have become more consolidated over time.

A regional breakdown of real per capita expenditure on agriculture over this period is presented in Table 10. For most of the regions, agricultural spending was less than 30 *birr* per capita. Some of the highest expenditures, however, took place in the relatively urbanized regions of Addis Abeba and Harari. The Gambella region spent by far the largest amount per capita in agriculture, likely reflecting the overall dramatically higher per capita public budget and federal transfers going to Gambella. While the national

figure for agricultural spending as a whole moderately increased during this period, high variation was seen at the regional level, meaning that no particular regional spending pattern is readily discernable.

Table 10: Real per capita regional expenditure on agricultural and natural resources (*Birr*)

Region	1993	1994	1995	1996	1997	1998	1999	2000
Addis Abeba	11.76	22.43	50.25	61.91	58.72	44.64	29.66	13.31
Afar	32.29	16.57	16.09	6.47	18.27	61.27	33.63	24.29
Amhara	8.25	10.40	10.40	11.27	12.12	11.96	9.10	9.69
Benesh.-Gumuz	18.87	23.90	19.84	11.29	14.66	43.24	56.86	36.78
Dire Dawa	14.42	18.32	17.52	14.16	15.26	14.91	8.39	7.86
Gambella	52.58	77.29	100.29	134.37	48.88	37.11	35.94	34.80
Harari	4.49	58.67	32.46	52.92	50.46	21.48	16.63	104.97
Oromia	10.30	14.76	12.79	20.28	14.93	12.08	10.77	15.50
SNNP	8.00	12.80	13.16	12.85	10.29	15.25	7.54	7.91
Somale	3.42	10.47	19.18	18.54	14.58	11.94	25.83	10.65
Tigray	17.67	19.04	13.80	34.80	26.91	17.18	12.98	12.91
Ethiopia	16.63	22.08	20.64	23.89	20.97	26.88	21.19	21.68

Source: Own calculations using data from MOFED.

The regional distribution of land productivity (an indicator of agricultural performance) is illustrated in Table 11. Thanks to its favorable agro-ecological conditions, Gambella had the highest yield levels by far, whereas the arid regions of Somale, Afar, Dire Dawa and Harari had the lowest yield levels.

Table 11: Yield of annual crops by region (quintals per hectare)

Region	1995	1996	1997	1998	1999	2000
Addis Abeba	14.9	12.0	13.0	10.0	10.3	12.6
Afar	7.9	13.2	7.3	n.a.	12.9	2.5
Amhara	9.8	10.2	8.9	9.5	9.4	9.5
Benesh.-Gumuz	11.1	10.5	11.4	11.3	10.7	10.2
Dire Dawa	5.9	11.6	7.4	10.5	10.0	9.2
Gambella	22.6	17.4	19.3	20.5	19.3	21.5
Harari	10.4	9.7	7.4	8.5	8.8	7.5
Oromia	13.1	13.2	12.2	11.7	12.1	12.9
SNNP	13.3	13.5	12.6	10.6	10.6	11.9
Somale	7.1	7.3	9.8	5.7	4.7	7.6
Tigray	11.0	12.3	8.9	10.8	11.1	9.8
Ethiopia	11.7	11.9	10.7	10.7	10.8	11.2

Source: calculated using data from the CSA's Agricultural Sample Surveys 1995-2000.

One could naturally expect there to be a lag period between the inception of agricultural expenditures and the point at which results might be observed in terms of agricultural performance. Even given this, however, it appears that over the 1990s, agricultural productivity had not fully responded to investments. It may therefore be necessary to perform an empirical extension of this descriptive analysis

in order to examine other indicators of agricultural performance, further dissect public services provision within the agricultural subsectors, and monitor agricultural sector performance indicators over a longer period.

Education

The rural literacy rate in Ethiopia (for the population 10 years old and above), started from a very low baseline in the early 1990s, and has since shown improvement both in levels and terms of urban-rural and gender disparities. In 1999, the rural and urban literacy rates were 22% and 70.4%, respectively (MOFED 2002), which were improved from 16% and 70% only two years earlier. The gender gap in rural literacy improved somewhat during this period, with the ratio of female to male literacy rate rising from 0.28 to 0.33. However, as of 2002, Ethiopia remained far behind other poor countries worldwide in terms of educational outcomes (see Table 12).

Table 12: Literacy rate (% of 15 years old and above)

	Male			Female			Gender gap	
	1990	2002	Increase	1990	2002	Increase	1990	2002
Ethiopia	37	49	12	20	34	14	17	15
South Asia	59	67	8	34	44	10	25	23
Sub-Saharan Africa	60	71	11	40	56	16	20	15
Low income	64	72	8	42	53	11	22	19

Source: WDI 2005.

Ethiopia has made some important progress when one considers the longer view and examines intermediate outcomes in the education sector. Over the past ten or so years, educational coverage at all levels has experienced a sustained increase. The greatest success was achieved at the primary level, where the gross enrollment ratio more than tripled from 20% in 1993 to 62% in 2001. The other levels also showed increases, with the enrollment ratio in secondary education increasing from 8% to 12%, and that in tertiary education increasing from 0.5% to 1.7% over the same period (World Bank 2005a; see also Table 13).

Table 13: Primary (grades 1-8) gross enrollment ratio

Region	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Addis Ababa	84.9	82.9	80.3	82.0	84.7	91.4	118.3[1]	128.4	135.4	142.6
Afar	8.4	8.4	8.4	8.4	7.1	9.1	11.5	12.6	13.8	14.8
Amhara	17.9	22.3	28.0	34.6	40.4	46.8	53.3	58.1	58.5	61.8
Beneshangul-Gumuz	35.4	42.8	48.6	69.9	74.9	81.8	88.5	89.1	98.4	100.5
Dire Dawa	41.0	41.6	50.7	58.9	60.0	62.4	75.7	80.2	78.6	83.2
Gambella	53.9	50.4	66.3	83.5	89.1	93.7	95.8	102.7	124.6	106.6
Harari	53.4	54.9	65.6	77.1	90.0	96.2	105.3	107.5	105.0	104.5
Oromia	21.2	26.0	30.8	39.6	45.0	51.6	57.9	62.4	66.9	72.7
SNNPR	28.8	38.4	44.4	55.7	56.8	59.8	63.8	67.5	71.8	74.2
Somale	11.6	11.6	11.6	11.6	8.0	8.3	10.6	13.1	15.1	15.1
Tigray	43.7	45.0	45.1	56.1	58.4	63.5	73.9	77.6	73.7	80.6
Ethiopia	26.2	30.1	34.7	41.8	45.8	51.0	57.4	61.6	64.4	68.4

Source: Ministry of Education.

1 The primary gross enrollment ratio is defined as the ratio between all students enrolled in primary school, and the population in the official age range for that cycle. In Ethiopia, the age range for primary schooling is 7–14 years. Thus, enrollment of students who are outside the official age bracket can lead to this ratio exceeding 100%.

Unfortunately, these improvements in coverage have been accompanied by a sustained deterioration in educational quality. The national average pupil-to-teacher ratio (PTR) increased steadily over the 1990s and into the new millennium (Table 14), with the most serious effects seen in rural areas. For example, the PTR in 1994 was 32 in rural areas and 34 in urban areas. By 2001, the PTR in rural areas had more than doubled to 73, whereas the urban ratio had grown to only 48. This has dramatically increased the burden on teachers in rural areas, making it more difficult to encourage graduates from cities and towns to take rural teaching positions.

Table 14: Primary school (grades 1-8) pupil-to-teacher ratio

Region	1992	1995	1999	2000	2001	2002	2003
Addis Ababa	49	51	46	45	38	41	39
Afar	29	23	28	29	31	29	32
Amhara	20	33	62	67	70	70	71
Beneshangul-Gumuz	18	38	50	50	52	49	51
Dire Dawa	33	38	43	44	41	40	41
Gambella	22	35	35	36	38	39	48
Harari	26	36	26	23	24	27	24
Oromia	21	32	53	60	66	68	72
SNNPR	28	51	61	63	66	67	67
Somale	13	21	37	35	44	52	52
Tigray	51	47	62	67	69	59	55
Ethiopia	27	38	56	60	63	64	65

Source: Ministry of Education.

In 1994, the government of Ethiopia adopted the New Education and Training Policy. This policy sought to change the existing structure of the education system, which was modeled after western

education systems and was perceived by the government as being inappropriate for the realities of Ethiopia. The new system defined primary education as grades 1 through 8, thus putting pressure on school capacities in the higher secondary grades (standardized testing was not administered prior to grade 8). This prompted the government to drastically increase enrollment barriers into the 11th grade, effective as of the 2001/02 school year. The 1994 reform also placed a new emphasis on the expansion of technical and vocational education and training (TVET), and required the use of local languages for primary instruction.

The policy focus on TVET translated into a substantial increase of public spending for this subsector relative to overall education spending. While recurrent education expenditures increased by 78% from 1993 to 2001, TVET expenditures increased more than 12-fold, or by 1120% (World Bank 2005a). Recurrent expenditures for higher education also increased disproportionately to the overall rise in spending, more than tripling during this period. While primary level spending constituted the largest share in education expenditure, it grew more slowly than overall expenditure, increasing by only 40% from 1993 to 2001. Possibly to rectify this imbalance, the government's 2002 poverty reduction strategy stated that improvement of access to primary education would be the top priority within the education sector.

Health

Although Ethiopia has shown modest and gradual improvements on a range of health indicators, these indicators remain at very low levels overall. Child mortality has improved from 269 per 1000 live births in 1960, to 204 in 1990, to 170 in 2002. However, in order for Ethiopia to meet the Millennium Development Goals for health this figure must be halved over the next decade (World Bank 2004). Immunization rates have been subject to large swings over the past few decades, with downswings often coinciding with periods of unrest and war. As of 2002, the immunization rate was slightly above 50%, making it one of the lowest rates even among very poor countries (see Table 15). Maternal mortality in Ethiopia is also among the worst in the world, at about 500-700 per 1000 births (World Bank 2004). Furthermore, only about a quarter of the rural population has access to any modern health services at all (Russel and Abdella 2002).

Table 15: Immunization and child mortality rates in 2002: Ethiopia and select African countries

		Immunization (% 1-2 yrs)		Mortality rate (per 1,000 live births)	
	GDP p.c.	DPT	Measles	Infant	Under-5
Ethiopia	124	56	52	114	171
Malawi	157	64	69	113	182
Sierra Leone	165	50	60	165	284
Tanzania	207	89	89	104	165
Chad	232	40	55	117	200
Ghana	429	80	81	60	97

Source: WDI 2005.

Wartime destruction was associated with the outbreak of epidemics and the lowest level of health services coverage in 30 years (Kloos 1998). Upon taking power in 1991, the transitional government set the rehabilitation of war-damaged hospitals and clinics as a major health priority. Beyond post-war priorities, the health sector of the new government formulated directions that departed markedly from the previous regime, most notably by emphasizing private participation and granting more authority to local governments. Specifically, the 1993 Ethiopian Health Policy laid out key elements of sectoral reform, including the strengthening of primary health care, a new focus on cost recovery mechanisms, decentralization of delivery, and encouraging greater participation of the private sector and NGOs in the provision of health care (Russell and Abdella 2002). Some of these principles were later compromised, such as when the Ministry of Health closed private clinics in Addis Abeba in 1996 (see Kloos 1998).

Table 16: Potential health service coverage (%)

Region	Includes health centers and health stations					Includes health centers, health stations, health posts, and private clinics		
	1999	2000	2001	2002	2003	2001	2002	2003
Addis Abeba	36.66	93.39	79.37	80.00	72.55	152.49	150.64	155.44
Afar	57.16	52.70	55.03	49.96	50.75	75.08	72.25	74.06
Amhara	42.37	43.50	42.55	40.21	15.85	59.72	56.85	51.76
Benesh.-Gumuz	166.79	86.21	161.95	159.48	148.15	206.19	200.86	207.07
Dire Dawa	72.44	51.52	86.26	54.62	68.92	140.35	103.64	127.03
Gambella	229.52	87.96	238.74	166.67	136.75	299.55	274.12	226.50
Harari	137.30	114.46	145.35	134.83	129.73	197.67	205.06	200.00
Oromia	53.17	46.91	52.29	51.47	52.22	66.61	68.03	70.78
SNNP	49.58	55.06	48.30	48.66	47.18	66.69	65.47	81.08
Somale	35.96	30.55	35.27	40.98	31.76	46.05	47.98	43.81
Tigray	65.91	66.24	64.60	67.52	63.46	81.65	86.12	87.04
Ethiopia	50.71	51.24	51.80	50.97	43.63	70.74	70.22	73.16

Source: Ministry of Health.

PHSC is defined in the Ethiopian context as the share of the population that had access to health facilities 10 km away or less (World Bank 2005c). May exceed 100%.

Table 17: Average distance to the nearest health center (in km)

	Rural		Total	
	Mean	Std. dev.	Mean	Std. dev.
Addis Ababa	6.47	5.13	2.07	3.35
Afar	18.09	23.20	9.57	18.59
Amhara	8.63	7.62	5.09	6.77
Benesh.-Gumuz	10.56	12.21	6.58	10.51
Dire Dawa	3.99	3.57	2.52	2.86
Gambella	8.33	9.58	4.91	7.98
Harari	4.05	3.05	2.46	2.79
Oromia	8.59	7.42	5.24	6.63
SNNPR	6.89	6.69	5.33	6.41
Somale	9.71	12.94	5.65	11.74
Tigray	7.88	5.89	4.65	5.15
Total	8.30	9.33	4.93	7.81

Source: Own calculations, Welfare Monitoring Survey 2000, CSA.

Access to health services, as measured by the potential health coverage (see Table 16), did not markedly improve from 1999 to 2003 in the strict context of access to health stations/centers. In fact, there was a significant decline in access to such health facilities from 2002 to 2003. This, however, may simply reflect the government's overall effort to downgrade many health stations to 'health posts' offering predominantly preventative services. As illustrated in Table 16 (right side), access to health services from a broader array of health facilities showed more of an increase during this period. While a regional distribution of potential health service coverage was not available prior to 1999, the MoH (1999) reported that nationwide PHSC by health stations/centers was 38% in 1992, 48.5% in 1996, and 51% in 1997. This suggests that coverage by health stations/centers increased rapidly in the first half of the 1990s and then stagnated and even declined slightly thereafter. Some of this decline was ameliorated by increased coverage by private clinics (World Bank 2004). One thing that is striking about the distribution in health coverage over this period is the relatively high coverage in regions often deemed marginal by various indexes of development. For example, Beneshangul-Gumuz and Gambella showed the highest coverage rates. This may reflect the strong policy focus on equalizing public services between regions. However, Table 17 indicates that the intensity of coverage was below average in these regions, implying that among those populations who fell into a given coverage area, people in regions like Beneshangul-Gumuz and Gambella were still more remote to health facilities compared to individuals in most other regions.

Since 1997, Ethiopian health sector policy has been guided by the Health Sector Development Program (HSDP).[12] This program, which was intended to steer health sector policy for the short and

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[12] The Sector Development Programs, which have been launched for the road, health, education, and some other sectors, have been motivated by a need to harmonize donor activities in these sectors, with the aim of using aid money more effectively. The aid

medium term, reaffirmed the previous focus on improving the accessibility and quality of primary health care and to increase the health budget share of total government spending. Indeed, in 2001 per GDP government expenditure on health in Ethiopia exceeded the average in South Asia and several other low income countries. However, per GDP government expenditure on health in Ethiopia fell below the Sub-Saharan African average, and public and private expenditure on health comprised a smaller share of GDP than in any of the other developing country groups (Table 18). This underscores the relatively large role that public financing plays in Ethiopia's health sector financing. In absolute terms, spending on health per person in Ethiopia falls very short of expenditures in Africa, South Asia, and the group of low-income countries. Health expenditures are $3 per head per annum in Ethiopia, which is between one-seventh and one-tenth of comparable expenditures in other low-income economies.

Table 18: Health expenditure in Ethiopia and other low-income country groups, 2001

	Expenditure as % of GDP		Public as % of total expenditure	Expenditure per capita ($)
	Total	Public		
Ethiopia	4	1	41	3
South Asia	5	1	22	22
Low income	4	1	26	23
Sub-Saharan Africa	6	3	41	29

Source: WDI 2005.

In the implementation of Ethiopia's decentralization policy, the devolution of resource allocation responsibility to the lower tiers of government was most extensive for the social sectors, including health. Accordingly, the regions accounted for over 87% of government recurrent expenditure and nearly all (99%) of capital expenditure in 2001. With the deepening of decentralization beginning in 2002, part of the regional health budgets were passed down to the weredas. As seen in the decentralization of spending responsibility in other sectors, some problems were associated with the devolution. For example, the weredas were not fully capable of maintaining facilities, did not have adequate staffing (despite the continued deployment of health personnel from the regions), and faced challenges in coordinating with other weredas for services and drug distribution activities spanning a wider geographic space.

In the following sections, we will build on this descriptive overview, expanding the inquiry to examine how public expenditure in key sectors may have differentially affected the welfare of rural households. The next section will set the stage by providing the conceptual context of how public spending may contribute to rural household incomes by affecting the productivity of household private

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agencies, especially the World Bank, have tended to place less emphasis on project financing in a move toward programmatic lending. Thus, Ethiopia's SDPs have been designed in collaboration and with the support of several donors.

assets. We will also discuss the possibility of expenditure policy itself being influenced by sector-specific levels of development, and what this implies for econometric identification in the analysis.

5. PUBLIC SPENDING, PUBLIC SERVICES, AND PRIVATE ASSETS

Access to public services can have both direct and indirect effects on household welfare. The direct effects include improvements in well being that are usually not captured by monetary measures of welfare such as the value of household expenditure or income. Ferroni and Kanbur (1992) incorporated non-monetary measures in designing a framework for poverty-oriented public expenditure allocation. For example, improved sanitation arising from public subsidies for the construction of household latrines directly benefits individuals through the inherent desirability of improved hygiene, while public provision of unconditional safety net transfers directly boosts household income.

Most public services, however, indirectly improve household welfare by affecting the returns to, or the productivity of, the household's private assets. For example, public investment in irrigation infrastructure improves the welfare of agricultural households by increasing the income contribution of their agricultural assets (e.g. cultivable land). Naturally, the provision of public services may have both direct and indirect impacts on well being; in the example of access to better sanitation given above, latrine subsidies offer the inherent (non-monetary) benefits of improved latrines, while health improvements arising from these public investments may make household members more productive. In this sense, sanitation investments indirectly affect welfare by increasing the returns to the household's labor assets. Similar mixed effects are typically seen in response to better access to education. However, in the present work we will primarily focus on the indirect effects of public services on household welfare.

In the above discussion, we explored how access to different types of public services may affect household well being. However, in order for households to benefit from services and infrastructure, resources must first be committed to providing these public services and building the necessary infrastructures. When assessing how public expenditure results in public capital, several issues affecting the transformation of financial resources into services and infrastructure must be considered.

First, there is typically a lag between the public expenses incurred in a sector, and the time when a response can be observed. The length of this lag may differ depending on the type of sector-specific service indicator. For example, substantial resource investment in road construction in a given region might be expected to affect a measure of road capital – road density – within one or two years of the investment. In contrast, education spending in a given region will not show an improvement in the literacy rate until several years later, because children educated today will figure into the literacy rate figure only after they become adults. The lag period will also differ for public spending within a given sector, depending on the sectoral variable. For example, education spending is expected to affect the enrollment ratio and/or school density much sooner than the literacy rate.

Second, the complementarity, mutual dependence, and sometimes negative externalities (as in Ersado et al. 2004) between investments across different sectors will also affect assessment of the returns to public investment. This interaction across various forms of public expenditure may occur in multiple ways. At the expenditure policy or budget process level, the decision to spend more in a given sector implies a reduction in resources for another sector. However, resources allocated to one sector may also immediately benefit outcomes in other sectors. For example, public investment in energy aimed at increasing town electrification may reduce the use of environmentally harmful in-house dung-burning practices, thus directly increasing health outcomes, especially for female household members. Such interrelated effects are more appropriately analyzed by assessing (for example) the effects of electricity connectivity on health, rather than the effects of electricity expenditure on health, particularly if the within-sector effects of spending are already accounted for.

6. EMPIRICAL STRATEGY

This paper explores the relative returns of different types of public investment to rural welfare in Ethiopia. Based on the conceptual frame discussed above, we designed the analysis to comprise three stages. In the first stage, we assess the role of access to public services in rural household welfare, incorporating the way in which public services affect the productivity of households' private assets. In the second stage, we determine the extent to which public expenditures translate to improved access to public services. In the final stage, we draw on the results of the prior two stages to show how public expenditure impacts rural household welfare.

Public Services and Private Assets

In the first stage, a household consumption equation specifies the effects of access to a range of public services (*PS*), which are allowed to operate directly (superscripted *d*) and indirectly (superscripted *A*) to potentially enhance the productivity of private assets. *X* constitutes the vector of control variables, which include a range of household and household head characteristics.

$$\ln(c_{ij}) = \alpha + \beta' X_{ij} + \phi_j^{d'} PS_{ij}^d + \phi_j^{A'} A_{ij} PS_{ij}^A + \varepsilon_{ij}$$

The dependent variable is the natural log of per-adult-equivalent household expenditure. This specification permits differentiation of the effects of public service access by region, agroecological zone, etc. The subscript *j*, which also pertains to the coefficient of interest ϕ, refers to a geographical or administrative unit. Expanding the equation to make this explicit, we have:

$$\ln(c_{ij}) = \alpha + \beta' X_{ij} + \sum_{j=1}^{J} \phi_j^{d'} D_j PS_{ij}^d + \sum_{j=1}^{J} \phi_j^{A'} D_j A_{ij} PS_{ij}^A + \varepsilon_{ij} \quad (1)$$

where D_j is a dummy equal to 1 if the household *i* is in location *j*. Note that the public service and private asset terms are still vectors because we are assessing the impact of multiple types of public service. The parameters of interest are thus obtained as:

$$\phi_j^* \equiv \partial \ln(c_{ij}) / \partial PS_{ij} = \phi_j^A \overline{A}_j$$

for the public services for which only indirect effects are assessed, where $\overline{A}_j$ is the mean of the measure of private assets, and:

$$\phi_j^* \equiv \partial \ln(c_{ij}) / \partial PS_{ij} = \phi_j^A \overline{A}_j + \phi_j^d$$

where both direct and indirect effects are captured.

Public Services and Public Spending

The second stage estimates the effects of public expenditure on services and infrastructure in selected sectors likely to be relevant to the poor. Some of the challenges faced when seeking to capture the impact of policy interventions, especially expenditure policy, were discussed in Section 5. In addition, public expenditure is a flow measure. In order to use such a measure to identify the effect on sectoral performance at some particular point in time, the utilized approach must account for the effect of public investments over time, especially in cases where the results may be expected to show a lag.

Several alternative approaches have been used to determine public expenditure impact. Below, we will briefly discuss each, drawing on selected previous studies to provide a context for the empirical strategy used in this paper. Given the concrete interest in discussing the merits of certain methodological questions that may inform the econometric specification (e.g. how the flow nature of public spending is handled, and how to account for the possible time lag in results) we will focus on studies that explicitly draw on public spending data, as opposed to studies that infer public investment effects from public capital returns.

In the specific context of Ethiopia, Collier et al. (2002) used public expenditure data at the national level to compute the unit costs of increasing the quantity and quality of health care, and then conducted simulations using these unit costs. The unit cost approach, while illustrative, fails to account for non-expenditure factors that may affect health capital variables, as well as the potential lag between intervention and outcome. However, limitations to expenditure data may necessitate this approach, which was also used in Fan, Zhang and Rao (2004) and Fan et al. (2005).

Similar to other CGE studies, Agenor et al. (2004) embedded the expenditure variables in a macroeconomic general equilibrium model in which public spending affects total demand, government budget balance, and taxes, and is affected by the size of each revenue source, etc. The general equilibrium approach has the advantage of assessing multiple pathways from spending to growth and poverty in an aggregate-macroeconomic framework. However, it is not clear whether the model, which depends on time

series data, accounts for the lag with which spending can be expected to affect growth via the variables in the model.

Gomanee et al. (2003) performed quantile regressions on cross-country panel data, in which the effect of social sector expenditure on the Human Development Index[13] was introduced contemporaneously. In other words, a given country's HDI of period t is regressed on expenditure in period t, along with other control variables. Unlike the unit cost approach, regression estimation allows control of non-expenditure influences on the outcome of interest. However, this strategy also fails to account for the possibility of lagged effects.

In contrast, Devarajan et al. (1996) attempted to account for the potential time interval from the onset of public resource spending until the realization of economic performance. In this strategy using a cross-country panel, a 5-year moving average of GDP growth (i.e. from time $t+1$ to $t+5$) is the dependent variable on which public expenditure at time t is hypothesized to have an influence, and the relationship is assessed using various reduced-form estimation methods. This structure is intended to account for investment lags, and should mitigate potential simultaneity arising from the fact that public policy is usually driven by economic performance indicators such as growth.

An alternative approach that explicitly accounts for the flow nature of public expenditure and the potential effects of past spending on current outcomes is akin to a distributed lag model:

$$PS_{j\tilde{t}}^{s} = \alpha + \sum_{q=0}^{\tilde{t}} \beta_q I_{j,\tilde{t}-q}^{s} + \gamma Z_j + u_j \quad (2)$$

where $I_{j,t-q}^{s}$ refers to public investment in sector s and region j undertaken at time t-q. This strategy includes investments made in each of the t time periods, and allows differentiation of the effects of spending in each year preceding the time period during which the sector-specific outcome variable is measured.

One challenge to this approach is the potentially high temporal correlation of investments in a given sector and region. In particular, sectors having a high component of recurrent expenditure (e.g. health and education) tend to be relatively stable over time; thus, for example, $I_{j,t}^{edu}$ and $I_{j,s}^{edu}$ would be highly correlated, tending to wash out the significance of the investment effects. In addition, there may be

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[13] The Human Development Index (HDI) is published every year in the Human Development Report by the United Nations Development Program (UNDP). The HDI is a broader definition of wellbeing that goes beyond GDP and provides a composite measure of three dimensions of human development: living a long and healthy life (measured by life expectancy), being educated (measured by adult literacy and enrollment rates), and having a decent standard of living (measured by purchasing-power parity income).

multiple ways to extract the parameter of interest from model (2). The question of interest here is: how much would a marginal increase in public investment in sector s affect performance in this sector? The implied policy change is thus not a one-time increase (for example, an increase in $I_{j,t}^{edu}$ at some point in time t), but rather one that is sustained through time. This issue will be explicitly addressed in the empirical framework used in this paper, which is detailed further below.

In a simultaneous equations model, Fan et al. (2000) and Fan et al. (2002) used a specification in the expenditure equations that allowed for lagged effects. On the issue of accounting for lags, these two studies differed methodologically from Devarajan et al. (1996) in two important ways. Firstly, Devarajan et al. implicitly sought to capture lagged effects by assessing the impact of current expenditure on subsequent (average annual) growth over five years. This strategy does not permit parameterization of the individual effects of spending at different time intervals (e.g. the effect of current spending vs. the effect of spending t years ago). Secondly, in Fan et al. (2000) and (2002), the lag length is not assumed to be fixed across all types of spending, but instead the appropriate lag structure is determined empirically using the adjusted-R^2 criterion. The potential collinearity among the lagged expenditures is addressed by constraining the parameters into a polynomial distributed lag structure (Davidson and MacKinnon 1993).

The approach we employ here uses as its point of departure the standard capital formation equation:

$$K_{jt}^s = K_{j,t-1}^s (1-\delta) + I_{jt}^s$$

with initial capital modeled following Kohli (1982) as:

$$K_{j0}^s = I_{j0}^s /(r+\delta) ,$$

where δ is the rate of depreciation and r is the rate of interest. Expanding the equation to express capital at time t as a function of investment only, gives:

$$K_{jt}^s = \sum_{q=1}^{t} I_{jq}^s (1-\delta)^{t-q} + I_0 /(\delta+r) .$$

Applying this capital formation equation to the public investment context, K_{jt}^s can be interpreted as 'accumulated public investment'. Thus, our approach assesses the effect of accumulated public investment in sector s and location j on sectoral outcomes in s and j:

$$PS_j^s = \alpha^s + \beta^s K_{jt}^s + \gamma^s Z_j + u_j. \qquad (3)$$

The marginal impact of interest is β^s. Unlike the prior approaches used in Fan et al. (2000) and (2002), estimating the impact of accumulated public investment on public services using our strategy does not generate separate estimates for expenditure effects in different years. However, one can derive time-differentiated effects from the estimated coefficients and parameters. For example, a one unit increase in K_{jt}^s corresponds to a $[1/(1-\delta)^q]$ unit increase in investment in s and j at time $t-q$. Therefore, the implied impact of an increase in public spending at time $t-q$ is $\beta^s/(1-\delta)^q$ (which, for example, would equal β^s for contemporaneous investment).

The S equations (equal to the number of sectors analyzed) are appropriately estimated in a systems framework. Firstly, it is likely that shocks that affect the general local economy in location j and also affect the random variations in performance or services in sector s may also affect unaccounted-for variation in the services of another sector s'. Secondly, we want to allow for cross-sectoral synergies, i.e. the possibility that outcomes in one sector may affect those in another sector.

Regardless of the approach used to model the impact of expenditure, the decision to invest public resources in a given activity will be influenced by the state of affairs in the target sector. If the health sector is better developed in one region compared to other regions, spending may be affected in two ways: i) strong equity focus in expenditure policy would imply the tendency to spend less per capita on health in that region compared to other regions, or ii) a higher density of health facilities and medical staff in the region will generate a greater need for complementary health resources (e.g. medical supplies) compared to locations with fewer facilities per capita. Thus, an expenditure policy based on resource needs would imply greater resource allocation to the developed region (in the case of this example, this would apply to expenditures complementary to facilities, rather than capital expenditure on the health centers themselves).

Furthermore, a sectoral expenditure policy primarily concerned with efficiency may lead to greater investments in a sector where performance indicators are already high. For example, areas with higher agricultural potential (due to agroecological conditions, existing high capital base, institutional structures, etc.) may also be areas in which public investment in modern inputs will generate higher returns in terms of agricultural productivity. Even if these areas are less poor than low-potential regions, a sectoral strategy driven by efficiency at the sector level, and spending decisions that are strongly aligned with sectoral strategies, would allocate relatively greater public resources in the agricultural sector to these better performing areas.

In addition to the question of whether a given region has an equity- or efficiency-oriented policy, sectoral development may determine sectoral public investment in other (more indirect) ways, suggesting that the direction of this influence is ambiguous. Naturally, the size of public expenditure in a given sector depends not only on sectoral policy, but also on the overall size of the public budget for that region. A given region receives a substantial share of its budget from federal transfers, or block grants (Table 1). Given the federal structure seen in Ethiopia, the sizes of the block grants from the federal government to the various regions are determined to some extent by the government's goal of reducing the inequality among regions. Hence, as shown in Table 1, the per capita transfers from the federal government to Beneshangul-Gumuz, a rather underdeveloped region, comprised 87% of the region's total budget in 1997, whereas those to Addis Abeba only comprised 4% of that region's budget. However, the simple correlation in per capita funds between non-federal, region-specific sources (regionally collected taxes, etc.) and federal grants was -0.70 during this period (Table 1), suggesting that the equity focus of federal fiscal policy is manifested in the actual transfers made.

However, other forces pull the relationship between regional sectoral development and sectoral spending in the other direction. In particular, the second major component of a given region's budget is its own revenue-raising capacity. Better-developed regions are generally better equipped to generate their own revenue through taxes, user fees, etc. This source of input to the regional budget therefore tends to be higher in regions with higher sectoral performance indicators. Through this link between regional development and the region's own revenue raising capacity, higher sectoral development tends to contribute to more public resources, in turn leading to higher levels of public expenditure in any given sector (given that all other factors, including federal transfers, remain constant).

In sum, to the extent that there is potential simultaneity in estimating the impact of sector-specific public investment on sectoral performance variables, the direction of the potential ensuing bias cannot be conclusively determined. However, the possible downward bias in the estimate of the effect of spending on sectoral outcomes arising from equity-oriented policies is likely to be limited given that: i) federal transfers represent a large proportion of many regional budgets and these transfers tend to be higher when the region's own revenue raising capacity is lower; ii) the overall size of the budget seems to be a significant factor in the size of sectoral investment; and iii) most importantly, regional sectoral investment decisions are made regionally, not centrally. Therefore, the impact of the variation in a region's total public budget may wash out the possibility that higher development in one sector could result in lower resource commitment to that sector.

Nevertheless, we cannot be certain that the various possible divergent effects of sectoral development on spending will cancel each other out. Thus, in order to acknowledge the role of the overall regional budget envelope in determining the size of sectoral spending, we instrument the accumulated

public investment variable with the size of expenditure on public administration for each region. This expenditure item is not associated with the capital, recurrent, overhead, etc. of any particular sector. Rather, it includes spending on the regional council, the regional finance bureau, the regional court system, etc., i.e. expenditure items that are not expected to directly impact performance measures in road infrastructure, health, education and others, but are expected to be correlated with the amount of spending in the sectors of interest.

It is highly likely that the sector-specific performance indicators may be all affected by shocks to the economy that are not captured in the equations, creating correlation of the error terms across equations. Thus, the latter are estimated as a system in order to capture the efficiency gains of system estimation in the context of cross-equation error correlation. These instruments were collectively employed in a System-2SLS framework.

Linking Public Spending with Household Welfare

In the third stage of analysis, we use the results of the first two stages to compare the effects of an increase in per capita public expenditure in various sectors on household well being, as measured by household consumption. For most sectors, these effects are differentiated by region. Using the results from the first two stages gives us:

$$\eta_j^s \equiv \partial \ln(c_{ij}) / \partial K_{jt}^s = \phi_j^{s*} \cdot \beta^s \quad (4)$$

i.e. the effect of interest for sector s and region j.

The standard errors of the welfare effect of spending are obtained using the delta method (Oehlert 1992). We let $h(\hat{\gamma})$ be an m-dimensional (linear or nonlinear) function of the parameter estimator vector $\hat{\gamma}$, i.e. $h(\hat{\gamma}) = [h_1(\hat{\gamma}),...,h_M(\hat{\gamma})]$, with the 1 x K parameter vector $\hat{\gamma}$ consisting of estimators from the 1st stage and 2nd stage regressions, i.e. $\hat{\gamma} = [\hat{\beta}'\ \hat{\phi}']'$. The variance-covariance matrix of this function of parameters can be estimated using the delta method:

$$\hat{var}_\Delta(h(\hat{\gamma})) = H \cdot \hat{var}(\hat{\gamma}) \cdot H'$$

(with the Δ subscript referring to the delta method approach). *H* is an *M* x *K* matrix defined as

$$H_{mk} = \left.\frac{\partial h_m(\hat{\gamma})}{\partial \hat{\gamma}_k}\right|_{\gamma=\hat{\gamma}} \; ; k = 1, \ldots, K; \; m = 1, \ldots, M$$

and $\text{vâr}(\hat{\gamma})$ is a simultaneous robust covariance matrix on the estimator vector (which, as mentioned above, is comprised of parameters from the two different models).

In the case of our model, the function $h(\hat{\gamma})$ takes on the simple nonlinear form of equation (4), i.e. $h_m(\hat{\gamma}) = \hat{\phi}_m \cdot \hat{\beta}_m$, and $M = K/2$, which is also the number of parameters from each regression involved in a nonlinear function. Hence, we can simplify the expression for the standard errors of the multiplicative function to:

$$\sqrt{diag\left[\text{vâr}_{\Delta m}(h(\hat{\gamma}))\right]} = \sqrt{\text{vâr}(\hat{\phi}_m)\hat{\beta}_m{}^2 + \text{vâr}(\hat{\beta}_m)\hat{\phi}_m{}^2} \; .$$

7. ESTIMATION

Table 19 provides descriptive statistics on the variables included in the first-stage regression (also see the tables in Section 4), and Table 20 gives the estimation results from the first stage. Indicators of performance (access to services) are included for the four sectors seen as being important for welfare enhancement in rural areas, namely road infrastructure, health, agriculture, and education.

Table 19: Descriptive statistics for Ethiopia's rural population[1]

Variable	Mean	Standard deviation
Log of per adult-equivalent household expenditure	7.23	0.48
Households with male head (share)	0.77	0.42
Age of head	43.66	14.97
Household size in adult-equivalents	3.43	1.35
Number of female workers[2]	1.13	0.70
Number of male workers[2]	1.03	0.80
Labor assets (number of working-age household members)[1]	2.57	1.40
Years household has lived in current house	9.00	10.10
Education of household head	1.37	0.97
Occupation solely in agriculture (share)	0.79	0.41
Agricultural assets index[3]	3.79	1.79

[1] Mean and standard deviations pertain to rural households only.

[2] 'Working age' is defined as 14-50 years old.

[3] Agricultural assets index includes the number of livestock weighted by Tropical Livestock Units (TLUs), as well as ownership of land, sickle(s), plough(s), sprayer(s), yoke(s), tractor(s), and other agricultural capital equipment.

Table 20a presents the 'short' model, in which the sector performance variables are introduced directly, and their impact is not geographically differentiated, although region effects are included. In Table 20b, access to education (proxied by the primary school enrollment rate) and access to health (measured by the distance to the nearest health facility) is interacted with the household's labor assets, given that better access to educational services is expected to increase labor productivity. This model is based on the hypothesis that higher average performance in agriculture and better access to roads will improve the contribution of farmers' agricultural assets to their welfare.

Ideally, we would capture the effect of access to services and infrastructure on the full set of rural household-related productive private assets. However, the utilized survey data included only information on agricultural assets, consumer durables, and "hybrid" assets having both functions. Therefore, our analysis traces the indirect effects for predominantly farming households, and more general effects for rural households in which farming does not constitute the dominant economic activity. Thus, equation (1), which was expressed in general vector form, becomes (in scalar form):

$$\ln(c_{ij}) = \alpha + \beta' X_{ij} + \sum_{j=1}^{J} D_j PS_{ij}^{ag} \left(\gamma_j^A A_{ij} D_{ij}^f + \gamma_j^d D_{ij}^{nf} \right) + \sum_{j=1}^{J} D_j PS_{ij}^{rd} \left(\delta_j^A A_{ij} D_{ij}^f + \delta_j^d D_{ij}^{nf} \right)$$

$$+ \sum_{j=1}^{J} \phi_j^A D_j PS_{ij}^{ed} A_{ij}^l + \sum_{j=1}^{J} \lambda_j^A D_j PS_{ij}^{hl} A_{ij}^l + \varepsilon_{ij} \qquad (1')$$

where the superscripts *ag*, *rd*, *ed*, and *hl* refer to the four sectors of agriculture, road, education and health, respectively; the superscripts *f* and *nf* refer to a predominant occupation in farming and non-farming, respectively; the superscripts *ag* and *l* signify agricultural and labor private assets, respectively; the superscripts *A* and *d* still serve to emphasize which coefficients capture indirect (*A*) and direct effects; and, D_j remains a dummy variable for region *j*.

The results for the short model (Table 20a), show that after region effects are controlled for, rural households in areas with better road infrastructure, education access, and agricultural productivity have higher consumption levels. The evidence on the contribution of access to health services is somewhat weaker when only average and direct effects are considered. The regional effects include all regions but the three 'city-states' of Dire-Dawa, Addis Abeba, and Harari, which are predominantly urban. Predictably, living in nearly any of the rural regions is associated with lower welfare compared to residence in one of the three city-states.

The results of the full first-stage estimation (Table 20b) are presented in two rows to allow for compact presentation. These results primarily serve as an input to the third stage analysis, and are therefore interpreted mainly as part of our discussion of the third stage. However, a few interesting observations can be made at this stage.

A strong inter-region variation is seen in the effects of road access. Interestingly, this effect is strong and significant in two neighboring regions, Afar and Amhara. These regions are agroecologically quite different, with Afar being a predominantly pastoralist region and Amhara consisting of mostly sedentary and partly agropastoralist households. The impact of road density is also positive and significant in Gambella. As noted earlier (Tables 7 and 8), Gambella and Afar have relatively high road densities, even though they are often referred to as backward regions. Amhara's road density is medium to high compared to that in other regions.

In the Southern region, however, the negative sign and significance of the road effect is surprising, albeit relatively small in magnitude. This suggests an interesting analog between the results for this region and those for the above-described regions, which were found to have high welfare returns to access to roads. As shown in Table 7, SNNP had the poorest access to roads in all the years for which data is available, suggesting that access to all-weather roads may yield increasing returns in terms of gains to the productivity of private household assets.

Table 20: Public services and private assets: determinants of household welfare

Table 20a: Direct and average effects of public services and infrastructure access

Dependent variable: *ln*(household consumption per adult-equivalent)
Ordinary least squares estimation with robust standard errors, errors corrected for enumeration area (EA) cluster-effects

Gender of head (male dummy)	-0.00267	*(0.0155)*
Age of head	-0.00061	*(0.0023)*
Age of head squared	0.00000	*(0.0000)*
Household size in adult-equivalents	-0.08008 ***	*(0.0073)*
No. of years household lived in this house	0.00137 *	*(0.0007)*
Number of female working-age hh members	0.00691	*(0.0092)*
Number of male working-age hh members	0.01615 *	*(0.0089)*
Education of household head	0.11197 ***	*(0.0075)*
hh head's main occupation is in agriculture	0.06702 ***	*(0.0162)*
Education:		
Primary enrollment rate	0.39556 ***	*(0.0748)*
Road infrastructure:		
Road density	0.06654 **	*(0.0332)*
Agriculture:		
Land productivity	0.02018 *	*(0.0050)*
Health:		
Distance to health facilities	-0.00199	*(0.0015)*
Region effects:		
Afar	-0.24331 ***	*(0.0807)*
Amhara	-0.26193 ***	*(0.0430)*
Beneshangul-Gumuz	-0.65519 ***	*(0.0944)*
Gambella	-1.59422 ***	*(0.3992)*
Oromia	-0.24756 ***	*(0.0415)*
SNNPR	-0.46192 ***	*(0.0416)*
Somale	0.22032 ***	*(0.0743)*
Tigray	-0.26003 ***	*(0.0486)*
Constant	7.05785 ***	*(0.0950)*
No. of observations		7890
No. of clusters (EAs)		674
R^2		0.20

Notes: Road density is in km roads per 1000 persons. Access to health facilities is distance to nearest health facility (in km). Primary enrollment rate represents gross enrollment rate in primary school (grades 1-8). Land productivity is the average physical yield of all annual crops. Road, education, and agriculture variables are measured as zonal averages. Standard errors are given in parenthesis and italicized. Coefficients significant at: * 10% level; ** 5% level; *** 1% level.

Table 20b: Regionally differentiated role of public service indicators
(including indirect effects)

Dependent variable: *ln*(household consumption per adult-equivalent). Ordinary least squares estimation with robust standard errors, errors corrected for enumeration area (EA) cluster-effects

Household demographics and other characteristics

Head is male	-0.01086	(0.0153)
Age of head	-0.00165	(0.0022)
Age^2	0.00002	(0.0000)
hh size (adult-equiv.)	-0.10358***	(0.0091)
No. years lived here	0.00055	(0.0007)
# of female workers	-0.01156	(0.0120)
# of male workers	-0.00365	(0.0113)
Education of head	0.11383***	(0.0080)
Engaged in agr.	0.47821***	(0.1114)

Road Infrastructure	*Effects via private agric'l assets*		*Direct effects*	
Afar	0.00455**	(0.0020)	0.23863***	(0.0451)
Amhara	0.03657***	(0.0113)	0.62973***	(0.1586)
Beneshangul-Gumuz	-0.00057	(0.0184)	-0.11560	(0.2051)
Gambella	-0.00289	(0.0051)	0.08075***	(0.0229)
Oromia	0.00558	(0.0081)	-0.03142	(0.1347)
SNNPR	-0.01289***	(0.0029)	0.00873	(0.0494)
Somale	0.04172	(0.0255)	0.12663	(0.2533)
Tigray	0.01138	(0.0127)	0.20045	(0.1732)

Agriculture	*Effects via private agric'l assets*		*Direct effects*	
Afar	-0.00003	(0.0001)	0.00784	(0.0081)
Amhara	0.00031	(0.0006)	0.01625	(0.0103)
Beneshangul-Gumuz	0.00221	(0.0046)	0.08058	(0.0530)
Dire Dawa	0.00248***	(0.0007)	0.05737***	(0.0131)
Gambella	0.00296	(0.0038)	-0.02054	(0.0134)
Harari	0.00348**	(0.0017)	0.07924***	(0.0149)
Oromia	0.00010	(0.0003)	0.03677***	(0.0091)
SNNPR	0.00206***	(0.0003)	0.04053***	(0.0084)
Somale	-0.00290	(0.0023)	0.07058	(0.0379)
Tigray	0.00164	(0.0009)	0.04290***	(0.0154)

	Health: *Effects via pr. labor assets*		***Education:*** *Effects via pr. labor assets*	
Afar	-0.00188***	(0.0005)	0.31098***	(0.1166)
Amhara	-0.00082	(0.0010)	0.03513	(0.0299)
Beneshangul-Gumuz	-0.00051	(0.0007)	0.00282	(0.0212)
Dire Dawa	0.00473	(0.0032)	0.08744***	(0.0333)
Gambella	0.00312**	(0.0015)	-0.04582***	(0.0174)
Harari	0.00383	(0.0062)	0.11019***	(0.0303)
Oromia	0.00073	(0.0009)	0.09605***	(0.0248)
SNNPR	-0.00072	(0.0009)	-0.00525	(0.0203)
Somale	0.00166	(0.0014)	0.37173***	(0.1018)
Tigray	-0.00083	(0.0017)	0.02306	(0.0258)

Constant	6.83605***	(0.1139)		
No. of observations				7871
No. of clusters (EAs)				674
R^2				0.22

Notes: (See also notes to Tables 19 and 20a for variable definitions.) Labor assets are the number of household members of working age (14-50 years old).

The specification also allows examination of whether the returns to household agricultural assets in terms of household consumption increase when average agricultural performance is high. Unlike the case of road infrastructure, the effects seen among those regions for which significant estimates were obtained are substantially less varied across regions. Zonal-average agricultural productivity shows the strongest effects on the productivity of rural households' productive assets in Dire Dawa and Harari. Given that the cities of Dire Dawa and Harer dominate in these two regions, this may suggest that the proximity of rural households to major markets considerably increases the returns from high (physical) agricultural productivity.

Interestingly, access to education (represented by the primary enrollment rate) shows the highest returns to labor assets in the Somale and Afar regions, which also have the lowest enrollment ratios (see Table 13). Returns to education investment are lowest in Gambella, which has among highest enrollment achievement. In contrast to the apparently positive relationship between relative levels and impact seen in the road infrastructure sector, it appears here that access to education leverages household labor assets to a greater degree in regions where the levels of access are lowest, and vice versa.

Table 21 shows the estimations of the second-stage model, in which we assess the impact of different types of public spending on the various sectoral performance variables in the context of the first stage results, as specified in (3). Table A4 in the Appendix shows descriptive statistics for variables not already presented in Section 4. The unit of analysis is the zone. The public spending variables are measured at the regional level, due to data being insufficiently disaggregated to the zonal level in a consistent manner for all years considered in the analysis.

Since each column reflects estimation of four sector-specific effects in a system of equations framework, each of these equations has its own constant, measure of fit, etc. The primary specification is in column (1). The other estimations are used to examine the specification robustness of the agricultural sector equation. Specification is varied with respect to two factors: the inclusion of cross-sector effects, and the inclusion of effects related to agricultural inputs.

The first specification is *a priori* selected as the primary specification, since the effects of the included inputs (improved seed, fertilizer, irrigation, and pesticides) are heavily dependent on public expenditure, and should thus be accounted for through the public investment variable. Secondly, we also a priori hypothesized the existence of cross-sectoral synergies, especially for agriculture. For example, a better road infrastructure may reduce transaction costs for both agricultural input and the marketing of agricultural outputs, both potentially leading to improved productivity. Similarly, in areas with greater exposure to health risks, agricultural labor productivity may be lower, which, *ceteris paribus*, may reduce yields. We were careful not to assess cross-sectoral effects by determining the impact of expenditure in

44

one sector on outcomes in another sector, but rather by assessing the influence of realized outcomes (or in the case of health, the existent risks) in one sector on those in another.

We also focused our determination of cross-sector effects on agriculture. Complementarities across sectors can be expected where the "affected" sector is measured by a (sectoral) performance variable, rather than with a more intermediate variable. For example, if the dependent variable in the health equation is a measure of a given population's exposure to ill health (e.g. maternal mortality or child stunting), then it would be necessary to account, for example, for how levels of education (via income effects and information) or agricultural performance (via its likely impact on access to food) would affect the health-dependent variable. However, since the dependent variable in this second-stage estimation, average distance to a health center, can be better understood as an intermediate health-sector outcome variable, we do not expect to see such cross-sector effects on the utilized health variable.

Table 21: Effect of public expenditures in four sectors (System-2SLS estimation)

	(1)		(2)		(3)		(4)	
Road Infrastructure								
K^{ROD}	0.0200***	(0.0016)	0.0198***	(0.0016)	0.0198 ***	(0.0016)	0.0199 ***	(0.0017)
sh.urban	0.8020	(0.9171)	0.8449	(0.9149)	0.8498	(0.9136)	0.8210	(0.9183)
pop.dens.	-0.0009	(0.0010)	-0.0009	(0.0010)	-0.0009	(0.0010)	-0.0009	(0.0010)
const.	-0.0636	(0.2085)	-0.0545	(0.2080)	-0.0535	(0.2077)	-0.0596	(0.2087)
PI effect (%Δ)	1.741%		1.724%		1.724%		1.732%	
Agriculture								
K^{AGR}	0.0053	(0.0047)	0.0043	(0.0045)	0.0048	(0.0045)	0.0052	(0.0050)
rain	0.0010	(0.0010)	0.0016	(0.0011)	0.0017	(0.0011)	0.0007	(0.0011)
land/hh	-1.8399*	(1.1043)	-2.4291**	(1.1038)	-2.3066 **	(1.0496)	-1.9083	(1.2102)
althi	0.4119	(0.8010)	-0.2071	(0.8165)	0.0250	(0.8012)	0.3896	(0.8557)
sh.seed			6.1748	(12.4710)	3.7125	(12.5625)		
sh.irrig.			6.5832***	(2.4808)	6.2182 ***	(2.3737)		
sh.pest.			8.5298	(5.8802)	5.9558	(5.7887)		
sh.fert.			1.9239	(2.5736)	1.2438	(2.4643)		
dist.road	-0.2615***	(0.0958)			-0.1719 *	(0.0966)		
malaria.vuln.	-1.5380	(1.3649)			-1.4675	(1.3530)		
const.	13.3064***	(1.9437)	9.5935***	(1.5861)	11.5570 ***	(1.8616)	11.1098 ***	(1.7317)
PI effect (%Δ)	0.047%		0.038%		0.043%		0.046%	
Education								
K^{EDU}	0.0014***	(0.0002)	0.0014***	(0.0002)	0.0014 ***	(0.0002)	0.0014 ***	(0.0002)
sh.urban	-0.3934*	(0.2120)	-0.4350**	(0.2075)	-0.4351 **	(0.2074)	-0.3961 *	(0.2125)
dist95	-0.0320***	(0.0096)	-0.0319***	(0.0096)	-0.0319 ***	(0.0096)	-0.0320 ***	(0.0096)
const.	0.5122***	(0.0546)	0.5044***	(0.0540)	0.5043 ***	(0.0540)	0.5117 ***	(0.0547)
PI effect (%Δ)	0.235%		0.235%		0.235%		0.235%	
Health								
K^{HLT}	-0.0084*	(0.0048)	-0.0085*	(0.0046)	-0.0083 *	(0.0046)	-0.0093 *	(0.0048)
sh.urban	-5.9016*	(3.3550)	-5.8615*	(3.3140)	-5.9450 *	(3.3112)	-5.5012	(3.3738)
malaria.vuln.	1.6480	(1.1814)	1.6505	(1.1813)	1.6452	(1.1804)	1.6733	(1.1863)
const.	7.3605***	(0.8044)	7.3610***	(0.8047)	7.3600 ***	(0.8041)	7.3653 ***	(0.8077)
PI effect (%Δ)	-0.119%		-0.120%		-0.117%		-0.132%	
R^2								
Road		82.6%		82.6%		82.6%		82.6%
Agriculture		25.3%		31.7%		38.4%		9.9%
Education		58.6%		58.5%		58.5%		58.6%
Health		24.5%		24.4%		24.5%		23.8%
χ^2 (p-value)								
Road	216.7 ***	(0.000)	216.3 ***	(0.000)	218.2 ***	(0.000)	212.6 ***	(0.000)
Agriculture	15.0 **	(0.020)	21.1 ***	(0.007)	28.6 ***	(0.002)	4.3	(0.365)
Education	57.1 ***	(0.000)	64.3 ***	(0.000)	64.3 ***	(0.000)	57.0 ***	(0.000)
Health	18.0 ***	(0.000)	18.3 ***	(0.000)	18.2 ***	(0.000)	18.5 ***	(0.000)

The utilized variables are abbreviated as follows: sh.urban = share of population that is urban; dist95 = zonal-average distance in km to the nearest school; rain = mean rainfall in mm; land = avg. hh land size (ha); althi = mid/highlands dummy; malaria.vuln. = share of population that is vulnerable to malaria; pop.dens. = population density (population per

km^2) ; sh.seed = share of cultivable land using improved seeds; sh.irrig = share of cultivable land that is irrigated; sh.pest = share of cultivable land using pesticides; sh.fert = share of cultivable land using fertilizer; dist.road = average distance in km to the nearest dry weather road. Standard errors are given in parentheses and italicized. N = 53. Coefficients significant at: * 10% level; ** 5% level; *** 1% level.

Table 21 shows that the results of the other three sectors are very stable vis-à-vis the changes in specification in the agriculture equation. The coefficients in the agriculture equation are also relatively stable. The coefficient on the variable of interest, agricultural spending, is somewhat reduced when agricultural inputs are included (e.g. comparing col. 4 with col. 2, or col. 1 with 3). The standard errors, however, are not affected. Interestingly, the inclusion of cross-effects somewhat increases the expenditure coefficient (compare col. 4 with 1, or 2 with 3).

Except in the case of agriculture, the public expenditure coefficients are significant or strongly significant for all sectors. The magnitudes of the coefficients on public investment are not directly comparable with one another, because the dependent variables are measured in different units. Therefore, the last row in each equation of the system compares the percentage increase from the mean values of the sectoral performance variables implied by a one-*birr* increase in per capita public expenditure in each of the sectors. For example, a one-*birr* increase in per capita public expenditure in education is associated with a 0.24% increase in the primary enrollment rate, and a 0.05% increase in land productivity. The largest percentage increase is achieved in the road sector. However, while this last interpretation of the expenditure coefficients facilitates comparison of expenditure returns across sectors by equalizing the units of measurement, the difference in the underlying outcome variables means that these figures are still only indicative of the comparative contribution of spending in the different sectors. By assessing household welfare effects, the third stage estimation allows for more direct comparability.

As discussed in Section 7, the third stage estimation draws on the first two stages of the analysis by using equation (4) to assess the effect of a marginal increase in per-capita public expenditure in various sectors on rural household consumption (Table 22). While the first stage regression showed that two regions seem to stand out in terms of the strong effect that access to roads appeared to have on consumption, the third stage allows the effect of road infrastructure expenditure on household consumption to be quantified. For example, a one *birr* increase in per capita expenditure on roads in Afar is found to lead to a five *birr* increase in per capita consumption of rural households in this region.[14]

As mentioned previously, the negative effect in the Southern region is puzzling, although the magnitude of the effect is limited. The possibility that strongly increasing returns in road investments may lie behind these findings may explain part of this effect, addressing why returns are lower in the Southern region than elsewhere, but does not explain why these effects are negative. This may suggest the need for

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[14] For ease of interpretation, the first-stage coefficients were first transformed so the third stage results reflect the impact of spending on per-adult-equivalent household expenditure, rather than its log.

additional work, including explicit modeling of additional mechanisms (other than returns to agricultural assets) by which road infrastructure may affect household income. More specifically, to the extent that better accessibility of all-weather roads may encourage formerly agricultural households to begin non-farm enterprises and facilitate access to the wage labor market, improved road density may in fact reduce the returns to agricultural assets by making agricultural production a less dominant livelihood for some households.

Table 22: Impact of per capita public expenditure on household welfare

Road infrastructure	Afar	5.0826***	+	*(1.540)*
	Amhara	12.0533***	+	*(2.945)*
	Beneshangul-Gumuz	-0.7005		*(3.507)*
	Gambella	0.1930	+	*(0.503)*
	Oromia	1.2425		*(2.277)*
	SNNPR	-2.5299***	+	*(0.673)*
	Somale	14.5123*		*(8.592)*
	Tigray	4.2142		*(3.418)*
Agriculture	Afar	0.0096		*(0.027)*
	Amhara	0.0431		*(0.054)*
	Beneshangul-Gumuz	0.2143		*(0.300)*
	Dire Dawa	0.2754	+	*(0.251)*
	Gambella	0.0423		*(0.103)*
	Harari	0.3630	+	*(0.335)*
	Oromia	0.0702	+	*(0.067)*
	SNNPR	0.1679	+	*(0.151)*
	Somale	-0.1058		*(0.232)*
	Tigray	0.1841	+	*(0.177)*
Health	Afar	0.0713	+	*(0.044)*
	Amhara	0.0250		*(0.033)*
	Beneshangul-Gumuz	0.0171		*(0.026)*
	Dire Dawa	-0.1770		*(0.157)*
	Gambella	-0.1033	+	*(0.076)*
	Harari	-0.1303		*(0.222)*
	Oromia	-0.0251		*(0.034)*
	SNNPR	0.0255		*(0.037)*
	Somale	-0.0572		*(0.057)*
	Tigray	0.0244		*(0.052)*
Education	Afar	1.9251**	+	*(0.793)*
	Amhara	0.1755		*(0.153)*
	Beneshangul-Gumuz	0.0155		*(0.117)*
	Dire Dawa	0.5333**	+	*(0.223)*
	Gambella	-0.2468**	+	*(0.103)*
	Harari	0.6100***	+	*(0.198)*
	Oromia	0.5384***	+	*(0.167)*
	SNNPR	-0.0304		*(0.118)*
	Somale	2.0819***	+	*(0.673)*
	Tigray	0.1103		*(0.125)*

Notes: Standard errors are given in parentheses and italicized. +Associated estimates significant in 1st-stage estimation in bold. Coefficients significant at: * 10% level; ** 5% level; *** 1% level.

The effects of spending on agriculture and health should be interpreted with caution, given that the standard errors obtained via the Delta method are large. Nevertheless, some tentative findings can be established. The strongest effects of spending appear to be associated with rural households in the two "city-states" Harari and Dire Dawa. In these locations, a one-*birr* increase in spending results in greater than 0.28 and 0.36 *birr* increases in per capita household consumption for the two regions, respectively.

Among those regions for which the coefficients are significant in the 1st stage estimation, the household welfare returns of a one *birr* increase in agricultural spending varies from 0.1 to 0.4 *birr*. Comparison to the results on road expenditure reveals that road expenditure displays both much lower as well as much higher effects, depending on the region. In other words, returns to agricultural expenditures, though not uniform, tend to be much more stable across regions than returns to roads spending. What is also noticeable, however, is that the highest returns to road spending are substantially higher than the highest returns to agricultural spending.

The returns to public spending on education appear to be larger than those to agricultural expenditure, but still fall substantially short of the road investment returns. As with the level of returns, the inter-regional variation of the returns to education spending lies between that in agriculture and road infrastructure. Similar to the case of agriculture, significant results were not observed with regard to rural welfare returns to health spending. Unlike the agricultural sector, however, the results from the first stage regression are weak for most regions. This is not inconsistent with the findings of Collier et al. (2002), who reported that in Ethiopia the returns to public expenditure on the 'quantity' of health care (which is what our measure of access to public services captures) is very low, especially in comparison to investments in the 'quality' of health care.

8. CONCLUDING REMARKS

We herein explore and compare the impact of different types of public spending on rural household welfare in Ethiopia. In order to get at this question empirically, we use a three-stage analysis: the first stage assesses the role of access to different sector-specific services and outcomes for household consumption, differentiating this effect geographically as well as tracing the effect that public services have on the productivity of household private assets. The second stage of the analysis determines the contribution of different types of public spending on key sector-specific outcomes, accounting both for the fact that this contribution is usually realized over time, and also for the potential that public expenditure volumes in a given sector may be affected by the state of development that sector. The final stage of the analysis draws on results from the two previous stages to estimate the rural welfare effect of a unit increase in public spending across different sectors.

We find that, among the sectors considered, returns to public investments in road infrastructure are by far the highest. However, the geographic variability of welfare returns to public spending on roads is also higher than that in other sectors. This regional variability in returns to road investment suggests the need for careful region-specific investment policies in the road sector. Tentative evidence also suggests that higher returns are seen in areas having better-developed road networks, and vice versa.

The household welfare impacts of public expenditure in agriculture and education are smaller than the effects of road spending, but they are less variable across regions, with returns to education spending being somewhat larger than returns to agricultural spending. Comparison of agricultural expenditure impact across regions shows that the largest returns are observed in two small regions that are each dominated by a major city. While proximity to markets is not explicitly analyzed herein, we suggest that the relatively high returns to agricultural spending for rural residents in the two most urbanized regions may be capturing the important role of market proximity for public spending on agriculture.

Some useful steps may be taken to further strengthen any conclusions arising from this analysis, and/or provide new insights into the relative effectiveness of different types of public spending. Firstly, while this paper assesses how rural household consumption is affected by public expenditure, our findings may also be used to simulate the poverty effects of public spending. Secondly, given the prominence of agriculture-driven development in Ethiopia's current poverty reduction strategy, it may not be doing full justice to the policy dimension of this enquiry to examine the impact of public expenditure in the aggregate. Specifically, additional studies may be warranted to separately examine the role of the various components of this investment, such as agricultural extension, agricultural research, and food security spending. At present, the lack of regionally disaggregated time series data on spending in the various

agricultural subsectors necessitates analysis of agricultural expenditure as a whole. Future efforts toward collecting additional data from the regional bureaus of agriculture and others would alleviate this constraint.

An issue that goes beyond the scope of this paper but is clearly worthy of additional study is the efficiency of public spending. The utility of public investments for household welfare and poverty reduction depends on at least two things: first, the portfolio of the public budget, or the appropriateness of the allocation of resources across sectors, and second, the efficiency with which resources are used in any given sector or subsector. This paper focused on the former issue. In a way, the results of this paper provoke an inquiry into the second question, and do so pointedly in the Ethiopian context, with respect to agricultural investments. This is both because agriculture strongly dominates Ethiopia's economy, and because the government's development strategy emphasizes the agricultural sector. Given that a substantial body of research suggests that a strategic focus on agriculture may be appropriate given the stage of development of Ethiopia (e.g. Diao et al. 2007), an investigation into the drivers of efficiency in the country's agricultural public spending may be the next important step in policy research in Ethiopia.

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APPENDIX

Table A1: Per capita household expenditure, based on the Household Income, Consumption and Expenditure (HICE) surveys

	1999			1995	Growth '95-'99
	total	urban	rural	rural	rural
Addis Abeba	2465.7	2482.9	1540.4	1685.9	-8.6%
Afar	1537.7	2302.0	1127.0	1520.5	-25.9%
Amhara	1165.6	1754.4	1095.7	974.4	12.4%
Beneshangul-Gumuz	1158.3	2014.3	1088.4	1075.0	1.3%
Dire Dawa	1767.0	1899.3	1394.4	1682.8	-17.1%
Gambella	1330.3	1898.1	1255.7	1706.7	-26.4%
Harari	1904.9	2106.2	1618.7	2388.7	-32.2%
Oromia	1208.4	1701.0	1144.5	1282.9	-10.8%
SNNP	1080.1	1768.9	1025.2	1021.3	0.4%
Somale	1626.7	2106.7	1395.1	1975.4	-29.4%
Tigray	1189.5	1536.7	1120.9	1209.6	-7.3%
Ethiopia	1222.5	1921.0	1109.9	1136.6	-2.3%

Source: CSA (2001).

Table A2: Per adult-equivalent household expenditure, based on the Welfare Monitoring (WM) Surveys

Region	Zones	1995	1999	Growth
Addis Ababa		1543.3	1521.0	-1.4%
Afar		2038.6	1770.1	-13.2%
Amhara (1)	E. & W. Gojam, Agawi	1493.4	1937.8	29.8%
Amhara (2)	N. & S. Gondar	1264.0	1629.2	28.9%
Amhara (3)	N. Wollo, Wag Hamra	1211.1	1430.1	18.1%
Amhara (4)	S. Wollo, Oromiya Zone, N. Shewa	1483.3	1501.8	1.2%
Beneshangul-G.		1296.7	1347.0	3.9%
Dire Dawa		1595.9	1573.9	-1.4%
Gambella		1464.3	1021.6	-30.2%
Harari		2615.7	1901.4	-27.3%
Oromiya (1)	E. & W. Hararghe	2087.8	1631.3	-21.9%
Oromiya (2)	E. & W. Wellega	1732.9	1809.7	4.4%
Oromiya (3)	E. Shewa, Arsi, Bale, Borena	1664.4	1599.8	-3.9%
Oromiya (4)	Illubabor, Jimma	1893.4	1501.4	-20.7%
Oromiya (5)	N. & W. Shewa	1965.1	1928.8	-1.8%
SNNP (1)	Hadiya, Kambata, Gurage	1319.9	1197.3	-9.3%
SNNP (2)	N. & S. Omo, Derashe, Konso	1708.0	2059.0	20.5%
SNNP (3)	Sidama, Gedeo, Burji, Amaro	1257.8	1106.9	-12.0%
SNNP (4)	Yem, Keficho, Maji, Shekicho, Bench	1492.9	1514.9	1.5%
Somale		2597.2	2313.3	-10.9%
Tigray		1412.8	1409.9	-0.2%

Source: World Bank (2005d)

Table A3: Spending in each region (as a % of total regional expenditures), 1998

	Addis Abeba	Afar	Amhara	Bene-shangul-Gumuz	Dire Dawa	Gambella	Harari	Oromia	SNNP	Somale	Tigray	Regions total
Roads	27.4	3.8	17.8	5.1	0.0	3.0	0.0	22.4	10.5	5.2	4.7	100.0
Education	7.9	2.6	21.9	2.0	0.9	2.9	1.0	33.7	18.3	2.7	6.2	100.0
Health	8.4	4.5	21.7	3.8	1.2	2.3	1.9	23.6	15.4	5.1	12.1	100.0
Agriculture	1.0	4.1	23.4	2.9	0.6	1.0	0.3	31.0	25.2	5.5	4.9	100.0
Natural resources	27.8	13.1	13.8	1.5	0.3	0.4	0.4	22.2	8.8	2.8	8.9	100.0
Energy & Mining	0.0	0.5	51.6	1.0	5.5	0.0	11.4	3.5	0.7	0.0	25.9	100.0
Transport & Comm.	26.6	4.1	14.6	3.7	6.5	0.0	0.0	41.4	0.3	2.6	0.2	100.0
Other	24.3	6.3	16.4	4.5	1.9	2.4	1.2	16.5	13.8	7.0	5.7	100.0
Total	15.8	5.1	19.4	3.4	1.1	2.2	1.0	24.8	15.8	4.9	6.6	100.0
Population	3.9	1.9	25.6	0.8	0.5	0.3	0.3	35.2	19.7	5.8	5.8	100.0

Source: Own calculations using data from MOFED.
[1]2001 data.

Table A4: Zonal averages for selected variables used in 2nd stage regression (see Table 21)

Zone	Dist. school	Dist. road	Malaria vuln.	% urban	Pop. dens.	High altit.	Rain-fall	Land/hh	% land seed	% land irrig	% land pesticid	% land fertilizer
Afar												
Afar 1	1.8890	1.6280	100.0%	14.2%	12	no	282.7	0.60	0.00%	99.34%	0.00%	0.37%
Afar 2	n.a.	n.a.	100.0%	2.5%	9	no	268.5		0.00%	0.00%	0.00%	0.00%
Afar 3	11.2440	12.8280	100.0%	26.7%	12	no	501.4	0.30	0.10%	0.24%	7.86%	9.64%
Afar 4	n.a.	n.a.	100.0%	1.5%	15	no	439.1		0.00%	0.00%	0.00%	0.00%
Afar 5	0.6670	27.8720	100.0%	0.0%	62	no	648.1		0.00%	0.00%	0.00%	0.00%
Amhara												
Agewawia	2.5420	12.7460	41.8%	10.8%	156	yes	1635.5	1.23	2.81%	1.09%	0.43%	46.48%
East Gojam	2.1970	8.6230	33.7%	10.2%	153	yes	1306.0	1.10	3.17%	0.11%	1.28%	44.16%
North Gonder	2.5670	6.6540	53.2%	13.4%	62	no	1295.7	1.22	1.32%	0.06%	0.52%	10.39%
North Shewa	3.0130	8.7490	41.8%	11.2%	123	yes	1114.5	1.10	0.61%	0.33%	5.39%	26.22%
North Wolo	4.3150	7.0560	27.6%	8.4%	126	yes	820.9	0.70	1.29%	0.03%	0.53%	7.66%
Oromiya Zone	7.7470	6.5620	100.0%	10.2%	138	no	959.7	0.60	0.04%	0.03%	0.48%	6.31%
South Gonder	2.5620	13.4100	47.0%	7.9%	153	yes	1275.6	1.00	0.81%	0.22%	1.31%	19.49%
South Wolo	1.7170	5.9640	42.2%	11.8%	158	yes	1048.8	0.70	0.88%	0.26%	0.25%	15.73%
Waghamera	10.4750	18.5850	100.0%	5.1%	42	yes	705.6	0.90	0.07%	0.11%	0.26%	1.51%
West Gojam	2.2080	6.2270	52.8%	7.2%	175	yes	1459.7	1.10	6.97%	0.47%	1.02%	52.09%
Benesh.-Gumuz												
Asosa	2.3820	1.8950	58.8%	9.4%	18	no	1228.6	0.99	0.67%	0.00%	0.90%	5.60%
Kemeshi	n.a.	15.9800	83.6%	0.0%	7	no	1543.7	1.24	3.05%	0.00%	0.22%	5.45%
Metekel	5.9440	10.7300	84.7%	11.5%	10	no	1283.7	1.40	1.69%	0.02%	0.16%	15.06%
Dire Dawa												
Dire Dawa	1.2030	1.0690	100.0%	73.1%	237	no	729.7	0.50	13.22%	9.75%	1.09%	20.79%
Gambella												
Gambela 1	5.6550	1.6280	100.0%	50.3%	12	no	1347.0	0.20	0.00%	0.00%	1.08%	0.74%
Gambela 2	n.a.	4.7790	100.0%	9.6%	3	no	1403.1	0.50	n.a.	n.a.	n.a.	n.a.
Gambela 3	n.a.	n.a.	100.0%	1.8%	14	no	1028.7	0.20	n.a.	n.a.	n.a.	n.a.
Gambela 4	n.a.	n.a.	n.a.	11.9%	26	no	1699.0	0.60	n.a.	n.a.	n.a.	n.a.
Godere	n.a.	8.5690	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Harari												
Harari 1	0.7400	0.7690	100.0%	61.2%	452	yes	799.8	0.60	3.00%	3.92%	4.60%	55.58%
Oromiya												
Arsi	3.2870	5.4980	17.1%	11.7%	120	yes	978.0	1.25	1.35%	0.16%	23.91%	72.36%
Bale	1.2230	2.6700	29.6%	12.8%	27	no	690.0	1.01	1.12%	0.04%	14.09%	39.14%
Borena	4.6610	2.8410	27.7%	11.0%	27	no	675.1	0.50	1.50%	0.00%	0.31%	10.41%
East Harerge	2.2110	4.0330	74.1%	6.5%	113	no	701.7	0.50	2.91%	2.01%	2.32%	40.39%
East Shewa	1.1120	1.4570	93.4%	30.7%	176	yes	900.4	1.40	3.70%	0.00%	15.69%	55.18%
East Wellega	3.4640	8.7930	81.9%	13.2%	79	yes	1659.1	1.20	7.38%	0.11%	1.65%	40.22%
Illibabor	4.0610	7.9560	94.7%	11.3%	73	yes	1918.3	1.10	8.82%	0.02%	5.82%	26.67%
Jimma	2.2720	6.1120	29.5%	11.6%	147	yes	1666.4	0.90	5.60%	0.00%	22.25%	36.07%
North Shewa	3.4120	5.7910	35.9%	8.9%	138	no	1600.4	1.20	1.00%	0.10%	4.79%	29.76%
West Harerge	3.0080	2.1780	68.5%	9.1%	98	yes	885.0	0.70	1.62%	1.36%	0.32%	16.93%
West Shewa	3.0740	4.0600	17.6%	11.6%	150	yes	1288.4	1.20	2.87%	0.23%	26.13%	56.43%
West Wellega	4.4450	6.7790	69.5%	10.3%	86	no	1600.4	1.00	6.84%	0.17%	1.56%	30.37%
SNNP												
Amaro	3.5420	12.1200	100.0%	3.7%	93	yes	927.0	0.40	0.87%	9.80%	1.91%	8.50%
Bench-Maji	3.6800	6.5310	18.0%	8.6%	18	no	1296.8	0.30	2.00%	0.00%	0.00%	7.00%
Burji	2.2080	3.6070	100.0%	13.6%	33	no	964.0	0.70	0.24%	0.00%	2.03%	6.33%
Derashe	5.0000	6.2080	100.0%	10.8%	86	no	1113.0	0.80	0.02%	3.49%	0.27%	0.90%
Gedio	1.7100	3.1250	57.7%	13.7%	505	yes	1564.8	0.30	1.87%	0.00%	0.00%	31.17%
Gurage	3.6290	5.6980	20.0%	5.9%	239	yes	1111.4	0.50	10.49%	0.09%	10.78%	61.80%
Hadiya	2.5370	4.4290	43.9%	7.7%	371	yes	1148.0	0.60	6.35%	0.02%	33.66%	82.82%
Keficho-Shek.	2.6050	12.2380	34.0%	9.2%	71	yes	1886.9	0.70	1.00%	0.00%	5.00%	5.00%
Kembata	2.3040	4.6850	59.4%	8.4%	395	yes	1089.3	0.60	6.21%	0.00%	18.57%	71.94%
Konso	1.6470	4.2890	100.0%	4.2%	88	no	878.0	0.60	0.00%	2.66%	0.03%	30.55%
North Omo	3.3470	8.4940	77.4%	8.1%	144	yes	1463.4	0.40	5.29%	0.00%	0.47%	40.04%
Sidama	2.3960	2.9780	75.7%	8.4%	382	yes	1235.9	0.30	13.51%	0.13%	0.00%	49.93%
South Omo	3.6320	7.8740	85.4%	8.0%	19	no	784.5	0.40	2.26%	0.05%	0.55%	3.54%
Yem	5.4170	6.3370	n.a.	2.0%	94	yes	1214.0	1.10	4.18%	0.00%	4.69%	39.90%
Somale												
Afder	n.a.	n.a.	100.0%	8.1%	6	no	232.8	0.60	n.a.	n.a.	n.a.	n.a.
Degehabur	n.a.	n.a.	100.0%	21.1%	9	no	355.9	1.50	n.a.	n.a.	n.a.	n.a.
Fiq	n.a.	n.a.	87.8%	10.9%	18	no	337.0	1.50	n.a.	n.a.	n.a.	n.a.
Gode	n.a.	n.a.	100.0%	23.9%	12	no	193.8	0.80	n.a.	n.a.	n.a.	n.a.
Jijiga	7.8540	0.8260	87.5%	21.3%	58	yes	599.8	1.30	0.49%	0.13%	0.12%	0.17%
Korahe	n.a.	n.a.	100.0%	17.2%	10	no	340.1	0.70	n.a.	n.a.	n.a.	n.a.
Liben	n.a.	n.a.	100.0%	10.6%	14	no	440.6	1.30	0.00%	0.00%	0.15%	0.92%
Moyale Zone	n.a.	3.3260	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Shinele	5.9170	1.6390	100.0%	16.6%	13	no	493.6	1.20	7.02%	52.19%	0.44%	17.54%
Warder	n.a.	n.a.	100.0%	8.6%	7	no	159.2	1.40	n.a.	n.a.	n.a.	n.a.
Tigray												
Central Tigray	3.0590	6.8800	68.8%	11.6%	111	yes	782.7	0.80	0.49%	0.13%	2.09%	46.25%
East Tigray	4.0160	3.9280	n.a.	17.4%	111	yes	564.3	0.50	1.40%	0.18%	0.59%	42.44%
Mekelle	0.2390	0.7280	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
South Tigray	5.0690	7.1220	30.4%	27.7%	96	yes	677.5	0.84	2.25%	2.89%	1.35%	18.39%
West Tigray	4.2200	12.2620	100.0%	13.9%	34	no	1089.3	1.00	0.04%	0.10%	0.63%	33.90%

Source: World Bank data for the draft Country Economic Memorandum.

Figure A1: Administrative Map of Ethiopia
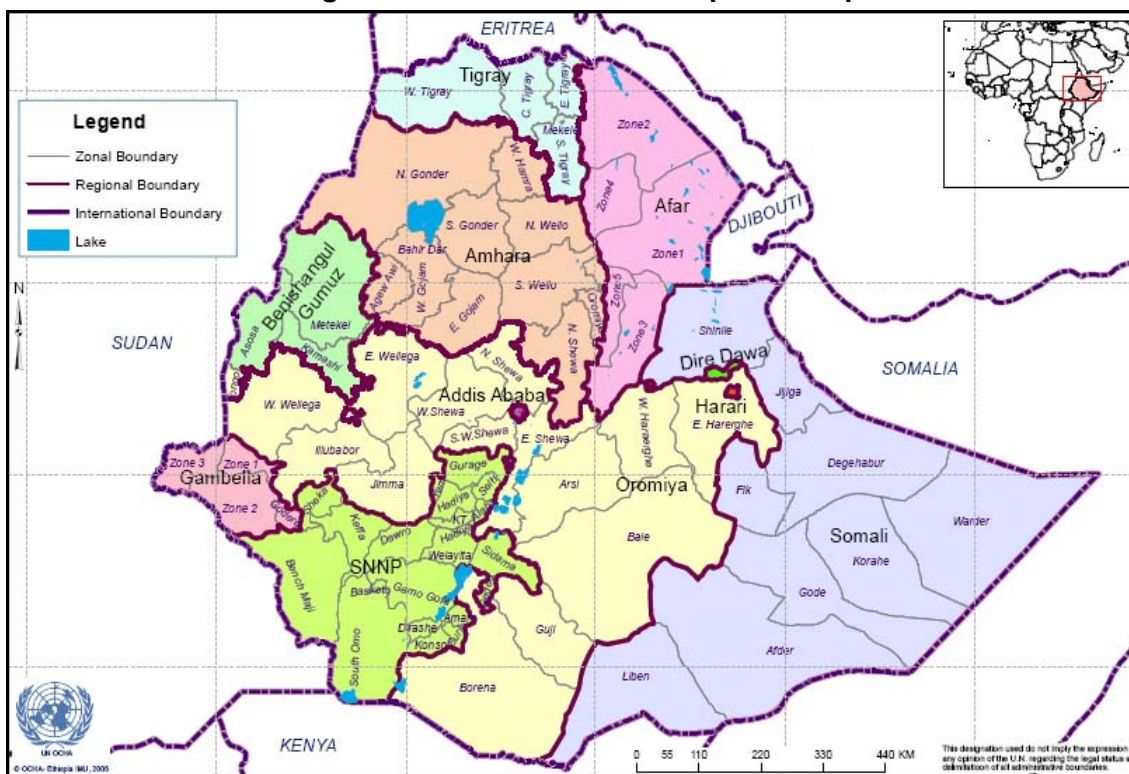
Source: UN-OCHA (United Nations – Office for the Co-ordination of Humanitarian Affairs)

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